Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC

FINAL

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Executive Summary

During spring 2007, Woodlot Alternatives, Inc. (Woodlot, now Stantec Consulting) conducted a radar survey of nocturnal migration at the proposed windpark in Coos County New Hampshire (the project). The survey is part of permitting efforts by Granite Reliable Power, LLC (Granite) for the project and represents the second season of investigation undertaken at this site. Surveys included nighttime surveys of birds and bats using radar and bat echolocation detectors.

The results of the field surveys provide useful information about site-specific migration activity and patterns in the vicinity of the project area. These findings are especially relevant when considered along with the fall 2006 studies. The survey data collected is a valuable tool for the assessment of risk to birds and bats during migration through the area.

Nocturnal Radar Survey

The spring field surveys were conducted on 30 nights from April 26 to June 1, 2007. Surveys were conducted using X-band radar, sampling from sunset to sunrise. Each hour of sampling included the recording of radar video files during horizontal and vertical operation. The radar site provided a good view of the airspace around its location at the summit of Owlhead Mountain.

The mean passage rate for the entire survey period was 342 ± 18 t/km/hr and nightly passage rates varied from 2 ± 1 targets per kilometer per hour (t/km/hr) to 870 ± 128 t/km/hr. Mean flight direction through the project area was 76º ± 53º.

The mean flight height of targets was 332 meters (m) ± 20 m (1089' ± 66') above the radar site. The average nightly flight height ranged from 81 m ± 20 m (266' ± 66') to 583 m ± 29 m (1913' ± 94'). The percent of targets observed flying below 125 m (410') also varied by night, from 6 percent to 61 percent. The seasonal average percentage of targets flying below 125 m was 14 percent.

The mean flight direction, qualitative analysis of the surrounding topography and landscape, and mean flight altitude of targets passing over the project area indicates that avian migration in this area involves a broad front type of landscape movement. This type of broad front movement, particularly in conjunction with the high flight heights, demonstrates a limited avian mortality risk during spring migration. Additionally, the flight height of targets indicates that the vast majority of bird migration in the area occurs well above the height of the proposed wind turbines.

Spring Bat Survey

The spring field survey included documentation of spring bat activity through passive surveys with four acoustic detectors, resulting in 126 detector-nights of recordings from April 26 to June 1, 2007. Two detectors were deployed in a meteorological measurement tower (met tower) on the summit of Owlhead Mountain in the northeastern section of the Project Area. An additional two detectors were deployed in a met tower near Trio Ponds, in the western section of the Project Area. A total of 33 bat call sequences were recorded during the spring sampling. The mean detection rate of all detectors was 0.3 detections per detector-night. The detection rate was generally lower than other recent spring studies in the region. Habitat, landscape, location, and survey effort probably account for the observed differences.

Bat calls were identified to the lowest possible taxonomic level. These were then grouped into four guilds based on similarity in call characteristics between some species and uncertainty in the ability of frequency division detectors to adequately provide information for this differentiation. The majority of calls (52%) were identified as unknown. Most of the remaining recorded call sequences (27%) were identified as, the big brown bat guild. *Myotis* call sequences comprised 9 percent of total calls and eastern red bat/ eastern pipistrelle calls accounted for 3 percent of the total call sequences. This trend in species composition is similar to that of other studies in the region.

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WAI PN 106195

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1.0 Introduction

1.1 Project Context

Granite Reliable Power, LLC (Granite) has proposed the construction of a wind development located in Coos County, New Hampshire (Figure 1). The project layout would include the erection of up to 67 wind turbines on or near the summits of Mt. Kelsey, Owlhead Mountain, the east side of Whitcomb Mountain, the east side of Long Mountain, and an unnamed peak just west of Mt. Patience (herein referred to as Fish Brook Ridge) (the project). The project would include turbine pads, turbines, access roads to and along the ridgelines, and a power collection system. The proposed turbines would have a height of approximately 125 meters (m) (410').

The topography within this region of New Hampshire is mountainous with elevations ranging from approximately 305 m (1,000') to 1,036 m (3,400'). These mountains occur within a landscape dominated by industrial forestry practices. High elevation spruce-fir forest exists at some of the summits, with the surrounding side slopes and valleys predominately yellow-birch (*Betula alleghaniensis)*, American beech (*Fagus grandifolia*), and sugar maple (*Acer saccharum*), species typically found in northern hardwood-conifer forests.

1.2 Survey Overview

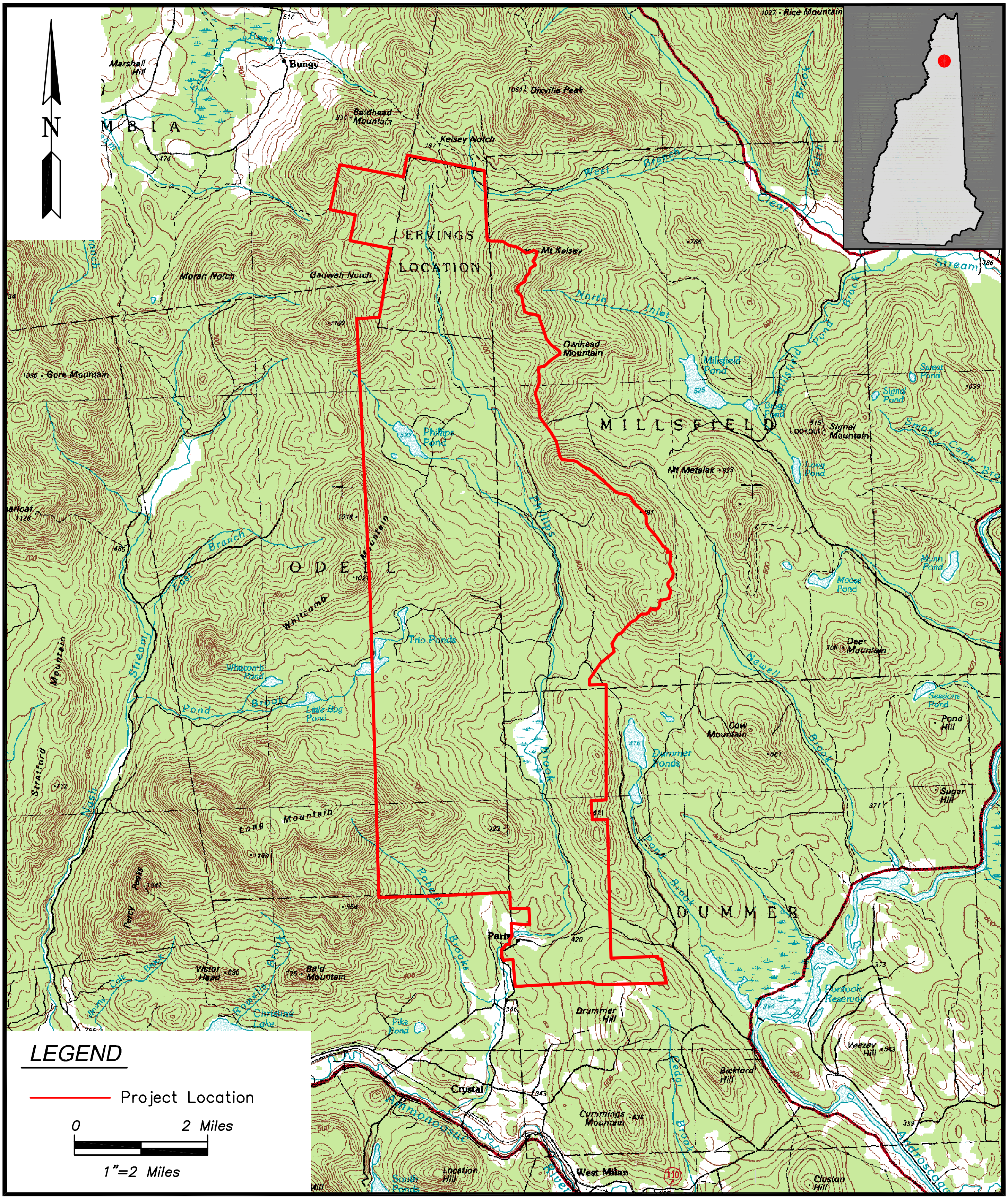
Woodlot Alternatives, Inc. (Woodlot), now Stantec Consulting[1], conducted field investigations for bird and bat migration during the spring of 2007. This was the second of two seasons of radar surveys and the first of three seasons of bat detector surveys conducted in the project area. The overall goals of the investigations were to document:

- the overall passage rates for nocturnal migration in the vicinity of the project area, including the number of migrants, their flight direction, and their flight altitude; and
- the presence of bats in the area, including the rate of occurrence and, when possible, species present during the spring migration period.

Surveys were conducted from April 26 to June 1, 2007, although effort for the different aspects of the work varied within this time period. A total of 30 nights of radar survey and 37 nights of bat detector surveys using 4 detectors were recorded.

This report is divided into two primary sections that discuss the methods and results for each field survey. Each section includes summary graphs of the survey results. In addition, supporting data tables are provided in a separate appendix for each chapter.

[1] On October 1, 2007, Woodlot Alternatives, Inc. was formally acquired by Stantec Consulting, Inc.



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ENVIRONMENTAL CONSULTANTS

106195-F101-Location.dwg

SHEET TITLE:

Project Location Map

PROJECT:

Proposed Coos County WIndpark
Coos County, New Hampshire

DATE: July 2007

SCALE: 1"=2 Miles

PROJ. NO.: 106195

FIGURE:

1-1

2.0 Nocturnal Radar Survey

2.1 Introduction

The majority of North American landbirds migrate at night. The strategy to migrate at night may be to take advantage of more stable atmospheric conditions for flapping flight (Kerlinger 1995). Conversely, species using soaring flight, such as raptors, migrate during the day to take advantage of warm rising air in thermals and laminar flow of air over the landscape, which can create updrafts along hillsides and ridgelines. Additionally, night migration may provide a more efficient medium to regulate body temperature during active flapping flight and could reduce the potential for predation while in flight (Alerstam 1990, Kerlinger 1995).

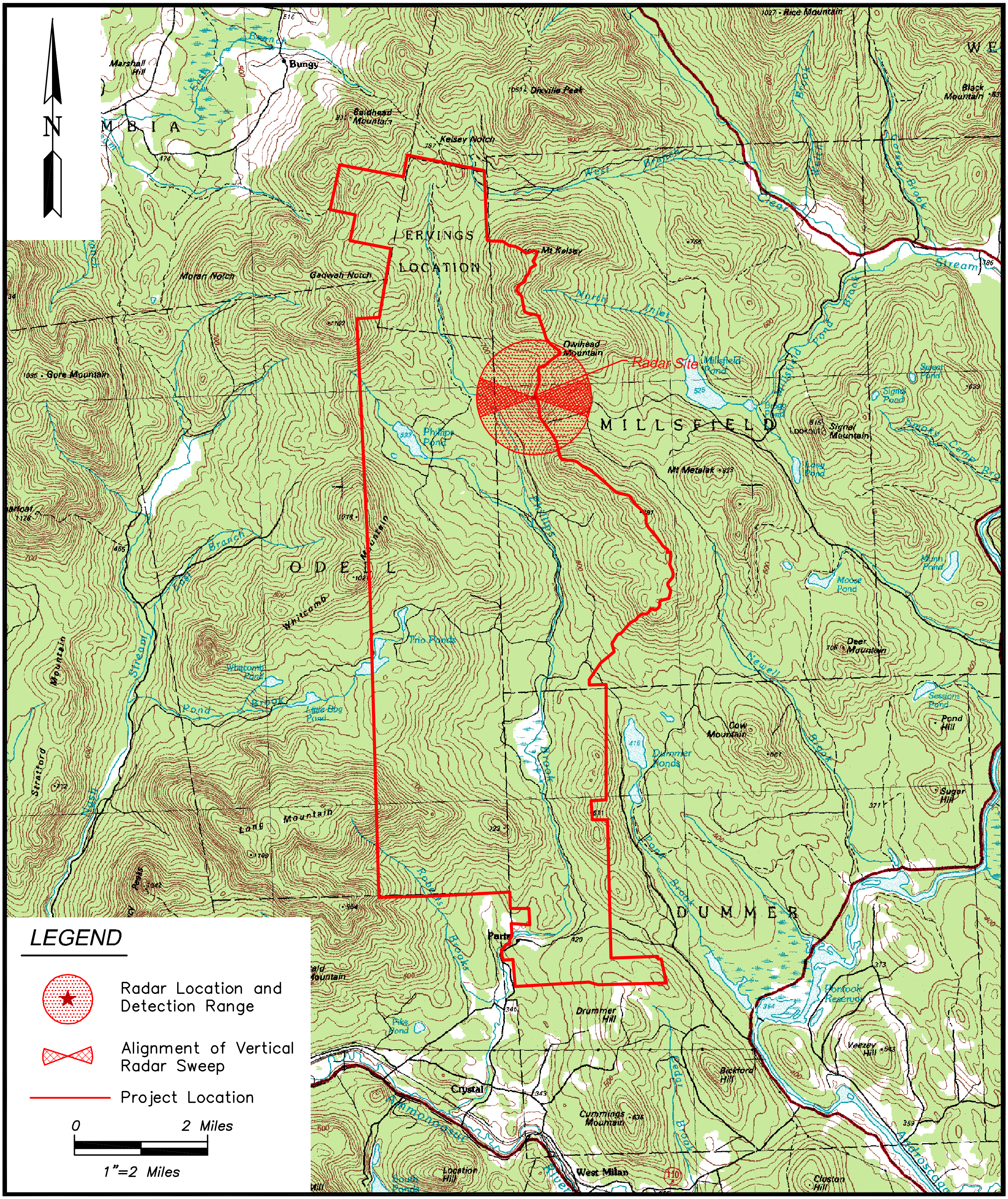
Because most birds migrate at night, radar surveys were conducted to characterize spring nocturnal migration patterns within the project area. The goal of the surveys was to document the overall passage rates for nocturnal migration in the vicinity of the project area, including the number of migrants, their flight direction, and their flight altitude.

