PRE-CONSTRUCTION ACOUSTIC MONITORING

Bayshore Regional Sewage Authority Wind Project

Monmouth County, New Jersey

Prepared for:
Bayshore Regional Sewage Authority
100 Oak Street
Union Beach, NJ 07735

Prepared by:

D. Scott Reynolds, Ph.D.
North East Ecological Services
52 Grandview Road
Bow, NH 03304

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Pre-Construction Acoustic Monitoring

Bayshore Regional Sewage Authority Wind Project

EXECUTIVE SUMMARY

The Bayshore Regional Sewage Authority Wind Project (“BRSA”) site is a proposed single turbine wind facility in Union Beach, Monmouth County, New Jersey. As a condition of the Coastal Area Facility Review Act (CAFRA) permit for this project, North East Ecological Services (NEES) was contracted to conduct pre-construction acoustic monitoring to determine the bat activity at the project site. Monitoring conducted during the fall migratory season of 2010 generated the following conclusions:

1) NEES was contracted to monitor bat activity from 28 June - 30 November, 2010. Across the three microphones, bat activity was monitored an average of 140.3 days, resulting in a data collection rate of 90.0% of the potential sampling time.

2) Overall bat activity across the monitoring survey was 31.4 calls per detector-night (calls/dn); bat activity during the summer period (84.5 calls/dn) was substantially higher than bat activity during the fall migratory period (10.9 calls/dn). Because of the overlapping sampling volumes, some microphones were recording the same bat activity. As a result, the overall bat activity is probably lower than these data suggest.

3) Although bat activity at the project site is relatively high (31.4 calls/dn), the composition of the activity is primarily from species that are not impacted by wind turbines in large numbers, such as the big brown bat (*Eptesicus fuscus*). The two most commonly-impacted bat species in the eastern United States (red bats and hoary bats) represented 31.6% of the total bat activity at the project site; for both species, the majority of this activity occurred during the summer period when rates of bat mortality from wind turbines are relatively low.

4) *Myotis spp.* represented 1.9% of the total bat activity. The *Myotis spp.* group contains four species including the federally-endangered Indiana myotis *(M. sodalis*) and the state Species of Special Concern eastern small-footed myotis *(M. leibii*). Bats within the *Myotis spp.* group cannot be reliably identified using acoustic signatures. This low level of activity is consistent with the lack of appropriate habitat for *Myotis* bats. It is also consistent with the major mortality of *Myotis* bats that has occurred throughout the eastern United States due to White-Nose Syndrome.

5) Across all microphones, the highest percent of activity came from the silver-haired/big brown bat (*Lnoct-Efus*) group (61.9%), followed by the red bat (*Lasiurus borealis*: 23.2%) and the hoary bat (*L. cinereus*: 8.4%).

6) The vast majority of bat activity at the BRSA site is most likely from the big brown bat (*Eptesicus fuscus*), a house-roosting bat that one would expect to find

in the light industrial or suburban environment characterized by Union Beach and adjacent areas.

7) The majority of the bat activity at the BRSA project site occurs during the summer months when bats would be foraging in the marsh habitat adjacent to the BRSA facility. Rates of wind-related bat mortality during the summer periods is usually very low.

8) There was little bat activity during the initial two hours and the final three hours of the nightly sampling, suggesting the 14-hr sampling protocol (18:00 - 08:00) captures the vast majority of bat activity at the site.

9) Based on 2) and 3) above, the current study protocol appears to have documented the majority of the daily and seasonal periods of bat activity during the late summer and fall migratory period at the BRSA site, and therefore should provide a reliable estimate of bat activity.

10) Over the course of 6,552 detector-hours, a total of 47,621 files were recorded. In total, 9,934 bat calls were recorded and identified.

11) Bat activity was documented on 87% of the sampling days, with relatively little bat activity during the final month of the survey, suggesting that fall migration had been completed by the time the project was terminated.

12) Bat activity at the NORTH and WEST microphones were very similar and highly correlated on both a daily and seasonal temporal scale. Bat activity at the EAST microphone was 76% lower than activity at the NORTH and WEST microphones, with very little bat activity detected prior to midnight compared to the other microphones.

1.0 PROJECT OVERVIEW

The Bayshore Regional Sewage Authority Wind Project ('BRSA') is a proposed one turbine wind facility located in northern Monmouth County, New Jersey (Fig. 1). The wind turbine will be located on the site of the regional wastewater treatment facility operated by the Bayshore Regional Sewage Authority and will be separated from the Raritan Bay by a coastal marsh habitat.

