Exhibit Petitioner
JG-2

Final Report

Bat Acoustic Studies for the Georgia Mountain Community Wind Project Chittenden County, Vermont

July 1 – October 31, 2008

Prepared for:

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WEST, Inc.

EXECUTIVE SUMMARY

Western EcoSystems Technology, Inc. initiated surveys in July 2008 designed to assess bat use within the proposed Georgia Mountain Community Wind Project, Chittenden County, Vermont. Acoustic surveys for bats using Anabat® SD-1 ultrasonic detectors at 3 ground-based stations and 2 vertical strata were conducted from July 1 to October 31, 2008. The objective of the surveys was to estimate the seasonal and spatial use of the study area by bats, as well as to estimate total bat activity, defined here as number of bat passes. In total, 2203 bat passes were recorded during 451 detector nights. Averaging bat passes across locations, we detected a mean of 4.9 bat passes per detector-night, with a range of 1 to 12.5 passes per night.

Total bat activity peaked in early August and no passes were recorded after October 8. Bat activity appears to have come predominately from *Myotis* bats, as 86.1% of calls were > 35 kHz (e.g., *Myotis* bat species). Calls that were < 35 kHz in frequency (e.g., big brown bat, silver-haired bat and hoary bat) comprised 13.9% of recorded activity. Bats with echolocation calls in the < 35 kHz range, especially silver-haired and hoary bats, have comprised the majority of fatalities at other wind power projects, though red bats, whose calls typically are > 35 kHz, have predominated fatalities at some eastern wind energy projects. Identification of bat passes to species was possible for the hoary bat and red bat. Calls attributable to big brown and silver-haired bats were combined, as they are too similar to differentiate. Hoary bats accounted for 56% of low-frequency passes and 8% of all passes, while red bats comprised 4.8% and 4.1% of high-frequency and total passes, respectively. Calls from the big brown/silver-haired complex accounted for 44% of low-frequency passes and 6.1% of all passes. Detection rates for hoary and red bats were highest in mid- to late-July, suggesting possible migration through the study area during this period. A smaller spike in hoary bat detections, accompanied by similar increases in red and big brown/silver-haired bat detections, occurred in early September suggesting a second, somewhat smaller wave of migration.

The mean number of bat passes per detector per night was compared to existing data at five wind energy facilities where both bat activity and mortality levels have been measured. The level of bat activity documented at the Georgia Mountain Wind Project was higher than that at wind facilities in Minnesota and Wyoming, where reported bat mortalities were low, but was lower than at facilities in the eastern and Midwestern US, where reported bat mortality has been highest. Assuming that the general relationship between bat activity and bat mortality observed at these five sites is broadly applicable to other sites, we expect that levels of turbine-related bat mortality at this site will be on the lower end of the spectrum, and on par with others from the region. Assuming that activity patterns by bats are relatively consistent from year to year, we expect most fatalities to occur from mid- July to mid-September.

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INTRODUCTION

Vermont Environmental Research Associates (VERA) is conducting biological surveys for a proposed wind-energy facility in Chittenden County, Vermont. VERA requested Western EcoSystems Technology, Inc. (WEST) to develop and implement a standardized protocol for baseline studies of bat use in the project area for the purpose of estimating potential impacts of the wind-energy facility on bats. The protocol for the baseline study is similar to protocols used at other wind-energy facilities in the United States, and follows both published guidelines (Kunz et al. 2007*a*) and guidance provided by Vermont Fish and Wildlife Department. The protocol included passive acoustic sampling to quantity bat use of the area using 5 Anabat™ bat detectors placed at 3 locations within the study area and at 2 vertical strata.

Modern wind-energy facilities typically use a few to several hundred large-scale turbines to capture a portion of the kinetic energy in wind. Wind rushing over the turbine blades generates lift and caused the blades to spin. The blades (usually 3 per turbine) are connected to a hub, which is connected to an electrical generator. Most modern turbines are capable of generating 1.5–2.0 MW of electricity, and reach 100 m (328 ft) or more into the sky.

As the nation's installed capacity of wind-energy has increased, so have concerns about the impacts to the birds and bats that sometimes collide with the turbines. As a result, both pre- and post-operations surveys for bats are recommended for most new wind-energy facilities.

The purpose of this report is to summarize and describe the results of pre-construction bat surveys during the summer and fall of 2008, and to highlight any items of biological interest, such as noteworthy changes in seasonal bat use. In addition to describing levels of bat activity estimated at this site, we present results in the context of other wind energy projects.

STUDY AREA

The proposed project area is in Chittenden and Franklin Counties approximately 2.5 miles (4 km) northeast of the town of Milton, Vermont (Figure 1). The project area is located on the southern peak of Georgia Mountain, a prominent local feature that rises to a height of 1437 feet (438 m) ASL. This area of Georgia Mountian currently has a single telecommunications tower. Arrowhead lake, at the base of the Georgia Mountain's north and west slopes, is damned for hydroelectic power generation. The project as proposed would have 3-5 wind turbines.

METHODS

Bat Acoustic Surveys

The objective of the bat use surveys was to estimate the seasonal and spatial use of the Georgia Mountain Project (GMCWP) by bats. Bats were surveyed using Anabat SD1™ bat detectors (Titley Electronics Pty Ltd., NSW, Australia). Bat detectors are a recommended method to index and compare habitat use by bats. The use of bat detectors for calculating an index to bat impacts has been used at several wind-energy facilities (Kunz et al. 2007*a*), and is a primary and economically feasible bat risk assessment tool (Arnett 2007). Anabat detectors record bat echolocation calls with a broadband microphone. The echolocation sounds are then translated into frequencies audible to humans by dividing the frequencies by a predetermined ratio. A division ratio of 16, which is appropriate for all species of bats in Vermont, was used for the study.

Bat activity was surveyed using 5 detectors from July 1 to October 31, 2008, a period corresponding to likely fall bat migration at this site, and which corresponds to the period when the majority of bat fatalities have been recorded at other wind energy projects (Arnett et al., 2008). Anabat detector stations were established at ground level (1.5 m) at 3 locations, including the base of the met tower, as well as 22 m and 38 m above ground at the met tower.

