Wildlife Baseline Studies for the Number Nine Wind Farm Aroostook County, Maine

Raptor Migration Report

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INTRODUCTION

Number Nine Wind Farm LLC, a subsidiary of EDPR Renewables North America LLC, (EDPR) has proposed a wind energy facility in Aroostook County, Maine, referred to as the Number Nine Wind Farm (Project). EDPR contracted Western EcoSystems Technology, Inc. (WEST) to conduct pre-Project construction surveys for wildlife resources in the Project area, including raptor migration surveys (RMS), to provide data useful in evaluating the potential risk and impacts that the development of a wind energy facility might have on migrating raptors in the area.

The principal objectives of the study were to: 1) provide site-specific raptor resource and use data that would be useful in evaluating potential impacts from the proposed wind energy facility; 2) provide information that could be used in Project planning and design of the facility to minimize impacts to raptors; and 3) recommend further studies or potential minimization and mitigation measures, if warranted.

STUDY AREA

The Project is located in Aroostook County, in northeastern Maine, approximately eight miles (13 kilometers [km]) west of the town of Bridgewater (Figure 1). The Project is located in the Laurentian Plains and Hills Ecoregion in northeastern Maine (USEPA 2007). The Laurentian Plains and Hills are characterized by spruce-fir forests with some patches of deciduous trees interspersed with glacial lakes. Land within the Project is privately owned and the primary land use is timber harvest. Elevations in the project area range from approximately 500 to 1,700 feet (ft; 152 to 518 meters [m]) above sea level. The dominant vegetation type is mixed spruce-fir and deciduous forest. Common deciduous trees in the Project include maple (*Acer* spp.), beech (*Fagus* spp.), and birch (*Betula* spp).

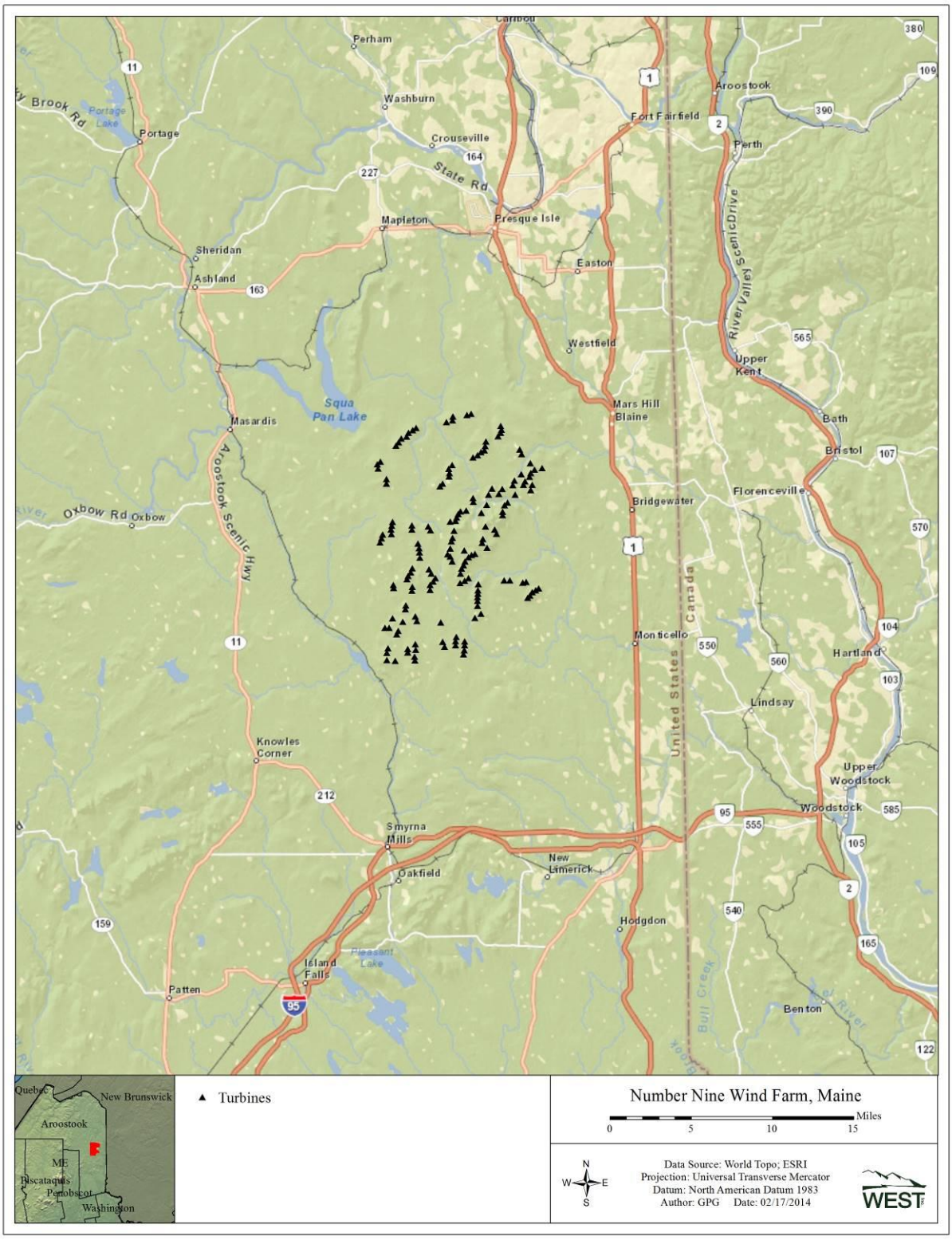


Figure 1. Location of the Number Nine Wind Farm.

The Study Area, encompassing the area within a 2-mile (3.2-kilometer [km]) buffer around the proposed turbine layout, is approximately 132,000 acres (206.7 square miles [mi^2]; 535.3 square km [km^2]) and is composed mostly of forest (75.4%; Table 1, Figure 2). Within the forest types are mixed forest (38.2%), deciduous forest (19.2%), and evergreen forest (18.0%; Figure 2, Table 1). Woody wetlands (11.6%) also occur throughout the Study Area, but other wetland types (open water [0.5%] and emergent wetlands [0.2%]) are uncommon. Shrub/scrub habitat (10.4%) is common throughout the Study Area due to logging activity that has removed the forest cover. The area and regional forests are transitional and in various stages of growth (from regenerating stands to mature forest) due to past and ongoing commercial logging activity.

Table 1. The land cover types, coverage, and percent composition within the Number Nine Wind Farm area.

Habitat	Square Miles	Percent Composition
Mixed Forest	78.85	38.2
Deciduous Forest	39.78	19.2
Evergreen Forest	37.13	18.0
Woody Wetlands	24.07	11.6
Shrub/Scrub	21.41	10.4
Herbaceous	2.73	1.3
Barren Land	1.00	0.5
Open Water	0.95	0.5
Emergent Herbaceous Wetlands	0.43	0.2
Developed, Open Space	0.20	0.1
Hay/Pasture	0.11	0.1
Cultivated Crops	0.01	<0.1
Developed, Low Intensity	<0.01	<0.1
Developed, Medium Intensity	<0.01	<0.1
Total	**206.67**	**100**

Data from US Geological Survey National Landcover Dataset (USGS NLCD 2009).

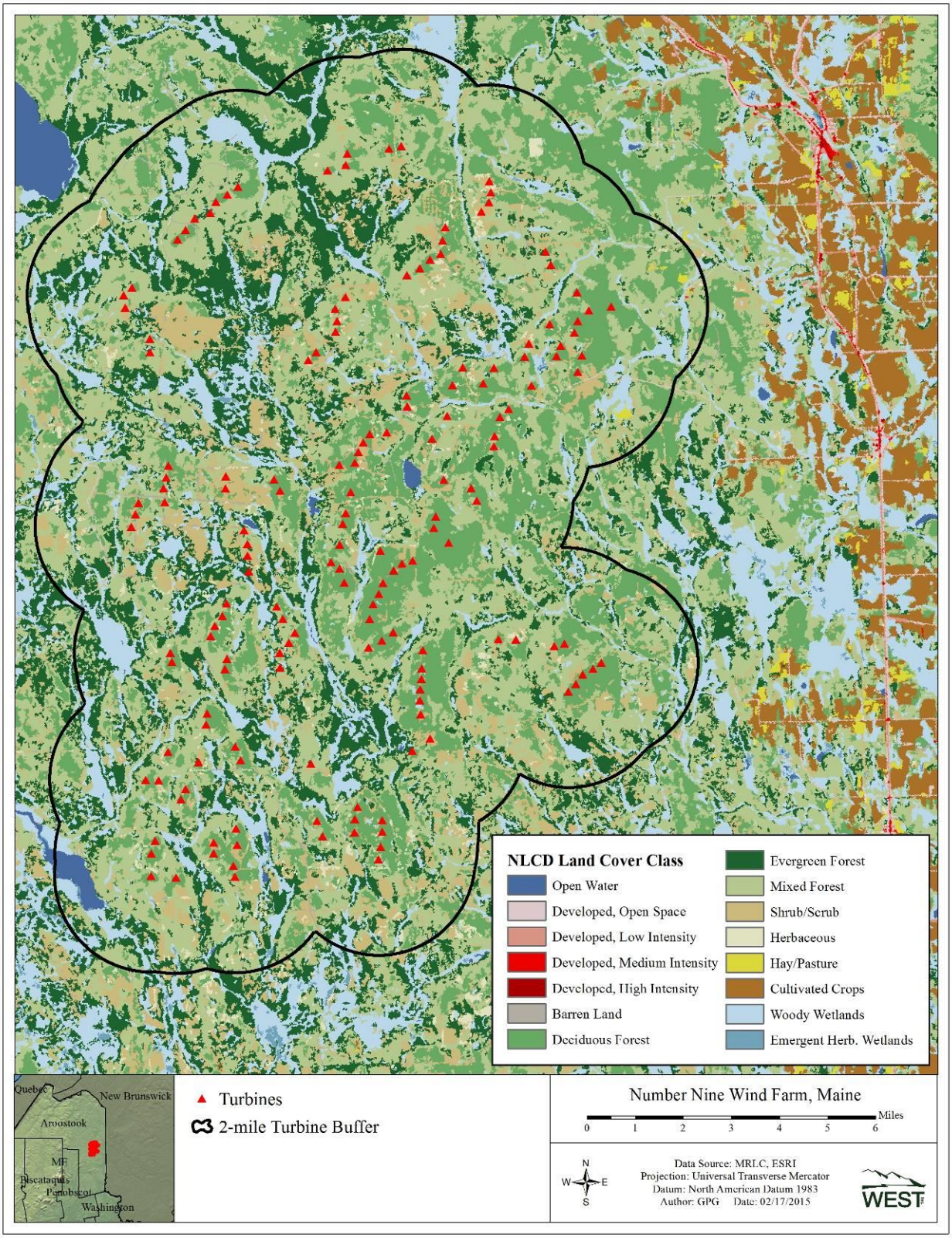


Figure 2. Overview and land cover types and coverage within the Number Nine Wind Farm.

METHODS

Raptor Migration Surveys

The objective of the RMS was to estimate the spatial and temporal use of the Project by migrant raptors and vultures. Point counts using variable circular plots (similar to Reynolds et al. 1980, Bibby et al. 1992) were conducted within the Project according to methods used by the Hawk Migration Association of North America (HMANA), with an observer continuously scanning the sky and surrounding area for raptors in an unlimited viewshed around the observation point. The emphasis of the RMS was to locate and count raptors migrating through the Project.

Survey Plot

One survey point was established each season within the Project to survey for migrant raptors, in the same general location on Number Nine Mountain as point 2 in raptor migration survey efforts performed in 2008 (Figure 3; see Appendix D). The point location was selected to provide good visual coverage in roughly 360^{o} around the point but with the best view to the south in the spring and to the north in the fall. This provided maximal visibility over long distances in the direction in which the prevailing migration would be coming from. Consistent with typical raptor migration surveys, the survey plot was an unlimited viewshed centered on the point (Figure 3).

Survey Methods

All raptors observed during the survey were assigned a unique observation number and plotted on a map, regardless of distance from observer. Data recorded for each survey included the date, start and end time of each observation period, and weather information such as temperature (degrees Fahrenheit [°F]), wind speed (miles per hour [mph]), wind direction, and cloud cover (percent). Species or best possible identification, number of individuals, sex and age class (if possible), distance from survey point when first observed (m), closest distance (m), altitude above ground (m), activity (behavior), and habitat(s) were recorded for each observation (see Appendix A). Approximate flight direction or flight paths and perch locations were mapped for all raptors seen. The behavior and habitat were recorded based on the point of initial observation. Behavior categories included perched, soaring, flapping, hunting, gliding, hovering, auditory, and other (noted in comments). Habitats included shrub/scrub, mixed forest, deciduous forest, spruce/fir forest, woody wetland, and other (noted in comments). The approximate flight height and distance from the point at first observation were recorded to the nearest m or a 5-m (16-ft) interval. Any comments or unusual observations were noted in the comments section.

Observation Schedule

Surveys were conducted approximately twice per week during the spring and fall study periods. Survey periods were approximately six hours per survey day, from approximately 9:00 am to 6:00 pm to cover the period for observing migrating raptors. To the extent practical, surveys were conducted on days when weather conditions were conducive to raptor migration (i.e. warm, clear, high pressure conditions).

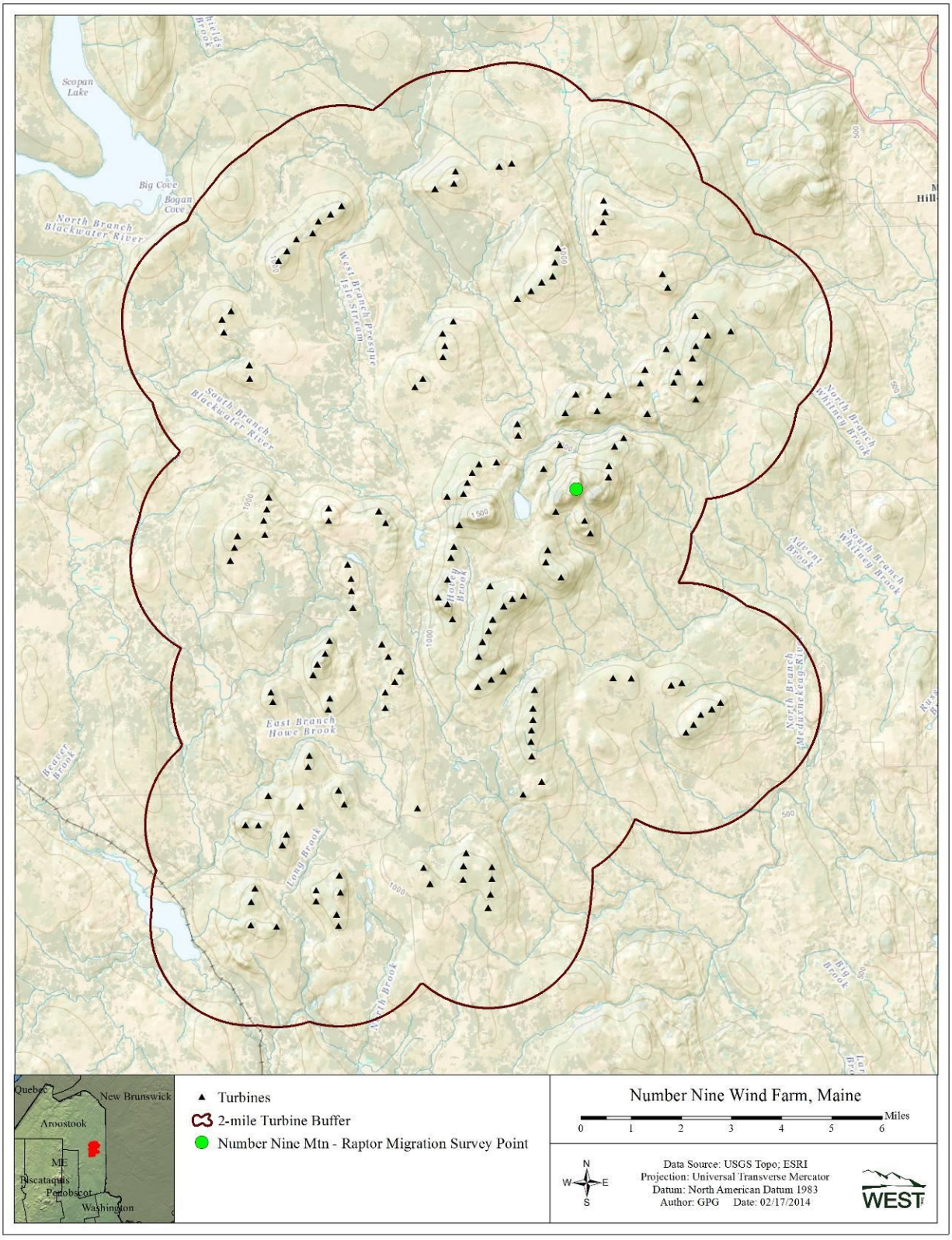


Figure 3. Location of the raptor migration survey point within the Number Nine Wind Farm.

Incidental Observations

The focus of the surveys was recording migrant raptors and vultures moving through the Project; however, observations of other birds and other wildlife that were observed during the surveys were also recorded. The objective of incidental wildlife observations was to provide a record of other wildlife seen in the Project area and/or outside of the standardized surveys.

Regional Hawk Migration Data

Existing raptor migration data (sources HMANA and HWI) were investigated to locate regional sites and data for comparing the relative magnitude of raptor migration through the Project with areas of known raptor migration. Efforts were focused on finding data from 2014 for comparison to help control for variation and trends in overall raptor populations that could influence the magnitude of regional raptor migration.

