STATE OF CONNECTICUT
CONNECTICUT SITING COUNCIL

Petition of BNE Energy Inc. for a Declaratory Ruling for the Location, Construction and Operation of a 3.2 MW Wind Renewable Generating Project on New Haven Road in Prospect, Connecticut ("Wind Prospect")	**Petition 980** **February 16, 2011**

PRE-FILED TESTIMONY OF DAVID TIDHAR

Q1. Mr. Tidhar, please state your name and position.

A. David Tidhar and I am a Project Manager and Research Biologist at Western EcoSystems Technology, Inc. ("West"). West's corporate office is located in Cheyenne Wyoming and WEST maintains a regional branch office in Waterbury, Vermont, of which I serve as the Branch Manager.

Q2. Please state your qualifications.

A. I have a Master's degree in Ecology (with Distinction) from the University of Aberdeen, Scotland (2000), and a Bachelor of Arts degree (with Honors) from the University of Montana (1997). My background includes over 13 years of professional experience in the field of wildlife biology and ecology, including six years of environmental consulting. I have been Project Manager for more than 4 years where I have led environmental site assessments and field investigations for proposed and existing commercial wind-energy projects. My responsibilities include study design, study implementation, field studies and surveys including for threatened and endangered species, managing personnel, managing budgets, client communications, agency communications, attendance of meetings and authoring reports and white papers. I have additional experience completing wildlife surveys for state and federal agencies, a conservation organization and universities. A copy of my resume is attached hereto as Exhibit 1.

Q3. <u>Please describe your involvement in this matter.</u>

A. West was retained to conduct the bat acoustic studies and breeding bird studies for BNE Energy Inc.'s ("BNE") project located at 178 New Haven Road in Prospect (the "Site"). The project is known as Wind Prospect. West's preliminary bat acoustic study is contained in BNE's petition and consists of a preliminary analysis of summer and fall 2010 acoustic bat survey. West's breeding bird survey also conducted in the summer of 2010 is located at Exhibit M of BNE's petition. Due to the fact that West was continuing to collect data concerning bat activity on the property, Exhibit L to the petition is a preliminary report. Our final bat acoustic report is attached hereto as Exhibit 2.

Q4. <u>Please describe aspects of Wind Prospect that will serve to avoid and/or minimize impacts to bat populations.</u>

A. West conducted both the breeding bird survey and bat acoustic studies in accordance with the United States Fish and Wildlife draft wind turbine guidelines, tiers one through three recommended assessments. The results of these surveys were considered in regards to project planning.

One of the key factors in minimizing impacts to bat populations is to avoid locating wind facilities near high-value bat habitat such as forested wetlands. Wind Prospect and the two proposed turbine locations on the Site are not in proximity to high-value bat habitat, which will minimize impacts to bats.

In addition, not only does the siting of the proposed turbines avoid potential bat habitat but additional design features of Wind Prospect help to further minimize potential impacts to bats. West has worked closely with VHB and other members of the BNE team to implement design features to minimize such impacts. These include not creating or locating either of the turbines near permanent standing water, and minimization of clearance areas for roads, turbines and infrastructures.

Q5. Will Wind Prospect have undue impacts to bat populations in the Prospect area?

A. No. Given the discussion above and the data collected, Wind Prospect is not anticipated to have undue impacts to bat populations. While wind projects do result in collision-induced mortality of bats, these impacts have not been shown to result in population-level effects.

Q6. Will Wind Prospect have undue impacts to breeding bird populations in the Prospect area?

A. No. While wind projects do result in collision-induced mortality of birds, these impacts have not been shown to result in population-level effects. The breeding birds identified at the Site are regionally common and no high value bird habitats are located within the development area of Wind Prospect.

February 16, 2011
Date

David Tidhar

ACTIVE/72955.3/CLARSON/2378601v1

EXHIBIT 1

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Waterbury, VT 05676
Phone: 802-244-1755
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EDUCATION

M.S.
University of Aberdeen
Aberdeen, Scotland
2000
Ecology, with Distinction

B.A.
University of Montana
Missoula, Montana
1997
Political Science/History, with honors

University of Edinburgh
Edinburgh, Scotland
1992-1996
Non-graduating International Student

SCIENTIFIC ORGANIZATION MEMBERSHIPS

The Wildlife Society

Hawk Migration Society of North America

David Tidhar, *Research Biologist/Project Manager*

PROFESSIONAL EXPERIENCE

2007-Present	*Research Biologist/Project Manager,* Western EcoSystems Technology, Inc., Waterbury, Vermont
2006-2007	*Visiting Professional Researcher,* College of William and Mary, Williamsburg, Virginia
2005	*Northern Goshawk Surveyor*, Idaho Fish and Game Department, Lewiston, Idaho
2004	*Wildlife Biologist*, Colorado Plateau Research Station, Flagstaff, Arizona
2003-2004	*Red Deer Research Assistant*, The Macaulay Institute, Scotland
2003, 1998	*Conservation Scientist & Hawk Mitigation Observer*, HawkWatch International, Salt Lake City, Utah
2000-2003	*Wildlife Biologist and Field Supervisor*, University of Aberdeen, Scotland

SPECIALTY AREAS

Project Management of environmental surveys related to commercial wind power projects including agency and client communication, project/study plan development and implementation, supervision/coordination of field staff, data and budget management, and report writing.

Coordination and conduct of wildlife and environmental surveys and monitoring related to the impact of human activities on wildlife and wildlife habitat. Survey design and implementation including pre- and post-construction surveys for threatened and endangered species; habitat evaluation; bio-monitoring; and biological impact assessments.

Preparation of scientific reports, presentations and documents including Avian and Bat Protection Plans, Incidental Take Permit Applications (e.g. New York State Article 11), and Biological Assessments and Biological Evaluations.

Recommendation and implementation of mitigation measures.

Experience in the development and implementation of scientific protocols (e.g. indirect inventory and monitoring tools for small mammals; threatened, endangered or rare species; and relative abundance surveys for raptors).

Received formal training and approval/certification for threatened, endangered, rare or sensitive species including: northern goshawk, pygmy rabbits & black-footed ferrets, and southern leopard frog.

SELECTED PROFESSIONAL PUBLICATIONS

Tidhar, D., W. L. Tidhar, C. Derby, K. Taylor, and T. Rintz. (in prep). Pygmy Rabbit Habitat Use and Distribution in Western and Central Wyoming.

Tidhar, D. and A. Sibbald (in prep). The Effect of Human Disturbance on Red Deer Behavior in Scotland.

Peacock, W. L., **D. Tidhar,** and J. R. Speakman. (in prep). The Effect of Predation Risk on Body Mass and Faecal Corticosterone Levels in the Field Vole: A Field Study.

Bierman, S. M., J. P. Fairbairn, S. J. Petty, D. A. Elston, **D. Tidhar,** and X. Lambin. 2006. Changes Over Time in the Spatiotemporal Dynamics of Cyclic Populations of Field Voles (*Microtus agrestis* L.) *The American Naturalist,* Vol. 167(4).

Tidhar, D., Gruver, J. and Courage, Z.. 2010. Middlebury Airport Vermont Bat Acoustic Survey Report. Technical report prepared for URS Corporation by Western EcoSystems Technology, Inc.

Derby, C., **Tidhar, D.,** Tidhar, W. L., Rintz, T., Taylor, K., Dahl, A. L. 2006. Overland Pass Pipeline Project: 2006 Pygmy Rabbit Presence-Absence Survey. Technical report prepared for NRG, Willbros Engineers, Inc., and Overland Pass Pipeline by Western EcoSystems Technology, Inc.

Derby C., **D. Tidhar,** and W. Erickson. 2005. Bird and Bat Fatality Monitoring of Six Un-guyed, Un-lit Cellular Telecommunications Towers with the Coconino and Prescott National Forests, Arizona: 2005 Season Results. Technical report prepared for American Tower corporation by Western EcoSystems Technology, Inc.

Lambin, X. L., J. P. Gairbairn, I. Graham, and **D. Tidhar.** 2003. Multi-Annual Population Cycles in Field Vole Populations: An Experimental Refutation of the Specialist Predation Hypothesis. 2nd International Conference on Rodent Biology & Management.

EXHIBIT 2

Bat Acoustic Studies for the Prospect Wind Resource Area New Haven County, Connecticut

Final Report
June 25 – November 1, 2010

Prepared for:

BNE Energy
Town Center, Suite 200
29 South Main Street
West Hartford, Connecticut 06107

Prepared by:

David Tidhar and Jeff Gruver

Western EcoSystems Technology, Inc.
PO Box 60
Waterbury, VT 05676

February 7, 2011

WEST Inc. Environmental & Statistical Consultants

NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

EXECUTIVE SUMMARY

Western EcoSystems Technology, Inc. initiated bat acoustic surveys in June 2010 on behalf of BNE Energy Inc. The purpose of the study was to characterize seasonal and spatial activity by bats during the summer maternity and fall migration seasons, and provide species identification of calls recorded to document presence of bat species, within the proposed Prospect Wind Resource Area (PWRA) in New Haven County, Connecticut. Surveys were conducted using Anabat™ SD1, Anabat™ SD2, and Wildlife Acoustic™ SM2Bat Unit ultrasonic detectors during the summer and fall of 2010.

The objective of the acoustic bat surveys was to characterize seasonal and spatial activity by bats within the PWRA during the maternity and migratory seasons. Bat activity was monitored using Anabats at two fixed stations from June 25 to November 1, 2010. A single SM2Bat Unit was deployed at the site for 36 nights during this period, 10 of which occurred within the estimated maternity season (June 25 – August 15) and 26 of which occurred within the estimated fall migration season (August 16 – November 1). The SM2Bat was used to identify the bat species using the study area and to estimate the relative levels of activity by different species within the site.

A total of two Anabat detectors recorded 2,303 bat passes during 254 detector-nights. Averaging bat passes across stations, a mean of 9.07 bat passes per detector-night was recorded, a value within the range of the five facilities in the eastern US where pre- and post-construction data are available (range: 0.3-38.3; mean: 19.58).