Ground-based stations located away from the met tower (Figure 1) were established by selecting sites that: 1) provided opportunity to monitor bat activity, and; 2) minimized risk of theft or vandalism. The stations were located 25-50 m off a well-used access trail within the deciduous canopy. We selected sites that provided small gaps in the canopy and oriented the reflector plates at angles of approximately 60° to improve sampling of the vertical airspace. Ground-based Anabat detector loggers were placed inside plastic weather-tight containers and connected to the microphone via a coaxial cable. The microphone was housed in a weatherproof PVC case and mounted on top of an 8" x 10" Plexiglass® reflector (Figure 2). The elevated Anabat microphones were encased in a Bat-Hat weatherproof housing systems (EME Systems, Berkeley, California) (Figure 3) and affixed to the met tower using hose clamps.

All units were programmed to turn on each night an approximate half-hour before sunset and turn off an approximate half-hour after sunrise. Calls were recorded to a compact flash memory card with large storage capacity. Bat echolocation detectors also detect other ultrasonic sounds made by insects, raindrops hitting vegetation, and other sources. A sensitivity level of six was used to reduce interference from these other sources of ultrasonic noise.

Statistical Analysis

Bat Acoustic Surveys

The units of activity were number of bat passes (Hayes, 1997). A pass was defined as a continuous series of greater than or equal to two call notes produced by an individual bat with no pauses between call notes of less 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. Total number of passes was corrected for effort by dividing by the number of detector nights. At the coarsest level, bat calls were classified as either high-frequency calls (≥35 kHz), which are generally given by small bats (e.g. *Myotis* sp.), or low-frequency (< 35 kHz), which are generally given by larger bats (e.g. silver-haired bat [*Lasionycteris noctivagans*], big brown bat [*Eptesicus fuscus*], hoary bat [*Lasiurus cinereus*]). In addition, high quality calls were identified to species level for hoary and red bats. Species identification was achieved by a combination of qualitative (eg, minimum frequency) and quantitative (eg, the overall shape and pattern of calls within a pass) measures. Lower quality calls, and those for which species identification is not feasible (eg, *Myotis* bats, big brown and silver-haired bats), were combined into taxonomic groups using primarily quantitative measures. Data determined to be noise (produced by a source other than a bat) or call notes that did not meet the pre-specified criteria to be termed a pass were removed from the analysis. To establish which species may have produced the high- and low-frequency calls recorded, a list of species expected to occur in the study area was compiled from range maps (Table 1; Harvey et al. 1999, BCI website).

The total number of bat passes per detector night was used as an index for bat use in the GMCWP. A detector-night is tallied when one detector operates continuously during a survey night. A survey night is defined as the period from the beginning of the daily survey until the end of the same continuous daily survey. Thus, the date of the survey night does not change at midnight (ie, the July 1 survey night ended at ½ hour past sunrise the morning of July 2). We used bat pass data to represent levels of bat activity rather than the numbers of individuals present because individuals cannot be differentiated by their calls. To predict potential for bat mortality (i.e. low, moderate, high), the mean number of bat passes per detector night (averaged across monitoring stations) was compared to existing data from wind-energy facilities where both bat activity and mortality levels have been measured.

RESULTS

Bat Acoustic Surveys

Bat activity was monitored at three horizontal and two vertical sampling locations on a total of 451 nights during the 615-night sampling period, resulting in collection of 2202 bat passes (Table 2). Averaging across stations, we detected 4.9 bat passes per night. Overall, passes by high-frequency bats (HF: 86%) outnumbered passes by low-frequency bats (LF: 14%) (Figure 5). High- and low-frequency passes were not evenly distributed among stations, with the ground-level stations recorded very few LF calls

Equipment failures (both electronically and biologically triggered) compromised data collection at some stations on nights during the study. In particular, rodent-chewed cables for the ground unit at the met tower (Station GM1L) resulted in failure of that unit to collect data for all but the first few weeks of the study (Table 2). Similarly, a combination of defective data loggers and rodent-gnawed cables resulted in the units at Station GM2 recording data on only 41% of possible nights. However, lost nights for GM2 were spread throughout the study period rather than concentrated during any one period. Anabat coverage during the study averaged 73.3% (451/615 possible nights), while 3.67 detectors, on average, operated on any given night (range: 3-5).

Species Composition

Species identification for specific passes was possible for the hoary bat, and to a lesser extent for red bats. Therefore, passes by these species were separated from passes by other low- and high-frequency bats, respectively. Hoary bats comprised 7.9% of total passes detected within the study area, and 56% of all LF passes, while red bats accounted for 4.1% and 4.8% of Total and HF passes, respectively (Table 2). Calls attributable to big brown/silver-haired bats comprised 6.1% of Total and 44% of LF passes. Calls attributable to bats in the genus Myotis were by far the most common and represented nearly 80% of all calls and 92.5% of HF calls.

Spatial Variation

Bat activity varied considerable between stations and by strata (Figures 6, 7). Station GM3 recorded the greatest number of bat calls (Figure 8). The other stations all recorded similar levels of activity, though species classifications differed (see below).

The number of bat passes attributable to LF and HF species was dependent on the sample height (Figure 9). Bat activity recorded by ground-based detectors was almost exclusively (> 99%) from HF bats, while 37% of the passes at 22 m and 24% of passes at 38 m were from HF bats.

Species composition of passes varied greatly among stations, particularly in the vertical strata. The elevated stations at 22- and 38-m accounted for 97% of all LF passes during the study (Figures 7, 8), whereas the 3 ground-level stations recorded a total of only 9 LF passes altogether (GM1L: 2; GM2: 4; GM3: 5). Of these, all but 2 were attributable to either big brown or silver-haired bats. Station GM2 recorded 2 hoary bat passes, which occurred 18 minutes apart on the evening of September 12. While the Ground stations recorded almost solely (greater than 99%) HF passes, the Elevated units accounted for 13% of the HF passes recorded, 42% (103/243) of which were attributable to red bats.