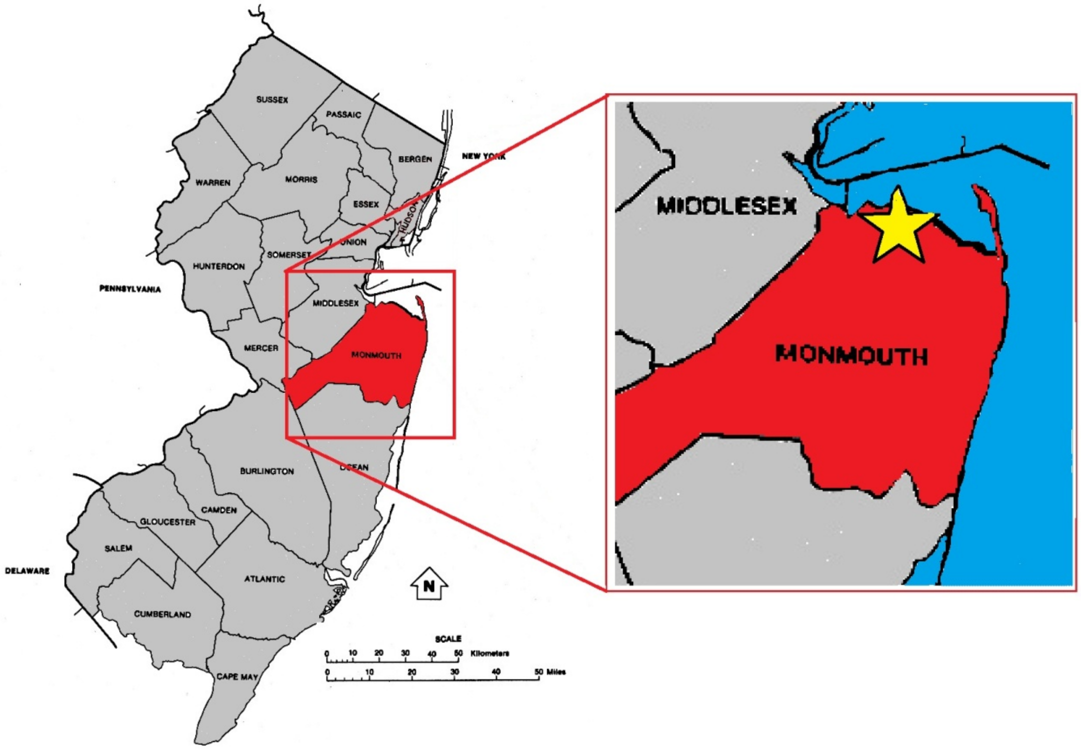

Figure 1: General location of the BRSA Wind Project Site

2.0 PRE-CONSTRUCTION ACOUSTIC SURVEY

Commercial wind energy has many positive environmental impacts at the local, regional, and global level. However, like all electricity-generating utilities, wind turbines have the potential to negatively impact wildlife. One of the largest operational impacts of wind energy is the impact of rotating turbine blades on bats. Consequently, an understanding of the movement of bats across a project site is critical in understanding the potential impact of a project on bats, whether this impact is on the breeding biology, migratory behavior, or loss of habitat through avoidance of wind project areas (NJDEP, 2010). The data collected for this project will help inform biologists and resource managers about the level of bat activity within a light industrial, and the potential impact of constructing a commercial wind facility on bats. Acoustic monitoring following construction of the BSRA site will create a Before-After/Control-Impact (BACI) study design that will allow the NJDEP greater certainty "as to the actual effects of wind turbines on the bird and bat species utilizing an area" (NJDEP, 2010). For wind projects that result in high levels of bat mortality, these data may also serve as a possible predictor of bat activity that could be used to assist in project mitigation or impact avoidance. Pre-construction acoustic monitoring for bat activity has been conducted at the BRSA site for the fall migratory period using a protocol that was informed by the guidelines of the New Jersey Department of Environmental Protection (NJDEP), the New York State Department of Environmental Conservation (NYSDEC), and the National Research Council (NRC, 2007).

2.1 Equipment Calibration and Data Collection

Data were collected using Anabat™ SD-1 ultrasonic detection systems placed at various orientations on an 15 m meteorological tower (Figure 2). On 28 June, 2010, we lowered the tower and attached the monitoring equipment facing north (NORTH: azimuth of 0°), west (WEST: azimuth of 270°), and east (EAST: (azimuth of 0°). All three microphones were oriented with the main receptive cone horizontal and parallel to the ground.

The microphones were housed in a weather-tight PVC housing and used a 10 cm^2 Lexan sheet to deflect sound up towards the microphone. The microphones were Titley™ HI-MIC pre-amplified microphones and attached to the Anabat ultrasonic detector using customized cables (EME Systems, Berkeley, California) based on a Canare Starquad™ video cable with an additional preamplifier soldered into the terminal end of the cable to increase signal strength.

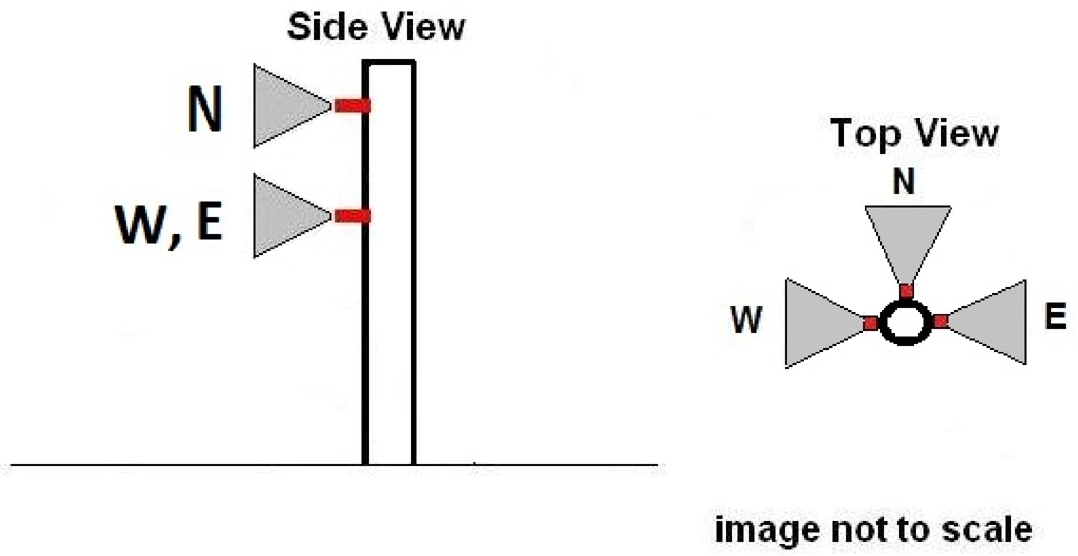

Figure 2. Schematic of Sampling Platform with relative microphone locations.

The Anabat™ SD-1 interface module stores bat echolocation signals on removable CF-flash cards. The detectors were placed in a NEMA-4 weatherproof enclosure mounted to the base of the tower and powered by a 30W photovoltaic charging system. All microphones and cables were calibrated (before installation and after de-construction) in a test facility using a Binary Acoustics AT-100 multifrequency tonal emitter (BAT, Las Vegas, Nevada) to confirm minimum performance standards for six different ultrasonic frequencies (20kHz, 30kHz, 40kHz, 50kHz, 60kHz, and 70kHz). In addition, a minimum cone of receptivity (15° off-center) was verified by rotating the microphone horizontally on a platform using the AT-100 as a sound source.

The Anabat monitoring systems were programmed to monitor for ultrasonic sound from 18:00 – 08:00 each night throughout the sampling period (28 June – 31 November, 2010). Data were retrieved remotely using a HPRS modem system that downloaded stored data from the Anabat SD-1 to an off-site server each morning after the systems shut down. When the server was non-operational, data cards were retrieved by BRSA personnel.

2.2 Data Analysis Protocol

Data were analyzed using the Analook™ 4.9j graphics software. Bat echolocation recordings were separated from non-bat sounds based on differences in time-frequency representation of the data (Table 1). Files that were determined to be of bat origin were analyzed semi-quantitatively using a dichotomous key that distinguishes species based on a variety of call features. Species identification was conservative to minimize identification error and maximize total number of calls included in the analysis. Specifically, high variation in calls within the genus *Myotis* precludes reliable species identification (Murray et al., 2001). We grouped silver-haired bats (*Lasionycteris noctivagans*) and big brown bats (*Eptesicus fuscus*) into a single group (Lnoct-Efus) to reduce errors in identification of these two species. For those calls that were not of a high enough quality to extract diagnostic features, an "Unknown Bats" category was used to document total bat activity.