Overall, passes by low-frequency bats (47.3% of all passes) outnumbered passes by mid-frequency bats (30.6%) and high-frequency bats (22.1%). However, this pattern was not consistent between stations. The majority (68.7%) of calls recorded at station PA1 were low-frequency. In comparison, station PA2 had higher proportions of both mid- and high-frequency calls. Species identification was possible for the hoary and eastern red bat. Passes by hoary bats (51 passes) comprised 2.2% of the total bat activity, while passes by eastern red bats (32 passes) comprised 1.4% of total activity. However, given the conservative approach used for species identification, it is likely that more hoary and eastern red bat calls were recorded than were positively identified.

Bat activity levels peaked in mid-July and again in late August. During the maternity season, high-frequency bat activity peaked during the period July 16 – 22, mid-frequency activity peaked during the period July 17 – 23 and low-frequency activity peaked July 14-July 20, 2010. The mid-summer peak in bat activity likely corresponds to the time when pups are being weaned and have joined the adult population in foraging. During migration, high-frequency bat activity peaked between September 5 and September 13, mid-frequency activity peaked during the period August 25-August 31, and low-frequency activity peaked August 26-September 1, 2010. The increase in activity in late-August/early September may represent movement of migrating bats through the area, which may also explain the greater number of low-frequency bat passes

during this period, as two of the three northern migratory species – hoary and silver-haired bats – produce low-frequency echolocation calls.

A total of 844 total files were recorded by the SM2Bat, 436 of which contained bat calls (51.7%). Of these 436 files with bat calls, 109 files (25.0%) were classified to frequency group and species identification. Six bat species were identified with PWRA: big-brown bat, eastern red bat, hoary bat, silver-haired bat, little brown bat and tri-colored bat. The proportion of nights each species was identified differed seasonally. Of the ten detector nights data was collected during the maternity season, big brown bat was identified during eight nights (80.0%), followed by hoary bat (5 detector nights; 50.0%). Eastern red bat and silver haired bat were identified on three (30.0%) and two (20.0%) detector nights, respectively, with tri-colored bat identified on only a single night (10.0%). Little brown bat was not identified during the maternity season. Big brown bat and silver-haired bat were identified on nine detector nights (34.6%), three times the number of detector nights in which the other species were identified, during the fall migration season. Both hoary and eastern red bats were identified on three detector nights during the fall migration season (11.5%), while little brown bat was identified on a single detector night (3.8%). Tri-colored bat was not identified during the migratory season (Table 6).

There appears to be some latitudinal variation in the eastern US, such that higher numbers of fatalities are estimated for more southerly sites compared to site in the north. Confirming this pattern requires more data but it may possibly reflect the migratory patterns of bats on a broad-scale in this region. Bat fatality patterns observed at facilities within the region in similar forest-dominated landscapes have been low to moderate, based on regional study results. If regional patterns based on latitude, landscape, and bat activity rates relative to mortality are consistent, then fatality rates for bats at the PWRA may be low to moderate.

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INTRODUCTION

BNE Energy, Inc (BNE) is proposing to develop a wind energy facility consisting of two GE 1.6 MW turbines located on 68 acres of undeveloped land on New Haven Road, in the town of Prospect, New Haven County, Connecticut. BNE contracted Western EcoSystems Technology, Inc. (WEST) to develop and implement a standardized protocol for a baseline study of bat activity within the Prospect Wind Resource Area (PWRA) for the purpose of estimating impact of the wind energy facility on bats. The protocol is based on WEST's experience studying wildlife and wind turbines at wind energy facilities throughout the US and is similar to protocols used at numerous wind energy facilities.

The purpose of the study was to characterize seasonal and spatial activity by bats within the PWRA during the summer maternity and fall migration seasons and provide species identification of calls recorded to document presence of bat species within PWRA. The study was completed using passive acoustic sampling, using Tetley Anabat™ and Widllife Acoustics SM2Bat™ ultrasonic bat detectors. The following report describes the results of acoustic bat surveys conducted during the summer and fall of 2010 in the PWRA. Breeding bird surveys were also completed during the summer of 2010 at the PWRA, the results of which are presented in a separate report.

STUDY AREA

The proposed wind energy facility (VHB 2010a; Figure 1) is located in the southwest hills of Connecticut, north of the Coastal Plain and just west of the lower Connecticut River Valley (Bell 1985). The Southwest Hills is a region of rolling hills that were formed by glacial erosion and deposition (VHB 2010a).

The PWRA is situated along the top and western slope of a north-south oriented hill composed of unsorted, dense glacial till, and can be described as drumlinoid in shape. The PWRA is approximately 67 acres (0.10 square miles [mi^2]) in size, with elevations ranging from approximately 550 to 810 feet (ft; 168 to 247 meters [m]) above sea level. Land use in the region is a mix of heavy development, including the city of Waterbury, located approximately seven miles (11 kilometers [km]) away, suburban development, and forest, with occasional small agricultural areas. The New Naugatuck Reservoir (also known as Long Hill Reservoir) exists within a valley approximately one-quarter mile (About 400 m) to the west of the PWRA. The majority of the study area is covered by secondary-growth (pole timber) upland deciduous forest; the understory is dominated byJapanese barberry (*Berberis thungbergii*), a non-native invasive species (VHB 2010a). There are also two small forested wetlands and 10 acres (0.02 mi^2) of field habitat on the hill.

Figure 1. Map of the proposed Prospect Wind Resource Area.

METHODS

Bat Acoustic Surveys

The objective of the bat acoustic surveys was to characterize seasonal and spatial bat activity within the PWRA during the summer maternity and fall migration seasons. The use of such detectors for calculating an index to bat impacts is a primary bat risk assessment tool for baseline wind development surveys (Arnett 2007, Kunz et al. 2007). Bat activity was surveyed within PWRA using ultrasonic detectors from June 25 to November 1, 2010; a period encompassing both the estimated summer maternity season and fall migration season at this site. From June 25 to August 10, bat activity was surveyed using two Anabat™ SD1 bat detectors (Titley Scientific™, Australia). On August 11, Anabat SD1 detectors were exchanged for Anabat™ SD2 detectors (Titley Scientific™, Australia), which were used for the remainder of the study period. In order to provide a better understanding and identification of the species composition within the project area, bat activity at the PWRA was also surveyed using a SM2Bat Unit (Wildlife Acoustics™, Inc., Concord, Massachusetts), utilizing full-spectrum recording technology compatible with zero crossing analysis on a variable one to two week schedule throughout the study period. This unit was initially deployed on July 28, 2010.

The Anabat detectors were placed near the ground at two fixed stations PA1 and PA2; the SM2Bat unit (PS1) was placed near the ground adjacent to PA1 (Figure 3). Station PA1 was set at the base of the meteorological (met) tower in an existing meadow surrounded by deciduous woodland (Appendix A). Station PA2 was established at one of the proposed turbine locations (Turbine 2) in deciduous woodland (Appendix B). The PS1 was placed at the base of the met tower 1 m (3.3 ft) from PA1. (Appendix C). Anabat detectors were placed inside plastic weather-tight containers with an opening in the side through which the microphone extended. Microphones were encased in poly-vinyl chloride (PVC) tubing that curved skyward at 45 degrees. To minimize potential for water damage due to rain, holes were drilled in the PVC. Detectors protected in this manner have been found to detect similar numbers of bat calls as detectors exposed to the environment (Britzke et al. 2010). The SM2Bat Unit (PS1) is a self contained weatherproof unit requiring no additional weatherproofing containers or retrofit of microphones. All units were raised approximately two m (6.6 ft) off the ground to minimize echo interference and lift the unit above ground vegetation.

Anabat detectors record bat echolocation calls with a broadband microphone. Calls were recorded to a compact high-capacity flash memory card; data were subsequently transferred onto a computer for analysis. The echolocation sounds were then translated into frequencies audible to humans by dividing the frequencies by a predetermined ratio. A division ratio of 16 was used for this study. Bat echolocation detectors also detect other ultrasonic sounds, such as those sounds made by insects, raindrops hitting vegetation, and other sources. Depending on the environment in which the unit was placed, a sensitivity level of 5.5 or six was used to reduce interference from these other sources of ultrasonic noise. The detection range of Anabat detectors depends on a number of factors (e.g., echolocation call characteristics, microphone sensitivity, habitat, the orientation of the bat, atmospheric conditions; Limpens and McCracken, 2002), but is generally less than 30 m (98 ft) due to atmospheric absorption of echolocation pulses (Fenton 1991). To ensure similar detection ranges among anabat units, microphone sensitivities were calibrated using a BatChirp ultrasonic emitter (Tony Messina, Las Vegas, Nevada) as described in Larson and Hayes (2000). All units were programmed to turn on each night approximately 30 minutes before sunset and turn off approximately 30 minutes after sunrise.

An additional objective of the survey was to identify the bat species using the study area and to estimate the relative levels of activity by different species within the site. To address this objective, an SM2Bat Unit (Wildlife Acoustics™, Inc., Concord, Massachusetts) was deployed at the site (Appendix C). The SM2Bat Unit is a full-spectrum bat detector, which records complete acoustic waveforms by sampling sound waves at 192 kHz. This high sampling rate enables the detector to record sound amplitude data at all frequencies up to 96 kHz and to make high resolution recordings (Wildlife Acoustics, 2010). In contrast, the zero-crossing meter in the Anabat SD1 or SD2 detector records the frequency of only the highest amplitude sound and samples at a lower rate (e.g., 1/16th of the sound frequency) which produces lower resolution recordings. The higher quality recordings produced by the SM2 detector provides more detailed information in which to make bat species identification at the cost of higher data storage requirements and slower data analysis. Calls were recorded to high-capacity SDHC memory cards, and subsequently transferred onto a computer for analysis in the SonoBat™ program, discussed under the statistical analysis section below (SonoBat™; Arcata, California).

As noted above, echolocation detectors, including the SM2Bat Unit, also detect other ultrasonic sounds. To reduce this type of interference during recording, frequencies below 16kHz (below the range of bat echolocation in the Northeast) were filtered out using a high-pass filter. In addition, an adaptive trigger level of 12 signal to noise ratio (SNR; adaptive +12dB) was used, which specified that incoming signals (presumably bat calls) exceed the average background spectrum within the frequency band by 12 dB. The adaptive trigger levels range from +1 and +88 dB SNR, where a higher value is less sensitive than a lower value between. The trigger window was set to 1 second. After initial deployment and continued discussion with Wildlife Acoustics and professional bat biologists, the settings were adjusted for the remainder of the study period, as follows: high pass filter of 16, adaptive trigger level of 15 dB SNR, and a trigger window of 5 seconds. This means that the SM2Bat Unit measured the rolling-average power spectrum in the appropriate frequency band (above 16kHz) for the length of the trigger window setting (5.0 seconds), and if a signal exceeding this threshold by 15dB was detected, the bat call or other ultrasonic noise signal was recorded until no trigger was detected for a full second.