Temporal Variation

Bat activity was variable on any given night, but there was a general trend toward a peak in activity in August (Figure 9). Overall bat activity was highest (16.6 passes per detector-night) during the week of August 3 (Figure 10). Overall bat activity declined substantially in the following weeks, particularly after mid-August, influenced perhaps by decreasing temperatures and increasing wind speeds (Figures 10, 11), but likely also driven by endogenous circannual rhythms triggered by exogenous changes in photoperiod and other factors not measured. Only 8 bat passes were recorded in October (all LF species) and no bat activity was detected after October 8.

Activity by HF and LF species, while differing in magnitude, also differed in timing. The general, overall temporal pattern of bat activity observed was influenced greatly by the overwhelming numbers of HF passes recorded during the study, most of which occurred in August (Figure 12). Examining separately the timing of activity by LF species reveals patterns that differ from the general trend. Whereas HF bats peaked in August, LF bats tended to have an early peak in July and a secondary peak in September, effectively side-boarding the presumed fall migration season (Figure 12). Further differentiating the LF group reveals other differences as well. For example, whereas the majority (69%) of hoary bat passes were detected in July with a smaller upturn in September, activity by red bats and big brown/silver-haired bats were more evenly distributed through time. Activity by red bats showed a small peak in August but was generally consistent, and passes by big brown/silver-haired bats were steady in July and August, but higher in September (Figure 13).

DISCUSSION

Potential Impacts

Assessing the potential impacts of wind energy development to bats at the GMCWP is complicated by our current lack of understanding of why bats die at wind turbines (Kunz et al. 2007b; Baerwald et al. 2008), combined with the inherent difficulties of monitoring elusive, night-flying animals (O'Shea et al. 2003). To date, monitoring studies of wind projects in the west suggest that a) migratory tree-roosting species (hoary, red and silver-haired bats) comprise almost 75% of reported bats killed, b) the majority of fatalities occur during the post-breeding or fall migration season (roughly August and September), and c) the highest reported fatalities occur at wind facilities located along forested ridge tops in the eastern U.S. (Arnett et al. 2008, Gruver 2002, Johnson et al. 2003, Kunz et al. 2007*b*), although recent studies in agricultural regions of Iowa and Alberta, Canada, report relatively high fatalities as well (Jain 2005, Baerwald 2006).

A small number of studies of wind projects have recorded both Anabat detections per night and bat mortality (Table 3). The number of bat calls per night as determined from bat detectors shows a rough correlation with bat mortality. However, extrapolation of these trends to other sites must be done cautiously because effort, timing of sampling, species recorded, and detector settings (equipment and locations) all vary among studies (Kunz et al. 2007*b*). In addition, our metric of bat use (bat passes per night) represents the result of a complex set of biological and ecological interactions that will vary with region, local bat population density, local landscape characteristics, and myriad other factors. Nonetheless, our best available estimate of potential mortality levels at a proposed wind project involves evaluation of our on-site bat acoustic data in terms of activity levels, seasonal variation and species composition, and topographic features of the project area.

Bat Activity

Bat activity within the GMCWP (mean = 4.9 bat passes per detector-night) was higher than that observed at facilities in Minnesota and Wyoming, where bat mortality was low, but it was much lower than activity recorded at sites in West Virginia, Tennessee and Iowa, where bat mortality rates were high (Table 3). Thus, based on the presumed relationship between pre-construction bat activity and post-construction fatalities, we expect that bat mortality rates at GMCWP may be greater than the 2.2 bat fatalities/turbine/year reported at Buffalo Ridge, Minnesota, but likely will be lower than the 20.8 fatalities/turbine/year reported at Buffalo Mountain, Tennessee.

Spatial Variation

The proposed wind-energy facility is not located near any large, known bat colonies or other lanscape features that are likely to attract large numbers of bats. Activity was relatively high at station GM3 compared to other ground-level stations. This level of activity likely reflects differences between GM3 and GM2 in terms of foraging habitat, drinking habitat, or presence of tree roost(s).

Based on proportion of bat calls recorded at the Elevated detectors at the met tower during this study, bat activity up to 40 m was relatively low at this project. In addition, the vast majority of all LF bat calls recorded during the study were recorded at these two stations. These results are similar to those seen in other studies (e.g., Arnett et al. 2006), and probably relate to the size, wing morphology and echolocation style of LF species like hoary, red and silver-haired bats (Norberg and Rayner 1987).

Temporal Variation

During this study, HF species were more commonly detected than LF species during 14 of 15 weeks. Activity by HF species (primarily *Myotis* species) was generally high in August and peaked during the week of August 3. Activity by LF species, conversely, was highest during the week of July 20 (mostly attributable to hoary bats), relatively low in August, and showed another small pulse in early September.

The number of bat calls detected per night at the GMCWP was highest during August, led mostly by a substantial increase in activity by HF bats during this period. Activity in mid- to late-August likely corresponds with conclusion of the reproductive season, when pups have become volant and foraging rates are high as both adults and juveniles prepare for hibernation. This is also the period when reproductive bats begin movements toward hibernacula and to find mates (Barbour and Davis 1969).

Activity hoary and red bats showed peaks in late-July, suggesting migration of this species through the area, or accumulation of bats preparing to migrate. Activity by big brown/silver-haired and red bats showed secondary peaks in early- and late-September, respectively which likely represented a second wave of migration through the area. By early October, bat activity was essentially nil, suggesting that most bats had left the area for winter hibernacula or warmer climates.

Fatality studies of bats at wind projects in the US have shown a peak in mortality in August and September and generally lower mortality earlier in the summer (Johnson 2005; Arnett et al. 2008). While the survey effort varies among the different studies, the studies that combine Anabat surveys and fatality surveys show a general association between the timing of increased bat call rates and timing of mortality, with both call rates and mortality peaking during the fall (Kunz et al. 2007*b*). Based on the available data, it is expected that bat mortality at the GMCWP will be follow the same temporal patterns seen at other sites.

Species Composition

Four of the 9 species of bat that may occur in the study area are known fatalities at wind-energy facilities (Table 1). Our results indicate that a majority of the passes were high-frequency, most of which were from bats in the genus *Myotis.* Many of these bats have echolocation calls that are very similar to and difficult to differentiate from congeners, and we did not attempt to differentiate them here. Myotis bats typically are not found in large numbers during fatality studies at wind farms.