Statistical Analysis

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, the observer was responsible for inspecting data forms for completeness, accuracy, and legibility. A series of database queries were made and compared to the raw data forms to look for potentially erroneous data in the electronic database. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate corrections in all steps were made.

Data Compilation and Storage

A Microsoft® ACCESS database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined protocol to facilitate subsequent QA/QC and data analysis. All data forms and electronic data files were retained for future reference.

Raptor Diversity and Species Richness

A species lists (with the number of individuals and number of groups) was generated for the raptor migration survey and included all observations of birds detected, regardless of their distance from the observer. In some cases, the tally of observations may represent repeated sightings of the same individual. Species richness was calculated by counting the number of species observed during a survey then averaging across the number of survey periods.

Raptor Use, Percent of Use, and Frequency of Occurrence

For raptor migration surveys, observations of birds detected within an unlimited viewshed were used in the analysis. Mean raptor use was defined as the mean number of raptor observations recorded per observer-hour. Mean use was calculated by counting the number of raptors

observed from the point during a survey and then averaging by the number of hours in the survey and then averaging across the number of survey periods.

Percent of use was calculated as mean use of a particular species divided by the total use for all species observed during the study. Frequency of occurrence for each species was calculated as the percent of surveys in which a particular species was recorded. Frequency of occurrence and percent of use provide relative estimates of risk to species recorded. For example, a species that migrates in large groups over an area may have a relatively high percent of use. However, examining the percent of use alone would not account for the acute exposure to the facility associated with a small number of very large flocks (low frequency of occurrence). A high percent of use may indicate that a species has higher exposure relative to other species, but when the exposure is short-term, the species may be less likely affected. Conversely, a species that has a relatively low percentage of use, but a relatively high frequency of occurrence would have greater long-term exposure to the facility, increasing the exposure that this species has to the facility. Exposure to facility infrastructure is more accurately assessed by evaluating both percent of use and frequency of occurrence.

Raptor Flight Height and Behavior

The approximate flight height recorded at the location where a bird was first observed was used to calculate mean flight height and the percentage of birds observed flying within the rotor swept height (RSH), the zone where it could be exposed to turbine blades or approximately 25 to 150 m [82 to 492 ft] above ground level. This area corresponds to what is considered the zone of risk for many modern turbines and turbines potentially proposed for use at the Project.

Temporal Use

To investigate changes in use over time of day, mean use was averaged across hour time blocks (e.g., 1000 – 1100 hours, 1100 – 1200 hours, etc.). This accounted for variation in survey effort among visits. For the study period, mean use during each time block of the survey day was calculated for each raptor subtype. In addition, total number of raptors and vultures recorded on each survey day was tallied.

RESULTS

Raptor migration surveys were conducted at the survey station on 22 days during the spring (March 18 to May 29, 2014), and on 34 days during the fall (September 3 to December 4, 2014). A total of 374 survey hours were conducted (Table 2).

Table 2. Survey dates and times for the spring and fall raptor migration surveys at the Number Nine Wind Farm.

Date	Start Time	End Time
Spring		
3/18/2014	11:15	15:15
3/19/2014	10:45	16:45
3/25/2014	11:15	17:15
3/26/2014	9:00	15:00
4/2/2014	11:45	17:45
4/3/2014	9:30	15:30
4/7/2014	12:00	18:00
4/11/2014	9:00	15:00
4/14/2014	12:00	18:00
4/18/2014	9:00	15:00
4/22/2014	9:00	15:00
4/23/2014	10:00	16:00
4/29/2014	9:30	15:30
4/30/2014	9:30	15:30
5/7/2014	11:50	16:50
5/8/2014	10:15	16:15
5/13/2014	9:00	15:00
5/14/2014	10:30	16:30
5/20/2014	9:00	15:00
5/23/2014	9:30	15:30
5/28/2014	10:30	16:30
5/29/2014	11:15	17:15
Fall		
9/3/2014	9:00	17:00
9/4/2014	9:00	17:00
9/9/2014	9:00	17:00
9/10/2014	8:30	16:30
9/15/2014	9:00	17:00
9/16/2014	8:30	16:30
9/22/2014	8:30	16:30
9/23/2014	9:00	17:00
9/30/2014	8:00	16:00
10/1/2014	8:30	16:30
10/7/2014	9:30	17:30
10/9/2014	8:30	16:30
10/15/2014	9:00	17:00
10/16/2014	8:00	16:00
10/21/2014	9:00	17:00

10/22/2014	8:30	16:30
10/28/2014	8:30	16:30
10/29/2014	8:30	16:30
10/30/2014	9:00	17:00
11/4/2014	9:00	16:00
11/5/2014	9:00	16:00
11/6/2014	9:00	16:00
11/13/2014	8:00	15:00
11/14/2014	8:30	15:30
11/15/2014	9:00	15:00
11/19/2014	9:00	15:00
11/20/2014	8:30	15:30
11/21/2014	8:30	15:30
11/25/2014	8:30	15:30
11/26/2014	8:00	12:00
12/1/2014	11:30	15:30
12/2/2014	8:30	15:30
12/3/2014	10:00	14:00
12/4/2014	8:00	14:00

Bird Diversity and Species Richness

Eight unique raptor species were observed during raptor migration surveys in the spring and eight unique species were observed in the fall; overall 11 different raptor species were observed (Table 5). One vulture species was observed during both fall and spring surveys. A mean of 0.77 birds per observer-hour was recorded in the spring, while mean bird use was slightly lower in the fall (0.67 birds per observer-hour; Table 5). Species richness was slightly higher in the fall (1.44 species per observer-hour) than in spring (1.32).

A total of 102 individual raptors (35 raptors in the spring and 67 raptors in the fall) and 169 vultures (54 vultures in the spring and 115 vultures in the fall; Table 3) were observed during the raptor migration surveys.

Table 3. Total number of groups and individuals for each bird type and species by season and overall during raptor migration surveys at the Number Nine Wind Farm.

		Spring		Fall		Overall	
Bird Type/Species	**Scientific Name**	**Groups**	**Individuals**	**Groups**	**Individuals**	**Groups**	**Individuals**
Diurnal Raptors		***32***	***35***	***66***	***67***	***98***	***102***
Accipiters		*7*	*8*	*8*	*8*	*15*	*16*
Cooper's hawk	*Accipiter cooperii*	0	0	1	1	1	1
northern goshawk	*Accipiter gentilis*	1	1	0	0	1	1
sharp-shinned hawk	*Accipiter striatus*	6	7	7	7	13	14
Buteos		*16*	*18*	*29*	*29*	*45*	*47*
broad-winged hawk	*Buteo platypterus*	2	3	0	0	2	3
red-tailed hawk	*Buteo jamaicensis*	14	15	26	26	40	41
rough-legged hawk	*Buteo lagopus*	0	0	3	3	3	3
Northern Harrier		*0*	*0*	*1*	*1*	*1*	*1*
northern harrier	*Circus cyaneus*	0	0	1	1	1	1
Eagles		*3*	*3*	*25*	*26*	*28*	*29*
bald eagle	*Haliaeetus leucocephalus*	3	3	25	26	28	29
Falcons		*5*	*5*	*2*	*2*	*7*	*7*
American kestrel	*Falco sparverius*	3	3	2	2	5	5
merlin	*Falco columbarius*	2	2	0	0	2	2
Osprey		*1*	*1*	*1*	*1*	*2*	*2*
osprey	*Pandion haliaetus*	1	1	1	1	2	2
Vultures		***26***	***54***	***27***	***115***	***53***	***169***
turkey vulture	*Cathartes aura*	26	54	27	115	53	169
Overall	**NA**	**58**	**89**	**93**	**182**	**151**	**271**

Bird Use, Percent Composition, and Frequency of Occurrence

Raptors

The average number of raptors observed per survey day was 1.59 in the spring and 1.97 in the fall (Table 4). Among the raptor subtypes *Buteos* were the most common during both seasons with an average of 0.82 and 0.85 per survey day for spring and fall, respectively. Eagles were the second most common subtype during the fall (0.76), while *Accipiters* were the second most common in the spring (0.36). On average 3.38 vultures were observed per survey day during both spring and fall surveys.

Table 4. Mean number of birds by raptor subtype observed per survey day during spring and fall raptor migration surveys at the Number Nine Wind Farm.

Bird Type	Daily Mean		Standard Deviation	
	Spring	Fall	Spring	Fall
All Raptors	**1.59**	**1.97**	**2.38**	**1.93**
Accipiters	0.36	0.24	1.05	0.65
Buteos	0.82	0.85	1.44	1.18
Eagles	0.14	0.76	0.47	1.02
Northern harrier	0.23	0.06	0.69	0.24
Falcons	0.00	0.03	0.00	0.17
Osprey	0.05	0.03	0.21	0.17
Vultures	**3.38**	**3.38**	**5.55**	**8.62**

Total raptor use was identical for spring and fall (0.25 birds/observer-hour/survey; Table 5). The raptor subtype with the highest recorded use in the spring was *Buteos* (0.13 birds/observer-hour/survey), while eagles had the highest use in the fall (0.11). Falcons and *Accipiters* also had higher use in the spring (0.03 and 0.06 birds/observer-hour/survey, respectively) than in the fall. Between raptors and vultures, raptors accounted for 32.4% of observations in the spring and 37.9% of observations in the fall. Raptors were observed during 54.5% of surveys in the spring and 73.5% of surveys during the fall.

Vultures

Vultures were comprised solely of turkey vulture (*Cathartes aura*); 0.52 birds/observer-hour/survey were recorded in the spring, while 0.41 were recorded in the fall (Table 5). Between raptors and vultures, vultures accounted for 67.6% of overall bird use in the spring and 62.1% in the fall. Turkey vultures were recorded during 50.0% of all spring surveys and 20.6% of fall surveys (Table 5).

Table 5. Mean bird use (birds/observer-hour), percent of total use, and frequency of occurrence, for each bird type and raptor subtype during spring and fall raptor migration surveys at the Number Nine Wind Farm.

	Mean Use		Standard Deviation		Percent of Use		Frequency of Occurrence	
Type / Subtype	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**
Raptors	**0.25**	**0.25**	**0.39**	**0.24**	**32.4**	**37.9**	**54.5**	**73.5**
Accipiters	0.06	0.03	0.17	0.07	7.7	4.1	13.6	14.7
Buteos	0.13	0.1	0.23	0.14	16.7	15.7	36.4	47.1
Northern Harrier	0	<0.01	0.00	0.02	0	0.6	0	2.9
Eagles	0.02	0.11	0.07	0.14	2.7	16.2	9.1	44.1
Falcons	0.03	<0.01	0.10	0.03	4.5	1	13.6	5.9
Osprey	<0.01	<0.01	0.03	0.02	0.8	0.5	4.5	2.9
Vultures	**0.52**	**0.41**	**0.85**	**1.06**	**67.6**	**62.1**	**50.0**	**20.6**
Overall	**0.77**	**0.67**	**0.93**	**1.11**	**100**	**100**		

Temporal Use

Daily temporal activity patterns among raptor subtypes varied during the migration surveys (Table 6; Appendix B). The most activity was observed between 1500 and 1800 in the spring and between 1000 and 1400 in the fall (Table 6; Appendix B). In the spring overall raptor use was highest between 1700 and 1800 hours (0.80 birds per survey) and was mostly influenced by relatively higher accipiter use (0.60 birds per survey) during this period. The second highest use value for all raptors in the spring occurred between 1500 and 1600 hours (0.69 birds per survey) which was influenced mostly by *Buteos* (0.38 birds per survey). In the fall, highest use occurred between 1200 and 1300 and was influenced by eagles (0.24 birds per survey) and *Buteos* (0.15 birds per survey).

Mean use by vultures was highest between 1000 and 1100 hours (0.93 birds per survey) in the spring and between 1500 and 1600 in the fall (1.96; Table 6). Overall, vulture mean use was highest earlier during the day in the spring (between 1000 and 1200) and later in the day (between 1400 and 1700) in the fall.

Table 6. Mean use (number of birds per observer-hour) of raptor types by survey hour recorded during spring raptor migration surveys at the Number Nine Wind Farm.

Time (hrs)	N	All Raptors	Accipiters	Buteos	Eagles	Falcons	Northern Harrier	Osprey	Vultures
Spring									
08:00-09:00	0	0	0	0	0	0	0	0	0
09:00-10:00	10	0.10	0.10	0	0	0	0	0	0.30
10:00-11:00	15	0.20	0.13	0.07	0	0	0	0	0.93
11:00-12:00	20	0.15	0	0	0.05	0.05	0	0.05	0.92
12:00-13:00	22	0.14	0.05	0.09	0	0	0	0	0.27
13:00-14:00	22	0.18	0	0.18	0	0	0	0	0.18
14:00-15:00	22	0.18	0	0.14	0	0.05	0	0	0.32
15:00-16:00	16	0.69	0.06	0.38	0.06	0.19	0	0	0.50
16:00-17:00	10	0.10	0	0	0.10	0	0	0	0.20
17:00-18:00	6	0.80	0.60	0.40	0	0	0	0	0
Fall									
08:00-09:00	18	0	0	0	0	0	0	0	0
09:00-10:00	32	0.13	0.03	0.03	0.06	0	0	0	0.03
10:00-11:00	33	0.39	0.03	0.15	0.18	0.03	0	0	0.06
11:00-12:00	34	0.35	0.03	0.09	0.24	0	0	0	0.12
12:00-13:00	33	0.48	0.03	0.15	0.24	0.03	0	0.03	0.09
13:00-14:00	33	0.24	0.06	0.18	0	0	0	0	0.30
14:00-15:00	31	0.23	0.03	0.16	0.03	0	0	0	0.55
15:00-16:00	28	0.18	0.04	0.07	0.04	0	0.04	0	1.96
16:00-17:00	17	0.12	0	0.12	0	0	0	0	1.35
17:00-18:00	1	0	0	0	0	0	0	0	0

Flight Height Characteristics

Raptors were observed flying in the RSH 70.3% of the time (Table 7). Osprey (*Pandion haliaetus*) and northern harrier (*Circus cyaneus*) were observed 100% of the time within the RSH; however only one observation of each species was recorded so these results would likely change with more observations. Other raptor subtypes that were observed within the RSH more often than the overall raptor type included falcons (85.7%) and *Buteos* (73.9%; Table 7) Vultures were observed within the RSH 90.4% of the time, at a higher rate than other raptor subtypes (Table 7).

Table 7. Flight height characteristics of birds observed during spring and fall raptor migration surveys at the Number Nine Wind Farm.

Bird Type/Species	Number of Groups	Number of Individuals	Mean Flight Height (m)	Flight Height std dev	Median Flight Height (m)	Percent in Flight	Percent Within RSH*
Raptors	**97**	**101**	**88.14**	**79.23**	**60**	**99**	**70.3**
Accipiters	*15*	*16*	*68.33*	*74.80*	*40*	*100*	*62.5*
Cooper's hawk	1	1	20.00	-	20	100	0
northern goshawk	1	1	20.00	-	20	100	0
sharp-shinned hawk	13	14	75.77	77.96	50	100	71.4
Buteos	*44*	*46*	*89.55*	*83.28*	*60*	*97.9*	*73.9*
broad-winged hawk	2	3	50.00	0	50	100	100
red-tailed hawk	39	40	93.85	87.14	70	97.6	72.5
rough-legged hawk	3	3	60.00	40.00	60	100	66.7
Harriers							
northern harrier	1	1	40.00	-	40	100	100
Eagles							
bald eagle	28	29	113.21	80.66	80	100	62.1
Falcons	*7*	*7*	*30.71*	*9.32*	*30*	*100*	*85.7*
American kestrel	5	5	33.00	9.75	30	100	100
merlin	2	2	25.00	7.07	25	100	50
Osprey							
osprey	2	2	80.00	28.28	80	100	100
Vultures							
turkey vulture	52	167	54.33	32.48	50	98.8	90.4
Overall	**149**	**268**	**76.34**	**68.54**	**50**	**98.9**	**82.8**

*RSH=likely rotor-swept heights for potential collision with a turbine blade or 25 to 150 m (82 to 492 feet) above ground level.

Incidental Observations

Fifty-seven bird species were observed incidentally during the surveys, totaling 3,287 birds within 609 separate groups (Table 8). Raptors and vulture incidental observations occurred

before or after the standardized survey periods (e.g,. while the field technician was traveling to and from the survey location).

Table 8. Incidental wildlife observed while conducting raptor migration surveys (RMS) at the Number Nine Wind Farm.

Species	Scientific Name	Number of Groups	Number of Individuals
Canada goose	*Branta canadensis*	10	1835
bald eagle	*Haliaeetus leucocephalus*	1	1
broad-winged hawk	*Buteo platypterus*	1	1
red-tailed hawk	*Buteo jamaicensis*	2	2
barred owl	*Strix varia*	1	1
turkey vulture	*Cathartes aura*	2	6
ruffed grouse	*Bonasa umbellus*	7	8
American crow	*Corvus brachyrhynchos*	17	144
common raven	*Corvus corax*	134	266
American goldfinch	*Spinus tristis*	5	13
American redstart	*Setophaga ruticilla*	3	4
American robin	*Turdus migratorius*	53	93
black-and-white warbler	*Mniotilta varia*	4	4
bay-breasted warbler	*Setophaga castanea*	1	1
black-capped chickadee	*Poecile atricapilla*	71	150
blue-headed vireo	*Vireo solitarius*	4	4
Blackburnian warbler	*Setophaga fusca*	1	1
blue jay	*Cyanocitta cristata*	19	27
black-throated blue warbler	*Setophaga caerulescens*	6	8
black-tailed gnatcatcher	*Polioptila melanura*	2	2
black-throated green warbler	*Setophaga virens*	2	3
cedar waxwing	*Bombycilla cedrorum*	5	23
common grackle	*Quiscalus quiscula*	10	149
common redpoll	*Acanthis flammea*	2	14
common yellowthroat	*Geothlypis trichas*	6	6
chestnut-sided warbler	*Setophaga pensylvanica*	9	12
dark-eyed junco	*Junco hyemalis*	46	142
golden-crowned kinglet	*Regulus satrapa*	4	9
hermit thrush	*Catharus guttatus*	8	9
magnolia warbler	*Setophaga magnolia*	1	1
mourning warbler	*Geothlypis philadelphia*	2	2
Nashville warbler	*Oreothlypis ruficapilla*	1	1
northern Parula	*Setophaga americana*	3	3
ovenbird	*Seiurus aurocapilla*	4	6
pine grosbeak	*Pinicola enucleator*	3	10
pine siskin	*Spinus pinus*	4	50
purple finch	*Haemorhous purpureus*	14	29
rose-breasted grosbeak	*Pheucticus ludovicianus*	3	3
red-breasted nuthatch	*Sitta canadensis*	7	9
ruby-crowned kinglet	*Regulus calendula*	2	2
red-eyed vireo	*Vireo olivaceus*	8	11

Table 8. Incidental wildlife observed while conducting raptor migration surveys (RMS) at the Number Nine Wind Farm.