The detection range of Anabat detectors and SM2Bat Units depend on a number of factors, such as echolocation call characteristics, microphone sensitivity, habitat, the orientation of the bat, and atmospheric conditions (Limpens and McCracken 2004; Ian Agranat, President & CEO Wildlife Acoustics, pers. comm. 2010). The SM2Bat unit was programmed to turn on each night at sunset and turn off at sunrise based on an internal solar tracking feature programmed with the specific coordinates and time zone for Prospect, CT.

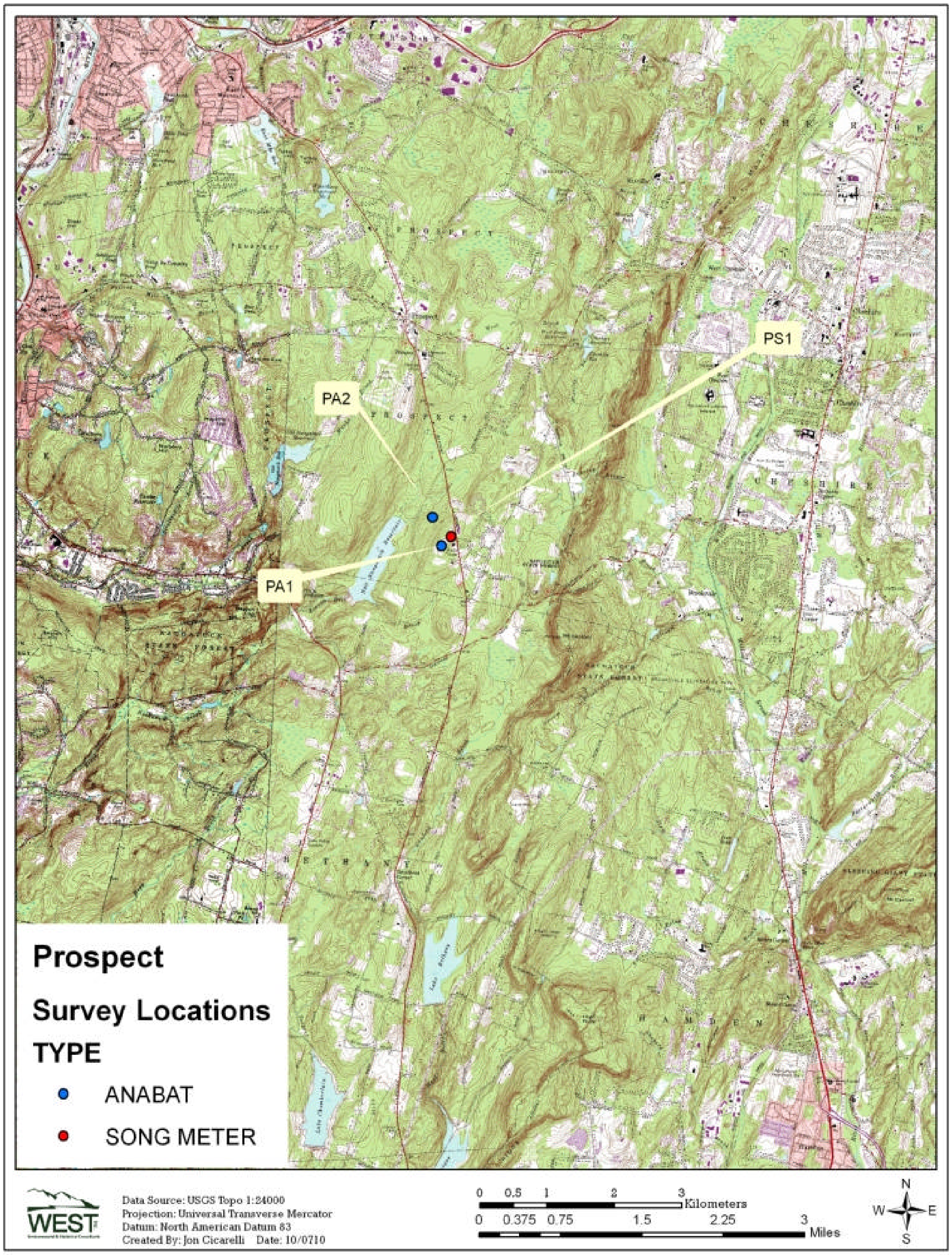

Figure 2. Study area map and acoustic bat sampling stations at the Prospect Wind Resource Area.

Statistical Analysis

Anabat Units

The units of bat activity used for analysis were number of bat passes (Hayes 1997). A bat pass was defined as a continuous series of two or more call notes produced by an individual bat with no pauses between call notes of more than one second (White and Gehrt 2001, Gannon et al. 2003). In this report, the terms bat pass and bat call are used interchangeably. The number of bat passes was determined by downloading the data files to a computer and tallying the number of echolocation passes recorded. Data files recorded by Anabat units were analyzed using AnalookW v3.5r (©2008, Chris Corben) and Analook DOS v4.9j (©2004, Chris Corben) software. The Analook software displays bat calls (and extraneous noise) as a series of pixels on a time over frequency display. Analook provides a framework to build filters that constrain the values of certain call parameters. Pixels that fall outside the specified range of the filter parameters are ignored (e.g. pixels not following a smooth line, pixels below or above a specified frequency, etc.). In addition, a series of filters, developed by WEST, was used to quickly and effectively separate out files that contained only noise, and to sort remaining files containing bat calls into frequency groups. Filtered files were visually examined by an analyst to ensure accuracy. Data determined to be noise (produced by a source other than a bat) and call notes that did not meet the pre-specified criteria to be termed a pass were removed. The total number of bat calls was then corrected for effort by dividing the number of calls by the number of detector-nights, where a detector-night was defined as one detector collecting data for one night.

While some bat species produce a call that has a distinctive sonogram (i.e., the shape on a frequency-time graph), there is much overlap and variation among some species. For this reason, a conservative approach to species identification was used. For each Anabat station, bat passes were sorted into three groups, based on their minimum frequency, that correspond roughly to species groups of interest. For example, the species of *Myotis* bats in Connecticut generally have echolocation with minimum frequencies near 40 kilohertz (kHz), whereas species such as the eastern red bat (*Lasiurus borealis*) typically have echolocation calls that fall between 30 and 40 kHz, and species such as big brown (*Eptesicus fuscus*), silver-haired (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*), have echolocation frequencies that fall at or below 25 kHz. Therefore, passes were classified as high-frequency (HF; more than 40 kHz), mid-frequency (MF; 30 to 40 kHz), or low-frequency (LF; less than 30 kHz). To establish which species may have produced passes in each category, a list of species expected to occur in the study area was compiled from range maps (Table 1; Harvey et al. 1999, CDEF 1999).

Table 1. Bat species with the potential to occur within Prospect Wind Resource Area. Data from Harvey et al. (1999) and the Connecticut Department of Environmental Protection (CDEP 1999).

Common Name	Scientific Name
High-Frequency (> 40 kHz)	
northern long-eared bat[2]	*Myotis septentrionalis*
Indiana bat[2]	*Myotis sodalis*
tri-colored bat[2]	*Perimyotis subflavus*
Mid-Frequency (30-40 kHz)	
eastern red bat[1,2]	*Lasiurus borealis*
little brown bat[2]	*Myotis lucifugus*
Low-Frequency (< 30 kHz)	
big brown bat[2]	*Eptesicus fuscus*
silver-haired bat[1,2]	*Lasionycteris noctivagans*
hoary bat[1,2]	*Lasiurus cinereus*

[1]long-distance migrant; [2]species known to have been killed at wind energy facilities

Within these categories, distinctive passes made by two *Lasiurus* species, hoary bat and eastern red bat, were identified. Echolocation calls that had a distinct U-shape and that exhibited variability in the minimum frequency across the call sequence were identified as belonging to the *Lasiurus* genus (C. Corben, pers comm.). Hoary and eastern red bats were distinguished based on minimum frequency. Hoary bats typically produce calls with minimum frequencies between 18 and 24 kHz, whereas eastern red bats typically emit calls with minimum frequencies between 30 and 43 kHz (J. Szewczak, pers comm.). Only sequences containing three or more calls were used for species identification. These are conservative standards. Given the high intra-specific variability of *Lasiurus* calls and the number of call files that were too fragmented for proper identification, it is likely that more hoary and eastern red bat calls were recorded than were positively identified.

Data determined to be noise (produced by a source other than a bat) and call notes that did not meet the pre-specified criteria to be termed a pass were removed from the Anabat analysis.

SM2Bat Unit

The SM2Bat unit is a full-spectrum recorder and differs from Anabat by preserving the amplitude and harmonic details of the original signal (Wildlife Acoustics, 2010b). Full-spectrum recording provides more data-rich output, which can be analyzed by software programs designed to process at a higher resolution. This provides potential for increased ability to accurately identify call to species. Echolocation calls were recorded to SDHC memory cards and subsequently transferred to a computer for analysis in Sonobat 3.02 (Sonobat, Arcata, California). Sonobat uses a proprietary algorithm to analyze 76 call parameters with a hierarchical discriminant function developed from a library of 10,000 known bat passes, and assigns a bat species and probability to each pass. However, as with Anabat some bat passes cannot be identified with certainty, either because the pass consists of only call fragments or because different bat species produce similar calls with overlapping characteristics that often cannot be distinguished. For analysis, Sonobat was instructed to report positive identification of bat species only if call quality was ≥80% and if discriminant probability was ≥90%. Therefore, only a small portion of recorded calls were identified to species. The Sonobat output was used to generate a list of species that appear to be present on site and to estimate the relative share of identifiable bat calls generated by each species by number of detector nights a species' call was identified.