Two species that typically do account for the bulk of the fatalities at wind farms studied to date, particularly in the east are hoary and red bats (Arnett et al, 2008). Distinctive characteristics of their echolocation calls allowed us to positively establish their presence in the study area. Of the

2202 bat passes detected during this study, 276 passes (12.5%) were attributable to hoary (n =173) and red bats (n = 103), suggesting that these species are present in relatively low numbers, at least during the period when bat fatalities have been highest at other wind energy projects.

Based on call characteristics, acoustic surveys were able to assign calls to a group that included big brown and silver-haired bats. Both of these species are known fatalities from wind turbine collisions. Although big brown bat fatalities are known from many of the wind farms studied so far, reflecting perhaps the species wide-spread distribution, they tend to appear in relatively low numbers. Silver-haired bats, like the more susceptible hoary and red bats, undertake continental-scale migrations in spring and autumn (Cryan 2003). This species appears to be less common in fatality studies conducted in the eastern U.S. than either little brown or eastern pipistrelle bats (Arnett et al. 2008), neither of which was differentiated by acoustic surveys, but which generally appear in relatively small numbers.

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Table 1. Bat species determined from range-maps (Harvey et al. 1999; BCI website) as likely to occur within the GMCWP, sorted by call frequency.

Common Name	Scientific Name
High-frequency (> 35 kHz)	
eastern red bat *‡	*Lasiurus borealis*
eastern small-footed bat †	*Myotis leibii*
little brown bat ‡	*M. lucifugus*
northern long-eared bat‡	*M. septentrionalis*
Indiana bat ~††	*M. sodalis*
eastern pipistrelle ‡	*Perimyotis subflavus*
Low-frequency (< 35 kHz)	
big brown bat ‡	*Eptesicus fuscus*
silver-haired bat *‡	*Lasionycteris noctivagans*
hoary bat *‡	*Lasiurus cinereus*

* long-distance migrant
‡ species known to have been killed at wind-energy facilities
~species distribution on edge or just outside project area
† state listed species
†† federally listed species

Table 2. Results of bat acoustic surveys conducted at GMCWP, July 1, 2008 - October 31, 2008

Anabat Station	# of HF Bat Passes	# of LF Bat Passes	# of Hoary Bat Passes	# of Red Bat Passes	Total Bat Passes	Detector - Nights	Bat Passes/ Night
GM1H	90	194	134	50	284	123	2.31
GM1M	153	102	37	53	255	123	2.07
GM1L	25	2			27	28	0.96
GM2	99	4	2		103	54	1.91
GM3	1528	5			1533	123	12.46
Total	**1895**	**307**	**173**	**103**	**2202**	**451**	**4.88**

Table 3. Wind-energy facilities in the U.S. with both pre-construction Anabat sampling data and post-construction mortality data for bat species (adapted from Kunz et al. 2007*b*).

Wind-Energy Facility	Activity (#/detector night)	Mortality (bats/turbine/year)	Reference
Georgia Mountain, VT	*4.9*		*This study*
Foote Creek Rim, WY	2.2	1.3	Gruver 2002
Buffalo Ridge, MN	2.1	2.2	Johnson et al 2004
Buffalo Mountain, TN	23.7	20.8	Fiedler 2004
Top of Iowa, IA	34.9	10.2	Koford et al. 2005
Mountaineer, WV	38.3	38	Arnett et al. 2005