Table 1. Descriptive breakdown of acoustic file source origins

Category	**General Description of Time-Frequency Analysis of Data**	**Probable Source(s)**
Wind Noise	random pixilation with little to no pattern	wind
Mechanical	Long calls (> 100 ms) with high constant-frequency (CF) component and drifting characteristic frequency (Fc)	cable resonance EM interference
Biological (non-bat)	Frequency-modulated (FM) call structure with ascending pitch or with characteristic frequency in audible range	insects birds, flying squirrels
Bat Activity	FM or CF dominated data file with species-specific call durations, pitch changes, or other attributes	bats

2.3 Data Assumptions and Presentation Format

The following data were collected in order to characterize the bat activity that occurs at the BRSA site. Several assumptions were made in order to characterize this activity:

a) bat activity recorded at the tower adequately represents bat activity across the Project site.
b) the microphones are properly oriented to record echolocation calls of bats as they fly across the Project site
c) there is relatively little bat activity during the daytime (0800 – 1800)

d) the sampling period accurately represents the late summer bat activity as well as the complete fall migratory period of bats at the Project site
e) the echolocation calls recorded on unique data files are independent and do not represent the same individual over multiple sampling periods
f) echolocation calls within the same data file can be treated as a set of calls from a single individual

Assumption a) is based on the technological and methodological constraints that exist at a wind development project. Prior to the concern about turbine-related bat mortality, there were only a few studies that attempted to acoustically document bat migratory activity (for example, Zinn and Baker, 1979; Barclay, 1984). Even fewer studies attempted to document bat activity at altitudes above the tree canopy (for example, Davis et al., 1962; McCracken, 1996). This lack of emphasis was due to the difficulty of recording ultrasonic sound over large periods of time (limitations of recording equipment), wide areas of space (high signal attenuation of ultrasonic wavelengths), or at high altitude. Most of the long-term migratory movement data collected for bats in the last eight years has been generated by monitoring projects related to the development and operation of commercial wind turbines (see references). Most of these project sites contain platforms (meteorological towers) that allow researchers to collect data at high altitude. Although Met towers are generally non-mobile and often spatially limited across the project site, they are sited within the project area and therefore provide the best opportunity for sampling the air space that is available for migratory bats at the project site. Because the BRSA did not have a full-height meteorological tower, we used a smaller instrument tower (approximately 15 m) that was located at the site of the potential wind turbine. Due to the tower location, it would appear to represent the air space presented to migratory bats across the project site. Assumption b) is a technical limitation of the condenser microphones used by the ultrasonic recording equipment. For the current study, study duration, microphone distribution, and microphone orientation were, within the physical constraints of the project site, dictated by the recommendations of the New Jersey Department of Environmental Protection' Technical Manual for Evaluating Wildlife Impacts of Wind Turbines Requiring Coastal Permits (NJDEP, 2010).

Table 2. Summary of terms and definitions used to describe bat activity

bat activity	Activity estimate calculated from the total number of echolocation calls recorded
high risk species	bats species known to collide with wind turbines at rates higher than predicted based on their abundance during capture (e.g. mist netting) sampling
calls/detector-hour (calls/dh)	Standardized measure of bat activity (controlling for variation in total sampling effort at each site)
peak 7-day activity	estimate of peak sustained migratory activity
peak fall migration	bat activity from 16 August through 15 September
fall migration	bat activity from 16 August through 30 November

Assumption c) has been validated by numerous field studies and therefore is strongly supported by existing data, including data collected during this study. Assumption d) has been validated by numerous field studies, including similar pre-construction acoustic monitoring surveys within New Jersey, New York, Pennsylvania, and Maryland. Assumptions e) and f) relate to how bat calls are recorded and represented. Although there is a wide range of opinion on how to interpret echolocation calls, there is a general agreement that researchers should not use echolocation call files as a measure of species abundance unless those calls are independent. This requires that data are collected and analyzed to ensure the spatial- and temporal-independence of each recording. Spatial independence is created by placing microphones in non-overlapping sampling environments. Temporal independence can be created by making assumptions about the time individual bats will remain within the sampling space. For example, two bat calls recorded at the NORTH microphone within ten seconds likely represents a single bat flying near the microphone whereas two calls recorded 60 minutes apart are unlikely to represent the same bat. Because there is insufficient data with which to make well-grounded assumptions about the temporal independence of individual calls, this report instead focuses on the intensities and types of bat activities that are observed rather than species abundance or species evenness (relative abundance of each species).

2.4 Acoustic Monitoring Station

The BRSA site is located on a small peninsula that extends into Raritan Bay. To deploy the acoustic monitoring stations, we utilized a pre-existing instrument tower that was located at the northern edge of the project site; this location was the proposed turbine location and was also the closest to Raritan Bay. The acoustic monitoring system was installed on the tower on 28 June, 2010. The three horizontal microphone were installed at similar heights (approximately 15 m) but differed in orientation. The NORTH microphone was oriented at 0° azimuth out into the salt-water marsh adjacent to the BRSA site; the microphone was projected away from the BRSA facility. The WEST microphone was oriented at 270° azimuth into similar marsh habitat but sampled parallel to some of the BRSA facility. The EAST microphone was oriented at 90° azimuth into marsh habitat, also sampling parallel to the BRSA facility. All three systems were operated continuously until disassembly in January. Data from the bat activity season (28 June - 30 November) are presented in this report.

3.0 ACOUSTIC MIGRATORY SURVEY RESULTS

3.1 Sampling Effort

Bat activity was monitored from 28 June through 30 November, 2010. The total sampling period was 156 days, or 2,184 hours per detector. Due to the potential for data overload, failure to swap cards, card reading failures, or equipment malfunction, the actual sampling effort of each microphone is generally less than this maximal potential sampling effort. The sampling effort at the BRSA site is summarized in Table 3.

Table 3. Acoustic Sampling Effort at the BRSA Project Site

Microphone	Total Days Monitoring	Percent of Total Monitoring	Reasons for Data Loss (days of loss)
WEST	156	100.0%	
NORTH	128	82.1%	System Failure (28)
EAST	137	87.8%	System Failure (19)
AVERAGE	**140.3**	**90.0%**	

3.2 Overall Data

A total of 47,621 files were recorded by the acoustic monitoring equipment. After analysis, 9,934 files (20.8%) were determined to be of bat origin. Although the majority of the acoustical activity was wind noise, there were some files that appeared to be mechanical and non-bat biological in origin. Combining data from all three microphones, bat activity was documented on 136 of the sampling days (87.2%). Bat activity was extremely low during the final month (November) of the sampling period, suggesting that most of the fall migratory period was documented by the current protocol. Mean daily bat activity across the 2010 monitoring period was 23.6 calls per detector-night (calls/dn).

A depiction of overall bat activity at each tower is shown in Figure 3. Each pie graph is scaled to represent total relative activity (with actual bat calls identified by the numbers next to each graph).