Species	Scientific Name	Number of Groups	Number of Individuals
red-winged blackbird	*Agelaius phoeniceus*	1	1
Savannah sparrow	*Passerculus sandwichensis*	2	4
song sparrow	*Melospiza melodia*	1	1
Tennessee warbler	*Oreothlypis peregrina*	1	1
unidentified sparrow	*n/a*	1	20
white-breasted nuthatch	*Sitta carolinensis*	1	1
winter wren	*Troglodytes hiemalis*	13	13
white-throated sparrow	*Zonotrichia albicollis*	34	61
yellow-rumped warbler	*Setophaga coronata*	32	84
ruby-throated hummingbird	*Archilochus colubris*	2	2
downy woodpecker	*Picoides pubescens*	7	7
hairy woodpecker	*Picoides villosus*	9	9
northern flicker	*Colaptes auratus*	5	5
pileated woodpecker	*Dryocopus pileatus*	3	3
yellow-bellied sapsucker	*Sphyrapicus varius*	8	9
belted kingfisher	*Ceryle alcyon*	1	1
Totals		**609**	**3287**

Sensitive Species Observations

Seven state-listed species of special concern were recorded during the surveys, generally incidental observations of non-raptor species (Table 9): white-throated sparrow (*Zonotrichia albicollis*; 61 observations), chestnut-sided warbler (*Setophaga pensylvanica*; 12), American redstart (*Setophaga ruticilla*; four), black-and-white warbler (*Mniotilta varia*; four), and Tennessee warbler (*Oreothlypis peregrine;* one*)*. One state-listed raptor species of special concern was recorded: northern harrier (*Circus cyaneus;* one observation) during the surveys in the fall season*.* One state species of special concern, bald eagle (*Haliaeetus leucocephalus*; 30 observations), was also recorded (Table 9). Bald eagle is also protected under the Bald and Golden Eagle Protection Act (BGEPA 1940). This sensitive species tally in some cases may represent repeated observations of the same individual.

Table 9. Summary of sensitive species observed at the Number Nine Wind Farm during raptor migration surveys (RMS) and as incidental observations (Inc.)

		RMS		Inc.		Total	
Species	**Status**	**Groups**	**Individuals**	**Groups**	**Individuals**	**Groups**	**Individuals**
white-throated sparrow	SSSC	0	0	34	61	34	61
bald eagle	ST, EA	28	29	1	1	29	30
chestnut-sided warbler	SSSC	0	0	9	12	9	12
American redstart	SSSC	0	0	3	4	3	4
black-and-white warbler	SSSC	0	0	4	4	4	4
Tennessee warbler	SSSC	0	0	1	1	1	1
northern harrier	SSSC	1	1	0	0	1	1
Total		**29**	**30**	**52**	**83**	**81**	**113**

SSSC = state species of special concern; ST = state threatened; EA = Eagle – federally protected

Regional Raptor Migration Data

Hawk Migration Sites

Data from four HMANA sites in Maine were compiled where spring and fall migration counts were made in 2014 for comparison: two with available spring migration counts and two from the fall (Tables 10 and 11). The spring sites, Cooper and Bradbury Mountain State Park, are located approximately 150 miles and 280 miles (240.1 km and 450.6 km) south-southeast of the Project. Cooper and Bradbury Mountain State Park HawkWatch sites are both situated eight and 20 miles (13 and 32 km) west of the Atlantic Coast, while the Project is located approximately 150 miles west of the coast. The Cooper site has reported spring raptor migration data for four years and most recently from April 2 to April 22, 2014 (HWI 2014). The Bradbury Mountain State Park site has 11 years (509 days) of spring raptor migration data and was monitored most recently from March 14 to May 15, 2014 (HWI 2014).

The two nearest HMANA sites with fall 2014 data available for comparison were Clary Hill and Cadillac Mountain, Acadia National Park. Fall raptor migration counts were not conducted at Bradbury Mountain State Park in 2014. No comparable data were recorded at the Cooper site; observations were recorded on only two days that did not overlap with the raptor migration survey dates at the Project. The Clary Hill site is located approximately 170 miles (274 km) southwest of the Project and 12 miles (20 km) north and west of the Atlantic Coast. Data have been collected during the four most recent fall migration periods and most recently from August – November 2014 at Clary Hill. Cadillac Mountain. is located on a coastal island approximately 140 miles south-southwest of the Project. Recent available data from Cadillac Mt. includes data from 20 years of fall raptor migrations. The most recent data at Cadillac Mt. were collected from August – October, 2014.

At the spring sites, peak numbers of red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*B. lineatus*), and bald eagle were observed between late March and late April; Cooper's hawk (*Accipiter cooperii*) between mid-March and late April; northern harrier (*Circus cyaneus*) in mid-April; American kestrel (*Falco sparverius*) and merlin (*F. columbarius*) throughout April; and broad-winged hawk (*B. platypterus*) and sharp-shinned hawk (*A. striatus*) between mid-April and early May (unpublished data; HWI 2014).

At fall sites, peak numbers of sharp sharp-shinned hawk (*A. striatus*) and Cooper's hawk (*Accipiter cooperii*) were observed in September; broad-winged hawk (*B. platypterus*) and American kestrel (*Falco sparverius*) between mid-September and early October; northern harrier (*Circus cyaneus*) and merlin (*F. columbarius*) throughout September and October; bald eagle between mid-September and November; red-shouldered hawk in late October, and red-tailed hawk between mid-October and early November (unpublished data; HWI 2014).

Table 10. Daily number of raptor observations per observer hour for the Number Nine Wind Farm compared to nearby HawkWatch sites in Spring 2014[A].

Date	Number Nine	Hawkwatch Site	
		Bradury Mountain State Park, Pownal, Maine	Cooper, Maine
3/18/2014	0.00	3.50	-
3/19/2014	0.33	7.13	-
3/25/2014	0.17	8.13	-
3/26/2014	0.00	0.00	-
4/2/2014	0.50	12.43	-
4/3/2014	0.17	7.88	-
4/7/2014	1.83	24.00	0.25
4/11/2014	0.83	14.25	0.40
4/14/2014	1.83	139.67	-
4/18/2014	0.83	9.13	0.00
4/22/2014	0.00	11.88	2.67
4/23/2014	0.00	1.25	-
4/29/2014	0.00	13.75	-
4/30/2014	1.83	1.00	-
5/7/2014	1.60	8.24	-
5/8/2014	1.17	4.25	-
5/13/2014	1.33	2.00	-
5/14/2014	1.67	1.63	-
5/20/2014	0.00	-	-
5/23/2014	0.33	-	-
5/28/2014	0.00	-	-
5/29/2014	0.67	-	-
average	0.69	15.01	0.83

A= obtained from HMANA

Table 11. Daily number of raptor observations per observer hour for the Number Nine Wind Farm compared to nearby HawkWatch sites in Fall 2014[A].

Date	Number Nine	Hawkwatch Site [B]	
		Clary Hill, Maine	Cadillac Mt., Acadia National Park
9/3/2014	2.75	-	1.4
9/4/2014	2.13	-	0.4
9/9/2014	4.75	7.50	3.4
9/10/2014	3.38	-	0.4
9/15/2014	3.00	23.68	16.91
9/16/2014	0	-	-
9/22/2014	0.25	12.67	0.80
9/23/2014	0.38	133.71	9.80
9/30/2014	0.13	-	-
10/1/2014	0.13	-	6.77
10/7/2014	0.63	-	0.0
10/9/2014	0.63	-	0.53
10/15/2014	0	-	-
10/16/2014	0	-	0.0
10/21/2014	0.13	-	1.60
10/22/2014	0.75	-	-
10/28/2014	0	-	4.80
10/29/2014	0	-	-
10/30/2014	0.63	9.33	2.20
11/4/2014	0.43	3.09	-
11/5/2014	0.14	-	-
11/6/2014	0	-	-
11/13/2014	0.57	-	-
11/14/2014	0	-	-
11/15/2014	0.50	-	-
11/19/2014	0.17	-	-
11/20/2014	0.71	-	-
11/21/2014	0.14	-	-
11/25/2014	0.43	-	-
11/26/2014	0.25	-	-
12/1/2014	0	-	-
12/2/2014	0.14	-	-
12/3/2014	0	-	-
12/4/2014	0.33	-	-
average	0.69	45.84	8.28

A= obtained from HMANA

B = No fall data collected at Bradury Mountain State Park, Pownal, Maine site; No comparable observation dates recorded at Cooper, Maine site.

Other Regional Wind Projects

Other wind projects in Maine and in the northeast U.S. have conducted pre-construction studies for wildlife including raptor migration surveys (see Appendix E). The Mars Hill wind project is the closest existing wind project to the Number Nine Wind Farm site and is located roughly 12 miles to the northeast. Spring raptor migration surveys were conducted at Mars Hill on 10 days between April 12 and May 18, 2006 (Woodlot 2006b) and fall raptor migrator surveys were conducted on 8 days between September 9 and October 13, 2005 (Woodlot 2006a). Spring surveys were conducted from three survey stations and fall surveys from two survey stations along the primary north-south ridgeline in the project area. A total of 60.25 hours of survey were conducted over the 10 survey days in spring and 42.5 hours over the 8 days in the fall. In the spring, a total of 64 raptors and vultures were recorded for a mean of 1.06 birds per observer hour (Woodlot 2006b). In the fall, a total of 115 raptors and vultures were recorded for a mean of 1.52 birds per observer hour (Woodlot 2006a). The most abundant species observed in spring was osprey (22 individuals) followed by red-tailed hawk (11 individuals) and turkey vulture (11 individuals). In the fall, the most abundant species observed was sharp-shinned hawk (40 individuals) followed by red-tailed hawk (26 individuals).

The Oakfield wind project is located roughly 20 miles south-southwest of the Number Nine Wind Farm site. Spring raptor migration surveys were conducted at Oakfield on 12 days between April 25 and May 30, 2008 (Stantec 2009d) and on 12 days in the fall between August 26 and October 14, 2008 (Stantec 2009e). Surveys were conducted from one station on the summit of a mountain in the project area. A total of 79 hours of survey were conducted over the 12 survey days in spring and a total of 84 hours over the 12 days in the fall. In the spring, a total of 58 raptors and vultures were recorded for a mean of 0.73 raptors and vulture per observer hour (Stantec 2009d). In the fall, a total of 60 raptors and vultures were recorded for a mean of 0.70 birds per observed hour (Stantec 2009e). The most abundant species observed in the spring was turkey vulture (29 individuals) followed by broad-winged hawk (11 individuals) and red-tailed hawk (8 individuals). In the fall, the most abundant species observed was turkey vulture (27 individuals) followed by sharp-shinned hawk (8 individuals) and red-tailed hawk (8 individuals).

DISCUSSION AND IMPACT ASSESSMENT

The proposed Project is located in rolling hills and plains that are heavily impacted by industrial timber harvests. Elevations in the Project range from approximately 500 to 1,700 ft above sea level and there are no prominent north-south trending ridgelines. The Project is located approximately 150 miles west of the coast (bay at Miramich, Maine).

No sites with raptor migration count data exist in northeast Maine, and most (six of eight) HMANA sites located in Maine have only monitored raptor migration in the fall. The Cooper and Bradbury Mountain State Park Hawk Watch sites, located approximately 150 and 280 miles south-southeast of the Project, respectively, are the only sites in Maine that monitored spring raptor migration. These sites were monitored in the spring of 2014 but discontinued surveys by

mid-May which is typically near the end of spring raptor migration and typical of most hawk watch sites. Both of these HMANA sites are located relatively close to the coast and are approximately six and 20 miles west of the Gulf of Maine, respectively. Spring raptor migration data from these coastal sites and the Project site may not be directly comparable due to these location differences, but data suggest that coastal site locations generally have higher concentrations of migrating raptors than compared inland sites (see Table 10).

For the fall raptor migration, data were compared with fall 2014 counts from the two nearest HMANA sites with dates available for comparison: Clary Hill and Cadillac Mountain, Acadia National Park. Clary Hill is located within 12 miles of the coast, while the Cadillac Mountain site is located on a coastal island within two miles of the shore. Both sites are located approximately 130 miles (209 km) to the southwest of the Project. Data from both fall HMANA raptor migration count sites showed average raptor counts per hour were many times greater than those observed at the Project and may indicate a lack of high migration activity at the Project even when taking into account the assumed concentration of raptors at these coastal comparison sites (see Table 11). Overall, the data suggest that in general there is much less raptor migration through the Project than areas where migrant raptors may be more typically concentrated.

The raptor migration results were also compared to 2008 results for Project (see Appendix D) and to other nearby wind project sites in Maine with available spring and fall raptor migration data, specifically the Mars Hill and Oakfield wind projects. In the spring of 2008, the overall raptor and vulture passage rate at the Project was 0.55 birds per observer-hour. The spring raptor and vulture passage rate at the Mars Hill project was 1.06 birds per observer hour and at the Oakfield project was 0.73 birds per observer hour. In the fall 2008, the overall raptor and vulture passage rate at the Project was 0.46 birds per observer-hour. The fall raptor and vulture passage rate at Mars Hill was 1.52 birds per observer-hour and at Oakfield it was 0.7 birds per observer-hour. The raptor and vulture passage rate estimates at the Project in 2014, 0.77 birds per observer hour in the spring and 0.67 in the fall, were similar to these other regional data. Results of the two years of study at the Project suggest that the site does not experience any large movement or concentration of raptor migration.

Overall, results of the 2014 surveys, and those from 2008, did not record substantial raptor migration through the Project. Passage rates expressed as the number of raptors per observer-hour, a comparable metric to typical raptor migration surveys of established raptor monitoring organizations (HMANA, HWI), was less than one per hour or roughly one raptor every three hours of observation. Topographic and physiographic features of the site do not appear to be conducive to concentrating migrant raptors in space and time. In addition, raptor mortality recorded at wind projects in the Northeastern U.S. has generally been low, with some monitored facilities recording no raptor mortality (see Appendix F for a summary of northeastern U.S. monitoring studies). Overall, the average number of raptor fatalities per MW as based on monitoring studies at wind projects throughout the Northeast U.S. has been 0.057 with a range from 0 to 0.59 fatality per MW (Appendix E). The median value for raptor fatalities among all the monitoring studies in the Northeast is 0.01 fatality per MW, or roughly one raptor fatality for

every 100 MW of wind power. For Projects that also had raptor use or passage rates determined pre-construction, raptor fatality rates post-construction ranged from 0 to 0.10 fatality per MW (Appendix E). Provided the Project is similar to the other wind projects with similar use estimates, then it could be expected that on average between 0 and 0.01 raptor fatalities per MW may occur at the site or between approximately 0 and 2.5 raptor fatalities per year.

The Project as proposed in this area is not expected to expose substantial numbers of migrant raptors to risks. The low exposure and expected low impacts in general, based on results from northeastern monitoring studies, do not suggest the Project would result in impacts greater than any other wind project in the region and in fact would likely be on the low end of the range.

REFERENCES

Arnett, E. B., M. R. Schirmacher, C. D. Hein, and M. M. P. Huso. 2011. Patterns of Bird and Bat Fatality at the Locust Ridge II Wind Project, Pennsylvania. 2009-2010 Final Report. Prepared for the Bats and Wind Energy Cooperative (BWEC) and the Pennsylvania Game Commission (PGC). Prepared by Bat Conservation International (BCI), Austin, Texas. January 2011.

Arnett, E. B., M. R. Schirmacher, M. M. P. Huso, and J. P. Hayes. 2009. Effectiveness of Changing Wind Turbine Cut-in Speed to Reduce Bat Fatalities at Wind Facilities: 2008 Annual Report. Prepared for the Bats and Wind Energy Cooperative (BWEC) and the Pennsylvania Game Commission. Bat Conservation International (BCI), Austin, Texas. April 2009. http://www.batsandwind.org/pdf/Curtailment_2008_Final_Report.pdf

Arnett, E. B., M. R. Schirmacher, M. M. P. Huso, and J. P. Hayes. 2010. Patterns of Bat Fatality at the Casselman Wind Project in South-Central Pennsylvania. 2009 Annual Report. Annual report prepared for the Bats and Wind Energy Cooperative (BWEC) and the Pennsylvania Game Commission. Bat Conservation International (BCI), Austin, Texas. January 2010.

Bald and Golden Eagle Protection Act (BGEPA). 1940. 16 United States Code (USC) § 668-668d. Bald Eagle Protection Act of 1940, June 8, 1940, Chapter 278, § 2, 54 Statute (Stat.) 251; Expanded to include the related species of the golden eagle October 24, 1962, Public Law (P.L.) 87-884, 76 Stat. 1246. As amended: October 23, 1972, P.L. 92-535, § 2, 86 Stat. 1065; Nov. 8, 1978, P.L. 95-616, § 9, 92 Stat. 3114.

