Appendix 14-3
2008 and 2009 Ecological Survey Reports

Fall 2008 Bird and Bat Migration Survey Report

Radar and Acoustic Avian and Bat Surveys for the
Highland Wind Project
Highland Plantation, Maine

February 2009 (Revised September 2010)

Prepared for

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Executive Summary

Highland Wind LLC (Highland) has proposed to construct a 128.6-megawatt (MW) wind energy project located in Highland Plantation and Pleasant Ridge Plantation, Somerset County, Maine (Figure 1-1). The Highland Wind Project (Project) includes 48 turbines, a 34.5 kV electrical collector system, an electrical collection substation, a 115 kV generator lead, an Operations and Maintenance (O&M) Building, and permanent meteorological towers.

The turbines will be located in two distinct strings. The western string will include 26 turbines located on the ridgeline that connects Stewart Mountain, Witham Mountain and Bald Mountain. The meteorological data collected on this ridgeline suggests that weather conditions can be extreme and that the wind resource is excellent. These conditions require a Class I turbine and the Project has opted to use Vestas V90 3 MW turbines in most of the 26 turbine locations along the western string. The Vestas turbines have an 80 meter (m) hub height, a 90 m rotor diameter and a maximum tip-of-blade height of 125 m. The eastern string will include 22 turbines extending from the northeastern end of Burnt Hill south to Briggs Hill. Because of a more moderate wind capacity, Siemens SWT-2.3-101 turbines will be used along the eastern string to maximize energy output. These turbines have an 80 m hub height, a 101 m rotor diameter and a maximum tip-of-blade height of 130.5 m. Turbines will be located at elevations between 1550 and 2670 feet above sea level.

The electrical collector system will transfer power from the turbines to the proposed collector substation located north of Witham Mountain. These collector lines will be located underground along the ridgeline to reduce the project footprint and to reduce potential line maintenance costs along the exposed ridges. The approximately 11 mile long 115 kV generator lead will connect the on-site collector station to the existing Wyman Dam substation located in Moscow, Maine, where power will be transferred to the Central Maine Power (CMP) system and ultimately distributed to the New England grid.

In planning for this Project, Highland Wind contracted with Stantec Consulting (Stantec) to perform a variety of environmental surveys. In 2008, Stantec conducted surveys to document nocturnal and diurnal biological activity focusing on avian and bat populations.

Nocturnal Radar Survey

The fall 2008 field survey targeted 20 nights from August 30 to October 7, 2008. 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 was located on a small knoll of a ridge. The site provided good visibility of the surrounding airspace and targets were observed in most areas of the radar display unit. The radar site provided excellent visibility and, therefore, the radar was capable of detecting targets within nearly all of its detection range.

Radar surveys are intended to document several variables determinant of nocturnal migration and biological activity within the Project area: passage rates, flight heights, and flight direction. The overall seasonal average was 549 targets per kilometer per hour (t/km/hr). Nightly passage rates varied from 68 t/km/hr on October 7.to 1201 t/km/h on September 15. Passage rates varied greatly between nights during the season, indicating migration occurred in pulses, with rates of migration likely influenced by weather patterns and conditions from night to night. Whereas, flight heights remained fairly consistent both throughout the survey period and in comparison with other seasons, suggesting a similar "use" of the airspace above the ridgeline by nocturnal migrants in both seasons. The seasonal average flight height was 348 ± 8 m (1142 ± 26') above the radar site. The average nightly flight height ranged from 250 m (820') on September 16 to 531 m (1742') on October 6. Flight heights indicate that the percentage of targets flying below 130.5 m (428') ranged from 4 to 28 percent with a seasonal average of 17 percent. Mean flight direction through the Project area was southwesterly at 227° ± 51.

Fall radar surveys at the Project documented patterns in nocturnal migration similar to those documented at most recent radar surveys. These include highly variable passage rates between nights, a generally southwestward flight direction, and flight heights primarily occurring between 200 and 600 m above the ridgeline. Within nights, migration activity was generally greatest two to four hours after sunset and declined steadily through the end of the night. While comparisons between radar studies are vague at best due to the variability of site circumstances, studies performed in similar regions, habitats, and at equivalent levels of effort to those at the Project do reveal consistent patterns in nocturnal migratory activity.

Bat Acoustic Survey

The fall 2008 field survey used Anabat detectors from August to October in order to document bat activity patterns near the rotor zone of the proposed turbines, at an intermediate height, and near the ground within the proposed Project area.

Surveys were conducted from August 11 to October 20, 2008 using six Anabat detectors. During August, six detectors were placed in trees in various locations in the Project area. When meteorological measurement (met) towers were erected in early September, the previously deployed detectors were moved to the three met towers locations. A total of 11,583 ultrasound bat calls were recorded over 360 detector-nights (mean [$\bar{x}$] = 20.8 ± 1.4 SE recordings/detector/night [r/d/n]). Detection rates at tree detectors were generally higher ($\bar{x}$ = 14.8 ± 1.0 r/d/n), than detection rates at the met tower detectors ($\bar{x}$ = 3.0 ± 0.6 r/d/n). Increased detection rates at met tower detectors in September and October was largely attributed to Lasiurine species (i.e., eastern red bat (*Lasiurus borealis*) and hoary bat (*L. cinereus*).

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 the uncertainty in the ability of frequency division detectors to adequately provide information for this differentiation. The majority of calls were identified as belonging to the *Myotis* guild (*n* = 6,521; 56.3%), or were categorized as Unknown because they could not be identified to species (n =

4,909; 42.4%). Less than 1% of calls were identified as belonging to the big brown/silver-haired/hoary bat guild (*n* = 112) red bat/tri-colored guild (*n* = 28), or hoary bat guild (n = 13).

When considering the level of activity documented in the Project area from August to October, it is important to acknowledge that numbers of recorded bat call sequences are not necessarily correlated with number of bats in an area. Acoustic detectors do not allow for differentiation between a single bat making multiple passes and multiple bats each recorded a single time.

Diurnal Raptor Survey

The fall 2008 field survey included 15 survey days (five of which were performed simultaneously by two surveyors in two different locations) totaling 135 hours of fall diurnal raptor migration surveys between September 3 and October 31, 2008 from Witham Mountain and Burnt Hill, to document the number and species of raptors migrating above the Project area, as well as flight height, general direction and flight path, and other notable flight behaviors.

During 2008 fall surveys, a total of 301 raptors representing 10 species were observed, yielding an overall observation rate of 2.25 individuals/hour. Broad-winged hawks (*Buteo platypterus*) were the most commonly observed raptor (n=134, 45%), sharp-shinned hawks (*Accipiter striatus*) the second, representing 25 percent of all observations (n=74), and turkey vultures (*Cathartes aura*) were the third, accounting for 7 percent of all observations (n=20). There were four bald eagle (*Haliaeetus leucocephalus*), currently listed as a State Threatened species in Maine, observations over the Project area on September 16 and 22 and October 7 and 15, 2008.

The majority of individuals observed during raptor surveys were believed to be migrant birds. Migrating raptors were generally observed moving directly in a southerly direction, parallel to the ridgeline or directly above the ridge; whereas, resident birds were generally observed circling, perching, or foraging over the ridgeline or adjacent valleys. Of those raptors observed within the 1 km-radius circle from the observer (n=251), 43 percent were flying less than or equal to 130.5 m above the ground for at least a portion of their flight through the Project area. The average estimated flight height of those birds observed outside of the 1 km-radius circle from the observer is 286 m (938') above ground.

Raptor activity in the Project during fall 2008 was similar to passage rates observed in the region in recent years. The flight paths of raptors observed in the Project area varied between survey dates and were influenced by varying wind direction and weather. The greater occurrence of migrants at low altitudes increases the potential for migrating raptors to come into the vicinity of the proposed wind turbines. However, raptors have demonstrated high collision turbine avoidance behaviors and relatively low collision mortality at existing wind farms in the region.

Table of Contents

Tables

Figures

Appendices

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1.0 Introduction

Highland Wind LLC (Highland) has proposed to construct a 128.6-megawatt (MW) wind energy project located in Highland Plantation and Pleasant Ridge Plantation, Somerset County, Maine (Figure 1-1). The Highland Wind Project (Project) includes 48 turbines, a 34.5 kV electrical collector system, an electrical collection substation, a 115 kV generator lead, an Operations and Maintenance (O&M) Building, and permanent meteorological towers.

The turbines will be located in two distinct strings. The western string will include 26 turbines located on the ridgeline that connects Stewart Mountain, Witham Mountain and Bald Mountain. The meteorological data collected on this ridgeline suggests that weather conditions can be extreme and that the wind resource is excellent. These conditions require a Class I turbine and the Project has opted to use Vestas V90 3 MW turbines in most of the 26 turbine locations along the western string. The Vestas turbines have an 80 meter (m) hub height, a 90 m rotor diameter and a maximum tip-of-blade height of 125 m. The eastern string will include 22 turbines extending from the northeastern end of Burnt Hill south to Briggs Hill. Because of a more moderate wind capacity, Siemens SWT-2.3-101 turbines will be used along the eastern string to maximize energy output. These turbines have an 80 m hub height, a 101 m rotor diameter and a maximum tip-of-blade height of 130.5 m[1]. Turbines will be located at elevations between 1,550 and 2,670 feet above sea level.

The electrical collector system will transfer power from the turbines to the proposed collector substation located north of Witham Mountain. These collector lines will be located underground along the ridgeline to reduce the project footprint and to reduce potential line maintenance costs along the exposed ridges. The approximately 11 mile long 115 kV generator lead will connect the on-site collector station to the existing Wyman Dam substation located in Moscow, Maine, where power will be transferred to the Central Maine Power (CMP) system and ultimately distributed to the New England grid.

In planning for this Project, Highland Wind contracted with Stantec Consulting (Stantec) to perform a variety of environmental surveys to characterize bird and bat activity within the Project area. This work included nocturnal radar surveys, acoustic bat surveys, and diurnal raptor surveys to help assess the Project's potential to impact birds and bats. The scope of the surveys was based on a combination of developing standard methods within the wind power industry for pre-construction surveys, guidelines outlined by U.S. Fish and Wildlife Service (USFWS) and Maine Department of Inland Fisheries and Wildlife (MDIFW), and is consistent with other studies conducted recently in the state and the Northeast. The surveys and methods used were briefly discussed with staff from MDIFW at a meeting in Sidney, Maine on September 11, 2008.

Following is a brief description of the Project; a review of the methods used to conduct scientific surveys and the results of those surveys; a discussion of results; and the conclusions reached based on those results.

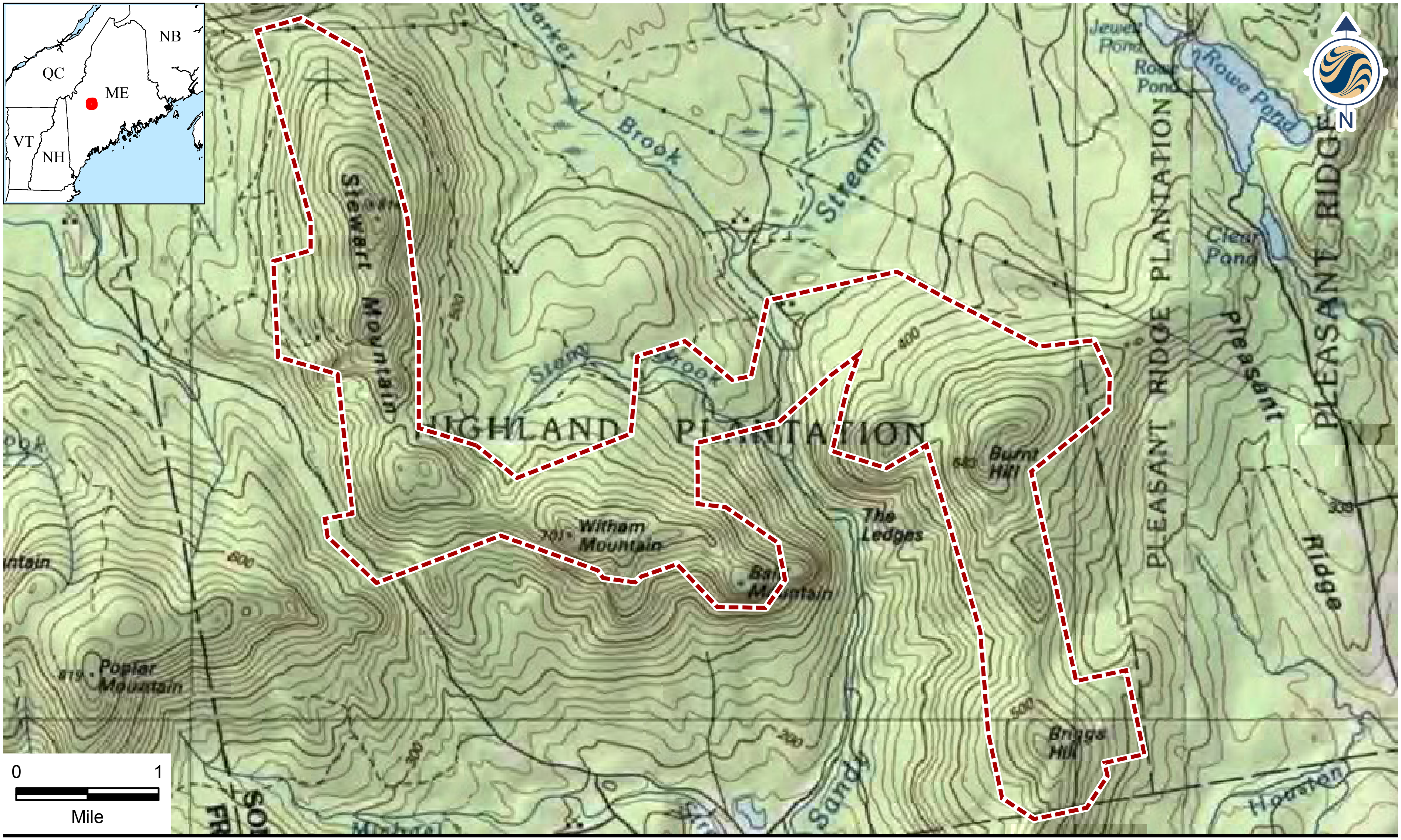
[1] Initial Project design included turbines with a maximum height of 128 m., This has changed with additional information about site wind conditions.

1.1 PROJECT AREA DESCRIPTION

The Project area is located within the Central and Western Mountains Ecoregion as defined in *Maine's Comprehensive Wildlife Conservation Strategy* (MDIFW 2005). This ecoregion is a consolidation of the Western Mountains and Central Mountains biophysical regions originally described by McMahon (1990). The Central and Western Mountains Ecoregion extends from the New Hampshire boarder south the White Mountains National Forest, north to Aroostook County and east to the western foothills. The average elevation within the western portion of the ecoregion (former Western Mountain Biophysical Region) is between approximately 305 m to 610 m (1,000' to 2,000') with several peaks exceeding 823 m (2,700'). The northern portion of this ecoregion includes some of the highest peaks in the state and has elevations that range from 183 m to 1,603 m (600' to 5,258'). The climate of this ecoregion is characterized by relatively low annual precipitation and cool temperatures. Heavy snow fall prolongs the winter resulting in a relatively short growing season (McMahon 1990). In general, ridge tops within this ecoregion are dominated by red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*) with lower elevations supporting deciduous species such as sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*) and American beech (*Fagus grandifolia*).

The Project area is located primarily within land managed by Wagner Forest Management, Ltd. These include Stewart Mountain, Witham Mountain, Bald Mountain Briggs Hill and Burnt Hill. Stewart Mountain represents the western boundary of the project and Briggs and Burnt Hill represent the eastern boundary. These two ridgelines are separated by Sandy Stream Valley. The northern end of Stewart Mountain is the highest in elevation reaching 817 m (2,680') and decreases southward to 671 m (2,200'). Witham Mountain is the next highest in elevation reaching nearly 701 m (2,300'); the remaining ridgelines heights are approximately 671 m (2,200') and lower.

Due to its relatively low elevation, the vegetation in the Project area is dominantly northern hardwood species and includes: sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), and American beech (*Fagus randifolia*). Red spruce (*picea rubens*) and balsam fir (*Abies balsamea*) are present primarily on those ridge tops that exceed approximately 610 m (2,000'). Historically and presently, the land within and surrounding the Project area, including the summits of the ridgelines, have been used for commercial timber management. This is evident by the recent and past cuts as well as the presence of the network of haul roads that extend through the Project area. These forest management operations have resulted in a variation of forest age classes.



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Legend

Approximate Project Area

Client/Project

Highland Wind, LLC
Highland Wind Project
Highland Plantation, Maine

Figure No.

1

Title

Project Location Map
October 27, 2009

1.2 SURVEY OVERVIEW

Stantec conducted field surveys for bird and bat migration during fall 2008. The overall goals of the investigations were to document:

- passage rates for nocturnal migration in the vicinity of the Project area, including the number of migrants, their flight direction, and their flight altitude;
- species composition and activity patterns of bats within the Project area including the rate of occurrence and relationship with weather factors and;
- passage rates and species composition of raptors migrating through the Project area;

The following sections outline the survey methodology and results contributing toward the achievement of survey goals. Discussion of survey results and subsequent conclusions follow each section.

2.0 Nocturnal Radar Survey

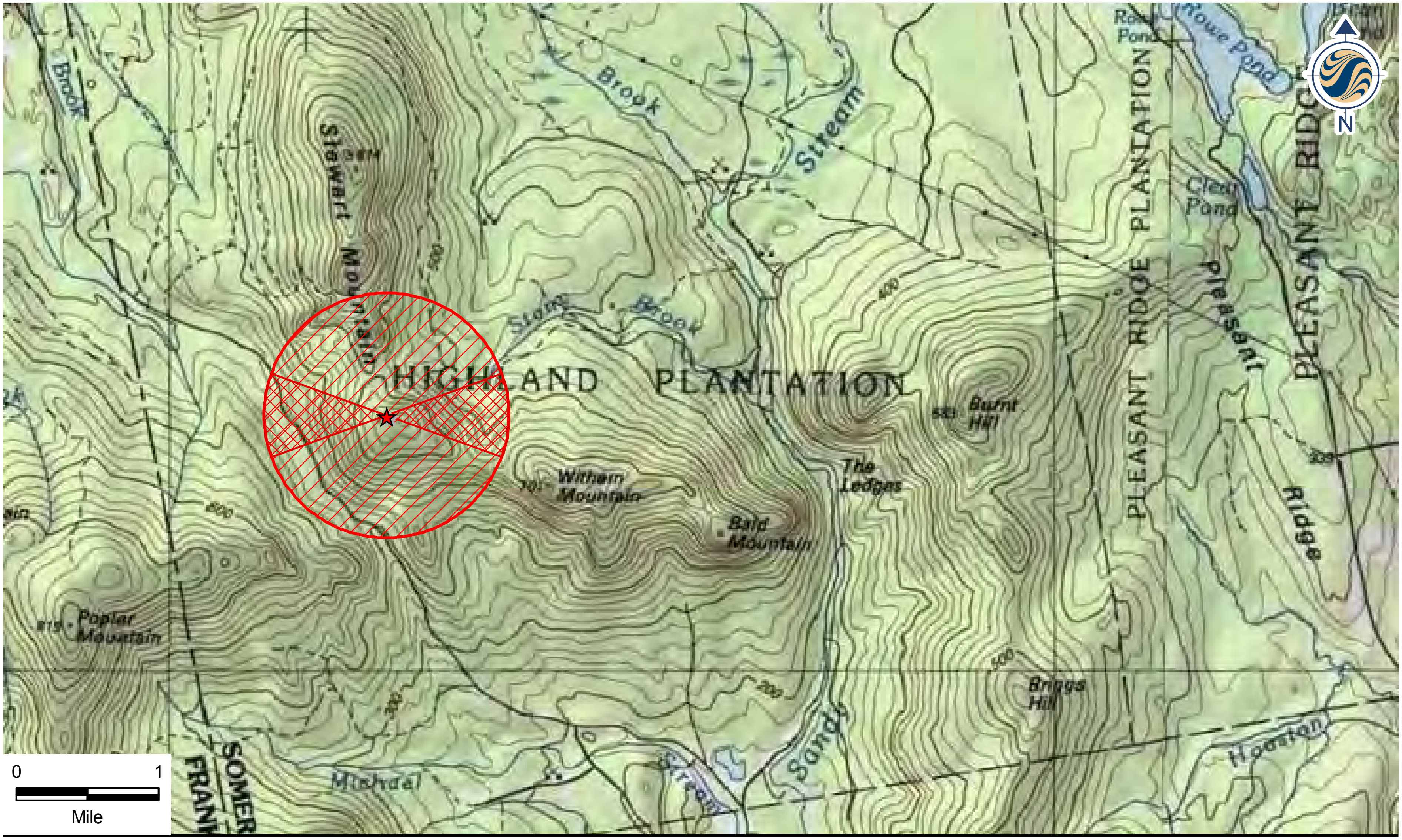
2.1 INTRODUCTION

Nocturnal radar surveys were conducted in the Project area to characterize fall 2008 nocturnal migration patterns. The majority of North American passerines (songbirds) migrate at night, unlike raptors that use rising day time thermals during migration. Raptors soaring flight uses the laminar flow of air over the landscape, which creates updrafts along hillsides and ridgelines. In contrast, passerines may have evolved to take advantage of more stable nighttime atmospheric conditions for their flapping flight (Kerlinger 1995). Nighttime migration during the cooler nighttime temperatures also may provide passerines a more efficient method of regulating body temperature during more active, flapping flight and reduce the risk of predation (Alerstam 1990, Kerlinger 1995). Therefore, while raptor migration can be documented by visual daytime (diurnal) surveys, documenting the patterns of nocturnal migrants such as passerines and bats requires the use of radar or other non-visual technologies. 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

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 kilowatts (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 the types of animals or species of animals that are detected. Consequently, all animals observed on the radar screen were identified as bird/bat targets or insect “targets” based on their flight speeds. The radar has an “echo trail” function which captures past echoes of flight trails, enabling determination of flight direction and flight speed. Flight speed was further analyzed to compensate for wind speed and direction. 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 with a vertical beam height of 20° (10° above and below horizontal).

The radar study was conducted from the southern summit of Stewart Mountain at an elevation of approximately 671 m (2200') (Figure 2-1). Objects on the ground (e.g., trees and hillsides) detected by the radar cause returns on the radar screen (echoes) that appear as blotches called ground clutter (Figures 2-2 and 2-3). Large amounts of ground clutter reduce the ability of the radar to track targets flying over those areas. Therefore, efforts were made to maximize the airspace sampled by elevating the antennae to the height of the surrounding trees, approximately 3 m (10') , thus reducing the amount of the radar beam reflected back from surrounding vegetation or hillsides to the center of the radar screen (Figures 2-3 and 2-4).



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Legend

- Radar Location
- Horizontal Radar Detection Range
- Alignment Vertical Radar Sweep

Client/Project

Highland Wind, LLC
Highland Wind Project
Highland Plantation, Maine

Figure No.

2-1

Title

Radar Location Map
November 5, 2009

00385-F201-Radar-Location-Map.mxd

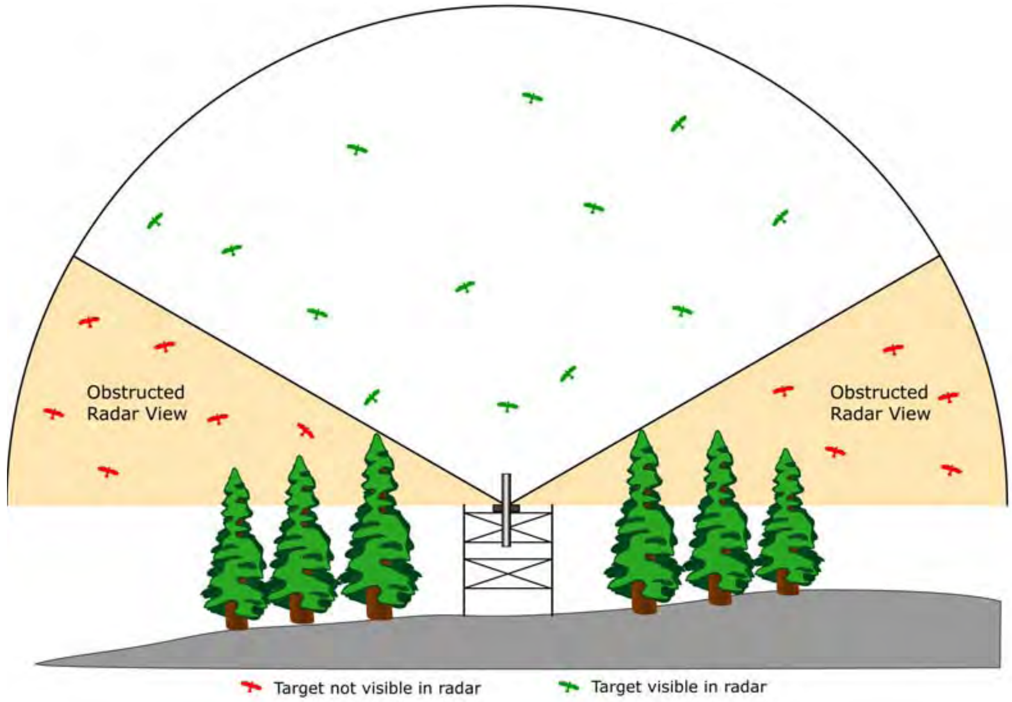
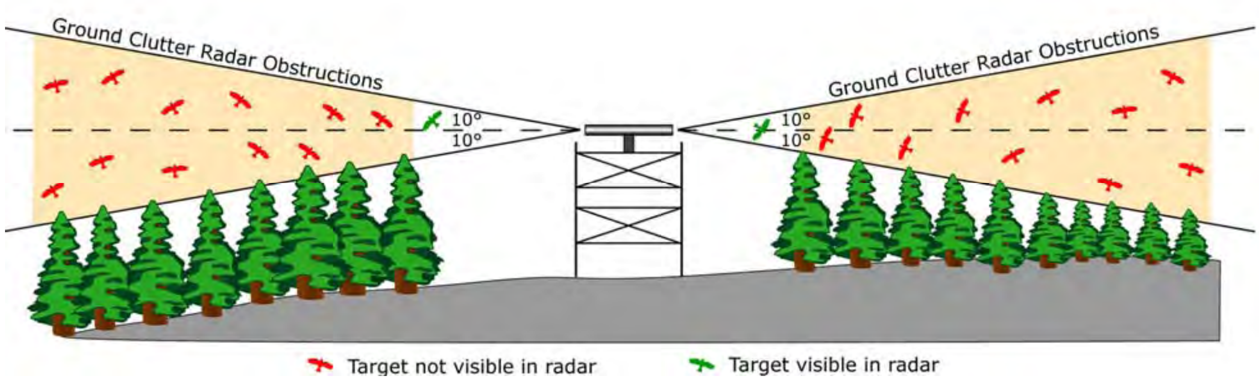


Figure 2-2. Examples of surrounding vegetation that causes "ground clutter" obstructions in vertical mode (top) and horizontal mode (bottom). Although the radar records three-dimensional space, it translates ground clutter on the radar screen into a two dimensional representation, which can cause targets to be obscured from view.



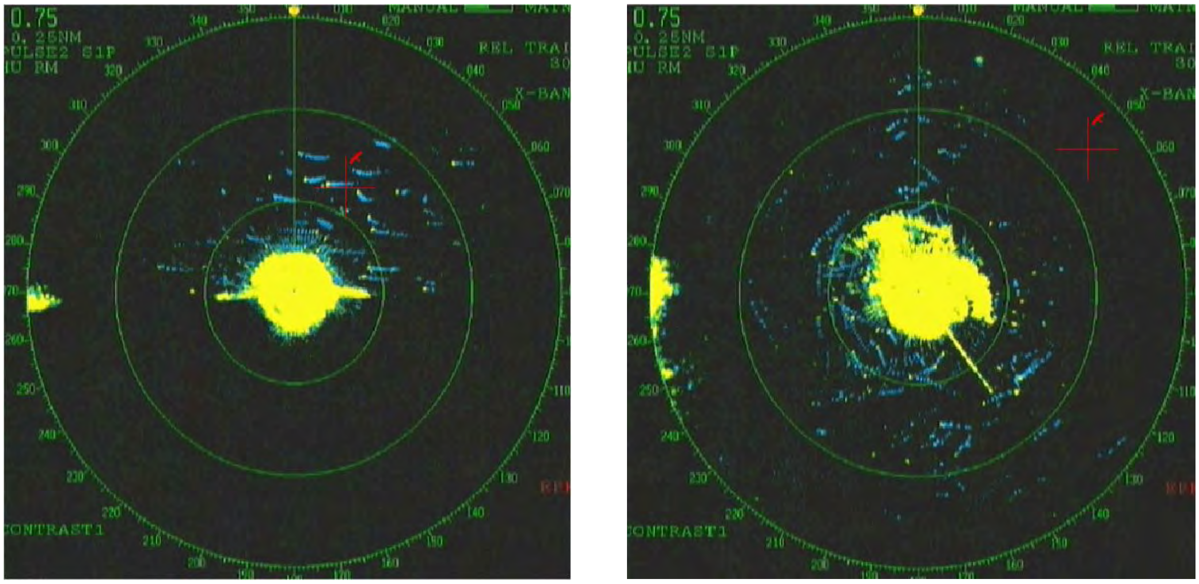


Figure 2-3. Radar Screenshot showing ground clutter (yellow). Note the ground clutter is restricted to the center of the radar screen (*left – vertical mode; right – horizontal mode*). Proper site selection can reduce ground clutter to the center of the radar screen, so that the majority of the two-dimensional radar screen remains relatively uncluttered, allowing targets to be tracked as they both enter and leave the cluttered area.

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 2-3 and 2-4).

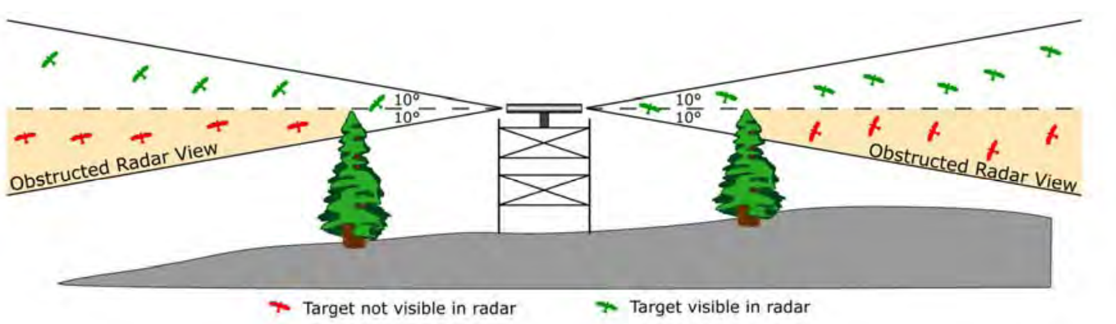


Figure 2-4. Positioning of radar near potential ground clutter can reduce or "hide" clutter-causing objects from the radar.

The irregular shape of the ground clutter shown on the horizontal screen shot (*right*) in Figure 2-3 is caused from the lower 10 degrees of the radar beam, as depicted in Figure 2-4, detecting the shape of the met tower opening until it reaches the surrounding tree-line. Once at the tree line the lower 10 degree portion of the 20 degree beam is stopped, allowing for a clear view of the airspace above tree-line up to a height of approximately 245 meters (203'). The area of ground clutter to the west (Figure 2-3) is a result of the radar beam detecting the eastern slope of Poplar Mountain across the valley nearly 1.4 km away.

The radar at this location (Figure 2-1) afforded coverage of the Stewart Mountain ridgeline to the north as well as Witham Mountain to the east. The goal of this particular location was to document nocturnal migration activity along these ridges as well as the saddle between them. This location also provided coverage of the valley west of Stewart Mountain which is bisected by the Long Falls Dam Road. The radar site, at an elevation of 671 m (2,200') and elevated even with the surrounding tree height provided excellent sampling of the airspace within 0.75 nautical miles (1.4 km, 4,557') of the site. One hundred percent of all quadrants were visible on the radar screen. In vertical mode views 5 degrees below the horizon to the west into the valley below were attainable due to low tree heights and steep topography on the western side of the radar location on south Stewart Mountain (Figure 2-1).

Radar surveys were conducted from sunset to sunrise, and were scheduled to occur on 20 nights between August 30 and October 7. Because the anti-rain function of the radar must be turned down to detect small songbirds and bats, surveys could not be conducted during active rainfall. Therefore, surveys were planned 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, mist, or fog were sampled.

The radar was operated in two modes throughout the course of each night. In surveillance mode, the antenna spins horizontally to survey the airspace around the radar and detects the number of targets and their flight direction as they pass within .75 NM (1.4 km; the radar viewshed) surrounding the radar (Figure 2-3 and 2-4). At this range, the echoes of small birds can be easily detected, observed, and tracked. At greater ranges, larger targets can be detected, but the echoes of small birds are reduced in size and restricted to a smaller portion of the radar screen, thus limiting the ability to observe the movement pattern of individual targets. By analyzing the echo trail, the flight direction and flight speed of targets can be determined. In vertical mode, the radar unit is tilted 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 (Figures 2-2 and 2-5). Both modes of operation were used during each hour of sampling.

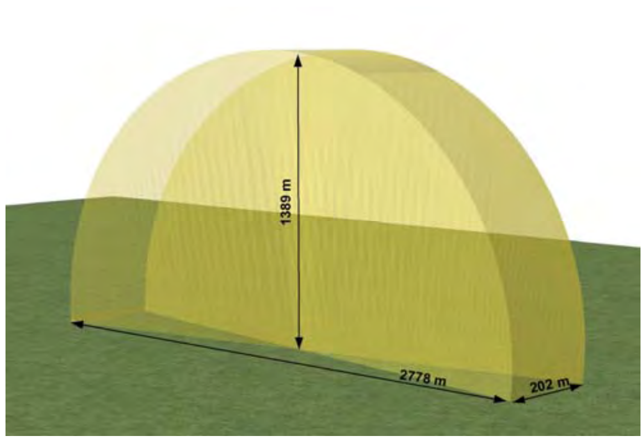


Figure 2-5. Detection Range of the radar in vertical mode

2.2.1 Data Collection

The radar display was connected to the video recording software of a computer enabling digital archiving of the radar data for subsequent analysis. This software recorded and archived video samples continuously every hour from sunset to sunrise of each survey night. By alternating the radar antenna every ten minutes from vertical mode to horizontal mode, a total of 30 minutes of vertical samples and 30 minutes of horizontal samples were collected within each hour. Video recordings were subsequently analyzed based on a random schedule for each night. This sampling schedule allowed for randomization of data analysis and prevented double-counting of targets due to the 30-second echo trail used to determine the flight path vector.

2.2.2 Data Analysis

Video samples were analyzed using a digital analysis software tool developed by Stantec. For horizontal samples, targets (either birds or bats) were differentiated from insects based on their flight speed. Following adjustment 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 within each horizontal sample, and these results 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, and then subsequently outputs the data to a spreadsheet. These datasets were then used to calculate passage rate (reported as targets per kilometer of migratory front per hour), 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 analysis are based on those used by Batschelet (1965), because they take into account the circular nature of the data. Nightly wind direction, which was collected from the north Stewart met tower, was also summarized using this method.

Flight altitude data were summarized using linear statistics. Mean flight altitudes (± 1 standard error [SE]) were calculated by hour, night, and overall season. The percent of targets flying below 130.5 m (428'), the approximate maximum height of the proposed wind turbines with blades, was also calculated hourly, for each night, and for the entire survey period.

2.2.3 Weather Data

Wind speed and direction were recorded on an hourly basis by the north Stewart met tower for the duration of the radar survey period. Temperature, relative humidity, wind speed, dew point, and barometric were also recorded for the duration of the survey period at hourly intervals by a weather station (HOBO Micro Station H21-002) located at the radar station. The mean, maximum, and minimum temperature, mean and maximum wind speed, relative humidity, barometric pressure, and dew point were calculated for each night. However, for the purposes of this report, weather data was used from the north Stewart met tower because this data is from heights closer to where migrants were observed to fly and the height of the proposed wind turbines.

2.3 RESULTS

Radar surveys were conducted during 20 nights from August 30 to October 7 (Appendix A, Table 1). The radar was located in the center of the meteorological tower (met tower) clearing, which was bordered by standing dead trees (snags) and regenerating red spruce (*Picea rubens*) (Figure 2-6). In vertical mode tree heights did not affect the radar view because the radar beam was directed vertically into the sky. Furthermore, as a result of elevating the radar antenna even with the heights of the surrounding trees and the steep topography to the west of the radar location, some targets were observed 5 degrees below the horizon in the valley to the west over the Long Falls Dam Road. Figure 2-3 shows the detection of the ridgeline to the west of the Long Falls Dam Road in both Horizontal and Vertical modes, showing that the range of the radar extended that far and provided full coverage of the valley.

Figure 2-6. Radar situated in Highland Project area.

2.3.1 Passage Rates

The mean passage rate for the entire survey period was 549 targets/kilometer/hour (t/km/hr) ± 32 t/km/hr (Figure 2-7; Appendix A, Table 1). Nightly passage rates varied from 68 targets per kilometer per hour (t/km/hr) on October 7 to 1201 t/km/h on September 15. Individual hourly passage rates ranged from 0 to 2480 t/km/h (Appendix A, Table 2). Hourly passage rates varied between and within nights throughout the season. For the entire season, passage rates were highest during the fourth hour after sunset and dropped off significantly during the fifth hour through sunrise (Figure 2-8).

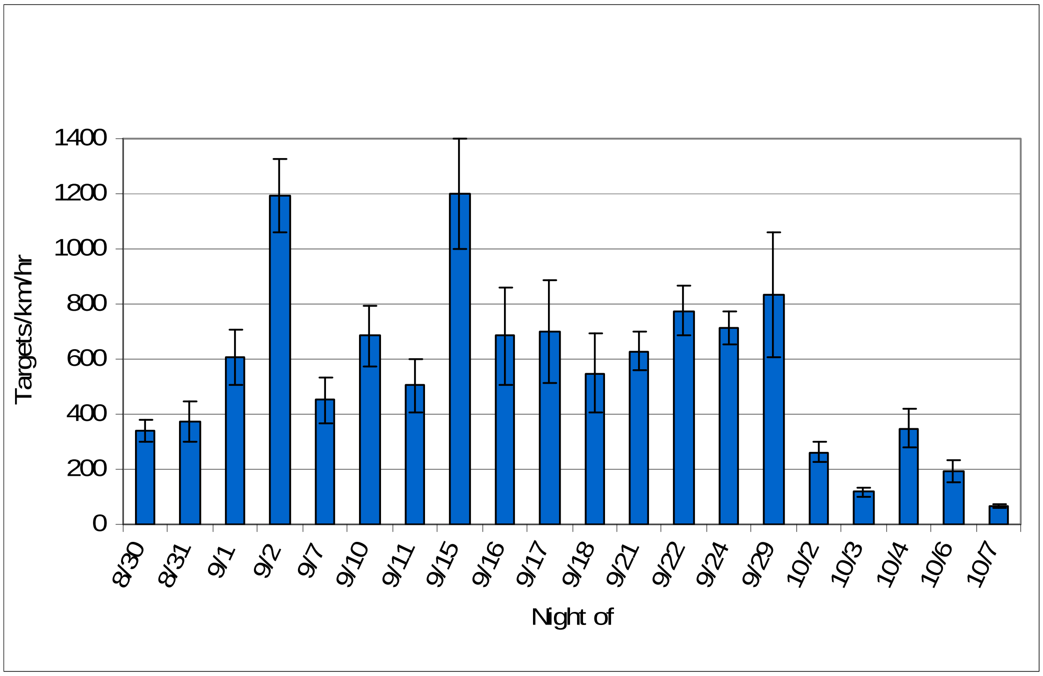


Figure 2-7. Nightly passage rates observed (error bars ± 1 SE)

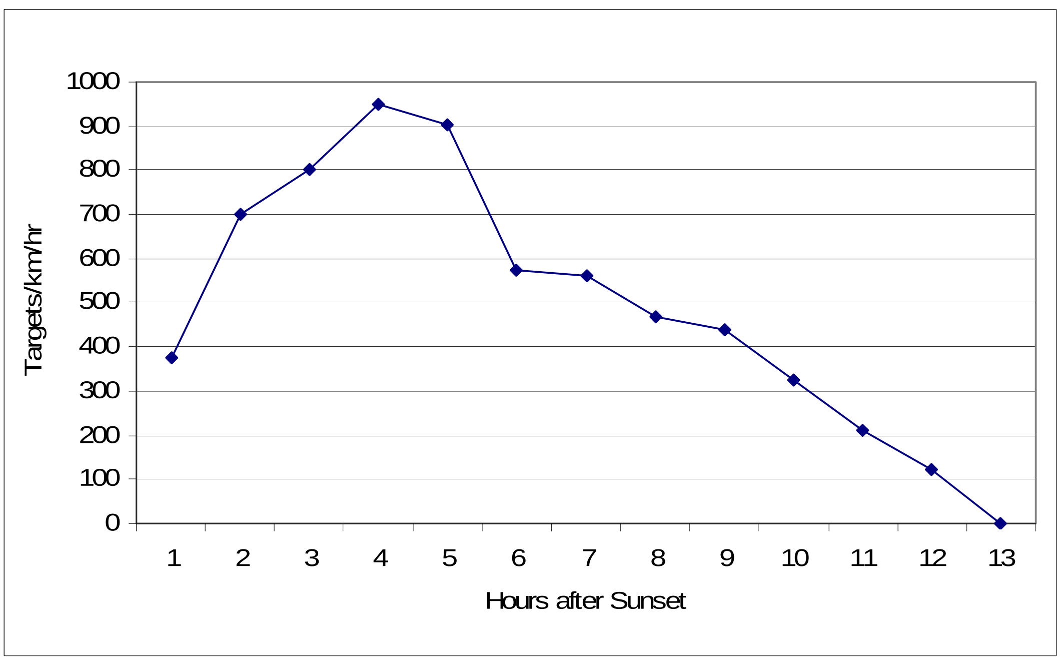


Figure 2-8. Hourly passage rates for entire season

2.3.2 Flight Direction

Mean flight direction through the Project area was 227° ± 51 (Figure 2-9). There was some variation between nights in mean flight direction, although most nights included flight directions generally to the southwest (Appendix A, Table 3).

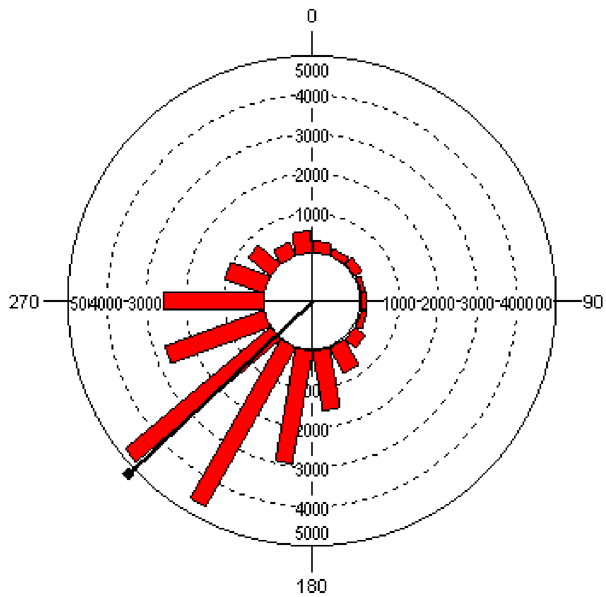


Figure 2-9. Mean flight direction for the entire season (the bracket along the margin of the histogram is the 95% confidence interval)

2.3.3 Flight Altitude

The seasonal mean flight height of all targets was 348 ± 8 m (1142’ ± 26’) above the radar site. The average nightly flight height ranged from 250 m (820’) on September 16 to 531 m (1742’) on October 6 (Figure 2-10; Appendix A, Table 4). The percent of targets observed flying below 130.5 m (428’) averaged 17 percent for the season and varied by night from 4 to 28 percent (Figure 2-11). The mean hourly flight height for the entire season was relatively constant throughout the first eleven hours, but increased significantly in the twelfth hour (Figure 2-12). Overall, within each night, flight heights remained relatively constant while much more variation was observed between nights.

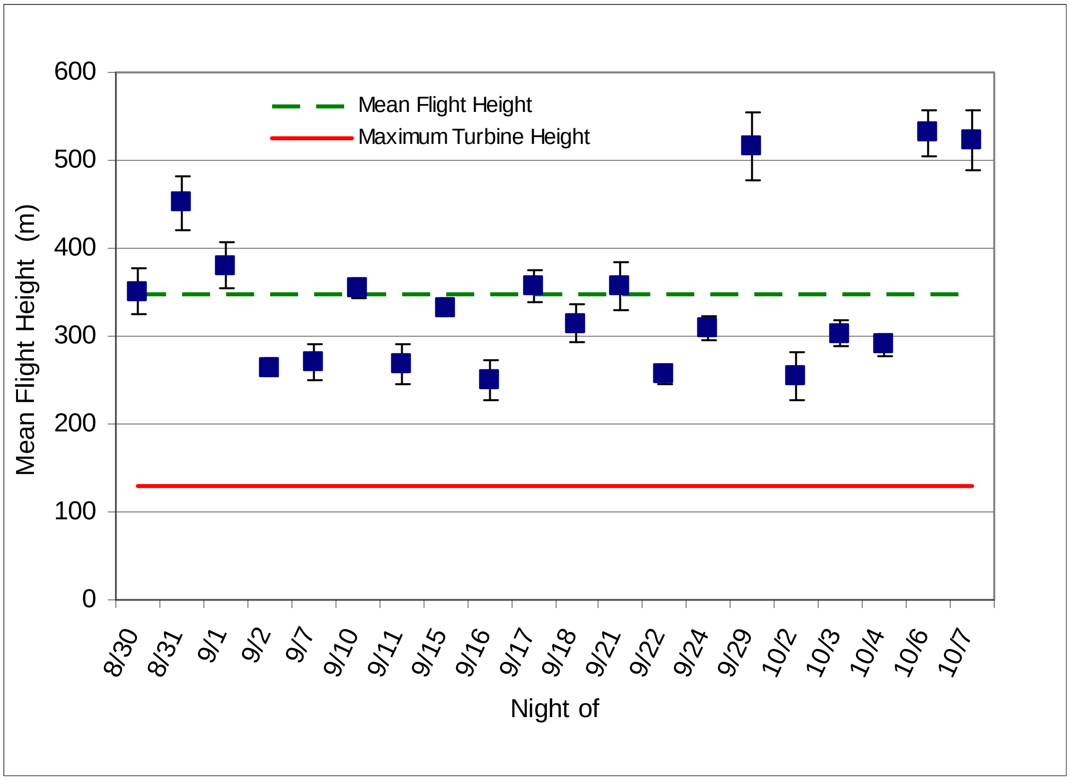


Figure 2-10. Mean nightly flight height of targets (error bars ± 1 SE)

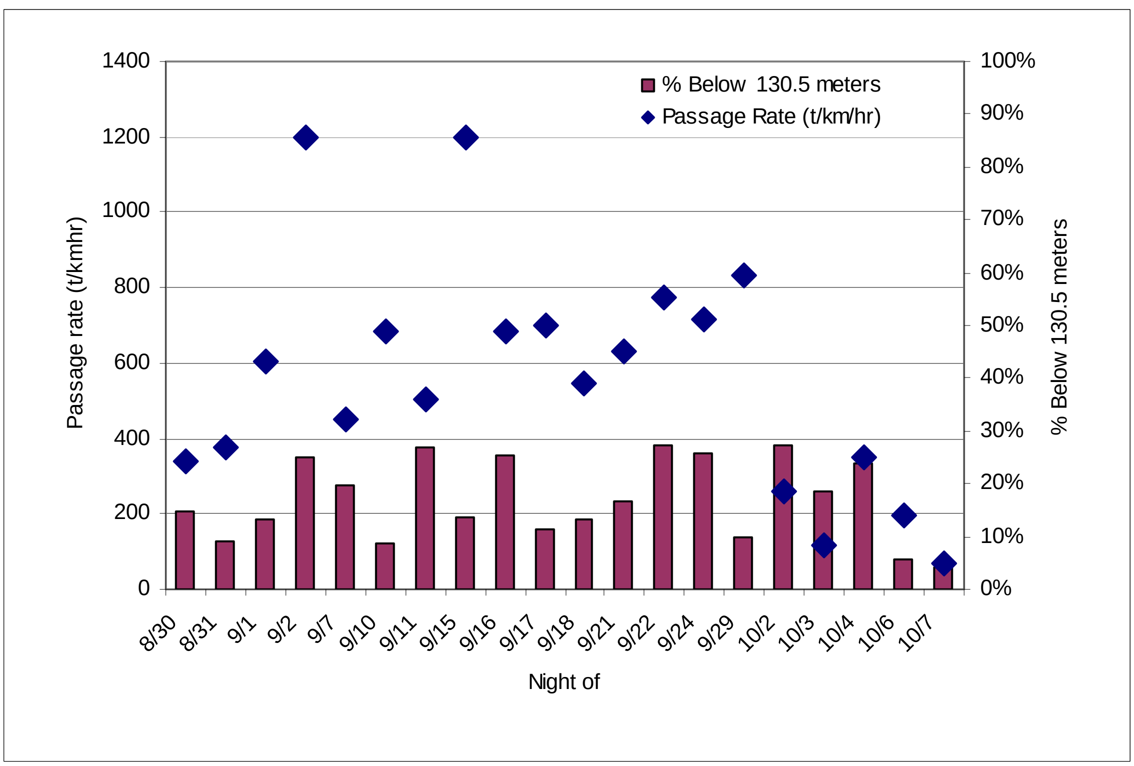


Figure 2-11. Percent of targets observed flying below a height of 130.5 m (428')

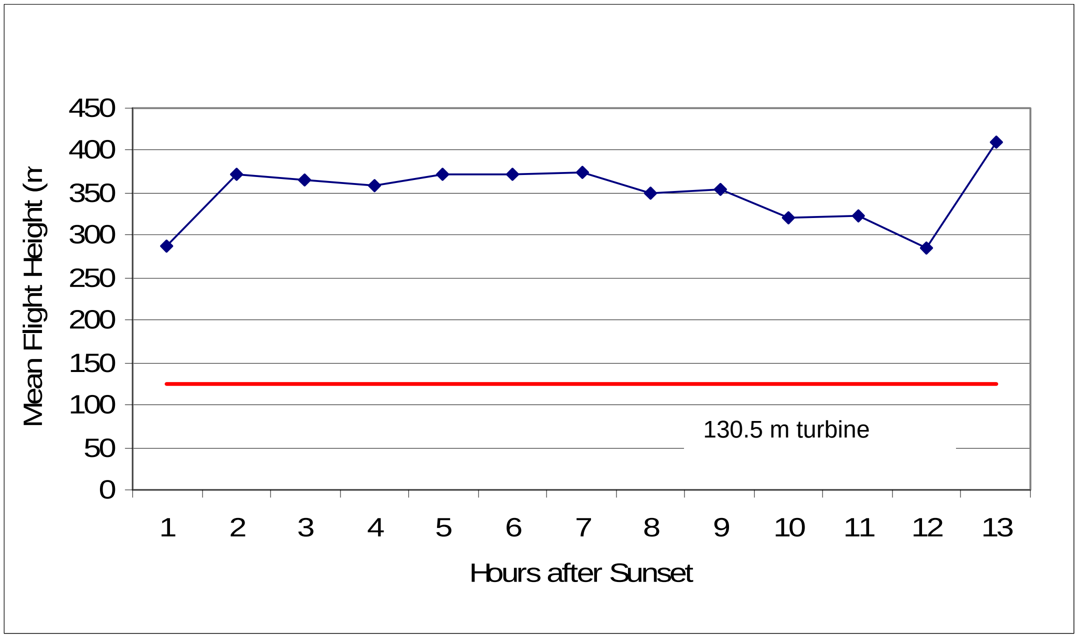


Figure 2-12. Hourly target flight height distribution. The peak in flight height during the 13th hour after sunset includes data from only four nights at the end of the season and is not necessarily directly comparable to other hourly blocks. Prior to the end of September, sunrise occurred prior to this 13th hour therefore no data was collected.

2.3.4 Weather Data

Mean nightly wind speeds in the Project area from August 30 to October 7 varied between 2 and 8 meters per second (m/s), with an overall mean of 4 m/s (Figure 2-13). Mean nightly temperatures varied between 3ºC and 16ºC, with an overall mean 9ºC (Figure 2-14).

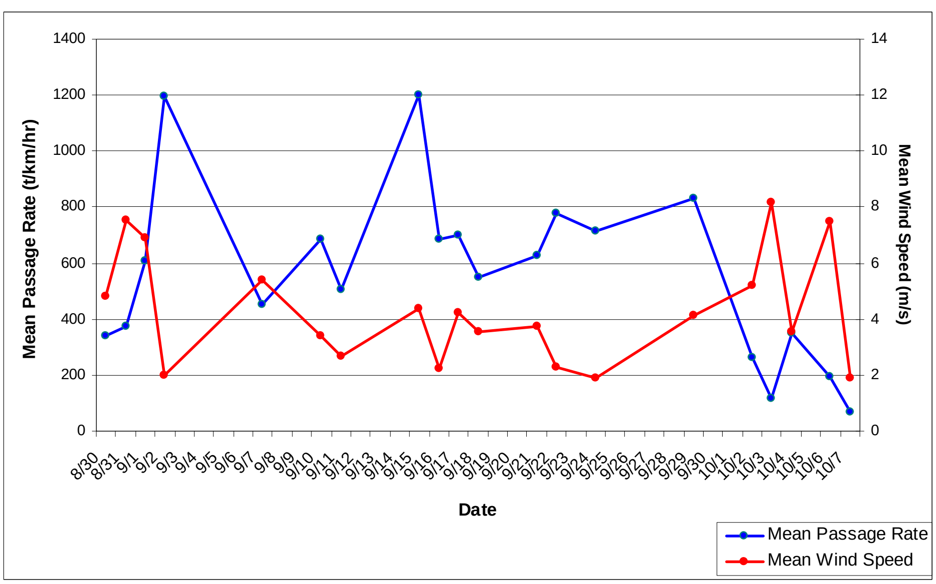


Figure 2-13. Mean wind speed versus passage rate in the Project area

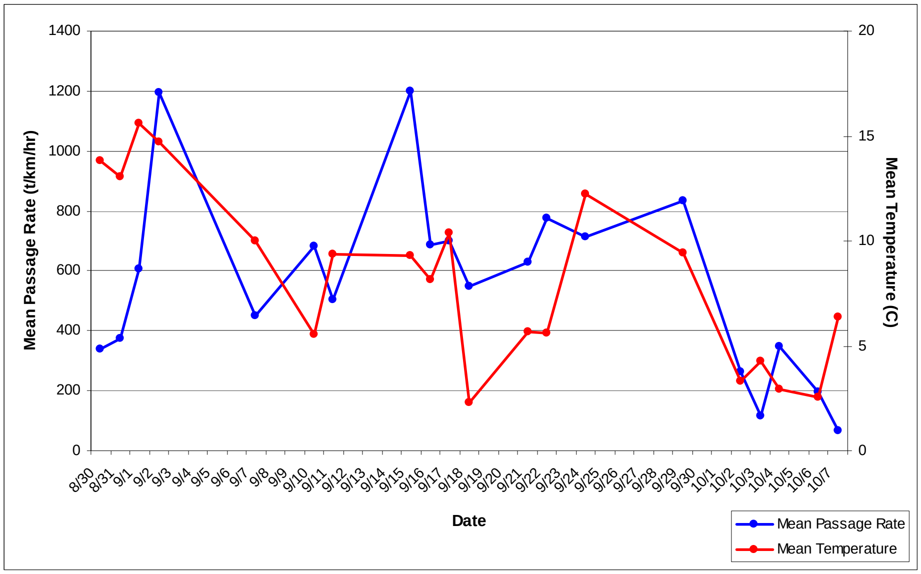


Figure 2-14. Passage rate versus mean temperature in the Project area

2.4 DISCUSSION

The results of this field survey provide useful information about site-specific migration activity and patterns in the Project area. Within the last several years, data from nocturnal radar surveys completed using similar methods and equipment have become available, providing an opportunity to compare the results from this Project with others in Maine and the northeastern United States. It is important to note that there are limitations in comparing data from previous years with data from 2008, as year-to-year variation in populations may influence how many migrants pass 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 and the subsequent calculation of passage rate. These differences should be recognized as one of the more significant limiting factors in making direct site-to-site comparisons of passage rates. Regardless of potential differences between radar survey locations, the results at the Project are within the typical range of results at projects on forested ridges in the northeast (Appendix A, Table 5).

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, Gauthreaux 1991). Nights with the highest passage rates appeared to have had moderate to light winds (2 to 4 m/s) from the northeast. Temperature does not seem to have an affect on passage rate at this 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 nocturnal migrants (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). Studies suggesting that nocturnal migrants are influenced by topography have typically been conducted in areas of steep and abrupt topography, such as the most rugged areas of the northern Appalachians and the Alps.

Emerging evidence from other Stantec studies, other consultants, and academic research, is beginning to indicate that flight height seems to be more important in determining potential collision risk than passage rate or flight direction (Cooper and Mabee 2000; Cooper *et al*. 2004; Gauthreaux and Livingston 2006; Mizrahi *et al*. 2008). Comparison of flight height between survey sites as measured by radar is generally less influenced by site characteristics as the main portion of the radar beam is directed skyward, and the potential effects of surrounding vegetation on the radar's view can be more easily controlled. The radar, centrally located on an exposed knoll at this Project site, allowed for unobstructed views in vertical mode and targets were observed flying in all areas of the vertical detection range. The radar view in horizontal mode was comparable to other regional studies conducted by Stantec in the state. The emerging body of studies characterizing nocturnal migration shows a relatively consistent pattern in flight altitude, with most migrants appearing to fly at altitudes of several hundred meters or more above the ground (Appendix A, Table 5). This pattern applies to this site, as targets appeared to fly at fairly consistent heights near 300 m above the radar nightly and throughout the survey period. The flight heights at the Project are well above the proposed turbine height of 130.5 m, indicating a limited mortality risk during fall migration.

There is currently no accurate quantitative method of directly correlating pre-construction passage rates at wind farms to operational impacts to birds and bats. Until radar surveys are conducted at a constructed site followed by mortality surveys the morning after, no direct correlations to collision risk can be made. This radar survey is designed to sample migration activity over a given point of time to provide baseline data pre-construction.

3.0 Acoustic Bat Survey

3.1 INTRODUCTION

Acoustic sampling of bat activity has become a standard aspect of pre-construction surveys for proposed wind-energy developments (Kunz *et al*. 2007a, b). Acoustic surveys are associated with several major assumptions (Hayes 2000) and results should not be used to determine the number of bats inhabiting an area or to determine the number of bats that may collide with the proposed turbines. Acoustic surveys can provide insight into seasonal patterns in activity levels and examine how weather conditions influence bat activity. This data may be useful in predicting trends in post-construction mortality rates. The objectives of acoustic surveys at the Project were (1) to document bat activity patterns from August through October in airspace near the rotor zone of the proposed turbines, at an intermediate height, and near the ground; and (2) to document bat activity patterns in relation to weather factors including wind speed, temperature, and barometric pressure.

Eight species of bats occur in Maine, based upon their normal geographical range. These are the big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), eastern small-footed myotis (*Myotis leibii*), little brown myotis (*M. lucifugus*), northern myotis, (*M. septentrionalis*), and tri-colored bat[2] (*Perimyotis subflavus*) (BCI 2001). Of these, the eastern small-footed myotis, eastern red bat, hoary bat, and silver-haired bat are listed in Maine as species of special concern.