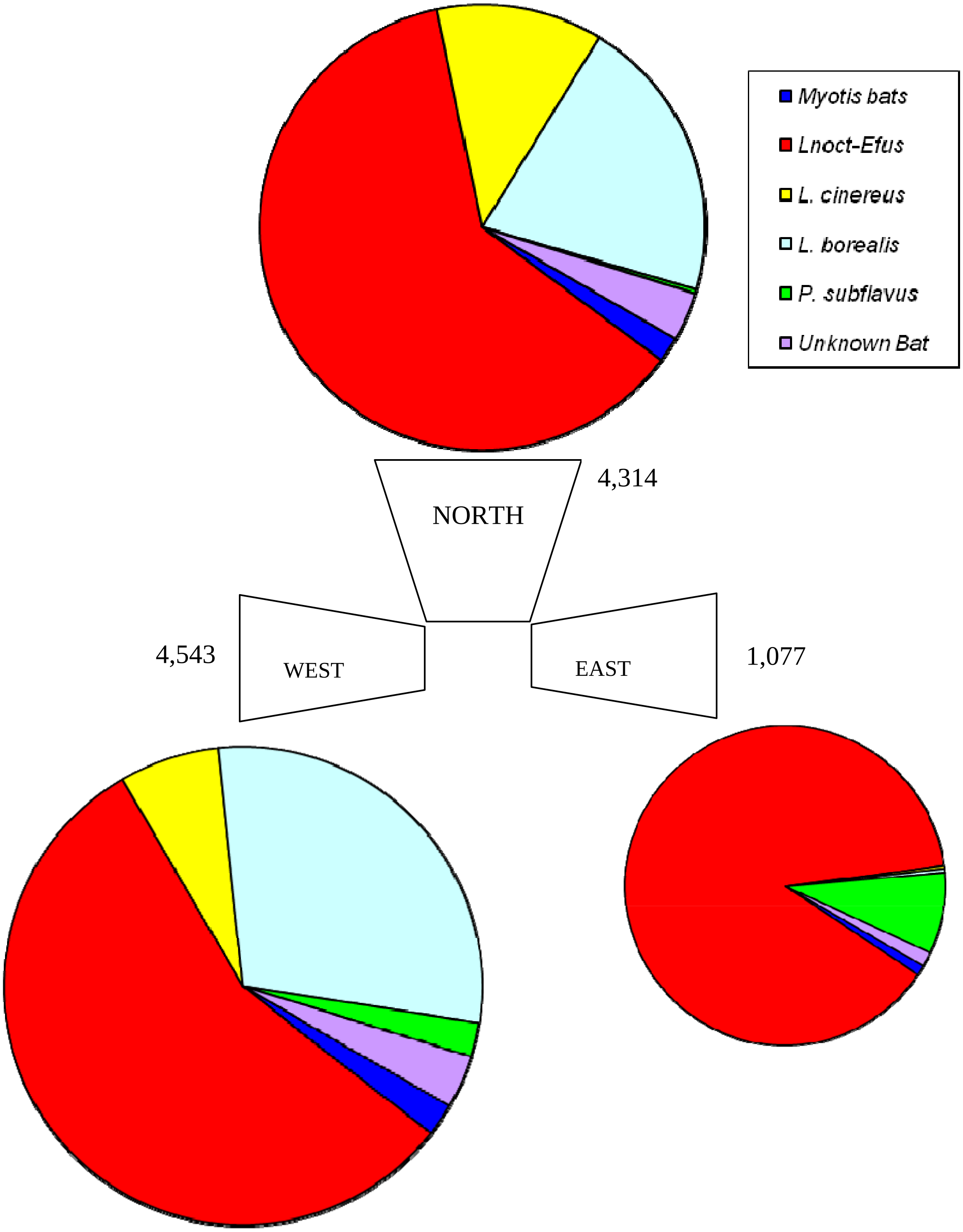

Figure 3: Distribution of Bat Activity at the Bayshore Regional Sewage Authority (BRSA) site across Microphone Orientation

3.3 Bayshore Regional Sewage Authority Wind Project

3.3.1 NORTH Microphone

During the period from 28 June through 30 November, 2010, a total of 22,442 files were recorded and analyzed. It was determined that 4,314 files were of bat origin. A minimum of five species or species groups were detected at the NORTH microphone. The silver-haired/big brown group (*Lnoct-Efus*) and the red bat (*L. borealis*) were the dominant bats heard at the NORTH microphone, comprising 61.5% and 20.7% of all calls, respectively (Figure 4).

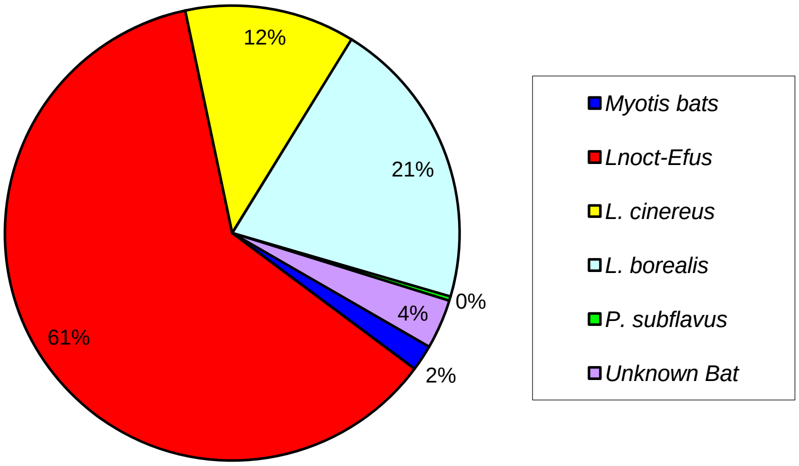

Figure 4: Distribution of Bat Activity at the BRSA NORTH Microphone

There was a large amount of variation in bat activity recorded at the NORTH microphone; the primary peak of bat activity occurred during the second week of sampling in late summer. The peak seven-day period of activity began 11 July (Figure 5) during the third week of sampling. Very low levels of bat activity were documented at the NORTH microphone through 22 November.

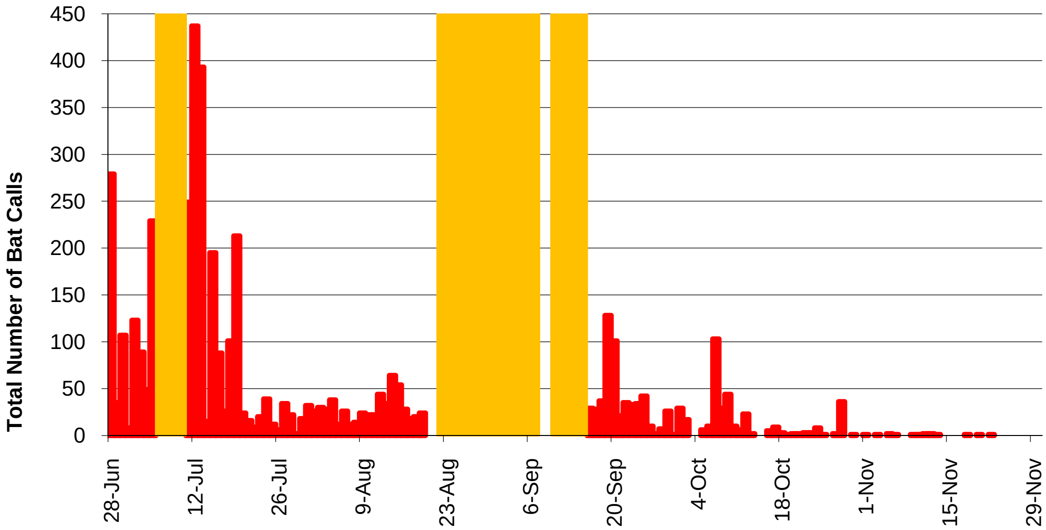

Figure 5: Seasonal Distribution of Bat Activity at the BRSA NORTH Microphone (orange bars represent periods of no monitoring)

3.3.2 WEST Microphone

During the period from 28 June through 30 November, 2010, a total of 23,739 files were recorded and analyzed. It was determined that 4,543 files were of bat origin. A minimum of five species or species groups were detected at the WEST microphone. The the silver-haired/big brown group (*Lnoct-Efus*) and the red bat (*L. borealis*) were were the dominant bats heard at the WEST microphone, comprising 56.0% and 29.1% of all calls, respectively (Figure 6).