2.2 Methods

Field Methods

The radar study was conducted within the on-site meteorological measurement tower (met tower) opening at the summit of Owlhead Mountain (Figure 2-1). This site is different than that used during the fall 2006 radar survey because at that time the met tower had not been installed. However, the spring 2007 site is only approximately 2.5 miles southwest of the previous season's location. This site, at an elevation of approximately 853 m (2800'), provided a good view in all directions. Marine surveillance radar similar to that described by Cooper *et al.* (1991) was used during field data collection. The radar has a peak power output of 12 kW and has the ability to track small animals, including birds, bats, and even insects, based on settings selected for the radar functions. It cannot, however, readily distinguish between different types of animals being detected. Consequently, all animals observed on the radar screen are called targets. The radar has an echo trail function that maintains past echoes of trails. During all operations, the radar's echo trail was set to 30 seconds.

The radar was equipped with a 2-m (6.5') waveguide antenna. The antenna has a vertical beam height of 20º (10º above and below horizontal) and the front end of the antenna was inclined approximately 5º to increase the proportion of the beam directed into the sky.



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ENVIRONMENTAL CONSULTANTS

106195-F201-Radar.dwg

SHEET TITLE:

Spring Radar Location Map

PROJECT:

Proposed Coos County Windpark
Coos County, New Hampshire

DATE: July 2007
SCALE: 1"=2 Miles
PROJ. NO.: 106195
FIGURE:
2-1

Objects on the ground detected by the radar cause returns on the radar screen (echoes) that appear as blotches called ground clutter. Large amounts of ground clutter reduce the ability of the radar to track birds and bats flying over those areas. However, vegetation and hilltops near the radar can be used to reduce or eliminate ground clutter by 'hiding' clutter-causing objects from the radar. These nearby features also cause ground clutter but their proximity to the radar antenna generally limits the ground clutter to the center of the radar screen (Figure 2-2). The presence of ground clutter and other objects that could reduce clutter were important factors considered during the site selection process and configuration of the radar station.

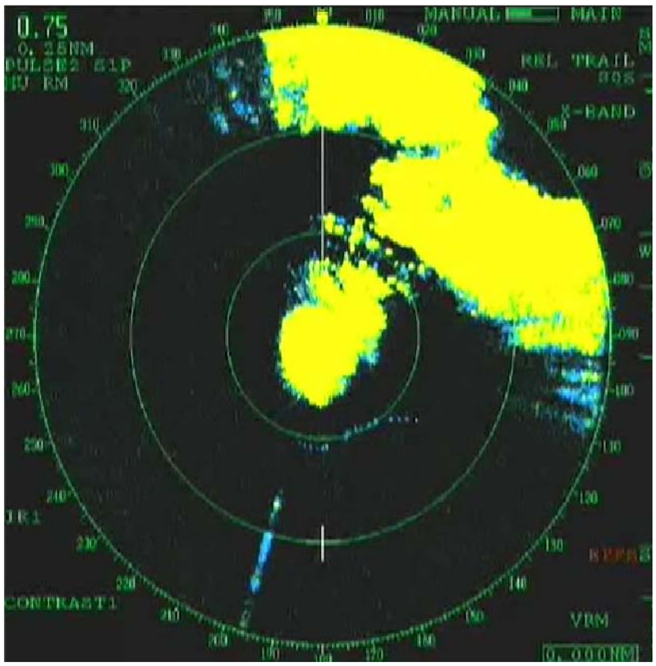


Figure 2-2. Ground clutter in project area

Radar surveys were conducted from sunset to sunrise. Thirty nights of surveys were targeted for sampling between April 15 and June 7, 2007. Because the anti-rain function of the radar must be turned down to detect small songbirds and bats, surveys could not be conducted during periods of inclement weather. Therefore, surveys were targeted largely for nights without rain. However, in order to characterize migration patterns during nights without optimal conditions, some nights with weather forecasts including occasional showers were sampled.

The radar was operated in two modes throughout the night. In the first mode, surveillance, the antenna spins horizontally to survey the airspace around the radar and detects targets moving through the area. By analyzing the echo trail, the flight direction of targets can be determined. In the second mode of operation, vertical, the antenna is rotated 90º to vertically survey the airspace above the radar (Harmata *et al.* 1999). In vertical mode, target echoes do not provide directional data but do provide information on the altitude of targets passing through the vertical, 20º radar beam. Both modes of operation were used during each hour of sampling.

The radar was operated at a range of 1.4 kilometer (km) (0.75 nautical miles). At this range, the echoes of small birds can be easily detected, observed, and tracked. At greater ranges, larger birds can be detected but the echoes of small birds are reduced in size and restricted to a smaller portion of the radar screen, reducing the ability to observe the movement pattern of individual targets.

Data Collection

The radar display was connected to the video recording software of a computer. Based on a random sequence for each night, approximately 25 minutes of video samples were recorded during each hour of operation. These included 15 one-minute horizontal samples and 10 one-minute vertical samples.

During each hour, additional information was also recorded, including weather conditions and ceilometer observations. Ceilometer observations involved directing a one-million candlepower spotlight vertically into the sky in a manner similar to that described by Gauthreaux (1969). The ceilometer beam was observed by eye for 5 minutes to document and characterize low-flying (below 125 m [410']) targets. The ceilometer was held in-hand so that any birds, bats, or insects passing through it could be tracked for several seconds, if needed. Observations from each ceilometer observation period were recorded, including the number of birds, bats, and insects observed. This information was used during data analysis to help characterize activity of insects, birds, and bats.

Data Analysis

Video samples were analyzed using a digital analysis software tool developed by Woodlot. For horizontal samples, targets were identified as birds and bats rather than insects based on their speed. The speed of targets was corrected for wind speed and direction; targets traveling faster than approximately 6 m (20') per second were identified as a bird or bat target (Larkin 1991, Bruderer and Boldt 2001). The software tool recorded the time, location, and flight vector for each target traveling fast enough to be a bird or bat. The results for each sample were output to a spreadsheet. For vertical samples, the software tool recorded the entry point of targets passing through the vertical radar beam, the time, and flight altitude above the radar location. The results for each sample were output to a spreadsheet. These datasets were then used to calculate passage rate (reported as targets per km of migratory front per hour [t/km/hr]), flight direction, and flight altitude of targets.

Mean target flight directions (± 1 circular standard deviation) were summarized using software designed specifically to analyze directional data (Oriana2© Kovach Computing Services). The statistics used for this are based on Batschelet (1965), which take into account the circular nature of the data. Nightly wind direction was also summarized using similar methods and data collected from the nearest met tower to the radar.

Flight altitude data were summarized using linear statistics. Mean flight altitudes (± 1 standard error) were calculated by hour, night, and overall season. The percent of targets flying below 125 m (410'), the approximate maximum height of the proposed wind turbines, was also calculated hourly, for each night, and for the entire survey period.

2.3 Results

Radar surveys were conducted during 30 nights between April 26 and June 1, 2007 (Appendix A Table 1). The radar site provided generally good visibility of the surrounding airspace and targets were observed in all areas of the radar display unit. The northeast quadrant of the radar screen was slightly obstructed by the ground clutter caused by the detection of the side slope of Mt. Kelsey; however, it did not impede the detection of targets as they entered or exited that area. Overall, the local topography and surrounding vegetation provided unobstructed views to the west, east, and south of the radar site.

Passage Rates

The overall mean passage rate for the entire survey period was 342 ± 18 t/km/hr. Nightly passage rates varied from 2 ± 1 t/km/hr (May 20) to 870 ± 128 t/km/hr (May 21) (Figure 2-3; Appendix A, Table 2). On nights with highest observed passage rates, the winds were either from the southwest or nonexistent. Individual hourly passage rates varied throughout the entire season from 0 to 1196 t/km/hr (Appendix A, Table 2). Hourly passage rates varied throughout each night and for the season overall. For the entire season, passage rates increased during the 1st hour after sunset and peaked during the fifth hour followed by a steady decline for the remainder of the night (Figure 2-4).

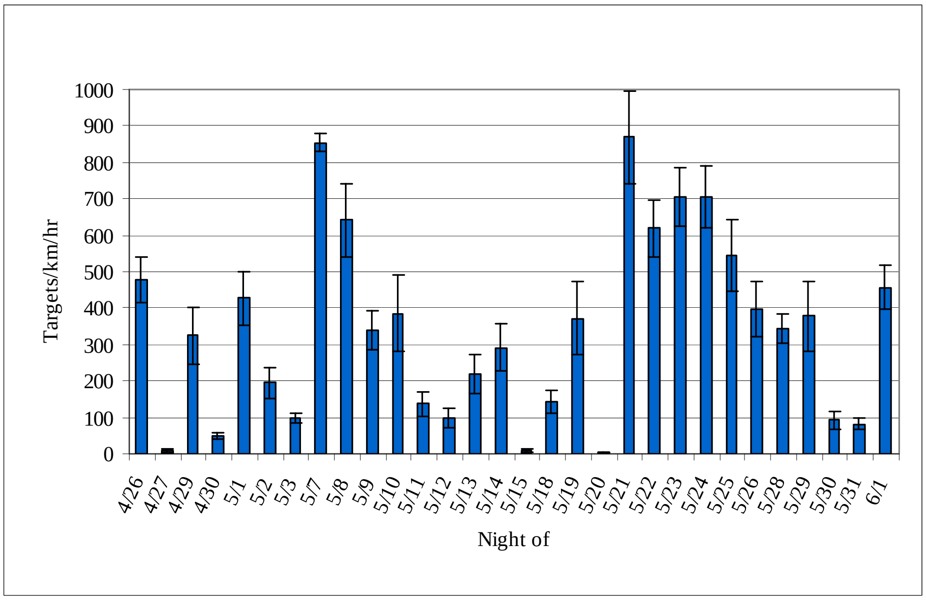


Figure 2-3. Nightly passage rates observed (error bars ± 1 SE)

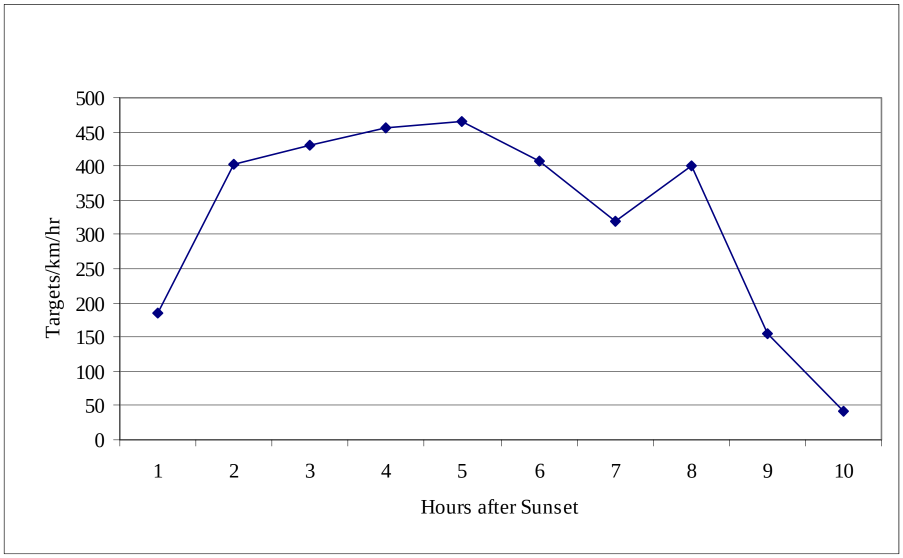


Figure 2-4. Hourly passage rates for entire season

Flight Direction

Mean flight direction through the project area was 76º ± 53º (Figure 2-5). There was considerable night-to-night variation in mean direction, although most nights included flight directions generally to the east or northeast (Appendix A, Table 2)

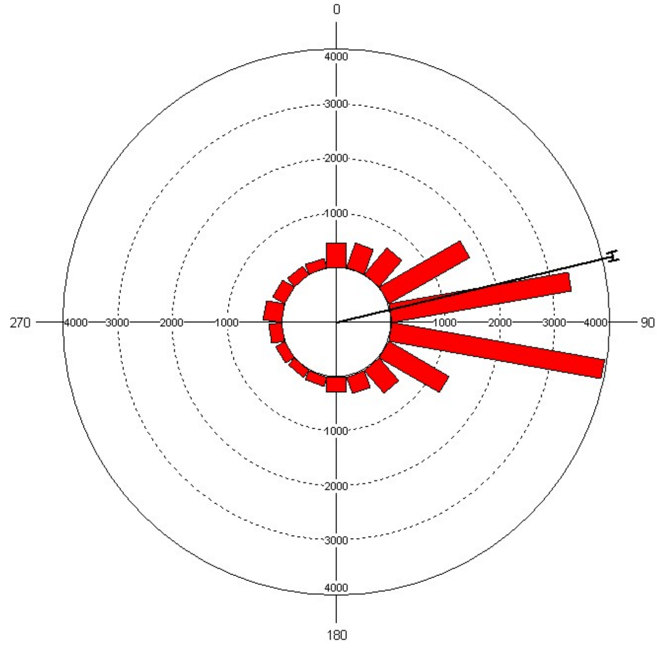


Figure 2-5. Mean flight direction for the entire season (the bracket along the margin of the histogram is the 95% confidence interval)

Flight Altitude

The seasonal average mean flight height of all targets was 332 m ± 20 m (1089' ± 66') above the radar site. The average nightly flight height ranged from 81 m ± 20 m (266' ± 66') to 583 m ± 29 m (1913' ± 94') (Figure 2-6, Appendix A Table 3). The seasonal average of targets flying below 125 m (410') was 14 percent and the percent of targets observed flying below 125 m (410') also varied by night, from 6 percent to 16 percent (Figure 2-7). Hourly flight height peaked during the third hour after sunset (Figure 2-8).