3.2 METHODS

3.2.1 Data Collection and Equipment

Anabat II and Anabat SD1 detectors (Titley Electronics Pty Ltd.) were used for the duration of the acoustic bat survey. 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. Anabat II detectors were coupled with CF Storage ZCAIM (Titley Electronics Pty Ltd.), which programmed the on/off times and stored data on removable 1 GB compact flash cards, while newer SD1 model detectors do not require use of a ZCAIM. Anabat detectors are frequency division detectors that divide the frequency of echolocation sounds made by bats by a factor of 16, and then record these sounds for subsequent analysis. The audio sensitivity setting of each Anabat system was set between six and seven (on a scale of one to ten) to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was then tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to detect bats up to a distance of at least 10 m (33').

Each Anabat detector was powered by 12-volt batteries charged by solar panels. Each solar-powered Anabat system was deployed in 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 unmodified Anabat unit.

Data was collected by five detectors that were deployed in locations throughout the Project area from August 11 to October 20 and were programmed to run continuously between 6:00 PM and 8:00 AM (Figure 3-1). Prior to the installation of the met towers, detectors were initially placed in trees along the ridgelines and were installed at heights ranging from approximately 2 to 8 m. One detector was located in a tree within the Briggs Hill met tower opening, one in a tree within the Burnt Hill met tower opening, one in a tree along the edge of the south Stewart met tower opening, one along a small stream on the western side of Stewart Mountain (Stewart Valley Detector), and one in a tree along the edge of the north Stewart Mountain met tower opening (Figure 3-1). A sixth detector was placed in at tree at the edge of the Witham met tower clearing; however this detector malfunctioned and provided no useable data.

[2] The scientific and common name of the eastern pipistrelle (*Pipistrellus subflavus*) has been changed to the tri-colored bat (*Perimyotis subflavus*).

The detectors were moved to the met towers once these structures were erected (August 11 to August 28, 2008, September 2, and September 8, 2008). Two detectors were suspended at different heights within the guy wire arrays of the south Stewart met tower, Witham Mountain met tower, and Briggs Hill met tower. “High” detectors were suspended at approximately 45 m and “Low” detectors were suspended at approximately 25 m. Maintenance visits for each detector were conducted roughly every two weeks to check on the condition of the detectors and download data to a computer for analysis. The “Low” detector at Witham malfunctioned and provided no useable data.

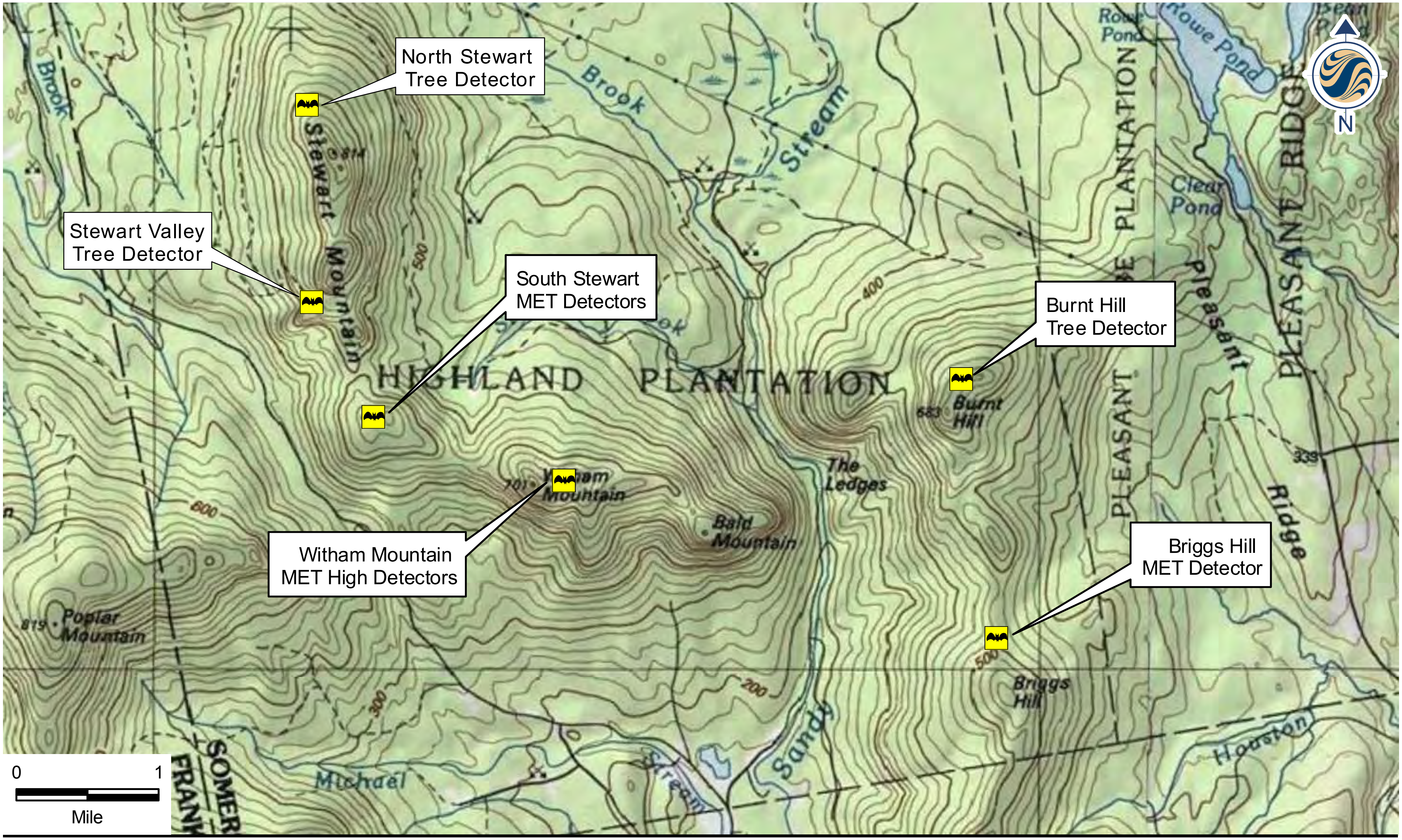
Briggs Hill Tree Detector: The Briggs Hill tree detector was deployed in this location from August 12 to August 28, 2008 until the met tower was installed. At this location the bat detector was suspended from a tree approximately 5 m (15’) high along the western edge of the met tower clearing with the microphone pointing north.

Burnt Hill Tree Detector: The Burnt Hill tree detector was deployed in this location from August 11 to September 2, 2008 until the met tower was installed at Briggs Hill. Once that met tower was installed this detector was moved to the Briggs Hill Met tower. During this period, the detector was attached to a dead softwood snag approximately 2 m (7') high on the summit of Burnt Hill at the edge of the access trail leading to the met tower opening. The microphone was pointed north across the trail.

Stewart Valley Detector: This detector was deployed at this location from August 11 to August 27, 2008 until the South Stewart Met Tower was installed. The detector at this location was approximately 1500’ down slope from the Stewart Mountain Summit at approximately 8 m (25’) high with the microphone directed across a skidder trail. A small stream crossed the skidder trail at this location and the microphone was directed up stream across the skidder trail.

South Stewart Tree Detector: This detector was deployed at this location from August 11 to September 2, 2008 until the met tower was installed. At this location the detector was positioned in a tree approximately 5 m (15’) high at the southern edge of the met tower clearing with the microphone facing north into the met tower clearing.

North Stewart Tree Detector: This detector was deployed at this location from August 11 to September 8, 2008. This detector was deployed approximately 5 m (15') up in a tree with the microphone facing east. This detector was located at the northern edge of the met tower clearing where the trail entered the opening on the summit.



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30 Park Drive
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Fax: (207) 729-2715
www.stantec.com

Legend

Bat Detector Location

Client/Project

Highland Wind, LLC
Highland Wind Project
Highland Plantation, Maine

Figure No.

3-1

Title

Bat Survey Location Map
November 5, 2009

00385-F301-Bat-Survey-Location-Map.mxd

3.2.2 Data Analysis

Ultrasound recordings of bat echolocation may be broken into recordings of a single bat call or recordings of bat call sequences. A call is a single pulse of sound produced by a bat, while a call sequence is a combination of two or more pulses recorded in an Anabat file. Recordings containing less than two calls were eliminated from analysis as has been done in similar studies (Arnett *et al*. 2006).

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 Maine 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.

Following extraction of call files, each file was visually inspected for species identification and to ensure that only bat calls were included in the data set. Insect activity, wind, and interference can also sometimes produce Anabat files that pass through the initial filter and need to be visually inspected and removed from the data set. Call sequences are easily differentiated from other recordings, which typically form a diffuse band of dots at either a constant frequency or widely varying frequency.

Because bat activity levels are highly variable among individual nights and individual hours (Hayes 1997, Arnett *et al*. 2006), detection rates are summarized on both of these temporal scales. Nightly detection rates were summarized by month as well as for the entire sampling period. Hourly detection rates were summarized by hour after sunset, as recommended by Kunz *et al*. (2007a,b). Quantitative comparisons among these temporal periods was not attempted because the high amount of variability associated with bat detection would required much larger sample sizes (Arnett *et al*. 2006, Hayes 1997).

Bat call sequences were individually marked and categorized by species group, or “guild” based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O’Farrell *et al*. 1999, O’Farrell and Gannon 1999). Call sequences were classified to species whenever possible, based on criteria developed from review of reference calls collected by Chris Corben, the developer of the Anabat system, as well as other bat researchers. However, due to similarity of call signatures between several species, all classified calls have been categorized into five guilds[3] reflecting the bat community in the region of the Project area and is as follows:

[3] Gannon *et al.* 2003 categorized bats into guilds based upon similar minimum frequency and call shape. These guilds were: Unidentified, Myotis, LABO-PISU and EPFU-LANO-LACI. We broke hoary bats out into a separate guild due to the importance of reporting activity patterns of migratory species in the context of wind energy development.

- **Unknown (UNKN)** – All call sequences with less than five calls, or poor quality sequences (those with indistinct call characteristics or background static). These sequences were further identified as either "high frequency unknown" (HFUN) for sequences with a minimum frequency above 30 to 35 kHz, or "low frequency unknown" (LFUN) for sequences with a minimum frequency below 30 to 35 kHz. The unknown calls are separated into these specific high frequency and low frequency groups because some inferences can be made as to the possible guilds based upon bats known to occur in this area. For this area, HFUN most likely represents eastern red bats, tri-colored bats and *Myotis* species since these species typically produce ultrasound sequences of more than 30 kHz. Big brown, silver-haired and hoary bats would be the species in this area typically producing ultrasound sequences of less than 30 kHz.

- **Myotis (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.

- **Eastern red bat/tri-colored bat[4] (RBTB)** – Eastern red bats and tri-colored 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.

- **Big brown/silver-haired bat (BBSH)** – Big brown and silver-haired bats. These species' call signatures commonly overlap and have therefore been included as one guild in this report.

- **Hoary bat (HB)** – Hoary bats. Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats by minimum frequency extending below 20 kHz or by calls varying widely in minimum frequency across a sequence.

This method of guild identification represents a conservative approach to bat call identification. Since some species 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 categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of recordings/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined.

3.2.3 Weather Data

Temperature (°C), wind speed (m/s), and barometric pressure (mbar) was collected from a 50 meter on-site met tower and was provided by Highland Wind for the period from August 11

[4] The scientific and common name of the eastern pipistrelle (*Pipistrellus subflavus*) has been changed to the tri-colored bat (*Perimyotis subflavus*).

through October 20. Mean nightly temperature, barometric pressure, and wind speed were calculated for each night, and nightly averages were plotted against nightly detections for this period for met tower detectors.

3.3 RESULTS

3.3.1 Detector Call Analysis

Detectors were operational on 360 of 401 potential detector-nights (90%) between August 11 and October 20 (Table 3-1). Detector malfunction at the Witham Low and Witham Tree locations accounted for all 42 detector nights of lost data. All other detectors sampled successfully on 100% of potential detector-nights.

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

Location	Dates	# of Possible Nights	# Detector-Nights*	# Recorded sequences	Detection Rate **
Briggs Hill Met High	Aug 28 – Oct 20	54	54	21	0.4
Briggs Hill Met Low	Aug 29 - Oct20	53	53	10	0.2
Stewart South Met High	Sept 03 - Oct 20	48	48	17	0.4
Stewart South Met Low	Aug 28 - Oct 20	54	54	15	0.3
Witham Met High	Sept 09 – Oct 20	42	42	4	0.1
Overall Met Tower Results		**251**	**251**	**67**	**0.3**
Briggs Hill Met Tree	Aug12 - Aug 28	17	17	3731	219.5
Stewart South Met Tree	Aug 11 – Sept 02	23	23	37	1.6
Stewart Valley Tree	Aug 11 – Aug 27	17	17	5478	322.2
Stewart North Met Tree	Aug 11 - Sept 08	29	29	2197	75.8
Burnt Hill Tree	Aug 11 – Sept 02	23	23	73	3.2
Overall Tree Results		**109**	**109**	**11516**	**106**
Overall Results		**360**	**360**	**11583**	**32.2**

* 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.

The overall mean nightly detection rate at the Project was 32.3 ± 5.8 (standard error [SE]) recordings/detector/night (r/d/n). Mean detection rate was highly variable among detectors and between met- and ground-level detectors (Table 3-2). Qualitatively, ground-level detectors exhibited higher detection rates and greater variability (106.6 ± 17.3 r/d/n) than met tower detectors (0.3 ± 0.1 r/d/n). Total number of detections varied with hour past sunset, with different trends observed at met tower and ground-level detectors (Figures 3-14 through 3-15).

Table 3-2. Monthly summary of 2008 acoustic survey results at Project detectors					
Detector / Month	**Dates**	**Number of Nights**	**Nights Sampled**	**Sequences Recorded**	**Detection Rate ****
Briggs Mountain Met High					
August	August 28 - August 31	4	4	14	3.5
September	September 01 - September 30	30	30	7	0.2
October	October 01 - October 20	20	20	0	0.0
Briggs Mountain Met Low					
August	August 29 - August 31	3	3	1	0.3
September	September 01 - September 30	30	30	8	0.3
October	October 01 - October 20	20	20	1	0.1
Briggs Mountain Met Tree					
August	August 12 - August 28	17	17	3731	219.5
September	--	--	--	--	
October	--	--	--	--	
Stewart South Met High					
August	--	--	--	--	
September	September 03 - September 30	28	28	13	0.5
October	October 01 - October 20	20	20	4	0.2
Stewart South Met Low					
August	August 28 - August 31	4	4	4	1.0
September	September 01 - September 30	30	30	11	0.4
October	October 01 - October 20	20	20	0	0.0
Stewart South Met Tree					
August	August 11 - August 31	21	21	35	1.7
September	September 01 - September 02	2	2	2	1.0
October	--	0	0		
Stewart Valley Tree					
August	August 11 - August 27	17	17	5478	322.2
September	--	0	0		
October	--	--	--	--	
Stewart North Met Tree					
August	August 11 - August 31	21	21	2143	102.0
September	September 01 - September 08	8	8	54	6.8
October	--	--	--	--	
Witham Met High					
August	--	0	0		
September	September 09 - September 30	22	22	4	0.2
October	October 01 - October 20	20	20	0	0.0
Burnt Hill Tree					
August	August 12 - August 31	20	20	51	2.6
September	September 01 - September 02	2	2	22	11.0
October	--	--	--	--	
Overall Results		**359**	**359**	**11583**	**32.3**
* 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 ultrasound sequences recorded per detector-night.					

The majority of the recorded call sequences were labeled as MYSP (*n* = 6,521; 56.3%), followed by UNKN sequences (*n* = 4,909; 42.4%), the BBSH guild (*n* = 112; 1.0%), the RBTB guild (*n* = 28; 0.2%), and hoary bats (*n* = 13; 0.1%; Table 3-3). Calls identified as UNKN consisted primarily of HFUN calls (*n* = 4,858; 99.0%), followed by LFUN calls (*n* = 49; 0.1%) and calls which could not be classified at all (*n* = 2; <0.1%). Calls identified as BBSH consisted primarily of calls that could not be identified to species (*n* = 85; 75.9%), followed by calls identified as silver-haired bats (*n* = 23; 20.5%), and big brown bats (*n* = 4; 3.6%). Calls identified as RBTB consisted primarily of calls that could not be identified to species (*n* = 17; 60.7%), followed by calls identified as red bats (*n* = 9; 32.1%) and tri-colored bats (*n* = 2; 7.1%).

Table 3-3. Distribution of detections by guild for detectors at Highland, ME, August - October, 2008.

Detector	Guild					Total
	BBSH	HB	RBTB	MYSP	UNKN	
Briggs Hill Met High	2	1	1	0	17	21
Briggs Hill Met Low	1	3	0	0	6	10
Stewart South Met High	6	1	1	0	9	17
Stewart South Met Low	3	0	0	1	11	15
Witham Met High	1	0	0	0	3	4
Overall Met Tower Results	**13**	**5**	**2**	**1**	**46**	**67**
Briggs Hill Met Tree	93	3	13	1,273	2,349	3,731
Stewart South Met Tree	0	1	0	8	28	37
Stewart Valley Tree	0	0	12	3,757	1,709	5,478
Stewart North Met Tree	0	1	1	1,464	731	2,197
Burnt Hill Tree	6	3	0	18	46	73
Overall Tree Results	**99**	**8**	**26**	**6520**	**4863**	**11516**
Overall Results	**112**	**13**	**28**	**6,521**	**4,909**	**11,583**
Guild Composition %	**1.0%**	**0.1%**	**0.2%**	**56.3%**	**42.4%**	

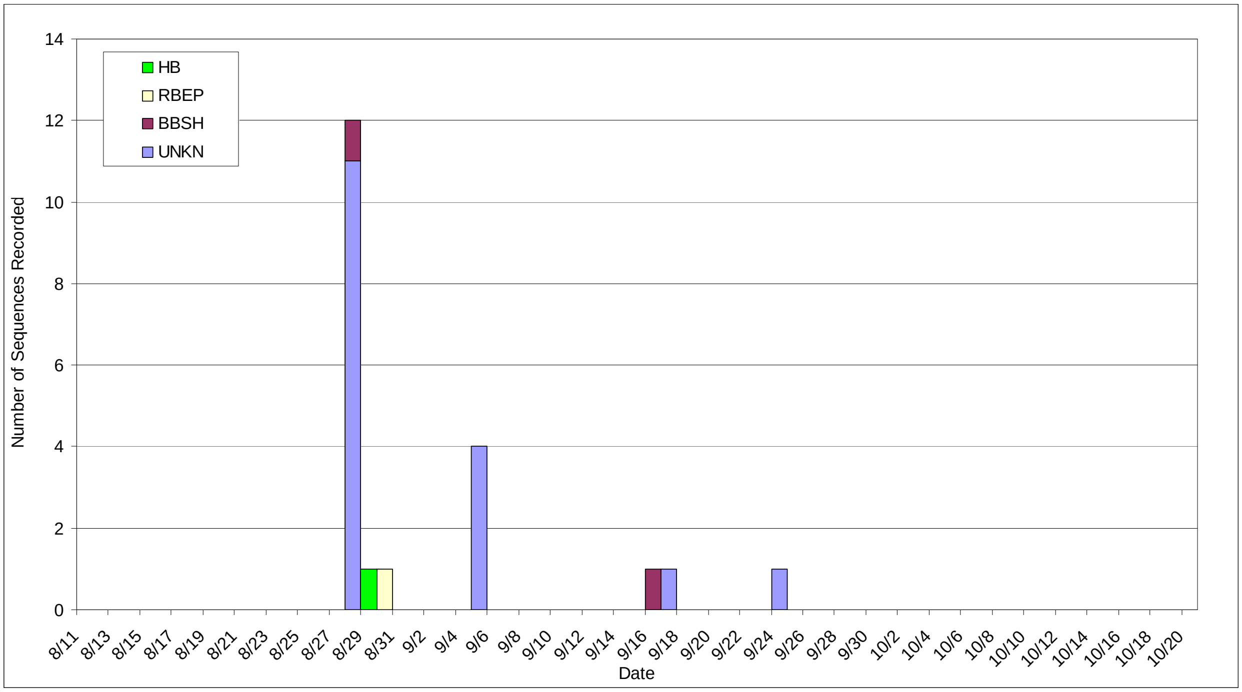


Figure 3-2. Nightly detections at the Briggs Hill High Met detector from August through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

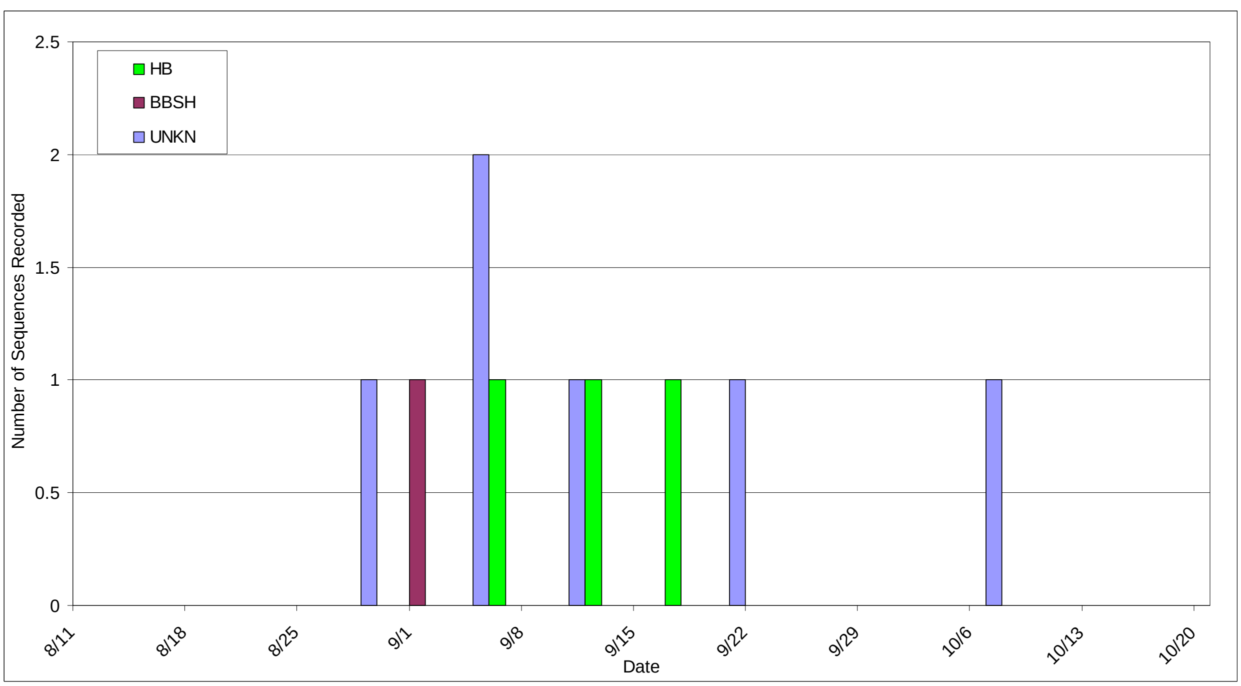


Figure 3-3. Nightly detections at the Briggs Hill Low Met detector from August through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

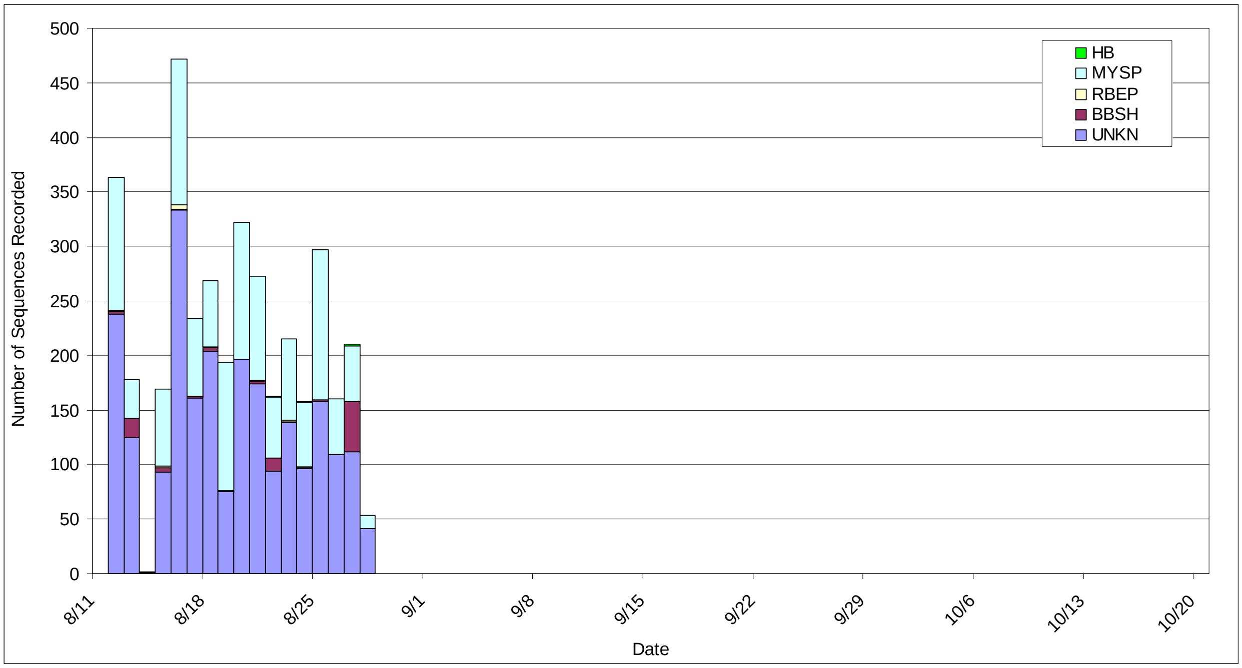


Figure 3-4. Nightly detections at the Briggs Hill Met Tree detector in August, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

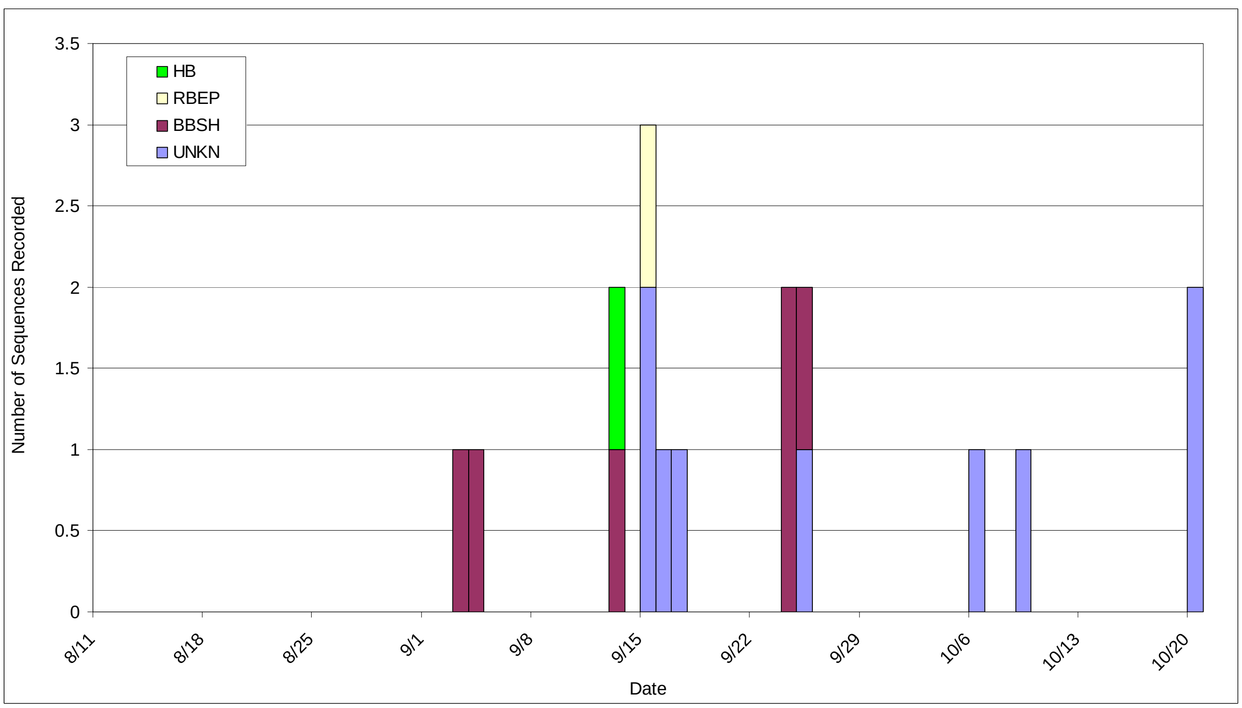


Figure 3-5. Nightly detections at the Highland Stewart South Met High detector from September through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

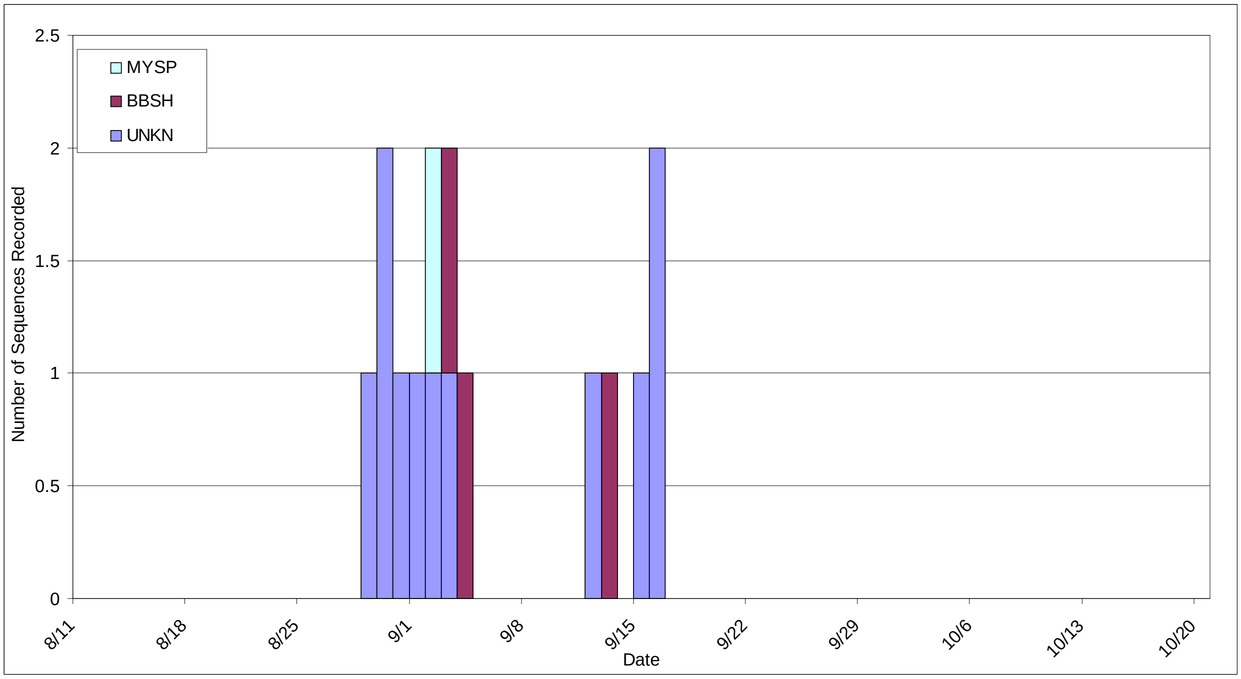


Figure 3-6. Nightly detections at the Highland Stewart South Met Low detector from late August through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

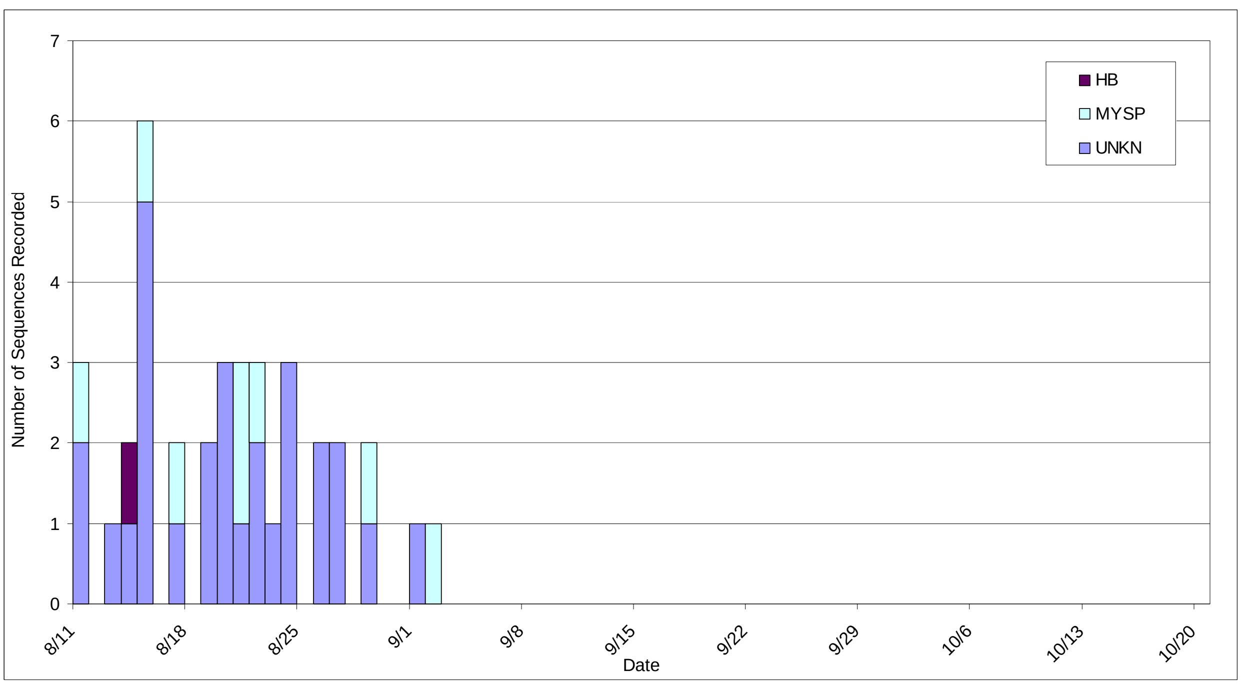


Figure 3-7. Nightly detections at the Highland Stewart South Met Tree detector from August through early September, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

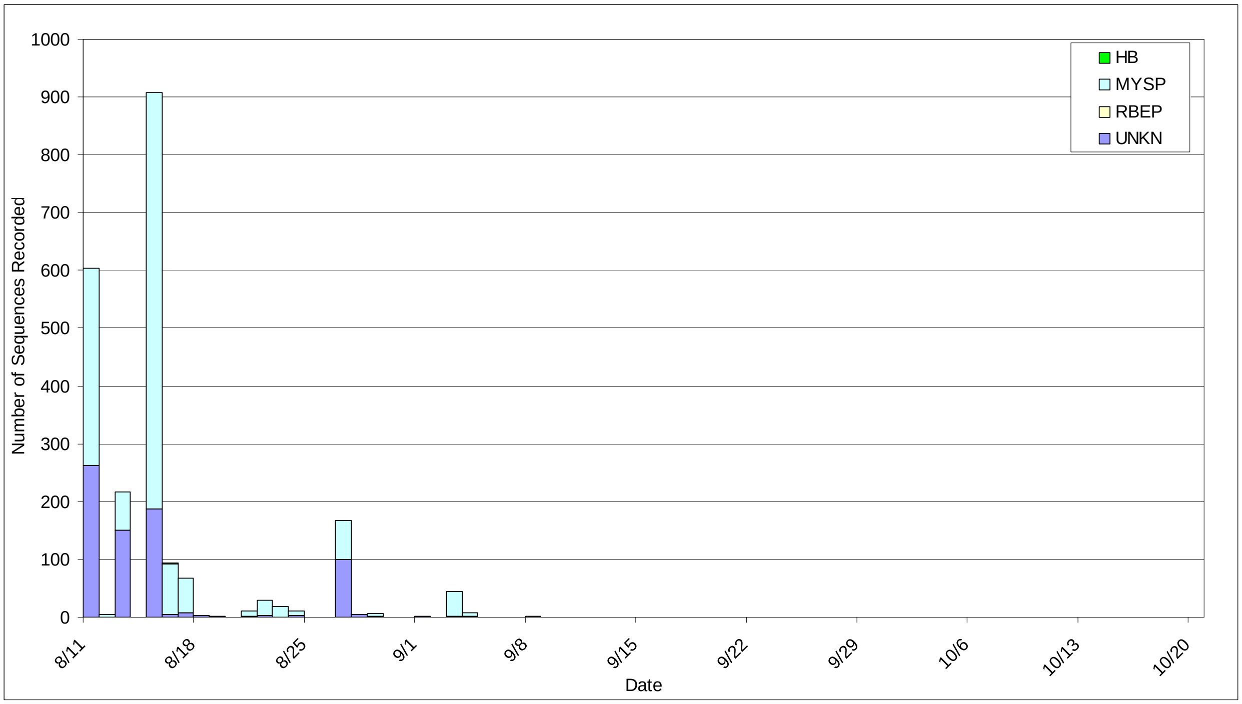


Figure 3-8. Nightly detections at the Highland Stewart North Met Tree detector from August through early September, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

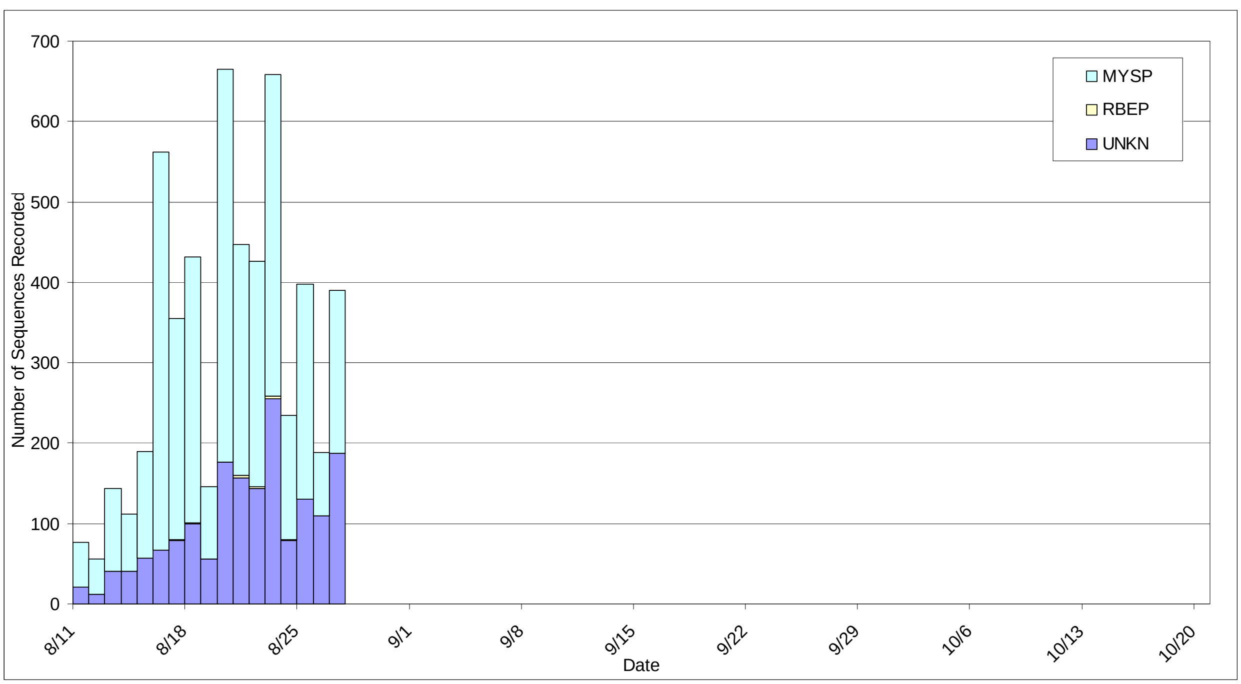


Figure 3-9. Nightly detections at the Highland Stewart Valley Tree detector in August, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

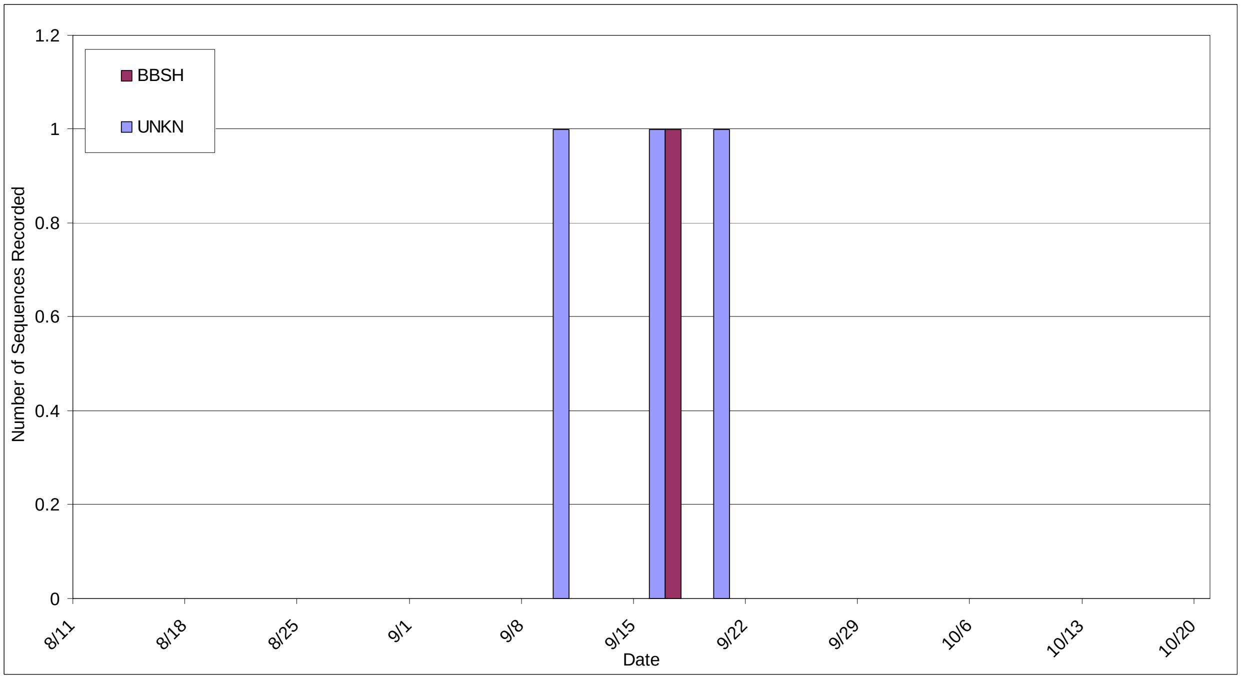


Figure 3-10. Nightly detections at the Highland Witham Met High detector from September through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

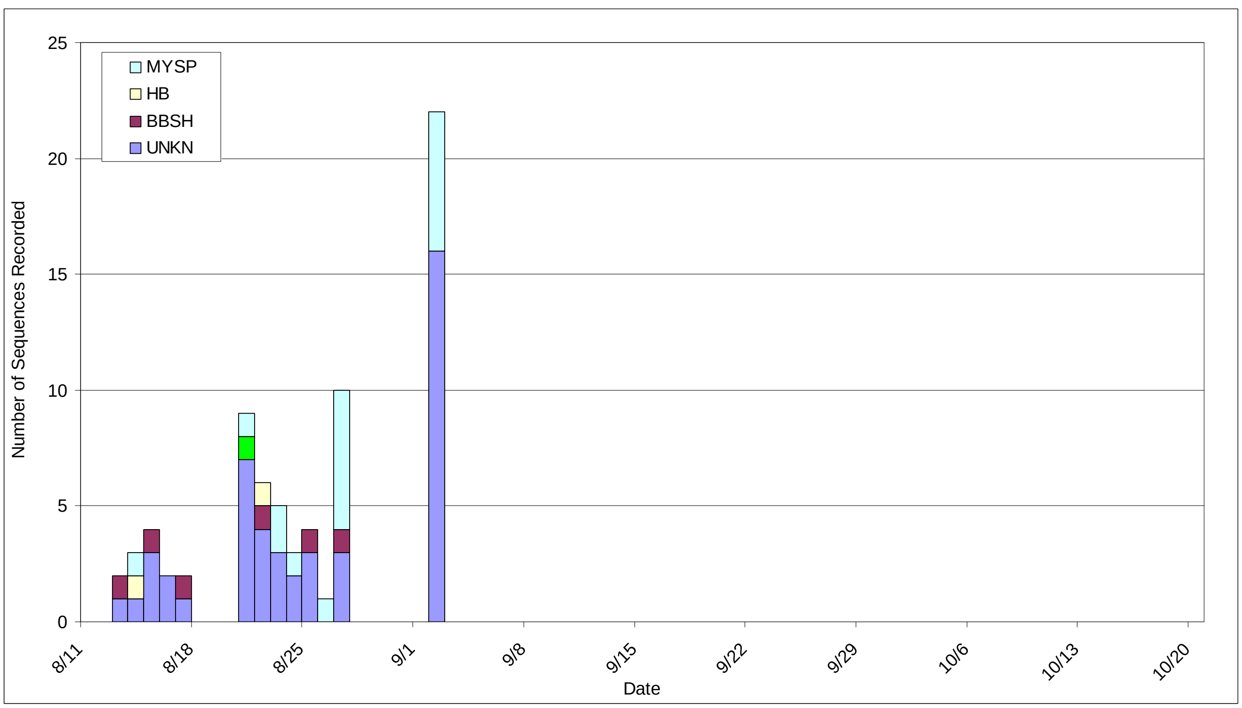


Figure 3-11. Nightly detections at the Highland Burnt Hill Tree detector from August through early September, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

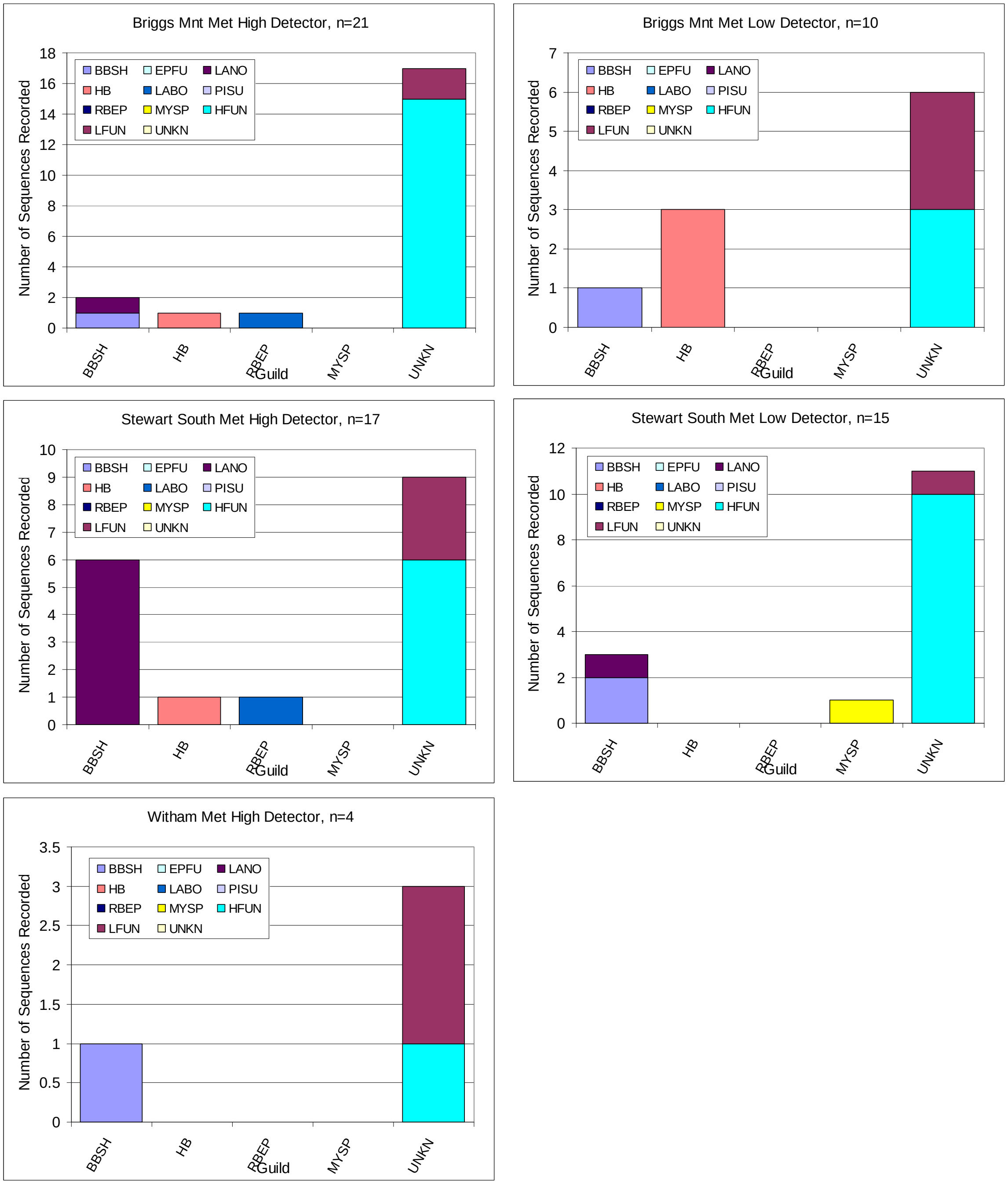


Figure 3-12. Number of guild and species detections at Highland met detectors from August through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

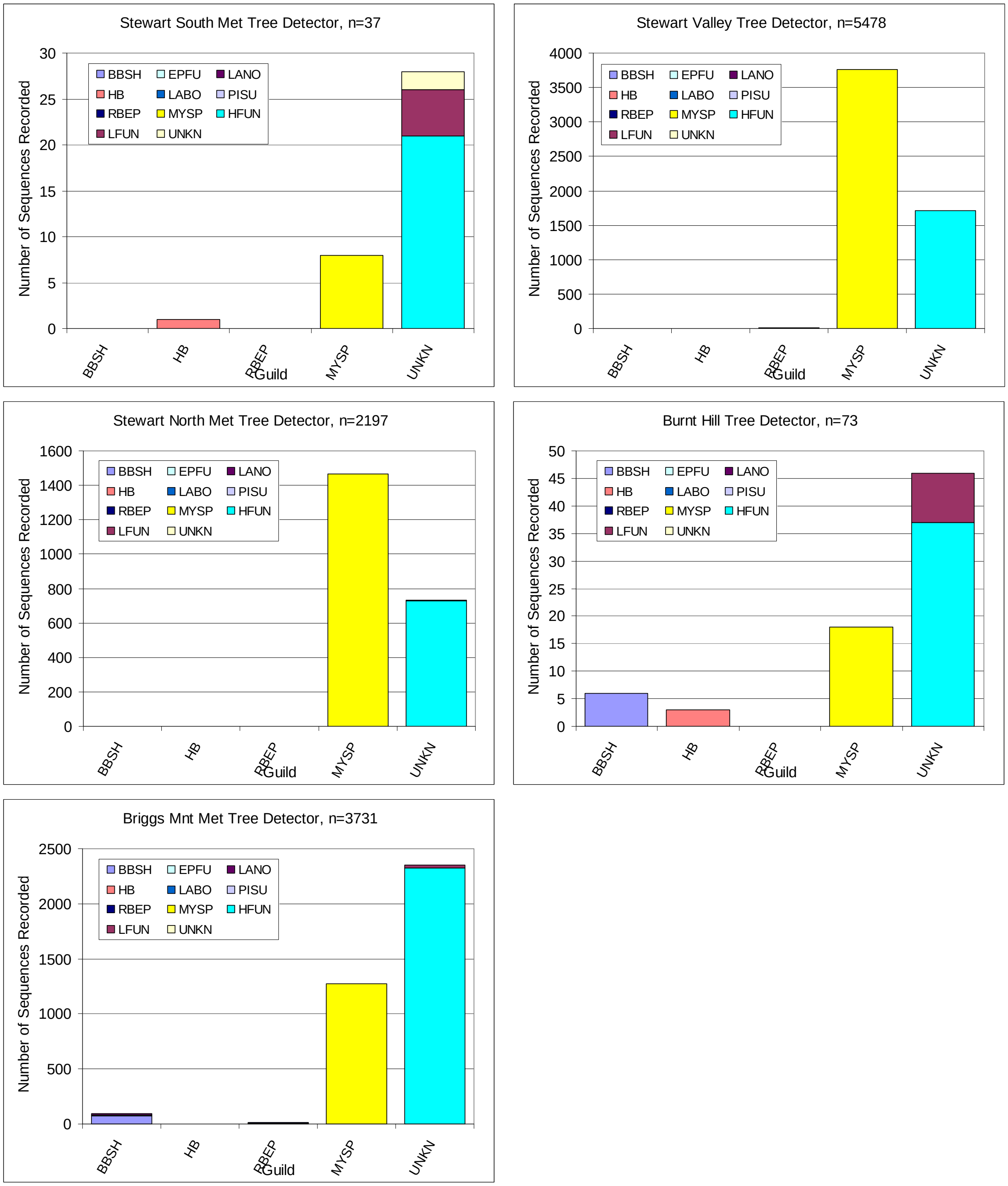


Figure 3-13. Number of guild and species detections at Highland ground-level detectors from August through October, 2008. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

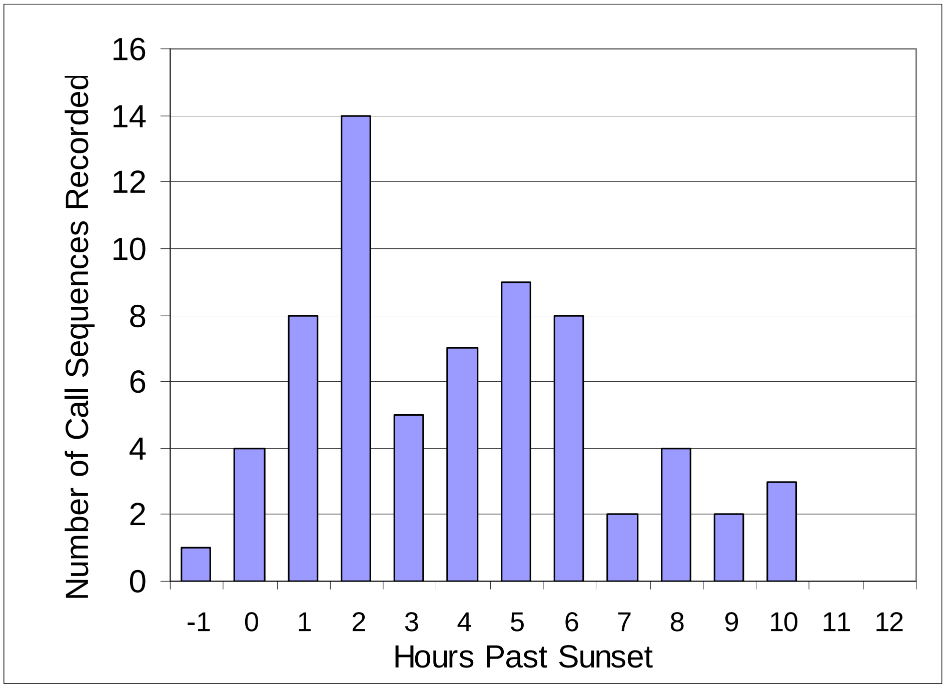


Figure 3-14. Distribution of hourly recorded call sequences at Highland Met Tower detectors from August through October, 2008.

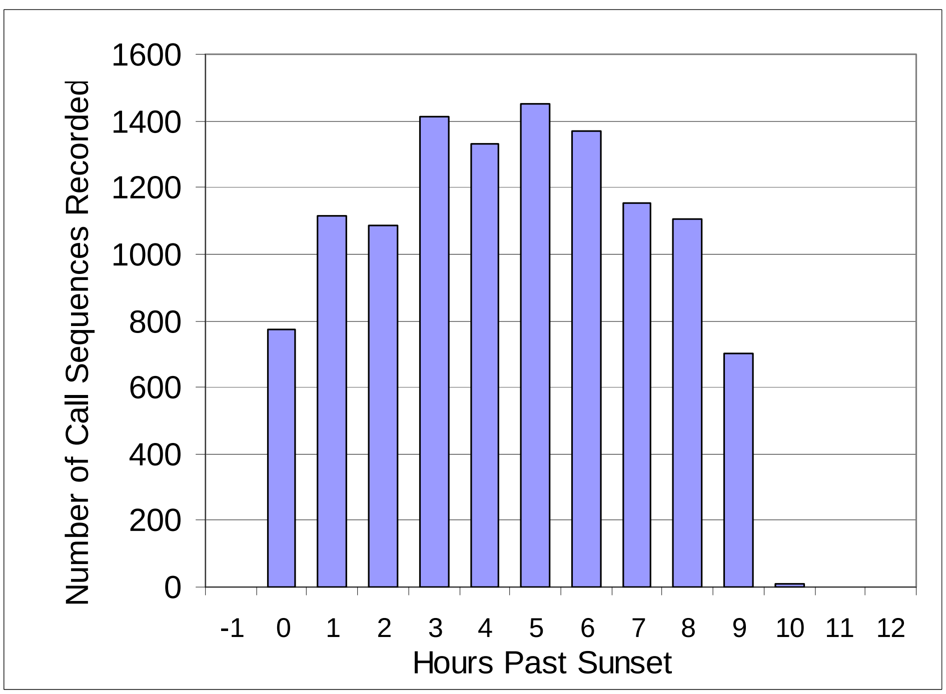


Figure 3-15. Distribution of hourly recorded call sequences at Highland ground level detectors from August through October, 2008.

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 13 provide information on the number of call sequences, by guild and suspected species, recorded at each detector and the weather conditions for that night.

3.3.2 Weather Data

Mean nightly temperature during the sampling period varied from -1.7 to 20.3° C, with a mean of 10.2° C. Mean nightly wind speed varied from 1.7 to 15.5 m/s, with a mean of 7.4 m/s. Mean nightly barometric pressure varied from 911.5 to 955.1 mbar, with a mean of 933.1 mbar. Mean nightly temperature, wind speed, and barometric pressure values were plotted against nightly number of bat detections (Figure 3-16). Data were plotted separately for met tower detectors and ground-level detectors because bats may respond to weather conditions differently at various heights (Arnett *et al*. 2006). A qualitative look at scatter plots of these data show no evident relationships between mean nightly temperature, wind speed, or barometric pressure and nightly bat detections.