The data collected by the SM2Bat unit and the discriminant analysis conducted were to determine presence/absence of species within PWRA, rather than to estimate levels of bat activity. Presence and absence is presented as the number and proportion of nights that at least one call from a species was detected and identified

RESULTS

Anabat Acoustic Surveys

Bat activity was monitored by Anabat units within the PWRA at two sampling locations on a total of 130 nights during the period June 25 to November 1, 2010. PA2 was not activated in the field until June 27, but PA1 was recording on June 25 and 26. The detector at station PA1 was inactive from August 25-27 due to an error code received when switching the compact flash card during servicing, however the detector at station PA2 did record during that time period. The average number of Anabat files containing only noise ranged, on a weekly basis, from 8.77 to 567.43. Noise files exceeded the number of files containing bat calls for about half the study period, and may have interfered with overall detection of bat calls, (Figure 4).

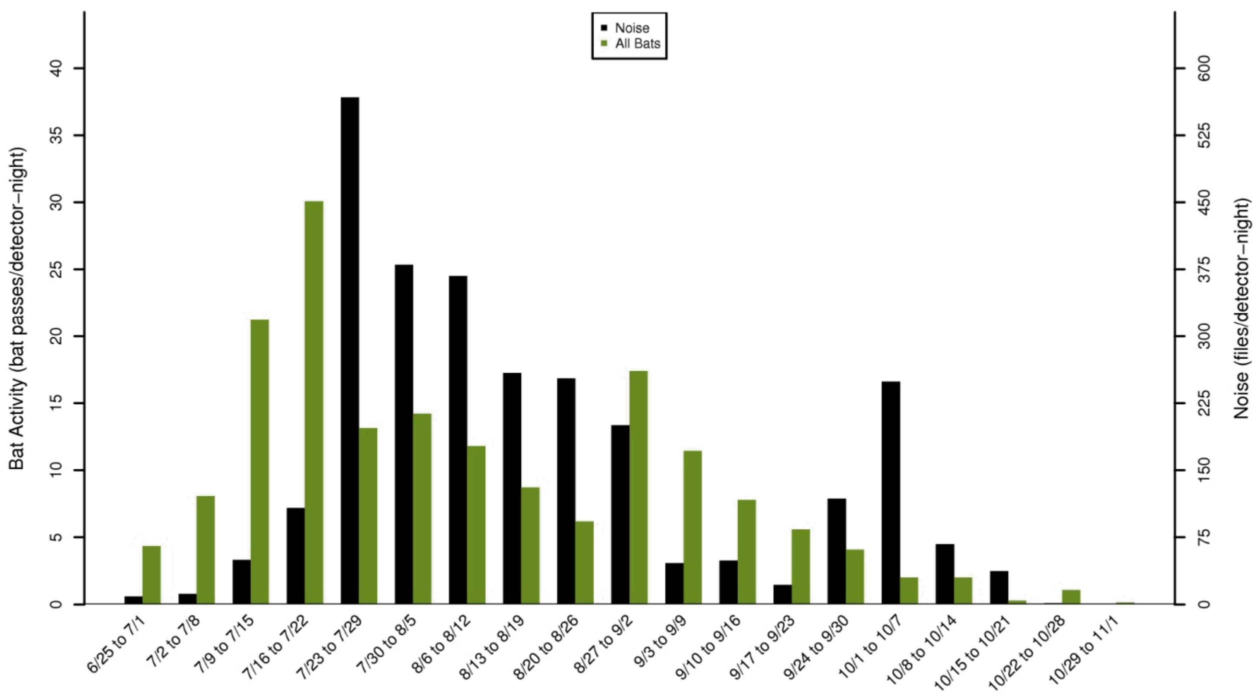

Figure 4. Bat activity and noise files recorded per detector-night within the Prospect Wind Resource Area, June 25 – November 1, 2010, presented weekly.

A total of 2,303 bat passes were recorded at the two Anabat stations on 254 detector-nights (Table 2). More passes were recorded at station PA1, which accounted for about 68% of the total calls recorded during the study period. Averaging recorded bat passes across stations gives a mean of 9.07 bat passes/detector-night. Mean bat activity was 12.31 and 5.82 bat passes per detector-night at stations PA1 and PA2, respectively (Table 2).

Table 2. Results of acoustic bat surveys conducted at the Prospect Wind Resource Area, June 25 – November 1, 2010, separated by call frequency (high-frequency [HF], mid-frequency [MF], and low-frequency [LF]).

Station	HF-Calls	MF-Calls	LF-Calls	Eastern Red Bat Calls[a]	Hoary Bat Calls[b]	Total Bat Passes	Detector-Nights	Bat Passes / Detector-Night[*]
PA1	253	237	1074	32	50	1564	127	12.31±0.97
PA2	256	467	16	0	1	739	127	5.82±1.03
Total	**509**	**704**	**1090**	**32**	**51**	**2303**	**254**	**9.07±0.78**

[a]Passes by eastern red bats are included in mid-frequency (MF) numbers; [b]Passes by hoary bats included in low-frequency (LF) numbers. [*]± bootstrapped standard error.

The type of calls recorded differed between stations (Table 2; Figure 5). The majority of calls (68.7%; 1074 LF passes) at station PA1 were LF calls, while HF and MF calls were about equal with 16.2% (253 HF passes) and 15.2% (237 MF passes), respectively (Table 2; Figure 5). In contrast, at station PA2, MF calls comprised the majority of bat activity (63.2%; 467 MF passes), compared to HF calls (34.6%; 256 HF passes) and LF calls (2.2%; 16 LF passes; Table 2; Figure 5). The number of MF calls recorded at station PA2 was twice as high as MF calls recorded at station PA1 (467 and 237 MF calls, respectively). The number of HF calls recorded at station PA1 and PA2 was equal (253 and 256, respectively) while station PA1 recorded almost all of the LF activity (1074 passes) compared to PA2 (16 LF passes; Table 2; Figure 5).

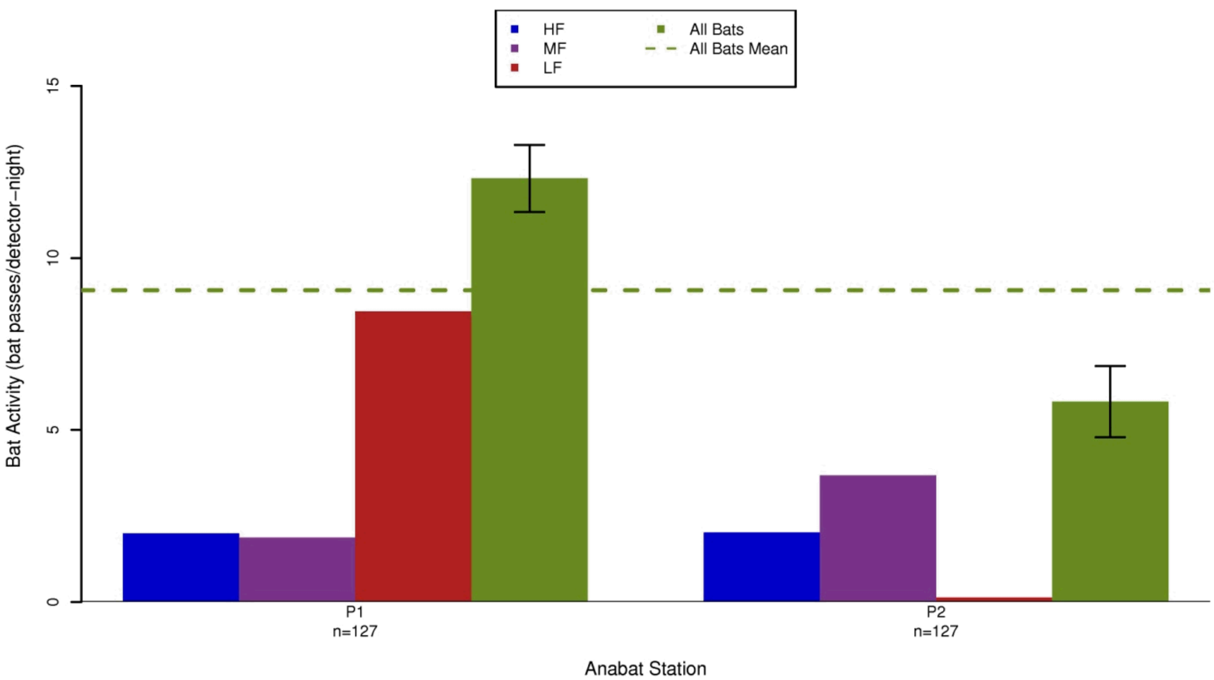

Figure 5. Bat activity (bat passes/detector-night) by frequency group recorded at Anabat stations within the Prospect Wind Resource Area from June 25 – November 1, 2010. Error bars represent standard errors.

The study was divided into two seasonal survey periods: summer and fall. Summer corresponded with the estimated maternity season, June 25 – August 15. The fall season was based on the migration period for bats in the northeast US, August 16 – November 1, 2010. Bat activity varied between and within seasons (Table 3; Figure 6). Overall bat activity was substantially higher during the summer season, averaging 14.51 bat passes per detector-night compared to bat activity during the fall, which averaged only 5.55 bat passes per detector-night (Table 3 and Figure 6). Both stations had higher bat activity rates during the summer than during the fall. However, the difference between seasonal activity rates at station PA1 was notably smaller than the difference between activity rates detected between seasons at station PA2. Station PA1 recorded an overall bat activity rate of 15.46 bat passes/detector night during the summer and a rate of 10.13 during the fall, whereas, PA2 recorded an overall bat activity rate of 13.55 bat passes/detector night during the summer and a rate of only 0.96 during the fall. Comparing peak bat activity between frequency groups between seasons, all frequency groups

(HF, MF, and LF) showed greater levels of activity during the summer season than during the fall (Table 3; Figure 6). This pattern was consistent at both stations in seasonal activity detection rates (Table 3).

Table 3 Mean nightly pass rates by pass type, station and season. Pass types are high-frequency (HF), mid-frequency (MF), low-frequency (LF), and all bats (AB) within the Prospect Wind Resource Area; from June 25 - November 1, 2010.