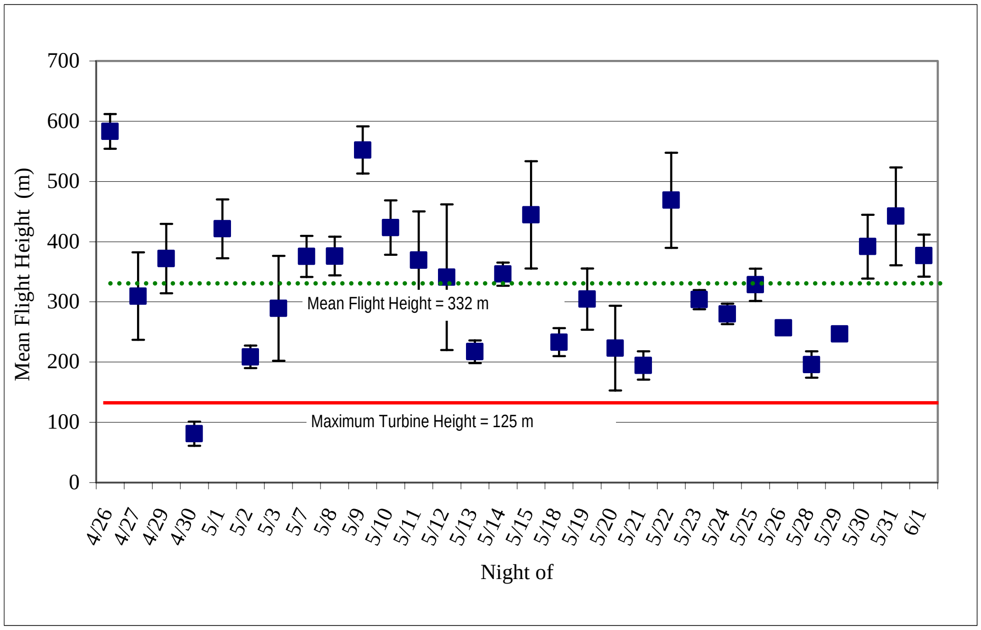


Figure 2-6. Mean nightly flight height of targets (error bars ± 1 SE)

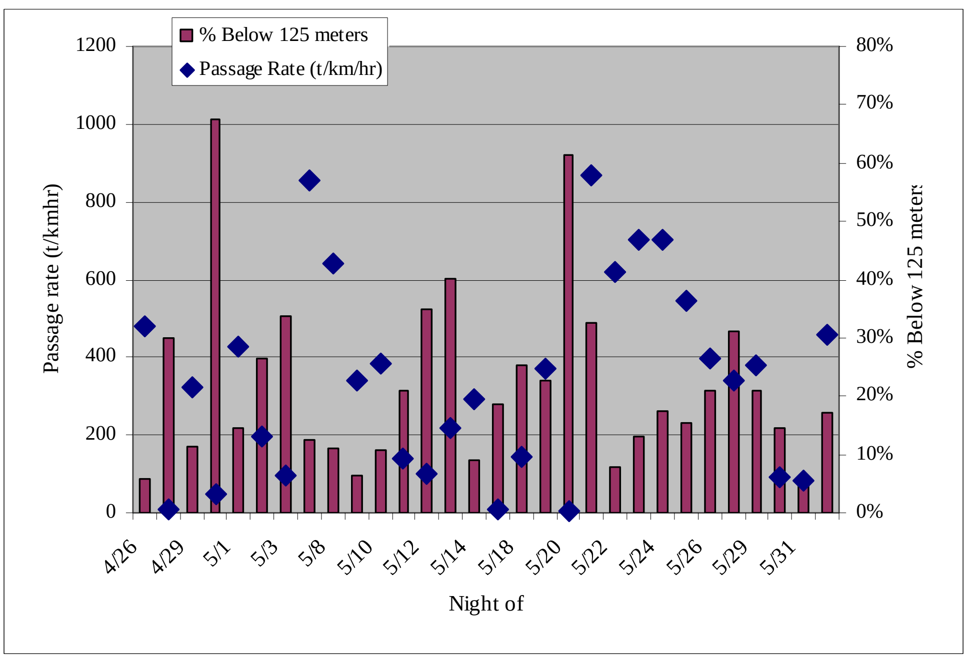


Figure 2-7. Percent of targets observed flying below a height of 125 m (410')

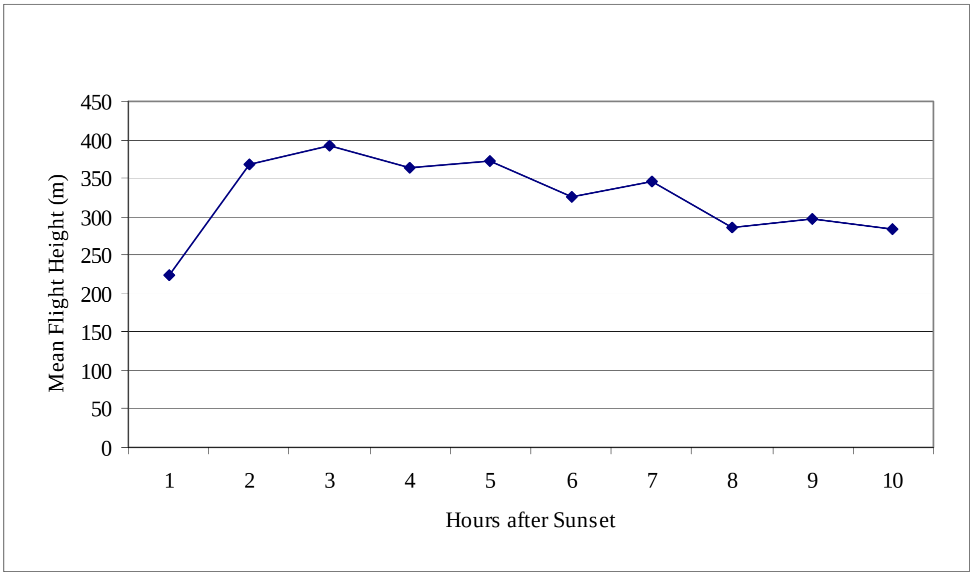


Figure 2-8. Hourly target flight height distribution

Ceilometer and Moonwatching Observations

Ceilometer data collected during the radar survey yielded a total of 232 five-minute observations. Those observations resulted in no bird or bat sightings in the ceilometer beam.

2.4 Discussion

Spring 2007 radar surveys documented migration activity and patterns in the vicinity of the proposed project. In general, migration activity and flight patterns varied between and within nights, which is very typical of nighttime migration. Nightly variation in the magnitude and flight characteristics of nocturnally migrating songbirds is not uncommon and is often attributed to weather patterns, such as cold fronts and winds aloft (Hassler *et al.* 1963, Gauthreaux and Able 1970, Richardson 1972, Able 1973, Bingman *et al.* 1982, and Gauthreaux 1991).

Data from regional surveys using similar methods and equipment conducted within the last several years are rapidly becoming increasingly available. These other studies provide an opportunity to compare the results from the proposed project with other areas of New Hampshire, the Northeast, and the central Appalachian states. There are limitations in comparing data from previous years with data from 2007, as year-to-year variation in continental bird populations may effect how many birds migrate through an area. Additionally, differences in site characteristics, particularly the topography, local landscape conditions, and vegetation surrounding a radar survey location, can play a large role in any radar's ability to detect targets of targets in all directions around it and the subsequent calculation of passage rate.

This last factor must be recognized for that part of the analysis as one of the more significant limiting factors, in making direct site-to-site comparisons in passage rates. It should, however, be noted that this consideration is not as important for the calculation of flight height, as the main portion of the radar beam is directed skyward, rather than in a 360° horizontal plane around the radar, and the potential effects of surrounding vegetation on the radar's view can generally be more easily controlled to be more similar across sites.

Regardless of any potential differences between the site conditions at radar survey locations, the nightly mean passage rates observed at the proposed project in spring 2007 (342 t/km/hr, ranging from 2 to 870 t/km/hr) were within the range of other available studies (Table 2-1), and were also comparable to the passage rate documented during the fall 2006 survey (469 t/km/hr, ranging from 2 to 1098 t/km/hr). Currently, in the wind power industry, there is no direct correlation between passage rates and risk of collisions with wind turbines, and it is not known precisely if or how passage rate calculated translates to overall fatalities. While conventional wisdom might be to assume that increased passage rates may translate to measurable increases in fatalities documented bird mortality to date at wind facilities has been low.

Seasonal variation in migration activity also occurs. Of the available radar studies, no clear trend in migration activity between spring and fall has yet been documented. In general, there seems to be no consistent trend in passage rate, such as an increase in passage rate from spring to fall (presumably when recruitment into the population should equate to a greater number of migrants documented at a site).

Some research suggests that bird migration may be affected by landscape features, such as coastlines, large river valleys, and mountain ranges. This has been documented for diurnally migrating birds, such as raptors, but is not as well established for nocturnally migrating birds (Sielman *et al*. 1981, Bingman 1980, Bingman *et al*. 1982, Bruderer and Jenni 1990, Richardson 1998, Fortin *et al*. 1999, Williams *et al.* 2001, Diehl *et al*. 2003).

Evidence suggesting topographic effects to night-migrating birds has typically included areas of varied topography, such as the most rugged areas of the northern Appalachians and the Alps. The landscape around the project area is of mountainous terrain. The overall elevation differential across the site is approximately 305 m (1,000') to 1,036 m (3,400'). This differential is fairly considerable when comparing to other sites in the northeast that are at lower elevation. The mean flight height of 322 m ± 20 m suggests some migrants might fly below ridgelines while others might be flying well above the ridgelines in the area. However, the mean flight height combined with the mean flight direction suggests that migrants use a broad front migratory path across the project area, and that areas of concentrated night-migrant density are not likely to occur in the project area.

Table 2-1. Summary of available spring avian radar survey results

Project Site	Number of Survey Nights	Number of Survey Hours	Landscape	Average Passage Rate (t/km/hr)	Range in Nightly Passage Rates	Average Flight Direction	Average Flight Height (m)	% Targets Below Turbine Height	Citation
Spring 2003									
Westfield Chautauqua Cty, NY	30	150	Great Lakes Shore	395	15-1702	29	528	(125 m) 4%	Cooper *et al.*2004
Spring 2005									
Churubusco, Clinton Cty, NY	39	310	Great Lakes plain/ADK foothills	254	3-728	40	422	(120 m) 11%	Woodlot 2005a
Ellenberg, Clinton Cty, NY	n/a	n/a	Great Lakes plain/ADK foothills	110	n/a	30	338	(n/a) 20%	Mabee *et al.* 2006a
Dairy Hills, Clinton Cty, NY	n/a	n/a	Great Lakes shore	117	n/a	14	397	(n/a) 15%	ED&R 2006b
Clayton, Jefferson Cty, NY	36	303	Agricultural plateau	450	71-1769	30	443	(150 m) 14%	Woodlot 2005b
High Sheldon, Wyoming Cty, NY	38	272	Agricultural plateau	112	6-558	25	418	(120 m) 6%	Woodlot 2006a
Prattsburgh, Steuben Cty, NY	20	183	Agricultural plateau	277	70-621	22	370	(125 m) 16%	Woodlot 2005c
Prattsburgh, Steuben Cty, NY	30	270	Agricultural plateau	170	3-844	18	319	(125 m) 18%	Mabee *et al.* 2005a
Cohocton, Steuben Cty, NY	3	29	Agricultural plateau	371	133-773	28	609	(125 m) 12%	ED&R 2006a
Munnsville, Madison Cty, NY	41	388	Agricultural plateau	160	6-1065	31	291	(118 m) 25%	Woodlot 2005d
Fairfield, Herkimer Cty, NY	40	369	Agricultural plateau	509	80-1175	44	419	(125 m) 20%	Woodlot 2005e
Jordanville, Herkimer Cty, NY	40	364	Agricultural plateau	409	26-1410	40	371	(125 m) 21%	Woodlot 2005f
Sheffield, Caledonia Cty, VT	20	179	Forested ridge	208	11-439	40	522	(125 m) 6%	Woodlot 2006b
Deerfield, Bennington Cty, VT	20	183	Forested ridge	404	74-973	69	523	(125 m) 4%	Woodlot 2005g
Franklin, Pendleton Cty, WV	23	204	Forested ridge	457	34-240	53	492	(125 m) 11%	Woodlot 2005h