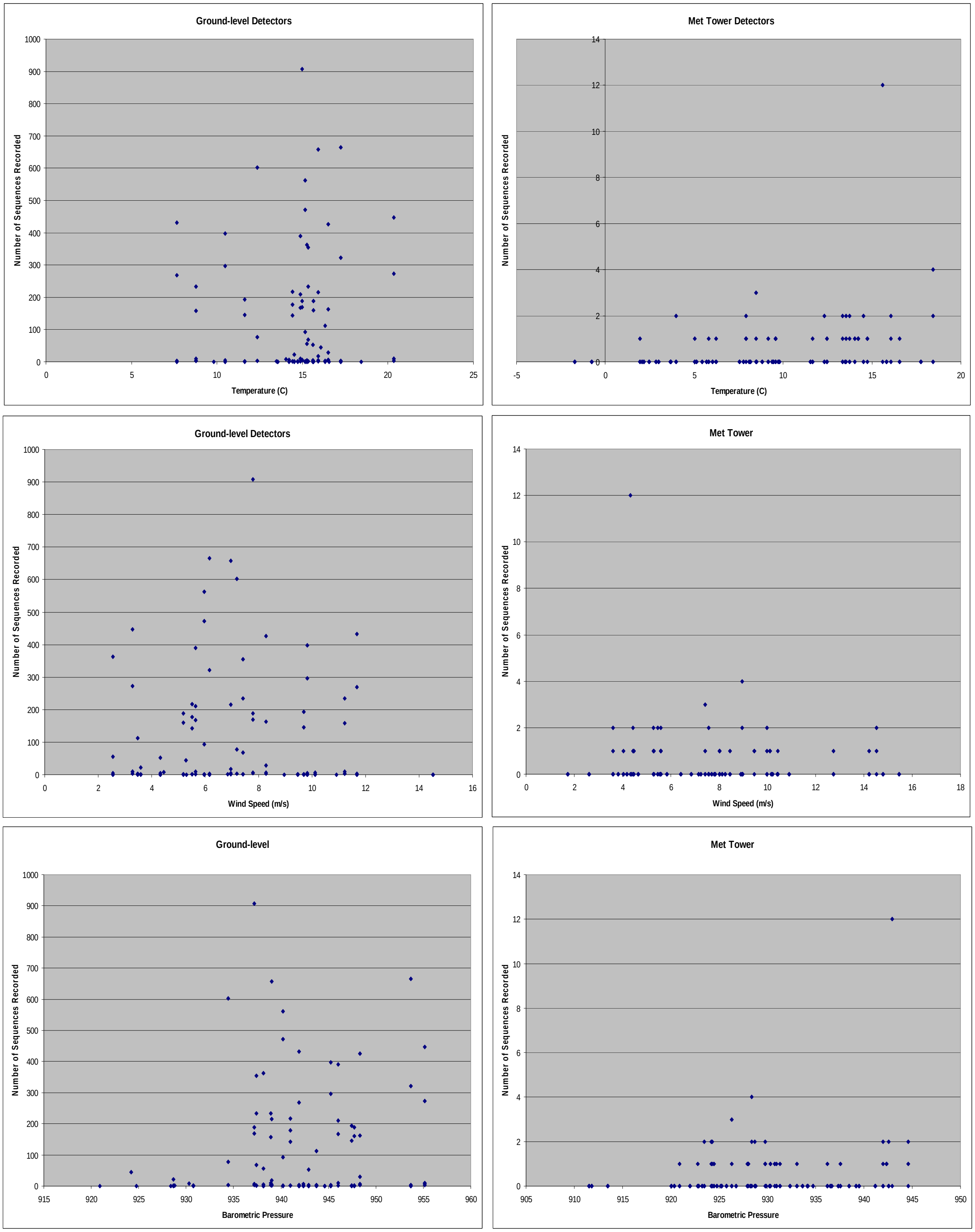


Figure 3-16. Nightly bat detections and mean nightly weather conditions at Highland bat detectors from August through October 2008.

3.4 DISCUSSION

Bat echolocation surveys provide some insight into possible activity patterns, species composition, and timing of movements of bats in the Project area. Variation in bat detections within and among detectors (Figures 3-2 through 3-15) illustrates the challenges associated with characterizing bat activity using acoustic detectors. However, some trends are evident based on patterns in timing and species composition of recorded call sequences.

Specifically, more than 99% of recorded sequences were collected at the tree detectors prior to being moved to the met towers. This difference in detection levels is likely a combination of several factors. First, the tree detectors were all placed at a height of 8 m (25') or less and therefore they were primarily picking up the activity of species that forage or are active closer to the ground. Based upon all of the call sequences collected during this field season, the highest percentage of identified calls (56.3%) were from genus *Myotis* and these species are more commonly detected beneath canopy level (Arnett *et al.* 2006). Putting these two factors together, the detectors placed in the trees were in a position to pick up more of the *Myotis* activity. Secondly, timing or seasonality of deployment also likely influenced call detection. Nightly activity rates at ground-level detectors were generally greatest during the first two weeks of sampling, and appeared to be generally declining by the end of August and early September when the detectors were moved to the met towers (Figures 3-2 to 3-11). Given the emerging relationship between bat activity and temperature at ground-level detectors documented in recent studies (Arnett *et al*. 2006), it is likely that ground-level detectors would have documented a substantial decline in activity during September and October had they remained deployed, since nightly average temperatures from September through October averaged only 8.6° C, with only 32 percent of nights having average nightly temperatures over 10° C.

Also of interest is the effect of wind speed and barometric pressure on bat detections and bat mortalities at wind developments. Acoustic surveys have documented a decrease in bat activity (or mortality) rates as wind speed increases, and as barometric pressure decreases (Arnett *et al*. 2005, Arnett *et al*. 2006, Arnett *et al*. 2008, Reynolds 2006). These patterns suggest that bats are more likely to migrate on nights with low wind speeds (less than 4 to 6 m/s) and high barometric pressure. No evident relationships were observed between wind speed and bat activity at this Project area.

Nightly trends in mean detections and mean weather conditions mask small-scale variation that occurs within a night. There are many factors driving such small-scale variation in hourly number of recordings, one of which is that most North American bats species emerge from their roost in large numbers shortly after dusk, periodically returning to their roosts for short periods during the night (see Hayes 1997 and cited references). This night-roosting behavior results in relatively higher activity levels shortly after dusk, when bats have not eaten or drank in many hours, and again just before dawn when many individuals will forage and drink again before returning to their roost for daylight hours. Although this bimodal trend in hourly activity rates is seen in many studies, this was not the case at the Highland site. Data from ground-level detectors showed a normal distribution of detections, and data from met towers showed an erratic pattern in hourly detections. While the erratic pattern documented at met detectors may be a result of low sample size, a much larger quantity of data were collected from ground-level detectors. Data are insufficient to explain why hourly detections at ground-level detectors were greatest 3-7 hours after sunset, but may be a reflection of high foraging activity at that period of the night.

Differences in detection rates between guilds at the various detector locations may reflect varying vertical distribution and habitat preferences of bat species (Arnett *et al*. 2006, Hayes 2000). Recent research using Anabat detectors recorded *Myotis* species more frequently at lower heights and larger species such as big brown and hoary bats were more frequently detected at greater heights (Arnett *et al*. 2006). This general trend matches the guild compositions reported in Figures 3-12 and 3-13. However, interpretation of guild composition is confounded by the high number of UNKN call sequences. Unknown call sequences could not be identified to guild or species due to short call sequences (less than five pulses) or poor call signature formation, often a result of bats flying at the edge of the detection zone of the detector or flying away from the microphone. The relatively small area sampled by bat detectors makes scenarios leading to un-identifiable call sequences common, but some information can still be gleaned from these poor recordings.

Specifically, 99 percent of UNKN sequences were identified as being HFUN, nearly all of which likely consist of red bats, pipistrelles, and *Myotis* species, since these species nearly always produce ultrasound sequences greater than 30 kHz. Of those HFUN calls, 99 percent of HFUN sequences were recorded at ground-level detectors. Because *Myotis* species are more frequently detected beneath the canopy level (Arnett *et al*. 2006), the inference is that the majority of HFUN sequences represent *Myotis* species. Conversely, the majority of HFUN sequences recorded at tower detectors (1% of HFUN sequences) are most likely red bats or tri-colored bats.

Qualitatively speaking, acoustic surveys at the Project site mirror similar surveys conducted in the Northeast during the fall. Specifically, detection rates at detectors suspended from met towers were low (less than 1 r/d/n), and detectors operating at ground-level exhibited tremendous variation, ranging from less than 10 to over 300 r/d/n. This type of variation reflects differing conditions (habitat, microclimates, etc.) and differing timing of operation among detectors. Thus, variability in bat activity, with generally low detection rates above canopy height, at the Highland site are consistent with the results of publicly available acoustic surveys conducted at other proposed wind developments in the northeast (Table 3-4).

Table 3-4. Summary of available fall bat detector surveys (results reported for individual detectors)

Year	Project	State	City	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
Tree or Low Tower detectors (10 m or below)											
2005	Clayton	NY	Clayton	forest edge	2	33	8/19	9/20	154	4.7	Woodlot 2005m
2005	High Sheldon	NY	Sheldon	field	2	49	8/1	10/4	5535	113	Woodlot 2005n
2005	Howard	NY	Howard	field	2	25	8/3	8/27	1493	51.5	Woodlot 2005o
2005	Jordanville	NY	Jordanville	field	2	34	8/12	9/22	124	4.4	Woodlot 2005q
2005	Lempster	NH	Lempster	forest edge	7.5	34	9/20	10/31	27	0.8	Woodlot 2005d
2005	Lempster	NH	Lempster	forest edge	2	42	9/20	10/31	2	0	Woodlot 2005d
2005	Marble River/Churubusco	NY	Churubusco	field	10	34	8/1	10/11	150	4.4	Woodlot 2005l
2005	Marble River/Churubusco	NY	Churubusco	field	2	18	8/1	10/11	113	6.3	Woodlot 2005l
2005	Stamford/Moresville	NY	Stamford	forest edge	2	58	8/15	10/15	280	4.8	Woodlot 2005e
2005	Top Notch	NY	Fairfield	field	2	34	8/19	9/21	44	1.3	Woodlot 2005p
2005	West Hill	NY	Munnsville	field	2	30	8/1	10/21	10	0.3	Woodlot 2005r
2006	Lempster	NH	Lempster	forest edge	10	29	9/9	10/24	2	0.1	Woodlot 2007a
2006	Lempster	NH	Lempster	forest edge	3	44	9/9	10/24	384	8.7	Woodlot 2007a
MET Tower Detectors											
2005	Dans Mountain	MD	Loarville	forest edge	11	53	8/1	9/22	574	10.8	Woodlot 2005a
2006	Brandon	NY	Brandon	field	12	62	7/25	10/4	1287	20.8	Woodlot 2006j
2005	Clayton	NY	Clayton	forest edge	30	0	8/19	9/20	0	0	Woodlot 2005m
2005	Dans Mountain	MD	Loarville	forest edge	23	31	8/1	9/22	388	12.5	Woodlot 2005a
2005	High Sheldon	NY	Sheldon	field	15	65	8/1	10/4	335	5.2	Woodlot 2005n
2005	High Sheldon	NY	Sheldon	field	30	58	8/1	10/4	137	2.4	Woodlot 2005n
2005	Howard	NY	Howard	field	30	13	8/3	8/19	30	2.3	Woodlot 2005o
2005	Howard	NY	Howard	field	27	15	8/3	8/14	30	2	Woodlot 2005o
2005	Jordanville	NY	Jordanville	field	15	34	8/12	9/22	143	4.2	Woodlot 2005q
2005	Jordanville	NY	Jordanville	field	30	41	8/12	9/22	255	6.2	Woodlot 2005q
2005	Marble River/Churubusco	NY	Churubusco	field	20	39	8/1	10/11	243	6.2	Woodlot 2005l
2005	Stamford/Moresville	NY	Stamford	forest edge	15	43	8/15	10/15	293	6.8	Woodlot 2005e
2005	Stamford/Moresville	NY	Stamford	forest edge	30	54	8/15	10/15	285	5.3	Woodlot 2005e
2005	Top Notch	NY	Fairfield	field	15	34	8/19	9/21	30	0.9	Woodlot 2005p
2005	Top Notch	NY	Fairfield	field	30	34	8/19	9/21	99	3	Woodlot 2005p
2005	West Hill	NY	Munnsville	field	15	47	8/1	10/21	179	3.8	Woodlot 2005r
2005	West Hill	NY	Munnsville	field	30	52	8/1	10/21	106	2	Woodlot 2005r
2006	Kibby	ME	Eustis	forest edge	45	72	6/20	10/25	18	0.3	Woodlot 2006m
2006	Kibby	ME	Eustis	forest edge	45	76	6/20	10/25	0	0	Woodlot 2006m
2006	Kibby	ME	Eustis	forest edge	20	44	6/20	10/25	4	0.1	Woodlot 2006m
2006	Kibby	ME	Eustis	forest edge	45	20	6/20	10/25	0	0	Woodlot 2006m
2005	Lempster	NH	Lempster	forest edge	15	42	9/20	10/31	14	0.3	Woodlot 2005d
2006	Lempster	NH	Lempster	forest edge	40	43	9/9	10/24	16	0.4	Woodlot 2007a
2006	Redington	ME	Redington	forest edge	15	21	8/10	10/24	0	0	Woodlot 2005u
2006	Redington	ME	Redington	forest edge	15	48	8/10	10/24	0	0	Woodlot 2005u
2006	Redington	ME	Redington	forest edge	30	29	8/10	10/24	0	0	Woodlot 2005u
2006	Redington	ME	Redington	forest edge	30	37	8/10	10/24	0	0	Woodlot 2005u
2006	Stetson	ME	Danforth	forest edge	30	73	6/28	10/16	8	0.1	Woodlot 2007b
2006	Stetson	ME	Danforth	forest edge	30	76	6/28	10/16	170	2.2	Woodlot 2007b
2006	Steuben	NY	Hartsville	field	15	76	7/26	10/10	119	1.6	EDR 2006b
2006	Steuben	NY	Hartsville	field	30	49	7/26	10/10	84	1.7	EDR 2006b
2006	Wethersfield	NY	Wethersfield	field	15	54	7/25	10/9	0	0	Woodlot 2006l
2006	Wethersfield	NY	Wethersfield	field	30	26	7/25	10/9	22	0.8	Woodlot 2006l
2006	Stetson	ME	Danforth	forest edge	15	105	6/28	10/16	108	1	Woodlot 2007b
2006	Stetson	ME	Danforth	forest edge	15	107	6/28	10/16	651	6.1	Woodlot 2007b
2006	Brandon	NY	Brandon	field	25	72	7/25	10/4	464	6.4	Woodlot 2006j
2006	Centerville	NY	Centerville	field	15	48	7/25	10/10	2	0	Woodlot 2006l
2006	Centerville	NY	Centerville	field	35	41	7/25	10/10	3	0.1	Woodlot 2006l
2006	Chateaugay	NY	Chateaugay	field	40	58	7/25	10/4	173	3	Woodlot 2006j
2006	Chateaugay	NY	Chateaugay	field	20	44	7/25	10/4	345	7.8	Woodlot 2006j
2006	Dutch Hill	NY	Cohocton	field	15	43	8/12	10/11	46	1.1	Woodlot 2006c
2006	Dutch Hill	NY	Cohocton	field	30	47	8/12	10/11	57	1.2	Woodlot 2006c

When considering the level of activity documented at the Project from August to October, it is important to acknowledge that numbers of recorded bat call sequences are not necessarily correlated with number of bats in an area. Acoustic detectors do not allow for differentiation between a single bat making multiple passes and multiple bats each recorded a single time (Hayes 2000). Thus, results of acoustic surveys must be interpreted with caution. However, the discussed patterns in peak timing of detection rates, and patterns of species may be useful for understanding activity levels of bats during the fall migration period and the summer.

4.0 Diurnal Raptor Surveys

4.1 INTRODUCTION

The Highland Wind Project area is located in the eastern portion of the "Eastern Continental Hawk Flyway,[5]" which extends from the Canadian Maritimes south to eastern Florida. Within this large area, raptors tend to concentrate along linear ridges, which create updrafts or "thermals" that raptors can use to fly long distances with minimal exertion (Berhold 2001). Designated by the state, the Western Maine Mountains biophysical region is an area of varied topography, with high peaks, plateaus, steep sided valleys, and foothills (McMahon 1990).

In coordination with the Maine Department of Inland Fisheries and Wildlife (MDIFW), Stantec designed and conducted fall diurnal raptor surveys at the Highland Wind Project to identify potential popular migration corridors and document species specific flight and behavioral patterns near the Project area. The surveys were conducted during the fall migration season for 15 days from early September to late October.

4.2 METHODS

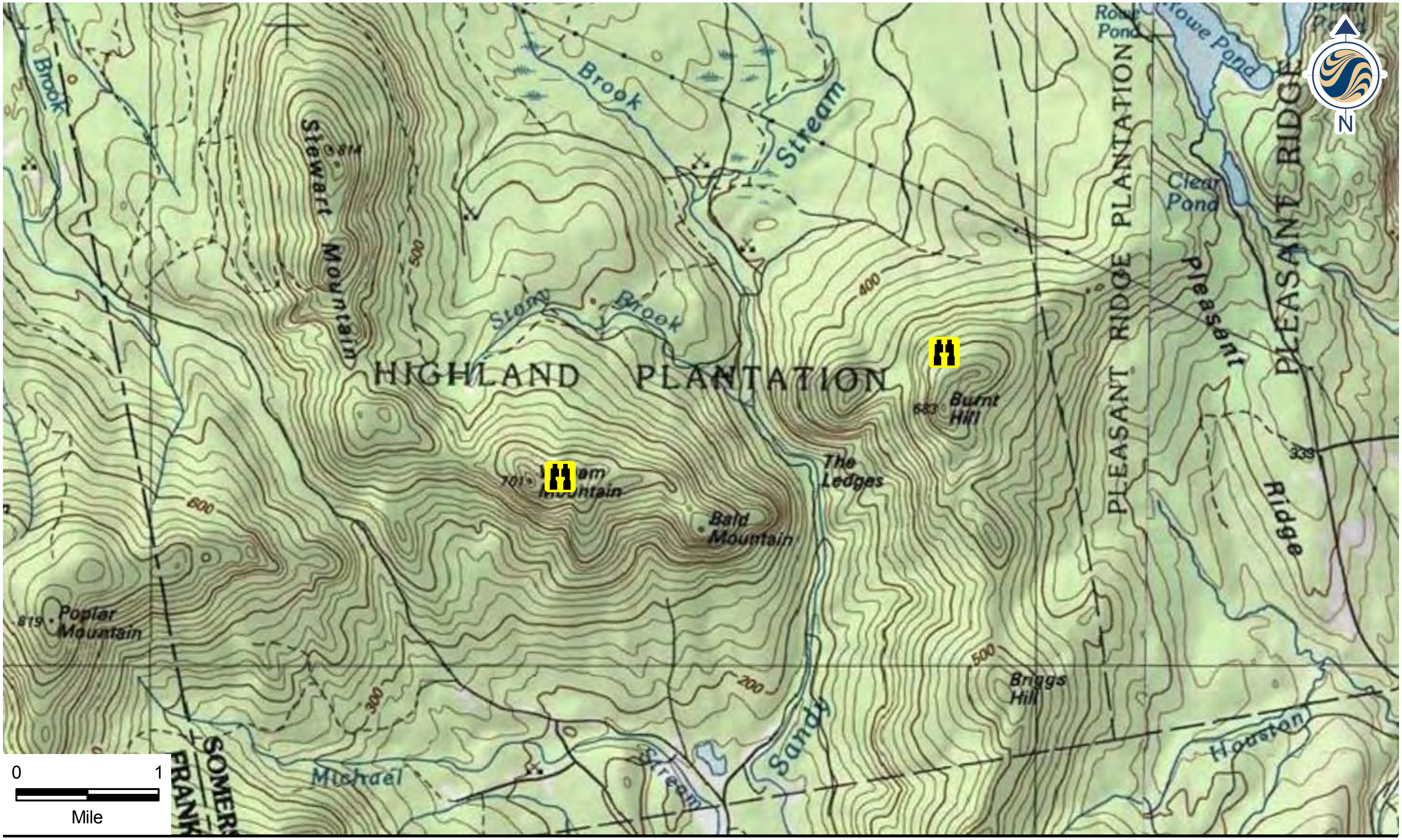
4.2.1 Field Surveys

Raptor surveys were conducted in two locations in the Project area. Two locations were discussed and chosen in coordination with MDIFW to provide adequate coverage the project area. The first was located in the clearing under the existing met tower on the summit of Witham Mountain and the other was located in the clearing under the existing met tower on Burnt Hill. Together these two locations afforded views of most of the Project area. Due to its topography and relatively low tree height, Witham Mountain location provided an excellent 360 degree view. The Burnt Hill location also afforded excellent views, although views to the south were slightly obstructed by trees and topography and views to the east were somewhat obstructed by trees (Figure 4-1). The majority of sampling occurred from the summit of Witham Mountain; however, 5 of the 15 survey days were sampled simultaneously with two observers

[5] The Eastern Continental Flyway includes the Maritime Provinces; New England; New York (south and east of a line from Jamestown to Utica to the north end of Lake Champlain); Pennsylvania (all except Erie County); Mid-Atlantic States through Georgia, West Virginia, Kentucky and Tennessee; Florida east of a line from Lake Seminole south to Apalachicola (Kellogg 2007).

(one at each survey location). Because views south from Burnt Hill were somewhat obstructed, there was limited overlap in birds that could be viewed from both locations. In addition, observers coordinated during the course of the simultaneous surveys using cell phone communication to reduce the likelihood that they were counting the same birds.

Surveys were conducted from 9 am to 4 pm, in order to include the time of day when the strongest thermal lift is produced and the majority of raptor migration activity typically occurs. Fall raptor surveys were generally conducted on days with favorable flight conditions, which typically occur on days following the passage of weather fronts or low-pressure systems causing northerly winds.



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Legend

Raptor Survey Location

Client/Project

Highland Wind, LLC
Highland Wind Project
Highland Plantation, Maine

Figure No.
4-1

Title
Raptor Survey Location Map
November 5, 2009

00385-F501-Raptor-Location-Map.mxd

Surveys were based on Hawk Migration Association of North America (HMANA) methods (HMANA 2007). During surveys, observers scanned the sky and surrounding landscape for raptors with binoculars and a spotting scope. Observations were recorded onto HMANA data sheets, which summarize the raptor count data by hour. Hourly weather observations, including wind speed and direction, temperature, percent cloud cover, and precipitation were recorded. Detailed notes for each observation were recorded on separate datasheets and Project area maps, including:

- The flight position(s) in relation to the ridge for each bird;
- The general flight path of each bird relative to topographic maps of the Project area;
- The minimum and maximum flight height for birds observed within 1 km-radius circle around the observer;
- An estimate of flight height for birds observed outside of 1 km-radius circle around the observer;
- The flight azimuth (in relation to true North); and
- Notes describing the general activity of the bird.

Flight positions were summarized into 4 categories: A) flight path directly over the ridge (A1-parallel to the ridge, A2-perpendicular to the ridge, or A3-over a saddle), B) flight path over upper slope of ridge, C) flight path over lower slope of ridge, and D) flight path over a valley (see Figure 3-2 below). As individual birds traveled through or in the vicinity of the Project, all position categories in which a bird occurred were recorded.

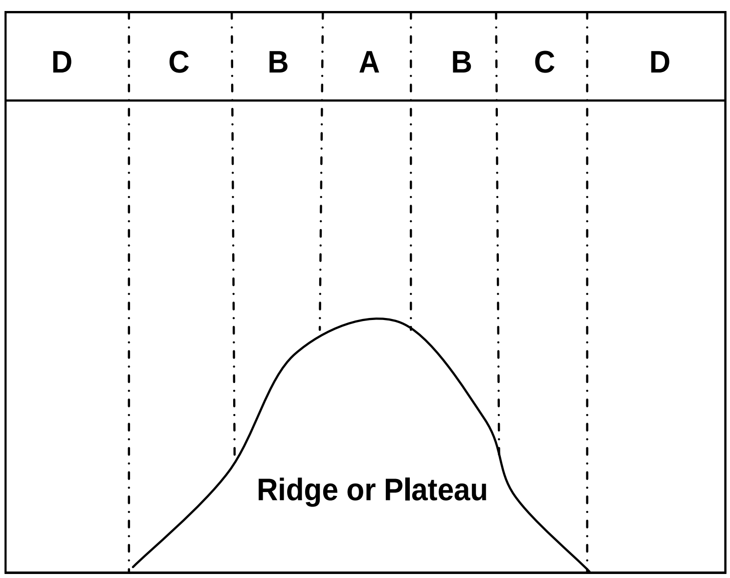

Figure 3-2. Raptor flight position categories within the Project area

Birds that flew too rapidly or were too far to accurately identify were recorded as unidentified to their genus or, if the identification of genus was not possible, unidentified raptor. Priority was given to raptor observations; however observers collected incidental data for other avian species observed including passerines and water birds.

4.2.2 Data Analysis

Results from raptor surveys were analyzed to derive the following summaries:

- Total number of individuals and species observed during each survey day and for the entire survey period;
- Total number of individuals observed flying above or below 130.5 m for each species observed within a 1 km-radius circle from the observer;
- Average flight height of birds observed outside of 1 km-radius circle from the observer;
- Number of birds suspected to be resident;
- The horizontal position of observed raptors with respect to the location of proposed turbines; and
- Hourly observation rate (birds per hour) for each survey day and for the entire survey period.

Flight height of each bird observed within 1 km was categorized as less than or greater than 130.5m (428’) above ground level, which is the approximate height of the proposed wind turbines. The mapped flight paths and recorded flight positions were reviewed to identify any general patterns for migrants in the vicinity of the Project area.

Observations from the Project were compared to data from regional HMANA hawk watch sites (Appendix C, Table 4). The regional hawk watch sites included for comparison are: Cadillac Mountain, ME; Little Round Top, NH; Pack Monadnock, NH; Allegheny Front, PA; Hawk Mountain, PA; Barre Falls, MA; Shatterack Mountain, MA; and Montreal West Island, QC. Also provided for comparison are the results of available regional surveys conducted at proposed wind farms located in New York, Vermont, New Hampshire and Maine (Appendix C, Table 5).

4.3 RESULTS

Between September 3 and October 21, 2008, Stantec conducted raptor surveys on 15 days (five of which were performed simultaneously by observers in two different locations) for a total of135 survey hours. Most surveys were conducted on clear days allowing for optimal visibility. Temperatures ranged from 0 to 24°C (32 to 75°F) during the survey period. Wind speeds during the survey period ranged from 0 to 24 km/h (0 to 15 mph); the average wind speed was 19 km/h (12 mph). Wind direction was variable throughout the survey days; however, the majority of days had winds from a northerly direction which is favorable for fall migration. Wind direction did not appear to affect the number of raptors seen per day; however, the peak day (n=87) occurred on September 15 when very light winds were predominantly from the west-northwest (Figure 3-3; Appendix B, Table 1).

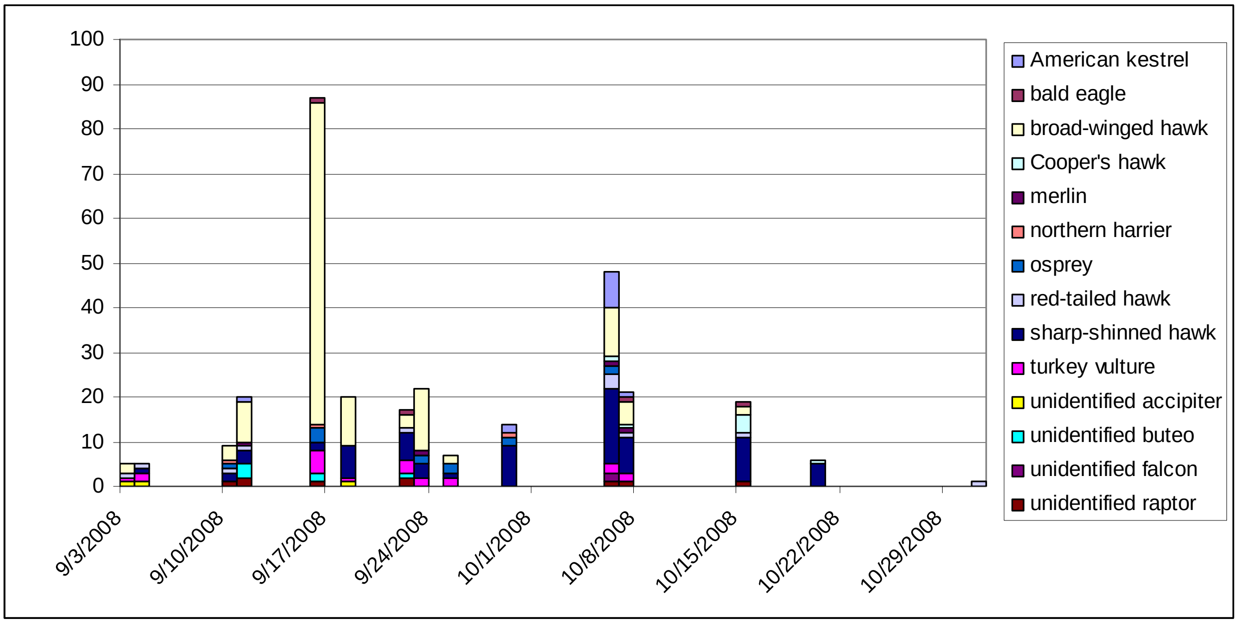

Figure 4-3. Total number of birds observed by species per survey day Fall 2008.

On a daily basis, the majority of observations occurred between 10:00 am and 4:00 pm; the peak activity hour was between 11:00 am and 12:00 pm, during the peak period of thermal development (Figure 4-4; Appendix B, Table 2).

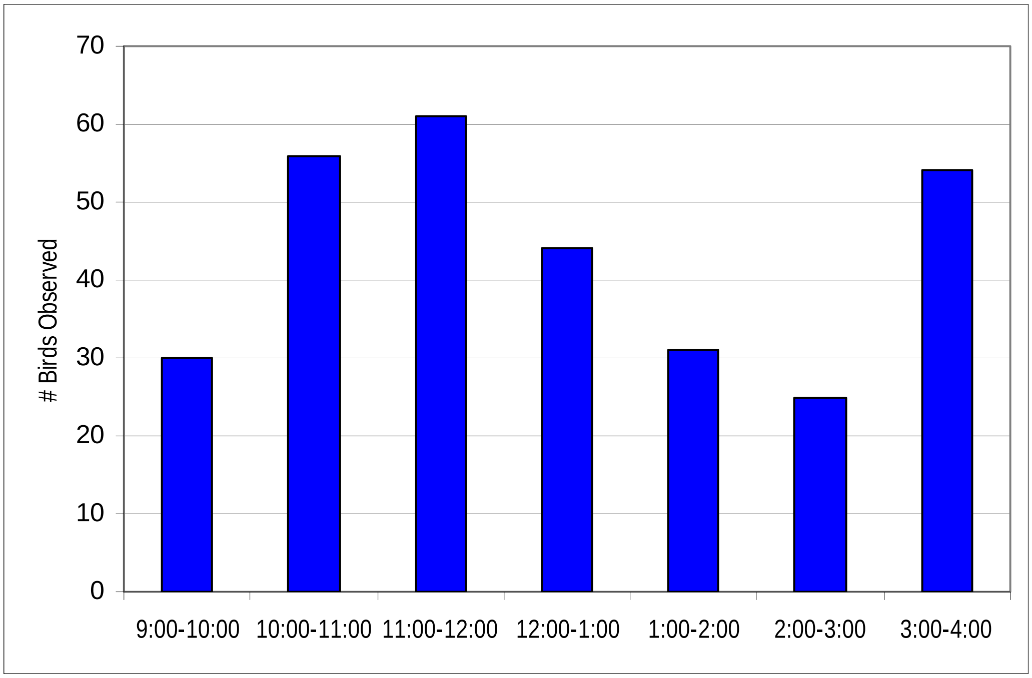

Figure 4-4. Number of individuals observed per survey hour - Fall 2008

During fall 2008 surveys, a total of 301 raptors representing 10 species plus individuals that could not be identified to species were observed. These results yielded an overall observation rate of 2.25 individuals/hour. Daily count totals ranged from 1 to 87 raptors (Appendix C, Table 1), and daily passage rates ranged from 0.2 to 6.2 birds/hour. Of the 301 total observations, 199 (65%) of those observations occurred during the 5 days of simultaneous surveys with two observers. Communication by the observers during the surveys limited the potential for "double-counting" birds.

Broad-winged hawks (*Buteo platypterus*) were the most commonly observed raptor (n=134, 45%; Figure 4-5). Approximately 53 percent of all observations of broad-winged hawks occurred on one day (September 16, 2008). Ninety-nine percent were believed to be migrants based on their direct flight paths and migratory behavior. Sharp-shinned hawks (*Accipiter striatus*) were the second most common species, representing 25 percent of all observations (n=74). Observers also documented the majority of these species as migratory (89%). Turkey vultures (*Cathartes aura*)[6] were the third most commonly observed species, accounting for 7 percent of all observations (n=20), and were almost equally documented to be migrant and resident individuals (40% and 55% respectively – 5% could not be determined to be either).

[6] While turkey vultures are not phylogenetically considered true raptors, they are diurnal migrants that exhibit flight characteristics similar to *Buteos, Accipiters* and other *Falconiformes* species, therefore vultures are typically included during hawk watch surveys.

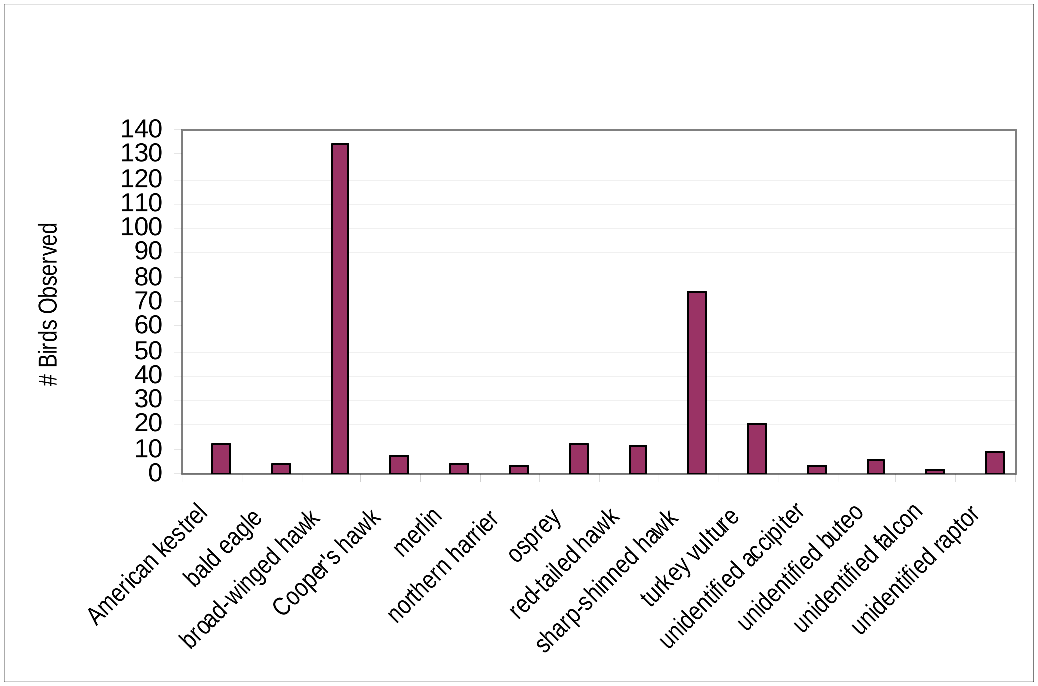

Figure 4-5. Number of individuals of species observed at Highland, ME - Fall 2008

Flight heights were categorized as above or below 130.5 m (428'), the maximum height of the proposed turbines. Of those raptors observed within the 1 km-radius circle from the observer (n=251), 43 percent were flying less than or equal to 130.5 m above the ground for at least a portion of their flight through the Project area (Figures 4-6 and 4-7; Table 4-1) and 40 percent were observed flying above 130.5 m. The remaining 17 percent of raptors were observed outside of the 1 km-radius circle with an average estimated flight height of 286 m (938') above ground.

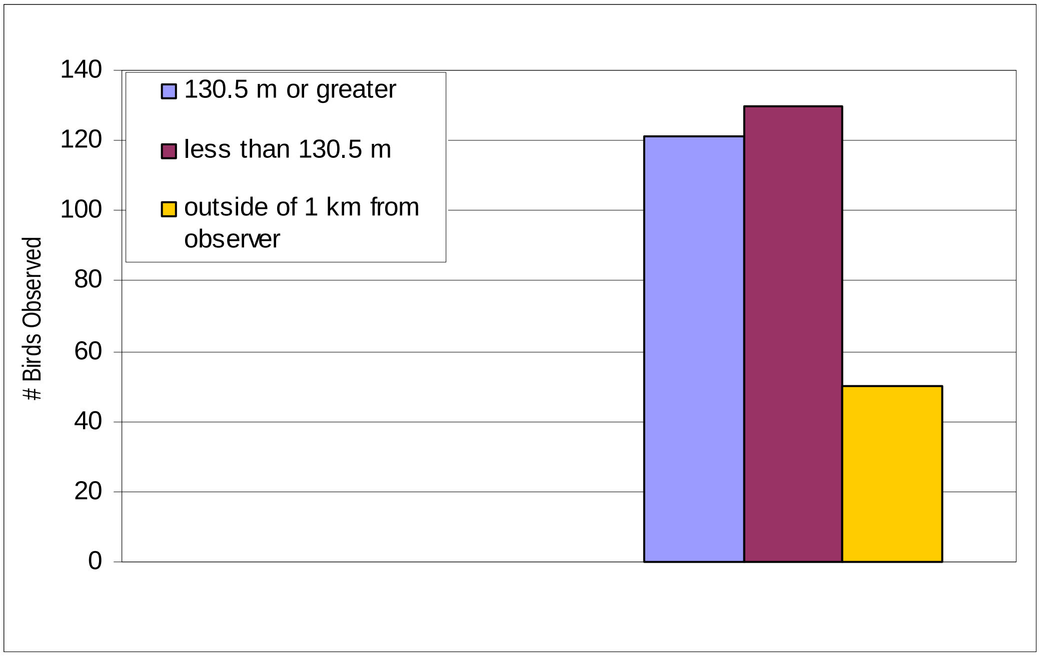

Figure 4-6. Number of individual species observed above or below 130.5 m (within 1 km from observer) and number of individuals observed beyond 1 km from observer at Highland, ME – Fall 2008

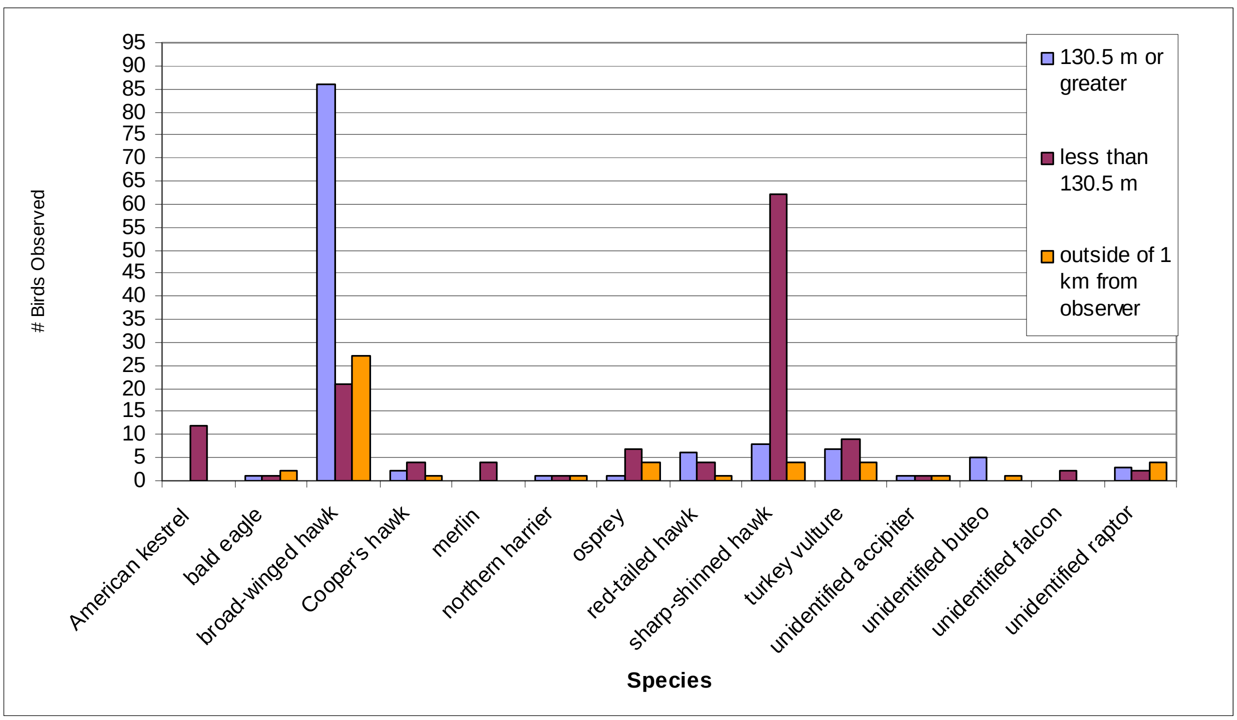

Figure 4-7. Raptor flight height distribution by species during Fall 2008 surveys at Highland, ME

Table 4-1. Number of observations and minimum flight heights within position categories relative to the Highland, ME Wind Project Area - Fall 2008							
	Position A) flight over ridge						
Total # Position Observations (n=360**)**	**A) flight over ridge**	**A1) flight along or parallel to ridge**	**A2) crossed ridge**	**A3) flight crossed depression or saddle**	**Position B - upper slope**	**Position C - lower slope**	**Position D - over valley**
No. of observations	30	121	73	55	38	19	24
Average minimum flight height (m)	178	150	108	87	80	153	288
	Combined number of observations and average min flight height for all positions over plateau (A, A1, A2, A3) 279; 131 m						

As raptors traveled through or in the vicinity of the Project area, they often occurred in multiple horizontal flight positions (A-D) along the ridge or outside of the Project area. Of the 360 total recorded flight positions, the majority of raptor observations[7] (n=279, 78%) flew over the ridge at some point in their flight path, 34 percent flying parallel to the ridge (Table 4-1; Figure 4-8). There were 55 observations of birds crossing the saddle between Witham and South Stewart Mountains at an average minimum flight height of 87 m.

[7] The number of observations is greater than the number of individuals because individuals can be observed crossing multiple position categories.

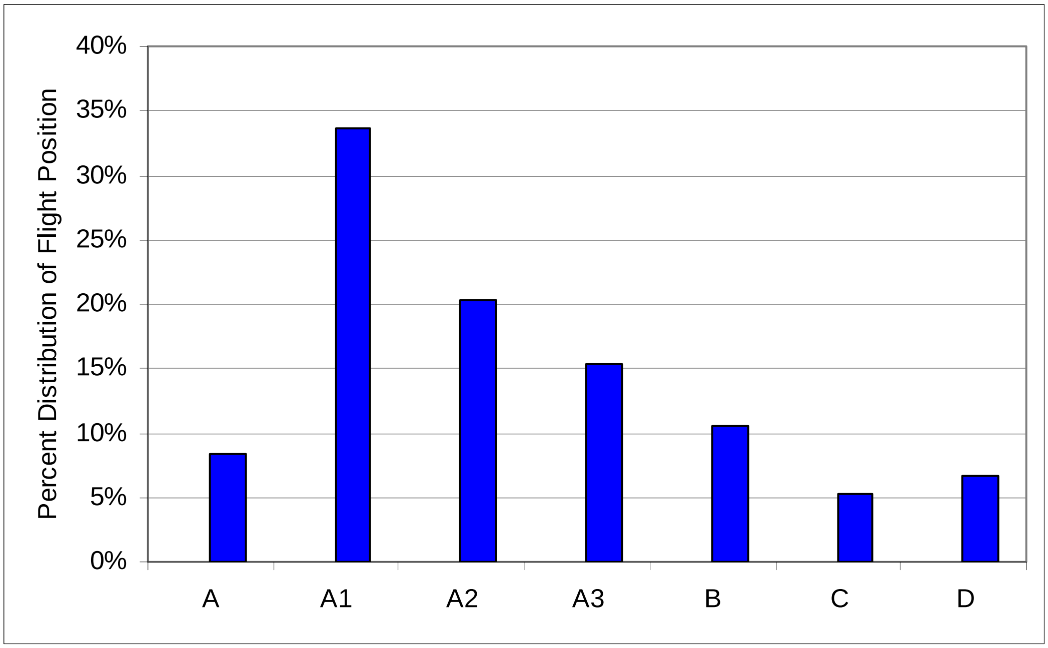

Figure 4-8. Raptor flight position distribution at Highland, Fall 2008. A = flight path directly over ridgeline, A1 = parallel to ridge, A2 = crosses ridge, A3 = crosses ridge in a gap or low area, B = over upper half of ridge but not on ridgeline, C = over lower half of ridge, D = not within Project boundary.

Rare, Threatened and Endangered Species

No state or federally listed threatened or endangered species were documented during the course of the raptor surveys. Observations during the fall surveys included, four bald eagles (*Haliaeetus leucocephalus*), a species currently listed as special concern in Maine[8]. These observations included one adult documented on September 16, a juvenile seen on September 22, a juvenile seen on October 7 and an adult bird recorded on October 15 (Figures 4-3 and 4-5). Observations occurred within the 1 km buffer zone as the individuals crossed the ridgeline (Figure 4-6; Appendix C, Table 2) and only one of the birds had a portion of its flight path below the proposed maximum turbine height. Three of the four individuals observed appeared to be residents based on their flight paths and behavior patterns. Three northern harriers (*Circus cyaneus*), also a Maine-listed species of special concern, were observed during these surveys.

[8] Effective September 12, 2009, the bald eagle was removed from Maine's list of Endangered and Threatened Species. It is currently listed as a species of special concern.

Incidental bird observations

During diurnal raptor surveys, other incidentally observed avian species also were documented (Table 4-2). These incidental observations were made while observers hiked to the designated survey points and during the course of the actual surveys. None of these species are state or federally listed as threatened or endangered. The white-throated sparrow (*Zonotrichia albicollis*) is a state listed species of special concern, but occurs commonly throughout much of the Project area.

Table 4-2. Species of birds observed incidentally during raptor surveys at Highland, ME Fall 2008
American crow
American goldfinch
black-capped chickadee
blue jay
boreal chickadee
brown creeper
Canada goose
common raven
dark-eyed junco
double-crested cormorant
downy woodpecker
golden-crowned kinglet
gray jay
hairy woodpecker
hermit thrush
yellow-rumped warbler
pileated woodpecker
red crossbill
snow bunting
unidentified waterfowl
white-throated sparrow
white-winged crossbill

4.4 DISCUSSION

Over the course of 15 survey days between September 3 and October 21, 301 raptors were observed. A total of 10 species as well as birds for which the species could not be determined were documented during this time. Broad-winged hawks, sharp-shinned hawks, and turkey vultures were the most commonly observed species. Most individuals, particularly among the broad-winged hawks, were believed to be migrant birds. Migrating raptors were generally observed moving in a southerly direction.

The passage rate at the Project area for the fall 2008 survey period was 2.25 birds/hour. The passage rates at the fall 2008 HMANA hawk watch sites in the region varied between a low of 7.7 (Second Mountain; Ft. Indiantown Gap, PA) and 18.2 (Waggoner's Gap; Carlisle, PA) birds/hr (Appendix B, Table 3 and 4). Compared to the HMANA 2008 fall data, the passage rate at the Project area was relatively low. It should be noted that visibility and topographic features at the Project area generally vary from those at HMANA sites; these factors can influence the results of observed passage rates at hawk watch sites. It should also be noted that raptor surveys at the Project area were not conducted on every possible day of the raptor migration period; therefore, peak movement days in the area were potentially missed, or have a greater potential to skew results given a limited number of overall survey days. For example, during the fall survey, a priority was placed on surveying consecutive days after the passage of a frontal system when northerly winds are most common. Additionally, the HMANA survey methods differ to some extent from survey methods conducted at proposed wind sites in that 1) flight heights are not gauged during HMANA surveys; 2) HMANA surveyors often do not count birds believed to be resident; and 3) HMANA surveys generally include multiple observers per day resulting in increased observer effort and increased detection rates. These factors should be considered when interpreting the results of the fall data.

Also, available for comparison are the public results of fall surveys at other proposed wind sites in the region from 1999 to 2006. Seasonal passage rates among these sites ranged from 0.9 (Deerfield Vermont; forested ridge) to 25.6 (Westfield, New York; Great Lakes Shore) birds/hr (Appendix A, Table 4 and 5). Raptor activity at the Highland site during fall 2008 was similar to passage rates observed in the region in recent years. There would be some degree of annual variation in passage rates at any particular hawk watch site due to variable regional populations from year to year, as well as differences in daily weather conditions at a site among years. The fall 2008 raptor survey is representative of a typical fall migration season in the Project area. Although there may be some annual variation in the fall passage rates, there is no reason to suspect that annual variations would be significant.

Raptors observed in Project area were observed flying along the ridge and over the ridgeline itself, including low flights through a saddle. Birds also were documented over the valley beyond the Project area. Flight heights ranged from treetop to nearly 1 km above the observation site, with 43 percent of raptors estimated to be below 130.5 m, the maximum height of proposed turbines. Studies have documented that raptors employ a high level of collision avoidance behaviors at modern wind facilities (Whitfield and Madders 2006, Chamberlain *et al.* 2006). As most raptors are diurnal, they may be able to visually, as well as acoustically detect turbines during periods of fair weather. Foraging raptors that become distracted by prey, or migrant raptors flying during periods of reduced visibility, may be at increased risk of collision with wind turbines.

Flight height of raptors varied by survey day, individual raptor, and species across the survey period. Variations in the flight heights of raptors are due to a variety of factors, particular flight behaviors of raptor species and daily weather conditions. Typically, accipiters and falcons use up-drafts from side slopes to gain lift and, therefore, fly low over ridgelines. Buteos and accipitors tend to use lift from thermals that develop over side slopes and valleys and tend typically to fly higher during hours of peak thermal development. Raptors typically fly lower than usual during windy or inclement headwinds. Tailwinds, on the other hand, create deflective updrafts and push birds higher (Bildstein 2006).

Migration of raptors is a dynamic process due to various behavioral and environmental factors. As a result, flight pathways and movements along ridges, side slopes, and across valleys may vary seasonally, daily or hourly. Raptors may shift and use different ridge lines and cross different valleys from year to year or season to season. Weather and wind are major factors that influence migration pathways. Wind direction and strength, in particular, strongly affect the propensity of raptors to congregate along ‘leading lines’ or topographic features. The location of a raptor along a ‘leading line’ can be influenced by lateral drift caused by crosswinds (Richardson 1998).The flight paths of raptors observed at the Project area varied between survey dates and were likely influenced by varying wind direction and weather.

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Appendix A

Radar Survey Results

Appendix A Table 1. Survey dates, results, level of effort, and weather - Fall 2008								
Date	**Passage rate**	**Flight Direction**	**Flight Height (m)**	**% below 130.5 m**	**Hours of Survey**	**Temperature (C)**	**Wind Speed (m/s)**	**Wind Direction (degrees)**
8/30	339	169	351	15%	6	15	5	347
8/31	375	201	452	9%	11	14	8	1
9/1	607	211	380	14%	11	16	7	2
9/2	1196	275	264	26%	11	15	2	63
9/7	451	199	271	21%	11	10	6	330
9/10	684	220	355	9%	11	6	4	356
9/11	504	265	268	27%	12	10	3	275
9/15	1201	212	333	14%	9	10	4	53
9/16	685	249	250	25%	12	9	2	1
9/17	701	252	357	11%	9	11	4	359
9/18	548	229	314	13%	11	3	4	74
9/21	629	223	357	17%	6	7	4	77
9/22	777	249	256	28%	12	6	2	110
9/24	715	269	310	26%	12	12	2	309
9/29	833	220	516	10%	11	10	4	85
10/2	261	183	254	27%	12	4	6	355
10/3	117	177	303	18%	12	4	8	15
10/4	349	220	290	25%	12	3	4	32
10/6	195	189	531	6%	12	3	7	53
10/7	68	173	522	4%	13	7	3	47
Entire Season	**549**	**227**	**348**	**17%**	**216**	**9**	**4**	**25**

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	11	12	13	Mean	Median	Stdev	SE
8/30	287	410	438	379	--	180	343	--	--	--	--	N/A	N/A	339	361	94	38
8/31	171	493	659	660	664	510	434	268	177	86	7	N/A	N/A	375	434	243	73
9/1	231	557	654	977	1186	846	766	504	493	407	56	N/A	N/A	607	557	327	99
9/2	471	1321	1466	1664	1468	1468	1400	1221	1414	980	284	N/A	N/A	1196	1400	441	133
9/7	571	771	1063	573	439	418	285	236	188	332	82	--	N/A	451	418	283	85
9/10	632	1275	1007	943	1043	868	626	439	343	236	114	--	N/A	684	632	373	112
9/11	137	664	818	932	1093	696	506	321	246	188	386	64	N/A	504	446	335	97
9/15	817	948	1452	2480	1757	--	1144	895	757	557	--	--	N/A	1201	948	605	202
9/16	411	693	943	1775	1720	1071	900	289	171	136	91	21	N/A	685	552	611	176
9/17	107	595	900	1302	1774	--	--	664	579	--	321	64	N/A	701	595	557	186
9/18	875	1463	--	1050	823	757	447	157	189	145	107	11	N/A	548	447	475	143
9/21	336	600	654	793	793	596	--	--	--	--	--	--	N/A	629	627	169	69
9/22	514	973	1043	943	882	887	1082	938	871	605	570	11	N/A	777	885	304	88
9/24	686	525	714	1039	960	807	804	789	607	686	701	257	N/A	715	708	201	58
9/29	807	1582	2202	1655	1425	321	354	--	314	155	139	211	--	833	354	745	225
10/2	225	373	375	329	257	236	424	268	379	214	--	57	0	261	263	129	37
10/3	21	204	134	133	142	86	100	186	121	96	107	75	--	117	114	49	14
10/4	69	123	230	--	343	300	223	546	823	543	343	648	0	349	321	248	72
10/6	81	380	416	300	336	229	193	171	129	77	11	16	--	195	182	139	40
10/7	51	91	99	107	70	79	69	98	70	64	43	48	0	68	70	29	8
Entire Season	**375**	**702**	**803**	**949**	**904**	**575**	**561**	**470**	**437**	**324**	**210**	**124**	**0**	**549**	**421**	**468**	**32**

-- indicates no data recorded for that hour; N/A indicates that sunrise occurred prior to that hour and no data was collected

Appendix A Table 3. Mean Nightly Flight Direction		
Night of	**Mean Flight Direction**	**Circular Stdev**
8/30	169	34
8/31	201	22
9/1	211	30
9/2	275	39
9/7	199	35
9/10	220	29
9/11	265	99
9/15	212	34
9/16	249	50
9/17	252	61
9/18	229	26
9/21	223	38
9/22	249	35
9/24	269	71
9/29	220	27
10/2	183	61
10/3	177	41
10/4	220	37
10/6	189	20
10/7	173	30
Entire Season	227	51

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 130.5 meters
	1	2	3	4	5	6	7	8	9	10	11	12	13	Mean	Median	STDV	SE	
8/30	246	313	335	403	420	389	--	--	--	--	--	--	--	351	362	66	27	15%
8/31	173	531	421	413	465	515	499	506	534	489	424	--	--	452	489	102	31	9%
9/1	301	511	506	473	401	347	370	364	361	266	280	--	--	380	364	86	26	14%
9/2	203	300	268	272	257	282	260	303	297	200	265	--	--	264	268	35	11	26%
9/7	304	335	343	377	271	282	275	202	317	148	206	195	--	271	278	70	20	21%
9/10	363	420	367	338	339	337	357	425	334	355	323	298	--	355	347	37	11	9%
9/11	328	442	340	282	274	235	257	215	173	200	165	308	--	268	266	79	23	27%
9/15	328	329	394	331	--	337	358	283	313	320	--	--	--	333	329	31	10	14%
9/16	316	373	272	216	244	233	221	234	298	211	334	50	--	250	239	82	24	25%
9/17	389	427	390	357	325	291	--	271	360	--	399	--	--	357	360	52	17	11%
9/18	271	351	274	249	354	369	384	371	361	286	367	129	--	314	352	75	22	13%
9/21	259	443	424	360	338	319	--	--	--	--	--	--	--	357	349	68	28	17%
9/22	272	246	231	296	287	238	275	295	295	250	221	169	--	256	261	38	11	28%
9/24	238	269	311	335	324	396	334	319	344	247	292	--	--	310	319	46	14	26%
9/29	312	310	361	417	612	731	701	598	563	624	482	502	489	516	502	139	38	10%
10/2	295	357	307	314	319	260	283	272	188	164	40	--	--	254	283	91	27	27%
10/3	285	334	434	303	317	321	316	230	275	314	275	316	219	303	314	53	15	18%
10/4	287	266	254	265	276	325	297	304	341	295	265	210	385	290	287	43	12	25%
10/6	294	542	589	588	625	565	617	563	522	441	586	423	550	531	563	93	26	6%
10/7	276	323	476	567	630	682	570	521	503	626	557	538	--	522	547	119	34	4%
Entire Season	**287**	**371**	**365**	**358**	**372**	**373**	**375**	**349**	**354**	**320**	**322**	**285**	**411**	**348**	**321**	**119**	**8**	**17%**
-- indicates no data for that hour																		

Appendix A Table 5. Summary of available avian fall radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

Year	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)	(Turbine Ht) % Targets Below Turbine Height	Reference
2005	Dairy Hills, Clinton Cty, NY	57	n/a	Agricultural plateau	64	n/a	180	466	(n/a) 10%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2005	Perry, Wyoming Cty, NY	n/a	n/a	Agricultural plateau	64	n/a	180	466	(125 m) 10%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2005	Alabama, Genesee Cty, NY	59	n/a	Agricultural plateau	67	n/a	219	489	(125 m) 11%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2004	Sheffield, Caledonia Cty, VT	18	176	Forested ridge	114	19-320	200	566	(125 m) 1%	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2005	Alabama, Genesee Cty, NY	40	n/a	Agricultural plateau	111	n/a	35	413	(125 m) 14%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2007	New Grange, Chautauqua Cty, NY	57	n/a	Great Lakes plain	112	n/a	208	458	(125 m) 10%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2005	Churubusco, Clinton Cty, NY	38	414	Great Lakes plain/ADK foothills	152	9-429	193	438	(120 m) 5%	Woodlot Alternatives, Inc. 2005. A Fall Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
2005	Maple Ridge, Lewis Cty, NY	57	n/a	Agricultural plateau	158	n/a	195	415	(125 m) 8%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2005	Swallow Farm, PA	58	n/a	Forested ridge	166	n/a	n/a	402	(125 m) 5%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2004	Casselman, PA	30	n/a	Forested ridge	174	n/a	n/a	436	(125 m) 7%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2004	Dans Mountain, MD	34	318	Forested ridge	188	2-633	193	542	(125 m) 11%	Woodlot Alternatives, Inc. 2004. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
2006	Villenova, Chautauqua Cty, NY	36	n/a	Great Lakes plain	189	16-604	216	353	(120 m) 9%	Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment.
2004	Prattsburgh, Steuben Cty, NY	30	315	Agricultural plateau	193	12-474	188	516	(125 m) 3%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
2005	Sheldon, Wyoming Cty, NY	36	347	Agricultural plateau	197	43-529	213	422	(120 m) 3%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.