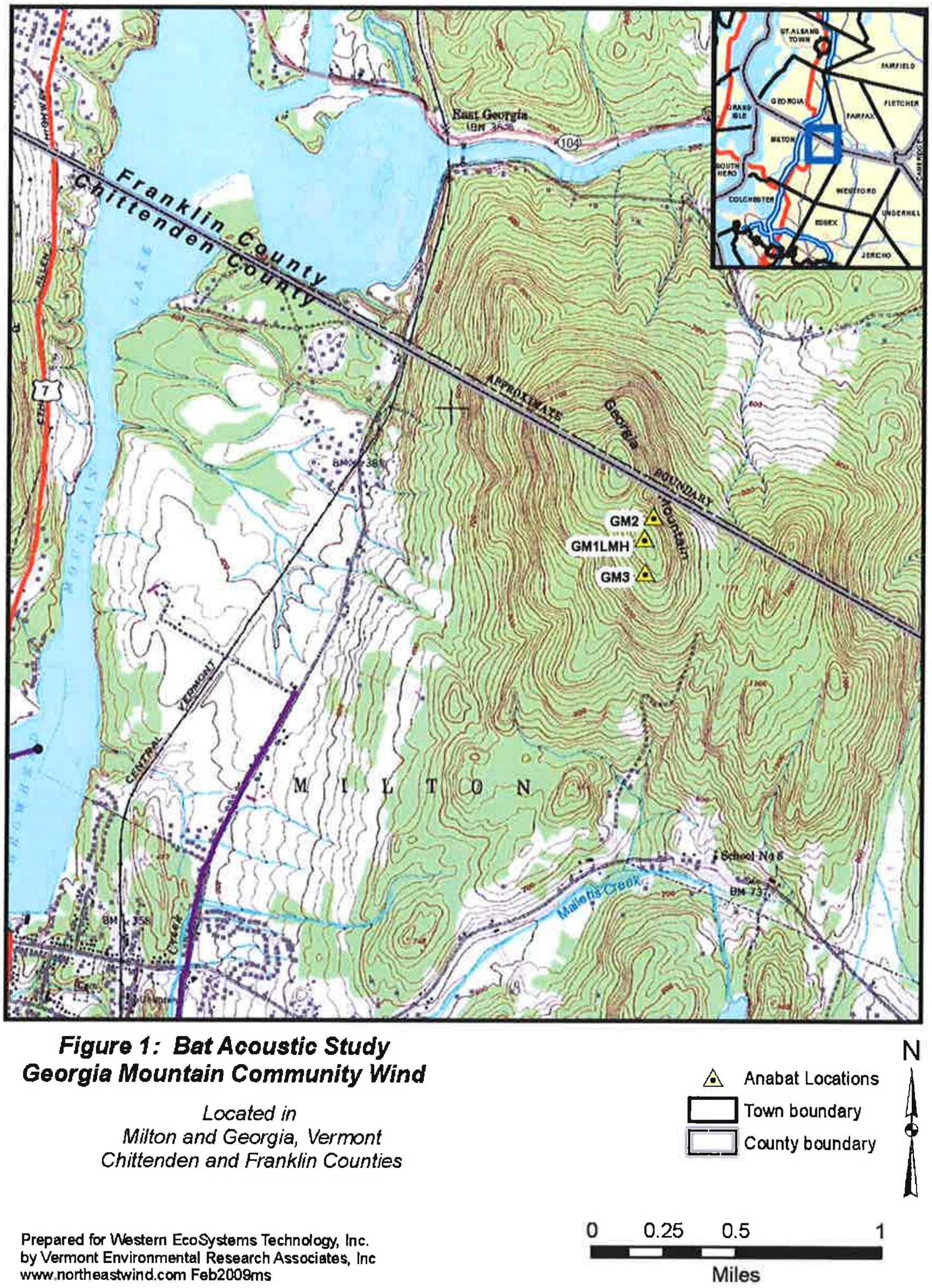

Figure 1. Vicinity map and Anabat sampling locations.

Figure 2. Example of ground-level monitoring station (GM3).

Figure 3. Example of Bat-Hat mounted on met tower, while tower is lowered.

Figure 4. Lower Anabat station on met tower in clearing, after tower is erect.

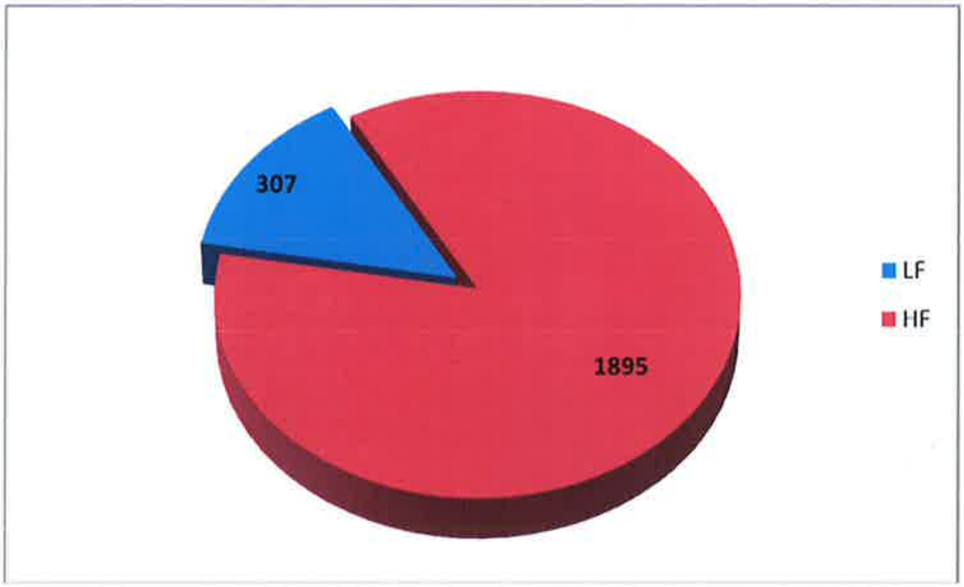

Figure 5. Proportion of high- and low-frequency bat passes recorded during the study.

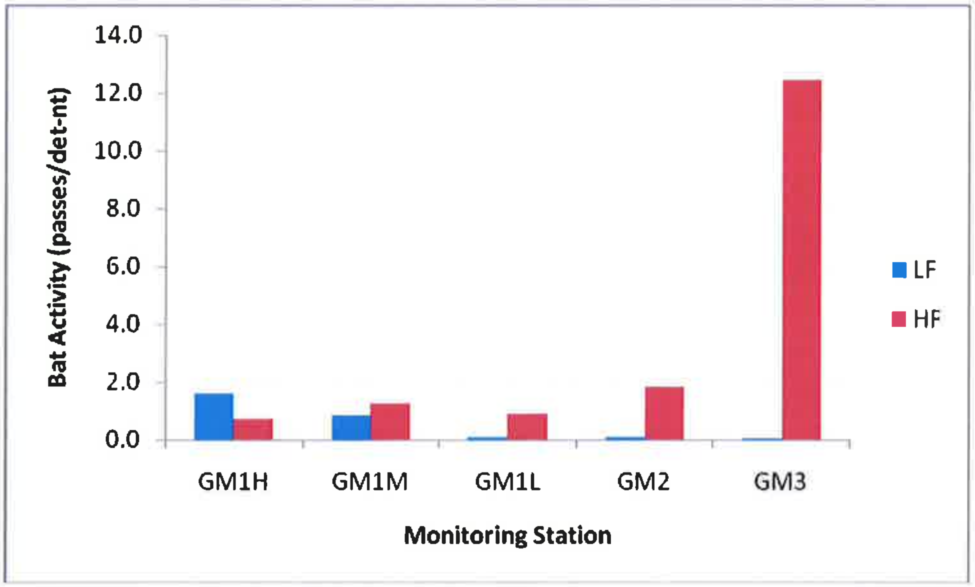

Figure 6. Number of bat passes per detector-night by Anabat location. Averaging across stations, 4.9 passes were detected per night.