Spring 2006									
Chateaugay, Franklin Cty, NY	35	300	Agricultural plateau	360	54-892	48	409	(120 m) 18%	Woodlot 2006c
Wethersfield, Wyoming Cty, NY	44	n/a	Agricultural plateau	324	41-907	12	355	(125 m) 19%	Mabee et al. 2006b
Centerville, Allegany Cty, NY	42	n/a	Agricultural plateau	290	25-1140	22	351	(125 m) 16%	Mabee et al. 2006b
Howard, Steuben Cty, NY	42	440	Agricultural plateau	440	35-2270	27	426	(125 m) 13%	Woodlot 2006d
Deerfield, Bennington Cty, VT	26	236	Forested ridge	263	5-934	58	435	(100 m) 11%	Woodlot 2006e
Kibby, Franklin Cty, ME (Mtn)	6	33	Forested ridge	456	88-1500	67	368	(120 m) 14%	Woodlot 2006f
Kibby, Franklin Cty, ME (Range 1)	10	80	Forested ridge	197	6-471	50	412	(120 m) 22%	Woodlot 2006f
Kibby, Franklin Cty, ME (Range 2)	7	57	Forested ridge	512	18-757	86	378	(120 m) 25%	Woodlot 2006f
Kibby, Franklin Cty, ME (Valley)	2	14	Forested valley	443	45-1242	61	334	(120 m) n/a	Woodlot 2006f
Mars Hill, Aroostook Cty, ME	15	85	Forested ridge	338	76-674	58	384	(120 m) 14%	Woodlot 2006g

The emerging body of studies characterizing nighttime bird movements shows a relatively consistent trend in regards to the altitude at which night migrants fly (Table 2-1). In general, nighttime migration typically occurs several hundred meters or more above the ground. The range in mean flight heights is approximately 300 m (1,000') to 600 m (2,000') above the ground. The percentage of targets documented at heights below that of typical modern wind turbines is variable, but is usually 10 to 20 percent. The average flight height documented during the spring at the proposed project (332 m, ranging from 81 to583 m) is similar to results documented in fall 2006 (455 m, ranging from 310 to 638 m) and is within the range of other studies in the region. The observed percentage of targets flying below the height of the turbines is also consistent with findings at other survey locations. The similarity in flight height between sites is likely due to consistent ways in which migrants respond to nightly atmospheric conditions and, as mentioned previously, the relatively uniform way that radars view the airspace over them while in vertical operation mode across survey sites.

The mean flight altitude of targets documented during this study likely further supports the presumption that topographic features are not affecting migration patterns, particularly flight direction. The mean flight altitude was high above the radar, which was located near the top of a mountain indicates that most birds are flying so high that their flight is unimpeded by topographic features, such as the hilltops of the project area.

2.5 Conclusions

Radar surveys during the spring 2007 migration period have provided important information on nocturnal bird migration patterns in the vicinity of the proposed project. The results of the surveys indicate that bird migration patterns are generally similar to patterns observed at other sites in the region.

Migration activity varied throughout the season, which is probably largely attributable to weather patterns. The mean passage rate is within, but at the low end of, the range in passage rates observed at similar studies. The combination of the flight height and flight direction data indicates that the majority of the migrants are flying at altitudes well above the ridges of the project area and are unimpeded by topography. The flight height data also suggests that the majority of migration during the spring survey period took place well above the height of the proposed turbines. The percent of targets flying below turbine height was within the range observed at other sites.

3.0 Acoustic Bat Survey

3.1 Introduction

Nine species of bat (*Microshirpotera*) may occur in New Hampshire, based upon their normal geographic range. These include little brown bat (*Myotis lucifugus*), northern long-eared bat (*M. septentrionalis*), Indiana bat (*M. sodalis*), eastern small-footed bat (*M. leibii*), silver-haired bat (*Lasionycteris noctivagans*), eastern pipistrelle (*Pipistrellus subflavus*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*) (Whitaker and Hamilton 1998). The Indiana bat is listed as federally endangered and the eastern small-footed bat is state-listed as an endangered species. There is a single documentation of Indiana bat in the state. The documented occurrence was in Carroll County in an abandoned mine approximately 50 km (31 miles) south of the project area (NHFGD 2005), though the credibility of this record has recently been questioned by the USFWS. The state endangered eastern small-footed bat is known from three summer records, as well as one wintering location (Mascot Lead Mine). The closest documented occurrence of eastern small footed bat is the Mascot Lead Mine, in Gorham, New Hampshire, approximately 34 km (21 miles) south of the project area, where nine individuals were documented in 2004 (NHFGD 2005).

To document bat activity in the proposed project area, Woodlot conducted an acoustic monitoring survey with Anabat detectors during the spring of 2007. The survey was designed to document bat passages near the rotor zone of the proposed turbines and at an intermediate height. This data was correlated with on-site weather conditions to characterize any weather-related trends in bat activity.

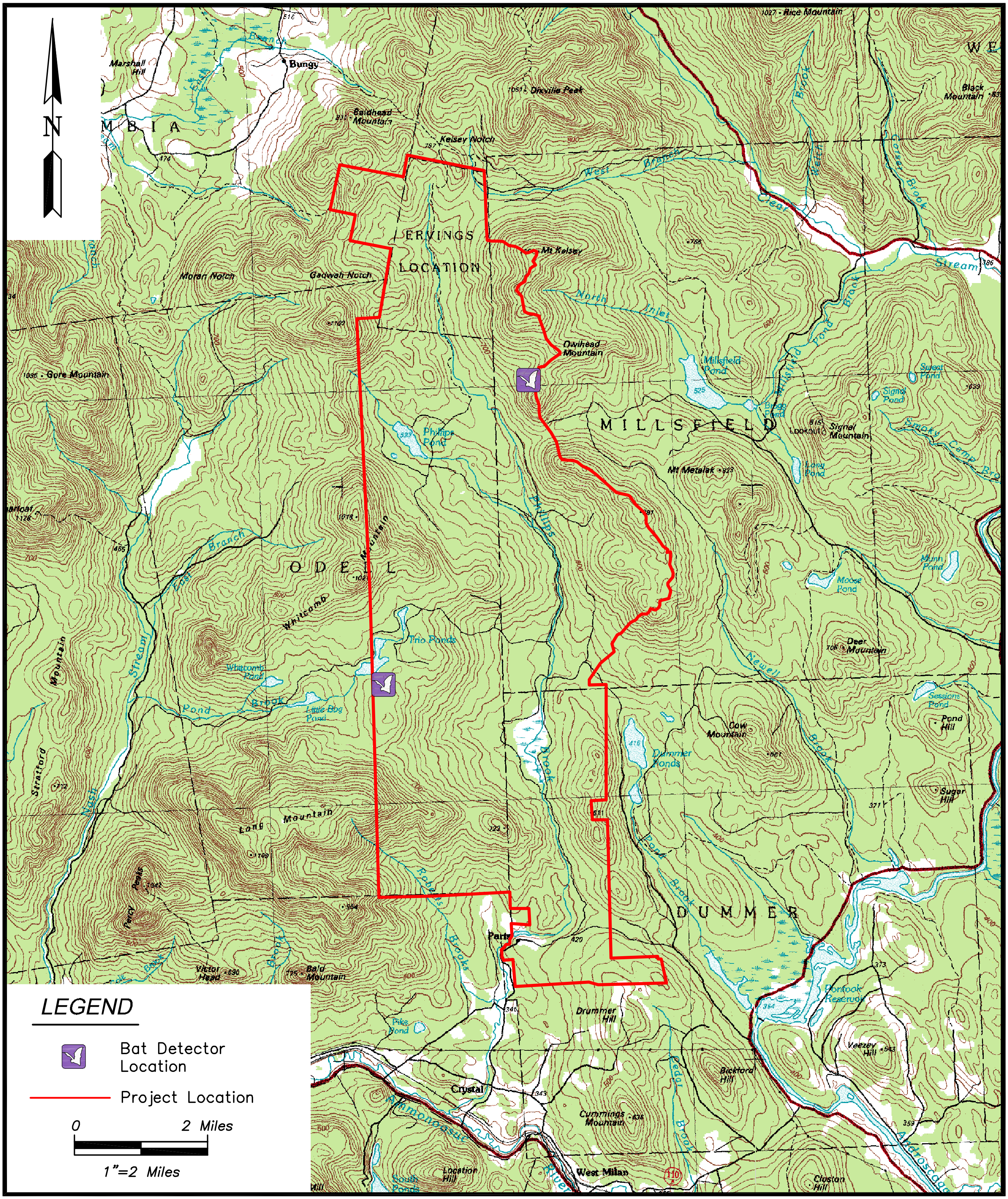
Anabat II and Anabat SD1 detectors were used for the duration of the spring 2007 migration survey. Anabat detectors are frequency division detectors, dividing the frequency of ultrasonic calls made by bats so that they are audible to humans. Anabat detectors were selected based upon their widespread use for this type of survey, their ability to be deployed for long periods of time, and their ability to detect a broad frequency range, which allows detection of all species of bats that could occur in the project area.

3.2 Methods

Field Surveys
A pair of detectors was deployed at two locations, for a total of four detectors deployed in the project area. These were passive surveys, as the detectors were placed at the site and left there for the duration of the study. The detectors were placed at heights of approximately 20 m (66’) and 50 m (164’) above the ground using the two on-site met tower sites. Deployment in this fashion allowed for data collection at two different heights as well as at different elevations and in different sections of the project area. Two detectors were deployed in the Owlhead met tower (elevation of approximately 853 m), and an additional two were deployed in the Trio Ponds met tower (elevation of approximately 740 m) (Figure 3-1). Detectors were deployed between April 26 and April 30, due to inclement weather, and were retrieved on June 2, 2007. Detectors were programmed to record nightly from 7:00 pm to 7:00 am.

Each Anabat acoustic monitoring system was deployed in a waterproof housing enabling the detector to record while unattended for the duration of the survey. The housing suspends the Anabat microphone downward to give maximum protection from precipitation. To compensate for the downward position, a reflector shield of smooth plastic is placed at a 45-degree angle directly below the microphone. The angled reflector allows the microphone to record the airspace horizontally surrounding the detector and is only slightly less sensitive than an unprotected Anabat unit.

Maintenance visits were conducted approximately every one to two weeks to check on the condition of the detectors and download data to a computer for later analysis. A division factor of 16 was used in this study to facilitate long term storage onto a compact flash card using a CF ZCAIM (or an SD1 Anabat with on-board CFC recording capabilities) (Titley Electronics Pty Ltd.) and downloaded to a computer for later analysis. The sensitivity knob was set at or near a value of 6 to ensure the highest sensitivity while limiting ambient background noise, which can obscure some bat recordings. The sensitivity of individual detectors was tested using an ultrasonic Bat Chirp (Reno, NV) at a distance of up to 10 m (30’) to manually calibrate for the greatest sensitivity with the lowest background noise.



PREPARED BY:

WOODLOT ALTERNATIVES, INC.
ENVIRONMENTAL CONSULTANTS

106195–F301–Bat.dwg

SHEET TITLE:	
	Bat Detector Location Map
PROJECT:	Proposed Coos County Windpark Coos County, New Hampshire

DATE: July 2007
SCALE: 1"=2 Miles
PROJ. NO.: 106195
FIGURE:
3-1

Data Analysis

Potential call files were extracted from data files using CFCread© software. The default settings for CFCread© were used during this file extraction process, as these settings are recommended for the calls that are characteristic of northeastern bats. This software screens all data recorded by the bat detector and extracts call files using a filter. Using the default settings for this initial screen also ensures comparability between data sets. Settings used by the filter include a max TBC (time between calls) of 5 seconds, a minimum line length of 5 milliseconds, and a smoothing factor of 50. The smoothing factor refers to whether or not adjacent pixels can be connected with a smooth line. The higher the smoothing factor, the less restrictive the filter is and the more noise files and poor quality call sequences are retained within the data set. A call is a single pulse of sound produced by a bat. A call sequence is a combination of two or more pulses recorded in a call file.

Following extraction of call files, each file was visually inspected to ensure that files created by static or some other form of interference, that were still within the frequency range of northeastern bats, were not included in the data set. Call sequences were identified based on visual comparison of call sequences with reference libraries, including known calls recorded by Woodlot during mist netting surveys in 2006 in New York and Pennsylvania, and reference calls from 2002 to 2005 provided by Chris Corben, developer of the Anabat system, and nationally-recognized bat expert Lynn Robbins. Bat calls typically include a series of pulses characteristic of normal flight or prey location (search phase calls) and capture periods (feeding buzzes) and visually look very different than static, which typically forms a diffuse band of dots at either a constant frequency or widely varying frequency, caused by wind, vibration, or other interference. Using these characteristics, bat call files are easily distinguished from non-bat files.