Appendix A Table 5. Summary of available avian fall radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

Year	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)	(Turbine Ht) % Targets Below Turbine Height	Reference
2005	Ellenberg, Clinton Cty, NY	57	n/a	Great Lakes plain/ADK foothills	197	n/a	162	333	(125 m) 12%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2005	Prattsburgh-Italy, NY	41	n/a	Agricultural plateau	200	n/a	177	365	(125 m) 9%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2005	Kibby, Franklin Cty, ME (Range 1)	12	101	Forested ridge	201	12-783	196	352	(125 m) 12%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
2004	Franklin, Pendleton Cty, WV	34	349	Forested ridge	229	7-926	175	583	(125 m) 8%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
2006	Wethersfield, Wyoming Cty, NY	56	n/a	Agricultural plateau	256	31-701	208	344	(125 m) 11%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2006	Centerville, Allegany Cty, NY	57	n/a	Agricultural plateau	259	12-877	208	350	(125 m) 12%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2008	Hounsfield, Jefferson Cty, NY	60	674	Great Lakes island	281	64-835	207	298	(125 m) 17%	Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC.
2005	Fayette Cty, PA	26	n/a	Forested ridge	297	n/a	n/a	426	(125 m) 5%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2005	Stamford, Delaware Cty, NY	48	418	Forested ridge	315	22-784	251	494	(110 m) 3%	Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2006	Somerset Cty, PA	29	n/a	Forested ridge	316	n/a	n/a	374	(125 m) 8%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2007	Laurel Mountain, Barbour Cty, WV	20	212	Forested ridge	321	76-513	209	533	(130 m) 6%	Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
2008	Georgia Mountain, VT	21	n/a	Forested ridge	326	56-700	230	371	(120 m) 7%	Stantec Consulting Services Inc. 2008. A Fall 2008 Survey of Bird Migration at the Georgia Mountain Wind Project, Vermont. Prepared for Georgia Mountain Community Wind.
2006	Cape Vincent, Jefferson Cty, NY	63	508	Great Lakes plain	346	n/a	209	490	(125 m) 8%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2007	Errol, Coos County, NH	29	232	Forested ridge	366	54 to 1234	223	343	(125 m) 15%	Stantec Consulting Inc. 2007. Fall 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. Prepared for Granite Reliable Power, LLC.

Appendix A Table 5. Summary of available avian fall radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

Year	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)	(Turbine Ht) % Targets Below Turbine Height	Reference
2007	Lincoln, Penobscot Cty, ME	22	231	Forested ridge	368	82-953	284	343	(120 m) 13%	Woodlot Alternatives, Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
2005	Preston Cty, WV	26	n/a	Forested ridge	379	n/a	n/a	420	(125 m) 10%	Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Preston Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC.
2005	Jordanville, Herkimer Cty, NY	38	404	Agricultural plateau	380	26-1019	208	440	(125 m) 6%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2005	Highland, VA	58	n/a	Forested ridge	385	n/a	n/a	442	(125 m) 12%	Plissner, J.H., T.J. Mabee, and B.A. Cooper. 2006 A radar and visual study of nocturnal bird and bat migration at the proposed Highland New Wind Development project, Virginia, Fall 2005. Report to Highland New Wind Development, LLC.
2005	Clayton, Jefferson Cty, NY	37	385	Agricultural plateau	418	83-877	168	475	(150 m) 10%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
2007	Roxbury, Oxford Cty, ME	20	220	Forested ridge	420	88-1006	227	365	(130 m) 14%	Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC.
2006	Bedford Cty, PA	29	n/a	Forested ridge	438	n/a	n/a	379	(125 m) 10%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2005	Bliss, Wyoming Cty, NY	8	n/a	Agricultural plateau	440	52-1392	n/a	411	(125 m) 13%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2007	Allegany, Cattaraugus Cty, NY	46	n/a	Forested ridge	451	n/a	230	382	(150 m) 14%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2005	Kibby, Franklin Cty, ME (Valley)	5	13	Forested ridge	452	52-995	193	391	(125 m) 16%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
2006	Stetson, Washington Cty, ME	12	77	Forested ridge	476	131-1192	227	378	(125 m) 13%	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2005	Howard, Steuben Cty, NY	39	405	Agricultural plateau	481	18-1434	185	491	(125 m) 5%	Woodlot Alternatives, Inc. 20065 A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2008	Oakfield, Penobscot Cty, ME	20	n/a	Forested ridge	501	116-945	200	309	(125 m) 18%	Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
2005	Mars Hill, Aroostook Cty, ME	18	117	Forested ridge	512	60-1092	228	424	(120 m) 8%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
2006	Dutch Hill, Steuben Cty, NY	21	n/a	Agricultural plateau	535	n/a	215	358	(125 m) 11%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf

Appendix A Table 5. Summary of available avian fall radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

Year	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)	(Turbine Ht) % Targets Below Turbine Height	Reference
2005	Deerfield, Bennington Cty, VT	32	324	Forested ridge	559	3-1736	221	395	(100 m) 13%	Woodlot Alternatives, Inc. 2006. Fall 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2005	Kibby, Franklin Cty, ME (Mountain)	12	115	Forested ridge	565	109-1107	167	370	(125 m) 16%	Woodlot Alternatives, Inc. 2006. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
2006	Lempster, Sullivan Cty, NH	32	290	Forested ridge	620	133-1609	206	387	(125 m) 8%	Woodlot Alternatives, Inc. 2007. A Fall 2007 Survey of Nocturnal Bird Migration,Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
2006	Chateaugay, Franklin Cty, NY	35	327	Agricultural plateau	643	38-1373	212	431	(120 m) 8%	Woodlot Alternatives, Inc. 2006. Fall 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2005	Fairfield, Herkimer Cty, NY	38	423	Agricultural plateau	691	116-1351	198	516	(145 m) 6%[1]	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
2005	Munnsville, Madison Cty, NY	31	292	Agricultural plateau	732	15-1671	223	644	(118 m) 2%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2007	New Creek, Grant Cty, WV	20	n/a	Forested ridge	811	263-1683	231	360	(130 m) 17%	Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project,West Virginia. Prepared for AES New Creek, LLC.
2007	Wolfe Island, Ontario, Canada*	n/a	n/a	Great Lakes island	n/a	n/a	95	233	(125m) 23%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf

Note:

1 The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

Appendix B

Acoustic Bat Survey Results

Appendix B Table 1. Summary of fall 2008 acoustic bat data and weather during each survey night at the Briggs Met High detector

		BBSH			LACI	RBEP			MYSP	UNKN							
Night of	**Operated Okay?**	**BBSH**	**big brown**	**silver-haired**	**hoary bat**	**eastern red**	**eastern pipistrelle**	**RBEP**	**MYSP**	**high-frequency**	**low-frequency**	**unknown**	**Total**	**Wind Speed (m/s)**	**Barometric Pressure**	**Relative Humidity (%)**	**Temperature (celsius)**
08/28/08	Yes	1								11			**12**	4.3	943		15.6
08/29/08	Yes				1								**1**	10.1	942		14.2
08/30/08	Yes					1							**1**	14.5	945		13.6
08/31/08	Yes												**0**				
09/01/08	Yes												**0**	9.5	931		14.7
09/02/08	Yes												**0**	3.6	929		14.5
09/03/08	Yes												**0**	5.3	924		16.1
09/04/08	Yes												**0**	4.5	930		14.0
09/05/08	Yes									2	2		**4**	9.0	928		18.4
09/06/08	Yes												**0**	5.3	921		16.6
09/07/08	Yes												**0**	10.9	925		9.8
09/08/08	Yes												**0**	6.8	929		13.5
09/09/08	Yes												**0**	10.2	925		7.8
09/10/08	Yes												**0**	4.0	936		6.2
09/11/08	Yes												**0**	5.6	933		9.6
09/12/08	Yes												**0**	5.6	924		12.5
09/13/08	Yes												**0**	10.0	924		13.3
09/14/08	Yes												**0**	15.5	912		17.8
09/15/08	Yes												**0**	7.4	926		8.5
09/16/08	Yes			1									**1**	5.6	930		7.9
09/17/08	Yes									1			**1**	8.0	928		9.6
09/18/08	Yes												**0**	4.4	938		2.1
09/19/08	Yes												**0**	7.8	937		5.7
09/20/08	Yes												**0**	8.4	931		11.7
09/21/08	Yes												**0**	3.6	938		5.0
09/22/08	Yes												**0**	2.6	941		6.0
09/23/08	Yes												**0**	7.2	940		8.1
09/24/08	Yes									1			**1**	4.4	942		13.7
09/25/08	Yes												**0**	7.6	943		12.3
09/26/08	Yes												**0**	8.3	937		11.5
09/27/08	Yes												**0**	5.6	930		15.8
09/28/08	Yes												**0**	7.6	923		12.5
09/29/08	Yes												**0**	4.2	926		8.8
09/30/08	Yes												**0**	5.6	920		9.4
10/01/08	Yes												**0**	3.8	912		9.4
10/02/08	Yes												**0**	8.9	913		3.0
10/03/08	Yes												**0**	14.8	920		3.7
10/04/08	Yes												**0**	8.0	930		2.9
10/05/08	Yes												**0**	6.4	932		2.2
10/06/08	Yes												**0**	12.7	931		1.9
10/07/08	Yes												**0**	14.2	928		5.8
10/08/08	Yes												**0**	7.7	922		9.7
10/09/08	Yes												**0**	10.4	923		9.2
10/10/08	Yes												**0**	9.0	934		6.2
10/11/08	Yes												**0**	8.1	939		5.1
10/12/08	Yes												**0**	7.2	937		8.2
10/13/08	Yes												**0**	7.6	934		7.5
10/14/08	Yes												**0**	10.2	927		5.4
10/15/08	Yes												**0**	5.8	925		8.5
10/16/08	Yes												**0**	10.4	923		3.7
10/17/08	Yes												**0**	7.8	928		-0.8
10/18/08	Yes												**0**	4.7	935		-1.7
10/19/08	Yes												**0**	1.7	934		2.5
10/20/08	Yes												**0**	5.5	923		4.0
By Species		**1**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**15**	**2**	**0**	**21**				
By Guild		**3**			**1**	**1**			**0**	**17**							
		BBSH			**LACI**	**RBEP**			**MYSP**	**UNKN**			**Total**				

Appendix B Table 2. Summary of fall 2008 acoustic bat data and weather during each survey night at the Briggs Met Low detector

		BBSH			HB	RBEP			MYSP	UNKN							
Night of	Operated Okay?	BBSH	big brown	silver-hiared	hoary bat	eastern red	eastern pipistrelle	RBEP	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Barometric Pressure	Relative Humidity (%)	Temperature (celsius)
08/29/08	Yes										1		**1**	10.1	942		14.2
08/30/08	Yes												**0**	14.5	945		13.6
08/31/08	Yes												**0**				
09/01/08	Yes	1											**1**	9.5	931		14.7
09/02/08	Yes												**0**	3.6	929		14.5
09/03/08	Yes												**0**	5.3	924		16.1
09/04/08	Yes												**0**	4.5	930		14.0
09/05/08	Yes									1	1		**2**	9.0	928		18.4
09/06/08	Yes				1								**1**	5.3	921		16.6
09/07/08	Yes												**0**	10.9	925		9.8
09/08/08	Yes												**0**	6.8	929		13.5
09/09/08	Yes												**0**	10.2	925		7.8
09/10/08	Yes												**0**	4.0	936		6.2
09/11/08	Yes										1		**1**	5.6	933		9.6
09/12/08	Yes				1								**1**	5.6	924		12.5
09/13/08	Yes												**0**	10.0	924		13.3
09/14/08	Yes												**0**	15.5	912		17.8
09/15/08	Yes												**0**	7.4	926		8.5
09/16/08	Yes												**0**	5.6	930		7.9
09/17/08	Yes				1								**1**	8.0	928		9.6
09/18/08	Yes												**0**	4.4	938		2.1
09/19/08	Yes												**0**	7.8	937		5.7
09/20/08	Yes												**0**	8.4	931		11.7
09/21/08	Yes									1			**1**	3.6	938		5.0
09/22/08	Yes												**0**	2.6	941		6.0
09/23/08	Yes												**0**	7.2	940		8.1
09/24/08	Yes												**0**	4.4	942		13.7
09/25/08	Yes												**0**	7.6	943		12.3
09/26/08	Yes												**0**	8.3	937		11.5
09/27/08	Yes												**0**	5.6	930		15.8
09/28/08	Yes												**0**	7.6	923		12.5
09/29/08	Yes												**0**	4.2	926		8.8
09/30/08	Yes												**0**	5.6	920		9.4
10/01/08	Yes												**0**	3.8	912		9.4
10/02/08	Yes												**0**	8.9	913		3.0
10/03/08	Yes												**0**	14.8	920		3.7
10/04/08	Yes												**0**	8.0	930		2.9
10/05/08	Yes												**0**	6.4	932		2.2
10/06/08	Yes												**0**	12.7	931		1.9
10/07/08	Yes									1			**1**	14.2	928		5.8
10/08/08	Yes												**0**	7.7	922		9.7
10/09/08	Yes												**0**	10.4	923		9.2
10/10/08	Yes												**0**	9.0	934		6.2
10/11/08	Yes												**0**	8.1	939		5.1
10/12/08	Yes												**0**	7.2	937		8.2
10/13/08	Yes												**0**	7.6	934		7.5
10/14/08	Yes												**0**	10.2	927		5.4
10/15/08	Yes												**0**	5.8	925		8.5
10/16/08	Yes												**0**	10.4	923		3.7
10/17/08	Yes												**0**	7.8	928		-0.8
10/18/08	Yes												**0**	4.7	935		-1.7
10/19/08	Yes												**0**	1.7	934		2.5
10/20/08	Yes												**0**	5.5	923		4.0
By Species		**1**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**3**	**3**	**0**	**10**				
By Guild		**4**			**3**	**0**			**0**	**6**							
		BBSH			**HB**	**RBEP**			**MYSP**	**UNKN**			**Total**				

Appendix B Table 3. Summary of fall 2008 acoustic bat data and weather during each survey night at the Briggs Met Tree detector

		BBSH			LACI	RBEP			MYSP	UNKN							
Night of	**Operated Okay?**	**BBSH**	**big brown**	**silver-haired**	**hoary**	**eastern red**	**eastern pipistrelle**	**RBEP**	**MYSP**	**high-frequency**	**low-frequency**	**unknown**	**Total**	**Wind Speed (m/s)**	**Barometric Pressure**	**Relative Humidity (%)**	**Temperature (celsius)**
08/11/08	No													7.2	934		12.4
08/12/08	Yes	2				1			122	238			**363**	2.5	938		15.3
08/13/08	Yes	9		8					36	123	2		**178**	5.5	941		14.4
08/14/08	Yes							1		1			**2**	3.5	944		16.3
08/15/08	Yes	2	1	1		1		1	70	92	1		**169**	7.8	937		15.0
08/16/08	Yes	1				3		1	134	333			**472**	6.0	940		15.2
08/17/08	Yes		2						71	160	1		**234**	7.4	937		15.3
08/18/08	Yes	2		1		1			61	204			**269**	11.7	942		7.7
08/19/08	Yes	1							117	75			**193**	9.7	947		11.6
08/20/08	Yes								125	197			**322**	6.2	954		17.2
08/21/08	Yes	2				1			96	173	1		**273**	3.3	955		20.3
08/22/08	Yes	7	1	4	1				56	91	3		**163**	8.3	948		16.5
08/23/08	Yes	1					1	1	74	137	1		**215**	7.0	939		15.9
08/24/08	Yes			1	1			1	59	96			**158**	11.2	939		8.8
08/25/08	Yes	1							138	158			**297**	9.8	945		10.5
08/26/08	Yes								51	109			**160**	5.2	948		15.6
08/27/08	Yes	46			1				51	100	12		**210**	5.6	946		14.9
08/28/08	Yes								12	40	1		**53**	4.3	943		15.6
By Species		**74**	**4**	**15**	**3**	**7**	**1**	**5**	**1273**	**2327**	**22**	**0**	**3731**				
By Guild		**96**			**3**	**13**			**1273**	**2349**							
		BBSH			**LACI**	**RBEP**			**MYSP**	**UNKN**			**Total**				

Appendix B Table 4. Summary of fall 2008 acoustic bat data and weather during each survey night at the Burnt Hill Tree detector

		BBSH			LACI	RBEP			MYSP	UNKN							
Night of	**Operated Okay?**	**BBSH**	**big brown**	**silver-haired bat**	**hoary**	**eastern red**	**eastern pipistrelle**	**RBEP**	**MYSP**	**high-frequency**	**low-frequency**	**unknown**	**Total**	**Wind Speed (m/s)**	**Barometric Pressure**	**Relative Humidity (%)**	**Temperature (celsius)**
08/11/08	No													7.2	934		12.4
08/12/08	Yes												**0**	2.5	938		15.3
08/13/08	Yes	1									1		**2**	5.5	941		14.4
08/14/08	Yes				1				1	1			**3**	3.5	944		16.3
08/15/08	Yes	1								2	1		**4**	7.8	937		15.0
08/16/08	Yes										2		**2**	6.0	940		15.2
08/17/08	Yes	1								1			**2**	7.4	937		15.3
08/18/08	Yes												**0**	11.7	942		7.7
08/19/08	Yes												**0**	9.7	947		11.6
08/20/08	Yes												**0**	6.2	954		17.2
08/21/08	Yes				1				1	5	2		**9**	3.3	955		20.3
08/22/08	Yes	1			1					4			**6**	8.3	948		16.5
08/23/08	Yes								2	3			**5**	7.0	939		15.9
08/24/08	Yes								1	2			**3**	11.2	939		8.8
08/25/08	Yes	1								1	2		**4**	9.8	945		10.5
08/26/08	Yes								1				**1**	5.2	948		15.6
08/27/08	Yes	1							6	2	1		**10**	5.6	946		14.9
08/28/08	Yes												**0**	4.3	943		15.6
08/29/08	Yes												**0**	10.1	942		14.2
08/30/08	Yes												**0**	14.5	945		13.6
08/31/08	Yes												**0**				
09/01/08	Yes												**0**	9.5	931		14.7
09/02/08	Yes								6	16			**22**	3.6	929		14.5
By Species		**6**	**0**	**0**	**3**	**0**	**0**	**0**	**18**	**37**	**9**	**0**	**73**				
By Guild		**9**			**3**	**0**			**18**	**46**							
		BBSH			**LACI**	**RBEP**			**MYSP**	**UNKN**			**Total**				

Appendix B Table 5. Summary of fall 2008 acoustic bat data and weather during each survey night at the Stewart N Met E Tree detector

		BBSH			LACI	RBEP			MYSP	UNKN							
Night of	**Operated Okay?**	**BBSH**	**big brown**	**silver-haired bat**	**hoary**	**eastern red**	**eastern pipistrelle**	**RBEP**	**MYSP**	**high-frequency**	**low-frequency**	**unknown**	**Total**	**Wind Speed (m/s)**	**Barometric Pressure**	**Relative Humidity (%)**	**Temperature (celsius)**
08/11/08	Yes								341	262			**603**	7.2	934		12.4
08/12/08	Yes								5				**5**	2.5	938		15.3
08/13/08	Yes								67	150			**217**	5.5	941		14.4
08/14/08	Yes												**0**	3.5	944		16.3
08/15/08	Yes							1	720	187			**908**	7.8	937		15.0
08/16/08	Yes				1				88	4			**93**	6.0	940		15.2
08/17/08	Yes								61	7			**68**	7.4	937		15.3
08/18/08	Yes									3			**3**	11.7	942		7.7
08/19/08	Yes									1			**1**	9.7	947		11.6
08/20/08	Yes												**0**	6.2	954		17.2
08/21/08	Yes								9	1			**10**	3.3	955		20.3
08/22/08	Yes								26	3			**29**	8.3	948		16.5
08/23/08	Yes								18				**18**	7.0	939		15.9
08/24/08	Yes								7	3			**10**	11.2	939		8.8
08/25/08	Yes												**0**	9.8	945		10.5
08/26/08	Yes												**0**	5.2	948		15.6
08/27/08	Yes								68	100			**168**	5.6	946		14.9
08/28/08	Yes									4			**4**	4.3	943		15.6
08/29/08	Yes								4	2			**6**	10.1	942		14.2
08/30/08	Yes												**0**	14.5	945		13.6
08/31/08	Yes												**0**				
09/01/08	Yes									1			**1**	9.5	931		14.7
09/02/08	Yes												**0**	3.6	929		14.5
09/03/08	Yes								42	1	1		**44**	5.3	924		16.1
09/04/08	Yes								7	1			**8**	4.5	930		14.0
09/05/08	Yes												**0**	9.0	928		18.4
09/06/08	Yes												**0**	5.3	921		16.6
09/07/08	Yes												**0**	10.9	925		9.8
09/08/08	Yes								1				**1**	6.8	929		13.5
By Species		**0**	**0**	**0**	**1**	**0**	**0**	**1**	**1464**	**730**	**1**	**0**	**2197**				
By Guild		**1**			**1**	**1**			**1464**	**731**							
		BBSH			**LACI**	**RBEP**			**MYSP**	**UNKN**			**Total**				

Appendix B Table 6. Summary of fall 2008 acoustic bat data and weather during each survey night at the Stewart N Met W Tree detector

		BBSH			LACI	RBEP			MYSP	UNKN							
Night of	Operated Okay?	BBSH	big brown	silver-haired bat	hoary	eastern red	eastern pipistrelle	RBEP	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Relative Humidity (%)	Temperature (celsius)
08/11/08	Yes												0				
08/12/08	Yes												0				
08/13/08	Yes												0				
08/14/08	Yes												0				
08/15/08	Yes									1			1				
08/16/08	Yes												0				
08/17/08	Yes												0				
08/18/08	Yes												0				
08/19/08	Yes												0				
08/20/08	Yes												0				
08/21/08	Yes									1			1				
08/22/08	Yes									1			1				
08/23/08	Yes									2			2				
08/24/08	Yes									1			1				
08/25/08	Yes												0				
08/26/08	Yes												0				
08/27/08	Yes									1	1		2				
08/28/08	Yes												0				
08/29/08	Yes												0				
08/30/08	Yes									1			1				
08/31/08	Yes												0				
09/01/08	Yes												0				
09/02/08	Yes												0				
09/03/08	Yes												0				
09/04/08	Yes												0				
09/05/08	Yes									1			1				
09/06/08	Yes												0				
09/07/08	Yes												0				
09/08/08	Yes												0				
By Species		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**1**	**0**	**10**				
By Guild		**0**			**0**	**0**			**0**	**10**							
		BBSH			**LACI**	**RBEP**			**MYSP**	**UNKN**			**Total**				

Appendix B Table 7. Summary of fall 2008 acoustic bat data and weather during each survey night at the Stewart S Met High detector

		BBSH			LACI	RBEP			MYSP	UNKN							
Night of	Operated Okay?	BBSH	big brown	silver-haired bat	hoary	eastern red	eastern pipistrelle	RBEP	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Barometric Pressure	Relative Humidity (%)	Temperature (celsius)
09/03/08	Yes			1									**1**	5.3	924		16.1
09/04/08	Yes			1									**1**	4.5	930		14.0
09/05/08	Yes												**0**	9.0	928		18.4
09/06/08	Yes												**0**	5.3	921		16.6
09/07/08	Yes												**0**	10.9	925		9.8
09/08/08	Yes												**0**	6.8	929		13.5
09/09/08	Yes												**0**	10.2	925		7.8
09/10/08	Yes												**0**	4.0	936		6.2
09/11/08	Yes												**0**	5.6	933		9.6
09/12/08	Yes												**0**	5.6	924		12.5
09/13/08	Yes			1	1								**2**	10.0	924		13.3
09/14/08	Yes												**0**	15.5	912		17.8
09/15/08	Yes					1				1	1		**3**	7.4	926		8.5
09/16/08	Yes									1			**1**	5.6	930		7.9
09/17/08	Yes									1			**1**	8.0	928		9.6
09/18/08	Yes												**0**	4.4	938		2.1
09/19/08	Yes												**0**	7.8	937		5.7
09/20/08	Yes												**0**	8.4	931		11.7
09/21/08	Yes												**0**	3.6	938		5.0
09/22/08	Yes												**0**	2.6	941		6.0
09/23/08	Yes												**0**	7.2	940		8.1
09/24/08	Yes			2									**2**	4.4	942		13.7
09/25/08	Yes			1							1		**2**	7.6	943		12.3
09/26/08	Yes												**0**	8.3	937		11.5
09/27/08	Yes												**0**	5.6	930		15.8
09/28/08	Yes												**0**	7.6	923		12.5
09/29/08	Yes												**0**	4.2	926		8.8
09/30/08	Yes												**0**	5.6	920		9.4
10/01/08	Yes												**0**	3.8	912		9.4
10/02/08	Yes												**0**	8.9	913		3.0
10/03/08	Yes												**0**	14.8	920		3.7
10/04/08	Yes												**0**	8.0	930		2.9
10/05/08	Yes												**0**	6.4	932		2.2
10/06/08	Yes									1			**1**	12.7	931		1.9
10/07/08	Yes												**0**	14.2	928		5.8
10/08/08	Yes												**0**	7.7	922		9.7
10/09/08	Yes										1		**1**	10.4	923		9.2
10/10/08	Yes												**0**	9.0	934		6.2
10/11/08	Yes												**0**	8.1	939		5.1
10/12/08	Yes												**0**	7.2	937		8.2
10/13/08	Yes												**0**	7.6	934		7.5
10/14/08	Yes												**0**	10.2	927		5.4
10/15/08	Yes												**0**	5.8	925		8.5
10/16/08	Yes												**0**	10.4	923		3.7
10/17/08	Yes												**0**	7.8	928		-0.8
10/18/08	Yes												**0**	4.7	935		-1.7
10/19/08	Yes												**0**	1.7	934		2.5
10/20/08	Yes									2			**2**	5.5	923		4.0
By Species		**0**	**0**	**6**	**1**	**1**	**0**	**0**	**0**	**6**	**3**	**0**	**17**				
By Guild		**7**			**1**	**1**			**0**	**9**							
		BBSH			**LACI**	**RBEP**			**MYSP**	**UNKN**			**Total**				

Appendix B Table 8. Summary of fall 2008 acoustic bat data and weather during each survey night at the Stewart S Met Low detector

		BBSH			HB	RBEP			MYSP	UNKN							
Night of	Operated Okay?	BBSH	big brown	silver-hiared	hoary bat	eastern red	eastern pipistrelle	RBEP	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Barometric Pressure	Relative Humidity (%)	Temperature (celsius)
08/28/08	Yes												**0**	4.3	943		15.6
08/29/08	Yes									1			**1**	10.1	942		14.2
08/30/08	Yes									2			**2**	14.5	945		13.6
08/31/08	Yes									1			**1**				
09/01/08	Yes									1			**1**	9.5	931		14.7
09/02/08	Yes								1	1			**2**	3.6	929		14.5
09/03/08	Yes	1								1			**2**	5.3	924		16.1
09/04/08	Yes	1											**1**	4.5	930		14.0
09/05/08	Yes												**0**	9.0	928		18.4
09/06/08	Yes												**0**	5.3	921		16.6
09/07/08	Yes												**0**	10.9	925		9.8
09/08/08	Yes												**0**	6.8	929		13.5
09/09/08	Yes												**0**	10.2	925		7.8
09/10/08	Yes												**0**	4.0	936		6.2
09/11/08	Yes												**0**	5.6	933		9.6
09/12/08	Yes									1			**1**	5.6	924		12.5
09/13/08	Yes			1									**1**	10.0	924		13.3
09/14/08	Yes												**0**	15.5	912		17.8
09/15/08	Yes										1		**1**	7.4	926		8.5
09/16/08	Yes									2			**2**	5.6	930		7.9
09/17/08	Yes												**0**	8.0	928		9.6
09/18/08	Yes												**0**	4.4	938		2.1
09/19/08	Yes												**0**	7.8	937		5.7
09/20/08	Yes												**0**	8.4	931		11.7
09/21/08	Yes												**0**	3.6	938		5.0
09/22/08	Yes												**0**	2.6	941		6.0
09/23/08	Yes												**0**	7.2	940		8.1
09/24/08	Yes												**0**	4.4	942		13.7
09/25/08	Yes												**0**	7.6	943		12.3
09/26/08	Yes												**0**	8.3	937		11.5
09/27/08	Yes												**0**	5.6	930		15.8
09/28/08	Yes												**0**	7.6	923		12.5
09/29/08	Yes												**0**	4.2	926		8.8
09/30/08	Yes												**0**	5.6	920		9.4
10/01/08	Yes												**0**	3.8	912		9.4
10/02/08	Yes												**0**	8.9	913		3.0
10/03/08	Yes												**0**	14.8	920		3.7
10/04/08	Yes												**0**	8.0	930		2.9
10/05/08	Yes												**0**	6.4	932		2.2
10/06/08	Yes												**0**	12.7	931		1.9
10/07/08	Yes												**0**	14.2	928		5.8
10/08/08	Yes												**0**	7.7	922		9.7
10/09/08	Yes												**0**	10.4	923		9.2
10/10/08	Yes												**0**	9.0	934		6.2
10/11/08	Yes												**0**	8.1	939		5.1
10/12/08	Yes												**0**	7.2	937		8.2
10/13/08	Yes												**0**	7.6	934		7.5
10/14/08	Yes												**0**	10.2	927		5.4
10/15/08	Yes												**0**	5.8	925		8.5
10/16/08	Yes												**0**	10.4	923		3.7
10/17/08	Yes												**0**	7.8	928		-0.8
10/18/08	Yes												**0**	4.7	935		-1.7
10/19/08	Yes												**0**	1.7	934		2.5
10/20/08	Yes												**0**	5.5	923		4.0
By Species		**2**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**10**	**1**	**0**	**15**				
By Guild		**3**			**0**	**0**			**1**	**11**							
		BBSH			**HB**	**RBEP**			**MYSP**	**UNKN**			**Total**				

Appendix B Table 9. Summary of fall 2008 acoustic bat data and weather during each survey night at the Stewart S Met Tree detector

		BBSH			HB	RBEP			MYSP	UNKN							
Night of	**Operated Okay?**	**BBSH**	**big brown**	**silver-hiared**	**hoary bat**	**eastern red**	**eastern pipistrelle**	**RBEP**	**MYSP**	**high-frequency**	**low-frequency**	**unknown**	**Total**	**Wind Speed (m/s)**	**Barometric Pressure**	**Relative Humidity (%)**	**Temperature (celsius)**
08/11/08	Yes								1	1	1		**3**	7.2	934		12.4
08/12/08	Yes												**0**	2.5	938		15.3
08/13/08	Yes									1			**1**	5.5	941		14.4
08/14/08	Yes				1					1			**2**	3.5	944		16.3
08/15/08	Yes								1	4	1		**6**	7.8	937		15.0
08/16/08	Yes												**0**	6.0	940		15.2
08/17/08	Yes								1		1		**2**	7.4	937		15.3
08/18/08	Yes												**0**	11.7	942		7.7
08/19/08	Yes											2	**2**	9.7	947		11.6
08/20/08	Yes									3			**3**	6.2	954		17.2
08/21/08	Yes								2	1			**3**	3.3	955		20.3
08/22/08	Yes								1	2			**3**	8.3	948		16.5
08/23/08	Yes										1		**1**	7.0	939		15.9
08/24/08	Yes									3			**3**	11.2	939		8.8
08/25/08	Yes												**0**	9.8	945		10.5
08/26/08	Yes									1	1		**2**	5.2	948		15.6
08/27/08	Yes									2			**2**	5.6	946		14.9
08/28/08	Yes												**0**	4.3	943		15.6
08/29/08	Yes								1	1			**2**	10.1	942		14.2
08/30/08	Yes												**0**	14.5	945		13.6
08/31/08	Yes												**0**				
09/01/08	Yes									1			**1**	9.5	931		14.7
09/02/08	Yes								1				**1**	3.6	929		14.5
By Species		**0**	**0**	**0**	**1**	**0**	**0**	**0**	**8**	**21**	**5**	**2**	**37**				
By Guild		**1**			**1**	**0**			**8**	**28**							
		BBSH			**HB**	**RBEP**			**MYSP**	**UNKN**			**Total**				

Appendix B Table 10. Summary of fall 2008 acoustic bat data and weather during each survey night at the Stewart Valley Tree detector

		BBSH			HB	RBEP			MYSP	UNKN							
Night of	Operated Okay?	BBSH	big brown	silver-hiared	hoary bat	eastern red	eastern pipistrelle	RBEP	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Barometric Pressure	Relative Humidity (%)	Temperature (celsius)
08/11/08	Yes								56	21			**77**	7.2	934		12.4
08/12/08	Yes								44	12			**56**	2.5	938		15.3
08/13/08	Yes								102	41			**143**	5.5	941		14.4
08/14/08	Yes								72	40			**112**	3.5	944		16.3
08/15/08	Yes								132	57			**189**	7.8	937		15.0
08/16/08	Yes								495	67			**562**	6.0	940		15.2
08/17/08	Yes							1	275	79			**355**	7.4	937		15.3
08/18/08	Yes							1	331	100			**432**	11.7	942		7.7
08/19/08	Yes								90	56			**146**	9.7	947		11.6
08/20/08	Yes								489	176			**665**	6.2	954		17.2
08/21/08	Yes							3	287	157			**447**	3.3	955		20.3
08/22/08	Yes							3	280	143			**426**	8.3	948		16.5
08/23/08	Yes							3	400	255			**658**	7.0	939		15.9
08/24/08	Yes						1		154	79			**234**	11.2	939		8.8
08/25/08	Yes								268	129	1		**398**	9.8	945		10.5
08/26/08	Yes								79	109			**188**	5.2	948		15.6
08/27/08	Yes								203	187			**390**	5.6	946		14.9
By Species		**0**	**0**	**0**	**0**	**0**	**1**	**11**	**3757**	**1708**	**1**	**0**	**5478**				
By Guild		**0**			**0**	**12**			**3757**	**1709**							
		BBSH			**HB**	**RBEP**			**MYSP**	**UNKN**			**Total**				

Appendix B Table 11. Summary of fall 2008 acoustic bat data and weather during each survey night at the Witham Met High detector

		BBSH			HB	RBEP			MYSP	UNKN							
Night of	Operated Okay?	BBSH	big brown	silver-hiared	hoary bat	eastern red	eastern pipistrelle	RBEP	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Barometric Pressure	Relative Humidity (%)	Temperature (celsius)
09/09/08	Yes												**0**	10.2	925		7.8
09/10/08	Yes										1		**1**	4.0	936		6.2
09/11/08	Yes												**0**	5.6	933		9.6
09/12/08	Yes												**0**	5.6	924		12.5
09/13/08	Yes												**0**	10.0	924		13.3
09/14/08	Yes												**0**	15.5	912		17.8
09/15/08	Yes												**0**	7.4	926		8.5
09/16/08	Yes									1			**1**	5.6	930		7.9
09/17/08	Yes	1											**1**	8.0	928		9.6
09/18/08	Yes												**0**	4.4	938		2.1
09/19/08	Yes												**0**	7.8	937		5.7
09/20/08	Yes										1		**1**	8.4	931		11.7
09/21/08	Yes												**0**	3.6	938		5.0
09/22/08	Yes												**0**	2.6	941		6.0
09/23/08	Yes												**0**	7.2	940		8.1
09/24/08	Yes												**0**	4.4	942		13.7
09/25/08	Yes												**0**	7.6	943		12.3
09/26/08	Yes												**0**	8.3	937		11.5
09/27/08	Yes												**0**	5.6	930		15.8
09/28/08	Yes												**0**	7.6	923		12.5
09/29/08	Yes												**0**	4.2	926		8.8
09/30/08	Yes												**0**	5.6	920		9.4
10/01/08	Yes												**0**	3.8	912		9.4
10/02/08	Yes												**0**	8.9	913		3.0
10/03/08	Yes												**0**	14.8	920		3.7
10/04/08	Yes												**0**	8.0	930		2.9
10/05/08	Yes												**0**	6.4	932		2.2
10/06/08	Yes												**0**	12.7	931		1.9
10/07/08	Yes												**0**	14.2	928		5.8
10/08/08	Yes												**0**	7.7	922		9.7
10/09/08	Yes												**0**	10.4	923		9.2
10/10/08	Yes												**0**	9.0	934		6.2
10/11/08	Yes												**0**	8.1	939		5.1
10/12/08	Yes												**0**	7.2	937		8.2
10/13/08	Yes												**0**	7.6	934		7.5
10/14/08	Yes												**0**	10.2	927		5.4
10/15/08	Yes												**0**	5.8	925		8.5
10/16/08	Yes												**0**	10.4	923		3.7
10/17/08	Yes												**0**	7.8	928		-0.8
10/18/08	Yes												**0**	4.7	935		-1.7
10/19/08	Yes												**0**	1.7	934		2.5
10/20/08	Yes												**0**	5.5	923		4.0
By Species		**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**4**				
By Guild		**1**			**0**	**0**			**0**	**3**							
		BBSH			**HB**	**RBEP**			**MYSP**	**UNKN**			**Total**				

Appendix B Table 12. Summary of fall 2008 acoustic bat data and weather during each survey night at the Whitham Met Low detector

		BBSH			HB	RBEP			MYSP	UNKN							
Night of	Operated Okay?	BBSH	big brown	silver-hiared	hoary bat	eastern red	eastern pipistrelle	RBEP	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Relative Humidity (%)	Temperature (celsius)
09/16/08	No								1	1			**2**				
09/17/08	No									1			**1**				
09/18/08	No												**0**				
09/19/08	No									1			**1**				
09/20/08	No												**0**				
09/21/08	No												**0**				
09/22/08	No												**0**				
09/23/08	No												**0**				
09/24/08	No										1		**1**				
09/25/08	No												**0**				
09/26/08	No												**0**				
09/27/08	No												**0**				
09/28/08	No												**0**				
09/29/08	No												**0**				
09/30/08	No												**0**				
10/01/08	No												**0**				
10/02/08	No												**0**				
10/03/08	No												**0**				
10/04/08	No												**0**				
10/05/08	No												**0**				
10/06/08	No												**0**				
10/07/08	No												**0**				
10/08/08	No												**0**				
10/09/08	No												**0**				
10/10/08	No												**0**				
10/11/08	No												**0**				
10/12/08	No												**0**				
10/13/08	No												**0**				
10/14/08	No												**0**				
10/15/08	No												**0**				
10/16/08	No												**0**				
10/17/08	No												**0**				
10/18/08	No												**0**				
10/19/08	No												**0**				
10/20/08	No												**0**				
By Species		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**3**	**1**	**0**	**5**				
By Guild		**0**			**0**	**0**			**1**	**4**							
		BBSH			**HB**	**RBEP**			**MYSP**	**UNKN**			**Total**				

Appendix B Table 13. Summary of fall 2008 acoustic bat data and weather during each survey night at the Whitham Met Tree detector

		BBSH			HB	RBEP			MYSP	UNKN							
Night of	Operated Okay?	BBSH	big brown	silver-hiared	hoary bat	eastern red	eastern pipistrelle	RBEP	MYSP	high-frequency	low-frequency	unknown	Total	Wind Speed (m/s)	Wind Direction (degrees)	Relative Humidity (%)	Temperature (celsius)
09/09/08	Yes												0				
09/10/08	Yes										1		1				
09/11/08	Yes												0				
09/12/08	Yes												0				
09/13/08	Yes									1			1				
09/14/08	Yes												0				
09/15/08	Yes												0				
By Species		0	0	0	0	0	0	0	0	1	1	0	2				
By Guild		0			0	0			0	2							
		BBSH			HB	RBEP			MYSP	UNKN			Total				

Appendix B Table 14. Summary of available fall bat detector surveys (results reported for individual detectors)

Year	Project	Project Location	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
Tree or Low Tower detectors (10 m or below)										
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	114	7/12	11/2	12291	107.8	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	53	8/2	10/16	5360	101.1	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	107	7/12	11/2	8996	84.1	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2005	Lempster	Lempster, Sullivan Cty, NH	forest edge	7.5	34	9/20	10/31	27	0.8	Woodlot Alternatives, Inc. 2005. Summary of fall 2005 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated November 18, 2005.
2005	Lempster	Lempster, Sullivan Cty, NH	forest edge	2	42	9/20	10/31	2	0	Woodlot Alternatives, Inc. 2005. Summary of fall 2005 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated November 18, 2005.
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	10	29	9/9	10/24	2	0.1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Lempster Mountain Wind Power Project in Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	3	44	9/9	10/24	384	8.7	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Lempster Mountain Wind Power Project in Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
2005	High Sheldon	Sheldon, Wyoming Cty, NY	field	2	49	8/1	10/4	5535	113	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
2005	Howard	Howard, Steuben Cty, NY	field	2	25	8/3	8/27	1493	51.5	Woodlot Alternatives, Inc. 2005. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2005	Jordanville	Jordanville, Herkimer Cty, NY	field	2	34	8/12	9/22	124	4.4	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
2005	Marble River	Churubusco, Clinton Cty, NY	field	10	34	8/1	10/11	150	4.4	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
2005	Marble River	Churubusco, Clinton Cty, NY	field	2	18	8/1	10/11	113	6.3	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
2005	Top Notch	Fairfield, Herkimer Cty, NY	field	2	34	8/19	9/21	44	1.3	Woodlot Alternatives, Inc. 2005. A Summer and Fall 2005 Radar and Acoustic Surveys of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
2005	West Hill	Munnsville, Madison Cty, NY	field	2	30	8/1	10/21	10	0.3	Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2005	Horse Creek	Clayton, Jefferson Cty, NY	forest edge	2	33	8/19	9/20	154	4.7	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
2005	Moresville	Stamford, Delaware Cty, NY	forest edge	2	58	8/15	10/15	280	4.8	Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	2	13	8/9	8/21	148	11.4	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	5	4	8/9	8/21	1	0.3	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	3	13	8/9	8/21	524	40.3	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	10	13	8/9	8/21	1576	121.2	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
MET Tower Detectors										
2007	Ball Hill	Villenova, Chautauqua Cty, NY	field	40	77	7/30	10/14	246	3.2	Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment, Inc.

Appendix B Table 14. Summary of available fall bat detector surveys (results reported for individual detectors)

Year	Project	Project Location	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
2007	Ball Hill	Villenova, Chautauqua Cty, NY	field	20	77	7/30	10/14	295	3.8	Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment, Inc.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	45	46	8/22	10/18	7	0.2	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	20	58	8/22	10/18	93	1.6	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	45	59	8/22	10/19	18	0.4	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	20	59	8/22	10/19	252	5.1	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2005	Dans Mountain	Loarville, Allegany Cty, MD	forest edge	11	53	8/1	9/22	574	10.8	Woodlot Alternatives, Inc. 2005. Fall 2005 Bat Echolocation Surveys at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
2005	Dans Mountain	Loarville, Allegany Cty, MD	forest edge	23	31	8/1	9/22	388	12.5	Woodlot Alternatives, Inc. 2005. Fall 2005 Bat Echolocation Surveys at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	40	95	7/12	11/2	66	0.7	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	20	106	7/12	11/2	155	1.5	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	45	72	6/20	10/25	18	0.3	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	45	76	6/20	10/25	0	0	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	20	44	6/20	10/25	4	0.1	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	45	20	6/20	10/25	0	0	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.
2006	Redington	Redington, Franklin Cty, ME	forest edge	15	21	8/10	10/24	0	0	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power.
2006	Redington	Redington, Franklin Cty, ME	forest edge	15	48	8/10	10/24	0	0	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power.
2006	Redington	Redington, Franklin Cty, ME	forest edge	30	29	8/10	10/24	0	0	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power.
2006	Redington	Redington, Franklin Cty, ME	forest edge	30	37	8/10	10/24	0	0	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power.
2006	Stetson	Stetson, Penobscot Cty, ME	forest edge	30	73	6/28	10/16	8	0.1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.

Appendix B Table 14. Summary of available fall bat detector surveys (results reported for individual detectors)

Year	Project	Project Location	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
2006	Stetson	Stetson, Penobscot Cty, ME	forest edge	30	76	6/28	10/16	170	2.2	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2006	Stetson	Stetson, Penobscot Cty, ME	forest edge	15	105	6/28	10/16	108	1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2006	Stetson	Stetson, Penobscot Cty, ME	forest edge	15	107	6/28	10/16	651	6.1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2005	Lempster	Lempster, Sullivan Cty, NH	forest edge	15	42	9/20	10/31	14	0.3	Woodlot Alternatives, Inc. 2005. Summary of fall 2005 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated November 18, 2005.
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	40	43	9/9	10/24	16	0.4	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Lempster Mountain Wind Power Project in Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
2006	Brandon	Brandon, Franklin, Cty, NY	field	12	62	7/25	10/4	1287	20.8	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Brandon and Chateaugay Windparks in Western New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2005	High Sheldon	Sheldon, Wyoming Cty, NY	field	15	65	8/1	10/4	335	5.2	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
2005	High Sheldon	Sheldon, Wyoming Cty, NY	field	30	58	8/1	10/4	137	2.4	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
2005	Howard	Howard, Steuben Cty, NY	field	30	13	8/3	8/19	30	2.3	Woodlot Alternatives, Inc. 2005. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2005	Howard	Howard, Steuben Cty, NY	field	27	15	8/3	8/14	30	2	Woodlot Alternatives, Inc. 2005. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2005	Jordanville	Jordanville, Herkimer Cty, NY	field	15	34	8/12	9/22	143	4.2	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
2005	Jordanville	Jordanville, Herkimer Cty, NY	field	30	41	8/12	9/22	255	6.2	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
2005	Marble River	Churubusco, Clinton Cty, NY	field	20	39	8/1	10/11	243	6.2	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
2005	Top Notch	Fairfield, Herkimer Cty, NY	field	15	34	8/19	9/21	30	0.9	Woodlot Alternatives, Inc. 2005. A Summer and Fall 2005 Radar and Acoustic Surveys of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
2005	Top Notch	Fairfield, Herkimer Cty, NY	field	30	34	8/19	9/21	99	3	Woodlot Alternatives, Inc. 2005. A Summer and Fall 2005 Radar and Acoustic Surveys of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
2005	West Hill	Munnsville, Madison Cty, NY	field	15	47	8/1	10/21	179	3.8	Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2005	West Hill	Munnsville, Madison Cty, NY	field	30	52	8/1	10/21	106	2	Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2006	Steuben	Hartsville, Steuben Cty, NY	field	15	76	7/26	10/10	119	1.6	Environmental Design and Research (RD&R). 2006. Draft Environmental Impact Statement for the Cohocton Wind Power Project. Town of Cohocton, Steuben County, New York, Prepared for Canandaigua Wind Partners, LLC.
2006	Steuben	Hartsville, Steuben Cty, NY	field	30	49	7/26	10/10	84	1.7	Environmental Design and Research (RD&R). 2006. Draft Environmental Impact Statement for the Cohocton Wind Power Project. Town of Cohocton, Steuben County, New York, Prepared for Canandaigua Wind Partners, LLC.
2006	Wethersfield	Wethersfield, Wyoming Cty, NY	field	15	54	7/25	10/9	0	0	Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Wethersfield	Wethersfield, Wyoming Cty, NY	field	30	26	7/25	10/9	22	0.8	Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.

Appendix B Table 14. Summary of available fall bat detector surveys (results reported for individual detectors)

Year	Project	Project Location	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
2006	Brandon	Brandon, Franklin, Cty, NY	field	25	72	7/25	10/4	464	6.4	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Brandon and Chateaugay Windparks in Western New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Centerville	Centerville, Allegany Cty, NY	field	15	48	7/25	10/10	2	0	Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Centerville	Centerville, Allegany Cty, NY	field	35	41	7/25	10/10	3	0.1	Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Chateaugay	Chateaugay, Franklin Cty, NY	field	40	58	7/25	10/4	173	3	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Brandon and Chateaugay Windparks in Western New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Chateaugay	Chateaugay, Franklin Cty, NY	field	20	44	7/25	10/4	345	7.8	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Brandon and Chateaugay Windparks in Western New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Cohocton/Dutch Hill	Cohocton, Steuben Cty, NY	field	15	43	8/12	10/11	46	1.1	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
2006	Cohocton/Dutch Hill	Cohocton, Steuben Cty, NY	field	30	47	8/12	10/11	57	1.2	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
2005	Clayton	Clayton, Jefferson Cty, NY	forest edge	30	0	8/19	9/20	0	0	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
2005	Munnsville	Munnsville, Madison Cty, NY	field	23	67	7/31	10/16	280	0.2	Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2005	Munnsville	Munnsville, Madison Cty, NY	field	15	67	7/31	10/16	210	0.3	Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2005	Moresville	Stamford, Delaware Cty, NY	forest edge	15	43	8/15	10/15	293	6.8	Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2005	Moresville	Stamford, Delaware Cty, NY	forest edge	30	54	8/15	10/15	285	5.3	Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2004	Liberty Gap	Franklin, Pendleton Cty, WV	forest edge	15	14	Sep	Nov	168	0.35	Woodlot Alternatives, Inc. 2005. A Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia – Fall 2004. Prepared for US Wind Force, LLC.
2004	Liberty Gap	Franklin, Pendleton Cty, WV	forest edge	30	14	Sep	Nov	165	0.19	Woodlot Alternatives, Inc. 2005. A Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia – Fall 2004. Prepared for US Wind Force, LLC.
2004	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	15	6	9/10	9/15	30	0.23	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2004	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	30	5	10/17	10/21	0	0	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2005	Mars Hill	Mars Hill, Aroostook Cty, ME	forest edge	20	22	8/31	9/21	25	n/a	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC.

Appendix B Table 14. Summary of available fall bat detector surveys (results reported for individual detectors)

Year	Project	Project Location	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
2005	Mars Hill	Mars Hill, Aroostook Cty, ME	forest edge	20	22	8/31	9/21	25	n/a	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC.

Appendix C

Raptor Survey Results

Appendix C Table 1. Species composition of raptors observed during raptor surveys

Species	9/3/2008	9/4/2008	9/10/2008	9/11/2008	9/16/2008	9/18/2008	9/22/2008	9/23/2008	9/25/2008	9/29/2008	10/6/2008	10/7/2008	10/15/2008	10/20/2008	10/31/2008	Grand Total
American kestrel				1						2	8	1				12
bald eagle					1		1					1	1			4
broad-winged hawk	2		3	9	72	11	3	14	2		11	5	2			134
Cooper's hawk											1	1	4	1		7
merlin				1				1			1	1				4
northern harrier			1		1					1						3
osprey			1		3			2	2	2	2					12
red-tailed hawk	1	1	1	1			1				3	1	1		1	11
sharp-shinned hawk		1	2	3	2	7	6	3	1	9	17	8	10	5		74
turkey vulture	1	2			5	1	3	2	2		2	2				20
unidentified accipiter	1	1				1										3
unidentified buteo				3	2		1									6
unidentified falcon											2					2
unidentified raptor			1	2	1		2				1	1	1			9
Grand Total	5	5	9	20	87	20	17	22	7	14	48	21	19	6	1	301

Appendix C Table 2. Observation totals of raptors by hour								
Species	**9:00-10:00**	**10:00-11:00**	**11:00-12:00**	**12:00-1:00**	**1:00-2:00**	**2:00-3:00**	**3:00-4:00**	**Grand Total**
American kestrel	2	1	3	2	1	3	0	12
bald eagle	0	0	0	2	0	2	0	4
broad-winged hawk	12	27	28	16	8	1	42	134
Cooper's hawk	2	1	2	0	1	1	0	7
merlin	0	2	0	1	1	0	0	4
northern harrier	1	0	0	1	0	1	0	3
osprey	1	4	3	2	0	1	1	12
red-tailed hawk	1	1	1	2	3	1	2	11
sharp-shinned hawk	10	14	11	13	8	9	9	74
turkey vulture	0	2	6	2	6	4	0	20
unidentified accipiter	0	0	0	1	1	1	0	3
unidentified buteo	0	1	4	0	1	0	0	6
unidentified falcon	0	2	0	0	0	0	0	2
unidentified raptor	1	1	3	2	1	1	0	9
Hourly totals	30	56	61	44	31	25	54	301

Appendix C Table 3. Raptor flight altitudes by species

Species	130.5 m or greater	less than 130.5 m	outside of 1 km from observer	Grand Total
American kestrel	0	12	0	12
bald eagle	1	1	2	4
broad-winged hawk	86	21	27	134
Cooper's hawk	2	4	1	7
merlin	0	4	0	4
northern harrier	1	1	1	3
osprey	1	7	4	12
red-tailed hawk	6	4	1	11
sharp-shinned hawk	8	62	4	74
turkey vulture	7	9	4	20
unidentified accipiter	1	1	1	3
unidentified buteo	5	0	1	6
unidentified falcon	0	2	0	2
unidentified raptor	3	2	4	9
Grand Total	121	130	50	301

Appendix C Table 4. Summary of Regional Fall (August to October) Migration Surveys*

Location	Obs Hours	BV	TV	OS	BE	NH	SS	CH	NG	RS	BW	RT	RL	GE	AK	ML	PG	SW	UR	UB	UA	UF	UE	TOTAL	Birds /Hour
Cadillac Mountain, ME *	242	0	40	230	21	145	1141	31	7	1	268	56	1	0	494	99	35	0	63	6	0	0	0	2,638	10.9
Little Round Top, NH*	84	0	18	41	32	1	34	12	0	0	3071	14	0	1	10	1	0	0	31	3	4	2	0	3,275	38.8
Pack Monadnock, NH*	338	0	21	255	48	66	1064	131	16	30	6835	74	0	0	180	51	17	0	15	6	3	2	0	8,814	26.1
Allegheny Front, PA *	476	15	92	108	56	36	899	136	5	10	3887	475	1	4	53	27	12	0	64	37	23	5	0	5,945	12.5
Hawk Mountain, PA *	610	19	108	449	181	174	2717	386	0	20	4289	176	0	10	286	95	58	0	44	13	15	10	0	9,050	14.8
Barre Falls, MA *	199	0	193	165	51	23	702	62	11	7	5235	40	0	0	135	30	19	0	12	1	0	0	0	6,686	33.6
Shatterack Mountain, MA *	116	0	21	70	15	18	391	15	0	5	5039	11	0	1	44	5	7	0	6	0	0	0	0	5,648	48.8
Montreal West Island, QC *	160	0	174	39	20	10	151	0	0	11	2142	157	0	0	31	0	0	0	0	0	0	0	0	2,735	17.1

* Data obtained from HMANA website.

Abbreviation Key:

BV - Black Vulture
TV - Turkey Vulture
OS - Osprey
BE - Bald Eagle
NH - Northern Harrier
SS - Sharp-shinned Hawk
CH - Cooper's Hawk
NG - Northern Goshawk
RS - Red-shouldered Hawk
BW - Broad-winged Hawk
RT - Red-tailed Hawk
RL - Rough-legged Hawk
GE - Golden Eagle
AK - American Kestrel
ML - Merlin
PG - Peregrine Falcon
SW - Swainson's Hawk
UR - unidentified Raptor
UB - unidentified Buteo
UA - unidentified Accipiter
UF - unidentified Falcon
UE - unidentified Eagle

Appendix C Table 5. Summary of available fall raptor survey results at wind sites in the east

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Reference
Fall 1996							
Searsburg, Bennington County, VT	Forested ridge	Sept. 11 - Nov. 3	20	80	430	12	Kerlinger, Paul. 1996. A Study of Hawk Migration at Green Mountain Power Corporation's Searsburg, Vermont, Wind Powewer Site: Autumn 1996. Prepared for the Vermont Public Service Board, Green Mountain Power, National Renewable Ener gy Laboratory, VERA.
Fall 1998							
Harrisburg, Lewis County, NY	Great Lakes plain/ADK foothills	Sept. 2 - Oct. 1	13	68	554	12	Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York. Unpublished report prepared for Niagara–Mohawk Power Corporation, Syracuse, NY, by ABR, Inc., Forest Grove, OR. 46 pp.
Wethersfield, Wyoming Cty, NY	Agricultural plateau	Sept. 2 - Oct. 1	24	107	256	12	Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York. Unpublished report prepared for Niagara–Mohawk Power Corporation, Syracuse, NY, by ABR, Inc., Forest Grove, OR. 46 pp.
Fall 2004							
Prattsburgh, Steuben Cty, NY	Agricultural plateau	Sept. 2 - Oct. 28	13	73	220	10	Woodlot Alternatives, Inc. .2005b. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
Cohocton, Stueben, Cty, NY	Agricultural plateau	Sept. 2 - Oct. 28	8	41.3	128	8	Woodlot Alternatives, Inc. 2005. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
Deerfield, Bennington Cty, VT (Existing Facility)	Forested ridge	Sept. 2 - Oct. 31	10	60	147	11 for both sites combined	Woodlot Alternatives, Inc. 2005c. Fall 2004 Avian Migration Surveys at the Proposed Deerfield Wind/Searsburg Expansion Project in Searsburg and Readsboro, Vermont. Prepared for Deerfield Wind, LLC and Vermont Environmental Research Associates.
Deerfield, Bennington Cty, VT (Western Expansion)	Forested ridge	Sept. 2 - Oct. 31	10	57	725	11 for both sites combined	Woodlot Alternatives, Inc. 2005c. Fall 2004 Avian Migration Surveys at the Proposed Deerfield Wind/Searsburg Expansion Project in Searsburg and Readsboro, Vermont. Prepared for Deerfield Wind, LLC and Vermont Environmental Research Associates.
Sheffield, Caledonia Cty, VT	Forested ridge	Sept. 11 - Oct. 14	10	60	193	10	Woodlot Alternatives, Inc. 2006a. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Fall 2005							
Alabama, Genesee Cty, NY	Great Lakes plain/ADK foothills	Sept. 11 - Oct. 10	5	19	148	4	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
High Sheldon, Wyoming Cty, NY	Agricultural and wooded plateau	Aug. 29 - Nov. 4	8	53.5	168	9	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.

Appendix C Table 5. Summary of available fall raptor survey results at wind sites in the east

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Reference
Wethersfield, Wyoming Cty, NY	Agricultural plateau	Sept. 13 - Sept. 18	3	21	0	0	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Wethersfield, Wyoming Cty, NY	Agricultural plateau	Sept. 21 - Nov. 1	3	21	231	11	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Bliss, Wyoming Cty, NY	Agricultural and wooded plateau	Sept. 12 - Sept. 17	2	21	0	0	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Cohocton, Stueben, Cty, NY	Agricultural plateau	Sept. 7 - Oct. 1	7	40.12	131	10	Woodlot Alternatives, Inc. 2005. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
West Hill, Maidson Cty, NY	Agricultural plateau	Sept. 6 - Oct. 31	11	65	369	14	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Clinton / Ellenburg, Clinton Cty, NY	Agricultural plateau	Sept. 23 - Sept. 28	3	21	0	0	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Altona, Clinton Cty, NY	Great Lakes plain/ADK foothills	Sept. 24 - Sept. 30	3	21	0	0	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Marble River, Clinton Cty, NY	Great Lakes plain/ADK foothills	Sept. 6 - Nov. 2	10	60	217	15	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Clayton, Jefferson Cty, NY	Great Lakes plain/ADK foothills	Sept. 9 - Oct. 16	11	63.5	575	13	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
New Grange, Chautauqua Cty, NY	Forested ridge	Sept. 17 - Oct. 15*	6	18	49	5	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Moresville, Deleware Cty, NY	Forested ridge	Aug. 31 - Nov. 3	11	72	228	11	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Churubusco, Clinton Cty, NY	Great Lakes plain/ADK foothills	Sept. 6 - Oct. 22	10	60	217	15	Woodlot Alternatives, Inc. 2005l. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.