Bibby, C. J., N. D. Burgess, and D. A. Hill. 1992. Bird Census Techniques. Academic Press, New York. 257 pp.

ESRI. 2014. Geographic Information System (GIS) Online Topographic Base Map. ESRI, producers of ArcGIS software. Redlands, California.

Hawk Migration Association of North America (HMANA) website. HawkWatch Site Profiles and Hawk Count Summaries. http://www.hmana.org/sitesel.php

HawkWatch International (HWI) website. Accessed August 2014. Homepage available online at: http://www.hawkwatch.org. Site profile and count data for Cooper, Maine, available online at: https://hawkcount.org/siteinfo.php?rsite=718; For the Bradbury Mountain State Park: https://hawkcount.org/siteinfo.php?rsite=616

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, A. Fuerst, and C. Hansen. 2009a. Annual Report for the Noble Ellenburg Windpark, LLC, Postconstruction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC by Curry and Kerlinger, LLC. April 13, 2009.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Histed, and J. Meacham. 2009b. Annual Report for the Noble Clinton Windpark, LLC, Postconstruction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC by Curry and Kerlinger, LLC. April 13, 2009.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, and M. Lehman. 2009c. Maple Ridge Wind Power Avian and Bat Fatality Study Report - 2008. Annual Report for the Maple Ridge Wind Power Project, Post-construction Bird and Bat Fatality Study - 2008. Prepared for Iberdrola Renewables, Inc, Horizon Energy, and the Technical Advisory Committee (TAC) for the Maple Ridge Project Study. Prepared by Curry and Kerlinger, LLC. May 14, 2009.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Quant, and D. Pursell. 2009d. Annual Report for the Noble Bliss Windpark, LLC, Postconstruction Bird and Bat Fatality Study - 2008. Prepared for Noble Environmental Power, LLC by Curry and Kerlinger, LLC. April 13, 2009.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, A. Fuerst, and A. Harte. 2010a. Annual Report for the Noble Bliss Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. March 9, 2010.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and A. Harte. 2011a. Annual Report for the Noble Wethersfield Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. January 22, 2011.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2010b. Annual Report for the Noble Clinton Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. March 9, 2010.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2010c. Annual Report for the Noble Ellenburg Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2009. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. March 14, 2010.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2011b. Annual Report for the Noble Altona Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. January 22, 2011.

Jain, A., P. Kerlinger, L. Slobodnik, R. Curry, and K. Russell. 2011c. Annual Report for the Noble Chateaugay Windpark, LLC: Postconstruction Bird and Bat Fatality Study - 2010. Prepared for Noble Environmental Power, LLC. Prepared by Curry and Kerlinger, LLC, Cape May, New Jersey. January 22, 2011.

Kerns, J. and P. Kerlinger. 2004. A Study of Bird and Bat Collision Fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. February 14, 2004. 39 pp. http://www.wvhighlands.org/Birds/MountaineerFinalAvianRpt-%203-15-04PKJK.pdf

Maine Department of Inland Fisheries and Wildlife (MDIFW). 2009. State List of Endangered and Threatened Species. September 12, 2009. Available online at: http://www.maine.gov/ifw/wildlife/endangered/listed_species_me.htm

Maine Department of Inland Fisheries and Wildlife (MDIFW). 2011. Species of Special Concern. March 1, 2011. Available online at: http://www.maine.gov/ifw/wildlife/endangered/specialconcern.htm

National Geographic Society (National Geographic). 2014. World Maps. Digital Topographic Map.

National Land Cover Database (NLCD). 2011. National Land Cover Database NLCD, Mulit-Resolution Land Characteristics Consortium (MRLC). US Geological Survey (USGS) Earth Resources Observation and Science (Eros) Center, Sioux Falls, South Dakota. Information available online at: http://www.mrlc.gov/nlcd11_leg.php

Normandeau Associates, Inc. 2010. Stetson Mountain II Wind Project Year 1 Post-Construction Avian and Bat Mortality Monitoring Study, T8 R4 NBPP, Maine. Prepared for First Wind, LLC, Portland, Maine. Prepared by Normandeau Associates, Inc., Falmouth, Maine. December 2, 2010.

Normandeau Associates, Inc. 2011. Year 3 Post- Construction Avian and Bat Casualty Monitoring at the Stetson I Wind Farm, T8 R4 NBPP, Maine. Prepared for First Wind Energy, LLC, Portland, Maine. Prepared by Normandeau Associates, Inc., Falmouth, Maine. December 2011.

North American Datum (NAD). 1983. NAD83 Geodetic Datum.

Reynolds, R. T., J. M. Scott, and R. A. Nussbaum. 1980. A Variable Circular-Plot Method for Estimating Bird Numbers. Condor 82(3): 309-313.

Stantec Consulting, Inc. (Stantec). 2008. 2007 Spring, Summer, and Fall Post-Construction Bird and Bat Mortality Study at the Mars Hill Wind Farm, Maine. Prepared for UPC Wind Management, LLC, Cumberland, Maine. Prepared by Stantec (formerly Woodlot Alternatives, Inc.), Topsham, Maine. January 2008.

Stantec Consulting, Inc. (Stantec). 2009a. Post-Construction Monitoring at the Mars Hill Wind Farm, Maine - Year 2, 2008. Prepared for First Wind Management, LLC, Portland, Maine. Prepared by Stantec Consulting, Topsham, Maine. January 2009.

Stantec Consulting, Inc. (Stantec). 2009b. Post-Construction Monitoring at the Munnsville Wind Farm, New York: 2008. Prepared for E.ON Climate and Renewables, Austin, Texas. Prepared by Stantec Consulting, Topsham, Maine. January 2009.

Stantec Consulting, Inc. (Stantec). 2009c. Stetson I Mountain Wind Project: Year 1 Post-Construction Monitoring Report, 2009 for the Stetson Mountain Wind Project in Penobscot and Washington Counties, Maine. Prepared for First Wind Management, LLC. Portland, Maine. Prepared by Stantec, Topsham, Maine. January 2009.

Stantec Consulting (Stantec). 2009d. 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 Portland, Maine. Prepared by: Stantec Consulting, Topsham, Maine. January 2009.

Stantec Consulting (Stantec). 2009e. Fall 2008 Bird Migration Survey Report Radar and Visual Surveys for the Oakfield Wind Project in Oakfield, Maine. Prepared for: First Wind Management, LLC Portland, Maine. Prepared by: Stantec Consulting, Topsham, Maine. January 2009

Stantec Consulting, Inc. (Stantec). 2010. Cohocton and Dutch Hill Wind Farms Year 1 Post-Construction Monitoring Report, 2009, for the Cohocton and Dutch Hill Wind Farms in Cohocton, New York. Prepared for Canandaigua Power Partners, LLC and Canandaigua Power Partners II, LLC, Portland, Maine. Prepared by Stantec, Topsham, Maine. January 2010.

Stantec Consulting, Inc. (Stantec). 2011. Cohocton and Dutch Hill Wind Farms Year 2 Post-Construction Monitoring Report, 2010, for the Cohocton and Dutch Hill Wind Farms in Cohocton, New York. Prepared for Canandaigua Power Partners, LLC, and Canandaigua Power Partners II, LLC, Portland, Maine. Prepared by Stantec, Topsham, Maine. October 2011.

Tidhar, D., L. McManus, Z. Courage, and W. L. Tidhar. 2012a. 2010 Post-Construction Fatality Monitoring Study and Bat Acoustic Study for the High Sheldon Wind Farm, Wyoming County, New York. Final Report: April 15 - November 15, 2010. Prepared for High Sheldon Wind Farm, Sheldon Energy LLC, Chicago, Illinois. Prepared by Western EcoSystems Technology, Inc. (WEST), Waterbury, Vermont. April 15, 2012.

Tidhar, D., L. McManus, D. Solick, Z. Courage, and K. Bay. 2012b. 2011 Post-Construction Fatality Monitoring Study and Bat Acoustic Study for the High Sheldon Wind Farm, Wyoming County, New York. Final Report: April 15 - November 15, 2011. Prepared for High Sheldon Wind Farm, Sheldon Energy LLC, Chicago, Illinois. Prepared by Western EcoSystems Technology, Inc. (WEST), Waterbury, Vermont. April 25, 2012.

Tidhar, D., M. Sonnenberg, and D.P. Young, Jr. 2013. 2012 Post-Construction Carcass Monitoring Study for the Beech Ridge Wind Farm, Greenbrier County, West Virginia. Final Report: April 1 - October 28, 2012. Prepared for Beech Ridge Wind Farm, Beech Ridge Energy, LLC, Chicago, Illinois. Prepared by Western EcoSystems Technology, Inc. (WEST), NE/Mid-Atlantic Branch, Waterbury, Vermont. January 18, 2013.

Tidhar, D., W. Tidhar, and M. Sonnenberg. 2010. Post-Construction Fatality Surveys for Lempster Wind Project, Iberdrola Renewables. Prepared for Lempster Wind, LLC, Lempster Wind Technical Advisory Committee, and Iberdrola Renewables, Inc. Prepared by Western EcoSystems Technology Inc. (WEST), Waterbury, Vermont. September 30, 2010.

Tidhar, D., W. L. Tidhar, L. McManus, and Z. Courage. 2011. 2010 Post-Construction Fatality Surveys for the Lempster Wind Project, Lempster, New Hampshire. Prepared for Iberdrola Renewables, Inc. and the Lempster Wind Technical Committee. Prepared by Western EcoSystems Technology, Inc., Waterbury, Vermont. May 18, 2011.

US Environmental Protection Agency (USEPA). 2007. Level III and IV Ecoregions. National Health and Environmental Effects Research Laboratory, USEPA. Available online at http://www.epa.gov/wed/pages/ecoregions.htm; Level III and Level IV ecoregion data of the continental United States available at http://www.epa.gov/wed/pages/ecoregions/level_iii.htm and http://www.epa.gov/wed/pages/ecoregions/level_iv.htm

US Geological Survey (USGS). 2014. The National Map/US Topo. Last updated January 5, 2014. Homepage available at: http://nationalmap.gov/ustopo/index.html

US Geological Survey (USGS) National Land Cover Database (NLCD). 2006. Land Use/Land Cover, USGS NLCD 2001 Data. USGS Headquarters, USGS National Center. Reston, Virginia. http://www.mrlc.gov/nlcd2006.php

US Geological Survey (USGS) National Land Cover Database (NLCD). 2009. Completion of the National Land Cover Database (NLCD) 1992–2001 Land Cover Change Retrofit Product: US Geological Survey Open-File Report 2008–1379. 18 pp.

Woodlot Alternatives, Inc. (Woodlot) 2006a. 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. Prepared By: Woodlot Alternatives, Inc. March 2006

Woodlot Alternatives, Inc. (Woodlot) 2006b. 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. Prepared By: Woodlot Alternatives, Inc. September 2006

Woodlot Alternatives, Inc. (Woodlot) 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 Windpower, LLC. Prepared By: Woodlot Alternatives, Inc. March 2006

Young, D.P. Jr., K. Bay, S. Nomani, and W. Tidhar. 2009. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: March - June 2009. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. August 17, 2009.

Young, D.P. Jr., K. Bay, S. Nomani, and W. Tidhar. 2010a. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: April - July 2010. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. August 27, 2010.

Young, D.P. Jr., K. Bay, S. Nomani, and W. Tidhar. 2010b. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: July - October 2009. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. February 12, 2010.

Young, D.P. Jr., M. Lout, Z. Courage, S. Nomani, and K. Bay. 2012a. 2011 Post-Construction Monitoring Study, Criterion Wind Project, Garrett County, Maryland: April - November 2011. Prepared for Criterion Power Partners, LLC, Oakland, Maryland. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming, and Waterbury, Vermont. April 20, 2012. Revised November 25, 2013.

Young, D.P. Jr., S. Nomani, Z. Courage, and K. Bay. 2011a. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: April - July 2011. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. August 29, 2011.

Young, D.P. Jr., S. Nomani, Z. Courage, and K. Bay. 2012b. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: July - October 2011. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. February 27, 2012.

Young, D.P. Jr., S. Nomani, W. Tidhar, and K. Bay. 2011b. Nedpower Mount Storm Wind Energy Facility, Post-Construction Avian and Bat Monitoring: July - October 2010. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology (WEST), Inc., Cheyenne, Wyoming. February 10, 2011.

Appendix A. Raptor Migration Survey Protocol and Datasheets

Number Nine Wind Farm,
Aroostook County, Maine
Raptor Migration Survey Protocol

Prepared for:

EDP Renewables North America LLC
Development - Eastern Region
52 James Street, 4th Floor
Albany, New York

Prepared by:

Western EcoSystems Technology, Inc.
415 W. 17th Street
Cheyenne, Wyoming

TABLE OF CONTENTS

1.0 INTRODUCTION AND BACKGROUND

Number Nine Wind Farm LLC, a subsidiary of EDPR Renewables North America LLC, (EDPR) has proposed a wind energy facility in Aroostook County, Maine, referred to as the Number Nine Wind Farm (Project). Pre-project studies of wildlife resources at the Project have been conducted in 2008 and 2013. Previous surveys have included avian point counts for raptors and all birds, breeding bird surveys, marine radar survey for nocturnal migrants, bat acoustic surveys, sensitive species surveys, and eagle observation surveys. The following survey protocol is for conducting raptor migration surveys at the Project. The overall purpose of the surveys is to provide data useful in evaluating the potential risk and impacts that the development of a wind energy facility might have on migrating raptors in the area.

The protocol is based largely on recommendations and guidelines from the U.S. Fish and Wildlife Service (USFWS) and Maine Department of Inland Fisheries and Wildlife (MDIFW). Specifically, the USFWS Wind Energy Guidelines (WEG) (USFWS 2012) and Eagle Conservation Plan Guidance (ECPG) (USFWS 2013) and the MDIFW Wind Power Preconstruction Study Recommendations (MDIFW 2013) were referenced in developing the survey protocol.

2.0 STUDY AREA

The Project is located in Aroostook County, in northeastern Maine, approximately eight miles (13 kilometers [km]) west of the town of Bridgewater (Figure 1). The Project is located in the Laurentian Plains and Hills Ecoregion in northeastern Maine (USEPA 2007). The Laurentian Plains and Hills are characterized by spruce-fir forests with some patches of deciduous trees interspersed with glacial lakes. Land within the Project is privately owned and the primary land use is timber harvest. Elevations in the project area range from approximately 500 to 1,700 feet (ft; 152 to 518 meters [m]) above sea level. The dominant vegetation type is mixed spruce-fir and deciduous forest. Common deciduous trees in the Project include maple (*Acer* spp.), beech (*Fagus* spp.), and birch (*Betula* spp.).

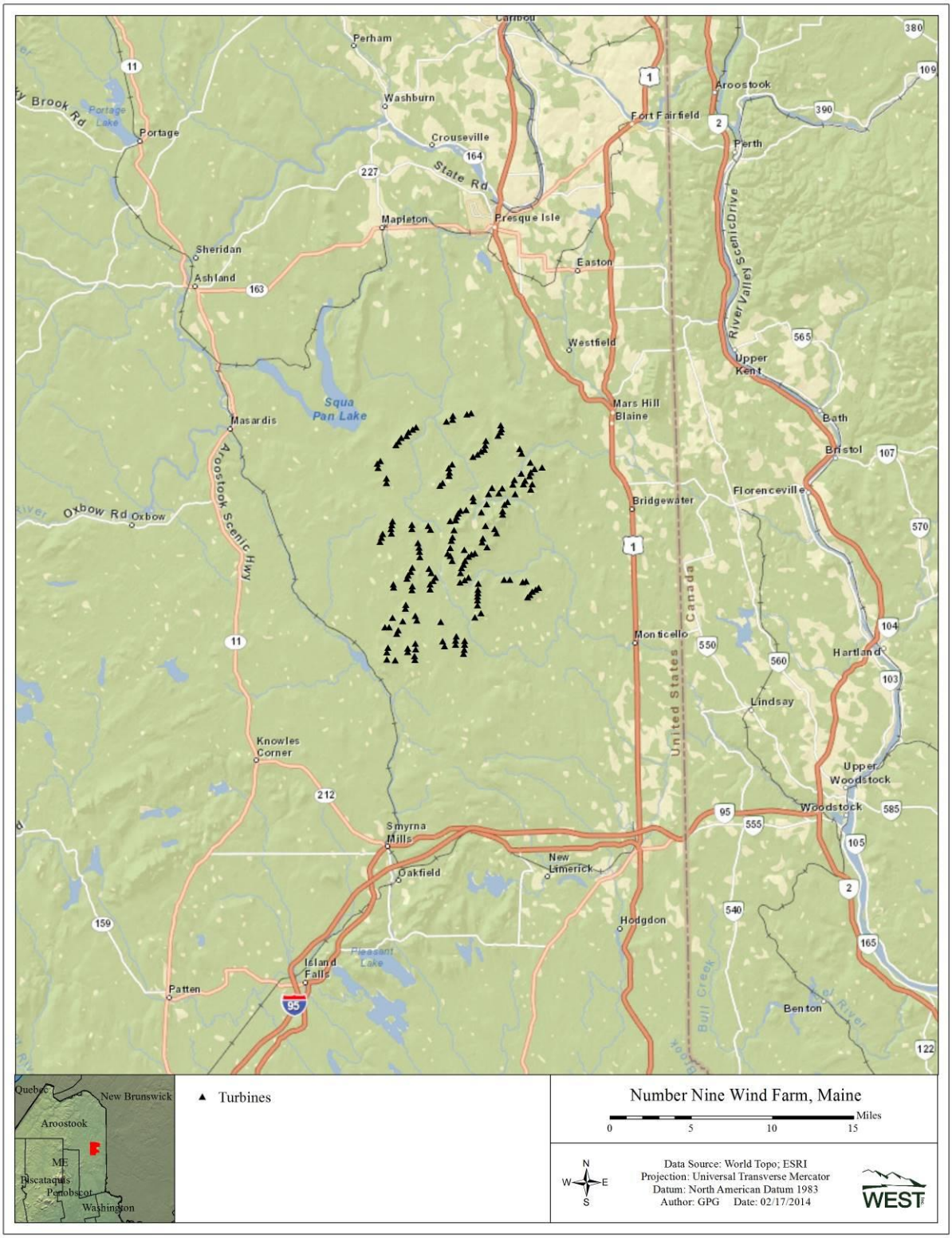


Figure 1. Location of the Number Nine Wind Farm.