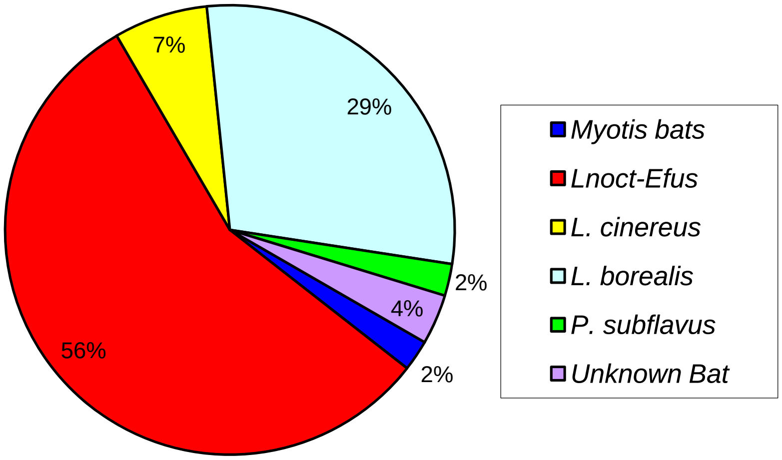

Figure 6: Distribution of Bat Activity at the BRSA WEST Microphone

Looking across the entire sampling period, there was one primary peak in bat activity during early July and a small secondary peak in activity in mid-September and early October. The seven-day period of peak bat activity began on 7 July (Figure 7), with bat activity documented at the project site through 23 November.

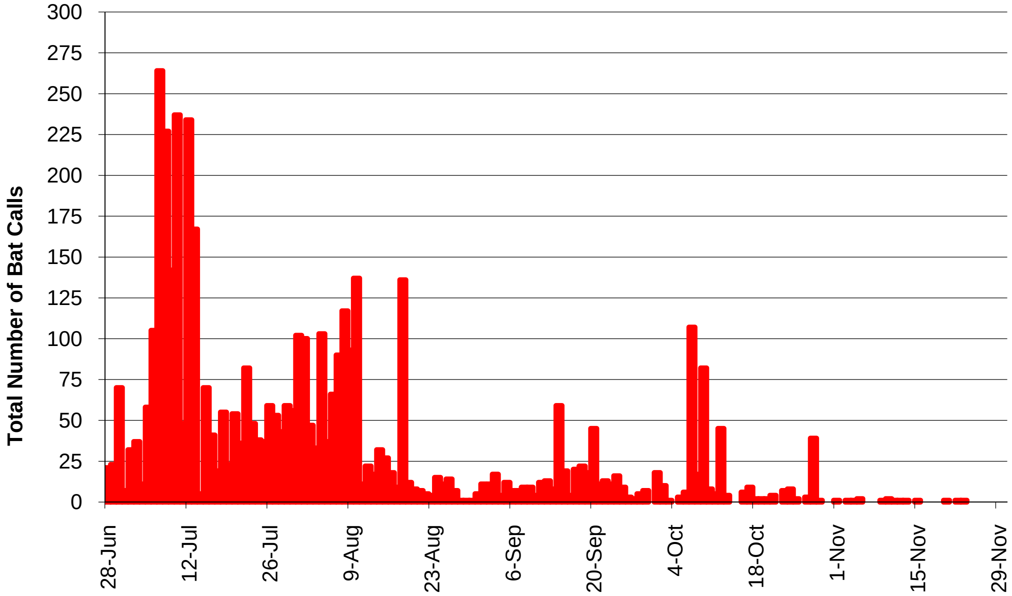

Figure 7: Seasonal Distribution of Bat Activity at the BRSA WEST Microphone

3.3.3 EAST Microphone

During the period from 28 June through 30 November, 2010, a total of 1,440 files were recorded and analyzed. It was determined that 1,077 files were of bat origin. A minimum of five species or species groups were detected at the EAST microphone. The silver-haired/big brown group (*Lnoct-Efus*) was the dominant bat group heard at the EAST microphone, comprising 88.7% of all the recorded calls (Figure 8).

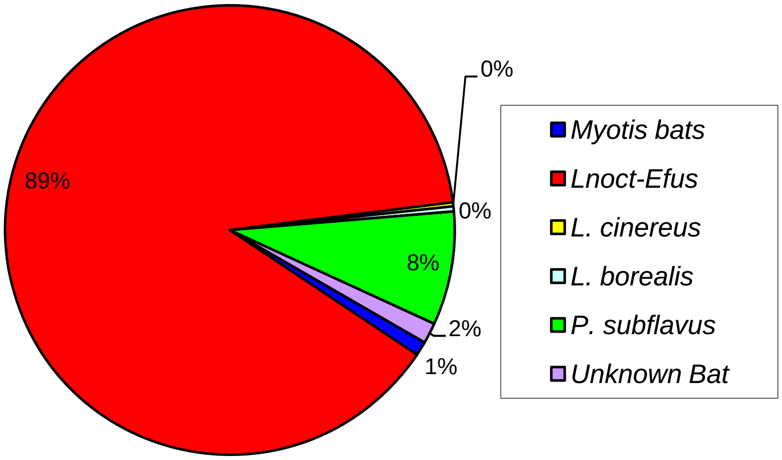

Figure 8: Distribution of Bat Activity at the BRSA EAST Microphone

There was generally a low level of bat activity at the EAST microphone compared to the other microphones. With the exception of three sampling days, the activity rate at the EAST microphone was below 14 calls/day. Two days, 28 June (334 calls) and 10 July (525 calls) accounted for 79.8% of all the bat activity at the EAST microphone (Figure 9). The last bat documented at the EAST microphone was on 17 October.