Appendix C Table 5. Summary of available fall raptor survey results at wind sites in the east

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Reference
Dairy Hills, Wyoming Cty, NY	Agricultural plateau	Sept. 11 - Oct. 10	4	16	48	6	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Howard, Steuben Cty, NY	Agricultural plateau	Sept. 1 - Oct. 28	10	57	206	12	Woodlot Alternatives, Inc. 2005o. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
Munnsville, Madison Cty, NY	Agricultural plateau	Sept. 6 - Oct. 31	11	65	369	14	Woodlot Alternatives, Inc. 2005r. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
Mars Hill, Aroostook Cty, ME	Forested ridge	Sept. 9 - Oct. 13	8	42.5	115	13	Woodlot Alternatives, Inc. 2005t. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC.
Lempster, Sullivan County, NH	Forested ridge	Fall 2005	10	80	264	10	Woodlot Alternatives, Inc. 2007c. Lempster Wind Farm Wildlife Habitat Summary and Assessment. Prepared for Lempster Wind, LLC.
Clayton, Jefferson Cty, NY	Agricultural plateau	Sept. 9 - Oct. 16	11	63.5	575	13	Woodlot Alternatives, Inc. 2005m. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
Fall 2006							
Stetson, Penobscot Cty, ME	Forested ridge	Sept. 14 - Oct. 26	7	42	86	11	Woodlot Alternatives, Inc. 2007b. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Lincoln, Penobscot Cty, ME	Forested ridge	Sept. 13 - Oct. 16	12	89	144	12	Woodlot Alternatives, Inc. 2007. Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V.
Wethersfield, Wyoming Cty, NY	Agricultural plateau	Sept. 21 - Nov. 11	3	21?	231	11	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Chateaugay, Franklin Cty, NY	Great Lakes plain/ADK foothills	Sept. 6 - Oct. 26	2	24	42	5	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
St. Lawrence, Jefferson Cty, NY	Agricultural plateau	Sept. 23 - Nov. 11	10	30	288	10	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.

Appendix C Table 5. Summary of available fall raptor survey results at wind sites in the east

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Reference
Cape Vincent, Jefferson Cty, NY	Great Lakes plain/ADK foothills	Sept. 23 - Nov. 11	10	30	165	10	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Jordanville, Herkimer Cty, NY	Agricultural plateau	Oct. 13 - Nov. 30	44	234.7	629	12	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Fall 2007							
Roxbury, Oxford Cty, ME	Forested ridge	Sept. 3 - Oct. 15	14	86	96	12	Stantec Consulting. 2008. Fall 2007 Migration Survey Report Visual, Acoustic, and Radar Surveys of Bird and Bat Migration conducted at the proposed Record Hill Wind Project In Roxbury, Maine. Prepared for Independence Wind, LLC.
Errol, Coos Cty, NH	Forested ridge	Sept. 5 - Oct. 16	11	68	44	9	Stantec Consulting. 2007. Fall 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. Prepared for Granite Reliable Power, LLC.
Laurel Mountain, Preston Cty, WV	Forested ridge	Sept. 12 - Dec. 1	24	147	769	12	Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
Greenland, Grant Cty, WV	Forested ridge	Sept. 12 - Dec. 1	27		858	13	Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project,West Virginia. Prepared for AES New Creek, LLC.
New Grange, Chautauqua Cty, NY	Forested ridge	Sept. 21 - Oct. 28	6	n/a	n/a	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Allegany, Cattaraugus Cty, NY	Forested ridge	Sept. 8 - Oct. 11	11	63.78	125	10	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Jericho Rise, Franklin Cty, NY	Great Lakes plain/ADK foothills	Sept. 12 - Oct. 26	7	28	59	7	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Fall 2008							
Oakfield, Aroostock Cty, ME	Agricultural plateau	Sept. 26 - Oct. 14	12	84	60	8	Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.

*Calculated for spring and fall combined.

**Calculated for spring and fall 2006 and 2007 combined.

***Non-migrants were not included in seasonal passage rates in NYSDEC 2008 table but were included in passage rates here.

Spring 2009 Ecological Surveys

for the Highland Wind Project
in Highland Plantation, Maine

Prepared for

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Stantec

November 2009

Executive Summary

Highland Wind LLC (Highland) has proposed to construct a 128.6-megawatt (MW) wind energy project located in Highland Plantation and Pleasant Ridge Plantation, Somerset County, Maine (Figure 1-1). The Highland Wind Project (Project) includes 48 turbines, a 34.5-kilovolt (kV) electrical collector system, an electrical collection substation, a 115-kV generator lead, an Operations and Maintenance Building, and permanent meteorological (met) towers.

The turbines will be located in two distinct strings. The western string will include 26 turbines located on the ridgeline that connects Stewart Mountain, Witham Mountain and Bald Mountain. The meteorological data collected on this ridgeline suggests that weather conditions can be extreme and that the wind resource is excellent. These conditions require a Class I turbine and the Project has opted to use Vestas V90 3 MW turbines in most of the 26 turbine locations along the western string. The Vestas turbines have an 80-meter (m) hub height, a 90 m rotor diameter and a maximum tip-of-blade height of 125 m. The eastern string will include 22 turbines extending from the northeastern end of Burnt Hill south to Briggs Hill. Because of a more moderate wind capacity, Siemens SWT-2.3-101 turbines will be used along the eastern string to maximize energy output. These turbines have an 80 m hub height, a 101 m rotor diameter and a maximum tip-of-blade height of 130.5 m. Turbines will be located at elevations between 1550 and 2670 feet above sea level.

The electrical collector system will transfer power from the turbines to the proposed collector substation located north of Witham Mountain. These collector lines will be located underground along the ridgeline to reduce the project footprint and to reduce potential line maintenance costs along the exposed ridges. The approximately 11 mile long 115 kV generator lead will connect the on-site collector station to the existing Wyman Dam substation located in Moscow, Maine, where power will be transferred to the Central Maine Power system and ultimately distributed to the New England grid.

In preparation for this Project, Highland Wind contracted Stantec Consulting (Stantec) to perform a variety of environmental surveys within the Project area. In 2009, Stantec conducted surveys to document nocturnal and diurnal migration activity focusing on avian and bat populations. This work represented the first season of breeding bird surveys and the second season for each of the other surveys. The survey protocol and locations were discussed and chosen in coordination with the Maine Department of Inland Fisheries and Wildlife to provide adequate coverage of the Project area. A work plan describing methods and level of effort needed was approved by MDIFW on April 16, 2009.

Nocturnal Radar Survey

The spring 2009 radar survey targeted 20 nights between April 15 and May 31, 2009. 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 at two different locations to provide adequate coverage of the Project area. The first radar unit was located on the summit of South Stewart Mountain, the same location as that used during the fall

2008 survey. Radar operations at this location completed one full survey year (fall and spring migration seasons) of sampling from a single local location. The second radar unit was situated just off a gravel road near Briggs Hill. This site was operated simultaneously with the radar on South Stewart on most nights. The radar at this second location supplied information on nocturnal migration activity from the eastern side of the Project area and provided views of the Sandy Stream Valley and the ridgeline saddle between Burnt Hill and Briggs Hill.

Radar surveys are intended to document several variables that characterize nocturnal migration within the Project area: passage rates, flight heights, and flight direction. The survey documented an overall passage rate for the entire survey period of 511 targets per kilometer per hour (t/km/hr) at Stewart and 496 t/km/hr at Briggs. Passage rates varied greatly between nights during the season, indicating migration occurred in pulses, with rates of migration likely influenced by weather patterns and conditions from night to night. In contrast, flight heights remained fairly consistent at both sites both throughout the survey period and in comparison with other seasons, suggesting a similar “use” of the airspace above the ridgeline by nocturnal migrants in fall and spring. The seasonal average flight height was 314 m (1035 feet [’]) at Stewart and 287 m (946’) at Briggs. When compared to the anticipated maximum turbine height of 130.5 m (428'), the seasonal average of targets flying below turbine height (using the adjusted flight heights) was 23 percent at Stewart and 26 percent at Briggs. Mean flight direction through the Project area was generally to the northeast for both radar sites.

Spring radar surveys at Highland documented patterns in nocturnal migration similar to those documented at most recent radar surveys. These include highly variable passage rates between nights, a generally northeastern flight direction, and flight heights primarily occurring between 200 and 600 m above ground. Within nights, migration activity was generally greatest 4-5 hours after sunset and declined steadily through the end of the night. While comparisons between radar studies are vague at best due to the variability of site circumstances, studies performed in similar regions, habitats, and at equivalent levels of effort to those at Highland do show a consistency in range of migratory activity.

Bat Survey

Six Anabat® acoustic bat detectors were deployed during the spring/summer 2009 survey between April 23 and August 17 to document the occurrence of bats near the rotor zone of the proposed turbines. Detectors were located within the same on-site met towers used during the second portion of the fall 2008 survey (South Stewart, Witham Mountain, and Briggs Hill). Data were summarized by guild and species and tallied per detector on a nightly and hourly basis. Data were also summarized by detector and detector groups according to height (e.g., high versus low detectors) and location (e.g., South Stewart vs. Witham Mountain met towers). Nightly acoustic activity levels were compared with nightly weather variables to identify any trends. Data recorded by the detectors were analyzed to provide the total number of detections per hour, per night, and per season by detector.

A total of 166 bat call sequences were recorded over 553 detector-nights ($\bar{x}$ =0.3 ± 0.05 SE recordings/detector/night [r/d/n]; range = 0 – 6). This detection rate is relatively low, but is comparable to the fall 2008 detection rate for those detectors deployed within the met towers. In 2009, extensive periods of rain during the deployment of the detectors may have contributed to the overall low activity levels that were documented. A total of 26.5 inches of rain fell in the nearby town of Bingham during the survey period with July experiencing the most rain during this period. In addition, the spring/summer survey period did not capture the peak in activity that typically occurs later in the season (mid-August to early September), but was captured during the 2008 surveys. Viewed seasonally, detection rates at detectors were generally very low, with activity level increasing through August. Those species that produce low frequency calls were detected most commonly, including the hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), and big brown bat (*Eptesicus fuscus*). These species also were most commonly detected when the detectors were deployed in the met towers in 2008; however, these results contrasts sharply with the results for detectors deployed in trees during the earlier part of the fall 2008 season. Detectors placed in trees were closer to the ground (within 8 m) and more commonly recorded *Myotis* species; a genus that is more commonly detected at lower heights.

Breeding Bird Surveys

Breeding bird surveys were conducted during spring/summer 2009 to determine the species composition, abundance, diversity, and distribution of breeding birds in the Project area. Consistent with United States Geological Survey North American Breeding Bird Survey methods, Stantec biologists conducted breeding bird point count surveys during three separate visits to the Project area: the first visit was at the end of May, and consecutive visits took place in June 2009. The habitats in the Project area were grouped into four categories: coniferous forest, deciduous forest, mixed coniferous and deciduous forest, and disturbed (e.g., clearings for meteorological towers and early succession cuts). Habitat types for each point count location were assigned based on the dominant vegetation cover present at each survey location. Quantitative data collected during point counts were used to calculate the species richness, relative abundance, community diversity, and frequency of breeding birds within the available habitats of the Project area. Surveys were conducted during the peak of the nesting season, in the morning when detection of birds is greatest, and during optimal weather conditions for detection. It is likely, therefore, that the species richness detected during surveys is a suitable reflection of the species composition of breeding birds in the area.

There were a total of 35 breeding bird point count locations surveyed within the Project. Each point was surveyed during the three separate site visits. A total of 52 species plus an unidentified woodpecker and two unidentified ducks were observed during field surveys at point count locations. The composition of species detected during breeding bird surveys was representative of the habitats that occur in the Project area. The most birds were observed within the disturbed habitat, but this in large part reflects the greater number of survey points within this habitat category. The greatest species richness also was documented in disturbed habitat. The relative abundance was highest within the deciduous forest followed by the disturbed habitat. The Shannon Diversity Index was relatively similar across the four habitat categories, indicating a similar species diversity and distribution among points sampled. The species with the greatest relative abundances among all points sampled included, white-throated sparrow (*Zonotrichia albicollis*), chestnut-sided warbler (*Dendroica pensylvanica*), black-throated-blue warbler (*Dendroica caerulescens*), and dark-eyed junco (*Junco hyemalis*).

In general, the species detected in the Project area are common and relatively abundant in the region. No state or federally threatened or endangered species were detected during the breeding bird surveys. Ten state-listed species of special concern were documented during these surveys; however many of these species including the white-throated sparrow and chestnut-sided warbler were commonly observed and are species that are typically associated with regenerating cuts and second-growth forests such as occur throughout the Project area.

Diurnal Raptor Survey

Diurnal raptor surveys were conducted during the spring 2009 migration season. The purpose of the surveys was to document the species that occur in the vicinity of the Project, as well as the relative flights height, flight path locations, and other flight behaviors of observed raptors. These surveys were conducted from two different sites in the Project area: the summits of Witham Mountain and Briggs Hill. Surveys were based on Hawk Migration Association of North America methods and were typically conducted from 9 am to 4 pm.

Raptor surveys were conducted from March 25, 2009 to May 19, 2009, resulting in a total of 139 survey hours. Surveys included 12 days (83 hours) on Witham Mountain and 8 days (56 hours) on Briggs Hill. On four of these days, surveys were conducted simultaneously by observers at both survey locations.

A total of 260 raptors were observed resulting in an overall passage rate of 1.87 birds per hour. At Witham, a total of 153 raptors were observed for a passage rate of 1.84 birds per hour. At Briggs, a total of 107 raptors were observed resulting in a passage rate of 1.91 birds per hour. Ten different species plus unidentified raptors and buteos were recorded. The most commonly seen species were turkey vultures and red-tailed hawks (*Buteo jamaicensis*).

Of the 260 birds observed during the surveys, 236 occurred within the Project boundaries. The majority of the birds within the Project boundaries were seen over Witham Mountain (n=94; 39 percent) and Briggs Hill (n=83; 35 percent). Birds flying over the surrounding valleys (n=43; 18 percent) and Stewart Mountain (n=16; 7 percent) represented a relatively small percentage of the observations. Although observation sites provided views of the surrounding ridgelines and valleys, birds closer to the observer's location on Witham Mountain and Briggs Hill would have been more readily detected. As such, the higher percentage of observations over these sites may in part reflect the proximity of birds to the observers.

For those flight positions most likely associated with the proposed turbine locations within the Project boundaries, flight heights were categorized as above or below the proposed maximum turbine height of 130.5 m (428'). Eighty percent of the raptors observed from Witham occurred below the proposed maximum rotor height (n=116) (Figure 5-6a, Appendix D Table 3). Similarly 86 percent of the raptors observed from Briggs Hill occurred below the proposed maximum rotor height (n=78).

No federally-listed threatened or endangered species were observed during the raptor surveys. A single peregrine falcon (*Falco peregrinus*), the breeding population of which is a state-listed endangered species, was observed flying through the Project area on April 10. Eight state-listed species of conservation concern also were identified during raptor surveys, including bald eagle (*Haliaeetus leucocephalus*), northern harrier (*Circus cyaneus*), chimney swift (*Chaetura pelagica*), tree swallow (*Tachycineta bicolor)*, American redstart (*Setophaga ruticilla)*, chestnut-sided warbler (*Dendroica pensylvanica*), white-throated sparrow and black-and-white warbler (*Mniotilta varia*).

Table of Contents

Tables

Figures

Appendices

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[*] *This report was prepared by Stantec Consulting Services Inc. for Highland Wind LLC. The material in it reflects Stantec's judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. Stantec accepts no responsibility for damages, if any suffered by any third party as a result of decisions made or actions based on this report.*

1.0 Introduction

Highland Wind LLC (Highland) has proposed to construct a 128.6-megawatt (MW) wind energy project located in Highland Plantation and Pleasant Ridge Plantation, Somerset County, Maine (Figure 1-1). The Highland Wind Project (Project) includes 48 turbines, a 34.5-kilovolt (kV) electrical collector system, an electrical collection substation, a 115 kV generator lead, an Operations and Maintenance Building, and permanent meteorological (met) towers.

The turbines will be located in two distinct strings. The western string will include 26 turbines located on the ridgeline that connects Stewart Mountain, Witham Mountain and Bald Mountain. The meteorological data collected on this ridgeline suggests that weather conditions can be extreme and that the wind resource is excellent. These conditions require a Class I turbine and the Project has opted to use Vestas V90 3 MW turbines in most of the 26 turbine locations along the western string. The Vestas turbines have an 80 meter (m) hub height, a 90 m rotor diameter and a maximum tip-of-blade height of 125 m. The eastern string will include 22 turbines extending from the northeastern end of Burnt Hill south to Briggs Hill. Because of a more moderate wind capacity, Siemens SWT-2.3-101 turbines will be used along the eastern string to maximize energy output. These turbines have an 80 m hub height, a 101 m rotor diameter and a maximum tip-of-blade height of 130.5 m. Turbines will be located at elevations between 1550 and 2670 feet above sea level.

The electrical collector system will transfer power from the turbines to the proposed collector substation located north of Witham Mountain. These collector lines will be located underground along the ridgeline to reduce the project footprint and to reduce potential line maintenance costs along the exposed ridges. The approximately 11 mile long 115 kV generator lead will connect the on-site collector station to the existing Wyman Dam substation located in Moscow, Maine, where power will be transferred to the Central Maine Power system and ultimately distributed to the New England grid.

1.1 PROJECT BACKGROUND

In 2008, Stantec Consulting (Stantec) conducted a variety of environmental surveys as part of the continued planning for this Project, including surveys to characterize bird and bat activity within the Project area. Surveys conducted in 2008 included:

- Nocturnal radar surveys;
- Acoustic bat surveys;
- Raptor migration surveys; and
- Wetland delineation and vernal pool reconnaissance.

The scope of these surveys was based on a combination of developing standard methods within the wind power industry for pre-construction surveys, guidelines outlined by U.S. Fish and Wildlife Service (USFWS) and Maine Department of Inland Fisheries and Wildlife (MDIFW), and is consistent with other studies conducted recently in the state and the Northeast.

Surveys conducted in 2009 represent the first season of breeding bird surveys and the second season for each of the other surveys. During winter 2009, Stantec worked with MDIFW to finalize the methods and level of effort needed for spring 2009 field surveys. A work plan describing methods and level of effort needed was approved by MDIFW on April 16, 2009. In addition to the bird and bat surveys described in this report a separate report summarizes surveys for northern bog lemming (*Synaptomys borealis*), northern spring salamander (*Gyrinophilus porphyriticus*), and Roaring Brook mayfly (*Epeorus frisoni*).

1.2 KEY QUESTIONS AND RESEARCH PRIORITIES

Surveys in the Project area are intended to provide baseline biological use information, which can be used to help make Project design decisions. In coordination and through consultations with state agencies, Stantec developed a work plan which addresses several Project specific ecological concerns using the following survey methods.

1) Nocturnal radar surveys were used to document nocturnal migration patterns within the Project area and in relation to area ridgelines, especially during migration periods. Spring surveys were conducted to supplement the fall 2008 radar surveys.

2) Passive acoustic bat surveys helped characterize presence and species composition of bats in the Project area and specifically within the blade-swept area of the proposed turbines. The surveys also should provide information from lower heights within the tree canopy to document activity of different species that utilize various heights. Spring and summer 2009 surveys were conducted to supplement the fall 2008 acoustic surveys.

3) Breeding bird surveys were conducted in order to document and characterize the breeding bird assemblage of the Project area, in a quantitative, repeatable way. The data collected will provide baseline information on the breeding bird species and abundance that are currently present within the Project area for later comparison with post-construction surveys.

4) Diurnal raptor surveys were used to develop baseline information regarding use of the Project area by migrating raptors. These surveys help characterize the occurrence and flight patterns of diurnally migrating raptors (hawks, falcons, harriers, and eagles) and turkey vultures (*Cathartes aura*) in the Project area. Data collected during the surveys include number and species, general flight direction, and approximate flight altitude. Spring 2009 surveys were conducted to supplement the fall 2008 raptor surveys.

Following is a brief description of the Project; a review of the methods used to conduct scientific surveys and the results of those surveys; a discussion of results; and the conclusions reached based on those results.

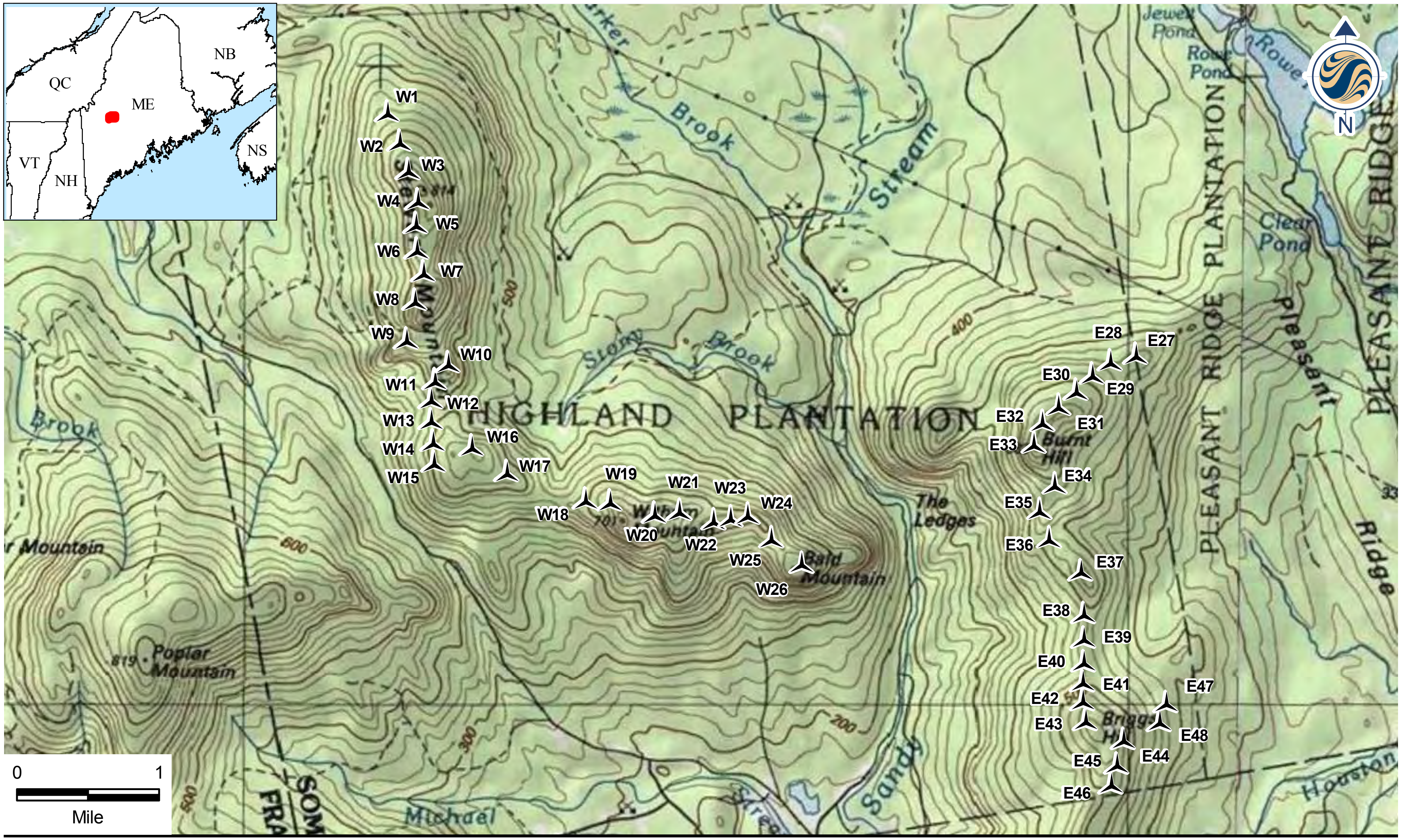
1.3 PROJECT AREA DESCRIPTION

The Project area is located within the Central and Western Mountains Ecoregion as defined in *Maine's Comprehensive Wildlife Conservation Strategy* (MDIFW 2005). This ecoregion is a consolidation of the Western Mountains and Central Mountains biophysical regions originally described by McMahon (1990). The Central and Western Mountains Ecoregion extends from the New Hampshire boarder south the White Mountains National Forest, north to Aroostook

County and east to the western foothills. The average elevation within the western portion of the ecoregion (former Western Mountain Biophysical Region) is between approximately 305 m to 610 m (1,000' to 2,000') with several peaks exceeding 823 m (2,700'). The northern portion of this ecoregion includes some of the highest peaks in the state and has elevations that range from 183 m to 1,603 m (600' to 5,258'). The climate of this ecoregion is characterized by relatively low annual precipitation and cool temperatures. Heavy snow fall prolongs the winter resulting in a relatively short growing season (McMahon 1990). In general, ridge tops within this ecoregion are dominated by red spruce (*Picea rubens*) and balsam fir (*Abies balsamea*) with lower elevations supporting deciduous species such as sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*) and American beech (*Fagus grandifolia*).

The Project area is located primarily within land managed by Wagner Forest Management, Ltd on a series of ridgelines that do not exceed 732 m (2,680’) in elevation. These include Stewart, Witham, and Bald Mountains; and Briggs and Burnt Hill. Stewart Mountain represents the western boundary of the project and Briggs and Burnt Hill represent the eastern boundary. These two ridgelines are separated by the Sandy Stream Valley. The northern end of Stewart Mountain is the highest in elevation reaching 817 m (2,680’) and decreases southward to 671 m (2,200’). Witham Mountain is the next highest in elevation reaching nearly 701 m (2,300’); the remaining ridgelines heights are approximately 671 m (2,200’) and lower.

Due to its relatively low elevation, the vegetation in the Project area is dominantly northern hardwood species and includes: sugar maple, yellow birch, and American beech. Due to its relatively low elevation, the vegetation in the Project area is dominantly northern hardwood species and includes: sugar maple, yellow birch, and American beech. Red spruce and balsam fir are present primarily on those ridge tops that exceed approximately 610 m (2,000’). Historically and presently, the land within and surrounding the Project area, including the summits of the ridgelines, have been used for commercial timber management. This is evident by the recent and past cuts as well as the presence of the network of haul roads that extend through the Project area. These forest management operations have resulted in a variation of forest age classes.



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Legend

Turbine

Client/Project

Highland Wind, LLC
Highland Wind Project
Highland Plantation, Maine

Figure No.

1-1

Title

Project Location Map
November 4, 2009

00385-F101-Locus.mxd

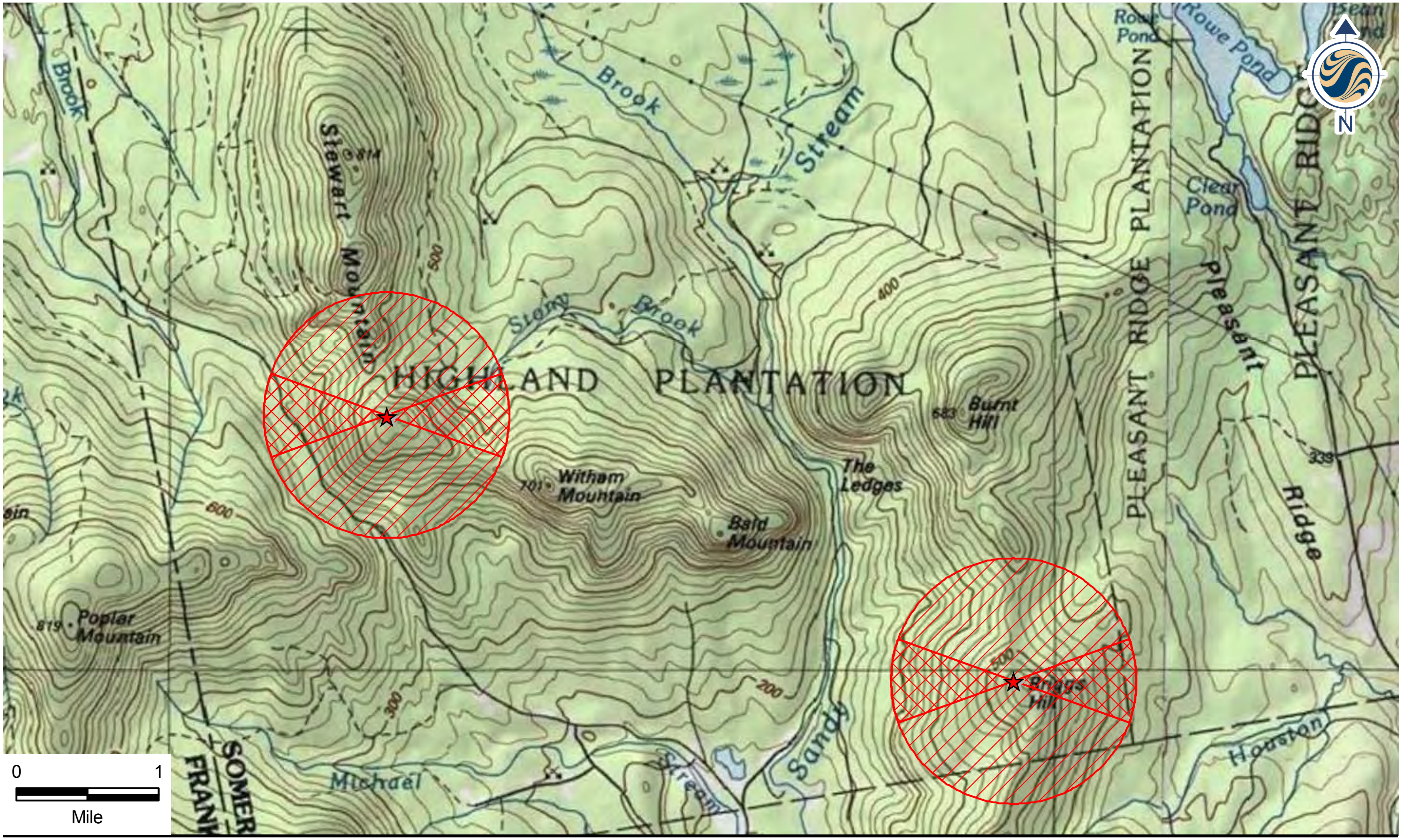
2.0 Nocturnal Radar Survey

2.1 INTRODUCTION

Nocturnal radar surveys were conducted in the Project area to characterize spring 2009 nocturnal migration patterns of passerine birds (songbirds) and bats. Unlike raptors, which migrate during the day using thermals resulting from rising warm air, the majority of North American passerines migrate at night. Raptors soaring flight uses the laminar flow of air over the landscape, which creates updrafts along hillsides and ridgelines; whereas, passerines may have evolved the strategy of migrating at night to take advantage of more stable atmospheric conditions for their flapping flight (Kerlinger 1995). Waiting to migrate during the cooler nighttime temperatures may have also provided passerines the extra benefits of a more efficient method of regulating body temperature during more active, flapping flight and the reduction of predation risk while in flight (Alerstam 1990, Kerlinger 1995). Therefore, while raptor migration can be documented by visual daytime (diurnal) surveys, documenting the patterns of nocturnal migrants requires the use of radar or other non-visual technologies. This approach also captures migrating bats, which are typically active at night. 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 SURVEY DESIGN

The spring 2009 radar study was conducted from two sites to provide more complete coverage of the Project area. One radar unit was located on the southern end of Stewart Mountain, the same location as that used during the fall 2008 survey. Radar operations at this location completed one full survey year (fall and spring migration seasons) of sampling from a single local location. The second radar unit was situated just off a gravel road near Briggs Hill. This site was operated simultaneously with the radar on South Stewart on most nights. The radar at this second location supplied information on nocturnal migration activity from the eastern side of the Project area and provided views of the Sandy Stream Valley and the ridgeline saddle between Burnt Hill and Briggs Hill. The radar sites (Figure 2 -1), provided excellent sampling of the airspace within 1.4 kilometers (km; approximately 4,500‘) of the site. Most of the quadrants were visible on the radar screen for both sites. Efforts were made to maximize the airspace sampled by elevating the antennae to approximately 3 m (10’), thus reducing the amount of the radar beam reflected back by surrounding vegetation (Figure 2-2). 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 kilowatts 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 were identified as “targets.” The radar has an “echo trail” function which captures past echoes of flight trails, enabling determination of flight direction. 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 width of 20º (10º above and below horizontal).



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![Stantec logo]

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Legend

- Radar Location
- Horizontal Radar Detection Range
- Alignment Vertical Radar Sweep

Client/Project

Highland Wind, LLC
Highland Wind Project
Highland Plantation, Maine

Figure No.
2-1

Title
Radar Location Map
August 12, 2009

00385-F201-Radar-Location-Map.mxd

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 (Figure 2-2).

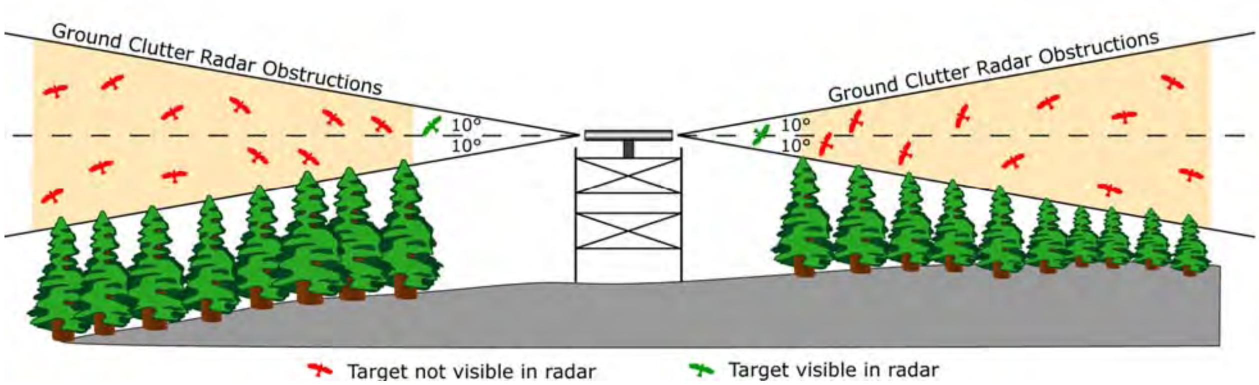
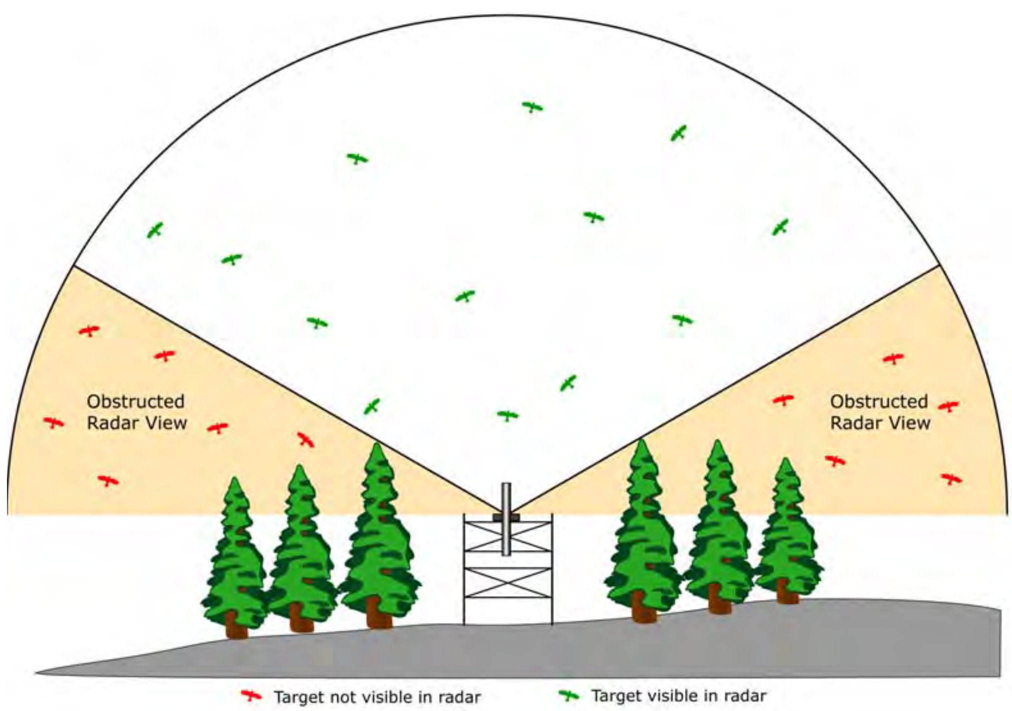


Figure 2-2. Ground clutter in horizontal mode (top) and vertical mode (bottom). Although the radar records three-dimensional space, it is translated by the radar screen into a two dimensional representation, which can cause targets to be obscured from view.



However, vegetation and hilltops near the radar can be used to reduce or eliminate ground clutter by “hiding” clutter-causing objects from the radar (Figure 2-3). 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 – targets are indistinguishable from the “clutter” as represented on the radar screen (Figure 2-4). The presence or reduction of potential clutter producing objects was carefully considered during site selection and radar station configuration.

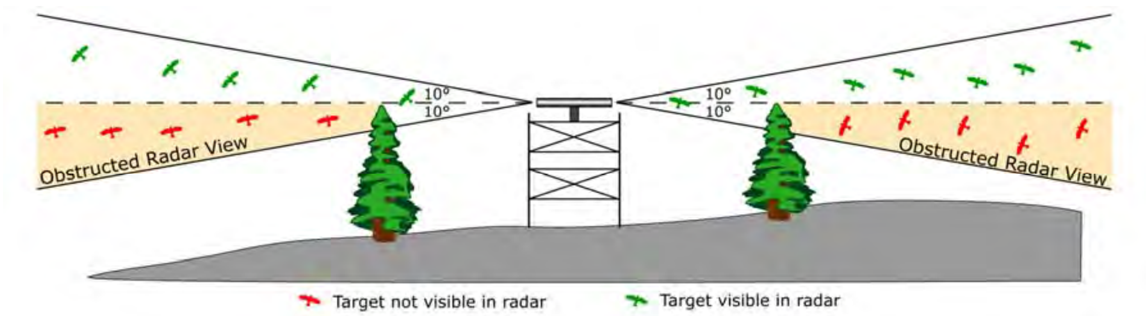


Figure 2-3. Proper site selection can reduce ground clutter to the center of the radar screen (top), so that the majority of the two-dimensional radar screen remains relatively uncluttered, allowing targets to be tracked as they both enter and leave the cluttered area (bottom).

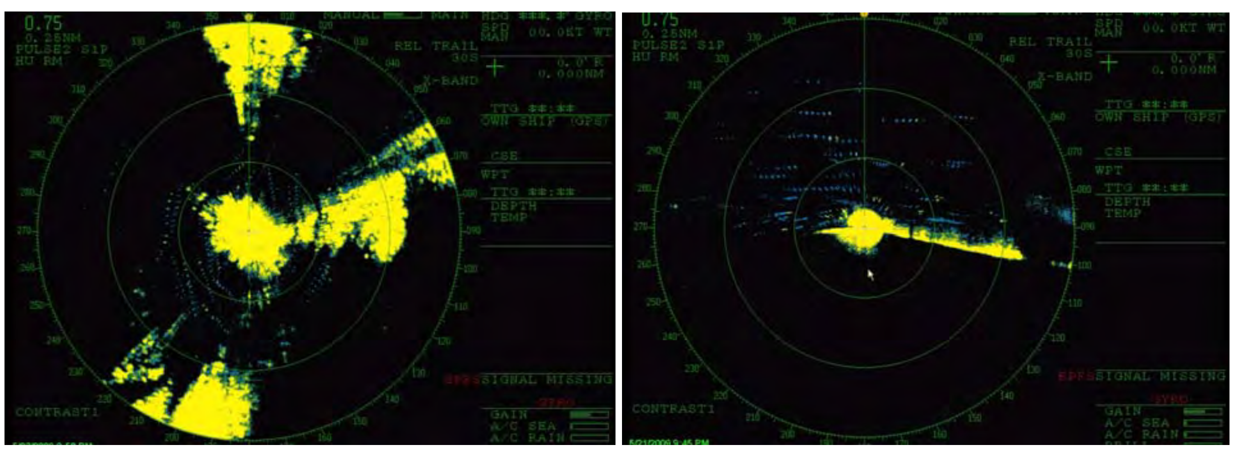


Figure 2-4 (top) Briggs Hill Radar Screen Shots (left = horizontal mode and right = vertical mode) (bottom) South Stewart Radar Screenshots (left = horizontal mode and right = vertical mode)

Radar surveys were conducted from sunset to sunrise, and were scheduled to occur on 20 nights between April 15 and June 1, 2009. Because the anti-rain function of the radar must be turned down to detect small songbirds and bats, surveys could not be conducted during active rainfall. Therefore, surveys were planned 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, mist, or fog were sampled.

The radar was operated in two modes throughout the course of each night. In surveillance mode, the antenna spins horizontally to survey the airspace around the radar and detects the number of targets and their flight direction as they pass through the Project Site (Figures 2-3 and 2-4). By analyzing the echo trail, the flight direction and flight speed of targets can be determined.

In vertical mode, the radar unit is tilted 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 (Figure 2-5). Both modes of operation were used during each hour of sampling.

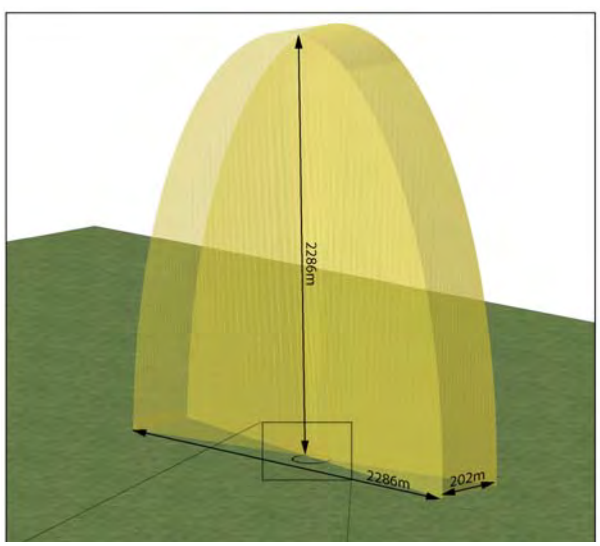


Figure 2-5. Detection Range of the radar in vertical mode

The radar was operated at a range of 1.4 km (4500'). 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, thus limiting the ability to observe the movement pattern of individual targets.

2.3 DATA COLLECTION METHODS

2.3.1 Radar Data

The radar display was connected to the video recording software of a computer enabling digital archiving of the radar data for subsequent analysis. This software recorded and archived video samples continuously every hour from sunset to sunrise of each survey night. By alternating the radar antenna every 10 minutes from vertical mode to horizontal mode, a total of 30 minutes of vertical samples and 30 minutes of horizontal samples were collected within each hour. Video recordings were subsequently analyzed based on a random schedule for each night. This sampling schedule allowed for randomization of sample collection and prevented double-counting of targets due to the 30-second echo trail used to determine the flight path vector.

2.4 DATA ANALYSIS METHODS

2.4.1 Radar Data

Video samples were analyzed using a digital analysis software tool developed by Stantec. For horizontal samples, targets (either birds or bats) were differentiated from insects based on their flight speed. Following adjustment 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 within each horizontal sample, and these results 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, and then subsequently outputs the data to a spreadsheet. These datasets were then used to calculate passage rate (reported as targets per kilometer of migratory front per hour), 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 analysis are based on those used by Batschelet (1965), because they take into account the circular nature of the data. Nightly wind direction, which was collected from the met tower next to the radar site, was also summarized using this method.

Flight altitude data were summarized using linear statistics. Mean flight altitudes (± 1 standard error [SE]) were calculated by hour, night, and overall season. The percent of targets flying below 130.5 m, the approximate maximum height of the proposed wind turbines with blades, was also calculated hourly, for each night, and for the entire survey period.

2.4.2 Weather Data

Temperature, wind speed, and wind direction were recorded on an hourly basis by the south Stewart met tower for the duration of the radar survey period (April 29 to May 31). The mean, maximum, and minimum temperature, mean and maximum wind speed, relative humidity, barometric pressure, and dew point were calculated for each night.

2.5 RESULTS

Radar surveys were conducted during 21 nights at the Briggs Hill radar site (April 29 to May 31, 2009); and 19 nights at the South Stewart Mountain radar site (April 29 to May 26, 2009). Of those nights, 16 were performed simultaneously at both radar sites (Appendix A, Table 1A & B).

2.5.1 Passage Rates

The mean passage rate for the entire survey period was 496 ± 31 targets per kilometer per hour (t/km/hr) at Briggs Hill and 511± 46 t/km/hr at South Stewart (Figure 2-6; also Appendix A, Table 1A & B). Nightly passage rates at Briggs Hill varied from 10 ± 4 t/km/hr on May 5 to 1,262 ± 173 t/km/h on May 19. At South Stewart, nightly passage rates ranged from 8 ± 5 t/km/hr on May 10 to 1735 ± 235 t/km/hr May 20. Individual hourly passage rates varied from 0 to 1757 t/km/hr at Briggs Hill and 0 to 2268 t/km/hr at South Stewart (Appendix A, Table 1A & B). The days with the highest mean passage rates for the two sites were different, but both sites had their lowest mean passage rates on the same days, May 5 and May 10. Hourly passage rates varied between and within nights throughout the season. For the entire season, passage rates were highest during the fourth or fifth hour after sunset (Figure 2-7).

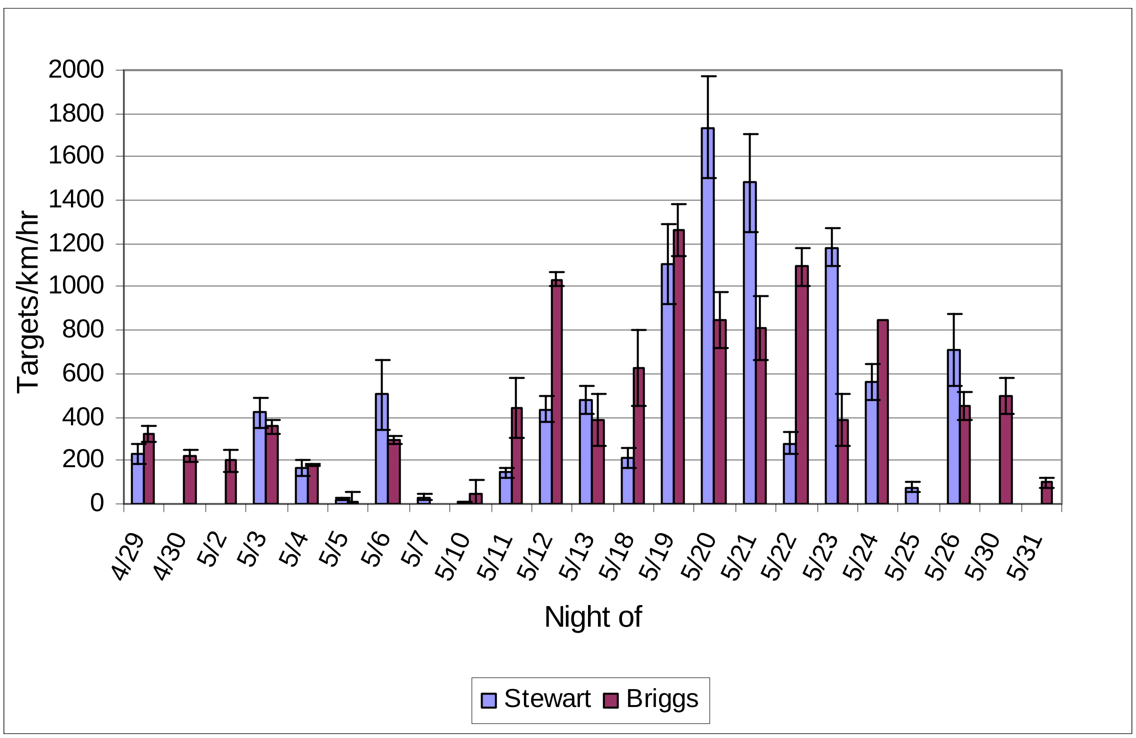


Figure 2-6. Nightly passage rates observed (error bars ± 1 SE)

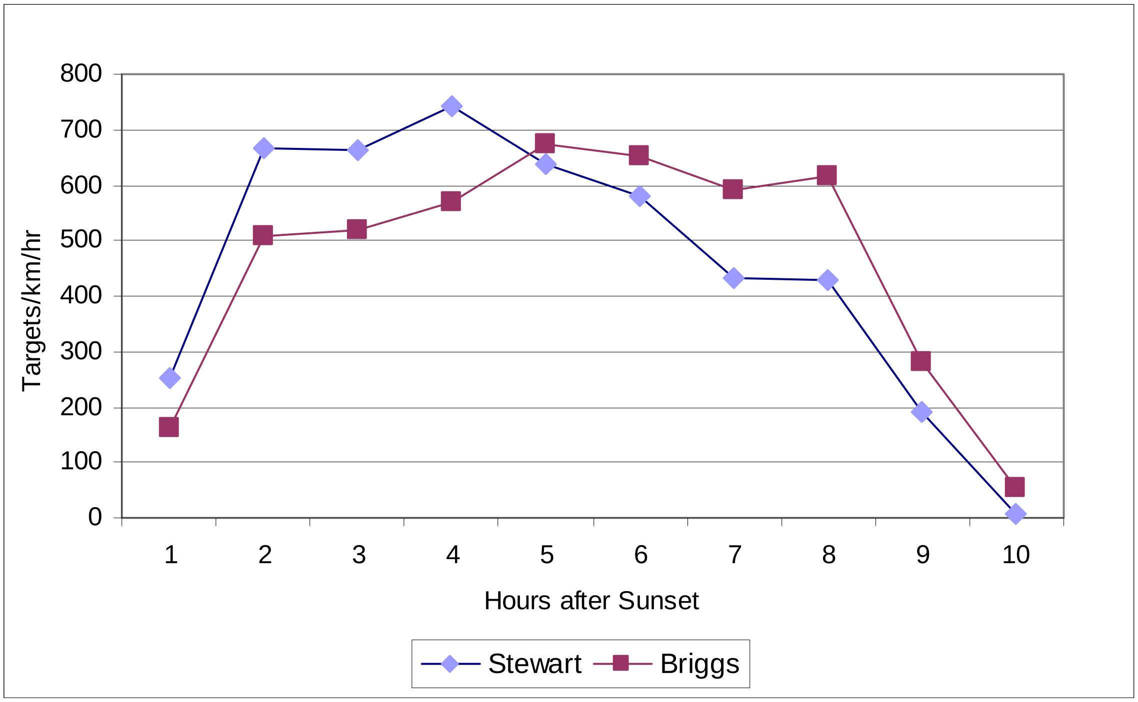


Figure 2-7. Hourly passage rates for entire season

2.5.2 Flight Direction

Mean flight direction through the Project area was 47°± 39° at Briggs Hill and 53° ± 48° at South Stewart (Figure 2-8). There was some variation between nights in mean flight direction although most nights at both sites included flight directions generally to the northeast, as is typical for the spring migration period (Appendix A, Table 2A & B).

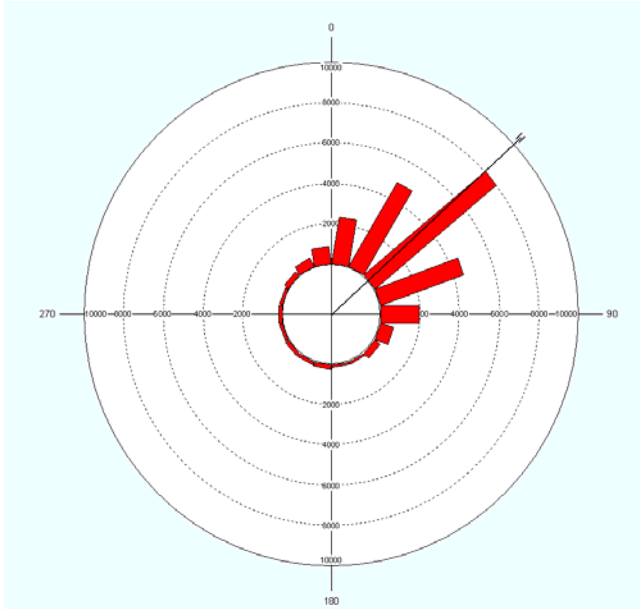
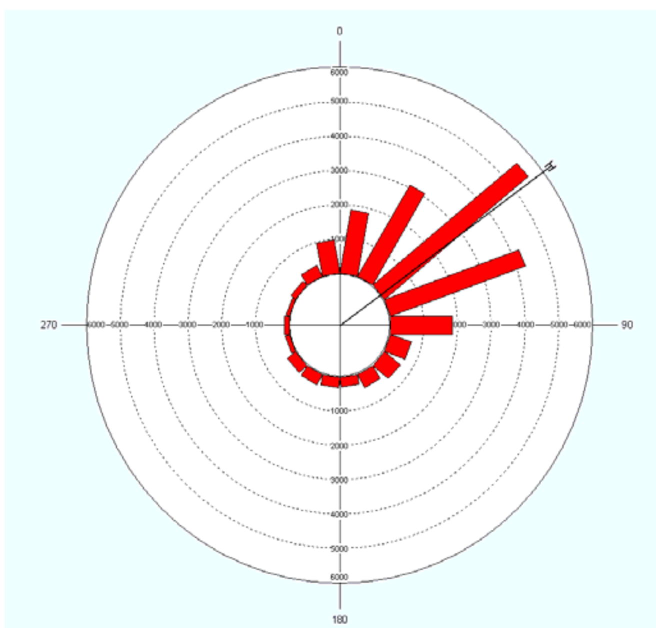


Figure 2-8. Stewart (top) and Briggs (bottom) mean flight directions for the entire season (the bracket along the margin of the histogram is the 95% confidence interval)



2.5.3 Flight Altitude

The seasonal mean flight height of all targets at Briggs Hill was 287 ± 8 m above the radar site and at South Stewart it was 314 ± 10 m. At Briggs Hill the average nightly flight height ranged from 115 ± 12 m on May 18 to 451 ± 33 m on April 30 and at South Stewart the average flight height ranged from168 ± 14 m April 29 to 514 ± 39 m on May 12 on South Stewart (Figure 2-9; Appendix A, Table 3A & B). The percent of targets observed flying below 130.5 m averaged 26 percent at Briggs Hill for the season and 23 percent at South Stewart for the season (Figure 2-

10). In general, those nights with the lowest mean flight heights corresponded to the nights with the highest percentage of targets below the maximum turbine height of 130.5 m. The mean hourly flight height for the entire season was relatively constant throughout the night at both sites (Figure 2-11).

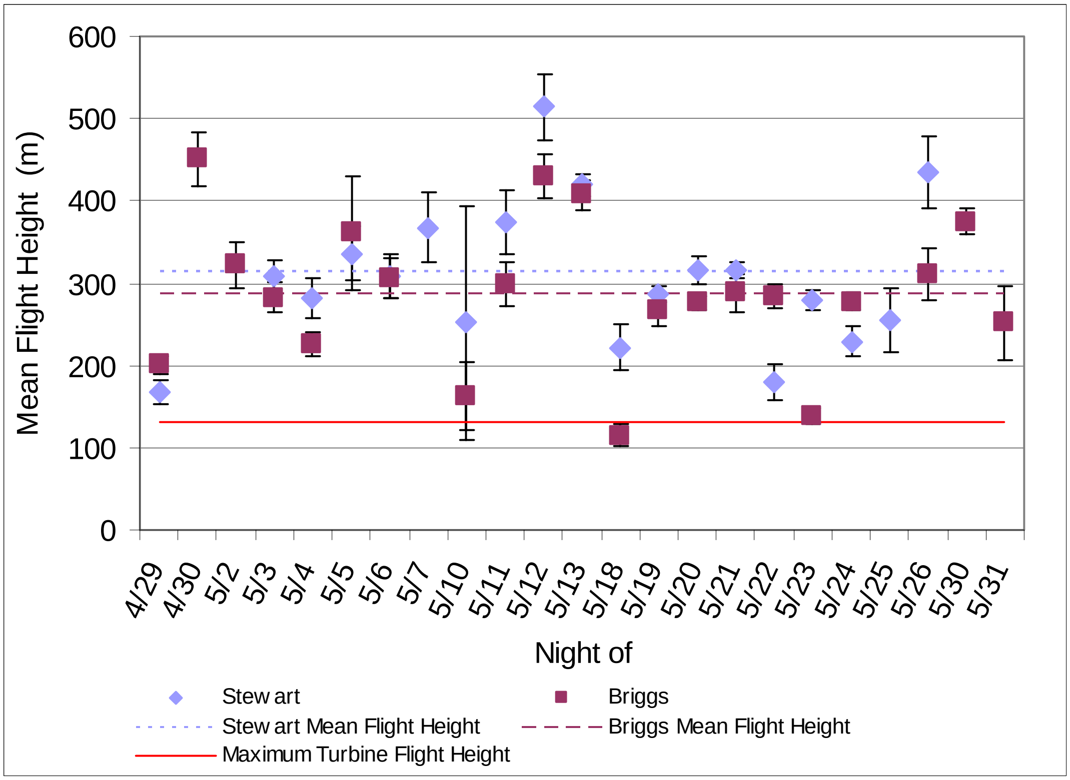
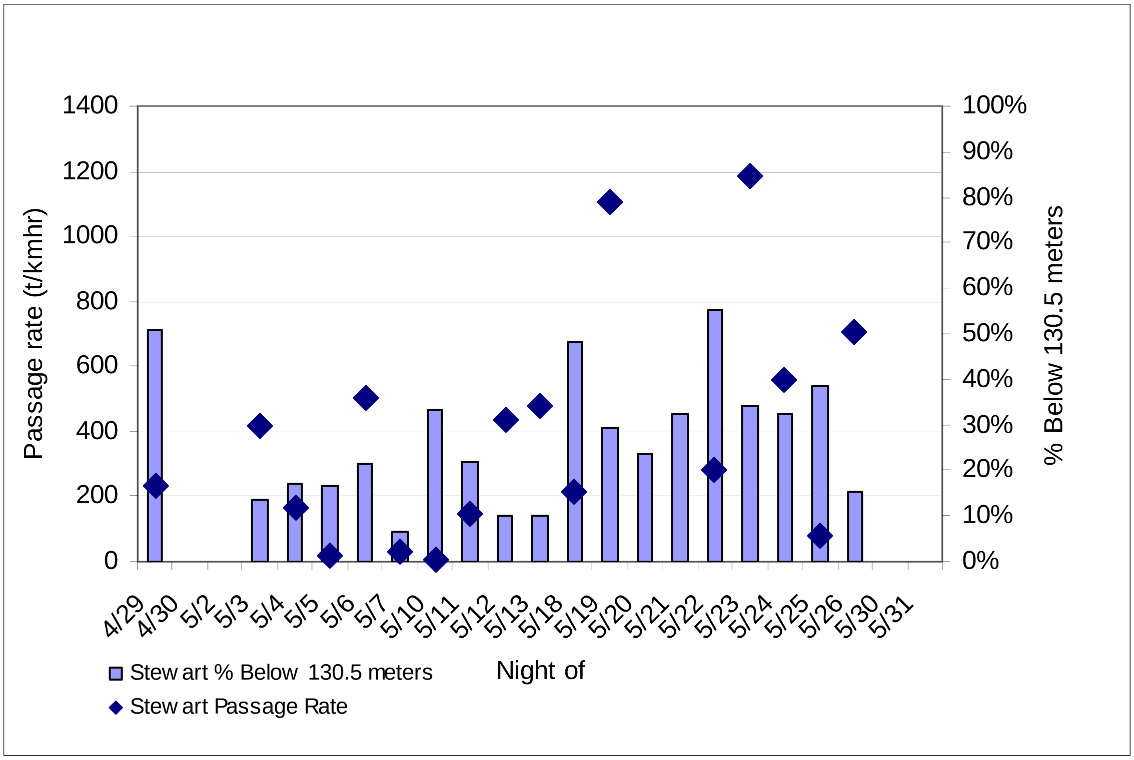


Figure 2-9. Mean nightly flight height of targets (error bars ± 1 SE)



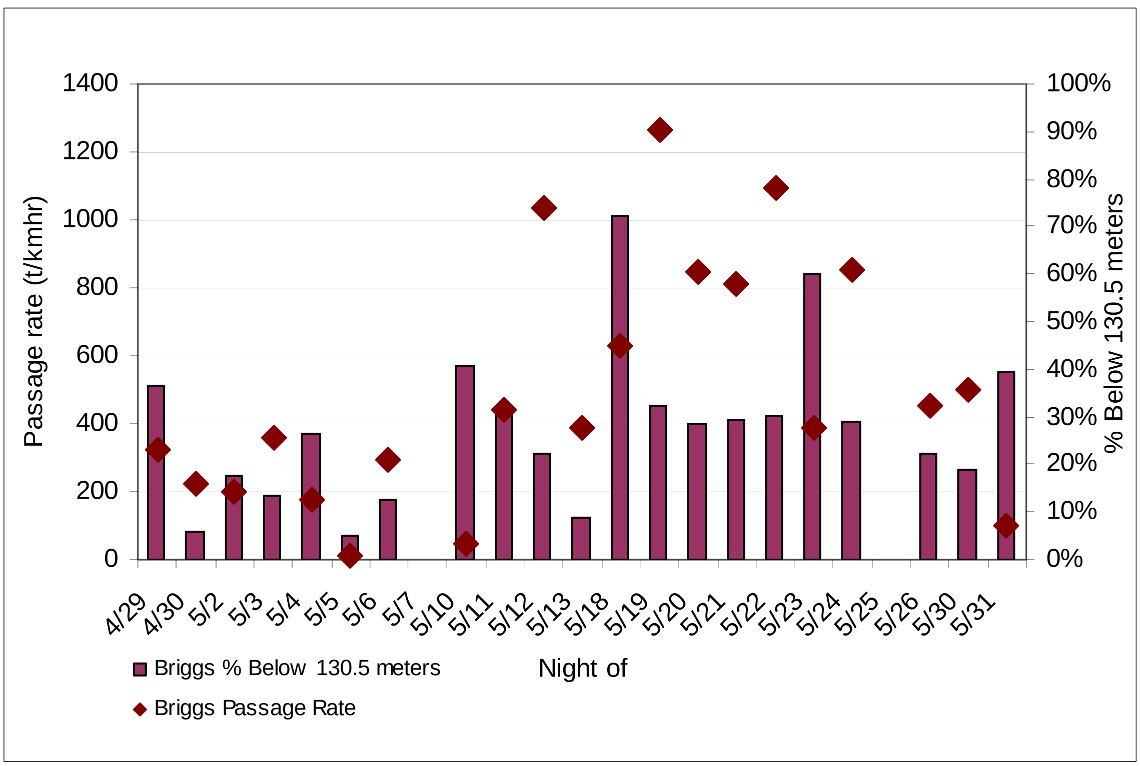


Figure 2-10. Stewart (top) and Briggs (bottom) percent of targets observed flying below a height of 130.5 m (428')

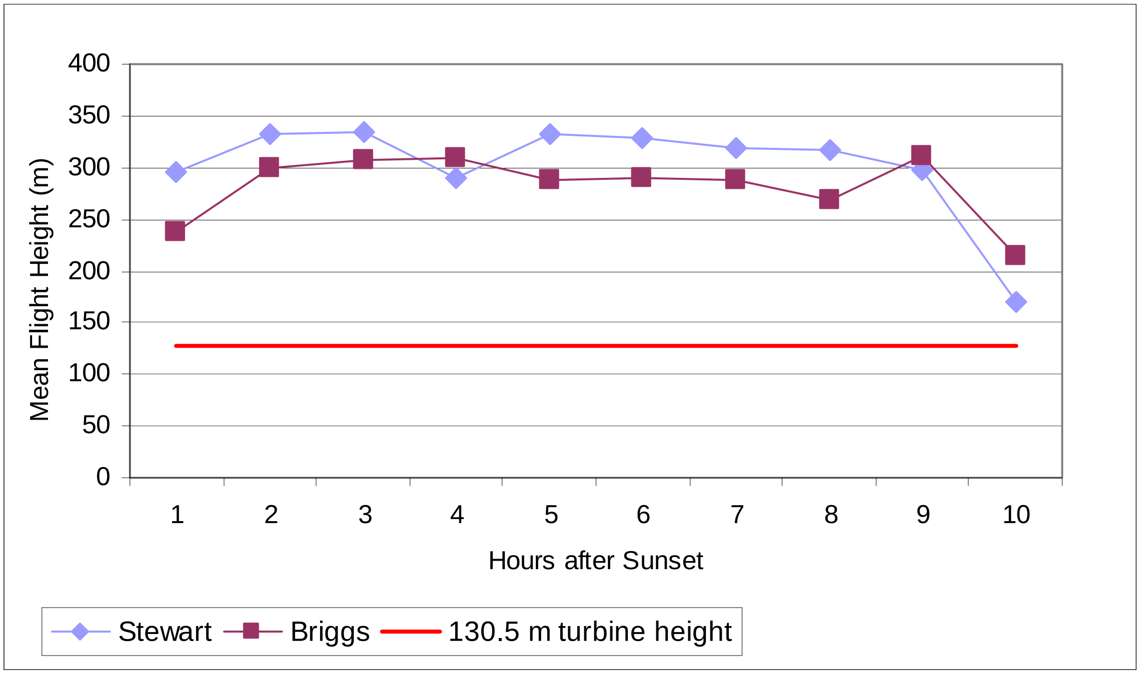


Figure 2-11. Hourly target flight height distribution

2.5.4 Weather Data

Mean nightly wind speeds in the Project area from April 29 to May 31 varied between 3.5 and 14.9 meters per second (m/s), with an overall mean of 7.7 m/s. Mean nightly temperatures varied between 1.5ºC and 19.8ºC, with an overall mean of 7.8ºC.