Qualitative visual comparison of recorded call sequences, of sufficient length, to reference libraries of bat call sequences allows for relatively accurate identification of bat species (O'Farrell *et al*. 1999, O'Farrell and Gannon 1999). A call sequence was considered of suitable quality and duration if the individual call pulses were 'clean' (i.e., consisting of sharp, distinct lines) and at least five pulses were included within the sequence. Call sequences were classified to species whenever possible, using the reference calls described above. However, due to similarity of call signatures between several species, all classified calls have been categorized into four guilds for presentation in this report. This classification scheme follows that of Gannon *et al.* (2003) and is as follows:

- Unknown (UNKN) – all call sequences with too few pulses (less than five) or of poor quality (such as indistinct pulse characteristics or background static);
- Myotid (MYSP) – All bats of the genus *Myotis*. While there are some general characteristics believed to be distinctive for several of the species in this genus, these characteristics do not occur consistently enough for any one species to be relied upon at all times when using Anabat recordings;
- Red bat/pipistrelle (RBEP) – Eastern red bat and eastern pipistrelle. Like many of the other northeastern bats, these two species can produce calls distinctive only to each species. However, significant overlap in the call pulse shape, frequency range, and slope can also occur; and
- Big brown/silver-haired/hoary bat (BBSHHB) – This guild will be referred to as the big brown guild. These species' call signatures commonly overlap and have therefore been included as one guild in this report.

This guild grouping represents the most conservative approach to bat call identification. Since some species do sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being grouped into the listed guilds. Tables and figures in the body of this report will reflect those guilds. However, since species-specific identification did occur in some cases, each guild will also be briefly discussed with respect to potential species composition of recorded call sequences.

Once all of the call files were identified and placed into the appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of calls/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined. It is important to note that detection rates indicate only the number of calls detected and do not necessarily reflect the number of individual bats in an area. For example, a single individual can produce one or many call files recorded by the bat detector, but the bat detector cannot differentiate between individuals of the same species producing those calls. Consequently, detections recorded by the bat detector system likely over-represents the actual number of animals that produced the recorded calls.

Ceilometer and Radar Data

Nocturnal radar surveys and hourly ceilometer surveys were conducted at the Owlhead Mountain met tower concurrently with the acoustic bat monitoring on 30 nights of the sampling period. While conclusive differentiation between bats and birds is not possible using radar, work conducted by Woodlot using radar and thermal imaging cameras indicates that nocturnal targets that move erratically or in curving paths are typically bats while those with straight flight paths are birds. Additionally, while bats can create radar flight paths more similar to birds (i.e., straight flight path), no birds were observed creating the erratic radar flight paths observed to be created by some bats (Woodlot, unpublished observations).

Targets with erratic flight paths were noted during the analysis of the radar video data. Nightly tallies of these targets were then made[2]. Additionally, the ceilometer observations made during the radar survey were an opportunity to document birds and bats flying at low altitude over the radar site. Any bats observed during the ceilometer surveys were recorded.

Weather Data

Wind speed, wind direction, ambient temperature and relative humidity data were collected from Weather Underground (www.wunderground.com), in nearby Berlin, New Hampshire. The mean, maximum, and minimum wind speeds and temperatures between 7:00 pm and 7:00 am were calculated for each night. In addition to the Weather Underground data temperature, relative humidity, and dew point were recorded for the duration of the survey period at 10-minute intervals by data loggers (HOBO Pro v2 U23-001, Onset Computer Corporation) placed on at least one of the bat detector systems. The mean, maximum, and minimum temperature, relative humidity, and dew point were calculated for each night.

[2] While these targets were noted and tallied they were included in the radar analysis data set for the calculation of passage rate, flight direction, and flight height.

3.3 Results

Two detectors were deployed at Owlhead for 37 nights between April 26 and June 1 and two detectors were deployed at Trio Ponds for 35 nights between April 28 and June 1.

At Owlhead, the high detector was deployed on April 26, the low detector was deployed on April 30, and both detectors were retrieved on June 2, 2007, (prior to immediate redeployment for the summer survey period) for a total survey period of 37 nights. Occasionally the detectors powered down due to equipment malfunctions. During the 37 night sampling period, the Owlhead met tower high detector (50 m) recorded 37 nights of data and the low detector (20 m) recorded 19 nights. At Trio Ponds, both the low (15 m) and high (30 m) detectors were deployed on April 28 and were retrieved on June 2 (prior to immediate redeployment for the summer survey period). Combined, 126 detector-nights of bat echolocation data were recorded during the spring survey period.

A total of 33 bat call sequences were recorded from both met tower locations during the sampling period (Table 3-1). The number of call sequences recorded by each detector ranged from 5 (by the Owlhead low detector) to 12 (by the Trio Ponds low detector). The mean detection rate for all four detectors was 0.3 calls/detector night. Detection rates at each of the four detectors ranged from 0.2 calls/detector-night by the two high detectors to 0.3 calls/detector-night by the two low detectors.

Table 3-1. Summary of bat detector field survey effort and results

Location	Dates	# Nights	# Detector-Nights*	# Recorded sequences	Detection Rate **	Maximum # calls recorded ***
Owlhead High	4/26-6/1	37	37	8	0.2	5
Owlhead Low	4/30-6/1	19	19	5	0.3	2
Trio Pond's High	4/28-6/1	35	35	8	0.2	3
Trio Pond's Low	4/28-6/1	35	35	12	0.3	2
Overall Results		***126***	***126***	***33***	***0.3***	--

* Detector-night is a sampling unit during which a single detector is deployed overnight. On nights when two detectors are deployed, the sampling effort equals two detector-nights, etc.

** Number of bat passes recorded per detector-night.

*** Maximum number of bat passes recorded from any **single** detector for a 12-hour sampling period.

Appendix B provides a series of tables with more specific information on the nightly timing, number, and species composition of recorded bat call sequences. Specifically, Appendix B Tables 1 through 4 provide information on the number of call sequences, by guild and suspected species, recorded at each detector and the weather conditions for that night. Appendix B Table 5 provides the actual data file information for each of the detectors. Included is the Analook file name for all 33 recorded call sequences, the night during which the call sequence was recorded, the timing of the recording, and the suspected identity of the species recorded.

The numbers of call sequences recorded per night by all four detectors combined were generally low, ranging from 0 to 5 total calls. Nights with peak activity occurred on May 5 and May 23, with 5 and 3 total calls, respectively.

Overall, during the survey period at the project, the majority of calls were recorded between 9 and midnight (Figure 3-2).

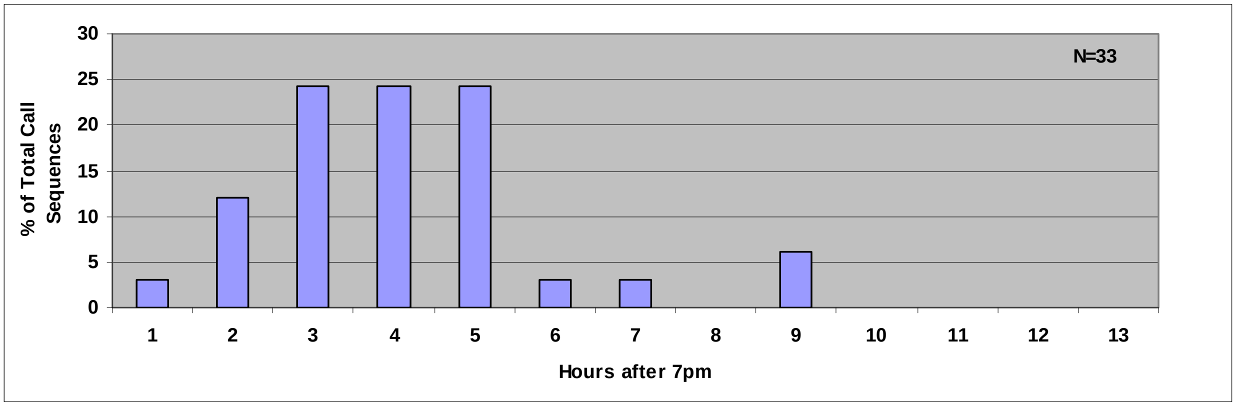


Figure 3-2. Hourly distribution of bat call sequences recorded at all four detectors

The majority of the recorded call sequences (52%) were labeled as unknown due to very short call sequences (less than five pulses) or poor call signature formation (probably due to a bat flying at the edge of the detection zone of the detector or flying away from the microphone) (Table 3-2). Of the calls that were identified to species or guild, those of the big brown guild were the most common (27% of all call sequences), followed by the *Myotis* spp. (18% of all call sequences). Red bat/eastern pipistrelle call sequences comprised 3 percent of the total recorded sequences.

Table 3-2. Summary of the composition of recorded bat call sequences.

Detector	Guild: Big brown guild	Red bat/ E. pipistrelle	Myotis	Unknown	Total
Owlhead High	1	1	0	6	8
Owlhead Low	3	0	2	0	5
Trio Pond's High	2	0	1	5	8
Trio Pond's Low	3	0	3	6	12
Total	***9***	***1***	***6***	***17***	***33***

Overall, species composition at each detector was similar (Figure 3-3). The greatest numbers of call sequences at all detectors were identified as unknown. The Owlhead high detector recorded the only red bat/eastern pipistrelle call sequence, and recorded no *Myotis* spp. call sequences. The other three detectors recorded call sequence(s) from *Myotis* spp., as well as the big brown guild.

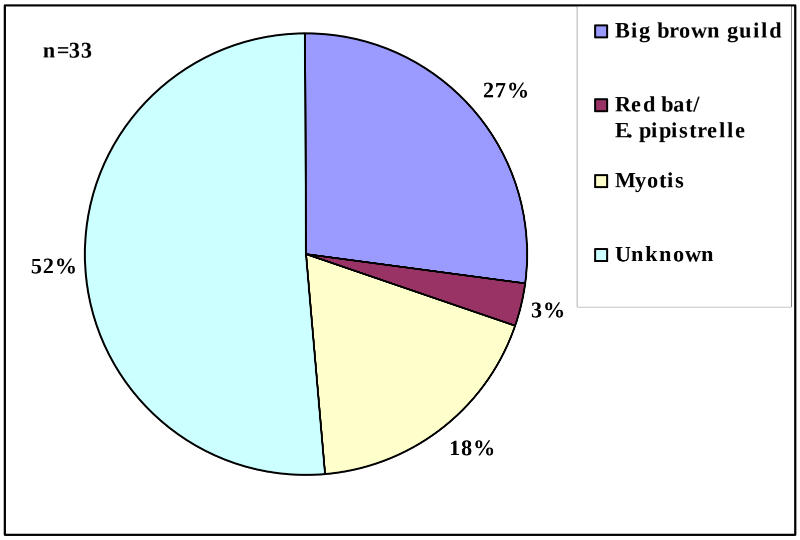


Figure 3-3. Overall composition of call sequences

Ceilometer and Radar Surveys

No bats were observed during the course of 232 five-minute ceilometer observation periods conducted during radar surveys. During analysis of the radar survey data, 2 percent of the target trails were identified as potential bats (Appendix A Table 5). These observations were mostly documented on a few nights. There was no correlation between the total number of recorded bat call sequences and ceilometer, radar target, or radar passage rates were observed.

Weather Data

Mean nightly wind speeds at the project area from April 15 to May 31 varied between 0 and 4.6 m per second (m/s), with an overall mean of 2.3 m/s (Figure 3-4). Mean nightly temperatures varied between -1ºC and 20ºC, with an overall mean of 7 ºC (Figure 3-5). While no significant relationships between call sequence detections and weather data occurred, detections became more common near the end of the sampling period, when nightly temperatures were higher.

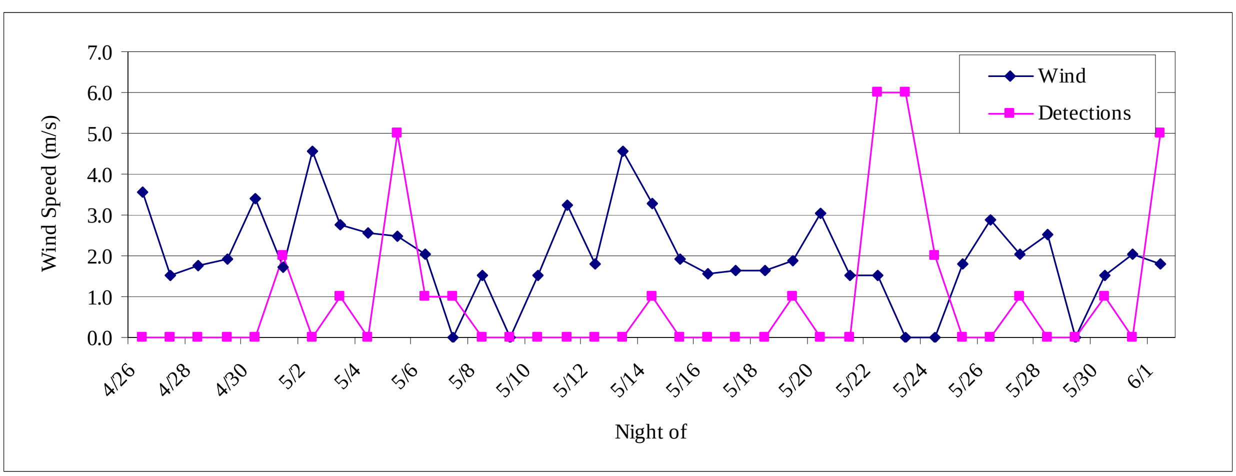


Figure 3-4. Nightly mean wind speed (m/s) and bat call detections (red line).