The area within a 2-mile (3.2-kilometer [km]) buffer around the proposed turbine layout, is approximately 132,000 acres (206.7 square miles [mi^2]; 535.3 square km [km^2]) and is composed mostly of forest (75.4%; Table 1, Figure 2). Within the forest types are mixed forest (38.2%), deciduous forest (19.2%), and evergreen forest (18.0%; Figure 2, Table 1). Woody wetlands (11.6%) also occur throughout the Study Area, but other wetland types (open water [0.5%] and emergent wetlands [0.2%]) are uncommon. Shrub/scrub habitat (10.4%) is common throughout the Study Area due to logging activity that has removed the forest cover. The area and regional forests are transitional and in various stages of growth (from regenerating stands to mature forest) due to past and ongoing commercial logging activity.

Table 1. The land cover types, coverage, and percent composition within a two mile buffer of the proposed Number Nine Wind Farm turbines.

Habitat	Square Miles	Percent Composition
Mixed Forest	78.85	38.2
Deciduous Forest	39.78	19.2
Evergreen Forest	37.13	18.0
Woody Wetlands	24.07	11.6
Shrub/Scrub	21.41	10.4
Herbaceous	2.73	1.3
Barren Land	1.00	0.5
Open Water	0.95	0.5
Emergent Herbaceous Wetlands	0.43	0.2
Developed, Open Space	0.20	0.1
Hay/Pasture	0.11	0.1
Cultivated Crops	0.01	<0.1
Developed, Low Intensity	<0.01	<0.1
Developed, Medium Intensity	<0.01	<0.1
Total	**206.67**	**100**

Data from US Geological Survey National Landcover Dataset (USGS NLCD 2009).

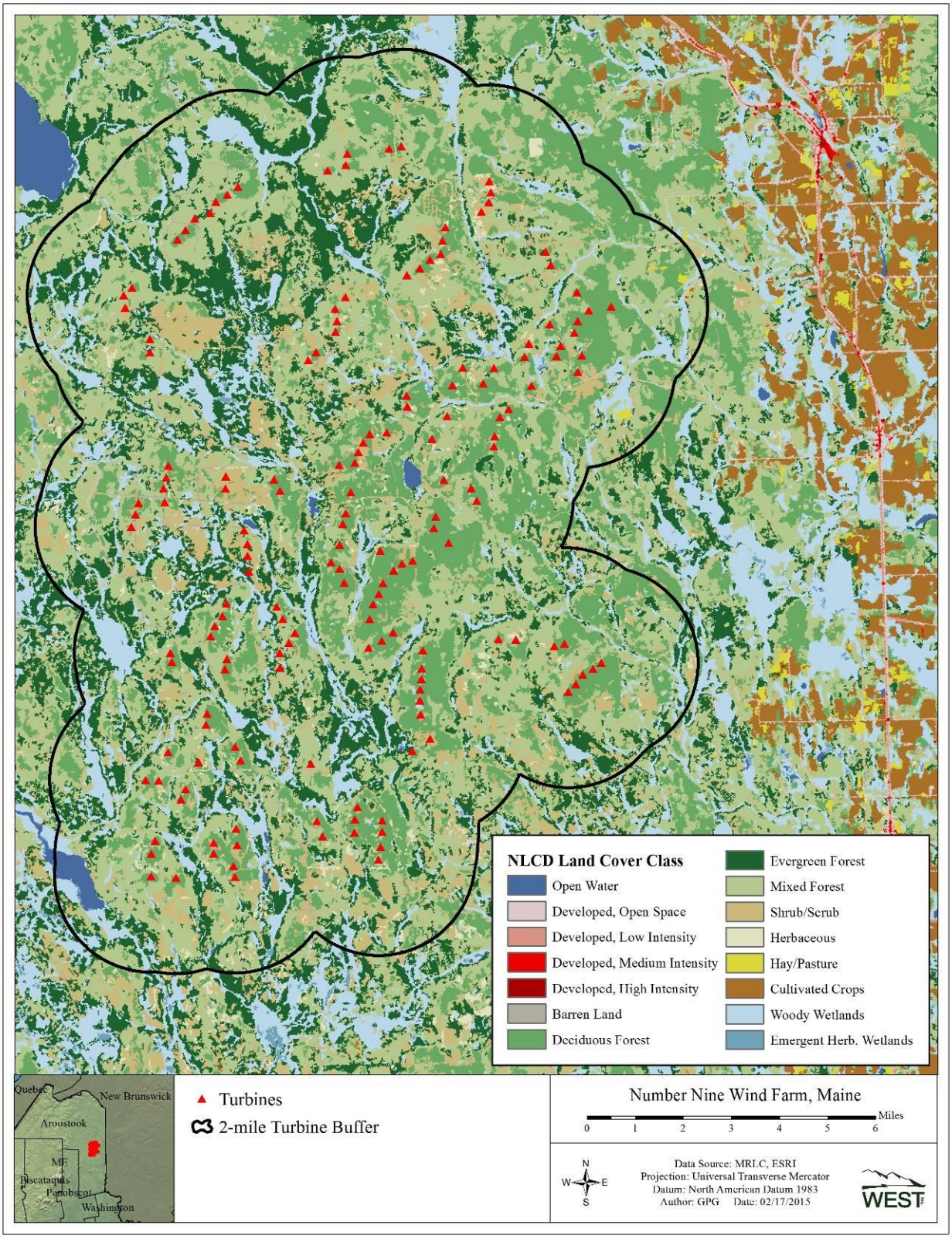


Figure 2. Overview and land cover types and coverage within the Number Nine Wind Farm.

3.0 METHODS

3.1 Raptor Migration Surveys

The objective of the raptor migration survey (RMS) is to estimate the spatial and temporal use of the Project by migrant raptors and vultures. Point count surveys (similar to Reynolds et al. 1980, Bibby et al. 1992) will be conducted within the Project according to methods used by the Hawk Migration Association of North America (HMANA), with an observer continuously scanning the sky and surrounding area for raptors in an unlimited viewshed around the observation point. The emphasis of the RMS is locating and counting raptors migrating through the Project area.

3.1.1 Survey Plot

One survey point will be established each season within the Project to survey for migrant raptors, in the same general location on Number Nine Mountain as previous raptor migration survey efforts conducted in 2008 (Figure 3). The point location will be selected to provide good visual coverage with the best view to the south in the spring and to the north in the fall. This is to provide maximal visibility over long distances in the direction in which the prevailing migration would be coming from.

3.1.2 Survey Methods

Data recorded for each survey will include the date, start and end time of each observation period, and weather information such as temperature (degrees Fahrenheit [°F]), wind speed (miles per hour [mph]), wind direction, and cloud cover (percent). Data recorded for each raptor or vulture observation will include the time of the observation, species or best possible identification, number of individuals, sex and age class (if possible), distance from the survey point when first observed (m), closest distance (m), approximate flight height or altitude above ground (m), approximate flight direction, behavior or activity, and vegetation types(s) over or in which the raptor was observed (see attached data sheet example). All raptors observed during the survey will be assigned a unique observation number and plotted on a map, regardless of distance from observer, to show location relative to the Project area. Approximate flight direction or flight paths and perch locations, if any, will be mapped for all raptors seen. The behavior and vegetation will be recorded based on the point of initial observation. Behavior categories include perched, soaring, flapping, hunting, gliding, hovering, auditory, and other (noted in comments). Vegetation types include shrub/scrub, mixed forest, deciduous forest, spruce/fir forest, woody wetland, and other (noted in comments). The approximate flight height and distance from the point at first observation will be recorded to the nearest 5-m interval. Any comments or unusual observations will be noted in the comments section.

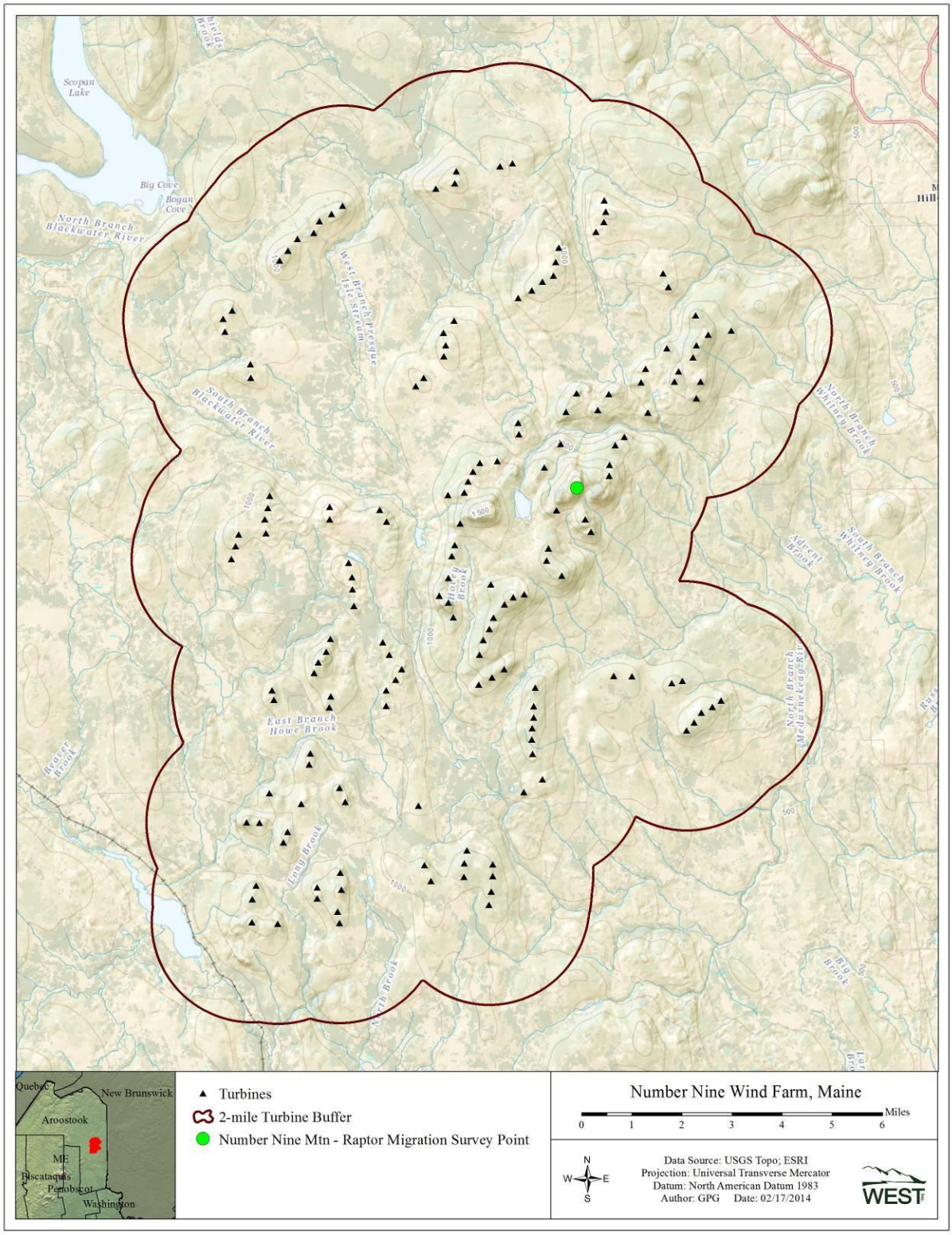


Figure 3. Approximate location of the raptor migration survey point within the Number Nine Wind Farm.

3.1.3 Observation Schedule

Surveys will be conducted approximately twice per week during the spring and fall study periods. Survey periods will be approximately six hours per survey day, between the hours of 9:00 am and two hours before sunset, or to 6:00 pm if raptors are still active, to cover the period when migrating raptors are most likely. To the extent practical, surveys will be conducted on days when weather conditions are conducive to raptor migration (i.e., warm, clear, high pressure conditions).

The spring survey period will be the months of March through May; the fall survey period will be the months of September through early-December. These are the periods when most raptors will be actively migrating and minimize the influence from recording resident raptors that may breed in the Project area.

3.2 Incidental Observations

The focus of the surveys will be recording migrant raptors and vultures moving through the Project; however, observations of other birds and other wildlife that are observed during the surveys or while the observer is in the Project area traveling to the survey point will also recorded. The objective of incidental wildlife observations is to provide a record of other wildlife seen in the Project area and/or outside of the standardized surveys.

3.3 Regional Hawk Migration Data

Existing raptor migration data from sources such as the Hawk Migration Association of North America (HMANA), Hawk Watch International (HWI), and studies of other wind energy projects will be investigated to locate regional sites and data for comparing the relative magnitude of raptor migration through the Project with areas of known raptor migration and other wind power developments. For the raptor migration sites, data from the same survey period and survey data will be used for comparison to help control for variation and trends in overall raptor populations that could influence the magnitude of regional raptor migration. Data from other wind projects will be used to compare the relative magnitude of raptor migration with sites where impacts to raptors have been monitored, to the extent possible.

4.0 DATA ANALYSIS AND REPORTING

4.1 Quality Assurance/Quality Control

Quality assurance and quality control measures will be implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. At the end of each survey each field technician will be responsible for inspecting his/her data forms for completeness, accuracy, and legibility. The project manager will review data forms to insure completeness and any problems detected will be addressed at that time. Any changes to data forms will be initialed and dated by the person making the change. Records from the electronic database will be compared to the raw data forms and any errors detected will be corrected. Any irregular codes, or data deemed questionable, will be discussed with the field technician and project manager. Errors or suspect data identified in later stages of analysis will be traced back to the raw data forms, and appropriate changes in all steps made as needed.

4.2 Data Compilation and Storage

Electronic databases will be established to store, retrieve and organize field observations. Data from field forms will be keyed into electronic data files using a pre-defined format that will make subsequent data analysis straightforward. All field data forms, field notebooks, and electronic data files will be retained for future reference.

4.3 Statistical Analysis

4.3.1 Raptor Diversity and Species Richness

Raptor diversity will be represented by species lists (with the number of individuals and number of groups) for each season and will include all observations of birds detected, regardless of their distance from the observer. In some cases, the tally of observations may represent repeated sightings of the same individual. Species richness will be calculated by counting the number of species observed during a survey then averaging across the number of survey periods.

4.3.2 Raptor Use, Percent of Use, and Frequency of Occurrence

For raptor migration surveys, observations of birds detected within an unlimited viewshed are used in the analysis. Mean raptor use is defined as the mean number of raptor observations recorded per observer-hour. Mean use is calculated by counting the number of raptors observed from the point during a survey and then averaging by the number of hours in the survey and then averaging across the number of survey periods.

Percent of use is calculated as mean use of a particular species divided by the total use for all species observed during the study. Frequency of occurrence for each species is calculated as the percent of surveys in which a particular species is recorded. Frequency of occurrence and percent of use provide relative estimates of risk to species recorded. For example, a species that migrates in large groups over an area may have a relatively high percent of use. However, examining the percent of use alone would not account for the acute exposure to the facility associated with a small number of very large flocks (low frequency of occurrence). A high percent of use may indicate that a species has higher exposure relative to other species, but when the exposure is short-term, the species may be less likely affected. Conversely, a species that has a relatively low percentage of use, but a relatively high frequency of occurrence would have greater long-term exposure to the facility. Exposure to facility infrastructure is more accurately assessed by evaluating both percent of use and frequency of occurrence.

4.3.3 Raptor Flight Height and Behavior

The approximate flight height recorded at the location where a bird is first observed within 800m of the point is used to calculate mean flight height and the percentage of birds observed flying within the rotor swept height (RSH), the zone where it could be exposed to turbine blades or approximately 25 to 150 m [82 to 492 ft] above ground level. This area corresponds to what is considered the zone of risk for many modern turbines and turbines potentially proposed for use at the Project.

4.3.4 Temporal Use

To investigate changes in use over time of day, mean use will be averaged across hour time blocks (e.g., 1000 – 1100 hours, 1100 – 1200 hours, etc.). This accounts for variation in survey effort among visits. For the study period, mean use during each time block of the survey day will be calculated for each raptor subtype and species to the extent possible. In addition, total number of raptors and vultures recorded on each survey day will be tallied to provide an indication of changes in abundance of migrating raptors over the seasonal period.

4.5 Reporting

The RMS will provide data for describing temporal and/or spatial use by raptors and vultures migrating through the Project. The data will be useful in evaluating potential impacts of the wind power development by identifying relative use estimates for species observed and comparing them to impacts recorded from monitoring studies at existing wind projects.

A written report following scientific report format will be prepared that includes an introduction, description of the methods, data analysis, results, and a discussion of the results for meeting study objectives, estimating potential impacts, and assisting with project planning, if warranted. If warranted based on the magnitude of migration, additional studies that may be necessary will be identified in the report. A draft report will be prepared for review following completion of the field surveys. The final report will be prepared following sequential review by EDPR and the agencies.

5.0 REFERENCES

Maine Department of Inland Fisheries and Wildlife (MDIFW). 2013 Wind Power Preconstruction Study Recommendations. Updated November 2013.