Station	Pass type	Summer Maternity 6/25/2010 to 08/15/2010	Fall Migration 816/2010 to 11/01/2010
PA1	LF	11.88	6.08
PA1	MF	2.31	1.56
PA1	HF	1.27	2.49
PA1	AB	15.46	10.13
PA2	LF	0.27	0.04
PA2	MF	8.9	0.4
PA2	HF	4.39	0.53
PA2	AB	13.55	0.96
Total	**LF**	**6.07±0.66**	**3.06±0.48**
Total	**Mid**	**5.60±0.73**	**0.98±0.15**
Total	**HF**	**2.83±0.54**	**1.51±0.14**
Total	**AB**	**14.51±1.57**	**5.55±0.65**

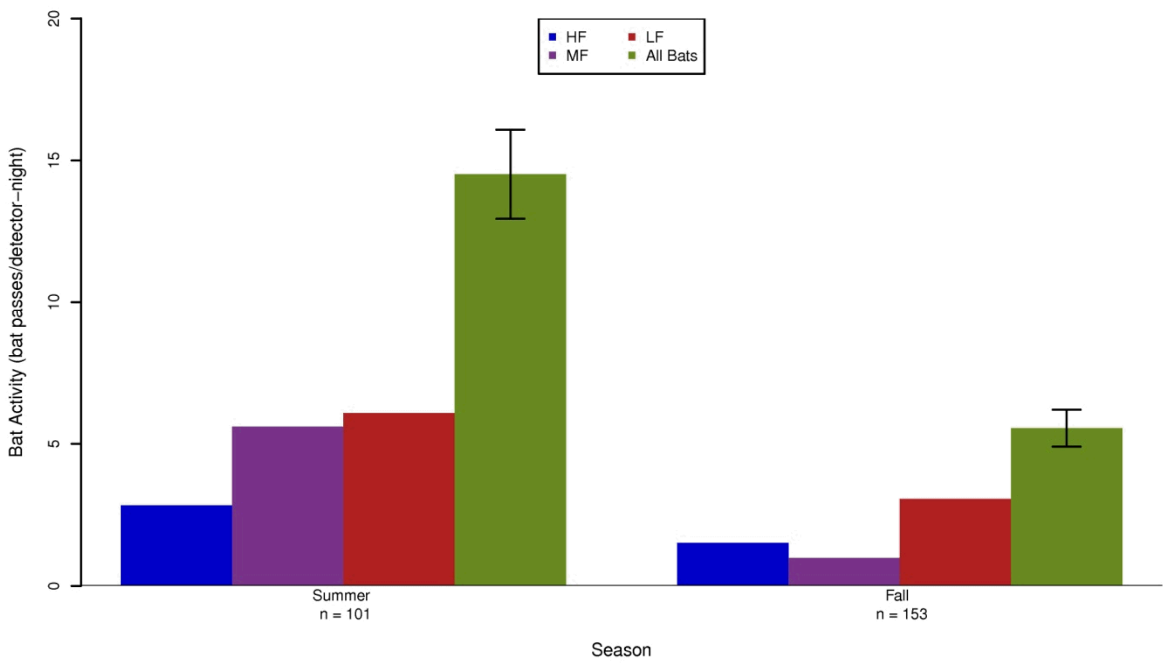

Figure 6. Seasonal bat activity at the Prospect Wind Resource Area: Summer Maternity (June 25-August 1, 2010) and Fall Migration (August 15-November 1, 2010). The bootstrapped standard errors are represented in the 'All Bats' columns.

The period of highest bat activity within the study area was estimated by taking the maximum average bat activity rate for any seven day period, not restricted to a particular starting date. If two or more consecutive seven day periods had this maximum rate, the start date and end date for peak activity was determined to be the start date of the first seven day period through the end date of the last seven day period. Peak bat activity was estimated for the maternity season, the fall migration season and for the entire study period (Table 4; Figure 7).

Bat activity for all groups was highest between July 16 and July 22, 2010. This pattern was similar for all frequency groups throughout the entire study period, with HF activity peaking from July 16-22, MF activity peaking between July 17 and July 23 and LF activity peaking July 14 to July 20, 2010. The same dates corresponded to the peak activity level detected during the maternity season for all bats and for each frequency group. During fall migration, peak activity detected during a seven day period was similar for all bats combined and for both MF and LF groups. Passes by all bats and by LF species peaked between August 26 and September 1, 2010, while passes from MF species peaked from August 25 to August 31, 2010. The high frequency group peaked 10 days later than all other frequency groups, September 5 to September 13, 2010 (Table 4; Figure 7).

Table 4. Highest activity rates within a seven day period, unconstrained by calendar week, sorted by call frequency (high frequency [HF], mid frequency [MF], and low frequency [LF]) and by identified species (Hoary and Eastern red bat) for the overall study period, summer maternity season, and the fall migration period.

Period of Interest	Seven Day Period of Highest Passage Rate
	All Bats
Overall	07/16/10 to 07/22/10
Summer Maternity Period	07/16/10 to 07/22/10
Fall Migration Period	08/26/10 to 09/01/10
	HF Bats
Overall	07/16/10 to 07/22/10
Summer Maternity Period	07/16/10 to 07/22/10
Fall Migration Period	09/05/10 to 09/13/10
	MF Bats
Overall	07/17/10 to 07/23/10
Summer Maternity Period	07/17/10 to 07/23/10
Fall Migration Period	08/25/10 to 08/31/10
	LF Bats
Overall	07/14/10 to 07/20/10
Summer Maternity Period	07/14/10 to 07/20/10
Fall Migration Period	08/26/10 to 09/01/10
	Hoary Bats
Overall	07/11/10 to 07/17/10
Summer Maternity Period	07/11/10 to 07/17/10
Fall Migration Period	08/25/10 to 08/31/10
	Eastern Red Bats
Overall	08/08/10 to 08/17/10
Summer Maternity Period	08/08/10 to 08/16/10
Fall Migration Period	09/15/10 to 09/23/10

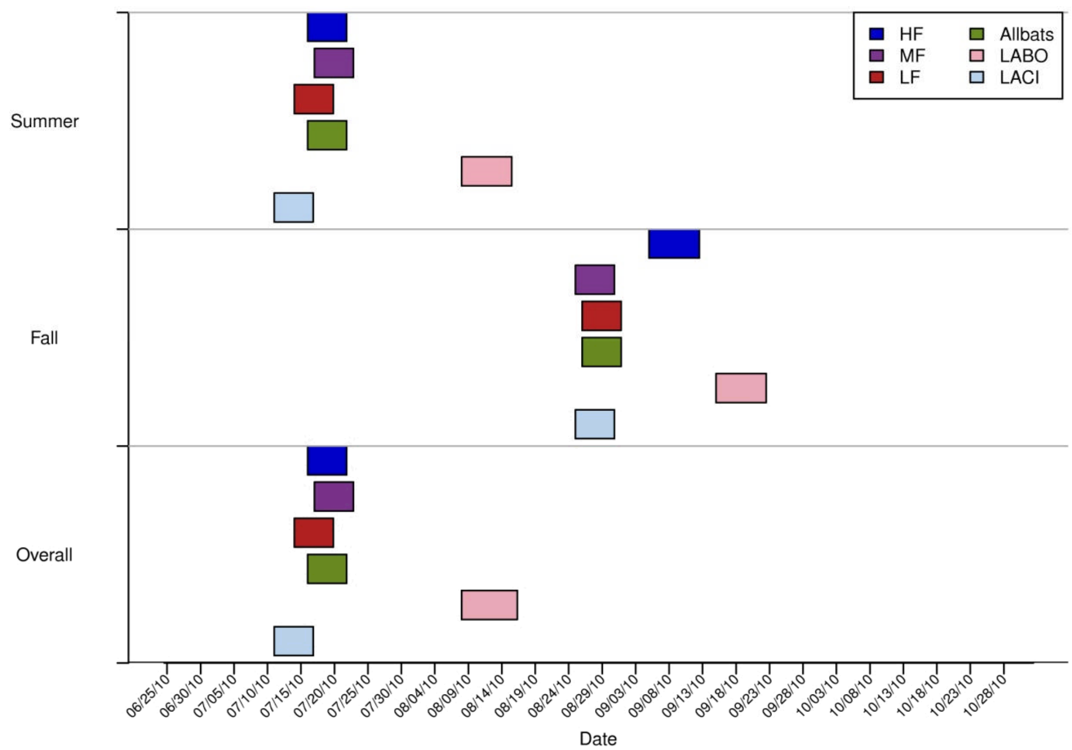

Figure 7. Highest activity rates detected within a seven night period, sorted by call frequency (high frequency [HF], mid frequency [MF], low frequency [LF]), for the overall study period, summer maternity, and fall migratory period Prospect Wind resource Area, June 25-November 1, 2010.

Overall bat activity followed a bell-shaped distribution from the start of the study through the last week of August and this pattern was generally consistent among frequency groups (Figure 5). During the last week of August there was a large increase in activity relative to the preceding few weeks, and it represented the third highest level of bat activity during the study period. This was primarily due to an increase in LF activity. Bat activity for all frequency groups increased for the first four weeks of the study, reaching a summer peak in activity from July 16 to July 22 with an overall bat pass rate of 30.1 bat passes/detector-night. Activity was lower for the remainder of July and early-mid August, reaching a low during the week of August 20 – 26 (6.1 bat passes/detector-night) before sharply increasing during the week of August 27 – September 2 (17.4 bat passes/detector-night). After September 2, 2010 activity for all bats and frequency groups showed a general trend of decreasing activity on a weekly basis. Mid-frequency species became seemingly absent by the second week of October with only 0.07 bat passes/detector-night recorded each week. Calls by high and low frequency species were recorded through the end of the study period, albeit in low numbers (Figure 5).