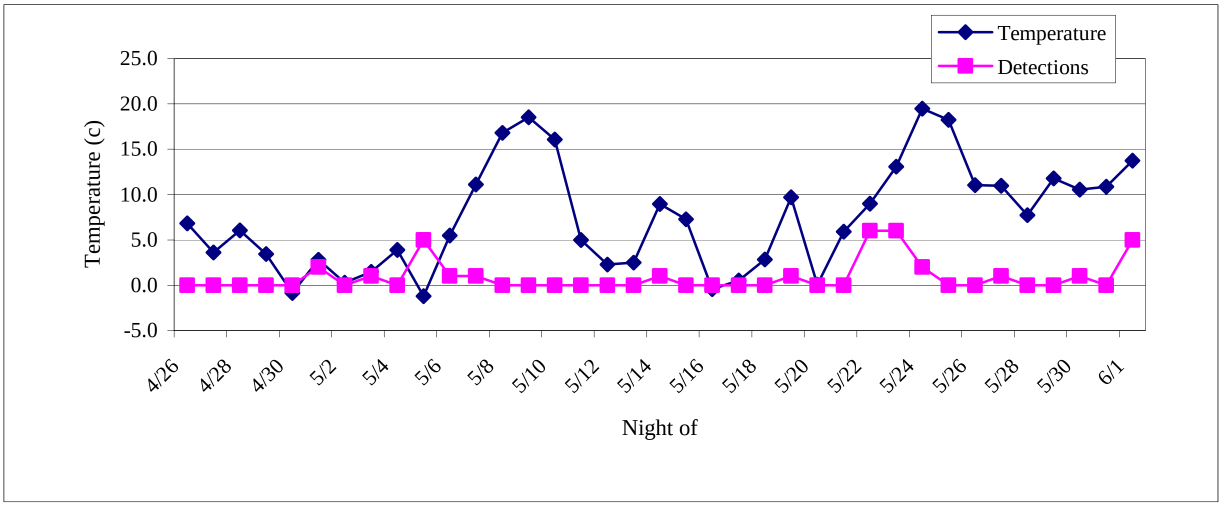


Figure 3-5. Nightly mean temperature (Celsius) and bat detections (red line).

3.4 Discussion

Bat echolocation surveys in 2007 at the proposed project provide some insight into bat activity patterns, possible species composition, and the timing of bat movements in the project area. Bat call sequences were not recorded until May 1 at the Trio Ponds detectors and May 3 at the Owlhead detectors. It is possible that this relatively late onset of bat activity was a result of a cool spring prolonging the thawing of snow pack until about this time period. The two day difference between initial documentation of bat activity at the Trio Ponds detectors and those at Owlhead may be a result of the difference in elevation between the sites. The Owlhead detectors were located approximately 80 m higher in elevation than those at Trio Ponds, potentially resulting in a different microclimate at these locations, and thereby delaying bat activity for a few days.

The overall mean detection rate at the proposed project during the spring 2007 survey period was 0.3 calls/detector-night. This rate is similar to other spring bat detector surveys conducted recently (Table 3-3).

Table 3-3. Summary of other available spring bat detector survey results			
Project Site	**Landscape**	**Calls Per Detector Night**	**Citation**
Spring 2005			
Churubusco, Clinton County, NY	Great Lakes plain/ADK foothills	0.26	Woodlot 2005a
Clayton, Jefferson County, NY	Agricultural plateau	0.90	Woodlot 2005b
Sheldon, Wyoming County, NY	Agricultural plateau	0.17	Woodlot 2006a
Prattsburgh, Steuben County, NY	Agricultural plateau	0.28	Woodlot 2005c
Cohocton, Steuben County, NY	Agricultural plateau	0.72	Woodlot 2006h
Munnsville, Madison County, NY	Agricultural plateau	0.27	Woodlot 2005d
Fairfield, Herkimer County, NY	Agricultural plateau		Woodlot 2005e
Jordanville, Herkimer County, NY	Agricultural plateau	0.50	Woodlot 2005f
Sheffield, Caledonia County, VT	Forested ridge	0.17	Woodlot 2006b
Deerfield, Bennington County, VT	Forested ridge	0.07	Woodlot 2005g
Franklin, Pendleton County, WV	Forested ridge	0.50	Woodlot 2005h
Spring 2006			
Chateaugay, Franklin County, NY	Agricultural plateau	2.00	Woodlot 2006c
Brandon, Franklin County, NY	Agricultural plateau	13.00	Woodlot 2006c
Wethersfield, Wyoming County, NY	Agricultural plateau	1.50	Woodlot 2006i
Centerville, Allegany County, NY	Agricultural plateau	2.10	Woodlot 2006i
Howard, Steuben County, NY	Agricultural plateau	0.40	Woodlot 2006d
Sheffield, Caledonia County, VT	Forested ridge	7.90	Woodlot 2006b
Deerfield, Bennington County, VT	Forested ridge	0.10	Woodlot 2006e
Kibby, Franklin County, ME	Forested ridge	0.30	Woodlot 2006f

During the spring surveys, the majority of calls were detected by the Trio Ponds low detector (20 m). However, each detector recorded a relatively similar number of call sequences. Interestingly, the two high detectors had identical detection rates, as did the two low detectors, despite being in opposite sides of the project area. It is possible that if the low detector at the Owlhead met tower had not powered down it may have recorded a greater magnitude of calls. The data suggests that more than half (60%) of the bat activity documented during the sampling period occurred near the Trio Ponds met tower. This could probably be due to a milder micro-climate at a lower elevation, and the met towers close proximity to Trio Ponds which would provide good foraging conditions for bats. The data further suggest that bat activity, at least in the spring, is low within the project area.

Bat calls were identified to guild within this report, although calls were provisionally categorized by species when possible during analysis. Certain species, such as the eastern red bat and hoary bat have easily identifiable calls, whereas other species, such as the big brown bat and silver-haired bat are difficult to distinguish from each other. Similarly, certain members of the *Myotis* genus, such as the little brown bat are far more common and have slightly more distinguishable calls than other species. The following paragraphs discuss each guild separately and address likely species composition of recorded bats within each guild.

The MYSP guild includes all four species of *Myotis* potentially occurring in the study area, including the little brown bat, northern long-eared bat, eastern small-footed bat, and the federally endangered Indiana bat. Of these species, the little brown bat and northern long-eared bat are by far the most common, and have calls that tend to be slightly more distinguishable using the Anabat system. Based on habitat types present, similarity between recorded calls, and call characteristics such as slope and the overall profile, the vast majority of calls within the MYSP guild were likely little brown bat or northern long-eared bat.

Due to the relatively low number of total call sequences recorded, and the relatively poor quality of some of the recordings it was difficult to determine specific *Myotis* species characteristics from many of the obviously *Myotis* call sequences. Only one call sequence had characteristics that appeared to be indicative of little brown bat. The remaining call sequences exhibited slope, minimum and maximum frequencies indicative of either little brown bat or northern long-eared myotis, and likely not small-footed bat or Indiana bat. *Myotis* call sequences identified to species level are the result of experience and professional judgement, based on patterns observed by qualified analysts. However, the overlap in call sequence characteristics, including frequency range, slope and cycles (i.e., magnitude at a specific frequency), create uncertainty in call identification to species level.

The RBEP guild includes the eastern pipistrelle and eastern red bat. Eastern red bat have relatively unique calls that span a wide range of frequency and have a characteristic hooked shape and variable minimum frequency. Eastern pipistrelle tends to have relatively uniform calls, with a constant minimum frequency and a sharply curved profile. The single call identified as RBEP, was likely an eastern red bat. The call sequence had a minimum frequency of approximately 37 kHz and a maximum frequency of about 56 kHz. The majority of cycles were within the 39 to 40 kHz range, and the call sequence consisted of four lower search phase type pulses and five feeding buzz type pulses. The call sequence was long enough to exhibit many of the characteristics indicative of eastern red bat and not of eastern pipistrelle.

The BBSHHB guild includes the big brown bat, silver-haired bat, and hoary bat. Within this grouping, the hoary bat has easily distinguishable calls characterized by highly variable minimum frequencies often extending below 20 kHz, and a hooked profile similar to the eastern red bat. Calls of silver-haired bats and big brown bats are occasionally distinguishable, but often overlap in range and can be difficult to distinguish, especially when comparing short duration calls typical of those recorded during passive monitoring. Of the nine calls classified as BBSHHB, three exhibited characteristics indicative of silver-haired bat, three where likely hoary bat and one was probably big brown bat. The remaining two calls had characteristics that were not clearly indicative of big brown bat or silver-haired bat; these were clumped into a sub-guild BBSH (big brown bat/silver-haired bat) guild.

Of the 33 total calls recorded at all 4 project detectors, 17 (52%) were classified as unknown, due to their short duration or poor quality. However, these calls were further identified as high frequency or low frequency. For the purposes of this analysis, high frequency call fragments were defined as having a minimum frequency above 30 kHz, and low frequency calls were defined as having a minimum frequency below 30 kHz. Nine of the 17 unknown calls were high frequency call sequences. The high minimum frequency of these calls indicates that they are likely *Myotis* calls or potentially eastern red bat, eastern pipistrelle or, less likely, pulses from a feeding buzz of either big brown bat or silver-haired bat. The low frequency unknown call sequences are definitively not *Myotis* but may be any of the species in the BBSHHB guild, and likely not RBEP.

Differences in detection rates between guilds at the various detectors deployed at Owlhead and Trio Ponds may reflect varying vertical distribution and habitat preferences of bat species. Recent research (Arnett *et al.* 2006) found that small *Myotis* species were more frequently recorded at lower heights while larger species were typically recorded more often at higher heights. In forested habitat, both large and small species were recorded in greater numbers at a medium height of 22 m, rather than at 1.5 m or 44 m. Within the project area *Myotis* activity was greater at the lower detectors (20 m). However, overall higher rates of bat activity were observed at the lower detectors, which were in forest openings. These results seem consistent with the findings of Arnett *et al*. (2006) of greater numbers at heights of 22 m in forested habitat.

Bat activity patterns during migration seem to be related to weather conditions based on mortality studies and acoustic surveys. Acoustic surveys have documented a decrease in bat activity rates as wind speeds increase and temperatures decrease, and bat activity has been shown to correlate negatively to low nightly mean temperatures (Reynolds 2006, Hayes 1997). Similarly, weather factors appeared related to bat collision mortality rates documented at two facilities in the southeastern United States, with mortality rates negatively correlated with both wind speed and relative humidity, and positively correlated to barometric pressure (Arnett 2005). These patterns suggest that bats are more likely to migrate on nights with low wind speeds (less than 4 to 6 m/s) and generally favorable weather (warm temperatures, low humidity, high barometric pressure). There were small negative correlations between temperature and bat activity and wind speed and bat activity. These correlations indicate that the bat activity results observed at the project area are consistent with other similar studies

Bat activity appeared to vary by time of night, with peaks in activity occurring soon after dusk. It is notable that only the two Owlhead detectors recorded call sequences after the seventh hour. However, peak activity in the early evening hours, till about the fifth hour of sampling, was consistent across all detectors. A complete bimodal nighttime distribution of bat activity (by hour) appears to be more typical, and has been documented with peaks occurring in the early morning as well as the early evening, in other studies (Hayes 1997). Anthony *et al*. (1981) documented that bats leave roosting sites at dusk to forage for a given period, return to their roosts during the middle portion of the night, then forage again later in the evening, closer to dawn. It is possible that the relatively small sample size, despite extensive survey effort, yielded results inconsistent with Hayes (1997) and Anthony *et al.* (1981).

Results of acoustic surveys must be interpreted with caution. Considerable room for error exists in identification of bats based upon acoustic calls alone, especially if a site or regionally specific library of recorded reference calls is not available. Also, detection rates are not necessarily correlated with the actual numbers of bats in an area, because it is not possible to differentiate between individual bats. Appendix B Table 4 provides the time that each call file was recorded to help shed light on the nightly timing of bat activity and identify potential repeat detections of individual bats, should that information be desired.

3.5 Conclusions

Detector surveys during the spring migration period have provided information on bat activity in the vicinity of the proposed project. The surveys documented the species that would be expected in the area based on the species' range and abundance, as well as the habitats in the project area. The overall low passage rate of all of the detection data represents that bat activity during the spring migration period is likely low. Nightly detection rates were generally low and peak activity nights occurred before mean nightly temperatures rose consistently above

15ºC. The generally low detection rates seem to be consistent with similar surveys conducted in the northeast, especially in southern Vermont at the Deerfield study area (Table 3-3). It is likely that the fragmented nature of the forested habitat, which is similar in both the Coos County sites and the Deerfield, Vermont sites supports lower levels of bat activity in the spring. Overall, the species composition and detection rates documented in the project area, indicate that there is not necessarily a substantial amount of bat activity in the vicinity of the two met towers.