U.S. Fish and Wildlife Service (USFWS). 2012. U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines - Recommendations on Measures to Avoid, Minimize, and Compensate for Effects to Fish, Wildlife, and Their Habitats. http://www.fws.gov/windenergy/docs/Wind_Energy_Guidelines_2_15_2011FINAL.pdf

U.S. Fish and Wildlife Service (USFWS). 2013. Eagle Conservation Plan Guidance. Module 1 - Land-Based Wind Energy. Version 2. Division of Migratory Bird Management, USFWS. April 2013. Available online at: http://www.fws.gov/migratorybirds/Eagle_Conservation_Plan_Guidance-Module%201.pdf

RAPTOR AND LARGE BIRD MIGRATION DATA SHEET Project Name:_____ Page ___ of____

Point _____ Date:_____ Observer(s) _____ Start time _____ End time_____

WEATHER (see notes) Time:_____ WindSpeed(mph): _____ Low: _____ High: _____ Dir.:_____

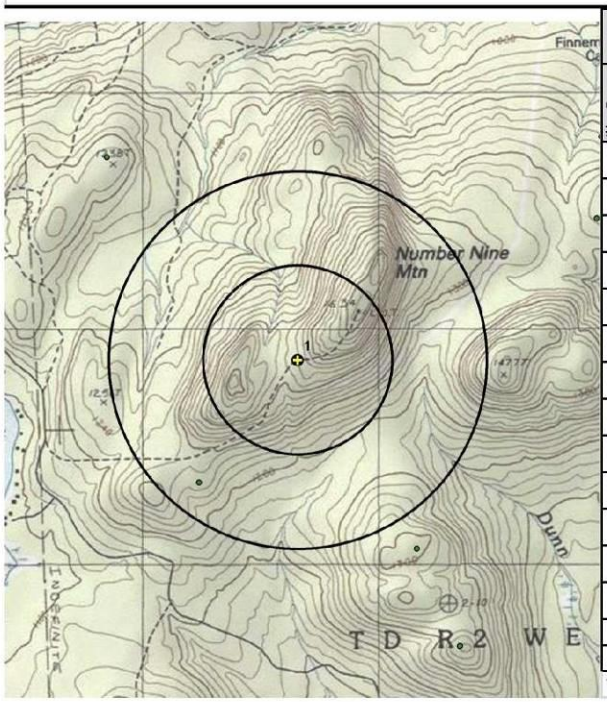
Temp(°F): _____ Cloud cover(%)_____ Max Visibility _____ Precip. (see notes) _____ Survey Duration(hr) _____

							dist (m) from obs					Flight Char.				
obs #	strt time	end time	species	# inds.	age	sex	1st dist	closest dist	Act 1st	Acts (2nd, 3rd, etc)	Aud only?	1st hght w/in 800 m	Dir	Habitat (1st, 2nd, 3rd; in order)	Map ?	Notes (use back if needed; indicate obs #)
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																
16																

activity codes: SO - soaring; FL - flapping-gliding; PE - perched; MOB - being mobbed; TER - undulating/territorial flight; AUD - auditory; OT-other, specify in notes; HU - hunting, kiting-hovering; ST - stooping/diving at prey; AG - stooping or diving agonistically w/other birds;

Habitat: (see instructions): SB - shrub; CR - cropland; GR - grassland; FR - forest/woodlot; RI - riparian; RO - rocky outcrop; WA - open water; OT -

Comments - (Incidental obs - list here and fill out incidental datasheet)



EAGLE OBS (update every min; instructions on back) use continuation DS if needed

obs #	time/min	Dist from obs: 1st / closest	1st Act	othr Act: 2nd/3rd/etc	Flt. Ht

*should match obs# from above tbl.

DIRECTIONS: Raptor and Large Bird Migration Survey Protocol

General: **(could vary by project)**

- Select raptor viewing point(s) that provides the best possible viewshed of the proposed Wind Resource Area.
- In the comments section, record GPS coordinates for the point(s) if changes or additions were made in the original location
- Follow methods similar to those used by HawkWatch International (HawkWatch 2007).
- Survey period (duration) at each point will vary by project.
- During surveys, each raptor, large bird, and sensitive status species should be identified to species or best possible identification. For sensitive species, check with PM or FS for details.

Header data:

- Weather: good, fair, poor; Wind direction: N NE E SE S SW W NW n/a ; Wind speed: (mph) enter in the average speed noting Lowest and High (gusts); Precipitation – Options= none, light rain, rain, light snow, snow, sleet, hail, other

Table data: Each observation should include the following data:

- **observation number** - Each observation is assigned a unique number
- **start time** when first observed and **end time** when last observed (to the best of your ability, without missing other birds)
- **Species** or best possible identification - Unknown species are appropriate (i.e. unknown raptor – UNRA)
- **Number of individuals**
- **Sex and age class** (if possible): M (male), F (female); A (adult), J (juvenile)
- **Distance from observer**: from plot center when **first observed and closest**
- **1st Activity:** enter code based on the activity first observed.
- **Other activities:** indicate any subsequent activities
- **Aud only?** - Check if the observation was auditory only
- **Flight characteristics:** Flight Height - Altitude above ground when first observed within 800-m of the survey point and Flight direction when first observed
- **Habitat –** will vary per project! See table for general codes. Indicate the habitat(s) or the vegetation type in which or over which the bird occurred based on the point **of first observation** within 800-m of the survey point. Check mark any additional habitats. E.G.: SB / CR / FR (in order of occurrence)
- **Map – (**see below too) if this is a species to be mapped, **c**heck mark on the table that you mapped it
- **Notes –** notes about the observation. If not enough room, indicate where note can be found
- **Comments -** Any comments about the general survey should be included in the comment section. **If any unusual observations are recorded in the comments section of the data sheet MUST be transcribed to the incidental datasheets.**

Map data:

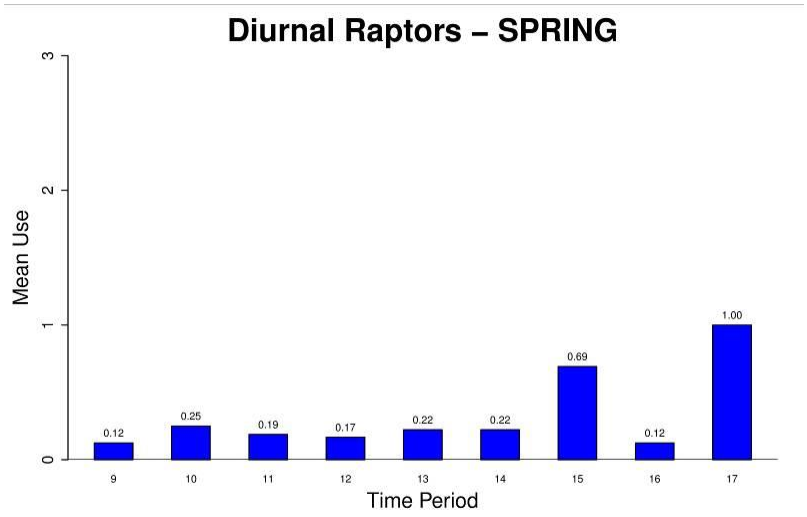
- Map all birds no matter distance. However, there are 800-m and 1600-m radius (project specific) buffers around the survey point in the above map.
- Plot the location of the flight path and/or perched locations of the raptors, large bird migrating species, and sensitive species that are observed within 1,600-m. Make sure to be aware of which species are to be mapped.
- Make sure to indicate observation number
- Check mark on the table if the bird was mapped on the **"Map?"** column in table
- **Clearly** mark perches with a "x" and flight paths with a line. Mark all activities the bird did.
- It is okay to use multiple/extra maps if your map is getting too crowded. Note which page in notes section.

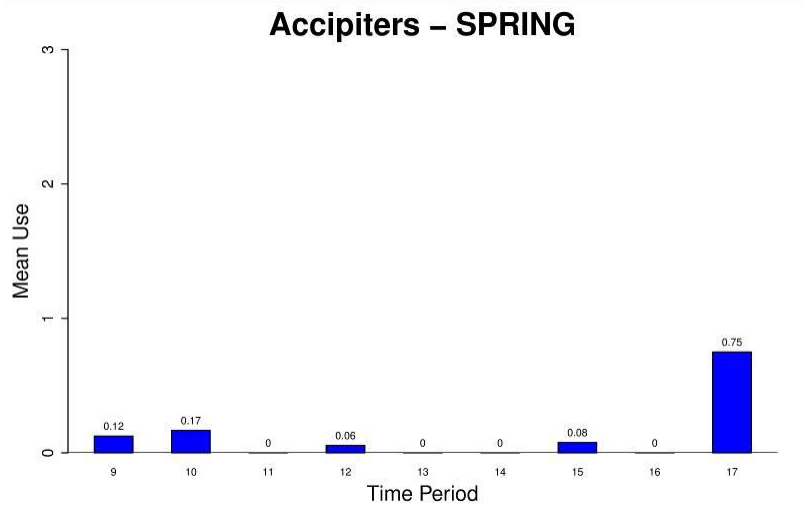
Eagle Obs Data table: **Update Information on GOEAs and BAEAs Every Minute.**

- Whenever an eagle is observed, record the observation number, the time of the initial sighting, distance from observer in meters, activity, and flight height in meters. At every minute after initial sighting, record the same information again until eagle is out of sight or the survey time ends. If more than one eagle is being tracked, be careful to record the correct observation number.
- If more than one eagle is being tracked, be careful to record the correct observation number.
- Use additional datasheets if needed but clearly note where information is to be found.

Notes Continued:

Appendix B. Temporal Use by Diurnal Raptors, Raptor Subtypes, and Vultures during Raptor Migration Surveys at the Number Nine Wind Farm from March 18 – December 4, 2014





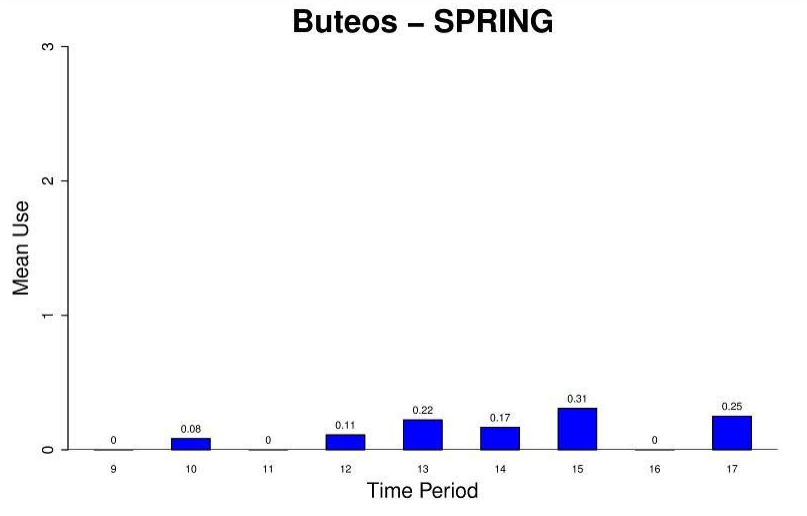
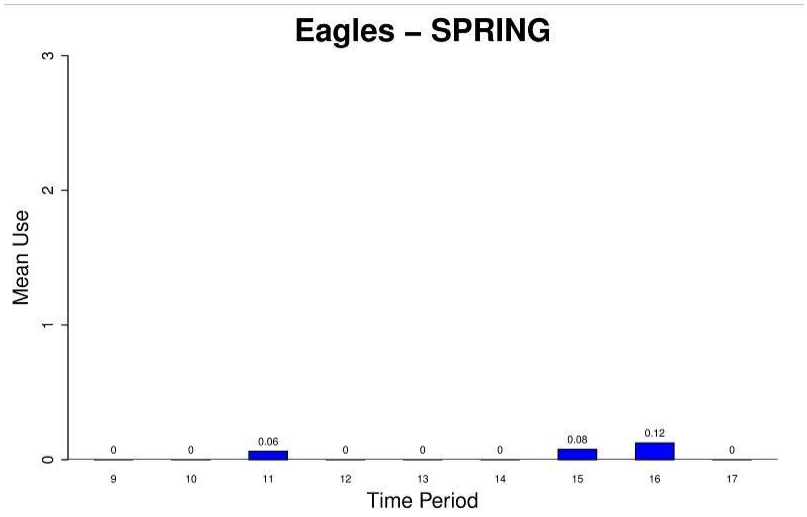
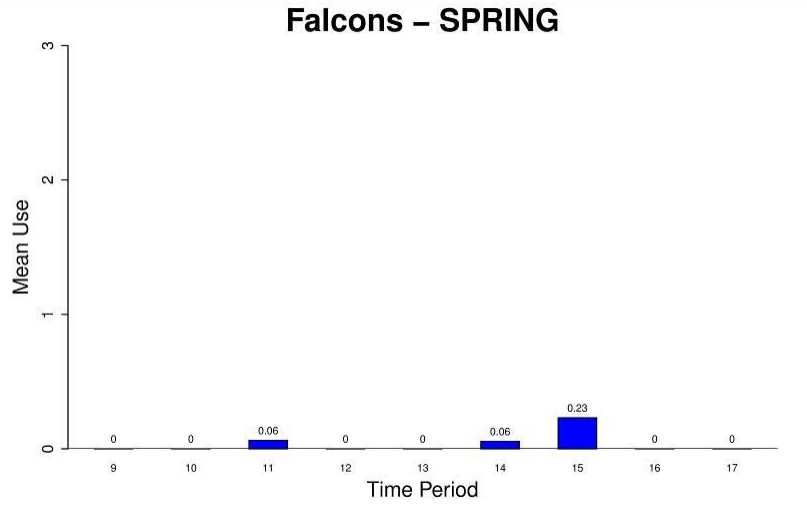


Figure B1. Mean use (number of birds/survey) by time period (hour) for the raptor migration surveys for diurnal raptors, raptor subtypes, and vultures at the Number Nine Wind Farm from March 18 – May 29, 2014.





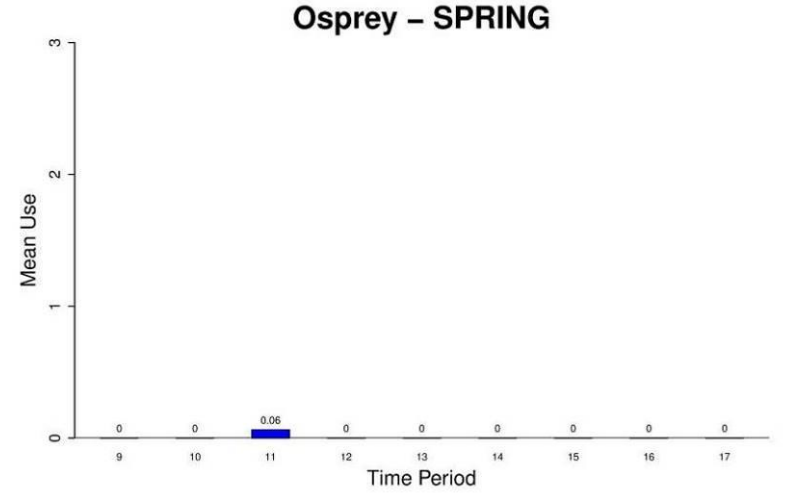


Figure B1 (*continued*). Mean use (number of birds/survey) by time period (hour) for the raptor migration surveys for diurnal raptors, raptor subtypes, and vultures at the Number Nine Wind Farm from March 18 – May 29, 2014.

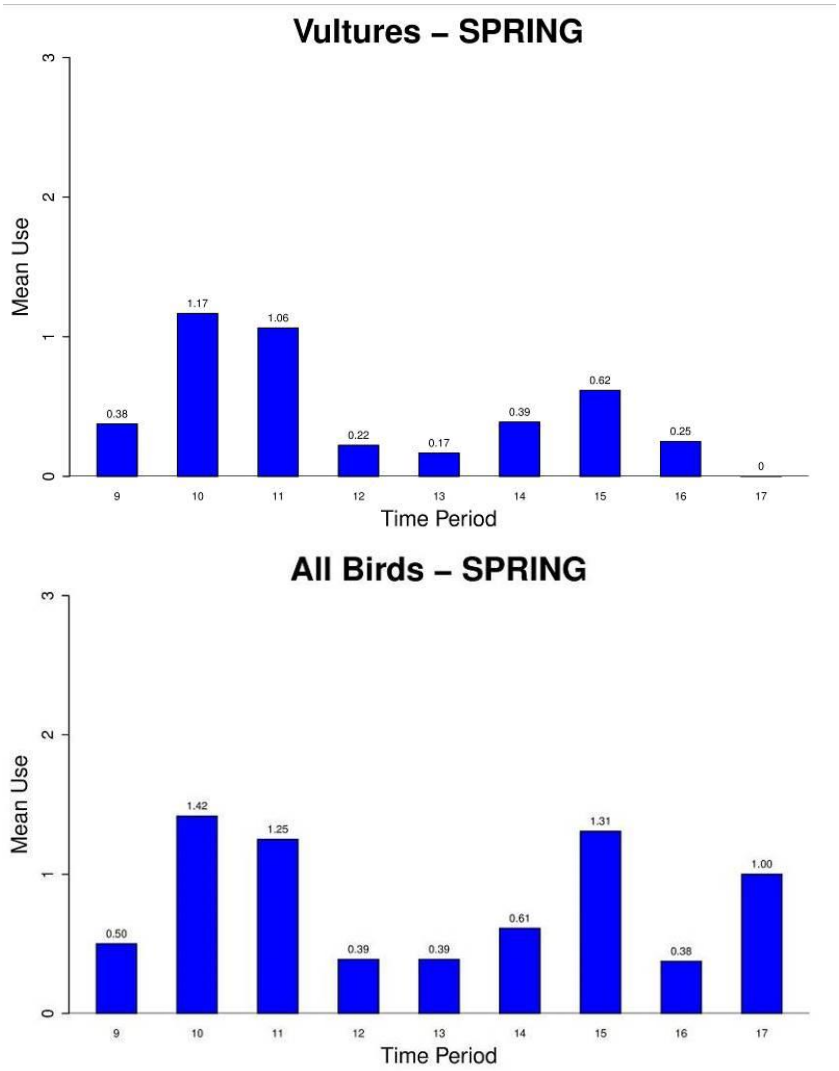


Figure B1 (*continued*). Mean use (number of birds/survey) by time period (hour) for the raptor migration surveys for diurnal raptors, raptor subtypes, and vultures at the Number Nine Wind Farm from March 18 – May 29, 2014.