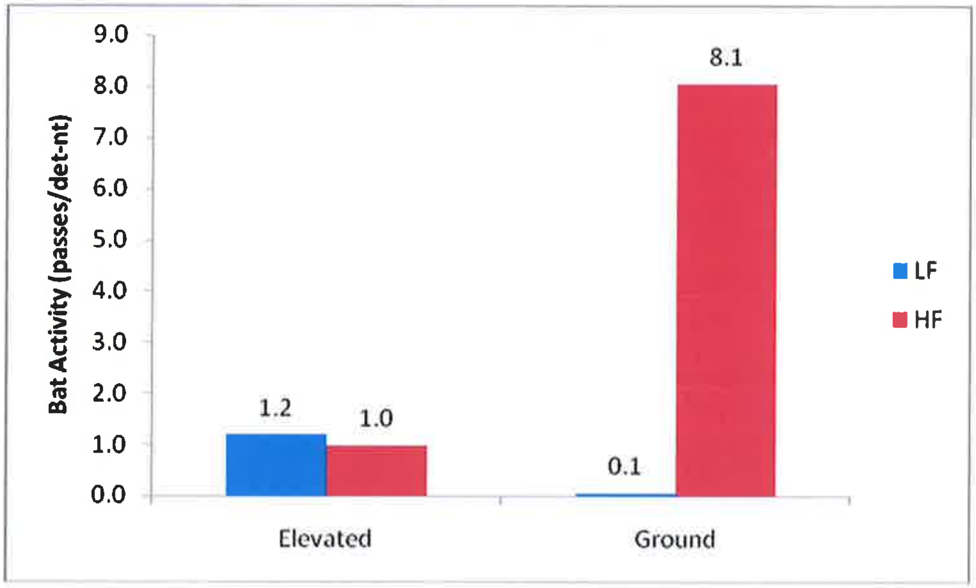

Figure 7. Bat activity measured at different vertical strata. Elevated totals are for GM1M and GM1H. Ground data are from GM1L, GM2 and GM3.

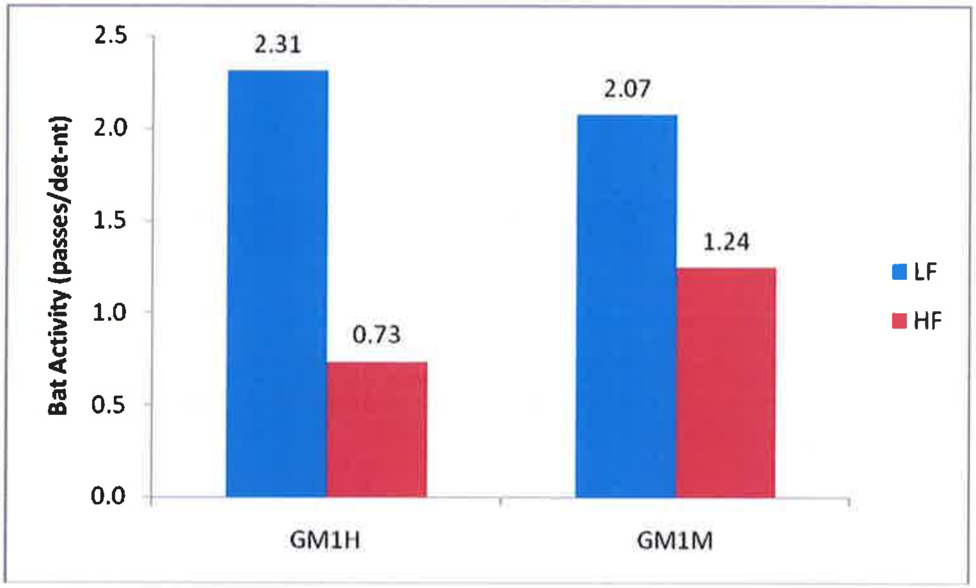

Figure 8. Distribution of bat passes detected at 38 m (GM1H) and 22 m (GM1M).

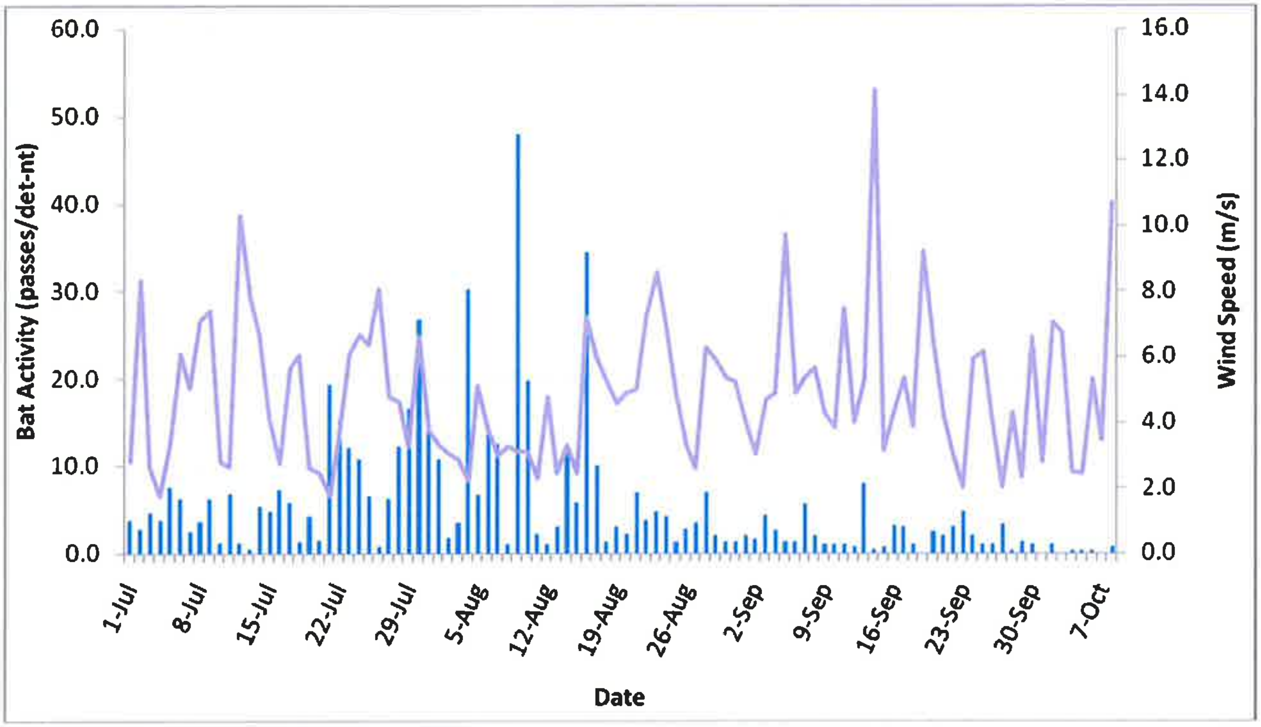

Figure 9. Nightly bat activity recorded between July 1 and October 8, 2008. Although sampling continued until October 31, no passes were recorded after the October 8. A maximum of 48 passes per detector-night on August 9, and the overall mean number of passes recorded was 4.9 per detector-night. In July and August, activity and wind speed appear to track fairly well, with activity inversely related to wind speed. The relationship becomes more tenuous in September and October, reflecting perhaps the necessity of bats to reach wintering grounds.