2.6 DISCUSSION

The results of this field survey provide useful information about site-specific migration activity and patterns in the Project area, especially when the results of the two sites are compared with each other and when results are compared with results of previous surveys conducted in Fall 2008.

The mean nightly passage rates at Stewart and Briggs were similar on most nights. On three nights in late May, the passage rate at Stewart was noticeably higher than at Briggs and on two nights in mid May and late May, the passage rate at Briggs was noticeably higher than at Briggs. This variation may be due to a general migration pattern where migrants, although moving in a broad front will occasionally pass in random concentrated pulses over the landscape. The overall trend of mean hourly passage rate was very similar at both sites. The mean nightly flight heights were also similar on most nights. The hourly mean flight height was relatively consistent throughout the night at both sites and ranged between 200 and 350 m above the radar.

Within the last several years, data from nocturnal radar surveys using similar methods and equipment as those used at this Project area rapidly becoming available. These other studies provide an opportunity to compare the results of this project to others in Maine and the northeastern United States. However, it is important to note that there are limitations in comparing data from previous years with data from 2009, as year-to-year variation in continental bird populations may influence 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 and the subsequent calculation of passage rate. These differences should be recognized as one of the most significant limiting factors in making direct site-to-site comparisons of passage rates. Regardless of potential differences between radar survey locations, the results at the Project are within the typical range of results at projects on forested ridges in the northeast (Appendix A Table 5).

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, Gauthreaux 1991). Nights with the highest passage rates appeared to have had moderate to light winds (2 to 4 m/s) from the northeast. Temperature does not seem to have an affect on passage rate at this 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). Those studies that suggest night-migrating birds are influenced by topography typically have been conducted in areas of steep and abrupt topography, such as the most rugged areas of the northern Appalachians and the Alps. Topography at the project site did not appear to influence migration patterns through the area.

Emerging evidence from other studies conducted by Stantec and other consultants, and academic research, suggests that flight height seems to be more important in determining potential collision risk than passage rate or flight direction (Cooper and Mabee 2000; Cooper *et al*. 2004; Gauthreaux and Livingston 2006; Mizrahi *et al*. 2008). Comparison of flight height between survey sites as measured by radar is generally less influenced by site characteristics as the main portion of the radar beam is directed skyward, and the potential effects of surrounding vegetation on the radar's view can be more easily controlled. The radars were centrally located within openings at this Project site, which allowed for unobstructed views in vertical mode and targets were observed flying in all areas of the vertical detection range. The radar views in horizontal mode were comparable to other regional studies conducted by Stantec in the state. The emerging body of studies characterizing nocturnal migrants shows a relatively consistent pattern in flight altitude, with most targets appearing to fly at altitudes of several hundred meters or more above the ground (Appendix A, Table 5). This pattern applies to this site, as targets appeared to fly at fairly consistent heights near 300 m above the ground nightly and throughout the survey period. The flight heights at the Project are well above the proposed turbine height of 130.5 m, indicating a limited mortality risk during migration.

There is currently no accurate quantitative method of directly correlating pre-construction passage rates at wind farms to operational impacts to birds and bats. Until radar surveys are conducted at a constructed site followed by mortality surveys the morning after, no direct correlations to collision risk can be made. This radar survey is designed to sample migration activity over a given point of time to provide baseline data pre-construction.

3.0 Acoustic Bat Survey

3.1 INTRODUCTION

Acoustic monitoring of bat activity has become a standard element of pre-construction surveys for proposed wind-energy developments (Kunz *et al*. 2007a,b). Acoustic surveys are associated with several major assumptions (Hayes 2000) and results should not be used to determine the number of bats inhabiting an area or to determine the number of bats that may collide with the proposed turbines. However, acoustic surveys can provide insight into seasonal patterns in activity levels and examine how weather conditions influence bat activity. This data may be useful in predicting trends in post-construction mortality rates. The objectives of acoustic surveys at the Project were (1) to document bat activity patterns from August through October in airspace near the rotor zone of the proposed turbines and at an intermediate height and (2) to document bat activity patterns in relation to weather factors including wind speed, temperature, and barometric pressure.

Eight species of bats occur in Maine, based upon their normal geographical range. These are the big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), eastern small-footed myotis (*Myotis leibii*), little brown myotis (*M. lucifugus*), northern myotis, (*M. septentrionalis*), and tri-colored bat (*Perimyotis subflavus*) (BCI 2001). Of these, the eastern small-footed myotis, eastern red bat, hoary bat, and silver-haired bat are listed in Maine as species of special concern

An initial season of acoustic surveys was conducted in the Project area between mid August and late October 2008. Detectors first were deployed in trees along access road corridors. Once the met towers were constructed in early September, the detectors were moved to guy wires at each of the three met towers. The second season of acoustic surveys began in April 2009, and continued through mid August 2009. The detectors were located in met towers for the duration of this survey period. This section summarizes results of 2009 surveys, making comparison to acoustic data collected in 2008 where appropriate.

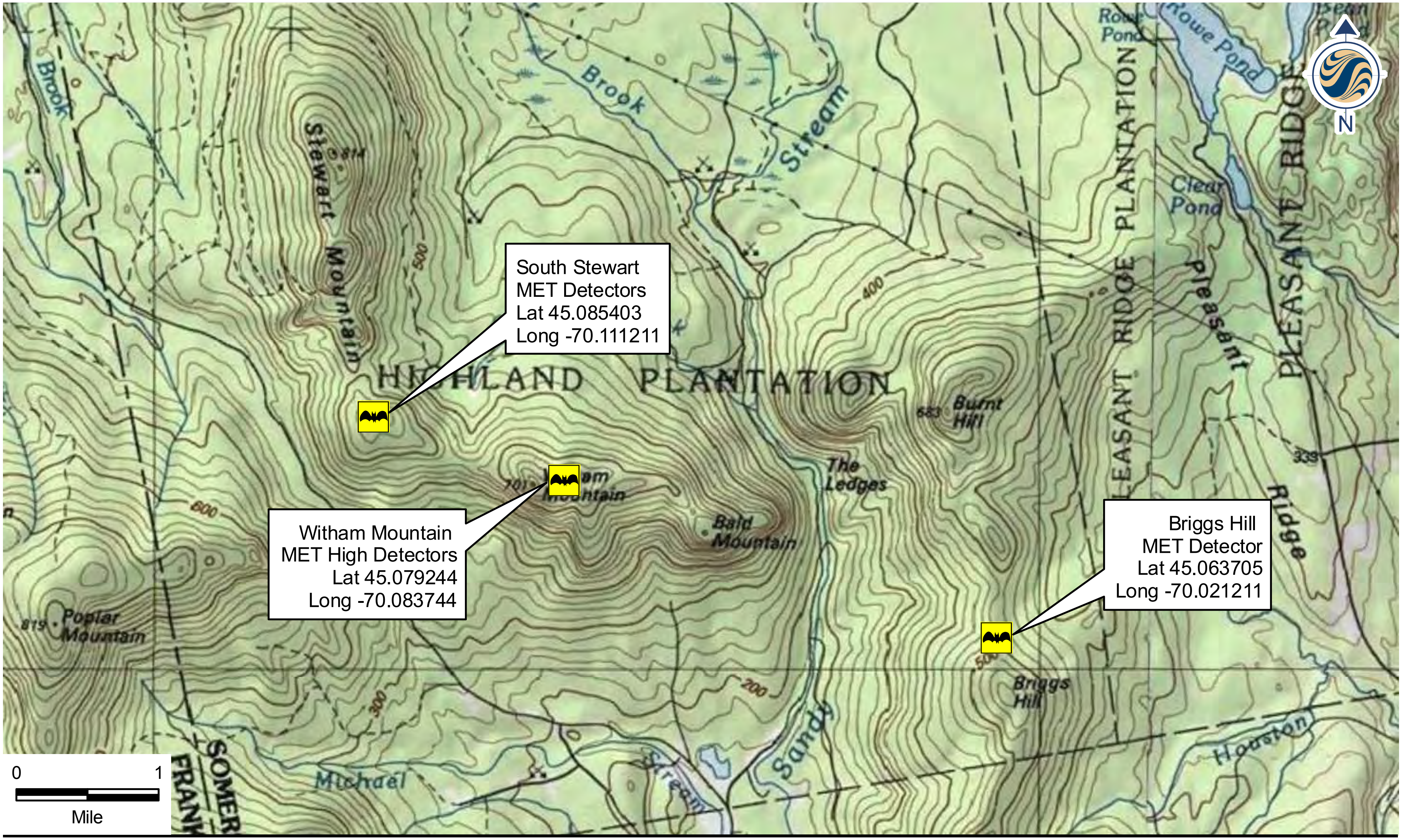
3.2 SURVEY DESIGN

3.2.1 Data Collection Methods

Anabat SD1 detectors (Titley Electronics Pty Ltd.) were used for the duration of the spring/summer 2009 acoustic bat survey. Each detector was programmed to sample continuously between 1900 and 0800 on a nightly basis, storing data from each night on removable compact flash cards. Anabat detectors operate by dividing the frequency of ultrasonic calls by an adjustable factor (set to 16 for North American species) so that they are audible to humans. The detectors also record frequency profiles of each detected bat call sequence for analysis and species identification, as described below. Anabat detectors were selected for use in this study based on 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.

The audio sensitivity setting of each Anabat system was set between 6 and 7 (on a scale of 1 to 10) to maximize sensitivity while limiting ambient background noise and interference. The sensitivity of individual detectors was then tested using an ultrasonic Bat Chirp (Reno, NV) to ensure that the detectors would be able to detect bats up to a distance of at least 10 m (33'). Detectors were powered by 12-volt batteries, charged by solar panels, and housed within waterproof boxes. Bat calls are directed to the microphone on the bat detectors using a 1.5 inch diameter PVC elbow, which protects the microphone from rain and weather while maximizing the volume of air sampled.

A total of six detectors were deployed between mid April and mid August 2009. Two detectors were deployed in each of the three met towers: South Stewart, Witham Mountain, and Briggs Hill (Figure 3-1). One detector was suspended at a height of approximately 20 m (66') and the other at a height of approximately 40 m (131') in each tower (Figure 3-2). Table 3-1 in section 3.3 lists deployment dates for each detector.



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Stantec

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Legend

Bat Detector Location

Client/Project

Highland Wind, LLC
Highland Wind Project
Highland Plantation, Maine

Figure No.

3-1

Title

Bat Survey Location Map
August 12, 2009

00385-F301-Bat-Survey-Location-Map.mxd

Figure 3-2. Typical view of acoustic bat detectors deployed from met tower guy wires.

3.2.2 Data Analysis Methods

Ultrasound recordings of bat echolocation may be broken into recordings of a single bat call or recordings of bat call sequences. A call is a single pulse of sound produced by a bat, while a call sequence is a combination of two or more pulses recorded in an Anabat file. Recordings containing less than two calls were eliminated from analysis as has been done in similar studies (Arnett *et al*. 2006).

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 Maine 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.

Following extraction of call files, each file was visually inspected for species identification and to ensure that only bat calls were included in the data set. Insect activity, wind, and interference can also sometimes produce Anabat files that pass through the initial filter and need to be visually inspected and removed from the data set. Call sequences are easily differentiated from other recordings, which typically form a diffuse band of dots at either a constant frequency or widely varying frequency.

Because bat activity levels are highly variable among individual nights and individual hours (Hayes 1997, Arnett *et al*. 2006), detection rates are summarized on both of these temporal scales. Nightly detection rates were summarized by month as well as for the entire sampling period. Hourly detection rates were summarized by hour after sunset, as recommended by Kunz *et al*. (2007a, b). Quantitative comparisons among these temporal periods was not attempted because the high amount of variability associated with bat detection would required much larger sample sizes (Arnett *et al*. 2006, Hayes 1997).

Bat call sequences were individually marked and categorized by species group, or “guild” based on visual comparison to reference calls. Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O’Farrell *et al*. 1999, O’Farrell and Gannon 1999). Call sequences were classified to species whenever possible, based on criteria developed from review of reference calls collected by Chris Corben, the developer of the Anabat system, as well as other bat researchers. However, due to similarity of call signatures between several species, all classified calls have been categorized into five guilds[2] reflecting the bat community in the region of the Project area and is as follows:

- **Unknown (UNKN)** – All call sequences with less than five calls, or poor quality sequences (those with indistinct call characteristics or background static). These sequences were further identified as either “high frequency unknown” (HFUN) for sequences with a minimum frequency above 30 to 35 kHz, or “low frequency unknown” (LFUN) for sequences with a minimum frequency below 30 to 35 kHz. The unknown calls are separated into these specific high frequency and low frequency groups because some inferences can be made as to the possible guilds based upon bats known to occur in this area. For this area, HFUN most likely represents eastern red bats, tri-colored bats and *Myotis* species since these species typically produce ultrasound sequences of more than 30 kHz. Big brown, silver-haired and hoary bats would be the species in this area typically producing ultrasound sequences of less than 30 kHz.

- **Myotis (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.

[2] Gannon *et al.* 2003 categorized bats into guilds based upon similar minimum frequency and call shape. These guilds were: Unidentified, Myotis, LABO-PISU and EPFU-LANO-LACI. We broke hoary bats out into a separate guild due to the importance of reporting activity patterns of migratory species in the context of wind energy development.

- **Eastern red bat/tri-colored bat[3] (RBTB)** – Eastern red bats and tri-colored 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.

- **Big brown/silver-haired bat (BBSH)** – Big brown and silver-haired bats. These species' call signatures commonly overlap and have therefore been included as one guild in this report.

- **Hoary bat (HB)** – Hoary bats. Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats by minimum frequency extending below 20 kHz or by calls varying widely in minimum frequency across a sequence.

This method of guild identification represents a conservative approach to bat call identification. Since some species 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 categorized in appropriate guilds, nightly tallies of detected calls were compiled. Mean detection rates (number of recordings/detector-night) for the entire sampling period were calculated for each detector and for all detectors combined.

3.2.2.1 Weather Data

Temperature (°C), wind speed (m/s), and barometric pressure (mbar) were collected from a 50 meter met tower at South Stewart and provided by Highland Wind for the duration of the survey period (April 23-August 17). Mean nightly temperature, barometric pressure, and wind speed were calculated for each night, and nightly averages were plotted against nightly detections.

3.3 RESULTS

3.3.1 Detector Call Analysis

Detectors were deployed for a total of 117 calendar-nights (692 detector-nights) between April 23 and August 17. Detectors were operational during 553, or approximately 80%, of these nights. At least one detector was operational at each met tower during every night of the survey period with the exception of a 6-night period at the Witham tower in early May, during which both detectors malfunctioned. Table 3-1 summarizes the ranges of dates each detector was deployed and overall results per detector.

[3] The scientific and common name of the eastern pipistrelle (*Pipistrellus subflavus*) has been changed to the tri-colored bat (*Perimyotis subflavus*).

Table 3-1. Summary of bat detector field survey effort and results, spring/summer 2009 surveys						
Location	**Dates Deployed**	**Calendar Nights**	**Detector-Nights***	**Recorded Sequences**	**Detection Rate ** **	**Maximum Sequences recorded *** **
Briggs High	April 23-August 13	113	73	19	0.3	3
Briggs Low	April 23-August 13	113	112	57	0.5	6
Stewart High	April 23-August 17	117	117	31	0.3	3
Stewart Low	April 23-August 17	117	74	22	0.3	3
Witham High	April 24-August 17	116	110	19	0.2	3
Witham Low	April 24-August 17	116	67	18	0.3	4
Overall Results		***692***	***553***	***166***	***0.3***	--
* One detector-night is equal to a one detector successfully operating throughout the night.						
** Number of bat echolocation sequences recorded per detector-night.						
*** Maximum number of bat passes recorded from any single detector for a detector-night.						

A total of 166 bat call sequences were recorded during the survey period, resulting in an overall detection rate of 0.3 ± 0.05 (standard error [SE]) recordings/detector/night (r/d/n) among detectors. Detection rates were similar between detectors, with individual detectors accounting for between 11% and 34% of the total number of recordings. Detection rates were higher in August than during any other month of the survey period, overall and by individual detector, although the mean number of recordings per detector-night remained below 1 even during August (Tables 3-2 and 3-3; Figure 3-3).

Table 3-2. Monthly combined detection rates for six acoustic detectors during 2009 surveys			
Month	# Detector-nights	# Recordings	Rate
April	22	1	0.05
May	121	24	0.20
June	135	36	0.27
July	181	36	0.20
August	94	69	0.73
Overall	**553**	**166**	**0.30**

Table 3-3. Monthly summary of 2009 acoustic survey results by detector

Detector / Month	Dates	Calendar Nights	Detector-Nights*	Recorded Sequences	Detection Rate **	Maximum Sequences recorded ***
Briggs High						
April	April 23-30	8	0	0	-	-
May	May 1-31	31	20	3	0.2	1
June	June 1-30	30	11	0	0.0	0
July	July 1-31	31	29	5	0.2	3
August	August 1-13	13	13	11	0.8	3
Briggs Low						
April	April 23-30	8	7	0	0.0	0
May	May 1-31	31	31	12	0.4	2
June	June 1-30	30	30	17	0.6	6
July	July 1-31	31	31	13	0.4	5
August	August 1-13	13	13	15	1.2	4
Stewart High						
April	April 23-30	8	8	0	0.0	0
May	May 1-31	31	31	9	0.3	1
June	June 1-30	30	30	11	0.4	3
July	July 1-31	31	31	1	0.0	1
August	August 1-17	17	17	10	0.6	2
Stewart Low						
April	April 23-30	8	1	1	1.0	1
May	May 1-31	31	7	0	0.0	0
June	June 1-30	30	18	4	0.2	3
July	July 1-31	31	31	2	0.1	1
August	August 1-17	17	17	15	1.0	2
Witham High						
April	April 24-30	7	6	0	0.0	0
May	May 1-31	31	26	0	0.0	0
June	June 1-30	30	30	1	0.0	1
July	July 1-31	31	31	7	0.2	3
August	August 1-17	17	17	11	0.9	2
Witham Low						
April	April 24-30	7	0	0	-	-
May	May 1-31	31	6	0	0.0	0
June	June 1-30	30	16	3	0.2	1
July	July 1-31	31	28	8	0.3	4
August	August 1-17	17	17	7	0.4	3
Overall Results		**692**	**546**	**166**	**0.3**	--

* One detector-night is equal to a one detector successfully operating throughout the night.
** Number of bat echolocation sequences recorded per detector-night.
*** Maximum number of bat passes recorded from any single detector for a detector-night.

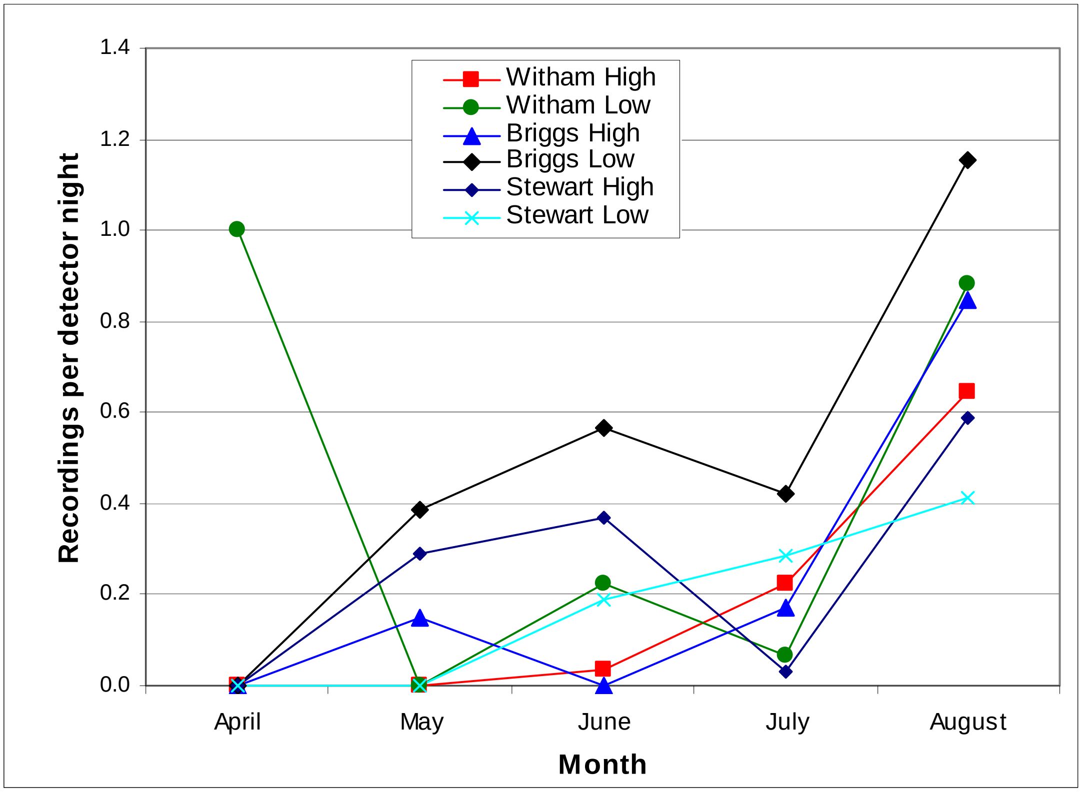


Figure 3-3. Total nightly bat call sequence detections by detector. The Witham Low detector was the only detector to record a bat call during April and it recorded only a single call sequence and as such this value for April is artificially high.

Figures 3-4 through 3-9 display nightly acoustic activity by guild at each acoustic detector deployed within the Project area during 2009 surveys. Generally, high and low detectors at each met tower documented similar acoustic activity patterns, with peaks in activity often coordinated between detectors. Levels of acoustic activity were also similar between high and low detectors, with no clear trend of greater activity at either the high or the low detectors (Figures 3-4 through 3-9).

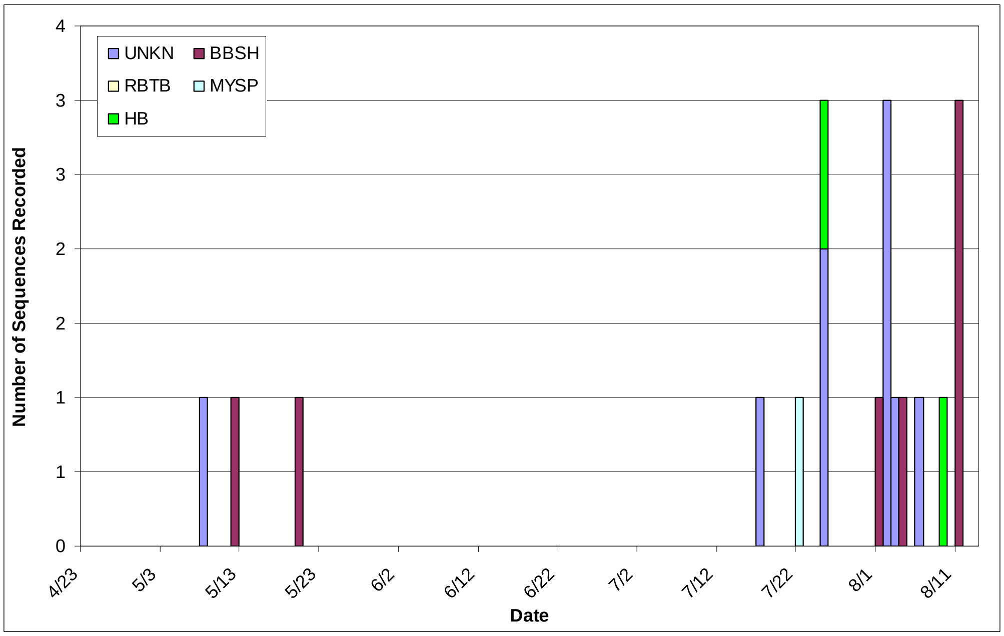


Figure 3-4a. Nightly detections at the Briggs Hill High detector from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

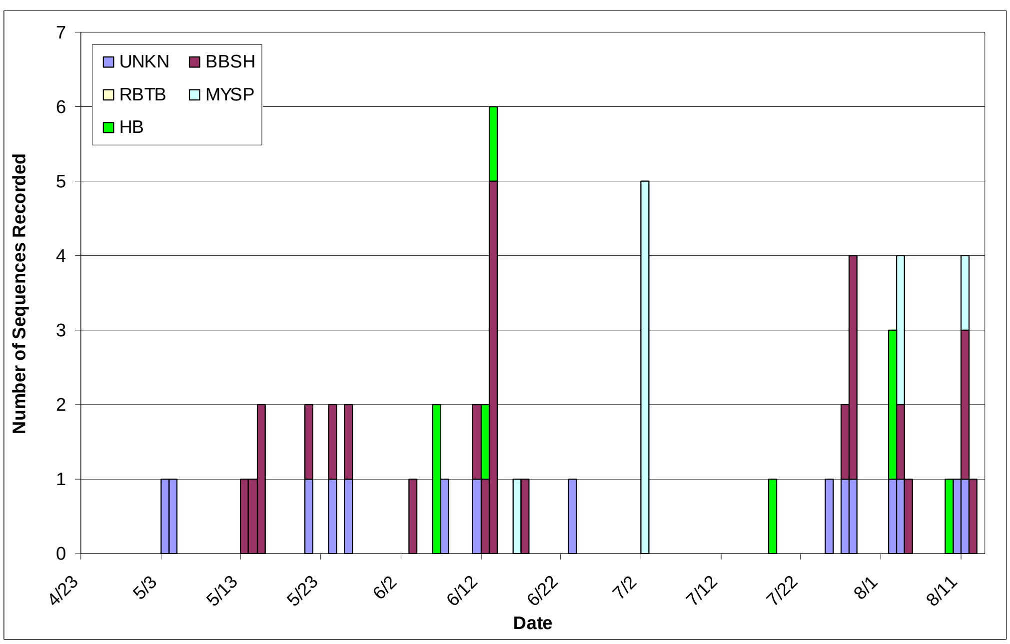


Figure 3-4b. Nightly detections at the Briggs Hill Low detector from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat/evening bat*); BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

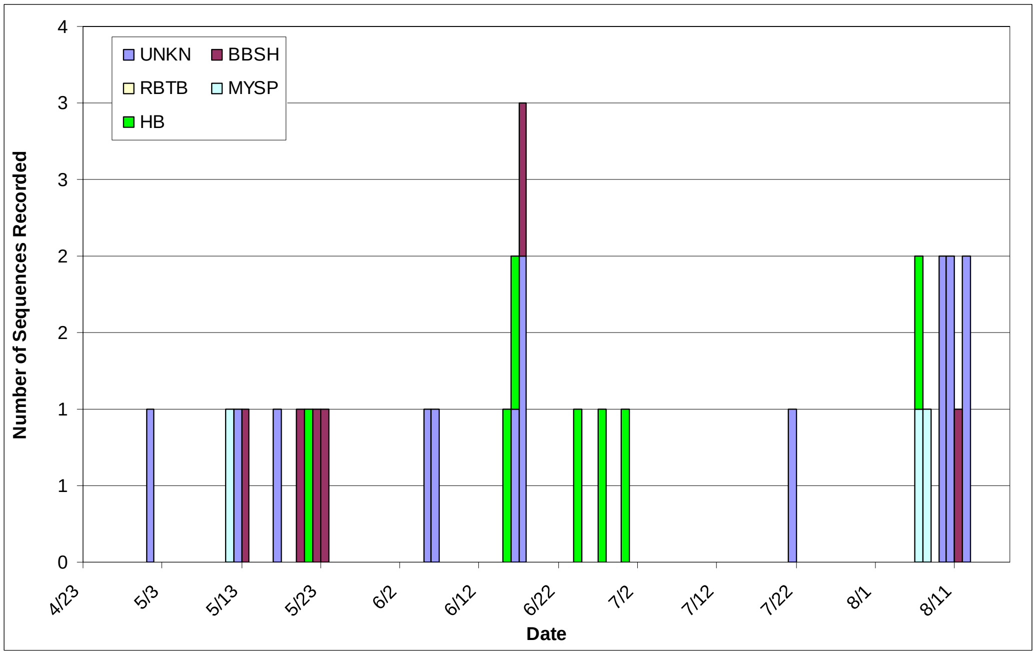


Figure 3-4c. Nightly detections at the Stewart High detector from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

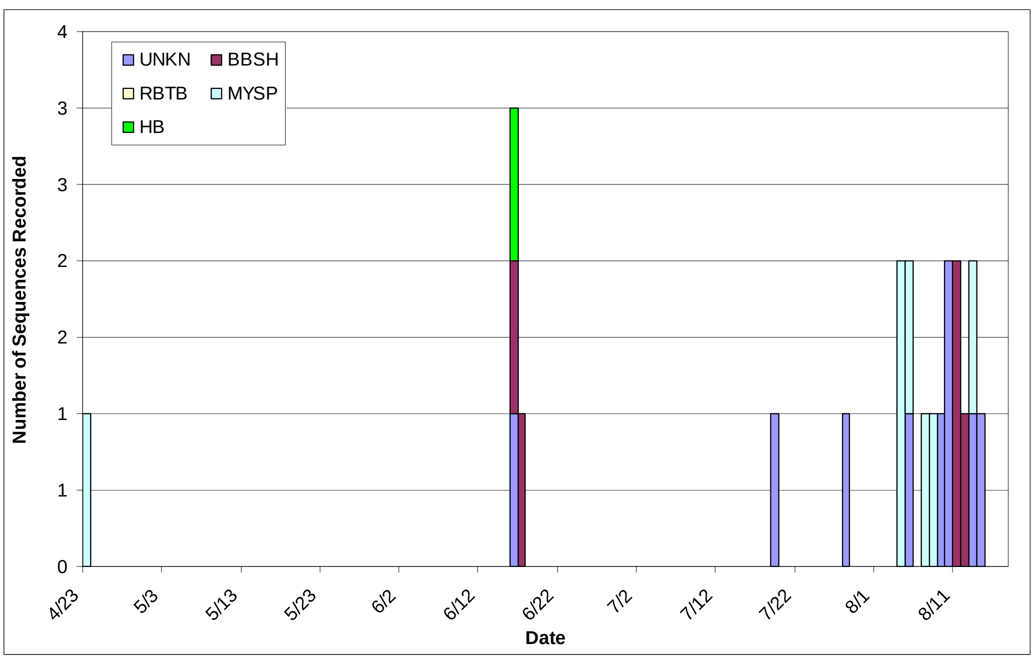


Figure 3-4d. Nightly detections at the Stewart Low detector from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

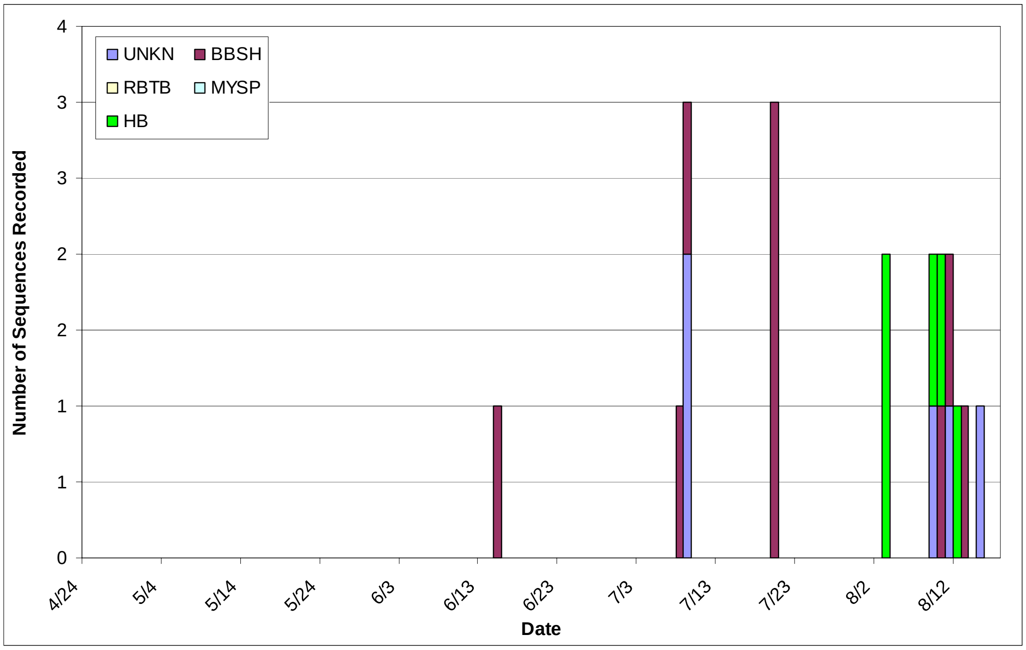


Figure 3-4e. Nightly detections at the Witham High detector from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

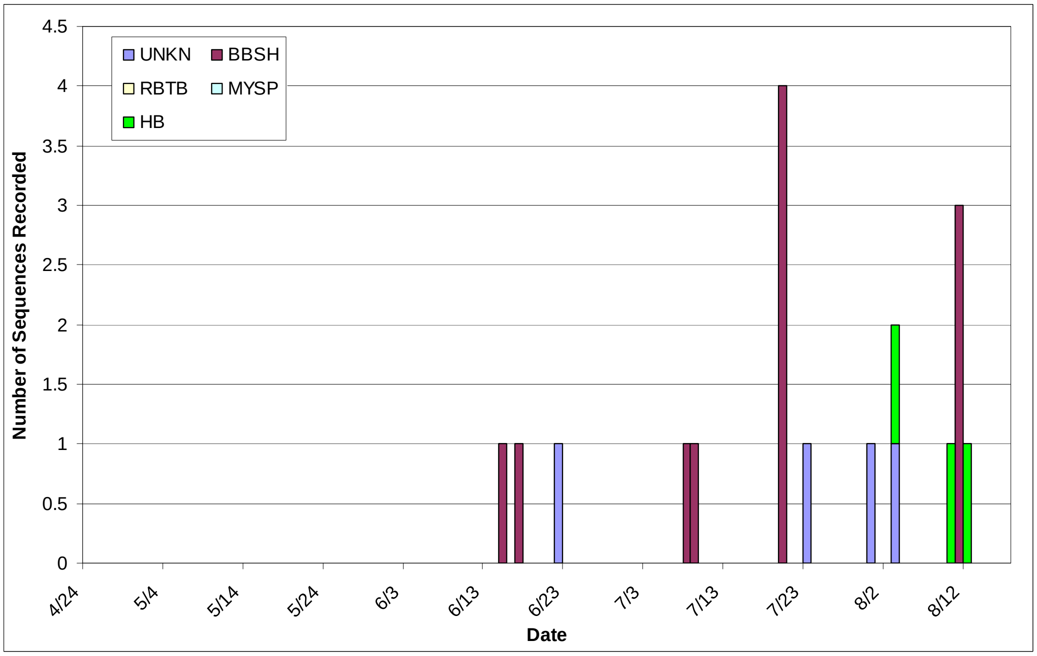


Figure 3-4f. Nightly detections at the Witham Low detector from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

Most recorded call sequences were classified as BBSH (*n* = 63; 38.0%), followed by UNKN (*n* = 57; 34.3%). Remaining sequences were split roughly evenly between HB (*n* = 26; 15.7%) and MYSP (*n* = 20; 12.0%). No call sequences were identified as RBTB (Table 3-4). Within the BBSH guild, 23 (37%) were identified as silver-haired bats, 3 (5%) were identified as big brown bats, and 37 (58%) could not be identified between the species. Within the UNKN category, the majority (*n* = 39; 68%) of call sequences were low frequency. Of those species documented within the Project area, the hoary bat (HB), silver-haired bat (SH) and big brown bat (BB) typically produce low frequency calls. As a single species, hoary bats (HB) accounted for a relatively high percentage of the total number of recorded sequences (*n* = 26; 16%).

Table 3-4. Distribution of detections by guild for detectors during spring/summer 2009 surveys

Detector	Guild					Total
	BBSH	HB	MYSP	RBTB	UNKN	
Briggs High	7	2	1	0	9	19
Briggs Low	25	8	9	0	15	57
Stewart High	6	7	3	0	15	31
Stewart Low	5	1	7	0	9	22
Witham High	9	5	0	0	5	19
Witham Low	11	3	0	0	4	18
Total	**63**	**26**	**20**	**0**	**57**	**166**
Guild Composition %	**38.0%**	**15.7%**	**12.0%**	**0.0%**	**34.3%**	

Among detectors, species composition varied slightly, although overall numbers of recorded call sequences were too low to characterize patterns. Figure 3-5 summarizes species composition of acoustic activity by detector for the entire survey period.

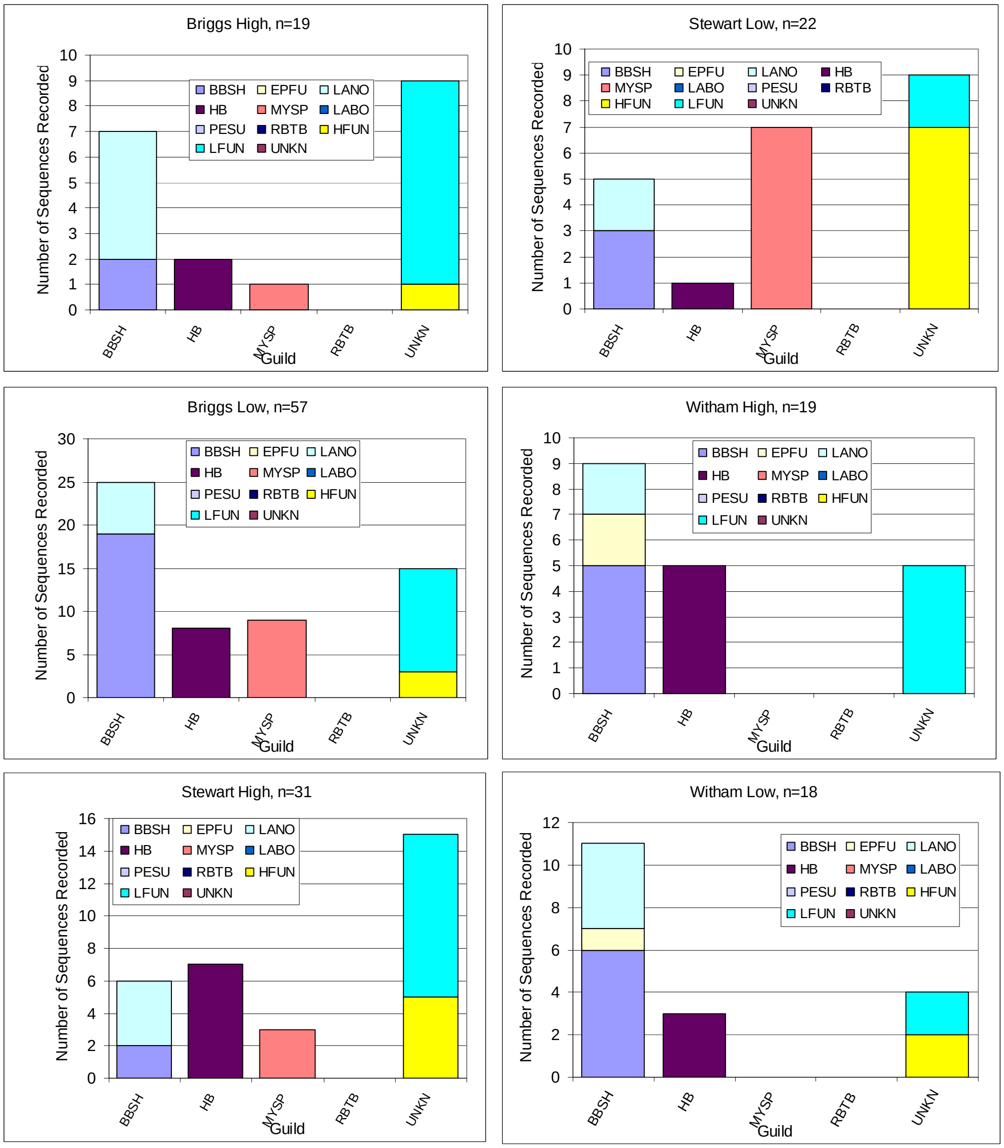


Figure 3-5. Guild and species composition of recorded bat call sequences at Highland met detectors from April through August, 2009. UNKN (*unknown guild*); RBTB (*red bat/tri-colored bat)*; BBSH (*big brown/silver haired*); HB (*hoary bat*); MYSP (*myotis*).

Timing of acoustic activity varied between detectors and nights, but exhibited a gradual peak between the second and fourth hour past sunset when data were combined for all detectors and all nights. Activity levels then dropped gradually between the fourth and tenth hour past sunset (Figure 3-6).

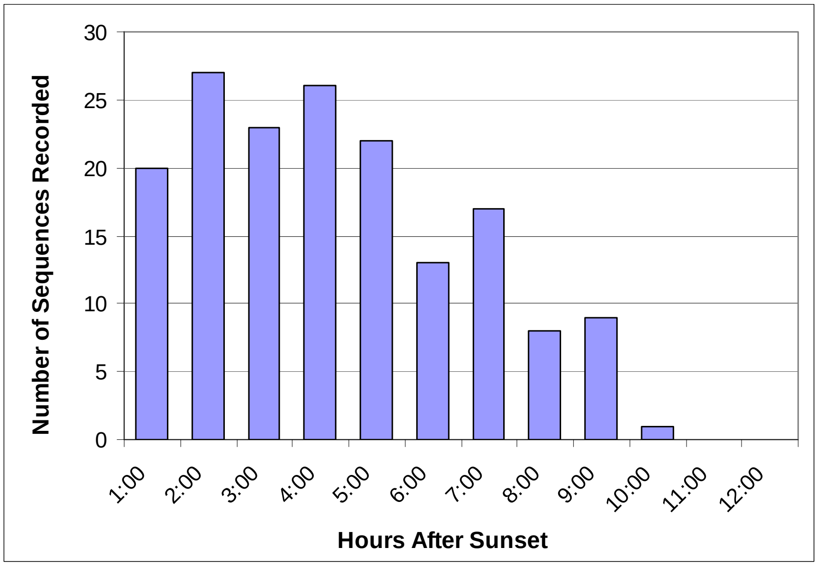


Figure 3-6. Timing of acoustic activity during 2009 surveys relative to sunset for six detectors combined.

3.3.2 Weather Data

Mean nightly wind speeds in the Project area from April 23 through August 17 varied between 2.0 and 16.6 m/s, with an overall mean of 6.8 m/s (Figure 3-7). Mean nightly temperatures varied between1.5ºC and 22.0ºC, with an overall mean of 12.0ºC (Figure 3-8). Mean nightly barometric pressure varied from 920 mm Hg to 952 mm Hg with a mean value of 940 mm Hg (Figure 3-9). Whereas wind speed and barometric pressure were variable throughout the survey period, mean nightly temperatures trended higher throughout the survey period. Generally speaking, bat activity levels were higher on nights with lower mean wind speeds and higher mean temperatures. Rainfall totaled 26.5 inches during the survey period and bats were seldom detected on nights with rainfall (Figure 3-10).

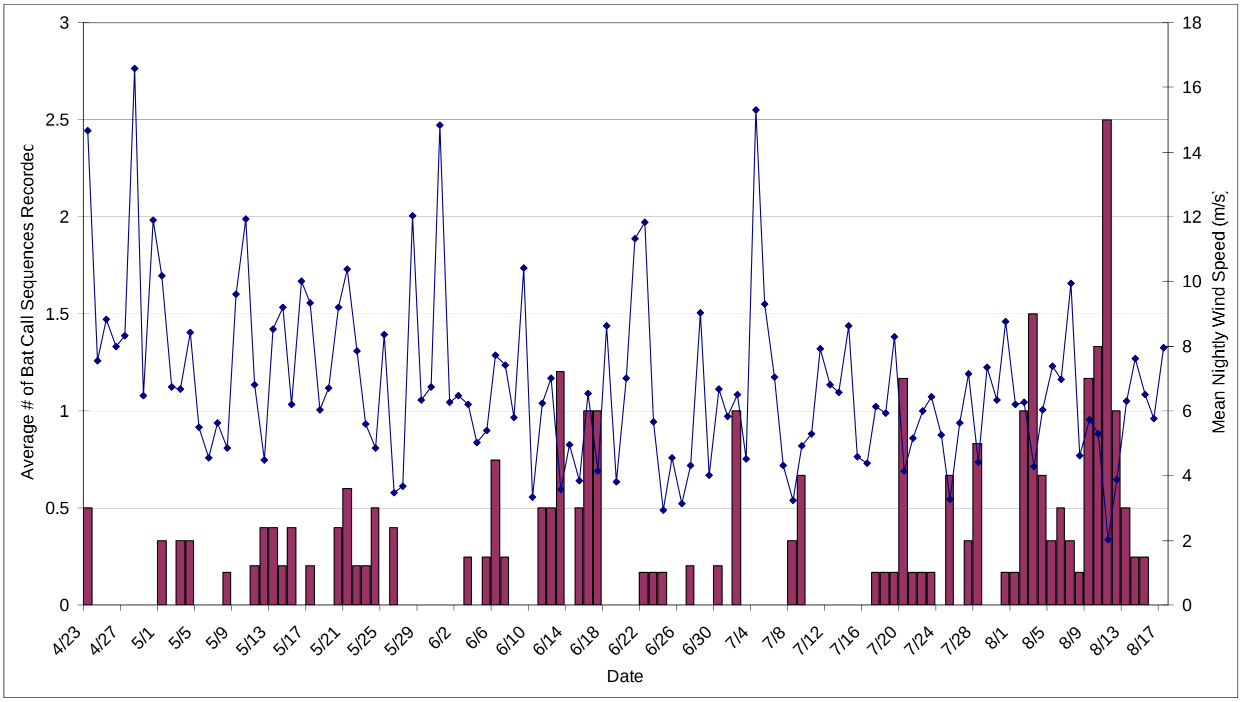


Figure 3-7. Nightly mean wind speed (m/s) (blue line) and bat call detections averaged across the six detectors

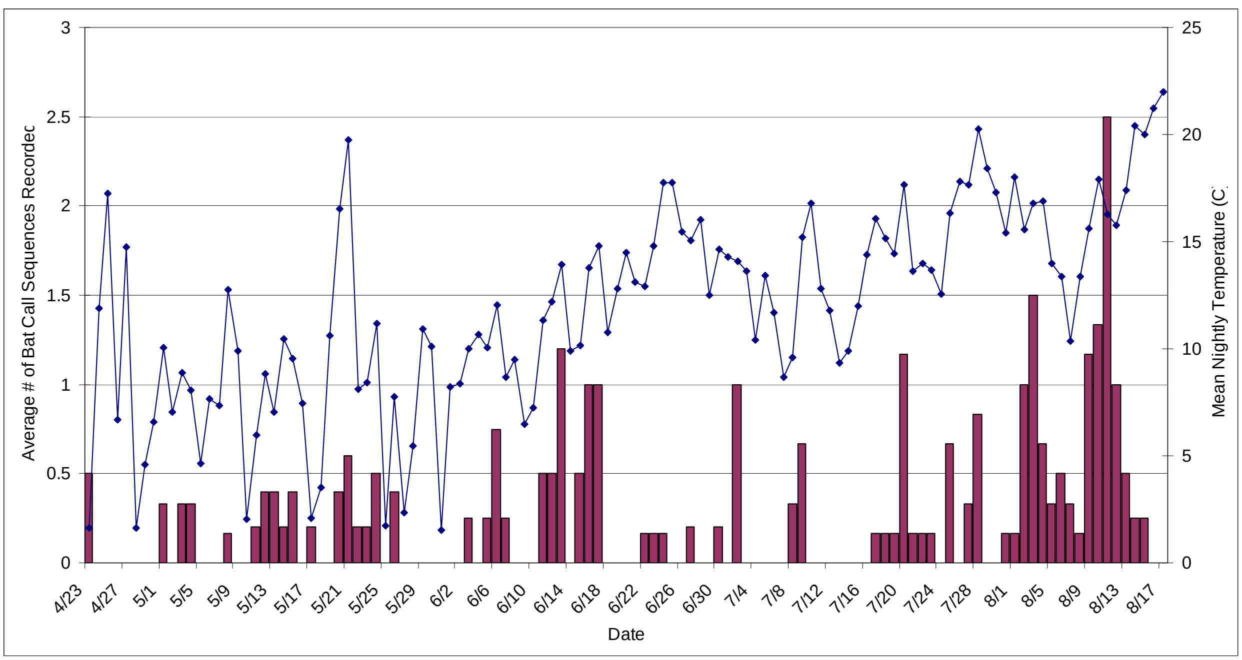


Figure 3-8. Nightly mean temperature (Celsius) (blue line) and bat call detections averaged across the six detectors

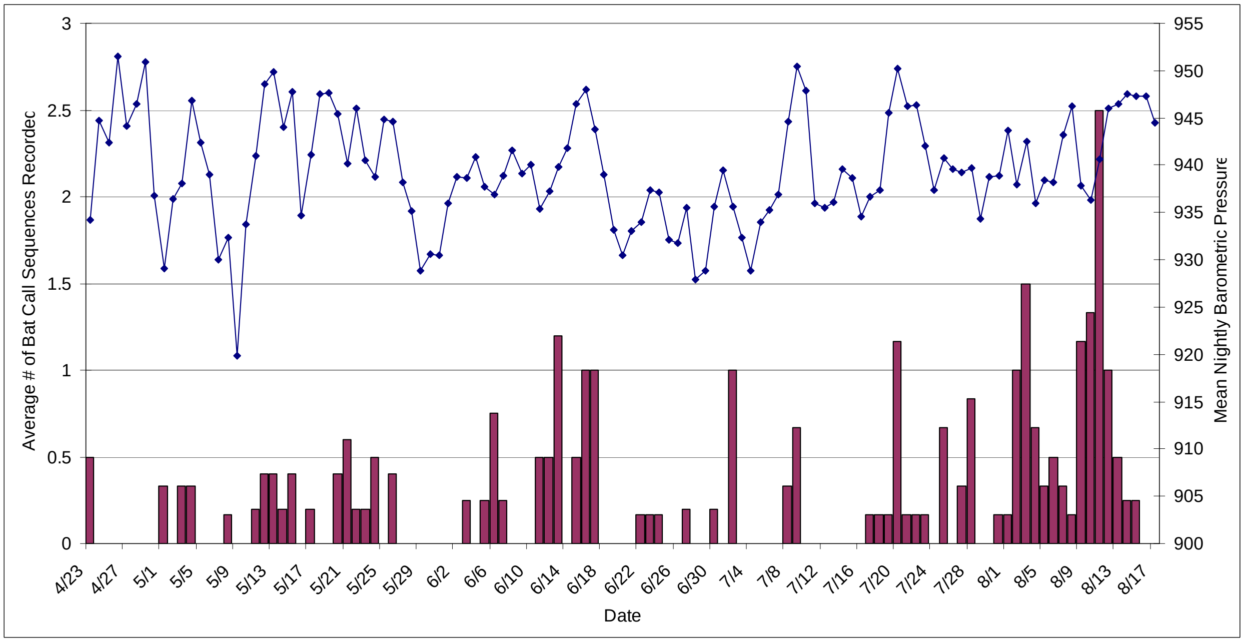


Figure 3-9. Nightly mean barometric pressure (mm Hg) (blue line) and bat call detections averaged across the six detectors

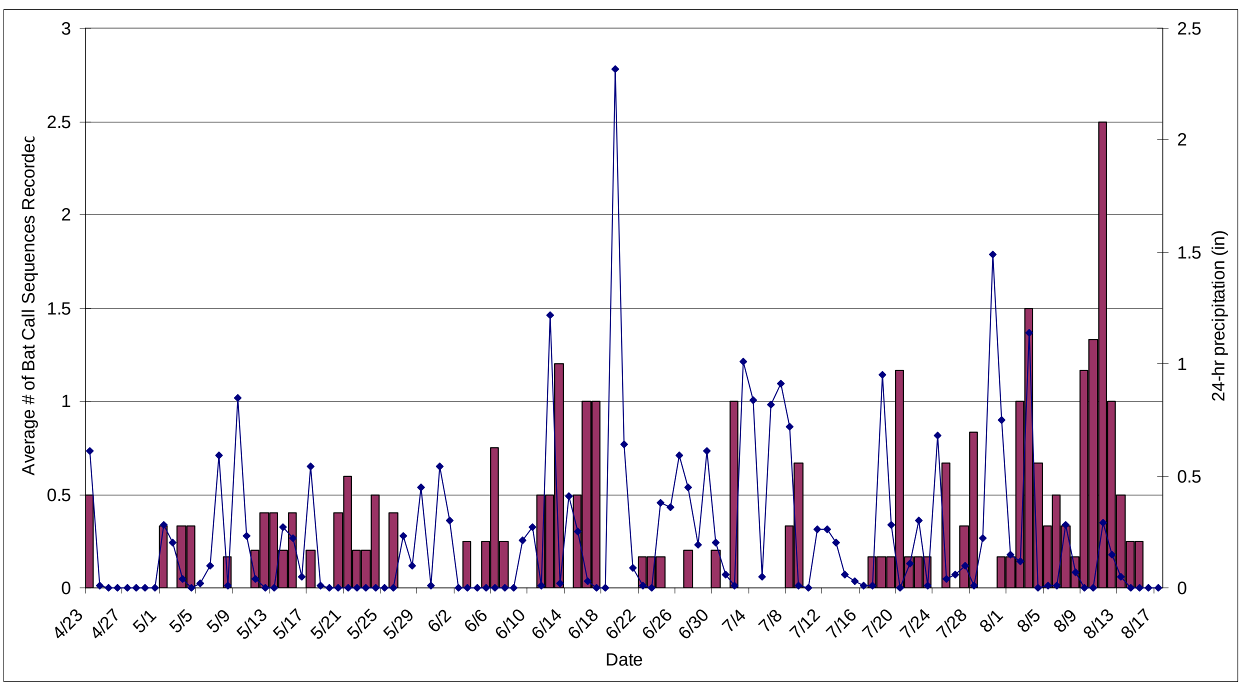


Figure 3-10. 24-hr total precipitation (inches; blue line) and bat call detections averaged across the six detectors. Because data on timing of rainfall were not available, rainfall data are reported as 24-hour totals, including daytime rain.

3.4 DISCUSSION

Bat echolocation surveys provide some insight into possible activity patterns, species composition, and timing of movements of bats in the Project area. Between 2008 and 2009 acoustic surveys, Stantec conducted nearly eight months of acoustic monitoring at three different met towers and several near-ground locations (in 2008) within the Project area. Together, these two seasons of monitoring provide information on the activity patterns of bats in the Project area. Acoustic surveys in 2009 documented low levels of acoustic activity among all six detectors. No detector recorded more than six call sequences during any single night, which is very low for this type of survey work, particularly in mid summer. Weather conditions during this time period, particularly high rainfall amounts, may have significantly influenced bat activity and resulting detection rates. In addition, the 2009 spring/summer survey period did not capture the peak in activity that typically occurs later in the season (mid-August to early September) because this time was cover during the 2008 surveys.