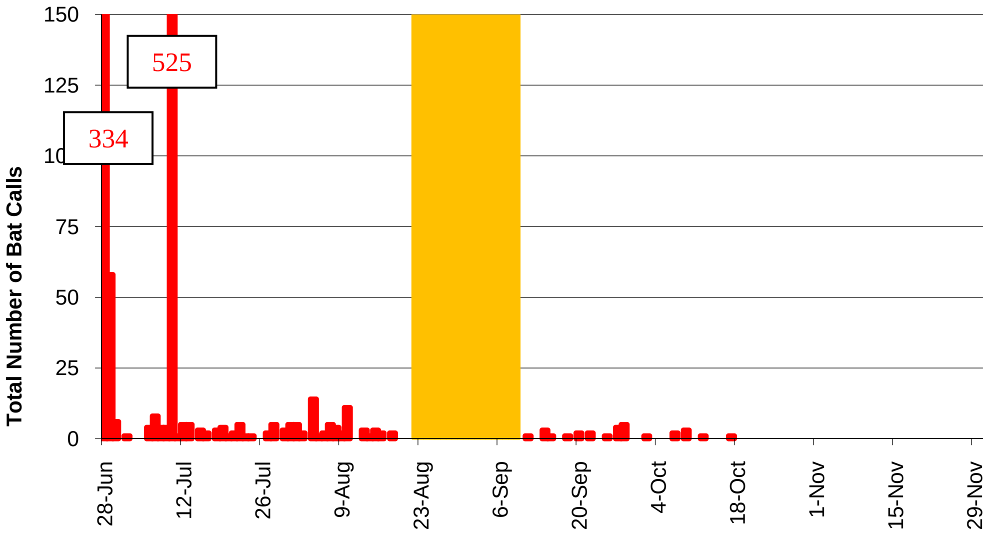

Figure 9: Seasonal Distribution of Bat Activity at the BRSA EAST Microphone (orange bars represent periods of no monitoring)

3.4 Spatial Distribution of Bat Activity

The NORTH and WEST microphone accounted for 89.1% of the total bat activity at the BRSA site. The NORTH and WEST microphones each had approximately 45% of the total bat activity, with the EAST microphone documenting the lowest amount of bat activity (Figure 10). When bat activity was standardized by total sampling effort, the NORTH microphone had an activity level of 33.7 calls per detector night (calls/dn), followed by the WEST (29.1 calls/dn), and the EAST (7.9 calls/dn) microphone.

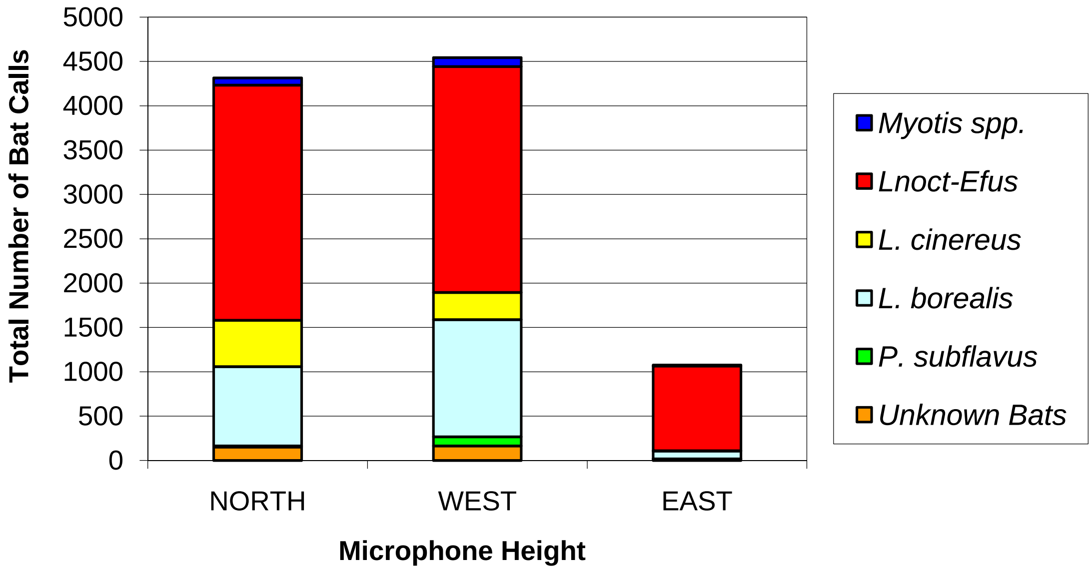

Figure 10: Distribution of Bat Activity Across Microphones by Species at the BRSA Project Site

There was no evidence of species-group patterns in bat activity, but this is most likely due to the fact that these microphones had overlapping receptive fields. The silver-haired/big brown bat group were dominant at all three microphones and represented 61.9% of all bat activity. Given the proximity of the BRSA site to suburban areas, it is likely that the vast majority of these calls were from house-roosting big brown bats (*Eptesicus fuscus*) foraging around the marsh habitat.

Because of their proximity to each other, it is likely that these microphones (particularly the NORTH and WEST) are sampling the same air space and therefore the total bat activity at the BRSA site is less than these data would suggest. This is primarily because the receptive field of the Anabat microphones are not conical, but lobular, with receptive sensitivities on both the side and back of the microphone condenser (Larson and Hayes, 2000). To test for pseudoreplication, we conducted a correlation analysis of daily bat activity between the two microphones using each sample day as an independent point. On days when both microphones were operating, 22.8% of the variation in bat activity at the NORTH microphone was explained by activity at the WEST microphone. Removing data from two days (28 June and 19 July) increased the level of explained variation between the two microphones to 31.1%. This suggests that the actual bat activity level may be lower than presented in this report.

3.5 Temporal Distribution of Bat Activity Across The Year

Pooling data from all three microphones, there was generally a high level of bat activity at the BRSA site. This activity was high at the beginning of the study period and bat activity remained detectable into mid-November (Figure 11). Standardized for sampling effort, the summer activity period (28 June - 15 August: 84.5 calls/dn) had the highest level of bat activity followed by the peak fall migratory period (16 Aug - 15 Sep: 14.2 calls/dn). Although the summer activity period represented only 49 of the sample days (31.4%), almost 89% of the silver-haired/big brown group (*Lnoct-Efus*) were recorded during the summer; presumably the vast majority of these bats were resident big brown bats (*E. fuscus*) that live in and around Union Beach. In contrast, red bats (*Lasiurus borealis*) were the most abundant bat species documented during the peak fall migratory period.

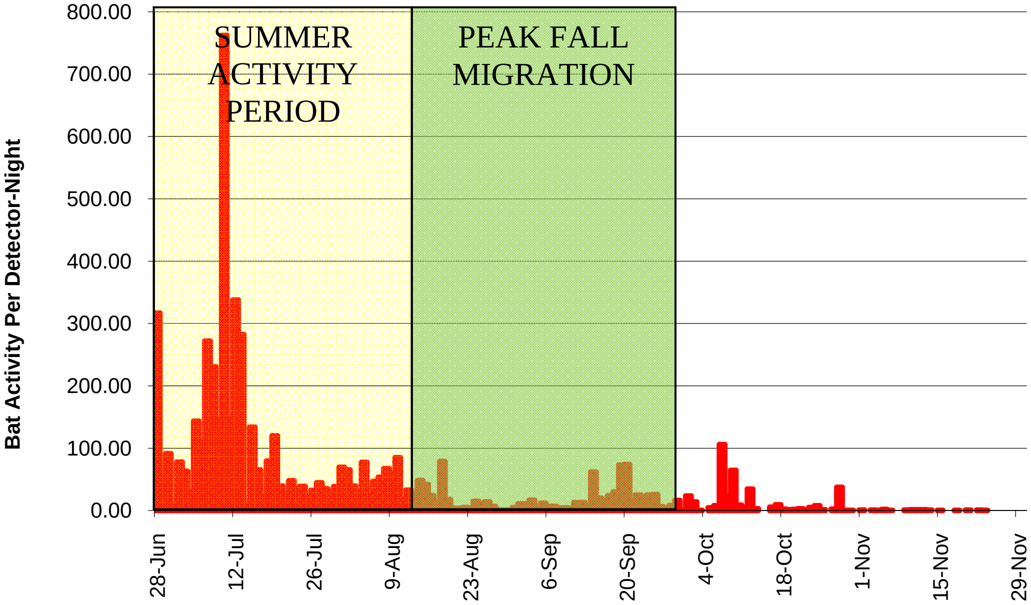

Figure 11: Distribution of Bat Activity Across the Sampling Period at the BRSA Project Site