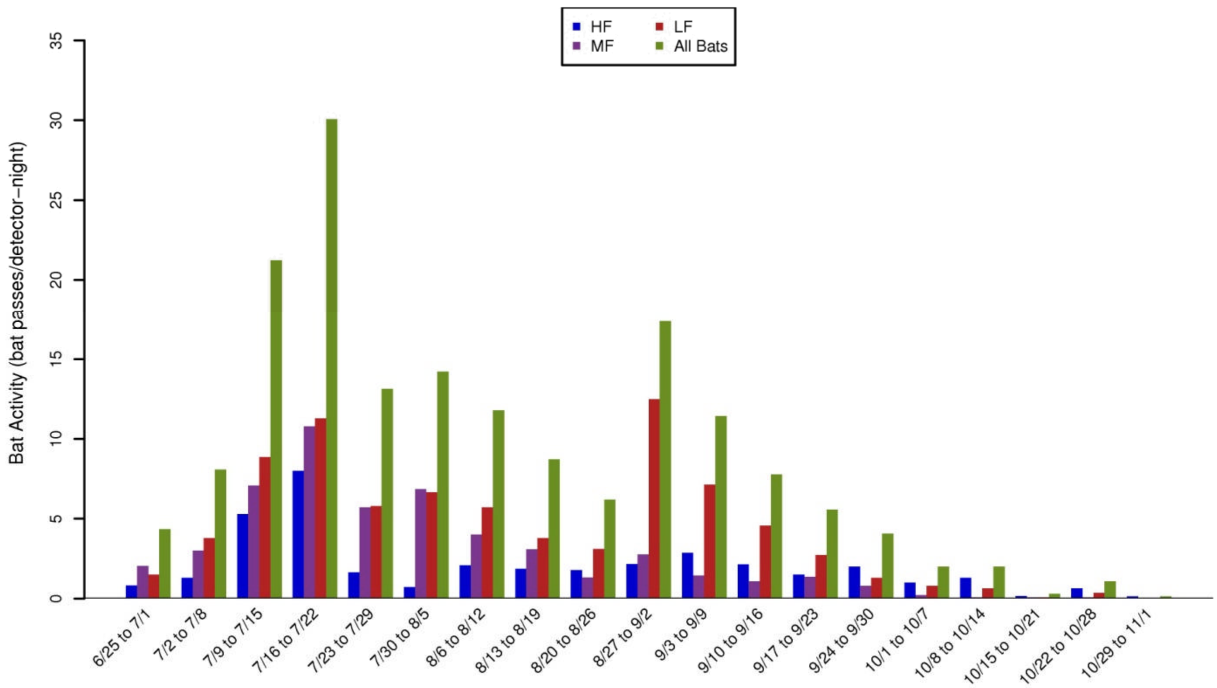

Figure 8. Weekly activity of high-frequency (HF), mid-frequency (MF), and low-frequency (LF) bats in the Prospect Wind Resource Area, eduring the study period June 25 – November 1, 2010.

The number of passes attributable to eastern red and hoary bats during the 2010 maternity season was low (83 passes for the two species combined; Table 2). Passes by hoary bats (51 passes) comprised only 2.2% of total passes detected within the study area and 4.7% of all LF passes. All but one hoary bat call was recorded at station PA1 (Table 2; Figure 8). The majority of recognizable hoary bat activity occurred between July 16 and July 22 (43.1%; Figure10); however, the peak activity within a 7-day period occurred during July 11 – 17, with a mean of 1.93 bat passes/detector-night (Table 4). No hoary bats were detected after September 16, 2010 (Figure10).

Passes by eastern red bats (32 calls) accounted for 1.4 % of total passes and 4.5% of all MF calls (Table 2). All (100%) of eastern red bat activity was recorded at station PA1 (Table 2; Figure 9). The majority of recognizable eastern red bat activity occurred between August 6 and August 19 (31.2%; Figure10), with peak activity within a 7-day period occurring between August 8 and 17, 2010 (mean of 0.64 bat passes/detector-night;Table 4). Overall, eastern red bat calls were detected throughout the entire study period.

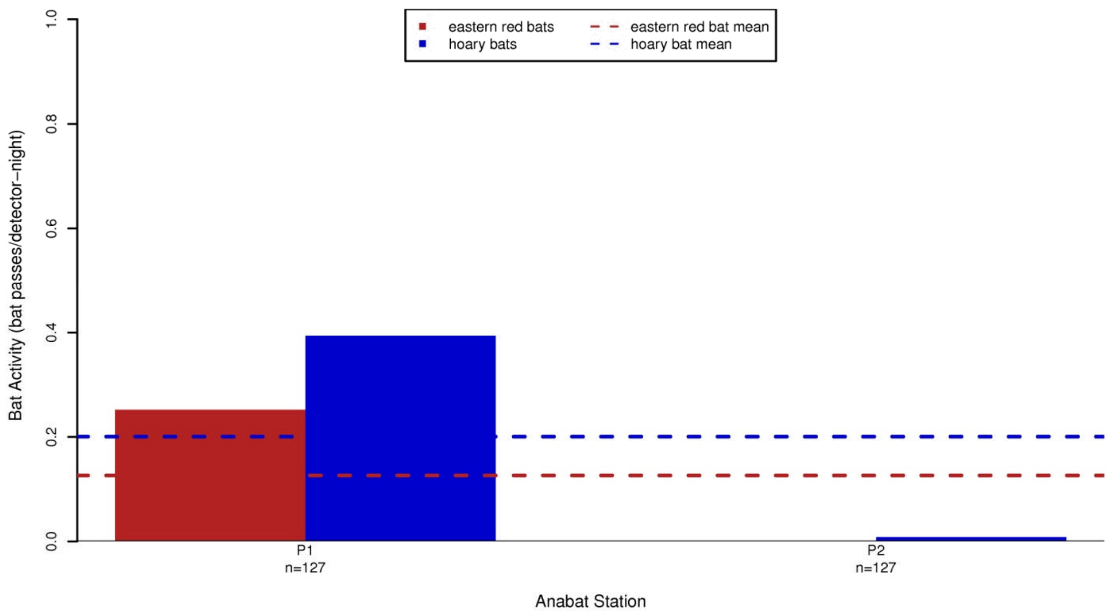

Figure 9. Hoary and eastern red bat activity (bat passes/detector-night) recorded within the Prospect Wind Resource Area by station, June 25 – November 1, 2010.

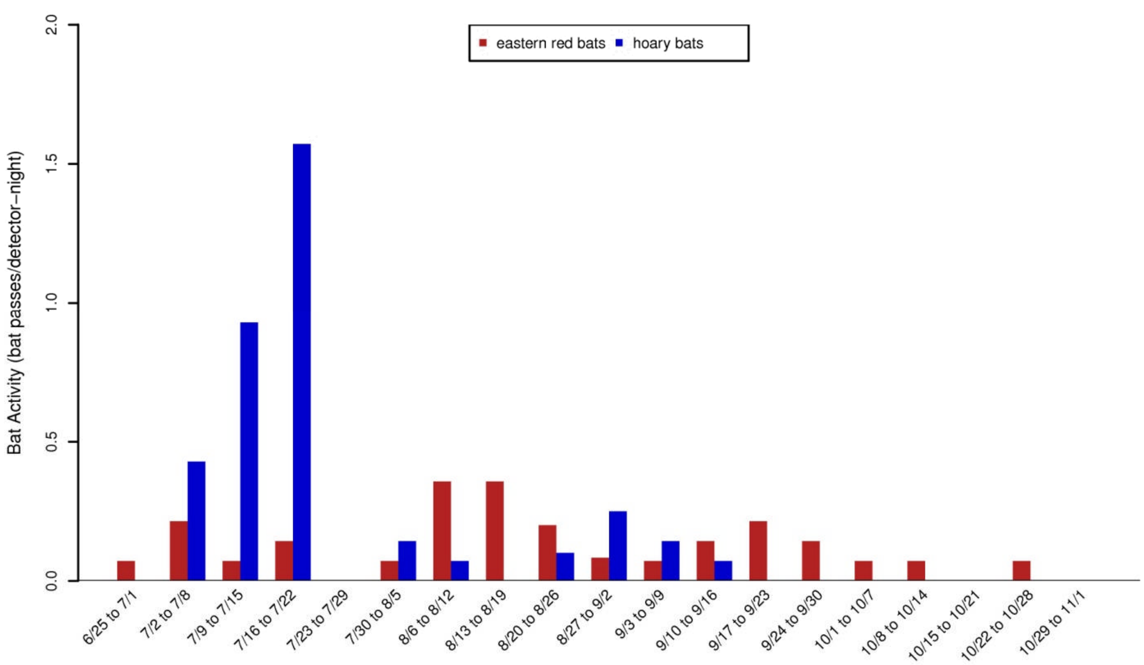

Figure10. Weekly activity by hoary and eastern red bats recorded within the Prospect Wind Resource Area, June 25 – November 1, 2010.

SM2Bat Acoustic Surveys

Bat echolocation was sampled by an SM2BAT unit (PS1) within the PWRA at one sampling location over 36 nights from July 28 to November 1, 2010 (Figure 2). The SM2Bat unit recorded data from sunset to sunrise on the nights it was deployed and active. Loss of battery power precluded data collection between September 22 and October 5, 2010.

As with the Anabat data, the full-spectrum study period was divided into two biologically relevant seasons: maternity season (July 28-August 15) and migration season (August 16-November 1, 2010). There were a total of 10 detector nights during the maternity season and 26 detector nights during the migratory season in which data was collected and species identified. Of the 844 total files collected, 436 contained bat calls (51.7%). Of these 436 files with bat calls, Sonobat classified 109 files (25.0%) to frequency group and species. Based on these results, six species were confirmed to have been present in the PWRA area during the 2010 study (Table 5). Of the calls classified to species, big brown bat was detected on the most nights (17 detector nights; 47.2%) during the study period followed by silver-haired bat (11 detector nights; 30.5%), hoary bat (8 detector nights; 22.2%) and eastern red bat (6 detector nights; 16.6%). Little brown bat (*Myotis lucifugus*) and tri-colored bat (*Perimyotis subflavus*) were each identified on only a single detector night (2.7%) during the study period (Table 5).

Table 5. Bat species identified by a SM2Bat detector during 36 detector nights at the Prospect Wind Resource Area, July 28-November 1, 2010. Bat calls summarized by number of detector nights and percentage of detector-nights each species was identified.