Comparison of the 2008 and 2009 survey results, using only the data collected at the met tower locations, indicates that the overall mean detection rate was the same (0.3 r/d/n). In 2008, detectors were originally deployed in trees along forested corridors and were placed at a height of 8 m or less. These lower detectors picked up a high number of call sequences (n=11,516) many of which were determined to be either *Myotis* sp. or high frequency unknown calls.

Species composition of recorded bat activity suggests that most bats flying above the canopy within the Project area are larger species, with hoary bats and silver-haired bats appearing to be the most commonly detected species, followed by big brown bats. Very few *Myotis* sp. bats were recorded above the tree canopy. These trends were true for both 2008 and 2009 acoustic surveys, and have also been observed at other regional studies. The *Myotis* sp. bats are detected most frequently near the ground and larger bats, which are presumably more capable fliers, are detected more frequently by detectors mounted high in met towers.

Differences in detection rates between guilds at the various detector locations may reflect varying vertical distribution and habitat preferences of bat species (Arnett *et al*. 2006, Hayes 2000). Recent research using Anabat detectors recorded *Myotis* species more frequently at lower heights and larger species such as big brown and hoary bats were more frequently at higher heights (Arnett *et al*. 2006). This general trend matches the guild compositions reported in Figure 3-5. However, interpretation of guild composition is confounded by the high number of UNKN call sequences. Unknown call sequences could not be identified to guild or species due to short call sequences (less than five pulses) or poor call signature formation, often a result of bats flying at the edge of the detection zone of the detector or flying away from the microphone. The relatively small area sampled by bat detectors makes scenarios leading to un-identifiable call sequences common, but some information can still be gleaned from these poor recordings. Specifically, 68 percent of UNKN sequences recorded in the Project area during 2009 surveys were identified as being LFUN, which include the hoary bat, silver-haired bat, and big brown bat, the three most commonly identified species during 2009 surveys. These species also were most commonly detected when the detectors were deployed in the met towers in 2008; however, these results contrasts sharply with the results for detectors deployed in trees during the earlier part of the fall 2008 season. Detectors placed in trees were closer to the ground (within 8 m) and more commonly recorded *Myotis* species; a genus that is more commonly detected at lower heights.

When met tower acoustic data from 2008 and 2009 are considered together, August stands out as the month with the highest acoustic activity levels. Although only half of the month was sampled during each year, activity levels peaked in August and gradually declined in September and October during 2008 surveys, and peaked in August after a gradual increase during 2009 surveys.

Comparison of acoustic bat activity levels and weather variables suggest that bats are most active during mild nights with no precipitation and low wind speeds. The large amount of rain between April and August, 2009, may have contributed to the overall low levels of acoustic activity documented in the Project area. July was the rainiest month, and a corresponding drop in activity levels was observed during this month. Because weather variables are not independent of one another, activity levels of bats are likely determined by the combination of variables rather than one single variable. Visual comparison of Figures 3-7 through 3-10 above show that during certain periods with low or no bat activity (example May 29 through June 2) wind speeds were high, temperatures were low, barometric pressure dropped, and considerable rain fell. While the weather was clearly not favorable for bats during certain intervals in the survey period, it is difficult to isolate which weather variable influenced bat activity most.

Qualitatively speaking, acoustic surveys at the Project area mirror similar surveys conducted in the Northeast Specifically, detection rates at detectors suspended from met towers were low (less than 1 r/d/n), and detectors operating at ground-level exhibited tremendous variation, ranging from less than 10 to over 300 r/d/n. This type of variation reflects differing conditions (habitat, microclimates, etc.) and differing timing of operation among detectors. The results of these Project specific surveys, including variability in bat activity and generally low detection rates above canopy height, are consistent with other publicly available acoustic surveys conducted at proposed wind developments in the Northeast. This Project area does appear to have activity levels that are consistently below those from similar surveys conducted in the region (Appendix B Table 1).

4.0 Breeding Bird Survey

4.1 INTRODUCTION

Stantec conducted a breeding bird survey during the spring and summer of 2009. The goal of the surveys was to determine the species composition, abundance, diversity, and distribution of breeding birds in the Project area. The surveys focused effort on documenting the occurrence of species of conservation concern, but considered all avian species visually or acoustically detected. Survey methods were conducted in accordance with the United States Geological Survey (USGS) North American Breeding Bird Survey methods (Sauer *et al.* 2003). The survey provides baseline data of the species present in the Project area, their abundance, as well as the community structures among the different habitats present on-site.

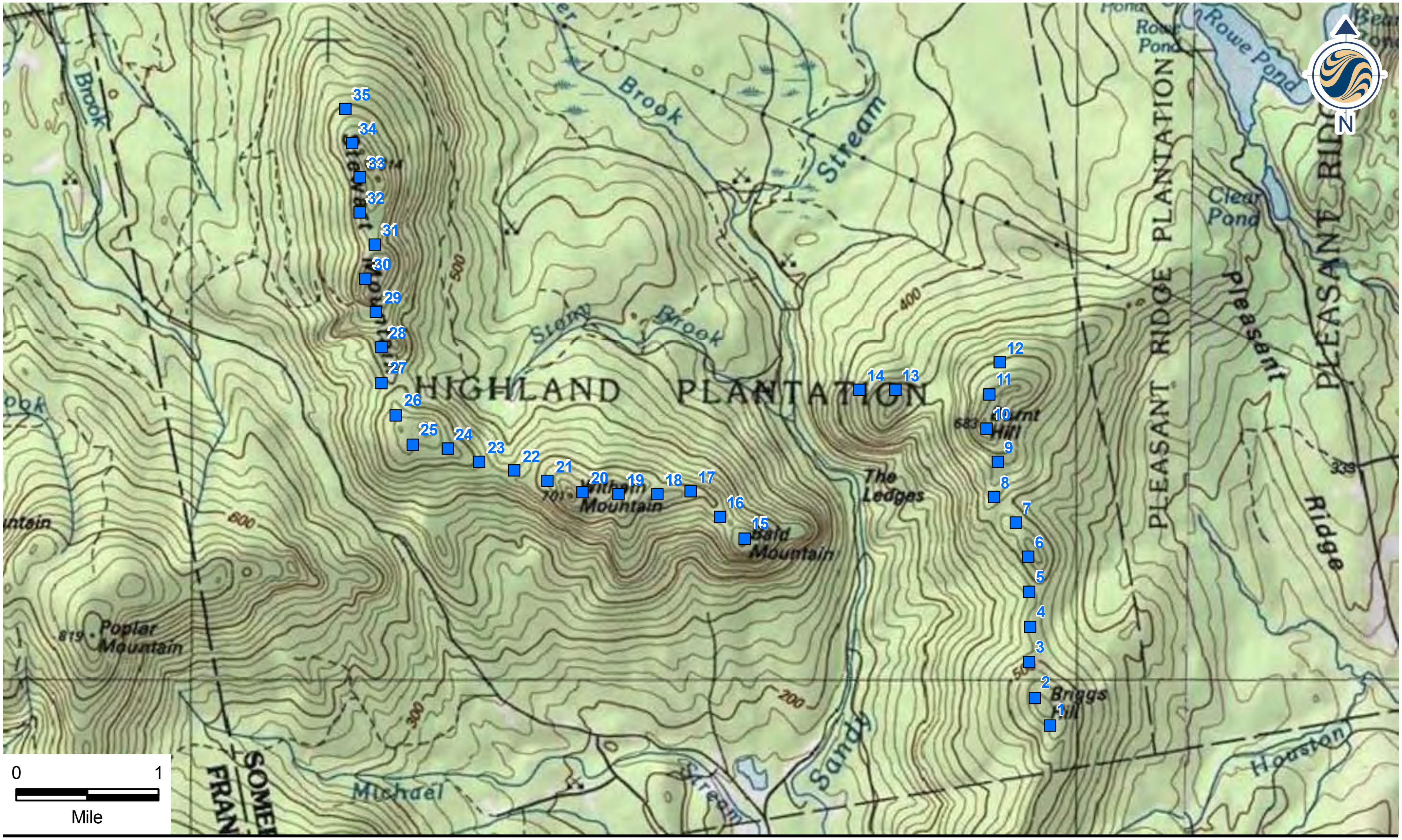
4.2 METHODS

4.2.1 Breeding Bird Survey Point Counts

Consistent with USGS North American Breeding Bird Survey methods, Stantec biologists conducted breeding bird point count surveys during three separate visits to the Project area: the first visit occurred at the end of May, and the other visits took place in June 2009.

The timing of surveys targeted the timeframe starting 15 minutes before sunrise to 6 hours after sunrise on days with suitably clear weather, mild temperatures, and when rain or wind would not inhibit the detection of birds. Point count locations were established over the proposed Project area using Global Positioning System (GPS) equipment (Figure 4-1), and were positioned to sample all habitats representative of the Project area. These included points along the ridgelines in proximity to the proposed turbine locations or access roads. At each survey point, GPS location, time, weather, habitat, species, number of individuals, and other behavioral notes were recorded.

During surveys, observers oriented themselves toward the north and record the general location of birds onto the directional quadrants of a count circle. Point count sample periods were broken into three periods: the first three minutes, the following two minutes, and the final five minutes. For the duration of the 10-minute count period, the species and the number of individuals occurring at distances of 0-50 m, 50-100 m, or greater than 100 m from the observer, or flying overhead, were recorded on datasheets for the period during which they were first heard. During each consecutive time period, observers would determine the location of previously recorded birds and track any movements within the count circle to avoid recounting birds. When possible, observers made digital recordings of rare or unusual birds. Observations of birds made before and after the point count timeframes were recorded separately as incidental observations.



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Legend

■ BBS Point Location

Client/Project

Highland Wind, LLC
Highland Wind Project
Highland Plantation, Maine

Figure No.
4-1

Title
Breeding Bird Survey Location Map
October 15, 2009

00385-F401-BBS-Points.mxd

The habitats in the Project area were summarized into four categories: coniferous forest, deciduous forest, mixed coniferous and deciduous forest, and disturbed. Habitat types for each point count location were assigned based on the dominant vegetation cover present at each survey location. The disturbed habitat category included clearings created for meteorological (met) towers as well as early successional cuts created by timber harvesting. Habitats that share similar characteristics were grouped wherever possible for statistical analysis purposes. For example, coniferous forest habitats included second-growth stands as well as coniferous stands that had undergone more recent harvesting, but were beyond the initial early successional stage of regeneration.

Quantitative data collected during point counts were used to calculate the species richness, relative abundance, community diversity, and frequency of breeding birds within the available habitats of the Project area.

- Species richness (SR) is the total number of species that are detected at a specific point, within a habitat classification, or across the Project area.
- Relative abundance (RA) measures the number of individuals of a species within a habitat classification or across the Project area, and takes into account the number of times each point is surveyed and the number of points per habitat, or per Project area.
- Frequency (Fr) of occurrence, expressed as a percentage, measures the number of points within a habitat type, or across the Project area, where a particular species is detected.
- The Shannon Diversity Index (SDI) is a measure of species diversity in a community or habitat. SDI can provide more information about community composition than species richness alone because it takes into account relative abundance and evenness of species. It indicates not only the number of species, but also how abundance is distributed among all the species in the community or habitat.

Species recorded as beyond 100 m from the observer, as flyovers, or birds detected incidentally were not included in the statistical analysis for relative abundance, species frequency, or community diversity due to the probability that they were not breeding within the direct vicinity of the point count location; however, these data were used to determine overall species richness and the total number of birds observed.

4.3 RESULTS

One round of surveys was conducted in May (May 21 to 22), and two were conducted in June (June 9 and 10, and June 21, 25, and 26). Breeding bird surveys were conducted when wind or rain conditions had no adverse effect on bird detection. Wind conditions were predominantly calm to 4 to 7 kph (2 to 4 mph); wind speeds did not typically exceed 19 kph (12 mph) during the surveys except for brief periods on May 21 and 22, June 9, and June 21. Weather conditions generally ranged from clear to overcast skies, although there were periods of fog or mist, drizzle, and showers during surveys on June 10, 21, and 26. Temperatures during the surveys ranged from -18 to 23º C (-0.4º to 73.4º F).

There were a total of 35 breeding bird point count locations surveyed within the Project area. Each point was surveyed during the three separate site visits. Fifty-two species and an unidentified woodpecker and two unidentified ducks were observed during point count surveys (Appendix C Table 1). Three additional species were detected incidentally between point count surveys: American kestrel (*Falco sparverius*), American woodcock (*Scolopax minor*), and eastern phoebe (*Sayornis phoebe*) (Appendix C Table 2).

4.3.1 BBS Point Counts

Including birds detected beyond 100 m from the observer and birds seen flying over head, a total of 1,057 individual birds representing 52 species were documented during the point count surveys. Fifty-two percent of birds (n=553) were detected within 50 meters of the observer, 37 percent (n=390) were detected 50 to 100 m, 7 percent (n=77) were detected at greater than 100 m from the observer, and 4 percent (n=37) were observed as flyovers (Appendix C Table 1). The species with the greatest relative abundance among the 35 point counts included white-throated sparrow (*Zonotrichia albicollis*; RA=1.02), chestnut-sided warbler (*Dendroica pensylvanica*; RA=0.68), black-throated-blue warbler (*Dendroica caerulescens*; RA=0.67), and dark-eyed junco (*Junco hyemalis*; RA=0.60).

Point count data were analyzed to determine species richness, relative abundances, and diversity for each habitat type (Table 4-1). Excluding birds detected greater than 100 m from the observer and birds seen flying over head (n=943), the species richness was 47 and the relative abundance of all birds among the 35 point count locations was 8.98. The SDI for all points surveyed was 3.25.

The ridgeline portion of the Project area is dominated by two habitat categories, and these were the most frequently surveyed habitats: disturbed areas (n=17 points) and coniferous forest (n=15 points). The most birds were observed within the disturbed habitat (n=517), but this in large part reflects the greater number of survey points within this habitat category. The greatest species richness also was documented in disturbed habitat (SR=38). The relative abundance was highest within the deciduous forest (RA=11.33) followed by the disturbed habitat (RA=10.14). The SDI was relatively similar across the four habitat categories, indicating a similar species diversity and distribution among points sampled.

Table 4-1. Summary of breeding bird point count results by habitat type

Habitat Type	# BBS Points	Total Birds Observed	Relative Abundance	Species Richness	Shannon Diversity Index
Coniferous forest	15	341	7.58	32	2.95
Deciduous forest	1	34	11.33	19	2.80
Mixed forest	2	51	8.50	20	2.82
Disturbed	17	517	10.14	38	2.98
All points	**35**	**943**	**8.98**	**47**	**3.25**

4.3.2 Species relative abundances and frequencies among habitats

Following is a summary of the relative abundance and frequency of occurrence for the most commonly detected species in the four surveyed habitats (Appendix C, Tables 3).

4.3.2.1 Coniferous forest

The species with the greatest relative abundance among the coniferous forest points were Nashville warbler (*Vermivora ruficapilla*; RA=0.89), yellow-rumped warbler (*Dendroica coronata*; RA=0.76), and golden-crowned kinglet (*Regulus satrapa*); RA=0.67). The species occurring most frequently among the coniferous forest points were dark-eyed junco (Fr=100%), yellow-rumped warbler (Fr=93%), golden-crowned kinglet (Fr=87%), and Nashville warbler (Fr=87%).

4.3.2.2 Deciduous forest

Species with the greatest relative abundances among deciduous forest points were dark-eyed junco (RA=1.33), black-throated blue warbler (RA=1.33), American redstart (*Setophaga ruticilla*); RA=1.00), and mourning warbler (*Oporornis philadelphia*); RA=1.00). Because only one point was surveyed in this habitat, the frequency of occurrence yields little information; all detected birds had a value of 100 percent.

4.3.2.3 Mixed forest

Species with the greatest relative abundances among mixed forest points were black-throated blue warbler (RA=2.67), yellow-rumped warbler (RA=1.67), hermit thrush (*Catharus guttatus*); RA=1.33) and bay-breasted warbler (*Dendroica castanea*); RA=1.33). Because only two points were surveyed in this habitat, species either had a frequency of occurrence of 50 percent (n=12) or 100 percent (n=8).

4.3.2.4 Disturbed

Species with the greatest relative abundances among disturbed habitat points were white-throated sparrow (RA=1.55), chestnut-sided warbler (RA=1.24), common yellowthroat (RA=1.10), and black-throated blue warbler (RA=0.78). The species observed most frequently were white-throated sparrow (Fr=100%), chestnut-sided warbler (Fr=94%), and common yellowthroat (Fr=88%).

4.4 DISCUSSION

During the 2009 breeding bird surveys, a total of 55 species were documented in the Project area. Surveys were conducted during the peak nesting period, and were initiated in the early morning when birds are typically the most vocal. Surveys were generally conducted during optimal weather conditions for detection of vocalizations. Certain species of bird vocalize less frequently and are, therefore, often under-represented during breeding bird surveys (Farnsworth *et al.* 2002). The 2009 surveys used standard methods that are comparable to other breeding bird surveys conducted in the region; therefore, the results of the surveys provide a suitable reflection of the breeding bird community in the Project area. The 2009 data represents baseline data that can be compared to similar studies conducted in the region, as well as future studies conducted on-site. .

The ridgeline portion of the Project area consists primarily of disturbed habitat and coniferous forests and as a result more of the point count locations fell within these two habitats. Largely as a result of number of survey points, most of the birds were observed within these two habitats. These two habitats also had comparatively higher species richness when compared to the deciduous and mixed habitat categories. The SDI for the four habitats was similar indicating a relatively even distribution of species among the surveyed points.

The species detected during breeding bird surveys were those that would typically be associated with the available habitats in the Project area. Those stands of more mature coniferous and deciduous forests provided habitat for interior forest species such as the golden-crowned kinglet and bay-breasted warbler. In contrast generalist species such as the Nashville warbler and edge-associated species (i.e., mourning warbler and white-throated sparrow) occurred more commonly in less mature stands and in the very early successional cuts and clearings.

No state- or federally-listed endangered or threatened species were observed during the 2009 breeding bird surveys, but 10 state-listed species of special concern were documented (Table 4-2). Although these species are listed as species of special concern in Maine, several of them are considered globally and regionally secure (NatureServe Explorer 2009). For example, the chestnut-sided warbler has shown no statistically significant decline and no clear population trends across its range. White-throated sparrow and chestnut-sided warbler, two species that respond well to regeneration following timber harvesting, had the highest RA during the point count surveys. With the possible exception of the black-throated blue warbler, which is more typically associated with interior forest habitats, the species with the greatest relative abundances among all points sampled are forest edge dwelling species and will inhabit areas with past forest disturbances such as timber harvesting. In general, the species that were detected on-site are common and regionally abundant species and they are representative of the habitats in which they were detected.

Table 4-2. Maine species of special concern detected during the 2009 breeding bird surveys	
Species	**Relative abundance among all points**
least flycatcher	0.01
yellow warbler	0.01
Tennessee warbler	0.03
Canada warbler	0.04
American redstart	0.24
black-and-white warbler	0.28
chestnut-sided warbler	0.68
white-throated sparrow	1.02
olive-sided flycatcher	*
eastern wood-pewee	*
*Observed greater than 100 m from observer.	

5.0 Diurnal Raptor Surveys

5.1 INTRODUCTION

The Project area is within the "Eastern Continental Hawk Flyway"[4], which extends from the Canadian Maritimes south to eastern Florida. Within this large area, raptors tend to concentrate along linear mountain ridgelines which provide 'leading lines' for migrants (Kellogg 2007). Updrafts are formed along the side slopes of ridges which raptors use in order to fly long distances with minimal exertion (Berthold 2001). Raptors also use thermals, pockets of warm, air that rise from the ground's surface as it is heated by the sun, to minimize energy expenditure during migration movements (Bildstein 2006). Because many raptor species avoid crossing large bodies of water, raptor migration in the Eastern Continental Hawk Flyway also tends to be concentrated along the shores of large bodies of water including lakes and the Atlantic Coast (Kellogg 2007).

It was the purpose of the raptor surveys to sample migration activity at central and prominent locations within the Project area, to document the species that occur in the vicinity of the Project, and the general flights height, flight path locations, and other flight behaviors of raptors within or in the vicinity of the Project.

[4] The Eastern Continental Flyway includes the Maritime Provinces; New England; New York (south and east of a line from Jamestown to Utica to the north end of Lake Champlain); Pennsylvania (all except Erie County); Mid-Atlantic States through Georgia, West Virginia, Kentucky and Tennessee; Florida east of a line from Lake Seminole south to Apalachicola (Kellogg 2007).

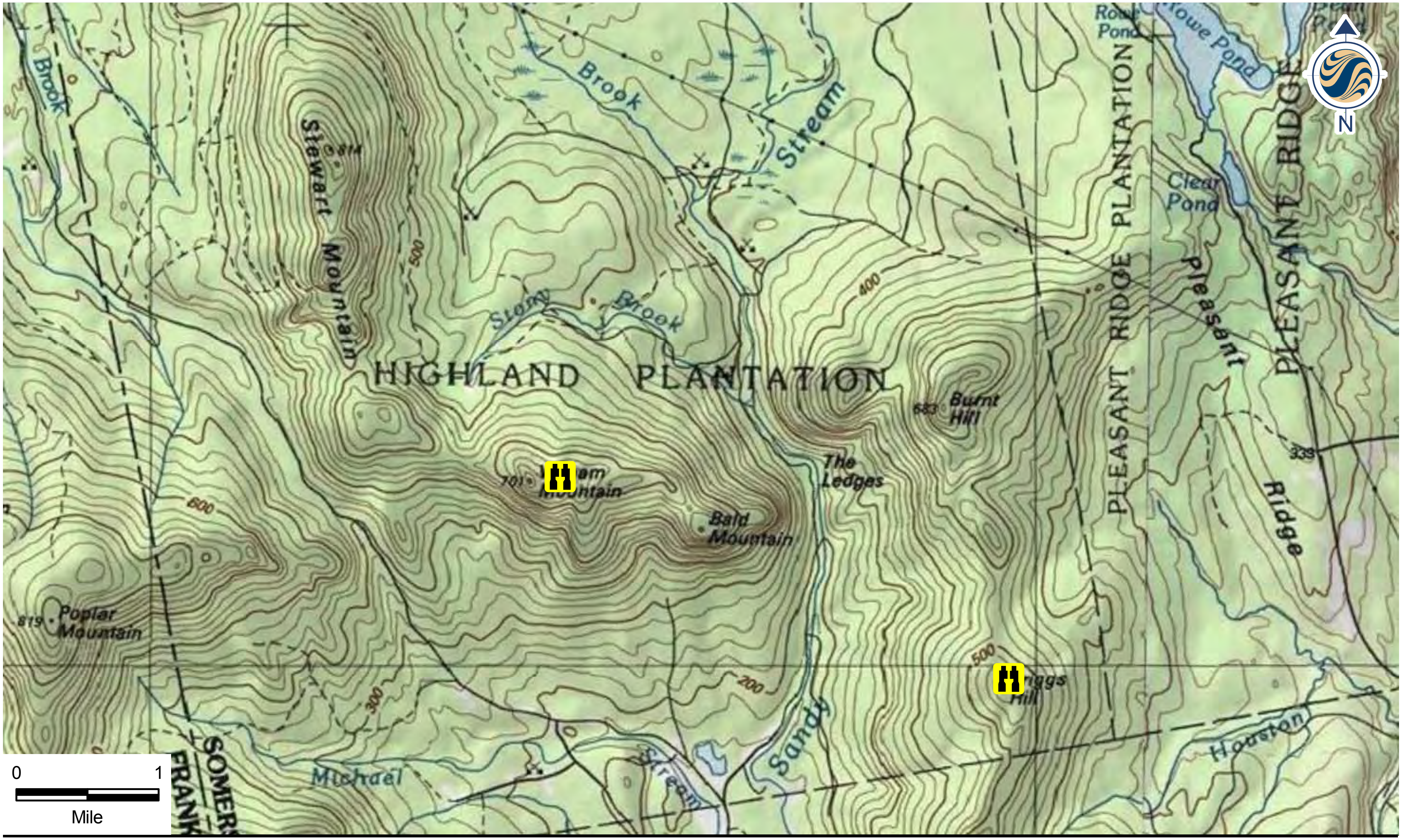
5.2 DATA COLLECTION METHODS

5.2.1 Field Surveys

Diurnal raptor surveys were conducted on days with favorable flight conditions. Days following the passage of weather fronts bringing favorable weather, good visibility, and days with southerly winds were targeted. Raptor migration is facilitated by tail winds (winds aligned with the preferred direction of travel), which "push" migrating raptors forward (Bildstien 2006); however, some raptors will fly in light or moderate headwinds. Days with headwinds also were sampled as some flight behaviors differ in moderate to strong headwinds.

Raptor surveys were conducted from two different sites in the Project area (see Figure 5-1). These two locations were chosen in coordination with MDIFW because they provided adequate coverage of the Project area. The primary raptor observation site was located on the exposed-bedrock summit of Witham Mountain, where unobstructed 360-degree views of the Project area are available. The summit of Briggs Hill located at the southern edge of the Project area was chosen as the second survey site[5]. Briggs offers good views to the south of approaching raptors as well as sweeping vistas across Bald, Witham, and Stewart Mountains.

[5] Burnt Hill, which is located at the northern end of the Project area, was used as the second survey site during the fall migration. This more northerly location provided a better opportunity to observe birds migrating south.



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Legend

Raptor Survey Location

Client/Project

Highland Wind, LLC
Highland Wind Project
Highland Plantation, Maine

Figure No.
5-1

Title
Raptor Survey Location Map
August 12, 2009

00385-F501-Raptor-Location-Map.mxd

Surveys were based on Hawk Migration Association of North America (HMANA) methods (HMANA 2007). Surveys were generally conducted from 9 am to 4 pm, during the peak hours of thermal development and raptor movement. During surveys, observers scanned the sky and surrounding landscape for raptors with binoculars or a spotting scope. Hourly weather observations, including wind speed and direction, temperature, sky conditions, percent cloud cover, and relative cloud height and type were recorded. Detailed information for each observation was recorded on datasheets and Project area maps, including:

- Observation date and time;
- Species, number of individuals, and age (if possible);
- If the raptor occurred within the Project boundary (as depicted in Figure 5-1);
- The flight positions of each bird in relation to topography of the area;
- The flight height (above ground) of each bird (within each different topographical flight position);
- The specific flight behaviors of each bird;
- The general flight direction of each bird; and
- If the bird was actively migrating as well as other notes describing the general activity of each bird.

Topographical flight positions were summarized into categories that describe the landscape surrounding the observation site (these positions apply to birds observed both within as well as outside of the Project boundary): A1) parallel to ridge, A2) perpendicular to ridge, A3) over saddle, B) flight path over upper slope of ridge, C) flight path over lower slope of ridge, and D) flight path over a valley (see Figure 5-2 below). As individual birds traveled through or in the vicinity of the Project, all position categories in which a bird occurred were recorded.

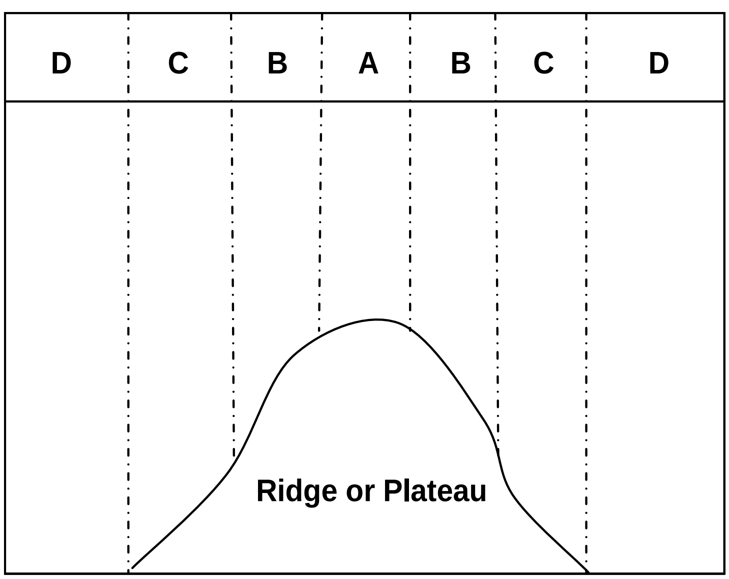

Figure 5-2. Raptor flight position categories in relation to the topography of the Project area.

Nearby objects with known heights, such as the met towers located on the ridges of Witham Mountain and Briggs Hill, were used to gauge flight height.

Flight behaviors where categorized as: circle soaring, linear soaring (straight-line soaring or slow gliding in a 'thermal street' formed between updrafts), gliding (with wings partially closed and bent wrists), powered flight (flapping wings), banking (breaking with fully extended wings and tail fanned), diving (wings partially to mostly closed while in descent), kiting (using wind current to kite with partially closed wings and tail), hovering (maintaining a stationary altitude with some flapping and fanned tail while hunting and looking downward), aerial feeding (eating prey in flight while in a soar or slow glide), aerial hunting low over the ground, aerial display (territorial or courtship aerial display), or perched. These behaviors in association with flight direction, species, and seasonality, were used to describe birds as actively migrating or not-actively migrating.

Birds that flew too rapidly or were too far to accurately identify were recorded as unidentified to their genus or, if the identification of genus was not possible, unidentified raptor. Although priority was given to raptor observations, incidental observations for other avian species, including passerines and water birds also were recorded.

5.3 DATA ANALYSIS METHODS

The raptor observation data was summarized by survey day and for the entire survey period for surveys conducted from both observation sites. Analysis included a summary of:

- The total number of individuals per species observed each survey day, and for the entire survey period;
- Daily passage rates (birds per hour [birds/hr]) calculated for each survey day, as well as for the entire survey period;
- Hourly observation totals per species;
- The percentage of birds within each topographical flight position category;
- The average minimum flight height of birds within each topographical flight position category;
- The percentage of all birds that occurred within the Project boundary;
- For all birds observed within the Project boundary, and within topographical positions where the turbines are to be located, flight heights were categorized as less than or greater than 130.5 m (428') above ground;
- A summary of the flight behaviors of all birds observed.

Observations from the Project survey were compared to Spring 2009 data from the following hawk watch sites: Barre Falls, Barre, Massachusetts; Poquonock, Poquonock, Connecticut; Plum Island, Newburyport, Massachusetts; Pilgrim Heights, North Truro, Massachusetts; and Bradbury Mountain, Pownal, Maine (HMANA 2009). Also provided for comparison were the results of available surveys conducted at proposed wind farms located primarily in New York, Vermont, New Hampshire, and Maine.

5.4 RESULTS

Raptor surveys were conducted from March 25, 2009 to May 19, 2009, resulting in a total of 139 survey hours. Surveys included 12 days (83 hours) on Witham Mountain and 8 days (56 hours) on Briggs Hill. On four of these days, surveys were conducted simultaneously observers at both survey locations. During the simultaneous surveys, observers used cell phones to communicate observations and limit potentially double-counting birds. Surveys were generally conducted from 9:00 am to 4:00 pm, and also included some extended morning and/or evening hours on days when flight conditions were favorable.

Survey days were dominated by high pressure atmospheric conditions and good visibility. Clouds heights were generally mid- to high-elevation, with cumulus and cirrus being the predominant cloud type. Temperatures ranged from -4° C, with a three foot snow-pack early season, to 24°C in mid-May (25 - 75°F). A few surveys were conducted on days with marginal flight conditions. Weather on two days included stratus clouds, drizzle, and passing low pressure, and two days had strong, gusty winds. The majority of days had winds from a westerly direction, which is normal for spring migration, but wind direction was variable throughout the survey period. Wind direction did not appear to affect the number of raptors seen per day; however, migration on April 29 may have been hampered by strong northerly winds (Figure 5-3; Appendix D Table 1).

During the spring 2009 surveys, a total of 260 raptors representing 10 species[6] plus unidentified raptors and unidentified buteos were observed. This included birds within the 1 kilometer Project boundary as well as birds observed beyond this boundary. The overall passage rate was 1.87 birds/hr. At Witham, a total of 153 raptors were observed for a passage rate of 1.84 birds/hr. At Briggs, a total of 107 raptors were observed resulting in a passage rate of 1.91 birds/hr. At Witham, daily counts ranged from 0 to 13 birds with daily passage rates ranging from 0 to 3.28 birds/hr. At Briggs, daily counts ranged from 4 to 30 birds with daily passage rates ranging from 0.57 to 4.29 birds/hr (Appendix D, Table 1).

Turkey vultures (*Cathartes aura*) were the most commonly observed species (Witham, n=57; Briggs, n=75), representing 37 percent and 70 percent of all observations at Witham and Briggs, respectively. At Witham, red-tailed hawks (*Buteo jamaicensis*; n=46; 30 percent) and sharp-shinned hawk (*Accipiter striatus*; n=15; 10 percent) were the next most commonly observed species. Similarly, at Briggs red-tailed hawks (n=14; 13 percent) were the most commonly observed species after turkey vultures. Ten or few observations were documented for each of the remaining species.

[6] While turkey vultures are not phylogenetically considered true raptors, they are diurnal migrants that exhibit flight characteristics similar to *Buteos, Accipiters* and other *Falconiformes* species, therefore vultures are typically included during hawk watch surveys.

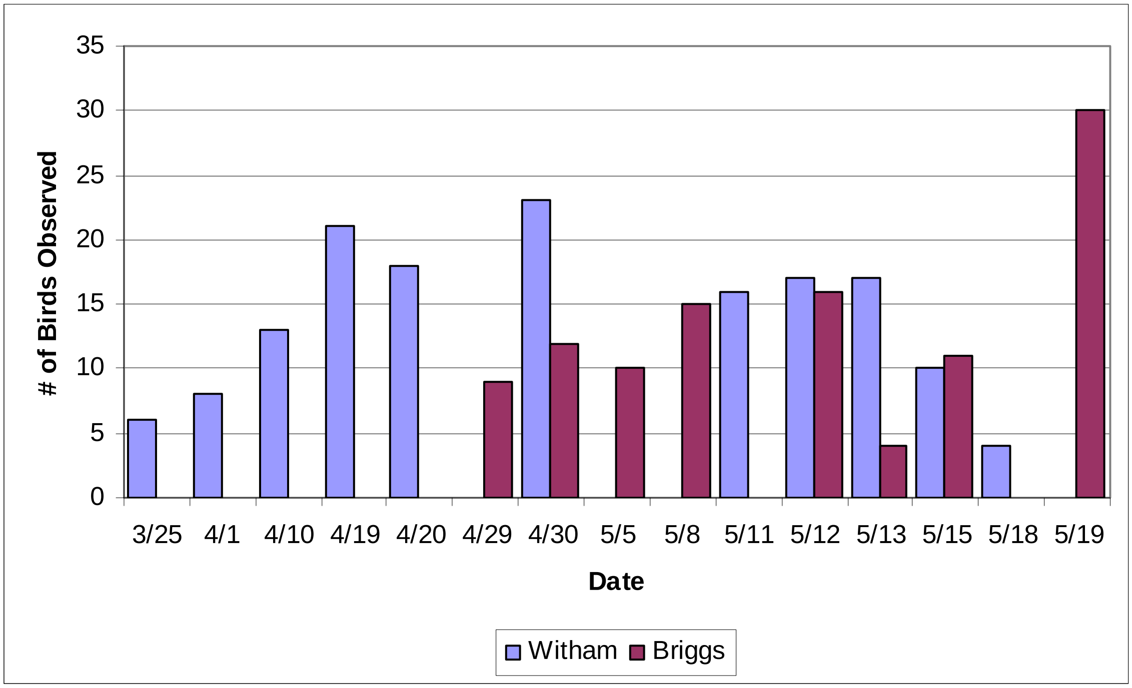

Figure 5-3. Total number of birds observed per survey day at Highland Wind Project – Spring 2009

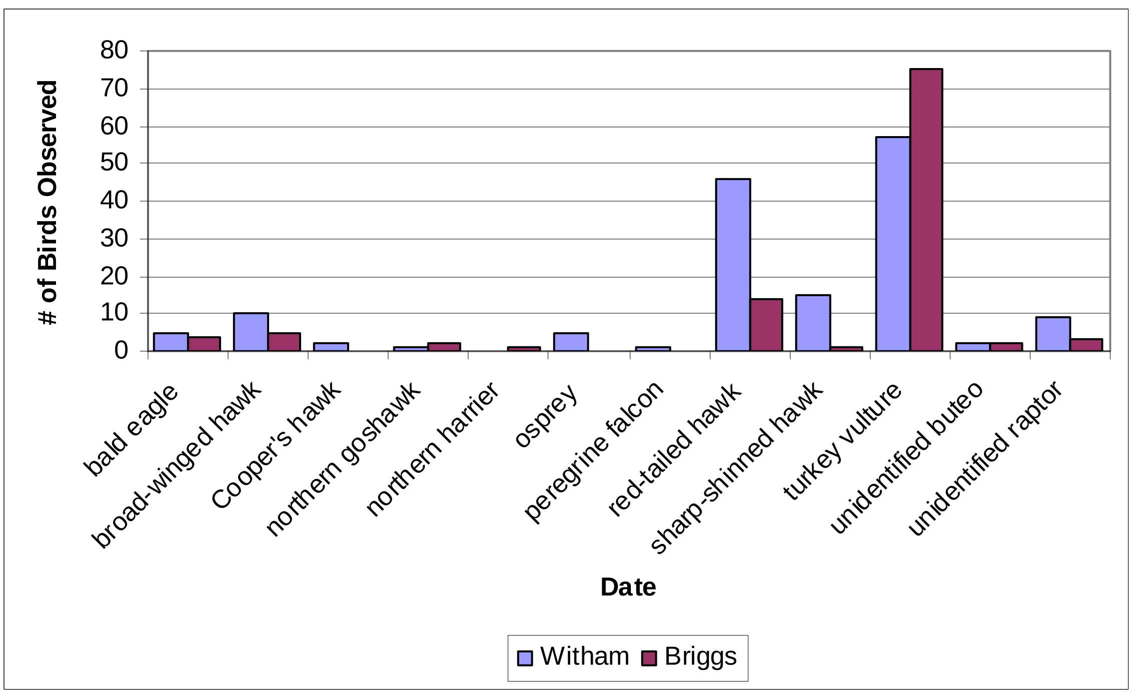

Figure 5-4. Number of individuals of species observed at Highland Wind Project – Spring 2009

On a daily basis, most observations occurred between 11:00 am and 1:00 pm, when thermal development is strong. A second, weaker peak occurred between 3:00 pm and 4:00 pm (Figure 5-5; Appendix D, Table 2).

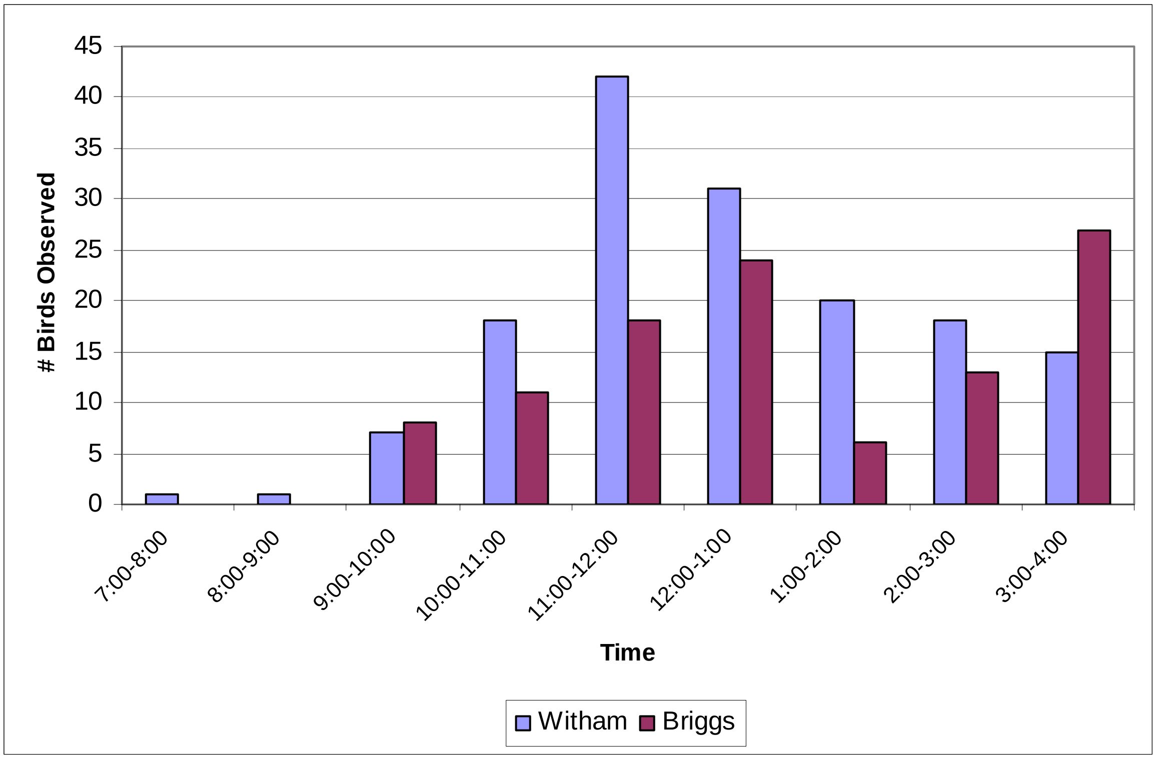

Figure 5-5. Number of individuals observed per survey hour at Highland Wind Project – Spring 2009

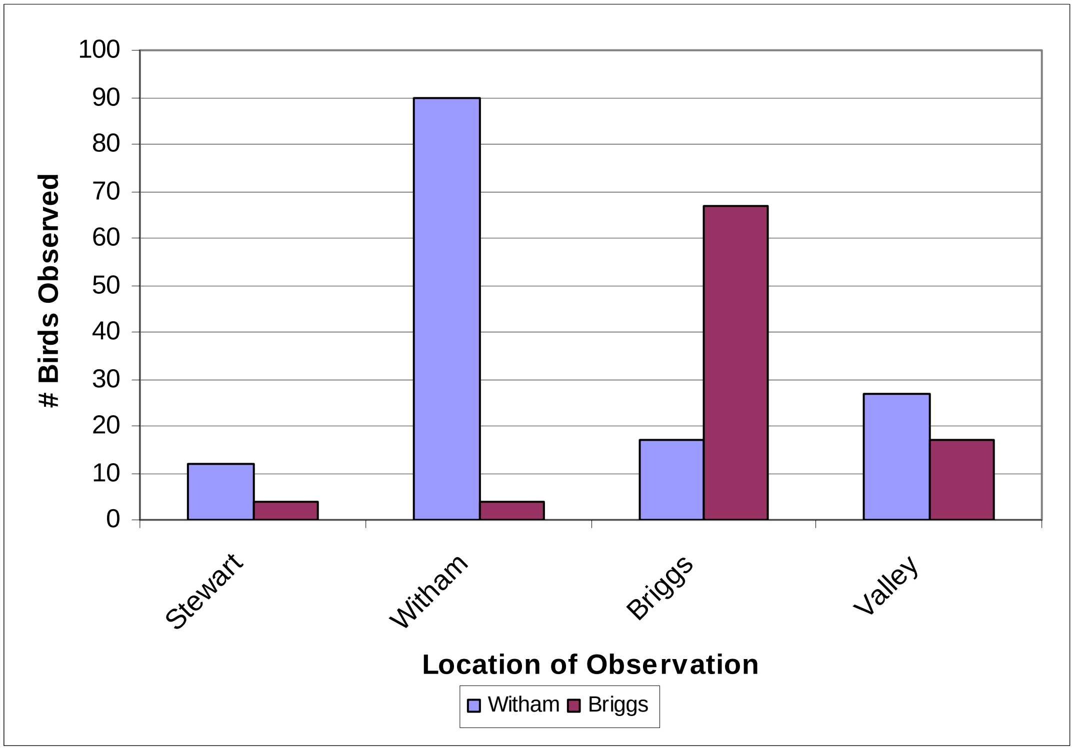

Figure 5-6. Number of individuals observed over topographical features of the Highland Wind Project as observed from Witham Mountain or Briggs Hill – Spring 2009

Raptors observed within the Project area were categorized as occurring over Stewart Mountain, Witham Mountain, Briggs Hill, and over the valleys surrounding the ridges (Figure 5-6). Of the 260 birds observed during the survey, 236 occurred within the Project boundary. Of these 236 birds, the majority were seen over Witham Mountain (n=94; 39 percent) and Briggs Hill (n=83; 35 percent). Birds flying over the surrounding valleys (n=43; 18 percent) and Stewart Mountain (n=16; 7 percent) represented a relatively small percentage of the observations. Although observation sites provided views of the surrounding ridgelines and valleys, birds closer to the observer's location on Witham Mountain and Briggs Hill would have been more readily detected. As such, the higher percentage of observations over these sites may in part reflect the proximity of birds to the observers.

Table 5-1. Number of observations and average flight heights for each position category for birds observed at, Highland - Spring 2009

Location	Flight Position Characteristic	A1) flight along or parallel to ridge	A2) crossed ridge	A3) flight crossed depression or saddle	B) upper slope	C) lower slope	D) over valley
Witham	No. of position observations (n=339)	44	47	36	99	66	47
	Average minimum flight height (m)	79.2	104.2	79.6	123.8	201.5	280.7
Briggs	No. of position observations (n=133)	37	16	5	19	18	38
	Average minimum flight height (m)	80.1	113.0	117.2	99.9	272.3	356.7

As raptors passed through the area they were typically observed in multiple flight positions (A-D) either within or beyond the Project boundary. Because birds occurred in more than one flight position, the following analysis includes more flight positions than total individuals observed within the Project boundary. At Witham, 339 total flight positions were documented. Twenty-nine percent of flight positions occurred along the upper slope (n=99) and 19 percent occurring along the lower slope (n=66) (Table 5-1). Each of the other flight positions represented 14 percent or less of the observations. At Briggs, 133 total fight positions were documented. Twenty-nine percent (n=38) of these flight position occurred over the valley and 28 percent occurred along/parallel (n=37) to the ridge (Table 5-1). Each of the other flight positions represented 14 percent or less of the observations.

For those flight positions within the Project boundary most likely associated with the proposed turbine locations (positions A1, A2, A3, and B), flight heights were categorized as above or below the proposed maximum turbine height of 130.5 m (428'). Eighty percent of the raptors observed from Witham in these four flight positions occurred below the proposed maximum rotor height (n=116) (Figure 5-7a, Appendix D Table 3). Similarly 86 percent of the raptors observed from Briggs Hill in these flight positions occurred below the proposed maximum rotor height (n=78) (Figure 5-7 b, Appendix D Table 3).

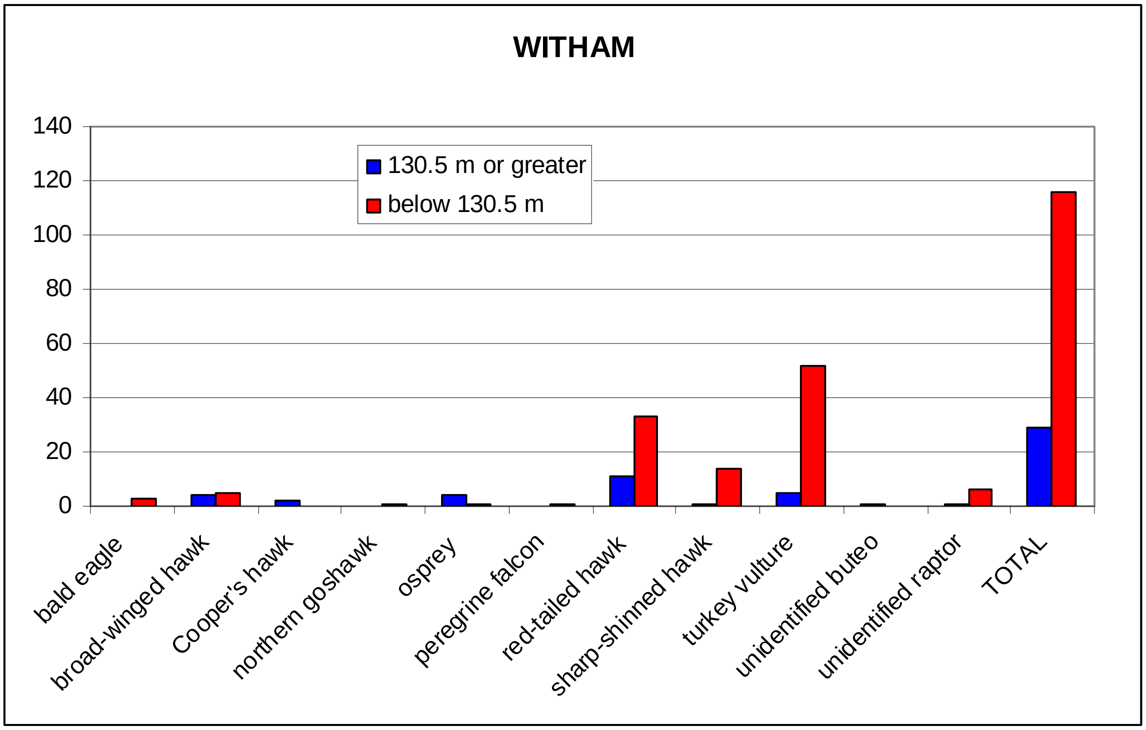

Figure 5-7a. Number of individuals by species observed within Highland Wind Project boundary in proposed turbine areas (A1, A2, A3, and B) below 130.5 m – Spring 2009

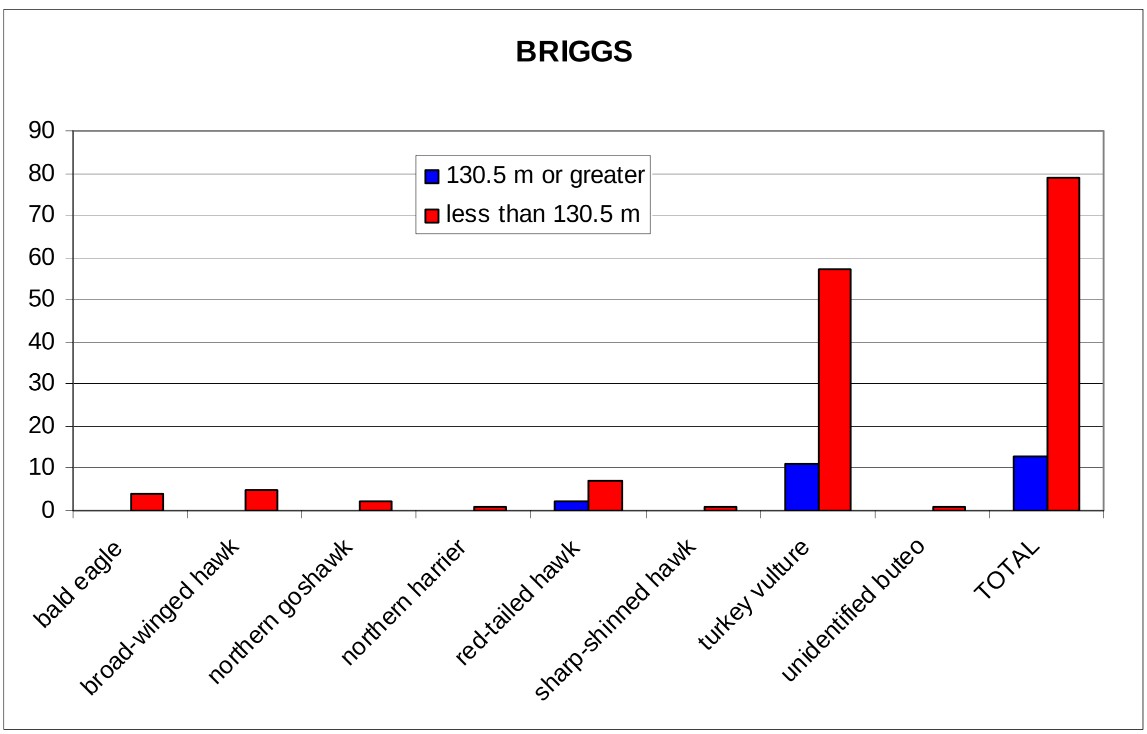

Figure 5-7b. Number of individuals by species observed within Highland Wind Project boundary in proposed turbine areas (A1, A2, A3, and B) below 130.5 m – Spring 2009

As raptors traveled within or beyond the Project boundary, they often exhibited multiple flight behaviors. As a result, the summary of flight behaviors includes more flight behaviors than total number of birds observed. Of the 207 flight behaviors documented from Witham Mountain, the majority of raptors were gliding (n=77; 37 percent) or circle soaring (n=69; 33 percent) (Figure 5-8; Appendix D Table 4). Of the 103 flight behaviors documented from Briggs Hill, the majority of birds were circle soaring (n=43; 42 percent) and linear soaring (n=36; 35 percent) (Figure 5-8; Appendix D Table 4).

Based on their flight behaviors and direction of travel, raptors were categorized as either migrants or non-migrants (seasonally local or stop-over birds). Birds that were traveling in a non-migration direction, were perched, engaged in aerial display, or appeared to be foraging were generally considered non-migrants. Sixty-three percent (n=165) of all raptors observed during the 2009 spring surveys were considered to be non-migrants, 33 percent (n=85) were considered to be migrants, and 4 percent (n=10) could not be categorized based on observed behavior.

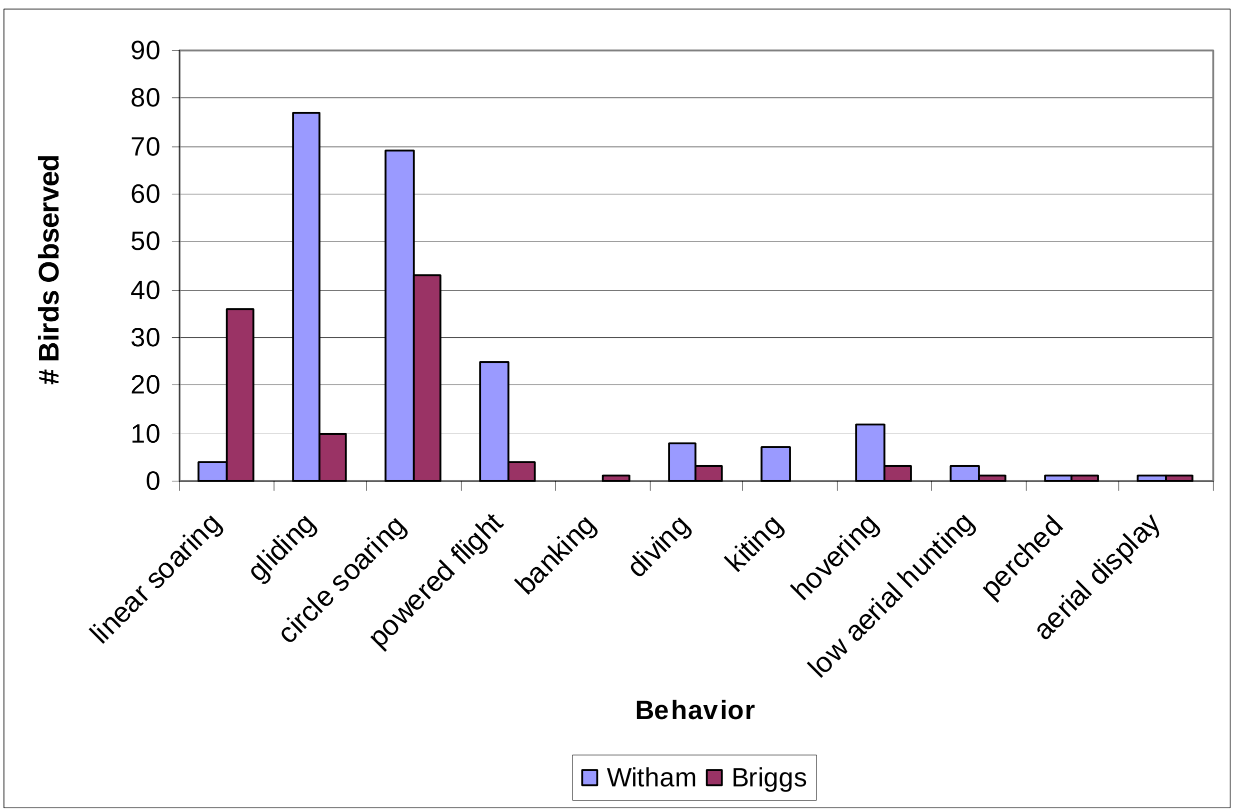

Figure 5-8. Number of observations by flight behaviors at Highland Wind Project – Spring 2009

5.4.1 Rare, Threatened and Endangered Species

No federally-listed threatened or endangered species were observed during the raptor surveys. Surveys documented one state-listed threatened species[7], peregrine falcon (*Falco peregrinus*; n=1). A single juvenile peregrine falcon was observed flying over Witham Mountain on April 7, at approximately 40 m above ground level. The bird continued north through the saddle between Witham and Stewart mountains. Two state-listed species of special concern, bald eagle (*Haliaeetus leucocephalus*; n=7) and northern harrier (*Circus cyaneus*; n=1) also were identified during the raptors surveys. The adult northern harrier was observed on April 30 at approximately 38 m above ground level. Seven bald eagles were documented in the Project area including four adults, one sub-adult, one juvenile, and one eagle of indeterminate age.[8] Four of the bald eagles crossed over the ridge and three of these were below the maximum turbine height for a portion of their flight. Six observations included flight paths along the slope, three of which included portions below maximum turbine height. One additional bald eagle was observed during the surveys, but it occurred outside of the 1 km Project boundary.

5.4.2 Incidental bird observations

During the 2009 raptor surveys, observers documented other avian species seen incidental to the targeted surveys (Table 5-2). These incidental observations were made while observers hiked to the designated survey points, or during the course of the raptor surveys. In total, 51 non-raptor avian species were observed.

Six of these incidentally observed species—tree swallow (*Tachycineta bicolor*), chimney swift (*Chaetura pelagica*), American redstart, black-and-white warbler, chestnut-sided warbler, white-throated sparrow—are state species of special concern. No breeding habitat exists within the Project area for the chimney swift so the single bird that was observed was migrating through the area. The two tree swallows also may have been migrating through the Project area. The other four species were documented during the 2009 breeding bird survey and two of the species, white-throated sparrow and chestnut-sided warbler, were the most commonly observed species based upon relative abundance calculations (Refer to Section 4 for additional discussion).

[7] The state status of endangered species only applies to breeding populations of peregrine falcons.
[8] The nearest documented bald eagle nests and are located on the Kennebec River approximately 6 miles from the nearest turbine. The nearest peregrine nest is located on the Kennebec River approximately 8 miles from the nearest turbine.