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Appendix A

Radar Survey Data Tables

Appendix A Table 1. Survey dates, results, level of effort, and weather - Spring 2007

Date	Passage rate	Flight Direction	Flight Height (m)	% below 125 m	Hours of Survey	Temperature (F)	Wind Speed (mph)	Wind Direction (from)
4/26	478	3.338°	583	6%	8	44	3.6	215
4/27	11	26.345°	310	30%	7	40	1.5	300
4/29	324	79.237°	372	11%	8	42	1.7	235
4/30	48	147.368°	81	68%	5	41	1.9	293
5/1	427	74.718°	421	15%	8	39	3.4	350
5/2	194	112.132°	209	26%	9	32	1.7	330
5/3	97	115.947°	289	34%	7	42	4.6	314
5/7	855	60.466°	375	13%	7	38		n/a
5/8	641	75.289°	376	11%	9	52	4	110
5/9	339	120.283°	552	6%	7	54	n/a	n/a
5/10	386	27.881°	423	11%	6	59	4	210
5/11	138	172.879°	369	21%	9	53	7	341
5/12	99	126.477°	341	35%	8	39	4	345
5/13	218	85.573°	217	40%	6	31	10	330
5/14	291	50.406°	346	9%	4	45	8	195
5/15	8	15.094°	444	19%	6	53	4	338
5/18	142	104.073°	233	25%	7	41	4	342
5/19	373	110.491°	305	23%	8	53	4	350
5/20	2	359.847°	223	61%	7	41	7	314
5/21	870	86.68°	194	32%	8	31	4	255
5/22	619	37.505°	469	8%	8	38	4	360
5/23	703	62.957°	304	13%	7	43	n/a	n/a
5/24	705	97.259°	280	18%	8	55	n/a	n/a
5/25	545	98.41°	328	15%	6	57	4	310
5/26	398	106.417°	257	21%	8	47	7	315
5/28	342	93.241°	196	31%	5	55	6	300
5/29	378	84.361°	247	21%	5	42	n/a	n/a
5/30	93	255.447°	392	15%	8	57	4	350
5/31	82	86.77°	442	6%	6	55	5	160
6/1	457	83.528°	377	17%	7	56	4	263

Appendix A Table 2. Summary of passage rates by hour, night, and for entire season.

Night of	Passage Rate (targets/km/hr) by hour after sunset										Entire Night		
	1	2	3	4	5	6	7	8	9	10	Mean	Stdev	SE
4/26	--	616	659	532	657	514	396	236	214	--	478	179	63
4/27	--	--	--	8	32	14	7	13	0	0	11	11	4
4/29	--	--	70	210	536	686	450	357	206	81	324	221	78
4/30	--	--	--	--	--	75	43	54	56	14	48	23	10
5/1	--	329	596	593	557	--	658	350	231	99	427	203	72
5/2	96	332	232	343	316	--	184	225	21	0	194	130	43
5/3	62	80	144	--	107	--	121	--	129	38	97	39	15
5/7	836	737	825	893	898	930	--	864	--		855	63	24
5/8	303	632	814	1016	1029	729	618	500	--	129	641	301	100
5/9	--	295	339	240	346	--	477	546	--	129	339	140	53
5/10	150	784	516	402	386	79	--	--	--	--	386	255	104
5/11	150	268	257	171	221	--	86	64	21	0	138	100	33
5/12	34	116	146	150	214	--	--	107	21	0	99	74	26
5/13	--	113	84	206	171	--	441	291	--	--	218	132	54
5/14	96	364	331	373	--	--	--	--	--	--	291	131	66
5/15	11	25	12	0	0	0	--	--	--	--	8	10	4
5/18	61	207	171	242	182	129	--	--	5	--	142	84	32
5/19	--	729	704	621	364	311	238	--	14	0	373	290	102
5/20	0	6	5	--	--	0	2	--	4	0	2	3	1
5/21	110	631	821	1157	1196	889	--	1029	1125	--	870	362	128
5/22	411	619	659	671	714	814	879	--	186	--	619	224	79
5/23	404	609	801	845	850	--	--	954	462	--	703	212	80
5/24	146	739	907	893	782	657	731	782	--	--	705	241	85
5/25	--	609	621	664	686	625	--	--	64	--	545	237	97
5/26	188	493	525	600	300	546	534	--	0	--	398	213	75
5/28	--	317	417	404	374	--	199	--	--	--	342	89	40
5/29	26	370	444	456	593	--	--	--	--	--	378	213	95
5/30	171	171	174	102	--	43	21	32	29	--	93	70	25
5/31	32	64	116	92	134	--	55	--	--	--	82	39	16
6/1	407	621	693	450	464	304	261	--	--	--	457	156	59
Entire Season	185	403	432	457	466	408	320	400	155	41	**342**	**97**	**18**

-- indicates no data for that hour

Appendix A Table 3. Mean Nightly Flight Direction

Night of	Mean Flight Direction	Circular Stdev
4/26	3.338°	51.094°
4/27	26.345°	62.988°
4/29	79.237°	57.88°
4/30	147.368°	67.07°
5/1	74.718°	62.477°
5/2	112.132°	68.851°
5/3	115.947°	53.385°
5/7	60.466°	22.717°
5/8	75.289°	33.8°
5/9	120.283°	91.54°
5/10	27.881°	51.448°
5/11	172.879°	111.721°
5/12	126.477°	67.92°
5/13	85.573°	38.304°
5/14	50.406°	44.015°
5/15	15.094°	44.509°
5/18	104.073°	87.24°
5/19	110.491°	80.555°
5/20	359.847°	43.653°
5/21	86.68°	27.827°
5/22	37.505°	64.757°
5/23	62.957°	47.371°
5/24	97.259°	36.549°
5/25	98.41°	43.657°
5/26	106.417°	77.514°
5/28	93.241°	45.209°
5/29	84.361°	36.934°
5/30	255.447°	137.003°
5/31	86.77°	30.737°
6/1	83.528°	42.755°
Entire Season	**76°**	**53°**

Appendix A Table 4. Summary of mean flight heights by hour, night, and for entire season.

Night of	Mean Flight Height (m) by hour after sunset										Entire Night			% of targets below 125 meters
	1	2	3	4	5	6	7	8	9	10	Mean	STDV	SE	
4/26	--	503	559	528	577	641	690	--	--	--	583	70	29	6%
4/27	--	117	--	390	--	483	516	--	232	120	310	178	73	30%
4/29	--	--	--	602	487	274	267	338	264	--	372	141	58	11%
4/30	--	--	--	--	--	40.9	100	102	--	--	81	35	20	68%
5/1	--	--	531	503	526	414	--	--	287	267	421	120	49	15%
5/2	--	228	210	217	239	239	--	--	118	--	209	46	19	26%
5/3	--	240	198	--	--	--	184	190	634	--	289	194	87	34%
5/7	329	311	274	284	325	330	--	500	535	490	375	102	34	13%
5/8	315	532	438	353	379	335	279	--	--	--	376	85	32	11%
5/9	--	626	653	642	--	611	558	556	425	347	552	111	39	6%
5/10	250	482	560	429	344	--	--	--	476	--	423	111	45	11%
5/11	188	279	311	316	843	303	345	--	--	--	369	215	81	21%
5/12	137	--	879	616	--	241	441	30	42.8	--	341	319	121	35%
5/13	--	156	--	171	241	203	287	--	269	193	217	50	19	40%
5/14	243	383	361	360	396	--	323	357	--	--	346	51	19	9%
5/15	--	518	548	267	--	--	--	--	--	--	444	154	89	19%
5/18	264	344	179	250	--	--	230	203	161	--	233	61	23	25%
5/19	--	--	381	439	291	404	--	160	153	--	305	125	51	23%
5/20	--	--	330	249	--	--	--	--	90.4	--	223	122	70	61%
5/21	153	303	197	194	181	140	--	--	--	--	194	58	24	32%
5/22	170	608	--	--	--	--	589	505	473	--	469	177	79	8%
5/23	243	397	320	308	283	284	277	316	--	--	304	45	16	13%
5/24	234	328	309	--	260	269	--	--	--	--	280	38	17	18%
5/25	--	436	319	369	310	--	--	251	286	--	328	65	27	15%
5/26	253	279	273	233	245	257	--	--	--	--	257	17	7	21%
5/28	--	248	217	197	--	--	116	201	--	--	196	49	22	31%
5/29	248	266	280	228	203	256	--	--	--	--	247	28	11	21%
5/30	211	274	498	393	424	549	--	--	--	--	392	129	53	15%
5/31	42.5	493	494	491	576	557	--	--	--	--	442	199	81	6%
6/1	298	478	473	398	331	284	--	--	--	--	377	86	35	17%
Entire Season	224	368	392	363	373	327	347	285	296	283	**332**	**110**	**20**	**14%**

-- indicates no data for that hour

Appendix A Table 5. Summary of radar data analysis, ceilometer observations, and weather

Night of	Radar Results				Ceilometer Results			Weather Conditions		
	Possible Bird Targets	Possible Bat Targets	Likely Insects	# of Obs Periods	Birds	Bats	Insects	Temp (F)	Wind Speed (mph)	Wind Direction (from)
4/26	100%	0%	0%	9	0	0	0	44	8	215
4/27	100%	0%	0%	9	0	0	0	40	4	300
4/29	100%	0%	0%	9	0	0	0	42	4	235
4/30	100%	0%	0%	9	0	0	0	41	8	293
5/1	100%	0%	0%	7	0	0	1	39	4	350
5/2	100%	0%	0%	8	0	0	2	32	10	330
5/3	100%	0%	0%	8	0	0	3	42	6	314
5/7	100%	0%	0%	8	0	0	13	38	n/a	n/a
5/8	96%	4%	0%	9	0	0	7	52	4	110
5/9	83%	17%	0%	8	0	0	6	54	n/a	n/a
5/10	91%	9%	0%	8	0	0	1	59	4	210
5/11	100%	0%	0%	8	0	0	2	53	7	341
5/12	100%	0%	0%	8	0	0	0	39	4	345
5/13	100%	0%	0%	7	0	0	4	31	10	330
5/14	100%	0%	0%	8	0	0	0	45	8	195
5/15	100%	0%	0%	5	0	0	4	53	4	338
5/18	99%	1%	0%	8	0	0	0	41	4	342
5/19	100%	0%	0%	8	0	0	0	53	4	350
5/20	100%	0%	0%	8	0	0	0	41	7	314
5/21	100%	0%	0%	8	0	0	0	31	4	255
5/22	100%	0%	0%	8	0	0	0	38	4	360
5/23	100%	0%	0%	8	0	0	0	43	n/a	n/a
5/24	100%	0%	0%	8	0	0	0	55	n/a	n/a
5/25	100%	0%	0%	8	0	0	0	57	4	310
5/26	100%	0%	0%	8	0	0	0	47	7	315
5/28	95%	5%	0%	8	0	0	0	55	6	300
5/29	97%	3%	0%	8	0	0	0	42	n/a	n/a
5/30	53%	47%	0%	8	0	0	0	57	4	350
5/31	79%	21%	0%	8	0	0	0	55	5	160
6/1	91%	9%	0%	8	0	0	0	56	4	263
Total	**98%**	**2%**	**0**	**232**	**0**	**0**	**43**	**46**	**5**	**289**

Appendix B

Bat Detector Survey Data Tables

Appendix B Table 1. Summary of species and weather during each survey night at the Owlhead high detector – Spring 2007

		BIG BROWN GUILD				RBEP		MYSP				UNKN		Wind Speed*	Wind Direction*	Temperature*
Night of	Operated Okay	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	little brown bat	*Myotis spp.*	northern myotis	small-footed myotis	unknown	Total	(m/s)	(degrees)	(C)
4/26/2007	Y												**0**	3.6	215.0	6.5
4/27/2007	Y												**0**	1.6	300.0	4.6
4/28/2007	Y												**0**	1.8	334.3	9.9
4/29/2007	Y												**0**	2.0	235.0	5.4
4/30/2007	Y												**0**	3.5	292.5	4.8
5/1/2007	Y												**0**	1.7	350.0	4.0
5/2/2007	Y												**0**	4.6	330.0	0.3
5/3/2007	Y											1	**1**	2.8	314.0	5.7
5/4/2007	Y												**0**	2.6	310.0	2.1
5/5/2007	Y											5	**5**	2.5	292.9	2.7
5/6/2007	Y												**0**	2.1	265.0	-0.4
5/7/2007	Y												**0**	Calm	Calm	3.3
5/8/2007	Y												**0**	1.6	110.0	10.9
5/9/2007	Y												**0**	Calm	Calm	12.2
5/10/2007	Y												**0**	1.6	210.0	15.3
5/11/2007	Y												**0**	3.3	341.4	11.8
5/12/2007	Y												**0**	1.8	345.0	3.8
5/13/2007	Y												**0**	4.6	330.0	-0.6
5/14/2007	Y												**0**	3.4	195.0	7.4
5/15/2007	Y												**0**	2.0	337.9	11.6
5/16/2007	Y												**0**	1.6	257.0	3.6
5/17/2007	Y												**0**	1.7	118.0	5.2
5/18/2007	Y												**0**	1.7	342.0	4.8
5/19/2007	Y												**0**	1.9	350.0	11.6
5/20/2007	Y												**0**	3.1	314.3	5.3
5/21/2007	Y												**0**	1.6	255.0	-0.3
5/22/2007	Y												**0**	1.6	360.0	3.3
5/23/2007	Y						1						**1**	Calm	Calm	6.0
5/24/2007	Y												**0**	Calm	Calm	12.6
5/25/2007	Y												**0**	1.8	310.0	13.8
5/26/2007	Y												**0**	2.9	315.0	8.5
5/27/2007	Y												**0**	2.1	290.0	11.6
5/28/2007	Y												**0**	2.5	300.0	12.9
5/29/2007	Y												**0**	Calm	Calm	5.8
5/30/2007	Y												**0**	1.6	350.0	14.1
5/31/2007	Y												**0**	2.1	160.0	12.7
6/1/2007	Y				1								**1**	1.8	262.5	13.1
By Species		**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**6**	**8**	* Weather data from these nights were obtained online at www.weatherunderground.com		
By Guild		**1**				**1**		**0**				**6**				
		BIG BROWN GUILD				**RBEP**		**MYSP**				**UNKN**	**Total**			

n/o - indicates that detector was not operating on that night

Appendix B Table 2. Summary of species and weather during each survey night at the Owlhead low detector – Spring 2007