3.6 Temporal Distribution of Bat Activity Across The Night

Data were pooled across the sampling period and analyzed for nightly activity patterns in 15-minute intervals. This showed relatively little bat activity during the first two hours (2.0% of total bat activity) and final three hours (2.3% of total bat activity) of the nightly sampling period. These data strongly suggest that the 14-hour sampling protocol is more than adequate to document bat activity at the project site. Nightly bat activity was characterized by a rapid increase in activity early in the evening (starting at approximately 20:45) that remained high throughout the evening before declining abruptly at 05:00 (Figure 12).

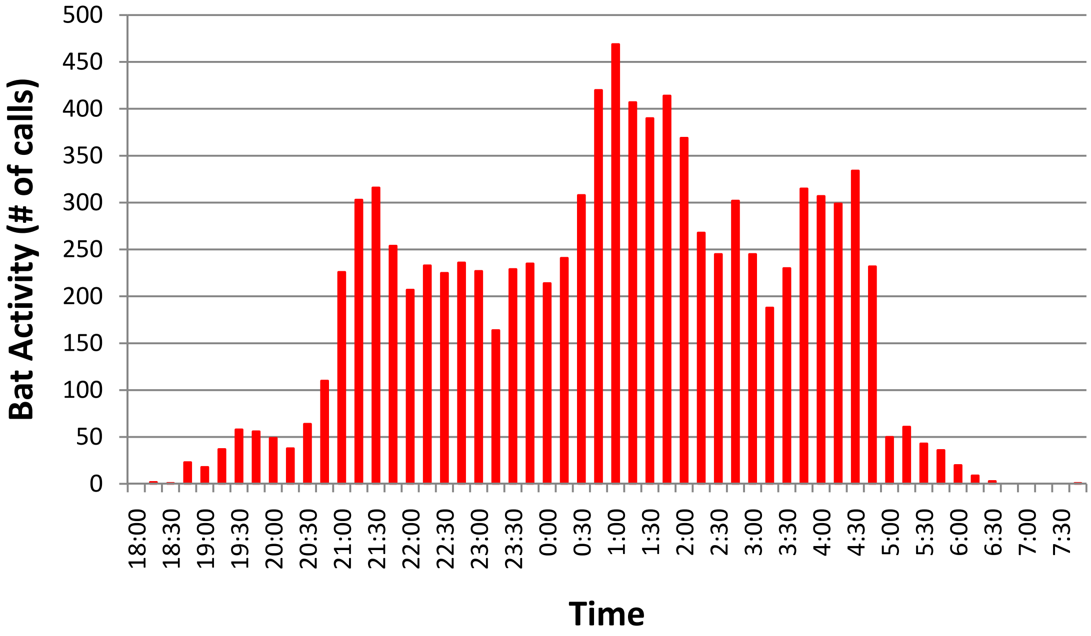

Figure 12: Temporal Distribution of Bat Activity at BRSA Across the Evening

When the bat activity is analyzed across the different microphones, the data show that the pattern of bat activity was similar for the NORTH and WEST microphone, but that the EAST microphone lacked substantial bat activity before midnight. All three microphones had peak bat activity at approximately 01:15; the high volume of early-morning bat activity at all three microphones (Figure 13) suggests that these data represent localized foraging activity rather than commuting or migratory activity, which would typically be concentrated in the early evening and much less episodic that the activity documented at the BRSA .

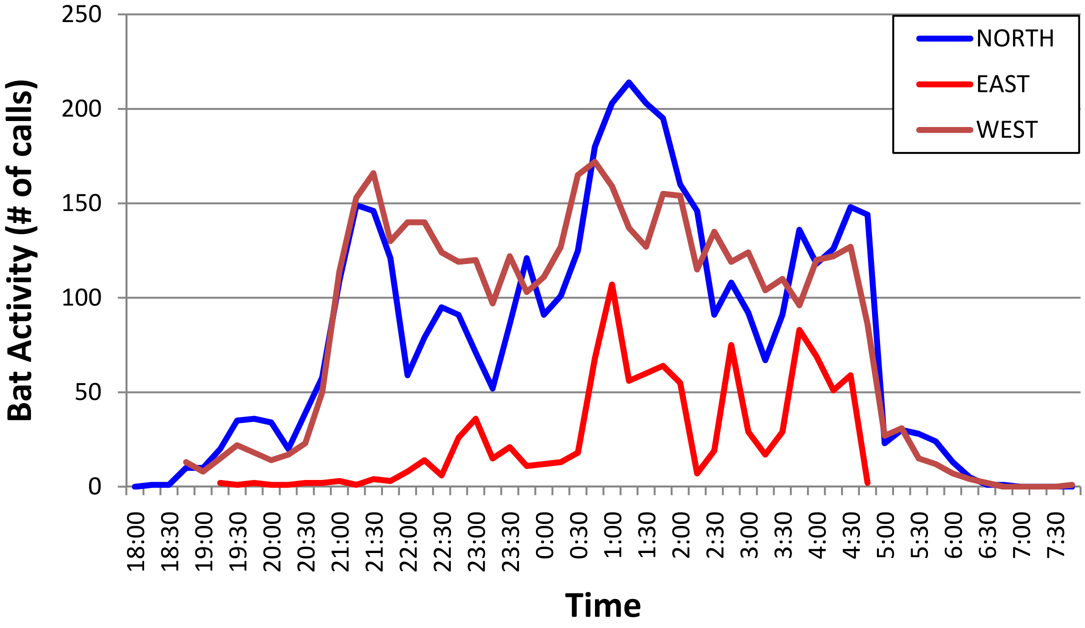

Figure 16: Temporal Distribution of Bat Activity at BRSA Across Microphones

3.7 Overview of Bat Migratory Acoustic Data

During the 156 days of monitoring at the BRSA site, a total of 9,934 bat calls was recorded and identified. Analysis of these data suggests the following:

a) Mean activity levels at the BRSA site was 31.4 calls per detector-night (calls/dn). Bat activity was highest during the late summer period (84.5 calls/dn), followed by the fall migratory period (10.9 calls/dn).

b) The NORTH and WEST microphones detected similar levels of bat activity on both a nightly and seasonal basis, suggesting that much of the bat activity at the project site was recorded by multiple detectors as the commuting and foraged around the marsh habitat adjacent to the sampling platform.

c) The EAST microphone had 76% less bat activity than the NORTH and WEST microphones and differed from these microphones in the nightly pattern of bat activity.

d) Across all microphones, the highest percent of activity came from the silver-haired/big brown bat (*Lnoct-Efus*: 61.9%), followed by the red bat (*L.borealis*: 23.2%) and the hoary bat (*L. cinereus*: 8.4%).

e) *Myotis spp.*, which contains four species including the federally-endangered Indiana myotis (*Myotis sodalis*) and the state Species of Special Concern eastern small-footed myotis (*Myotis leibii*), represented only 1.9% of the total bat activity. The low level of activity documented for this group at the BRSA site is consistent with the lack of habitat and the large-scale elimination of the *Myotis* bats in the eastern United States due to mortality from White-Nose Syndrome.