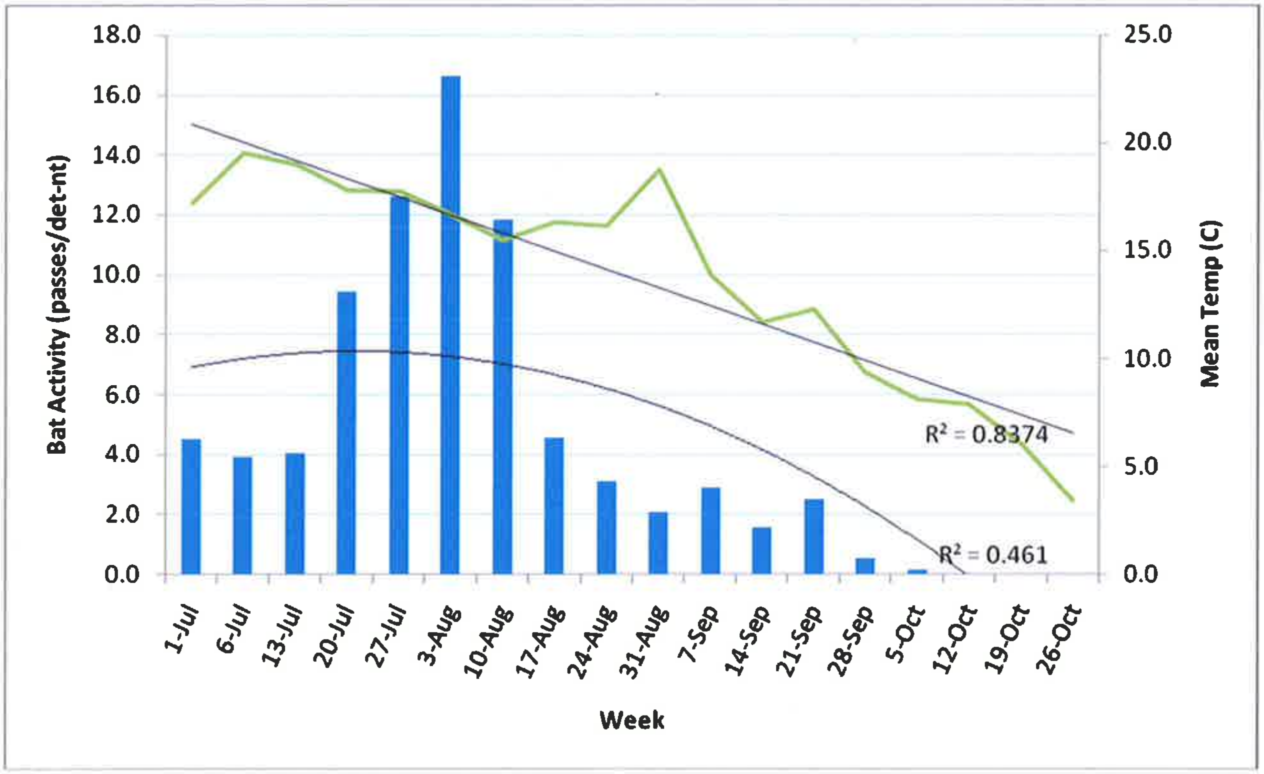

Figure 10. Temporal pattern of bat activity relative to mean daily temperature. The general trend is decreasing activity and temperature as the season progressed.