		BIG BROWN GUILD				RBEP		MYSP				UNKN		Wind Speed	Wind Direction	Temperature
Night of	Operated Okay	big brown bat	hoary bat	silver-haired bat	silver-haired/big brown	eastern pipistrelle	eastern red bat	little brown bat	*Myotis spp.*	northern myotis	small-footed myotis	unknown	Total	(m/s)	(degrees)	(C)
4/30/2007	Y												**0**	3.5	292.5	4.8
5/1/2007	Y												**0**	1.7	350.0	4.0
5/2/2007	n/o												**0**	4.6	330.0	0.3
5/3/2007	n/o												**0**	2.8	314.0	5.7
5/4/2007	n/o												**0**	2.6	310.0	2.1
5/5/2007	n/o												**0**	2.5	292.9	2.7
5/6/2007	n/o												**0**	2.1	265.0	-0.4
5/7/2007	n/o												**0**	Calm	Calm	3.3
5/8/2007	n/o												**0**	1.6	110.0	10.9
5/9/2007	n/o												**0**	Calm	Calm	12.2
5/10/2007	n/o												**0**	1.6	210.0	15.3
5/11/2007	Y												**0**	3.3	341.4	11.8
5/12/2007	Y												**0**	1.8	345.0	3.8
5/13/2007	Y												**0**	4.6	330.0	-0.6
5/14/2007	n/o												**0**	3.4	195.0	7.4
5/15/2007	n/o												**0**	2.0	337.9	11.6
5/16/2007	n/o												**0**	1.6	257.0	3.6
5/17/2007	n/o												**0**	1.7	118.0	5.2
5/18/2007	n/o												**0**	1.7	342.0	4.8
5/19/2007	Y												**0**	1.9	350.0	11.6
5/20/2007	Y												**0**	3.1	314.3	5.3
5/21/2007	Y												**0**	1.6	255.0	-0.3
5/22/2007	Y								2				**2**	1.6	360.0	3.3
5/23/2007	Y												**0**	Calm	Calm	6.0
5/24/2007	Y	1											**1**	Calm	Calm	12.6
5/25/2007	Y												**0**	1.8	310.0	13.8
5/26/2007	Y												**0**	2.9	315.0	8.5
5/27/2007	Y												**0**	2.1	290.0	11.6
5/28/2007	Y												**0**	2.5	300.0	12.9
5/29/2007	Y												**0**	Calm	Calm	5.8
5/30/2007	Y												**0**	1.6	350.0	14.1
5/31/2007	Y												**0**	2.1	160.0	12.7
6/1/2007	Y		1		1								**2**	1.8	262.5	13.1
By Species		**1**	**1**	**0**	**1**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**5**	* Weather data from these nights were obtained online at www.weatherunderground.com		
By Guild		**3**				**0**		**2**				**0**				
		BIG BROWN GUILD				**RBEP**		**MYSP**				**UNKN**	**Total**			

n/o - indicates that detector was not operating on that night

Appendix B Table 3. Summary of species and weather during each survey night at the Trio Ponds high detector – Spring 2007

		BIG BROWN GUILD				**RBEP**		**MYSP**				**UNKN**		**Wind Speed**	**Wind Direction**	**Temperature**
Night of	**Operated Okay**	**big brown bat**	**hoary bat**	**silver-haired bat**	**silver-haired/big brown**	**eastern pipistrelle**	**eastern red bat**	**little brown bat**	***Myotis spp.***	**northern myotis**	**small-footed myotis**	**unknown**	**Total**	(mph)	(degrees)	(C)
4/28/2007	Y												**0**	4.0	334.3	9.9
4/29/2007	Y												**0**	4.4	235.0	5.4
4/30/2007	Y												**0**	7.7	292.5	4.8
5/1/2007	Y												**0**	3.9	350.0	4.0
5/2/2007	Y												**0**	10.4	330.0	0.3
5/3/2007	Y												**0**	6.3	314.0	5.7
5/4/2007	Y												**0**	5.8	310.0	2.1
5/5/2007	Y												**0**	5.7	292.9	2.7
5/6/2007	Y												**0**	4.7	265.0	-0.4
5/7/2007	Y												**0**	Calm	Calm	3.3
5/8/2007	Y												**0**	3.5	110.0	10.9
5/9/2007	Y												**0**	Calm	Calm	12.2
5/10/2007	Y												**0**	3.5	210.0	15.3
5/11/2007	Y												**0**	7.3	341.4	11.8
5/12/2007	Y												**0**	4.1	345.0	3.8
5/13/2007	Y												**0**	10.4	330.0	-0.6
5/14/2007	Y												**0**	7.5	195.0	7.4
5/15/2007	Y												**0**	4.4	337.9	11.6
5/16/2007	Y												**0**	3.6	257.0	3.6
5/17/2007	Y												**0**	3.7	118.0	5.2
5/18/2007	Y												**0**	3.7	342.0	4.8
5/19/2007	Y												**0**	4.2	350.0	11.6
5/20/2007	Y												**0**	6.9	314.3	5.3
5/21/2007	Y												**0**	3.5	255.0	-0.3
5/22/2007	Y								1			1	**2**	3.5	360.0	3.3
5/23/2007	Y			1								2	**3**	Calm	Calm	6.0
5/24/2007	Y											1	**1**	Calm	Calm	12.6
5/25/2007	Y												**0**	4.1	310.0	13.8
5/26/2007	Y												**0**	6.5	315.0	8.5
5/27/2007	Y											1	**1**	4.6	290.0	11.6
5/28/2007	Y												**0**	5.7	300.0	12.9
5/29/2007	Y												**0**	Calm	Calm	5.8
5/30/2007	Y			1									**1**	3.5	350.0	14.1
5/31/2007	Y												**0**	4.6	160.0	12.7
6/1/2007	Y												**0**	4.1	262.5	13.1
By Species		**0**	**0**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**5**	**8**	* Weather data from these nights were obtained online at www.weatherunderground.com		
By Guild		**2**				**0**		**1**				**5**				
		BIG BROWN GUILD				**RBEP**		**MYSP**				**UNKN**	**Total**			

n/o - indicates that detector was not operating on that night

Appendix B Table 4. Summary of species and weather during each survey night at the Trio Ponds low detector – Spring 2007

		BIG BROWN GUILD				RBEP		MYSP				UNKN		Wind Speed	Wind Direction	Temperature
Night of	**Operated Okay**	**big brown bat**	**hoary bat**	**silver-haired bat**	**silver-haired/big brown**	**eastern pipistrelle**	**eastern red bat**	**little brown bat**	***Myotis spp.***	**northern myotis**	**small-footed myotis**	**unknown**	**Total**	(mph)	(degrees)	(C)
28-Apr	Y												**0**	4.0	334.3	9.9
29-Apr	Y												**0**	4.4	235.0	5.4
30-Apr	Y												**0**	7.7	292.5	4.8
1-May	Y											2	**2**	3.9	350.0	4.0
2-May	Y												**0**	10.4	330.0	0.3
3-May	Y												**0**	6.3	314.0	5.7
4-May	Y												**0**	5.8	310.0	2.1
5-May	Y												**0**	5.7	292.9	2.7
6-May	Y								1				**1**	4.7	265.0	-0.4
7-May	Y				1								**1**	Calm	Calm	3.3
8-May	Y												**0**	3.5	110.0	10.9
9-May	Y												**0**	Calm	Calm	12.2
10-May	Y												**0**	3.5	210.0	15.3
11-May	Y												**0**	7.3	341.4	11.8
12-May	Y												**0**	4.1	345.0	3.8
13-May	Y												**0**	10.4	330.0	-0.6
14-May	Y		1										**1**	7.5	195.0	7.4
15-May	Y												**0**	4.4	337.9	11.6
16-May	Y												**0**	3.6	257.0	3.6
17-May	Y												**0**	3.7	118.0	5.2
18-May	Y												**0**	3.7	342.0	4.8
19-May	Y											1	**1**	4.2	350.0	11.6
20-May	Y												**0**	6.9	314.3	5.3
21-May	Y												**0**	3.5	255.0	-0.3
22-May	Y				1				1				**2**	3.5	360.0	3.3
23-May	Y							1				1	**2**	Calm	Calm	6.0
24-May	Y												**0**	Calm	Calm	12.6
25-May	Y												**0**	4.1	310.0	13.8
26-May	Y												**0**	6.5	315.0	8.5
27-May	Y												**0**	4.6	290.0	11.6
28-May	Y												**0**	5.7	300.0	12.9
29-May	Y												**0**	Calm	Calm	5.8
30-May	Y												**0**	3.5	350.0	14.1
31-May	Y												**0**	4.6	160.0	12.7
1-Jun	Y											2	**2**	4.1	262.5	13.1
By Species		**0**	**1**	**0**	**2**	**0**	**0**	**1**	**2**	**0**	**0**	**6**	**12**	* Weather data from these nights were obtained online at www.weatherunderground.com		
By Guild		**3**				**0**		**3**				**6**				
		BIG BROWN GUILD				**RBEP**		**MYSP**				**UNKN**	**Total**			

n/o - indicates that detector was not operating on that night

Appendix B Table 5. Call sequences at all detectors - Spring 2007

Filename	Date (night of)	Time	Site	Detector	Guild	Species
H5012304.45#	5/1/07	23:04	Trio Ponds	Low	UNKN	HFUN
H5012304.45#	5/1/07	23:04	Trio Ponds	Low	UNKN	HFUN
H5031904.28#	5/3/07	19:04	Owlhead	High	UNKN	HFUN
H5052032.26#	5/5/07	20:32	Owlhead	High	UNKN	HFUN
H5052032.42#	5/5/07	20:32	Owlhead	High	UNKN	HFUN
H5052058.04#	5/5/07	20:58	Owlhead	High	UNKN	HFUN
H5052105.30#	5/5/07	21:05	Owlhead	High	UNKN	HFUN
H5052105.51#	5/5/07	21:05	Owlhead	High	UNKN	HFUN
H5062102.57#	5/6/07	21:02	Trio Ponds	Low	MYSP	MYSP
H5072308.29#	5/7/07	23:08	Trio Ponds	Low	BBSHHB	BBSH
H5142045.57#	5/14/07	20:45	Trio Ponds	Low	BBSHHB	LACI
H5192325.23#	5/19/07	23:25	Trio Ponds	Low	UNKN	LFUN
H5222230.30#	5/22/07	22:30	Owlhead	Low	MYSP	MYSP
H5222241.35#	5/22/07	22:41	Owlhead	Low	MYSP	MYSP
H5222302.16#	5/22/07	23:02	Trio Ponds	Low	BBSHHB	BBSH
H5222146.40#	5/22/07	21:46	Trio Ponds	Low	MYSP	MYSP
H5222241.41#	5/22/07	22:41	Trio Ponds	High	UNKN	LFUN
H5222151.12#	5/22/07	21:51	Trio Ponds	High	MYSP	MYSP
H5232259.48#	5/23/07	22:59	Owlhead	High	RBEP	LABO
H5232257.15#	5/23/07	22:57	Trio Ponds	Low	UNKN	LFUN
H5232208.40#	5/23/07	22:08	Trio Ponds	Low	MYSP	MYLU
H5232213.12#	5/23/07	22:13	Trio Ponds	High	unkn	HFUN
H5232301.50#	5/23/07	23:01	Trio Ponds	High	BBSHHB	LANO
H5232129.10#	5/23/07	21:29	Trio Ponds	High	UNKN	LFUN
H5242147.39#	5/24/07	21:47	Owlhead	Low	BBSHHB	EPFU
H5250156.42#	5/24/07	1:56	Trio Ponds	High	UNKN	LFUN
H5272331.08#	5/27/07	23:31	Trio Ponds	High	UNKN	LFUN
H5302203.35#	5/30/07	22:03	Trio Ponds	High	BBSHHB	LANO
H6020337.41#	6/1/07	3:37	Owlhead	Low	BBSHHB	BBSH
H6012345.33#	6/1/07	23:45	Owlhead	Low	BBSHHB	LACI
H6020336.16#	6/1/07	3:36	Owlhead	High	BBSHHB	BBSH
H6012147.19#	6/1/07	21:47	Trio Ponds	Low	UNKN	LFUN
H6020017.27#	6/1/07	0:17	Trio Ponds	Low	UNKN	LFUN