4.0 DISCUSSION AND CONCLUSION

The timing of the present migratory study is consistent with other acoustic monitoring surveys at wind development sites (Erickson et al., 2002; Reynolds, 2006; 2007a; 2007b; 2008a; NEES, 2010a; NEES, 2010b) and with the recommendations of the New York Department of Conservation (NYDEC, 2007) and New Jersey Department of Environmental Protection (NJDEP, 2010) technical guidelines. These data appear to present a reasonable picture of low altitude bat activity within the project area. The level of bat activity documented at the BRSA site is generally higher than that documented at other wind development sites (usually 1.1 - 16.4 calls/dn: Reynolds, 2007b; Reynolds, 2008a; NEES, 2008; Reynolds, 2009; NEES, 2010a; NEES, 2010b) but is similar to data collected at one site in New York (34.4: Reynolds, 2009). The relatively high level of bat activity at the BRSA site is partly due to the fact that only low-altitude microphones were used. Although bat activity from acoustic monitors deployed near the ground do not necessarily correlate with mortality (Erickson et al., 2002; Young et al., 2009), there are several reasons not to be concerned by the BRSA project site. First, the high level of activity seen at the BRSA project site results from overlapping sampling fields so that individual bats were most likely recorded on multiple microphones; this was documented by the correlation in bat activity between the WEST and NORTH microphones. Second, there is generally a sharp decline in bat activity with altitude, so that high ground-level activity does not necessarily predict high rotor-sweep activity levels. But the two most important facts that suggest the BRSA site will not have high levels of bat mortality are due to the species and temporal composition of the bat activity.

The primary source of bat activity was the silver-haired/big brown bat group; overall, this group represented over 60% of the total bat activity. Given that it is unlikely that silver-haired bats are found near the BRSA project site, we can be reasonably confident that the vast majority of this activity came from big brown bats that live and foraging in the surrounding area. Big brown bats are one of the most abundant bats in North America and are often found near wind development sites. Despite this, they are not found in post-construction mortality searches in large numbers. We believe this is due to the fact that big brown bats forage relatively close to the ground and do not migrate seasonally, two behaviors that keep them below the rotor swept zone where turbine collisions occur.

The other major indication that the BRSA site will have a relatively low impact on bat populations is that the vast majority of bat activity occurred during the summer rather than the fall migratory period. This is presumably because most of the activity we documented in summer foraging activity rather than fall migratory activity. Because the vast majority of bat mortality occurs during the fall migratory season, it is unlikely that this high summer bat activity will result in high mortality.

From the perspective of endangered species, one limitation of the current study is the inability to reliably identify species within the genus *Myotis*. This inability is well documented throughout the range of this genus (Ahlén, 2004; Jones et al., 2004), and therefore does not represent a limitation of the current protocol *per se*. The inability to distinguish within the genus *Myotis* does, however, limit our ability to use these data to quantitatively predict risk for threatened and endangered species such as the Indiana myotis and the eastern small-footed myotis. However, several facts suggest the BRSA project site poses very little risk to threatened or endangered species within the *Myotis* group. First, there is no appropriate habitat for either the Indiana myotis or the eastern small-footed myotis on or near the BRSA project site. Second, the *Myotis* group represented less than two percent of the total bat activity, and most of this activity was presumably little brown myotis activity. Therefore, it is unlikely that the BRSA project will have any impact on protected bat species.

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APPENDIX ONE: Bayshore RSA Calibration Sheets, Page 1 of 2

Project Name: BAYSHORE

Site Name:

Monitoring Season: SUMMER\FALL 2010

Project Start Date:

Acutal Start Date: 28 JUN 2010

Project End Date:

Actual End Date:

Tower Height: 15 m

Tower Type: ([✓ lattice], monopole, other)

Habitat Description: industrial area (sewage treatment facility) on the edge of salt marsh habitat on New Jersey shore

Contact Name: Bob Fischer

Phone:

Access Code:

Other Access Information:

PV Panel: NEES 223

Box ID: 21

Key:

Battery: 21

Mike Mount: fixed (fixed, square bracket pulley, pole pulley, other)

	Mike Number	Mike Height	Mike Orientation	Cable Number
WEST ~~LOW~~	NEES 55	15m	W	NEES 04 (BROWN)
NORTH ~~MID~~	NEES 44	15m	UP - N	NEES 74 (BLACK)
EAST ~~HIGH~~	NEES 66	15	E	NEES 76 (GRAY)

	Detector (or SD1)	ZCAIM	Sensitivity Setting	Other Comments
WEST ~~LOW~~	NEES 0242	03528	6	MODEM CARD 96 -73 dbm
NORTH ~~MID~~	NEES 0237	04042	6	MODEM 7062 CARD 140 -75 dbm
EAST ~~HIGH~~	NEES 0240	03977	6	CARD 78

Other Installation Comments:

APPENDIX ONE: Bayshore RSA Calibration Sheets, Page 2 of 2

Microphone Calibration - Initiation

Mike ID	Status (G/B)	20 kHz	30 kHz	40 kHz	50 kHz	60 kHz	70 kHz	Angle Test
NEES 55	G	79	67	62	56	64	74	
NEES 66	G	75	67	59	56	64	77	
NEES 44	G	81	65	62	56	64	73	

CALIBRATION SETTINGS

Sensitivity: 6

Distance: 10 m

ANGLE TEST SETTINGS

Sound Level: 58 dB

Frequency 50 kHz

Distance: 10 m

Sensitivity: 6

Microphone Calibration - Termination

Mike ID	Status (G/B)	20 kHz	30 kHz	40 kHz	50 kHz	60 kHz	70 kHz	Angle Test
NEES 55	G	79	67	62	50	64	76	
NEES 66	G	79	72	62	62	67	78	
NEES 44	G	82	65	62	56	64	72	

CALIBRATION SETTINGS

Sensitivity: 6

Distance: 10 m

ANGLE TEST SETTINGS

Sound Level: 56 dB

Frequency 50 kHz

Distance: 10 m

Sensitivity: 6

Detector Calibration - Initiation

Detector ID	Firmware	Calibration Date	Storage Confirmation Date	End Time	Calibration Date
(03528) NEES 0242	v402Mw	5/9/10	5/9/10	+3,807	3/8/11
(04042) NEES 0237	v402Mw	5/9/10	5/9/10	+4,415	3/8/11
(03977) NEES 0240	v402Mw	5/8/10	5/8/10	+2,983	3/8/11