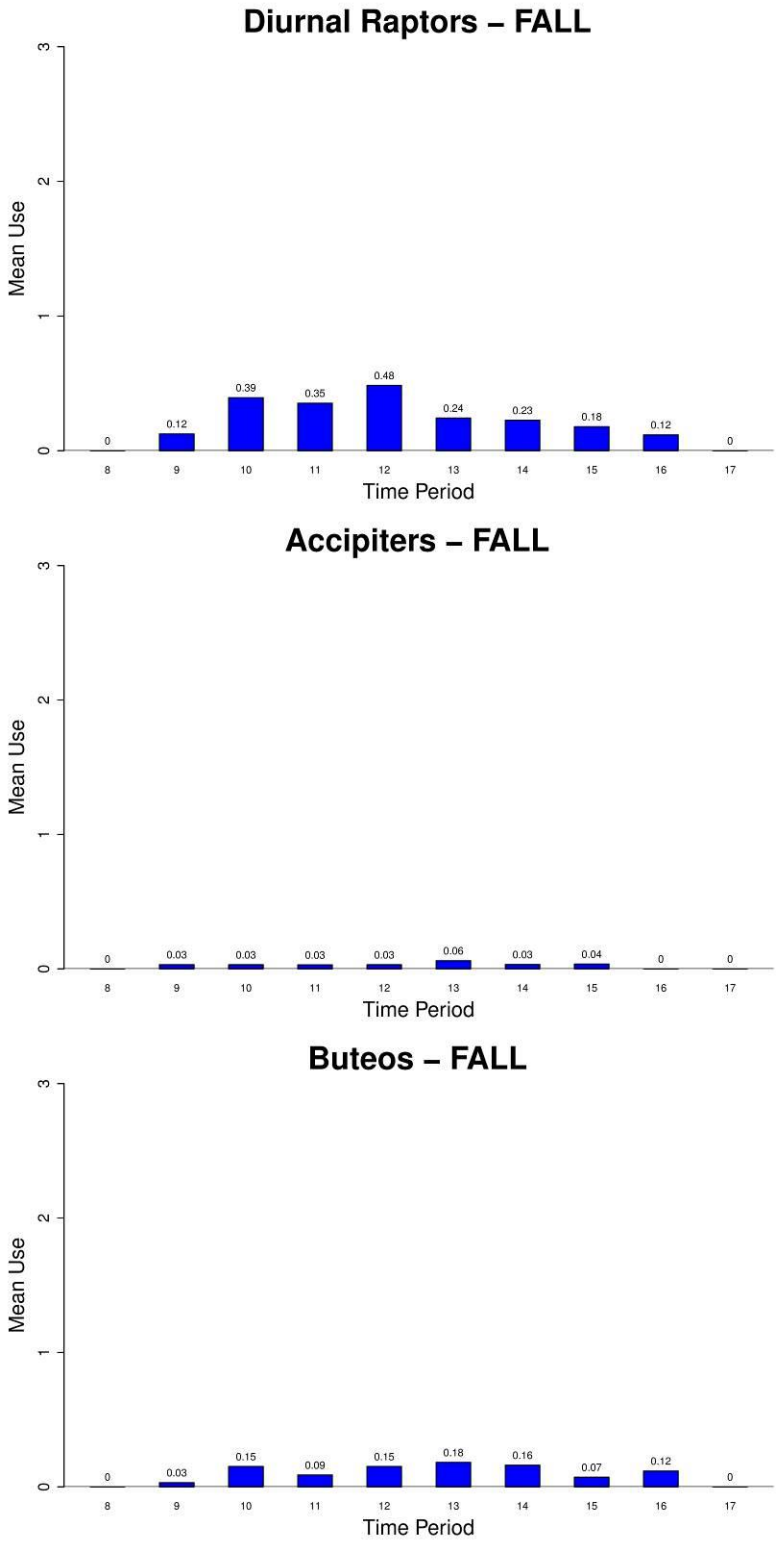


Figure B2. Mean use (number of birds/survey) by time period (hour) for the raptor migration surveys for diurnal raptors, raptor subtypes, and vultures at the Number Nine Wind Farm from September 3 – December 4, 2014.

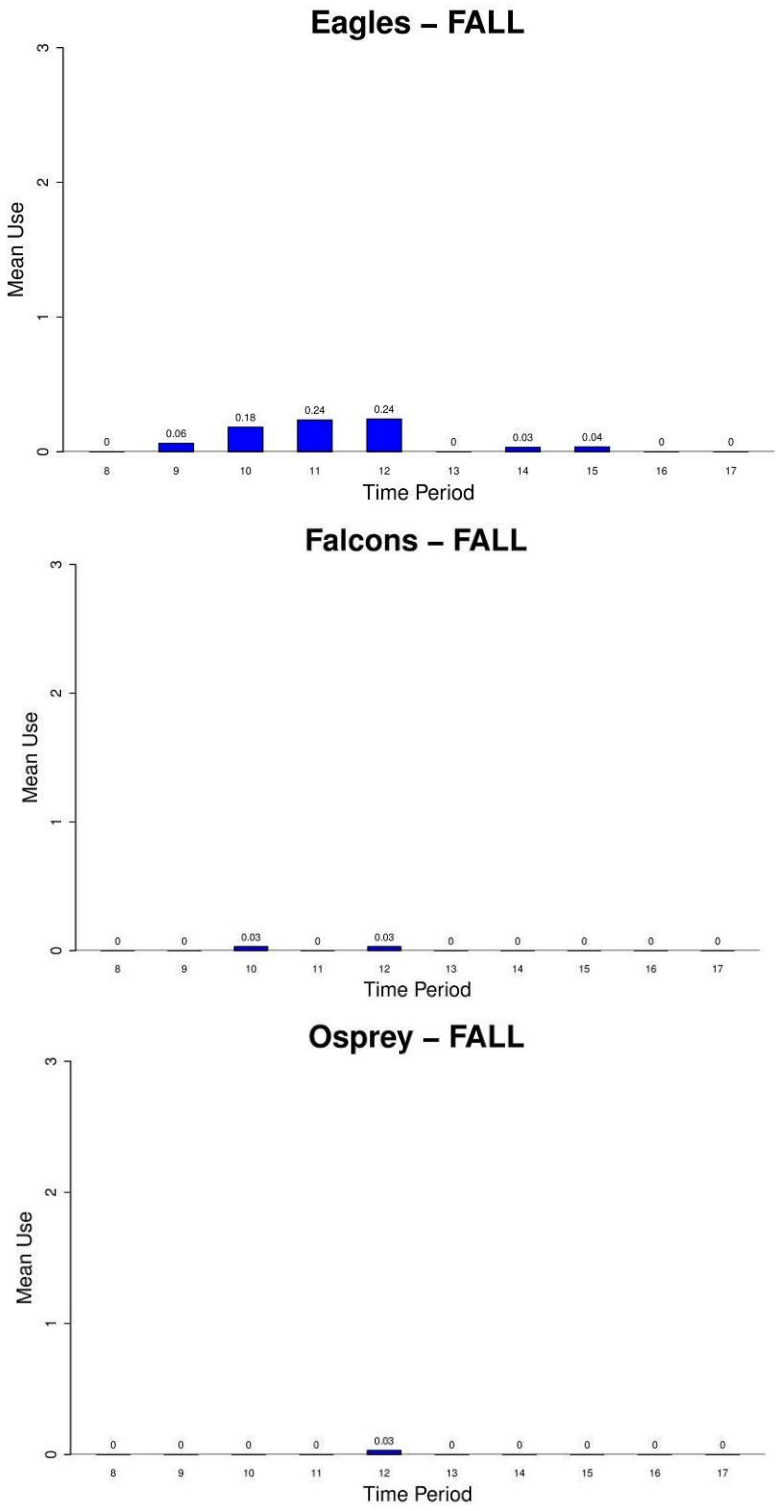


Figure B2 (*continued*). Mean use (number of birds/survey) by time period (hour) for the raptor migration surveys for diurnal raptors, raptor subtypes, and vultures at the Number Nine Wind Farm from September 3 – December 4, 2014.

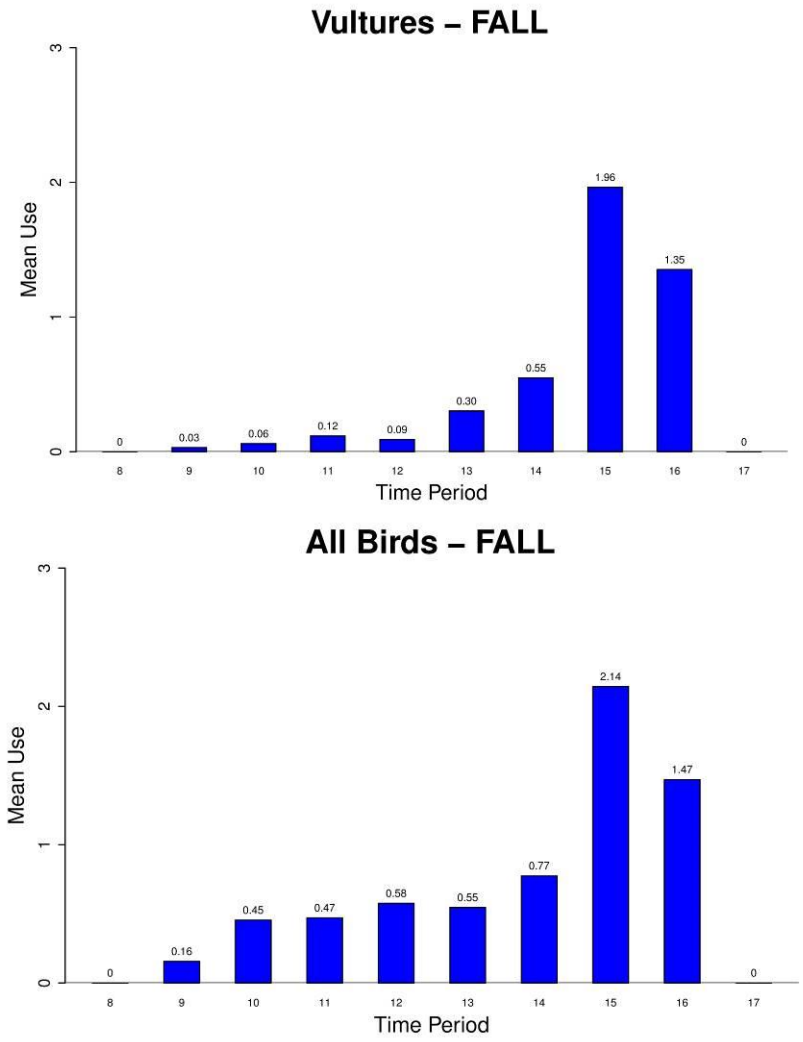


Figure B2 (*continued*). Mean use (number of birds/survey) by time period (hour) for the raptor migration surveys for diurnal raptors, raptor subtypes, and vultures at the Number Nine Wind Farm from September 3 – December 4, 2014.

Appendix C. Raptor and Vulture Count by Day during Raptor Migration Surveys at the Number Nine Wind Farm from March 18 – December 4, 2014

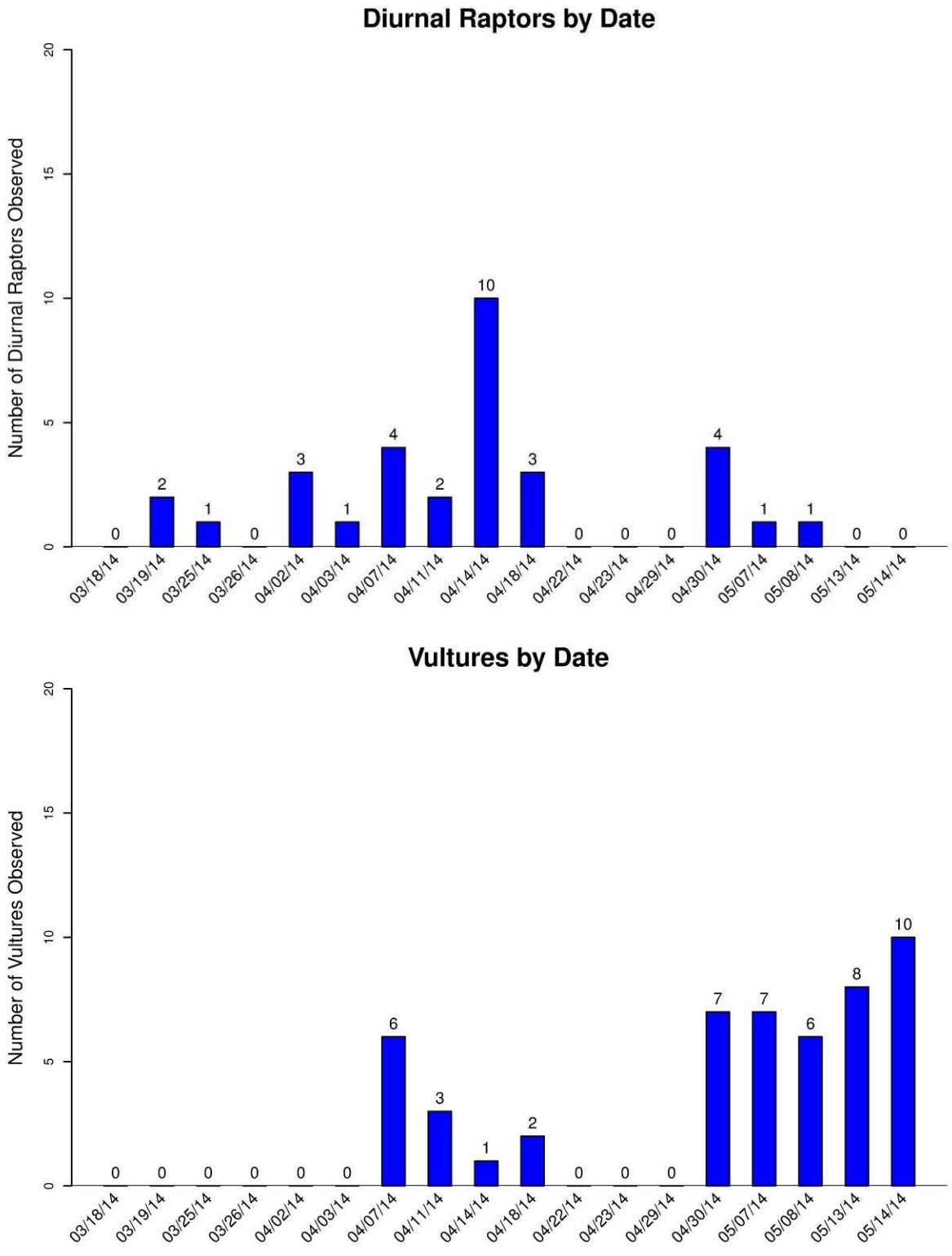


Figure C1. Total number of raptor and vulture observations by survey day during spring raptor migration surveys at the Number Nine Wind Farm from March 18 – May 29, 2014

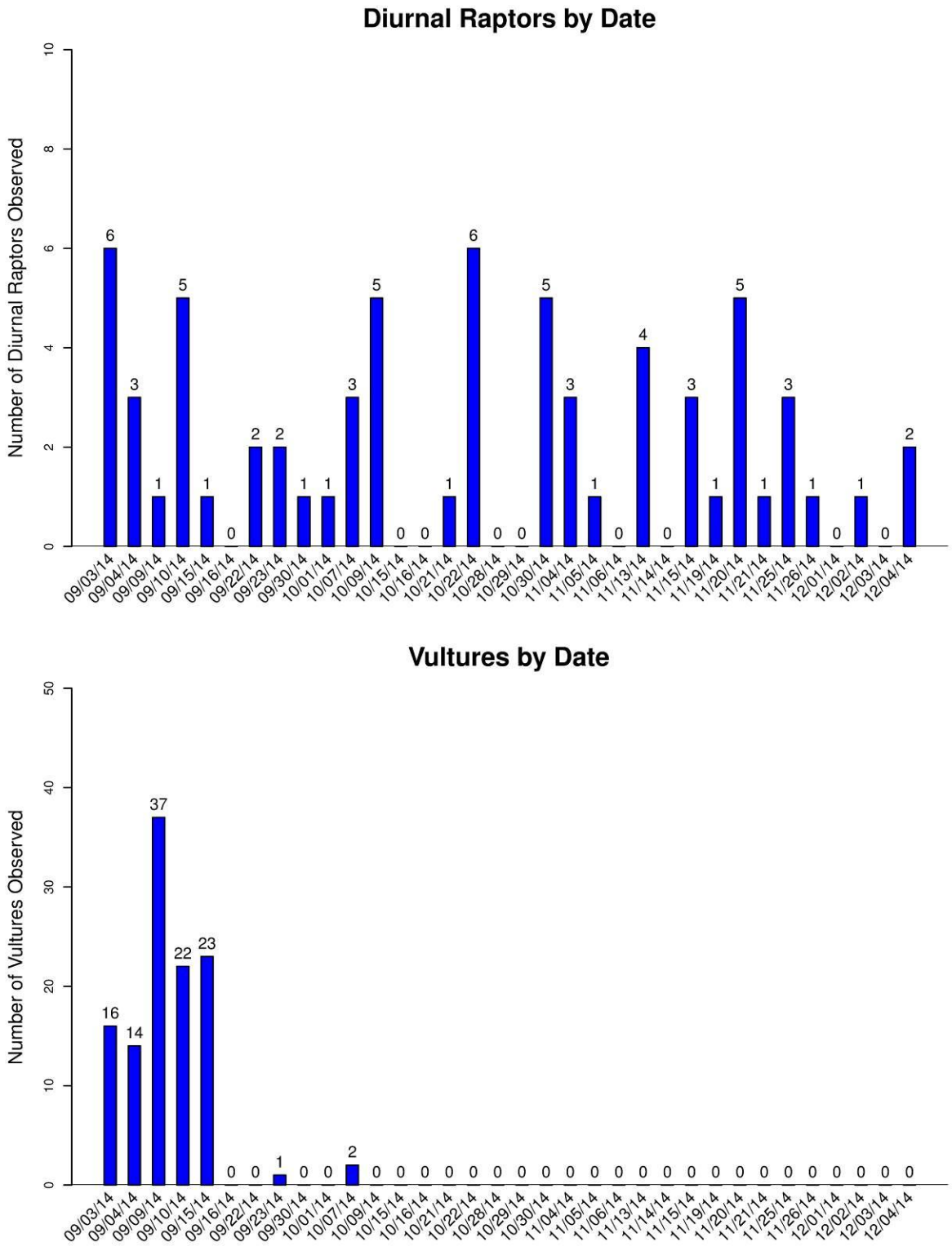


Figure C2. Total number of raptor and vulture observations by survey day during fall raptor migration surveys at the Number Nine Wind Farm from September 3 – December 4, 2014.