Species		Study Period; July 28-Nov 1, 2010	
Common Name	**Scientific Name**	**Detector Nights**	**Percentage**
Big brown bat	*Eptesicus fuscus*	17	47.2
Eastern red bat	*Lasiurus borealis*	6	16.6
Hoary bat	*Lasiurus cinereus*	8	22.2
Silver-haired bat	*Lasionycteris noctivagans*	11	30.5
Little brown bat	*Myotis lucifugus*	1	2.7
Tri-colored bat*	*Perimyotis subflavus*	1	2.7

*formerly known as Eastern pipistrelle

The proportion of nights each species was identified differed seasonally (Table 6; Figure 11). Of the ten detector nights data was collected during the maternity season, big brown bat was identified during eight nights (80.0%), followed by hoary bat (5 detector nights; 50.0%). Eastern red bat and silver haired bat were identified on three (30.0%) and two (20.0%) detector nights, respectively, with tri-colored bat identified on only a single night (10.0%). Little brown bat was not identified during the maternity season. There were 26 detector nights during the migratory season. Of these, big brown bat and silver-haired bat were identified on nine detector nights (34.6%), three times the number of detector nights in which the other species were identified. Both hoary and eastern red bats were identified on three detector nights (11.5%), while little brown bat was identified on a single detector night (3.8%). Tri-colored bat was not identified during the migratory season (Table 6).

Table 6. Seasonal patterns of bat species composition from the SM2Bat survey between maternity (July 28-August 15, 2010) and migratory seasons (August 16-November 1, 2010) at the Prospect Wind Resource Area.

	Maternity Season		Migration Season	
Species	**Detector Nights**	**% of Nights**	**Detector Nights**	**% of Nights**
Big brown bat	8	80.0	9	34.6
Eastern red bat	3	30.0	3	11.5
Hoary bat	5	50.0	3	11.5
Silver-haired bat	2	20.0	9	34.6
Little brown bat	0	0	1	3.8
Tri-colored bat*	1	10.0	0	0

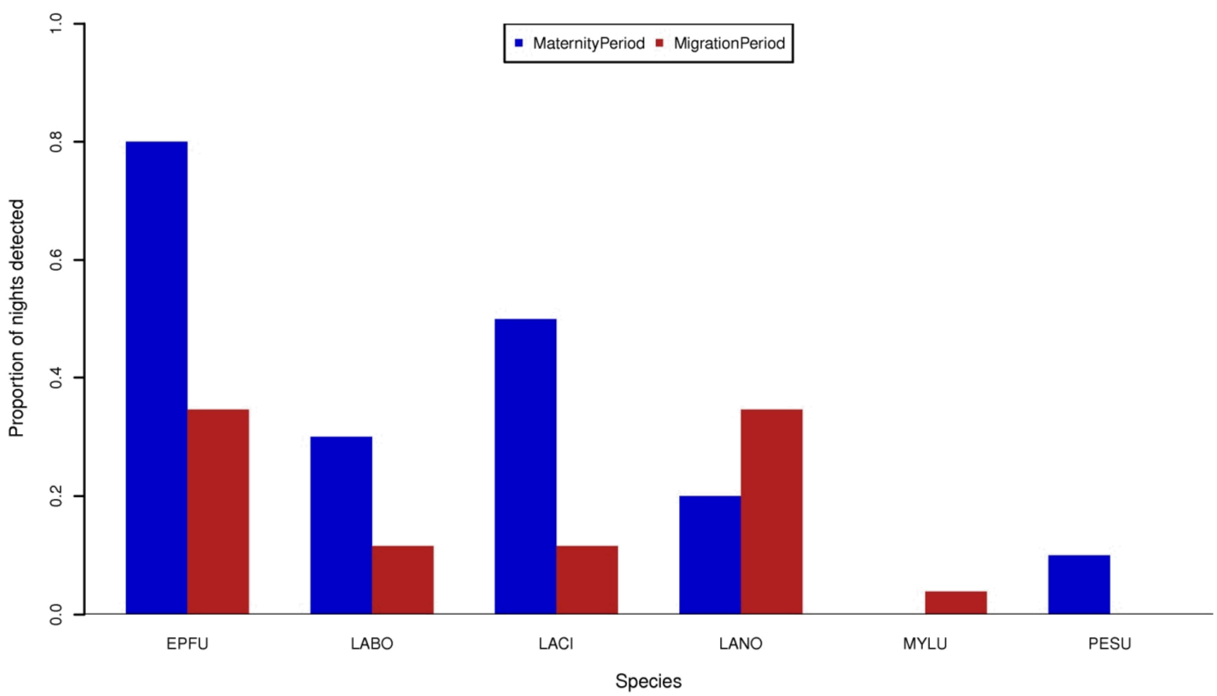

Figure 11. Proportion of detector nights that each species was recorded and identified by at least one bat call; presented by maternity and migratory seasons within PWRA during the study period, July 28 – November 1, 2010.

*EPFU=big brown bat; LABO=eastern red bat; LACI=hoary bat; LANO=silver-haired bat; MYLU=little brown bat and PESU=tri-colored bat (formerly known as eastern pipistrelle).

The three most commonly identified species (big brown, silver-haired, and hoary bats) all produce low frequency echolocation calls (Table 1). The eastern red bat (three nights) and little brown bat and tri-colored bat (one night each) are grouped within the mid to high frequency class, producing calls above 30 kHz. Therefore, when divided by frequency group across the entire study period and by season, low frequency species were detected more often than high/mid-frequency species (Table 7). During the maternity season, high-frequency species were detected on three nights (30.0%) compared to low-frequency species (8 detector nights; 80.0%). During the migratory season, high/mid-frequency species were identified on four nights (15.4%) compared to low-frequency species (14 detector nights; 30.8%). Across the entire study period, high/mid-frequency species were identified on seven nights or 19.4% of all detector nights, compared to 22 nights (61.1%) of all detector nights for low-frequency species (Table 7).

Table 7. Number of calls by high/mid-frequency and low-frequency bats within PWRA by detector night, as determined by Sonobat for the SM2Bat.

	Maternity Season		Migratory Season		Total: Study Period	
Frequency Class	**Detector nights**	**%**	**Detector nights**	**%**	**Detector nights**	**%**
High/Mid-Frequency	3	30.0	4	15.4	7	19.4
Low Frequency	8	80.0	14	30.8	22	61.1

DISCUSSION

This final report reviewed results from the period June 25 – November 1, 2010, a period encapsulating the majority of the summer bat maternity and fall bat migratory season in central Connecticut.

The PWRA is not in the vicinity of any known bat colonies or features likely to attract large numbers of bats. The site is located along a forested ridge with little variation in vegetation or topography relative to the surrounding landscape. VHB completed a habitat assessment of the Project (VHB 2010a). The project contains forestlands and some forested wetlands which likely support tree-roosting bat species common to the region. These habitat types are not unique to the project; nor do they occur in greater abundance or quality relative to the surrounding region, based on landcover imagery and the results of the VHB habitat analysis. Tree-roosting bat species which are likely to occur within the region are largely solitary roosting and do not generally occur in large aggregations (Harvey 1999, BCI 2010, DeGraaf and Yamaski 2001). Overall bat activity recorded between June 25 and November 1 was twice as high at station PA1 as it was at station PA2. This is likely the result of habitat differences – PA1 was located in a forest clearing, whereas PA2 was located below canopy cover within a deciduous forest. The open field and associated edge habitat at PA1 likely provided increased foraging opportunities for bats relative to the surrounding forest, especially for the larger-bodied

LF species (Norberg and Rayner 1987). In addition, an increase in deciduous foliage tends to reduce the transmission of LF echolocation (Patriquin et al. 2003).

Eight species of bat have the potential to occur within the PWRA (Table 1), all of which have been recorded as casualties at wind-energy facilities. Acoustic bat passes recorded by Anabat detectors were classified to frequency groups. Overall, passes by LF bats (47.3% of all passes) outnumbered passes by MF bats (30.6%), and HF bats (22.1%). This suggests a higher relative abundance of LF species, such as big brown bat, silver-haired bat and hoary bat, and MF species, such as eastern red bat and little brown bat; however, this pattern differed between stations. The majority (68.7%) of calls recorded at station PA1 in open habitat were LF passes, compared to only 2.2% of passes at station PA2, a more acoustically cluttered habitat. In comparison, station PA2 had higher proportions of both MF (63.2%) and HF (34.6%) calls than station PA1. This most likely reflects different foraging behaviors among species. Generally, LF species tend to forage in less cluttered conditions than HF species due to their wing morphology and echolocation call structure (Norberg and Rayner 1987). The open meadow and forest edge habitat at station PA1 may provide more favorable foraging opportunities or movement corridors for LF species compared to station PA2, which is situated within a largely closed forest environment.

Based on the information available concerning the ecology and habitat use of these species in New England (DeGraaf and Yamasaki 2001), it is likely that the majority of HF-bats recorded at were northern long-eared bat, a species with the anatomy and ability to forage within forested areas (Lacki et al. 2007). However, this was not supported by the results of the analysis of full-spectrum data, which did not identify any northern long-eared bats. Tri-colored bats tend not to use dense forest and are more likely to have been recorded at station PA1 (DeGraaf and Yamasaki 2001). Some of the calls within the HF group may also have been produced by little brown bats. Bats active at low altitudes within the forest cover dominating the site are likely to be species such as northern long-eared bat or little brown bat which have the size and anatomy to able to maneuver between the trees and are known to forage in intact forest habitats (Lacki et al. 2007). Very few northern long-eared bats have been recorded as casualties at wind-energy facilities (Kunz et al. 2007b).

Bats that produce low-frequency echolocation calls with the potential to occur near the study area include hoary, silver-haired, and big-brown bat. Owing to their call structure, generally larger body size and wing shape, these bats are predicted to forage primarily in open relatively uncluttered air space (Norberg and Rayner 1987, Lacki et al. 2007). For this reason, it is not surprising that the majority of LF bat passes were detected at station PA1. All but one hoary bat call was recorded at station PA1. The small number of recognizable hoary bat calls recorded within the study area may be due to their relative abundance, to the conservative approach taken to determine species identification, or to not being as readily detectable by ground-based detectors. The majority of recognizable hoary bat activity occurred between July 16 and July 22 and the peak activity period occurred during July 11 – 17. Little is known about summer populations of silver-haired bats in Connecticut. Silver-haired bats use forest clear-cuts for foraging while big brown bats utilize less forest-dominated areas. Both are likely to forage along forest edges, with silver-haired bats using air-space closer to the ground than big brown bats (DeGraaf and Yamasaki 2001).