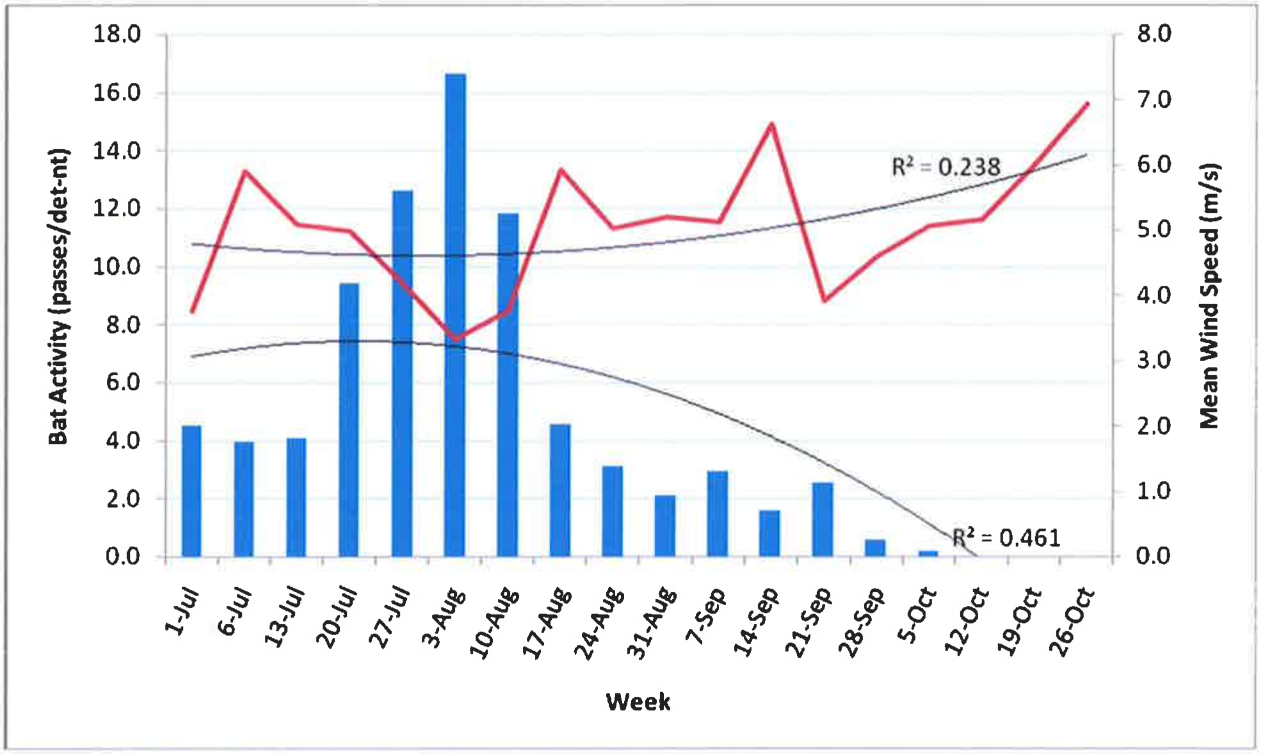

Figure 11. Weekly bat activity relative to mean nightly wind speed. The peak of activity during the week of August 3 corresponds to a period of relatively low wind speeds. Activity and wind speed seem to be generally inversely related.

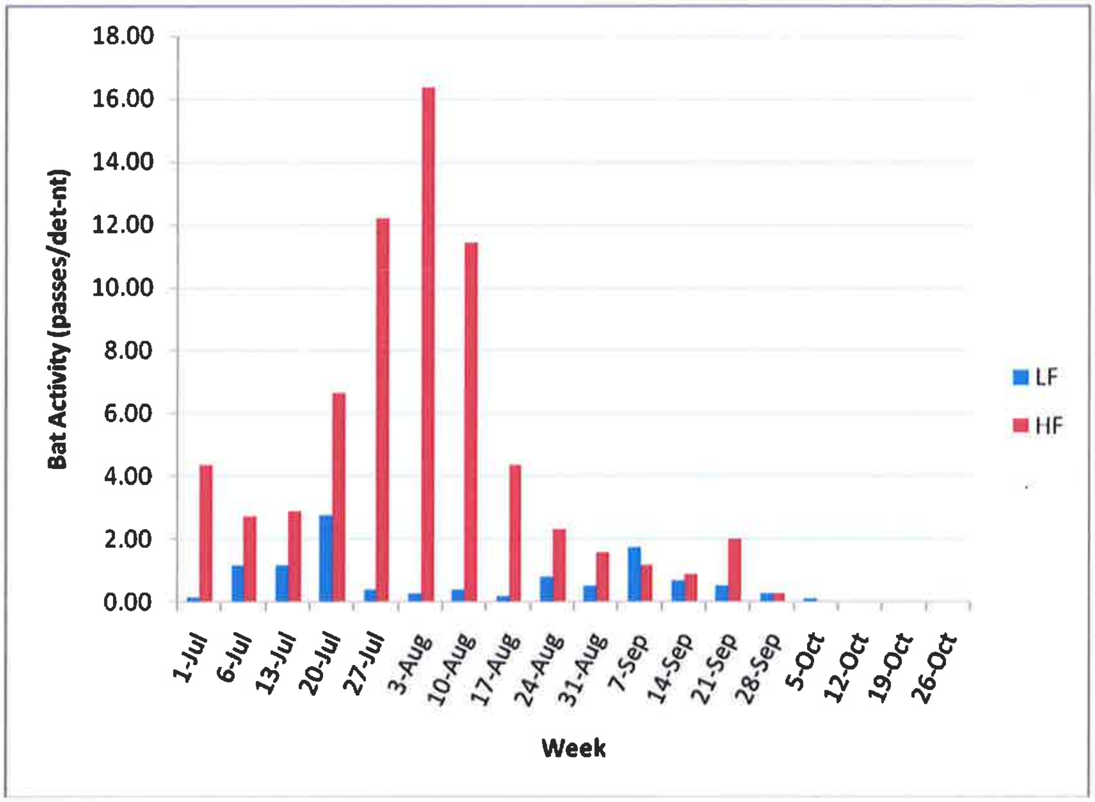

Figure 12. Temporal pattern of low- and high-frequency bat passes. Far more HF than LF activity was recorded, though the temporal patterns differed.

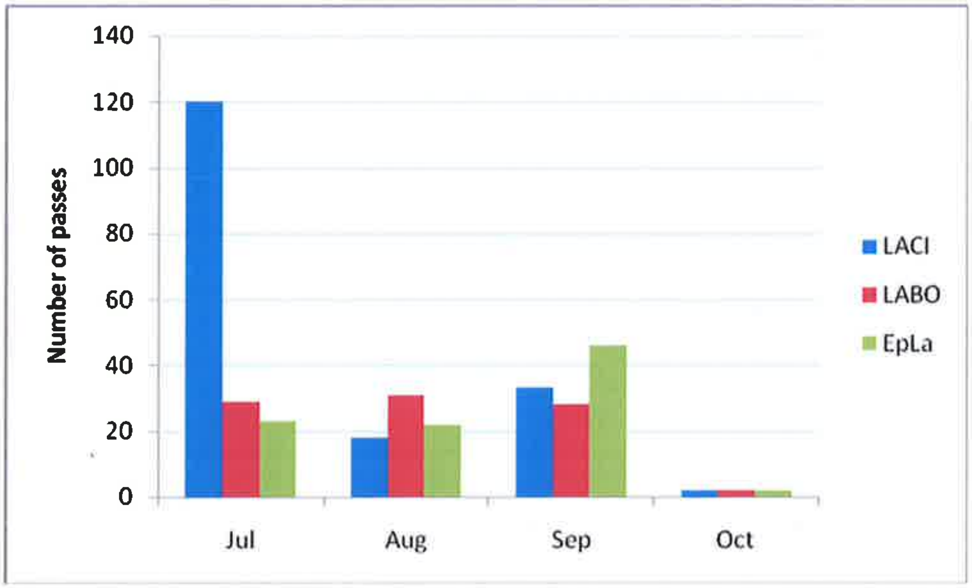

Figure 13. Seasonal patterns of activity by the migratory species. LACI = hoary bat; LABO = red bat; EpLa = big brown/silver-haired group.

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