Table 5-2. Incidental observation of non-raptor avian species made during raptor surveys - Highland Wind Project, Spring 2009

American crow	golden-crowned kinglet
American goldfinch	hairy woodpecker
American redstart	hermit thrush
American robin	killdeer
black-and-white warbler	magnolia warbler
black-capped chickadee	mourning dove
black-backed gull	Nashville warbler
blue-headed vireo	northern flicker
blue jay	ovenbird
boreal chickadee	pine siskin
bohemian waxwing	pileated woodpecker
brown creeper	rose-breasted grosbeak
black-throated blue warbler	ruby-crowned kinglet
black-throated green warbler	ruffed grouse
Canada goose	sandhill crane
chipping sparrow	tree swallow
chimney swift	unidentified duck
cliff swallow	unidentified gull
common loon	unidentified finch
common merganser	unknown passerine
common raven	white-breasted nuthatch
common yellowthroat	winter wren
chestnut-sided warbler	white-throated sparrow
dark-eyed junco	white-winged crossbill
downy woodpecker	yellow-bellied sapsucker
European starling	yellow-rumped warbler

5.5 DISCUSSION

A total of 260 individual raptors were documented during the 2009 spring raptor surveys. These observations included birds from 10 different species. Turkey vultures and red-tailed hawks were the most commonly observed species. Based upon flight behavior, the majority of individuals (65%) were believed to be non-migratory birds. During the fall 2008 raptor surveys, a total of 301 individual raptors were documented. These observations also included birds from 10 different species. The most commonly observed species were broad-winged hawks (*Buteo platypterus*) and sharp-shinned hawks (*Accipiter striatus*) and in contrast to the spring 2009 survey the majority of all birds (89%) were believed to be migratory based upon flight behavior. .

During the spring 2009 survey period, the passage rates for the two observations sites were similar with 1.84 birds/hr at Witham and 1.91 birds/hr at Briggs. For those birds seen flying in the proposed turbine areas, 80 percent of those observed from Witham occurred below the maximum turbine height and 86 percent of the birds observed from Briggs occurred below the maximum turbine height. More of the birds observed from Witham occurred over the upper and lower slopes than the other flight positions. In contrast, more of the birds observed from Briggs occurred over the valleys or flying parallel to the ridgelines. Annual variation in passage rates at any hawk watch site is expected as a result of regional population fluctuations and differences in daily weather conditions. Despite this expected variation, the results of the spring 2009 raptor survey appears to be representative of a typical spring migration for the Project area.

The 2009 spring passage rates at other regional HMANA hawk watch sites ranged from 3.78 (Poquonock, CT) to 9.3 (Bradbury Mountain, ME) birds/hr (Appendix D Table 4). Compared to these HMANA survey results, the passage rates at the Project area were relatively low. It should be noted that visibility and topographic features at the Project area generally vary from those at HMANA sites, which can influence the results of observed passage rates. Additionally, the HMANA survey methods differ to some extent from survey methods employed for this Project: 1) flight heights are not gauged during HMANA surveys; 2) HMANA surveyors often do not count birds believed to be non-migrants; and 3) multiple observers used during HMANA surveys have the potential to increase detection rates. These factors should be considered when interpreting the results of the spring data.

In addition to the results of HMANA surveys, data from spring surveys conducted at other proposed wind sites in the region were compared to the Project area surveys. Seasonal passage rates at these other sites ranged from 0.1 (Clinton/Ellenburg, NY and Whethersfield, NY) to 25.6 (Westfield, New York)) birds/hr (Appendix D Table 5). The results of the Project area surveys fell within this range, although at the lower end of the range. The percentage of raptors observed below the maximum turbine height also fell within the range of 3 to 94.7 percent observed at other regional Project sites (Appendix D Table 5).

Despite the relatively low flight heights of raptors, studies have documented high turbine collision avoidance behaviors at modern wind facilities (Whitfield and Madders 2006, Chamberlain *et al.* 2006). Raptor flight heights vary due to a variety of factors; particularly fight behaviors and daily weather conditions. Typically, *accipiters* and falcons use up-drafts from side slopes to gain lift and, therefore, usually fly low over ridgelines. *Buteos* tend to use lift from thermals that develop over side slopes and valleys and tend to fly high during hours of peak thermal development. Raptors, particularly *accipiters*, typically fly lower during windy or inclement conditions. Local birds also may fly at lower altitudes while making small scale movements between foraging locations (Barrios and Rodriguez, 2004).

Although the occurrence of some raptors within the zone of the proposed rotor blades increases the potential for migrating raptors to come into the vicinity of the turbines, raptor mortality in the United States, outside of California, has been documented to be relatively low. With some exceptions, mortality rates found at wind developments have ranged from 0 to 0.07 fatalities/turbine/year from 2000-2004 (GAO 2005). Several recent studies have documented relatively low raptor mortality with less than 50 total raptor and owl fatalities documented by 25 studies at 20 different locations throughout the United States (Osborn *et al.* 2000, Johnson *et al*. 2002, Kerlinger 2002, Young *et al.* 2003, Erickson *et al.* 2000, Erickson *et al.* 2004, Kerlinger

2006, Erickson *et al.* 2003, Johnson *et al*. 2003, Kerns and Kerlinger 2004, Arnett *et al* 2005, Koford *et al*. 2005, Fiedler *et al*. 2007, Howe *et al.* 2002, Jain *et al*. 2007, Jain *et al*. 2008, Jain *et al.* 2009a, Stantec 2008, Stantec 2009, Young *et al*. 2009, Tidhar 2009, Jain *et al.* 2009b, Jain *et al.* 2009c, Jain *et al.* 2009d). In general, these results suggest that there is a relatively low collision risk of raptors with wind turbines. As most raptors are diurnal, they may be able to visually, as well as acoustically detect turbines during periods of fair weather. Foraging raptors that may become distracted by prey, or migrant raptors flying during periods of reduced visibility, may be at increased risk of collision with wind turbines.

During the spring 2009 surveys, raptors were observed in multiple flight positions along the ridgelines as well as over the valley beyond the Project area boundary. Raptor migration is a dynamic process due to behavioral and environmental factors. As a result, flight pathways and movements along ridges, side slopes, and across valleys may vary seasonally, daily or hourly. Raptors may shift and use different ridge lines and cross different valleys from year to year or season to season. Weather and wind are major factors that influence migration pathways. Wind direction and strength, in particular, affect the propensity of raptors to congregate along ‘leading lines’ or topographic features. The location of a raptor along a ‘leading line’ can be influenced by lateral drift caused by crosswinds (Richardson 1998). The flight paths of raptors observed in the Project area varied between survey dates and were likely influenced by varying wind direction and weather.

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Appendix A

Radar Survey Data Tables

Appendix A Table 1A. Survey dates, results, level of effort, and weather - Briggs Hill site Spring 2009								
Date	**Passage rate**	**Flight Direction**	**Flight Height (m)**	**% below 130.5 m**	**Hours of Survey**	**Temperature (C)**	**Wind Speed (m/s)**	**Wind Direction (degrees)**
29-Apr	324	40.469°	201	37%	10	4	7	282
30-Apr	221	19.687°	451	6%	7	6	12	180
2-May	199	45.219°	322	18%	10	7	7	245
3-May	357	35.304°	283	13%	10	9	7	237
4-May	178	199.738°	226	26%	9	8	9	25
5-May	10	250.939°	361	5%	9	5	6	64
6-May	297	32.055°	307	13%	9	8	4	191
10-May	45	92.601°	163	41%	10	2	12	312
11-May	440	68.612°	298	31%	10	6	7	343
12-May	1037	55.882°	430	22%	9	9	5	310
13-May	388	37.448°	407	9%	9	7	8	183
18-May	628	49.614°	115	72%	9	3	6	306
19-May	1262	53.196°	267	32%	9	11	7	296
20-May	848	38.093°	276	29%	9	16	9	257
21-May	813	48.561°	288	30%	9	20	11	273
22-May	1094	50.214°	284	30%	9	8	8	356
23-May	389	51.264°	138	60%	9	8	6	205
24-May	850	39.667°	278	29%	9	11	5	316
26-May	453	34.716°	311	22%	9	8	3	147
30-May	500	48.421°	375	19%	9	10	7	247
31-May	97	46.564°	252	39%	9	1	15	294
Entire Season	**496**	**47.443°**	**287**	**26%**	**9**	**8**	**8**	

Appendix A Table 1B. Survey dates, results, level of effort, and weather - South Stewart Mtn site Spring 2009								
Date	**Passage rate**	**Flight Direction**	**Flight Height (m)**	**% below 130.5 m**	**Hours of Survey**	**Temperature (C)**	**Wind Speed (m/s)**	**Wind Direction (degrees)**
29-Apr	233	51	168	51%	9	4	7	282
3-May	421	38	308	14%	10	9	7	237
4-May	167	222	282	17%	10	8	9	25
5-May	21	290	336	17%	10	5	6	64
6-May	506	28	308	22%	8	8	4	191
7-May	32	65	367	6%	10	7	5	270
10-May	8	151	252	33%	7	2	12	312
11-May	147	133	374	22%	9	6	7	343
12-May	438	65	514	10%	9	9	5	310
13-May	481	33	420	10%	9	7	8	183
18-May	214	71	221	48%	6	3	6	306
19-May	1103	60	287	29%	9	11	7	296
20-May	1735	53	316	24%	8	16	9	257
21-May	1482	60	315	33%	9	20	11	273
22-May	280	77	179	55%	6	8	8	356
23-May	1184	60	279	34%	8	8	6	205
24-May	560	86	229	32%	6	11	5	316
25-May	77	184	255	39%	9	2	9	338
26-May	709	34	434	15%	9	8	3	147
Entire Season	**511**	**53**	**314**	**23%**	**8**	**8**	**7**	

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

Night of	Passage Rate (targets/km/hr) by hour after sunset										Entire Night			
	1	2	3	4	5	6	7	8	9	10	Mean	Median	Stdev	SE
29-Apr	18	69	304	450	480	536	525	354	286	223	324	329	182	61
30-Apr	225	361	246	207	225	221	64	N/A	N/A	N/A	221	225	87	35
2-May	289	100	175	230	318	317	198	193	146	21	199	196	95	32
3-May	282	579	504	343	437	437	389	296	296	11	357	366	156	52
4-May	214	264	244	240	261	146	124	64	43	N/A	178	214	86	30
5-May	11	4	17	5	4	0	25	25	0	N/A	10	5	10	4
6-May	111	186	300	357	313	475	497	296	136	N/A	297	300	136	48
10-May	4	30	71	110	111	64	11	N/A	5	0	45	30	45	16
11-May	89	496	568	532	579	549	546	568	464	11	440	539	209	70
12-May	175	925	1071	1396	1493	1282	1104	1132	750	N/A	1037	1104	395	140
13-May	236	518	404	479	418	411	357	418	254	N/A	388	411	93	33
18-May	29	525	546	857	1018	961	789	693	232	N/A	628	693	331	117
19-May	279	1254	1007	1004	1589	1714	1757	1711	1043	N/A	1262	1254	488	173
20-May	157	849	800	957	1189	1057	914	1186	525	N/A	848	914	331	117
21-May	171	1071	943	900	1111	1046	971	864	236	N/A	813	943	355	125
22-May	296	954	954	1079	1346	1582	1443	1507	689	N/A	1094	1079	423	150
23-May	29	271	357	518	630	670	536	471	16	N/A	389	471	241	85
24-May	197	891	939	1082	1264	844	956	1086	393	N/A	850	939	342	121
26-May	321	629	671	618	514	425	446	375	81	N/A	453	446	184	65
30-May	282	500	614	571	711	786	614	414	11	N/A	500	571	238	84
31-May	18	164	171	14	118	186	118	82	5	N/A	97	118	71	25
Entire Season	**164**	**507**	**519**	**569**	**673**	**653**	**590**	**618**	**281**	**53**	**496**	**393**	**424**	**31**

N/A indicates no data for that hour

Appendix A Table 2B. Summary of passage rates by hour, night, and for entire season - South Stewart Mtn site.														
Night of	**Passage Rate (targets/km/hr) by hour after sunset**										**Entire Night**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Mean**	**Median**	**Stdev**	**SE**
29-Apr	0	89	155	356	343	351	270	300	232	N/A	233	270	126	45
3-May	243	738	664	539	419	462	463	377	289	11	421	441	210	70
4-May	171	300	246	364	150	157	77	96	94	14	167	154	108	36
5-May	46	39	18	4	7	11	11	64	14	0	21	13	21	7
6-May	129	227	381	681	531	1461	418	218	N/A	N/A	506	400	426	161
7-May	21	11	21	14	21	27	21	57	114	7	32	21	32	11
10-May	4	4	4	N/A	0	11	0	N/A	32	N/A	8	4	11	5
11-May	13	113	236	157	159	167	211	167	104	N/A	147	159	65	23
12-May	46	514	596	604	544	400	400	467	368	N/A	438	467	170	60
13-May	507	796	661	532	521	404	375	339	193	N/A	481	507	179	63
18-May	N/A	N/A	182	143	396	254	164	146	N/A	N/A	214	173	103	46
19-May	514	1436	1569	1918	1371	1068	1046	670	339	N/A	1103	1068	523	185
20-May	421	1775	2264	2268	2132	1871	1268	1879	N/A	N/A	1735	1875	622	235
21-May	1100	1821	1929	2189	2146	1596	1311	1029	214	N/A	1482	1596	638	226
22-May	N/A	N/A	193	218	457	393	214	207	N/A	N/A	280	216	121	54
23-May	N/A	1311	1251	1543	1538	1247	1152	893	536	N/A	1184	1249	225	85
24-May	218	736	550	529	604	725	N/A	N/A	N/A	N/A	560	577	189	84
25-May	25	182	193	82	100	54	32	26	0	N/A	77	54	70	25
26-May	561	1221	1504	1196	679	370	360	336	155	N/A	709	561	479	169
Entire Season	**251**	**666**	**664**	**741**	**638**	**580**	**433**	**428**	**192**	**8**	**511**	**336**	**578**	**46**
N/A indicates no data for that hour														

Appendix A Table 3A. Mean Nightly Flight Direction from Briggs Hill.		
Night of	**Mean Flight Direction**	**Circular Stdev**
29-Apr	40.469°	34.064°
30-Apr	19.687°	31.699°
2-May	45.219°	42.603°
3-May	35.304°	32.346°
4-May	199.738°	51.776°
5-May	250.939°	38.526°
6-May	32.055°	44.064°
10-May	92.601°	45.203°
11-May	68.612°	44.826°
12-May	55.882°	28.011°
13-May	37.448°	39.733°
18-May	49.614°	30.811°
19-May	53.196°	37.15°
20-May	38.093°	43.047°
21-May	48.561°	27.029°
22-May	50.214°	38.473°
23-May	51.264°	27.349°
24-May	39.667°	34.082°
26-May	34.716°	44.037°
30-May	48.421°	33.914°
31-May	46.564°	36.095°
Entire Season	**47.443°**	**39.763°**

Appendix A Table 3B. Mean Nightly Flight Direction from South Stewart Mtn. site		
Night of	**Mean Flight Direction**	**Circular Stdev**
29-Apr	51.367°	24.104°
3-May	37.54°	39.847°
4-May	222.197°	37.885°
5-May	290.413°	56.854°
6-May	27.765°	38.06°
7-May	65.214°	66.757°
10-May	150.854°	28.316°
11-May	132.933°	76.27°
12-May	64.549°	37.557°
13-May	32.964°	44.698°
18-May	70.987°	42.594°
19-May	60.42°	38.08°
20-May	53.127°	32.76°
21-May	60.461°	41.557°
22-May	77.38°	50.779°
23-May	60.246°	40.667°
24-May	86.487°	106.944°
25-May	183.947°	83.204°
26-May	33.763°	39.506°
Entire Season	53.415°	48.666°

Appendix A Table 4A. Summary of mean flight heights by hour, night, and for entire season at Briggs Hill site.															
Night of	**Mean Flight Height (m) by hour after sunset**										**Entire Night**				**% of targets below 130.5 meters**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Mean**	**Median**	**STDV**	**SE**	
29-Apr	226	221	205	191	184	234	190	220	212	122	201	209	32	10	37%
30-Apr	282	479	464	497	458	413	565	N/A	N/A	N/A	451	464	88	33	6%
2-May	387	355	384	475	364	261	299	171	212	317	322	336	90	29	18%
3-May	253	312	348	337	350	305	313	206	198	208	283	309	61	19	13%
4-May	162	200	229	230	175	272	294	263	213	N/A	226	229	44	15	26%
5-May	--	--	--	500	227	--	256	461	--	N/A	361	359	140	70	5%
6-May	222	246	262	333	441	333	286	330	--	N/A	307	308	69	24	13%
10-May	81	241	213	43	236	--	--	--	--	--	163	213	93	42	41%
11-May	210	373	446	310	214	332	289	214	293	--	298	293	80	27	31%
12-May	223	443	502	460	444	480	412	445	460	N/A	430	445	81	27	22%
13-May	299	488	454	444	416	397	379	385	404	N/A	407	404	54	18	9%
18-May	174	125	131	79	76	101	96	86	169	N/A	115	101	37	12	72%
19-May	206	315	278	364	321	220	216	234	252	N/A	267	252	55	18	32%
20-May	262	323	308	277	270	250	270	246	--	N/A	276	270	27	9	29%
21-May	266	317	347	278	311	248	209	189	425	N/A	288	278	72	24	30%
22-May	216	289	290	372	301	258	249	304	279	N/A	284	289	43	14	30%
23-May	177	179	122	105	133	119	121	144	--	N/A	138	128	27	10	60%
24-May	242	324	324	284	284	288	257	253	245	N/A	278	284	31	10	29%
26-May	217	211	214	235	313	400	431	407	368	N/A	311	313	93	31	22%
30-May	275	384	442	364	338	379	402	364	429	N/A	375	379	50	17	19%
31-May	384	166	169	--	184	202	216	179	512	N/A	252	193	127	45	39%
Entire Season	**238**	**300**	**307**	**309**	**288**	**289**	**287**	**268**	**311**	**215**	**287**	**277**	**107**	**8**	**26%**
-- indicates no targets for that hour									N/A indicates no data for that hour						

Appendix A Table 4B. Summary of mean flight heights by hour, night, and for entire season - South Stewart Mtn site.

Night of	Mean Flight Height (m) by hour after sunset										Entire Night				% of targets below 130.5 meters
	1	2	3	4	5	6	7	8	9	10	Mean	Median	STDV	SE	
29-Apr	171	204	260	124	173	165	136	102	151	195	168	168	45	14	51%
3-May	269	357	355	368	382	372	298	250	229	197	308	327	68	21	14%
4-May	203	341	375	282	248	315	292	360	287	120	282	289	77	24	17%
5-May	--	451	--	--	258	348	--	292	332	--	336	332	73	33	17%
6-May	263	210	237	346	431	354	256	370	N/A	N/A	308	304	77	27	22%
7-May	399	524	548	448	369	334	291	180	210	N/A	367	369	128	43	6%
10-May	N/A	--	N/A	60	529	--	--	N/A	167	N/A	252	167	246	142	33%
11-May	308	476	578	334	406	256	428	401	183	N/A	374	401	119	40	22%
12-May	231	452	587	593	562	593	477	578	555	N/A	514	562	118	39	10%
13-May	356	465	481	453	419	407	381	394	419	N/A	420	419	41	14	10%
18-May	N/A	200	135	167	265	322	238	N/A	N/A	N/A	221	219	68	28	48%
19-May	251	275	289	268	282	336	327	299	260	N/A	287	282	29	10	29%
20-May	325	362	366	347	329	302	256	238	N/A	N/A	316	327	47	17	24%
21-May	305	365	325	316	343	298	266	296	324	N/A	315	316	29	10	33%
22-May	N/A	174	102	131	212	203	254	N/A	N/A	N/A	179	189	56	23	55%
23-May	N/A	218	306	253	274	312	287	270	315	N/A	279	280	33	12	34%
24-May	252	307	213	209	207	186	N/A	N/A	N/A	N/A	229	211	44	18	32%
25-May	523	265	215	193	119	195	351	252	180	N/A	255	215	120	40	39%
26-May	293	318	296	310	507	617	560	458	548	N/A	434	458	130	43	15%
Entire Season	**296**	**331**	**333**	**289**	**332**	**329**	**319**	**316**	**297**	**171**	**314**	**299**	**119**	**10**	**23%**

-- indicates no targets for that hour N/A indicates no data for that hour

Appendix A Table 5. Summary of available avian spring radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

Year	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)	(Turbine Ht) % Targets Below Turbine Height	Citation
2005	Ellenberg, Clinton Cty, NY	40	n/a	Great Lakes plain/ADK foothills	110	n/a	30	338	(125 m) 20%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2005	Sheldon, Wyoming Cty, NY	38	272	Agricultural plateau	112	6-558	25	422	(120 m) 6%	Woodlot Alternatives, Inc. 2006. A Spring 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
2005	Munnsville, Madison Cty, NY	41	388	Agricultural plateau	160	6-1065	31	291	(118 m) 25%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2005	Sheffield, Caledonia Cty, VT	20	180	Forested ridge	166	12-440	40	552	(125 m) 6%	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2005	Stamford, Delaware Cty, NY	35	301	Forested ridge	210	10-785	46	431	(110 m) 8%	Woodlot Alternatives, Inc. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2005	Churubusco, Clinton Cty, NY	39	310	Great Lakes plain/ADK foothills	254	3-728	40	422	(120 m) 11%	Woodlot Alternatives, Inc. 2005. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
2005	Prattsburgh, Steuben Cty, NY	20	183	Agricultural plateau	277	70-621	22	370	(125 m) 16%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
2005	Deerfield, Bennington Cty, VT	20	183	Forested ridge	404	74-973	69	523	(100 m) 4%	Woodlot Alternatives, Inc. 2005. Spring 2005 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2005	Jordanville, Herkimer Cty, NY	40	364	Agricultural plateau	409	26-1410	40	371	(125 m) 21%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
2005	Franklin, Pendleton Cty, NY	21	204	Forested ridge	457	34-1240	53	492	(125 m) 11%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
2005	Clayton, Jefferson Cty, NY	36	303	Agricultural plateau	460	71-1769	30	443	(150 m) 14%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
2005	Dans Mountain, MD	23	189	Forested ridge	493	63-1388	38	541	(125 m) 15%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
2005	Fairfield, Herkimer Cty, NY	40	369	Agricultural plateau	509	80-1175	44	419	(145 m) 16%[1]	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
2006	Kibby, Franklin Cty, ME (Range 1)	10	80	Forested ridge	197	6-471	50	412	(120 m) 22%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
2006	Deerfield, Bennington Cty, VT	26	236	Forested ridge	263	5-934	58	435	(100 m) 11%	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.

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Appendix A Table 5. Summary of available avian spring radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

Year	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)	(Turbine Ht) % Targets Below Turbine Height	Citation
2006	Centerville, Allegany Cty, NY	42	n/a	Agricultural plateau	290	25-1140	22	351	(125 m) 16%	Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006.
2006	Wethersfield, Wyoming Cty, NY	44	n/a	Agricultural plateau	324	41-907	12	355	(125 m) 19%	Mabee, T.J., J.H. Plissner, and B.A. Cooper. 2006a. A Radar and Visual Study of Nocturnal Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks, New York, Spring 2006. Report prepared for Ecology and Environment, LLC and Noble Environmental Power, LLC. July 2006.
2006	Mars Hill, Aroostook Cty, ME	15	85	Forested ridge	338	76-674	58	384	(120 m) 14%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
2006	Chateaugay, Franklin Cty, NY	35	300	Agricultural plateau	360	54-892	48	409	(120 m) 18%	Woodlot Alternatives, Inc. 2006. Spring 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Howard, Steuben Cty, NY	42	440	Agricultural plateau	440	35-2270	27	426	(125 m) 13%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2006	Kibby, Franklin Cty, ME (Valley)	2	14	Forested ridge	443	45-1242	61	334	(120 m) n/a	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
2006	Kibby, Franklin Cty, ME (Mountain)	6	33	Forested ridge	456	88-1500	67	368	(120 m) 14%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
2006	Kibby, Franklin Cty, ME (Range 2)	7	57	Forested ridge	512	18-757	86	378	(120 m) 25%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine.
2007	Stetson, Washington Cty, ME	21	138	Forested ridge	147	3-434	55	210	(120 m) 22%	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2007	Cape Vincent, Jefferson Cty, NY	50	300	Great Lakes plain	166	n/a	34	441	(125 m) 14%	Western EcoSystems Technology, Inc. (WEST). 2007. Avian and Bat Studies for the Proposed Cape Vincent Wind Power Project, Jefferson County, NY. Prepared for BP Alternative Energy North America.
2007	New Grange, Chautauqua Cty, NY	41	n/a	Great Lakes plain	175	n/a	18	450	(125 m) 13%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2007	Laurel Mountain, Barbour Cty, WV	20	197	Forested ridge	277	13-646	27	533	(130 m) 3%	Stantec Consulting Services Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
2007	Errol, Coos County, NH	30	212	Forested ridge	342	2 to 870	76	332	(125 m) 14%	Stantec Consulting Inc. 2007. 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. Prepared for Granite Reliable Power, LLC.
2007	Villenova, Chautauqua Cty, NY	40	n/a	Great Lakes plain	419	22-1190	10	493	(120 m) 3%	Stantec Consulting Services Inc. 2008. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment.

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Appendix A Table 5. Summary of available avian spring radar survey results conducted at proposed (pre-construction) US wind power facilities in eastern US, using X-band mobile radar systems (2004-present)

Year	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)	(Turbine Ht) % Targets Below Turbine Height	Citation
2007	Roxbury, Oxford Cty, ME	20	n/a	Forested ridge	539	137-1256	52	312	(130) 18%	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Record Hill Wind Project, Roxbury, Maine. Prepared for Roxbury Hill Wind LLC.
2007	Lempster, Sullivan Cty, NH	30	277	Forested ridge	542	49-1094	49	358	(125 m) 18%	Woodlot Alternatives, Inc. 2007.A Spring 2007 Survey of Nocturnal Bird Migration,Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
2008	Lincoln, Penobscot Cty, ME	20	189	Forested ridge	247	40-766	75	316	(120 m) 13%	Stantec Consulting Services Inc. 2008.A Spring 2008 Survey of Bird and Bat Migration at the Rollins Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
2008	Allegany, Cattaraugus Cty, NY	30	275	Forested ridge	268	53-755	18	316	(150 m) 19%	New York Department of Conservation [Internet]. c2008. Publicly Available Radar Results for Proposed Wind Sites in New York. Albany, NY: NYDEC; [updated May 2008; cited June 2009]. Available at http://www.dec.ny.gov/docs/wildlife_pdf/radarwindsum.pdf
2008	Oakfield, Penobscot Cty, ME	20	194	Forested ridge	498	132-899	33	276	(120 m) 21%	Stantec Consulting Services Inc. 2008.A Spring 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.
2008	Hounsfield, Jefferson Cty, NY	42	379	Great Lakes island	624	74-1630	51	319	(125 m) 19%	Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the Hounsfield Wind Project, New York. Prepared for American Consulting Professionals of New York, PLLC.
2008	New Creek, Grant Cty, WV	20	n/a	Forested ridge	1020	289-2610	30	354	(130 m) 13%	Stantec Consulting Services Inc. 2008. A Spring 2008 Survey of Bird Migration at the New Creek Wind Project,West Virginia. Prepared for AES New Creek, LLC.

Note:
[1] The percent targets below turbine height can be found in the addendum to the report "Effect of Top Notch (now Hardscrabble) Wind Project revision to turbine layout and model changes on the spring and fall 2005 nocturnal radar survey reports." Prepared August 26, 2009, by Stantec Consulting Services Inc.

Appendix B

Publicly Available Bat Survey Results

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Appendix B Table 1. Summary of available spring bat detector surveys (results reported for individual detectors)

Year	Project	Project Location	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
Tree or low tower detectors (10 m or below)										
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	5	21	4/5	6/12	16	0.8	Woodlot Alternatives, Inc. 2006. Summary of spring 2006 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated July 26, 2006.
2006	Howard	Howard, Steuben Cty, NY	field	8	35	4/15	6/3	29	0.8	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2005	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	10	4	5/12	5/29	0	0	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	8	38	4/24	6/13	840	22.1	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	9	37	4/24	6/13	90	2.4	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	8	34	4/24	6/13	178	5.2	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Deerfield	Deerfield, Bennington Cty, VT	forest edge	2	37	4/14	6/11	4	0.1	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	21	4/23	5/22	34	1.6	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	29	4/23	5/22	16	0.6	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
Met tower detectors										
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	40	52	4/23	6/14	29	0.6	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	20	23	4/23	6/14	40	1.7	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	40	23	5/22	6/14	3	0.1	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	20	23	5/22	6/14	3	0.1	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	40	53	4/22	6/14	166	3.1	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	20	53	4/22	6/14	106	2.0	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2007	Ball Hill	Villenova, Chautauqua Cty, NY	field	40	32	3/28	5/30	4	0.1	Stantec Consulting Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, NY. Prepared for Nobel Environmental Power, LLC and Ecology and Environment, Inc.
2007	Ball Hill	Villenova, Chautauqua Cty, NY	field	20	54	3/28	5/30	74	1.4	Stantec Consulting Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, NY. Prepared for Nobel Environmental Power, LLC and Ecology and Environment, Inc.
2007	Stetson	Stetson, Penobscot Cty, ME	forest edge	30	47	4/24	6/18	52	1.1	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2007	Stetson	Stetson, Penobscot Cty, ME	forest edge	30	56	4/24	6/18	235	4.2	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2007	Stetson	Stetson, Penobscot Cty, ME	forest edge	30	56	4/24	6/18	36	0.6	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	50	14	5/4	6/19	0	0	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development, Inc.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	50	24	5/4	6/19	0	0	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development, Inc.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	20	35	5/4	6/19	31	0.7	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development, Inc.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	50	35	5/4	6/19	0	0	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development, Inc.
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	40	60	4/5	6/12	7	0.1	Woodlot Alternatives, Inc. 2006. Summary of spring 2006 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated July 26, 2006.
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	20	50	4/5	6/12	3	0.1	Woodlot Alternatives, Inc. 2006. Summary of spring 2006 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated July 26, 2006.
2005	Cohocton/Dutch Hill	Cohocton, Steuben Cty, NY	field	30	29	5/2	5/30	21	0.7	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC
2005	High Sheldon	Sheldon, Wyoming Cty, NY	field	30	36	4/21	5/30	6	0.2	Woodlot Alternatives, Inc. 2006. A Spring 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
2005	Jordanville	Jordanville, Herkimer Cty, NY	field	30	29	4/14	5/13	15	0.5	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
2005	Marble River	Churubusco, Clinton Cty, NY	field	30	46	4/14	5/30	12	0.3	Woodlot Alternatives, Inc. 2005. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.

Appendix B Table 1. Summary of available spring bat detector surveys (results reported for individual detectors)

Year	Project	Project Location	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
2005	Prattsburgh	Prattsburgh, Steuben Cty , NY	field	30	17	4/15	5/10	8	0.5	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
2005	Prattsburgh	Prattsburgh, Steuben Cty , NY	field	15	20	4/11	5/30	8	0.4	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
2006	Chateaugay	Chateaugay, Franklin Cty, NY	field	40	54	4/16	6/8	117	2.2	Woodlot Alternatives, Inc. 2006. Spring 2006 Bat Surveys at the Proposed Brandon and Chateaugay Wind Farms in Northern New York. Prepared for Nobel Environmental Power, LLC and Ecology & Environment, Inc.
2006	Chateaugay	Chateaugay, Franklin Cty, NY	field	20	54	4/16	6/8	103	1.9	Woodlot Alternatives, Inc. 2006. Spring 2006 Bat Surveys at the Proposed Brandon and Chateaugay Wind Farms in Northern New York. Prepared for Nobel Environmental Power, LLC and Ecology & Environment, Inc.
2006	Brandon	Brandon, Franklin Cty, NY	field	15	38	4/7	6/4	848	22	Woodlot Alternatives, Inc. 2006. Spring 2006 Bat Surveys at the Proposed Brandon and Chateaugay Wind Farms in Northern New York. Prepared for Nobel Environmental Power, LLC and Ecology & Environment, Inc.
2006	Brandon	Brandon, Franklin Cty, NY	field	30	36	4/7	6/4	114	3.2	Woodlot Alternatives, Inc. 2006. Spring 2006 Bat Surveys at the Proposed Brandon and Chateaugay Wind Farms in Northern New York. Prepared for Nobel Environmental Power, LLC and Ecology & Environment, Inc.
2006	Howard	Howard, Steuben Cty, NY	field	50	36	4/15	6/4	5	0.1	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2006	Howard	Howard, Steuben Cty, NY	field	20	45	4/15	6/7	16	0.4	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2005	Horse Creek	Clayton, Jefferson Cty, NY	forest edge	20	42	4/20	5/31	55	1.3	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
2005	Horse Creek	Clayton, Jefferson Cty, NY	forest edge	15	36	4/20	5/31	12	0.3	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
2005	Moresville	Stamford, Delaware Cty, NY	forest edge	30	27	4/12	5/8	8	0.3	Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2005	Deerfield	Deerfield, Bennington Cty, VT	forest edge	15	40	4/19	6/15	4	0.1	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy/Deerfield Wind, LLC.
2005	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	20	31	5/1	5/31	6	0.2	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Deerfield	Deerfield, Bennington Cty, VT	forest edge	35	60	4/14	6/13	4	0.1	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2006	Deerfield	Deerfield, Bennington Cty, VT	forest edge	15	47	4/14	5/31	0	0	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2006	Deerfield	Deerfield, Bennington Cty, VT	forest edge	30	29	4/14	5/20	0	0	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2006	Deerfield	Deerfield, Bennington Cty, VT	forest edge	15	21	4/14	5/16	7	0.3	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2006	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	31	36	4/24	6/13	5	0.14	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2005	Liberty Gap	Franklin, Pendleton Cty, WV	forest edge	30	21	4/17	6/7	2	0.1	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
2005	Liberty Gap	Franklin, Pendleton Cty, WV	forest edge	15	21	4/17	6/7	19	0.9	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
2006	Wethersfield	Wethersfield, Wyoming Cty, NY	field	21	63	4/6	6/7	60	1.0	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Wethersfield	Wethersfield, Wyoming Cty, NY	field	10	63	4/6	6/7	132	2.1	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Centerville	Centerville, Allegany Cty, NY	field	25	63	4/6	6/8	139	2.2	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC
2006	Centerville	Centerville, Allegany Cty, NY	field	10	63	4/6	6/8	131	2.1	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC
2007	Coos	Coos Cty, NH	forest edge	50	37	4/26	6/1	8	0.2	Stantec Consulting Inc. 2007. 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. Prepared for Granite Reliable Power, LLC.
2007	Coos	Coos Cty, NH	forest edge	20	19	4/30	6/1	5	0.3	Stantec Consulting Inc. 2007. 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. Prepared for Granite Reliable Power, LLC.
2007	Coos	Coos Cty, NH	forest edge	30	35	4/28	6/1	8	0.2	Stantec Consulting Inc. 2007. 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. Prepared for Granite Reliable Power, LLC.
2007	Coos	Coos Cty, NH	forest edge	15	35	4/28	6/1	12	0.3	Stantec Consulting Inc. 2007. 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. Prepared for Granite Reliable Power, LLC.

Appendix C

Breeding Bird Survey Data Tables

Appendix C Table 1. Total number of species and individuals detected, and distance from observer at 35 point count locations during three survey periods - Spring 2009*

Common name	Scientific name	0-50 m	50-100 m	> 100 m	Flyovers	Grand Total
alder flycatcher	*Empidonax alnorum*	8	4	1		13
American crow	*Corvus brachyrhynchos*			1		1
American goldfinch	*Carduelis tristis*	4			6	10
American redstart	*Setophaga ruticilla*	16	9			25
American robin	*Turdus migratorius*	3	2	1		6
black-and-white warbler	*Mniotilta varia*	25	4			29
bay-breasted warbler	*Dendroica castanea*	13	3			16
black-capped chickadee	*Poecile atricapilla*	4	1			5
blue headed vireo	*Vireo solitarius*	9	5	1		15
blackburnian warbler	*Dendroica fusca*	22	4			26
blue jay	*Cyanocitta cristata*	5	1	3	5	14
blackpoll warbler	*Dendroica striata*	11	9			20
boreal chickadee	*Poecile hudsonicus*	9				9
brown creeper	*Certhia americana*	1				1
black-throated blue warbler	*Dendroica caerulescens*	40	30	3		73
black-throated green warbler	*Dendroica virens*	8	12	5		25
Canada warbler	*Wilsonia canadensis*	4				4
cedar waxwing	*Bombycilla cedrorum*	7			8	15
common raven	*Corvus corax*				6	6
common yellowthroat	*Geothlypis trichas*	34	24	3	1	62
chestnut-sided warbler	*Dendroica pensylvanica*	46	25	4		75
dark-eyed junco	*Junco hyemalis*	38	25	4		67
eastern wood-pewee	*Contopus virens*			2		2
golden-crowned kinglet	*Regulus satrapa*	26	11			37
hairy woodpecker	*Picoides villosus*	3	2		1	6
hermit thrush	*Catharus guttatus*	11	32	7		50
least flycatcher	*Empidonax minimus*	1				1
magnolia warbler	*Dendroica magnolia*	28	9		1	38
mourning dove	*Zenaida macroura*	1		1		2
mourning warbler	*Oporornis philadelphia*	7	4			11
Nashville warbler	*Vermivora ruficapilla*	27	22	1		50
northern flicker	*Colaptes auratus*	1	1	1	1	4
northern parula	*Parula americana*		1			1
olive-sided flycatcher	*Contopus cooperi*			1		1
ovenbird	*Seiurus aurocapillus*	10	12	5		27
purple finch	*Carpodacus purpureus*	2		1		3
rose-breasted grosbeak	*Pheucticus ludovicianus*	3	7	2		12
red-breasted nuthatch	*Sitta canadensis*	8	5			13
ruby-crowned kinglet	*Regulus calendula*	2				2
red-eyed vireo	*Vireo olivaceus*	9	12	1		22
red-tailed hawk	*Buteo jamaicensis*			1	3	4
ruffed grouse	*Bonasa umbellus*	1	1	1		3
scarlet tanager	*Piranga olivacea*		1			1
sharp-shinned hawk	*Accipiter striatus*				1	1
Swainson's thrush	*Catharus ustulatus*	3	2			5
Tennessee warbler	*Vermivora peregrina*	2	1			3
unidentified duck	*n/a*				2	2
unidentified woodpecker	*n/a*		1			1
winter wren	*Troglodytes troglodytes*	14	34	5		53
white-throated sparrow	*Zonotrichia albicollis*	45	62	21	1	129
yellow-bellied flycatcher	*Empidonax flaviventris*	2	2			4
yellow-bellied sapsucker	*Sphyrapicus varius*	1	1			2
yellow-rumped warbler	*Dendroica coronata*	38	9	1	1	49
yellow warbler	*Dendroica petechia*	1				1
Total birds observed		**553**	**390**	**77**	**37**	**1057**

*Numbers largely represent singing males but also include male and some female individuals that were visually detected.

Appendix C Table 2. Species detected incidentally between point count survey locations
American kestrel
American redstart
American robin
American woodcock
black-and-white warbler
blue-headed vireo
blackburnian warbler
black-throated blue warbler
black-throated green warbler
common yellowthroat
chestnut-sided warbler
dark-eyed junco
eastern phoebe
least flycatcher
magnolia warbler
mourning dove
Nashville warbler
Northern parula
olive-sided flycatcher
ovenbird
rose-breasted grosbeak
ruffed grouse
scarlet tanager
winter wren
white-throated sparrow
yellow-bellied sapsucker
yellow-rumped warbler

Appendix C Table 3. Total number of observations, relative abundance, and frequency of species at coniferous forest and deciduous forest point count locations during three survey periods - Spring 2009

Species	Coniferous forest (16 points)			Deciduous forest (9 points)		
	Total[a]	Relative abundance[b]	Frequency[c]	Total[a]	Relative abundance[b]	Frequency[c]
alder flycatcher		0.00	0	5	0.19	33
American goldfinch		0.00	0	1	0.04	11
American redstart		0.00	0	15	0.56	67
American robin	1	0.02	6	4	0.15	33
bay-breasted warbler	12	0.25	56		0.00	0
black-and-white warbler	2	0.04	13	13	0.48	78
blackburnian warbler	18	0.38	75	2	0.07	11
black-capped chickadee	2	0.04	13	1	0.04	11
blackpoll warbler	16	0.33	50		0.00	0
black-throated blue warbler	18	0.38	63	26	0.96	100
black-throated green warbler	5	0.10	25	2	0.07	11
blue jay	2	0.04	13	1	0.04	11
blue-headed vireo	7	0.15	31	4	0.15	44
boreal chickadee	9	0.19	25		0.00	0
brown creeper	1	0.02	6		0.00	0
Canada warbler		0.00	0	3	0.11	22
cedar waxwing		0.00	0	6	0.22	22
chestnut-sided warbler	7	0.15	25	31	1.15	100
common yellowthroat	2	0.04	13	25	0.93	89
dark-eyed junco	28	0.58	94	9	0.33	44
golden-crowned kinglet	32	0.67	88		0.00	0
hairy woodpecker	1	0.02	6	2	0.07	22
hermit thrush	11	0.23	50	20	0.74	89
least flycatcher		0.00	0	1	0.04	11
magnolia warbler	24	0.50	69	4	0.15	44
mourning dove		0.00	0		0.00	0
mourning warbler		0.00	0	10	0.37	33
Nashville warbler	42	0.88	88	1	0.04	11
northern flicker		0.00	0	1	0.04	11
northern parula		0.00	0	1	0.04	11
ovenbird	2	0.04	13	15	0.56	89
purple finch	2	0.04	13		0.00	0
red-breasted nuthatch	10	0.21	50		0.00	0
red-eyed vireo	2	0.04	6	13	0.48	78
rose-breasted grosbeak		0.00	0	10	0.37	78
ruby-crowned kinglet		0.00	0		0.00	0
ruffed grouse		0.00	0	2	0.07	22
scarlet tanager		0.00	0		0.00	0
Swainson's thrush	3	0.06	19	2	0.07	22
Tennessee warbler	3	0.06	13		0.00	0
unidentified woodpecker	1	0.02	6		0.00	0
white-throated sparrow	26	0.54	75	33	1.22	100
winter wren	27	0.56	69	7	0.26	44
yellow-bellied flycatcher	4	0.08	25		0.00	0
yellow-bellied sapsucker	1	0.02	6	1	0.04	11
yellow-rumped warbler	34	0.71	88	3	0.11	22
yellow warbler		0.00	0	1	0.04	11
Total birds observed	**355**			**275**		
Relative abundance	**7.40**			**10.19**		
Species richness	**32**			**34**		
Shannon Diversity Index	**2.95**			**2.99**		

a Total number of individuals detected (mainly singing males, also males and females that were visually observed).
b Mean number of birds observed.
c Percentage of survey points at which the species was observed.

Appendix C Table 4. Total number of observations, relative abundance, and frequency of species at mixed forest and regenerating clearcut point count locations during three survey periods - Spring 2009

	Mixed forest (7 points)			Regenerating clearcut (3 points)		
Species	Total[a]	Relative abundance[b]	Frequency[c]	Total[a]	Relative abundance[b]	Frequency[c]
alder flycatcher	4	0.19	14	3	0.33	67
American goldfinch	3	0.14	14		0.00	0
American redstart	7	0.33	57	3	0.33	67
American robin		0.00	0		0.00	0
bay-breasted warbler	4	0.19	29		0.00	0
black-and-white warbler	8	0.38	86	6	0.67	100
blackburnian warbler	6	0.29	43		0.00	0
black-capped chickadee	2	0.10	14		0.00	0
blackpoll warbler	4	0.19	29		0.00	0
black-throated blue warbler	19	0.90	71	7	0.78	67
black-throated green warbler	13	0.62	71		0.00	0
blue jay	3	0.14	29		0.00	0
blue-headed vireo	3	0.14	43		0.00	0
boreal chickadee		0.00	0		0.00	0
brown creeper		0.00	0		0.00	0
Canada warbler	1	0.05	14		0.00	0
cedar waxwing	1	0.05	14		0.00	0
chestnut-sided warbler	21	1.00	71	12	1.33	100
common yellowthroat	16	0.76	57	15	1.67	100
dark-eyed junco	19	0.90	100	7	0.78	67
golden-crowned kinglet	4	0.19	29	1	0.11	33
hairy woodpecker		0.00	0	2	0.22	33
hermit thrush	9	0.43	57	3	0.33	33
least flycatcher		0.00	0		0.00	0
magnolia warbler	5	0.24	71	4	0.44	67
mourning dove	1	0.05	14		0.00	0
mourning warbler		0.00	0	1	0.11	33
Nashville warbler	6	0.29	57		0.00	0
northern flicker	1	0.05	14		0.00	0
northern parula		0.00	0		0.00	0
ovenbird	4	0.19	29	1	0.11	33
purple finch		0.00	0		0.00	0
red-breasted nuthatch	3	0.14	29		0.00	67
red-eyed vireo	3	0.14	14	3	0.33	67
rose-breasted grosbeak		0.00	0		0.00	0
ruby-crowned kinglet	2	0.10	29		0.00	0
ruffed grouse		0.00	0		0.00	0
scarlet tanager		0.00	0	1	0.11	33
Swainson's thrush		0.00	0		0.00	0
Tennessee warbler		0.00	0		0.00	0
unidentified woodpecker		0.00	0		0.00	0
white-throated sparrow	32	1.52	100	16	1.78	100
winter wren	10	0.48	71	4	0.44	67
yellow-bellied flycatcher		0.00	0		0.00	0
yellow-bellied sapsucker		0.00	0		0.00	0
yellow-rumped warbler	9	0.43	86	1	0.11	33
yellow warbler		0.00	0		0.00	0
Total birds observed	**223**			**90**		
Relative abundance	**10.62**			**10.00**		
Species richness	**30**			**18**		
Shannon Diversity Index	**3.01**			**2.52**		

a Total number of individuals detected (mainly singing males, also males and females that were visually observed).

b Mean number of birds observed.

c Percentage of survey points at which the species was observed.

Appendix D

Raptor Survey Data Tables

Appendix D Table 1. Daily totals of raptor species observed at Highland Spring 2009

Site	Species	3/25/2009	4/1/2009	4/10/2009	4/19/2009	4/20/2009	4/29/2009	4/30/2009	5/5/2009	5/8/2009	5/11/2009	5/12/2009	5/13/2009	5/15/2009	5/18/2009	5/19/2009	Grand Total
Briggs	bald eagle						1			1						2	4
	broad-winged hawk								2			1		1		1	5
	northern goshawk												1			1	2
	northern harrier							1									1
	red-tailed hawk						1	1	2	3		3		1		3	14
	sharp-shinned hawk								1								1
	turkey vulture						6	10	5	10		12	3	8		21	75
	unidentified buteo						1							1			2
	unidentified raptor									1						2	3
	Total birds observed	**--**	**--**	**--**	**--**	**--**	**9**	**12**	**10**	**15**	**--**	**16**	**4**	**11**	**--**	**30**	**107**
Witham	bald eagle	1	1								1	1		1			5
	broad-winged hawk					3					5	1		1			10
	Cooper's hawk			1				1									2
	northern goshawk													1			1
	osprey				1	3						1					5
	peregrine falcon			1													1
	red-tailed hawk	2	7	5	3	4		3			6	4	10	2			46
	sharp-shinned hawk			2	5	4						3	1				15
	turkey vulture			3	11	3		18			2	6	6	4	4		57
	unidentified buteo					1		1									2
	unidentified raptor	3		1	1						2	1		1			9
	Total birds observed	**6**	**8**	**13**	**21**	**18**	**--**	**23**	**--**	**--**	**16**	**17**	**17**	**10**	**4**	**--**	**153**
	Project Total	**6**	**8**	**13**	**21**	**18**	**9**	**35**	**10**	**15**	**16**	**33**	**21**	**21**	**4**	**30**	**260**

Appendix D Table 2. Hourly summary of raptor observations at Highland Spring 2009											
Site	**Species**	**7:00-8:00**	**8:00-9:00**	**9:00-10:00**	**10:00-11:00**	**11:00-12:00**	**12:00-1:00**	**1:00-2:00**	**2:00-3:00**	**3:00-4:00**	**TOTAL**
Briggs	bald eagle			1		3					4
	broad-winged hawk			1		1	2	1			5
	northern goshawk			1			1				2
	northern harrier			1							1
	red-tailed hawk				3	2	5		3	1	14
	sharp-shinned hawk								1		1
	turkey vulture			3	8	10	15	5	9	25	75
	unidentified buteo			1						1	2
	unidentified raptor					2	1				3
	TOTAL			8	11	18	24	6	13	27	107
Witham	bald eagle					2	1		2		5
	broad-winged hawk				2	4	1	1		2	10
	Cooper's hawk								2		2
	northern goshawk					1					1
	osprey				2	1	1	1			5
	peregrine falcon				1						1
	red-tailed hawk			2	3	4	13	11	5	8	46
	sharp-shinned hawk		1	3	3	3	2	2	1		15
	turkey vulture			1	6	25	12	4	5	4	57
	unidentified buteo			1					1		2
	unidentified raptor	1			1	2	1	1	2	1	9
	TOTAL	1	1	7	18	42	31	20	18	15	153
	Project Total	1	1	15	29	60	55	26	31	42	260

Appendix D Table 3. Number of individuals of species observed within Project boundary in proposed turbine areas (flight positions A1, A2, A3, B) above or below 130.5 m

WITHAM			
Species	**130.5 m or greater**	**below 130.5 m**	**TOTAL**
bald eagle		3	3
broad-winged hawk	4	5	9
Cooper's hawk	2		2
northern goshawk		1	1
osprey	4	1	5
peregrine falcon		1	1
red-tailed hawk	11	33	44
sharp-shinned hawk	1	14	15
turkey vulture	5	52	57
unidentified buteo	1		1
unidentified raptor	1	6	7
TOTAL	**29**	**116**	**145**
BRIGGS			
Species	**130.5 m or greater**	**less than 130.5 m**	**TOTAL**
bald eagle		4	4
broad-winged hawk		5	5
northern goshawk		2	2
northern harrier		1	1
red-tailed hawk	2	7	9
sharp-shinned hawk		1	1
turkey vulture	11	57	68
unidentified buteo		1	1
TOTAL	**13**	**78**	**91**

Appendix D Table 4. Summary of Regional Spring 2009 (February to May) Migration Surveys*

Site Number**	Location	Observation Hours	BV	TV	OS	BE	NH	SS	CH	NG	RS	BW	RT	RL	GE	AK	ML	PG	SW	MK	EK	SK	UR	UB	UA	UF	UE	TOTAL	BIRDS/ HOUR
1	**Highland Wind Farm; Highland, ME**	139	0	132	5	9	1	16	2	3	0	15	60	0	0	0	0	1	0	0	0	0	12	4	0	0	0	260	1.87
2	**Barre Falls; Barre, MA**	118.25	0	64	66	19	14	100	10	1	11	593	78	0	0	67	2	1	0	0	0	0	8	0	0	0	0	1034	8.74
3	**Poquonock; Poquonock, CT**	378	15	242	75	22	15	111	35	2	36	634	172	1	2	30	6	3	0	1	0	0	23	2	1	1	0	1429	3.78
4	**Plum Island; Newburyport, MA**	136.25	0	44	35	5	121	141	18	0	0	1	5	4	0	672	79	21	0	0	1	0	3	0	2	2	0	1154	8.47
5	**Pilgrim Heights, North Truro, MA**	304	1	703	94	13	20	353	63	2	22	137	81	2	0	404	42	10	0	0	0	0	0	1	3	3	0	1954	6.43
6	**Bradbury Mt. State Park, Pownal, ME**	442.75	1	280	321	46	114	747	56	6	92	###	273	0	1	394	68	6	1	0	0	1	21	22	12	0	2	4116	9.30

*** Data obtained from HMANA 2009.**

**** See map to right for site location.**

Appendix D Table 5. Summary of available spring raptor data at proposed wind sites in the East 1999-2008

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Full citation
Spring 1999									
Wethersfield, Wyoming Cty, NY	Agricultural plateau	April 20 - May 24	24	97	348	12	3.6	n/a (23 m mean flight height)	Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York. Unpublished report prepared for Niagara–Mohawk Power Corporation, Syracuse, NY, by ABR, Inc., Forest Grove, OR. 46 pp.
Spring 2003									
Westfield Chautauqua Cty, NY	Great Lakes Shore	April 16 - May 15	50	100.7	2,578	17	25.6	n/a (278 m mean flight height)	Cooper, B.A., A.A. Stickney, J.J. Mabee. 2004. A visual and radar study of 2003 spring bird migration at the proposed Chautauqua wind energy facility, New York. 2004. Final Report prepared by ABR Inc. Chautauqua Windpower LLC.
Spring 2005									
Churubusco, Clinton Cty, NY	Great Lakes plain/ADK foothills	Spring 2005	10	60	170	11	2.83	(120 m) 69%	Woodlot Alternatives, Inc. 2005b. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
Clinton/Ellenburg, Clinton Cty, NY	Great Lakes plain/ADK foothills	April 18 to April 20	3	21	(2 non-migrant BWHA)	1	0.1***	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Dairy Hills, Clinton Cty, NY	Great Lakes Shore	April 15 to April 26	5	20	50	6	2.5	125 m (94.7%)*	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Altona, Clinton Cty, NY	Great Lakes plain/ADK foothills	May 5 to May 6	3	21	(4 non-migrant TUVU)	1	0.19***	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.

Appendix D Table 5. Summary of available spring raptor data at proposed wind sites in the East 1999-2008									
Project Site	**Landscape**	**Survey Period**	**# of Survey Days**	**# of Survey Hours**	**Total # Observed**	**# of Species Observed**	**Seasonal Passage Rate (raptors/hr)**	**(Turbine Ht) and % Raptors Below Turbine Height**	**Full citation**
Bliss Wind Park, Eagle, Wyoming Cty, NY	Agricultural and wooded plateau	April 21, 26, 28	3	21	19	3	0.9	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Alabama, Genesee Cty, NY	Great Lakes plain/ADK foothills	April 16-April 29	5	20	177	8	9	(125 m) 84.5%*	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
High Sheldon, Wyoming Cty, NY	Agricultural and wooded plateau	April 2 to May 14	7	37	119	7	3.2	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Wethersfield, Wyoming Cty, NY	Agricultural and wooded plateau	April 22 to April 29	3	21	5	3	0.1	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
New Grange, Chautauqua Cty, NY	Great Lakes plain/ADK foothills	April 16 to May	5	20	55	8	4.37	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Stockton, Chautauqua Cty, NY	Great Lakes plain/ADK foothills	April 16 to May 15	5	20	122	8	4.65	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Clayton, Jefferson Cty, NY	Agricultural plateau	March 30 - May 7	10	58	700	14	12.1	(150 m) 61%	Woodlot Alternatives, Inc. 2005a. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic

Appendix D Table 5. Summary of available spring raptor data at proposed wind sites in the East 1999-2008

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Full citation
									Renewable.
Prattsburgh, Steuben Cty, NY	Agricultural plateau	Spring 2005	10	60	314	15	5.23	(125 m) 83%	Woodlot Alternatives, Inc. 2005c. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
Cohocton, Steuben Cty, NY	Agricultural plateau	Spring 2005	10	60	164	11	2.73	(125 m) 77%	Woodlot Alternatives, Inc. 2005. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
Munnsville, Madison Cty, NY	Agricultural plateau	April 5 to May 16	10	60	375	12	6.25	(118 m) 78%	Woodlot Alternatives, Inc. 2005d. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
Moresville, Delaware County, NY	Forested ridge	March 28 to May 10	8	45	170	6	3.8	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Sheffield, Caledonia Cty, VT	Forested ridge	April to May	10	60	98	10	1.63	(125 m) 69%	Woodlot Alternatives, Inc. 2006b. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Deerfield, Bennington Cty, VT (Existing facility)	Forested ridge	April 9 to April 29	7	42	44	11 (for both sites combined)	1.05	(125 m) 83% (at both sites combined)	Woodlot Alternatives, Inc. 2005e. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy/Deerfield Wind, LLC.
Deerfield, Bennington Cty, VT (Western expansion)	Forested ridge	April 9 to April 29	7	42	38	11 (for both sites combined)	0.9	(125 m) 83% (at both sites combined)	Woodlot Alternatives, Inc. 2005e. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy/Deerfield Wind, LLC.

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Spring 2006									
Mars Hill, Aroostook Cty, ME	Forested ridge	April 12 to May 18	10	60.25	64	9	1.06	(120 m) 48%	Woodlot Alternatives, Inc. 2006c. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
Lempster, Sullivan County, NH	Forested ridge	Spring 2006	10	78	102	n/a	1.3	125 m (18%)	Woodlot Alternatives, Inc. 2007a. A Spring 2007 Survey of Nocturnal Bird Migration,Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
Howard, Steuben Cty, NY	Agricultural plateau	April 3 to May 19	9	52.5	260	11	4.95	(125 m) 64%	Woodlot Alternatives, Inc. 2006d. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
Chateaugay, Franklin Cty, NY	Great Lakes plain/ADK foothills	April 19 to April 28	3	21	47	12	1.9	(121 m) 3%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
St. Lawrence, Jefferson Cty, NY	Great Lakes Shore	April 14 to May 12	4	12	91	8	7.5	(125 m) 81%**	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Cape Vincent, Jefferson Cty, NY	Great Lakes Shore	April 14 to May 12	4	12	79	10	6.5	(125 m) 72%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Stockton, Chautauqua Cty, NY	Great Lakes plain/ADK foothills	n/a	n/a	n/a	n/a	n/a	4.65	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Spring 2007									

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St Lawrence, Jefferson Cty, NY	Great Lakes Shore	March 21 to May 1	7	21	232	8	15.4	(125 m) 81%**	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Cape Vincent, Jefferson Cty, NY	Great Lakes Shore	March 21 to May 1	7	21	205	9	9.8	(125 m) 72%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
New Grange, Chautauqua Cty, NY	Great Lakes plain/ADK foothills	April 26 to May 22	5	n/a	n/a	n/a	4.37	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Jericho Rise, Franklin Cty, NY	Great Lakes plain/ADK foothills	April 4 to May 28	8	32	112	10	3	(125 m) 74.6%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Stetson, Penobscot Cty, ME	Forested ridge	April 26 to May 4	9	59	34	10	0.6	(125 m) 65%	Woodlot Alternatives, Inc. 2007b. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Laurel Mountain, Preston Cty, WV	Forested ridge	March 30 to May 17	10	63.75	266	12	4.17	(125 m) 55%	Stantec Consulting. 2008b. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia – November 2007. Prepared for AES Laurel Mountain, LLC.
Spring 2008									
Oakfield, Aroostock Cty, ME	Agricultural plateau	April 25-May 30	12	79	58	9	0.7	(120 m) 80%	Stantec Consulting. 2008c. Spring and Summer 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the Oakfield Wind Project in Oakfield, Maine. Prepared for First Wind Management, LLC.

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Roxbury, Oxford Cty, ME	Forested ridge	March 11 to May 27	15	97	118	12	1.2	n/a	Stantec Consulting. 2008d. Spring 2008 Bird and Bat Migration Survey Report Breeding Bird, Raptor, and Acoustic Bat Surveys for the Record Hill Wind Project Roxbury, Maine. Prepared for Record Hill Wind, LLC.
Lincoln, Penobscot Cty, ME	Forested ridge	April 3 to June 3	15	108	122	12	1.1	(125 m) 76%	Stantec Consulting. 2008e. Spring 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind Management, LLC.
Greenland, Grant Cty, WV	Forested ridge	March 21 to May 14	10	68	212	9	3.12	(125 m) 68%	Stantec Consulting. 2008f. Spring, Summer, and Fall 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the New Creek Mountain Project West Virginia. Prepared for AES New Creek, LLC.
Highland, Maine	Forested ridge	March 25 to May 19	12 days Witham, 8 days Briggs	139	260	12	1.87	(130.5 m) Whitham 80 %, Briggs 86%	*this report*
*Calculated for spring and fall combined.									
**Calculated for spring and fall 2006 and 2007 combined.									
***Non-migrants were not included in seasonal passage rates in NYSDEC 2008 table but were included in passage rates here.									