Activity for LF bats was highest in the third week of July, likely corresponding to the energy-intensive lactation period and the subsequent weaning period of pups. During lactation energy requirements are at their highest for female mammals and as such foraging is increased (Kurta et al. 1989, Lacki et al. 2007); in addition, juvenile bats begin to fly prior to weaning increasing the number of calls recorded. In New England, young of hoary bats, silver-haired bats, and big brown bats are typically born in late-May-early June, June-July, and June, respectively; and it is likely that weaning occurs at approximately 5-6 weeks (DeGraff and Yamasaki 2001; Barclay and Harder 2005). Calls recorded from the last week of August are likely to represent migrating bats traveling through the area.

The results from the full-spectrum analysis of data indicate the presence of six species of bat within the PWRA during the study period: big brown bat, eastern red bat, hoary bat, silver haired bat, little brown bat and tri-colored bat. The only species that were not identified were the Indiana and northern long-eared bat. The PS1 unit was located adjacent to PA1, and sampled within relatively open airspace. Therefore, it was not surprising to observe that 61.1% of the detector nights with identified bat calls had low-frequency species compared to 19.4% of detector nights with high/mid frequency species.

Not all species were detected in both the maternity and migratory seasons (Table 3). The pattern of detections indicates that some species (e.g., the big brown bat) are likely summer residents within the project area, whereas other species (e.g., silver-haired bat) are more transitory. The SM2Bat unit was not able to be deployed until the end of July, so results regarding the maternity season may not be completely representative of species composition and occupancy rates. Species composition at the end of July may be indicative of resident species as well as possible early migratory movement within the area. The results from the Anabat analysis of species calls (i.e., hoary and eastern red bat) suggest that the SM2BAT captured the peak of eastern red bat maternity activity but missed the hoary bat peak of activity during the maternity season. Two of the species, tri-colored bat and little brown bat were only identified in one season or the other on a single night. The apparent dearth of little brown bat calls may indicate that they are not common at the site, or may relate to population declines due to White-nose Syndrome (Dzal et al., 2010, Brooks 2011). No northern long eared bat calls were identified during the study period. This may also be an artifact of their biology and foraging behavior as they also tend to forage within intact forest systems. The absence of calls identified to this species does not provide definitive evidence of absence within the project area. The Anabat unit at station PA2 had higher proportions of both MF (63.2%) and HF (34.6%) calls than station PA1, and it is expected that both northern long-eared bats and little brown bats were present within the forested environment and within PWRA.

Potential Impacts

Assessing the potential impacts of wind-energy development to bats is confounded due the proximate and ultimate causes of bat fatalities at turbines being poorly understood (Kunz et al. 2007b, Baerwald et al. 2008, Cryan 2008, Cryan and Barclay 2009). In addition, the monitoring of elusive, night-flying animals is inherently difficult (O'Shea et al. 2003) and although installed wind-energy capacity has increased rapidly in recent years, the availability of results from well-designed studies from these projects has lagged (Kunz et al. 2007b). Nonetheless, monitoring studies at constructed wind-energy facilities to date suggest that:

a) bat mortality shows a rough correlation with bat activity (Table 8);
b) the majority of fatalities occur during the post-breeding or fall migration season (roughly August and September);
c) migratory tree-roosting species (eastern red, hoary, and silver-haired bats) comprise almost 75 % of reported bat casualties, and;
d) some of the highest reported fatalities occur at wind-energy facilities located along forested ridge tops in the eastern and northeastern US, although high fatalities have been also been observed in the Midwest and Rocky Mountain plains (Baerwald 2008, Gruver et al, 2009).

Based on these patterns, current guidance on estimating potential mortality levels of a proposed wind-energy development involves the evaluation of on-site bat acoustic data including activity levels, seasonal variation, and species composition (Kunz et al. 2007b), as well as comparing overall results with regional data.

There are few instances where both bat activity and bat mortality have been recorded at wind-energy facilities and where results are comparable. For this reason, a definitive relationship between pre-construction bat activity and post-construction bat mortality has not been established empirically. From the data available, there appears to be a positive correlation between the two variables and there is the expectation amongst the scientific and resource management communities that when more data become available this relationship will hold (Kunz et al. 2007a). Data such as that provided by the current study will further contribute to our understanding of this relationship. Table 8 summarizes the results of publically-available activity and fatality data from wind-energy facilities in the eastern US and Canada. To our knowledge, activity data were collected using ground-based Anabat™ detectors.

Table 8. Summary of publically available bat activity and bat fatality data from wind-energy facilities in eastern North America.

Wind Energy Facility	Bat Activity Estimate[A]	Fatality Estimate[B]	No. of Turbines	Total MW
Prospect, CT	*9.07*		*2*	*3.2*
Buffalo Mountain, TN (2006)		39.70	18	29
Mountaineer, WV	38.3	31.69	44	66
Buffalo Mountain, TN (2000-2003)	23.7	31.54	3	2
Meyersdale, PA		18.00	20	30
Cohocton/Dutch Hill, NY		16.02	50	125
Casselman, PA		15.66	23	34.5
Maple Ridge, NY (2006)		15.00	120	198
Noble Bliss, NY (2008)		14.66	67	100
Mount Storm, WV (2008)	35.2	12.11	82	164
Maple Ridge, NY (2007)		9.42	195	321.75
Noble Clinton, NY (2009)		6.48	67	100
Wolfe Island, Ont.		6.42	86	197.8
Noble Bliss, NY (2009)		5.50	67	100
Noble Ellenburg, NY (2008)		5.45	54	80
Noble Ellenburg, NY (2009)		5.34	54	80
Ripley, Ont.		4.67	38	76
Noble Clinton, NY (2008)		3.63	67	100
Lempster, NH (2009)	0.4	3.08	12	24
Mars Hill, ME (2007)		2.91	28	42
Stetson Mountain, ME	0.30	1.40	38	57
Munnsville, NY		0.46	23	34.5
Mars Hill, ME (2008)		0.45	28	42

A=bat passes per detector night
B=number of bat fatalities/MW/study period
C=averaged across phases and/or study years, and may not be directly related to mortality estimates
D=bat activity not measured concurrently with bat mortality studies
Data from the following sources:

Facility	Use Estimate	Mortality Estimate	Facility	Use Estimate	Mortality Estimate
Buffalo Mountain, TN (2006)		Fiedler et al. 2007	Noble Ellensburg, NY		Jain et. al 2009
Mountaineer, WV	Arnett (pers comm. 2005)	Kerns & Kerlinger 2004	Noble Ellenburg, NY (2009)		Jain et. al 2010
Buffalo Mountain, TN (2000-2003)	Fiedler 2004	Nicholson 2005	Ripley, Ont.		Stantec 2009
Meyersdale, PA		Arnett et al. 2005	Noble Clinton, NY		Jain et. al 2009
Cohocton/Dutch Hill, NY		Stantec 2010	Wolfe Island, Ont.		Stantec 2010
Casselman, PA		Arnett et al. 2009	Lempster, NH	Stantec 2006	Tidhar et al 2010
Maple Ridge, NY (2006)		Jain et al. 2007	Mars Hill, ME (2007)		Stantec 2008b
Noble Bliss, NY		Jain et. al 2009	Stetson Mountain, ME	Stantec 2009	Stantec 2009
Mount Storm, WV (2008)	Young et. al 2009	Young et. al 2009	Munnsville, NY		Stantec 2009
Maple Ridge, NY (2007)		Jain et al. 2008	Mars Hill (2008)		Stantec 2009

Fatality estimates from post-construction monitoring at wind-energy facilities in eastern North America range from 0.45 to 39.7 bats/MW/year (Table 4). Activity between June 25 – November 1 within the PWRA was 9.07±0.78 bat passes/detector-night; a value within the range of the five facilities in the eastern US where pre- and post-construction data is available (range: 0.3-38.3; mean: 19.58). There appears to be some latitudinal variation in the eastern US, such that higher numbers of fatalities are estimated for more southerly sites compared to those further north. This requires more data but may possibly reflect the migratory patterns of bats on a broad-scale in this region. Bat fatality patterns observed at facilities within the region in similar forest-dominated landscapes (e.g Noble Ellenberg NY, Noble Clinton NY, Maple Ridge NY, Lempster NH, Stetson Mountain ME and Mars Hill ME) have been low to moderate based on regional study results. If latitudinal, landscape and patterns of bat activity rates relative to fatality rates are consistent for the PWRA with regional study results then fatality rates for bats may be low to moderate.

The vast majority of formal post-construction mortality studies completed in the Unites States have been completed at facilities with substantially larger numbers of turbines and MW capacity than what have been proposed for the PWRA. For example, the mean project size for studies included in Table 8 is 53.8 turbines (range: 3-195). Impacts from small wind facilities such as the PWRA may be lower in terms of the number of bats killed per year compared to these facilities given only two turbines are proposed for the site.

Bat activity was highest between July 16 and July 22, 2010 at the PWRA, whereas post-construction monitoring at wind-energy facilities throughout North America show the highest number of bat casualties during fall migration (approximately mid-August through mid-September) with lower numbers in general in the summer and spring (Johnson 2005; Arnett et al. 2008).

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Appendix A. Photographs of Anabat Station PA1 Placement and Surrounding Habitat within the Prospect Wind Resource Area for the Period of June 25 – November 1, 2010.

Appendix A. Photographs of Anabat station PA1 placement and surrounding habitat within the Prospect Wind Resource Area for the period of June 25 – November 1, 2010.

Pictures taken in clockwise direction with the top picture at the front of the station.

Appendix B. Photographs of Anabat Station PA2 Placement and Surrounding Habitat within the Prospect Wind Resource Area for the Period of June 25 – November 1, 2010.

Appendix B. Photographs of Anabat station PA2 placement and surrounding habitat within the Prospect Wind Resource Area for the period of June 25 – November 1, 2010.

Pictures taken in clockwise direction with the top picture at the front of the station.

Appendix C. Photographs of SM2Bat Station PS1 Placement and Surrounding Habitat within the Prospect Wind Resource Area for the Period of July 28 – November 1, 2010.

Appendix C. Photographs of SM2Bat unit PS1 placement and surrounding habitat within the Prospect Wind Resource Area for the period of July 28 – November 1, 2010.

Pictures taken in clockwise direction with the top picture at the front of the station.