Appendix D. 2008 Raptor Migration Surveys, Number Nine Wind Project, Aroostook County, Maine

2008 RAPTOR MIGRATION SURVEYS

Raptor migration surveys were conducted with the proposed Number Nine Wind Project area in the spring and fall of 2008. The objective of the raptor migration surveys was to estimate the relative abundance of raptors[1] migrating through the Project.

METHODS

Survey Points

Two survey points per season (spring and fall) were established within the project area to increase coverage within the Project area and investigate potential spatial variation in raptor migration within the Project area (Figure 1). Three different survey points were used in the study, with two survey points used per season: surveys were conducted from points 1 and 2 in the spring, and from points 1 and 3 in the fall. Survey points were selected to provide good visual coverage in roughly 360^{o} around the point and over long distances to look for migrant raptors while also providing good visual coverage of the vegetation types, topographic features, and areas proposed for turbine construction. The survey plot was an unlimited viewshed around the point consistent with standard raptor migration survey methods.

Field Methods

Modified point count surveys were conducted in the Project using observation methods typical for raptor migration surveys and Hawk Watch sites (e.g., Hawk Migration Association of North America [HMANA] and Hawk Watch International [HWI]). Raptors, other diurnal migrant birds, vultures, and sensitive species were recorded during the surveys. Surveys were conducted consistent with protocols established by HMANA, with observers continuously scanning the sky and surrounding areas for raptors in the survey area. Surveyors used binoculars and spotting scopes to help in spotting and identifying birds. The date, start and end time of the observation period, and weather information such as air temperature, wind speed, wind direction, percent cloud cover, precipitation, and maximum visibility estimates were recorded for each survey. Each individual or group of birds observed was assigned a unique observation number. Time of observation; species or best possible identification; number of individuals; age and sex (if possible); approximate distance from point when first observed; approximate altitude above ground; approximate flight direction; activity (behavior); and habitat(s) or topographic features the bird(s) was flying over were recorded for each observation. Information about each observation of approximate flight height, behavior, and habitat was recorded from the point of first observation.

[1] Raptors are defined here as kites, accipiters, buteos, harriers, eagles, falcons, and owls. Estimates for vultures are included separately.

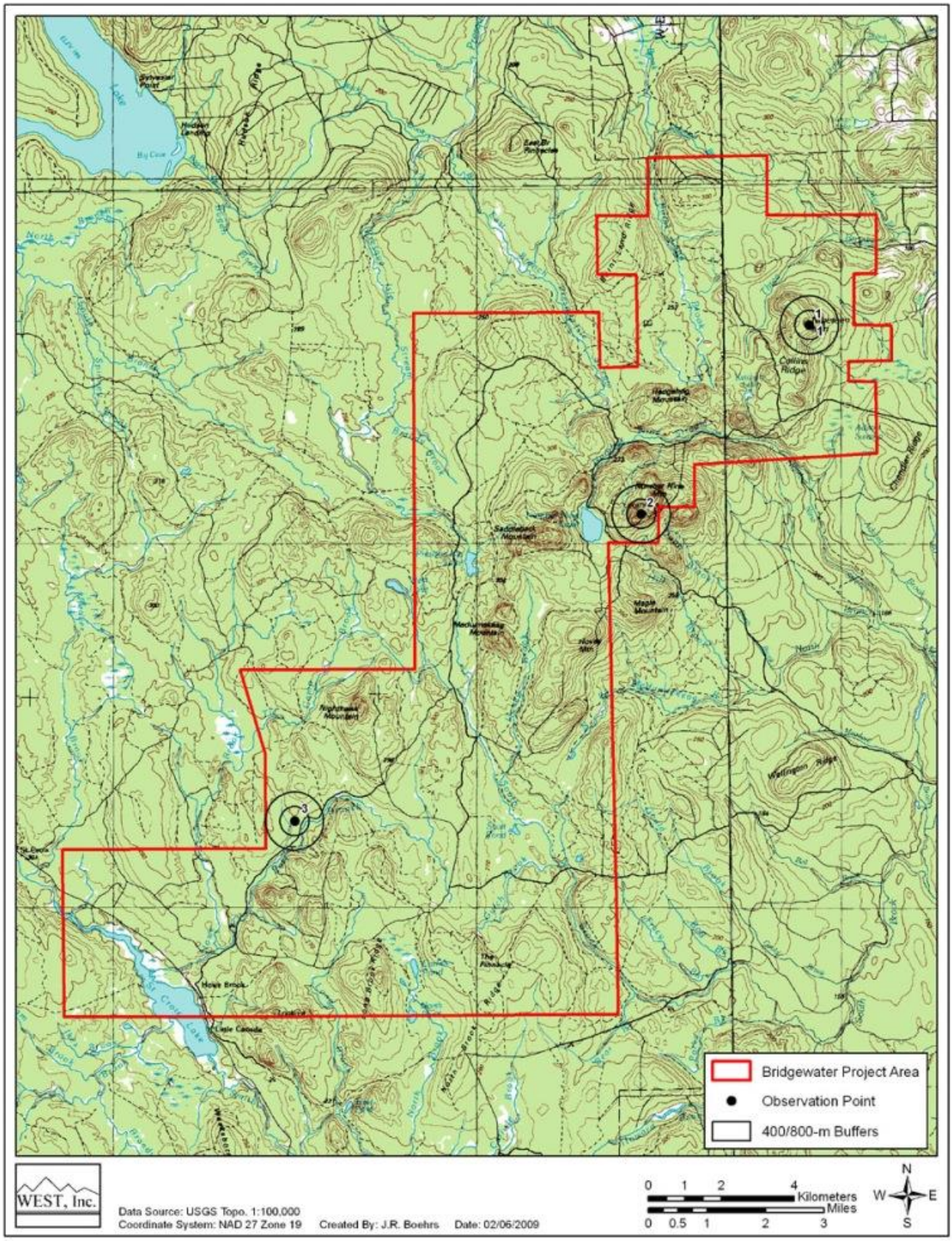


Figure 1. Raptor migration survey points used in 2008 at the Number Nine Wind Project area.

Behavior categories included perched, circling/soaring, flapping, active hunting, gliding, hovering, vocalizing, and other (noted in comments). Behavior was used to aid in identifying migrant raptors versus resident or winter resident birds. Habitat categories included shrub, grassland, riparian, open water, forest/woodlot, rocky outcrop, and other (noted in comments).

Locations of raptors and other birds observed were recorded on field maps by observation number. Sensitive species (Federally or state listed endangered, threatened, candidate, etc. species) were also recorded in the same manner. Flight paths and locations of perched birds were recorded in the field and were later digitized using ArcGIS 9.3.

Observation Schedule

Each survey point was visited approximately 20 times during the spring and fall migration seasons. Survey periods at each point were 3 hours long and surveys were conducted during daylight hours to approximately cover the peak period (0900-1700) for observing migrant raptors. To the extent possible, both points were surveyed the same day for a total of 6 survey-hours per survey day.

Statistical Analyses

Bird Diversity and Species Richness

Bird diversity was represented by the total number of unique species observed. Species lists, with the number of observations and the number of groups, were generated by season. Species richness was calculated as the mean number of species observed per survey. Species diversity and richness were compared between seasons.

Bird Use

For raptor migration surveys, use by species or bird type is typically calculated as the mean number of individuals per observer-hour within an unlimited viewshed around the survey point. This metric allows standardized comparison between sample locations, time (hours, days, weeks, seasons), or with other studies where similar data exist.

Percent of Use and Frequency of Occurrence

The frequency of occurrence is calculated as the percent of surveys in which a particular species or bird type was observed. Percent of use (sometimes referred to as Species Composition) is calculated as the proportion of the overall mean use for a particular species or bird type.

Flight Characteristics

To calculate potential risk to flying birds, the first flight height recorded was used to estimate the percentages of birds flying within the likely “zone of risk” (ZOR) for potential collision with turbine blades. Because the type of turbines that will be used at the Project is currently unknown, the ZOR used in the analysis was (35 to 130 m (approximately 114 to 427 ft) AGL, which is the blade height of typical turbines that could be used at the Project.

Spatial Use

Use estimates were compared among the survey plots to investigate differences in raptor migration across the Project area.

RESULTS

Twenty-four raptor migration surveys were conducted between May 1 and May 31 and 22 surveys were conducted between September 1 and October 31, 2008 (Table 1).

Bird Diversity and Species Richness

A total of 14 unique bird species were recorded observed during the spring surveys, with a mean of 2.00 species observed per survey (Table 1). In the fall, 12 bird species were observed, with a mean of 1.83 species observed per survey (Table 1). A total of 163 individual birds within 104 separate groups were recorded during the surveys; including 81 individual raptors representing eleven species (Table 2).

Table 1. Summary of bird use, species richness, and sample size by season and point during 2008 raptor migration surveys at the Number Nine Wind Project Area.

Season	Point	Number of Visits	Mean Use	Number of Species per Survey	Number of Species	Number of Surveys Conducted
Spring	Point 1	11	0.66	2.27	11	11
	Point 2	13	0.81	2.08	7	13
Overall		**24**	**0.69**	**2.00**	**14**	**24**
Fall	Point 1	12	1.52	1.83	9	12
	Point 3	10	0.58	1.90	7	10
Overall		**22**	**1.04**	**1.83**	**12**	**22**

Bird Use, Percent of Use, and Frequency of Occurrence

For all birds recorded, mean use was lower in the spring, 0.69 individuals per survey-hour, than the fall 1.04 birds per survey-hour (Table 1). Raptors comprised 52.6% of the overall bird use recorded in the spring and 44.4% of overall bird use in the fall. Raptors were observed during 26.3% of surveys in spring and 20.6% of surveys in fall.

Raptors

Raptor use was less than one individual per survey-hour in both the spring and fall, 0.34 and 0.46 birds per survey-hour respectively (Table 3). Accipiters, primarily sharp-shinned hawks, represented the raptor group with highest use during the spring (0.14 birds/survey-hour); while buteos, primarily broad-winged hawks and red-tailed hawks, represented the raptor groups with the highest use in the fall (0.27 birds/survey-hour) (Table 3).

Vultures

No vultures were observed during fall surveys, while in the spring vulture use at was 0.21 birds per survey hour. Turkey vulture was the only vulture species observed. Vultures comprised approximately one-third (33.1%) of the overall bird use in the spring, and were observed during 13.8% of surveys.

Other Diurnal Migrants

Waterfowl comprised almost half (46.6%) of the overall bird use in the fall, with use being 0.48 birds per survey-hour. However, waterfowl were observed in only 1.0% of surveys and high use was due to one large flock of Canada geese. No waterfowl were observed during the spring surveys. There was a small amount of waterbird use in the spring (0.01 birds/survey-hour) and shorebird use in the fall (0.06 birds/survey-hour). Waterbirds comprised 1.4% of use in the spring and were observed in only 0.9% of surveys; while shorebirds comprised 6.1% of use in the fall and were observed in only 1.0% of surveys.

Flight Height Characteristics

Approximately 14% of birds observed during the surveys were observed within the ZOR (Table 4). Raptors and vultures were the only bird types that had individuals observed within the ZOR. Of the 81 raptors observed, 23.5% were observed flying within the ZOR. Forty-five percent of accipiters were observed within the ZOR, which is based on twenty individuals. Although 100% of falcons (American kestrels) were observed within the ZOR, this was based on only one observation. Two bald eagles were observed during raptor migration surveys. They were observed flying at mean height of 160 m (approximately 525 ft) AGL. Twelve northern harriers were observed flying at a mean height of 85.6 m (approximately 281 ft) AGL. Twenty-five percent of observations of this species were within the ZOR. Approximately 17% of turkey vultures were observed within the ZOR (Table 4).

Over 40% of all birds at all points were observed flying at heights of 200-300 m (Figure 2). When points are displayed separately, 51.9% of birds observed at Point 1 were flying at this height, compared to only 4.35% of birds observed at Point 3. The majority of birds observed at Point 3 (21.7%) were seen flying at a height of 100-200 m. Over forty percent (42.9%) of raptors observed at Point 2 were observed flying at 200-300 m, while at Points 1 and 3 the flight bands with the highest number of raptors observed were 0-200 m at Point 1 and 100-200 m and 600-700 m at Point 3.

Temporal Variation

Daily Use

Bird use during the surveys was highest between the hours of 10:00 and 11:00 (1.61 and 1.43 birds/survey-hour) and at 14:00 hrs (2.17 birds/survey-hour) (Figure 3). No birds were observed after hour 17:00.

Seasonal Use

In the spring, the number of raptors observed per day varied from zero to nine (Figure 4). The highest number of raptors seen on a given day was on May 11, 2008. In the fall, the number of

raptors observed per day varied from zero to six. The highest number of raptors observed on a given day was six, and occurred on September 23, 2008.

Table 2. Total number of groups and individuals for each bird type and species by season and overall, during 2008 raptor migration surveys at the Number Nine Wind Project area.

	Spring		Fall		Total	
Species/Type	Number of Groups	Number of Individuals	Number of Groups	Number of Individuals	Number of Groups	Number of Individuals
Waterbirds	**1**	**1**	**0**	**0**	**1**	**1**
unidentified gull	1	1	0	0	1	1
Waterfowl	**0**	**0**	**1**	**46**	**1**	**46**
Canada goose	0	0	1	46	1	46
Shorebirds	**0**	**0**	**1**	**6**	**1**	**6**
unidentified shorebird	0	0	1	6	1	6
Raptors	**40**	**40**	**38**	**41**	**78**	**81**
Accipiters	*15*	*15*	*5*	*5*	*20*	*20*
Cooper's hawk	1	1	2	2	3	3
sharp-shinned hawk	14	14	3	3	17	17
Buteos	*14*	*14*	*20*	*23*	*34*	*37*
broad-winged hawk	3	3	5	8	8	11
red-shouldered hawk	2	2	1	1	3	3
red-tailed hawk	6	6	13	13	19	19
rough-legged hawk	1	1	1	1	2	2
unidentified buteo	2	2	0	0	2	2
Northern Harrier	*5*	*5*	*7*	*7*	*12*	*12*
northern harrier	5	5	7	7	12	12
Eagles	*2*	*2*	*0*	*0*	*2*	*2*
bald eagle	2	2	0	0	2	2
Falcons	*1*	*1*	*0*	*0*	*1*	*1*
American kestrel	1	1	0	0	1	1
Owls	*0*	*0*	*1*	*1*	*1*	*1*
barred owl	0	0	1	1	1	1
Other Raptors	*3*	*3*	*5*	*5*	*8*	*8*
osprey	2	2	3	3	5	5

Table 2. Total number of groups and individuals for each bird type and species by season and overall, during 2008 raptor migration surveys at the Number Nine Wind Project area.

	Spring		Fall		Total	
Species/Type	**Number of Groups**	**Number of Individuals**	**Number of Groups**	**Number of Individuals**	**Number of Groups**	**Number of Individuals**
unidentified hawk	1	1	0	0	1	1
unidentified raptor	0	0	2	2	2	2
Vultures	**15**	**18**	**0**	**0**	**15**	**18**
turkey vulture	15	18	0	0	15	18
Passerines	**5**	**8**	**3**	**3**	**8**	**11**
American crow	1	1	0	0	1	1
common raven	4	7	3	3	7	10
Total	**61**	**67**	**43**	**96**	**104**	**163**

Table 3. Mean bird use (number/observer hour), percent of total use, and frequency of occurrence (percent of survey) for each bird type and species by season during 2008 raptor migration surveys at the Number Nine Wind Project area.

	Use		Percent of Use		Frequency of Occurrence	
Species/Type	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**
Waterbirds	**0.01**	**0**	**1.4**	**0**	**0.9**	**0**
unidentified gull	0.01	0	1.4	0	0.9	0
Waterfowl	**0**	**0.48**	**0**	**46.6**	**0**	**1.0**
Canada goose	0	0.48	0	46.6	0	1.0
Shorebirds	**0**	**0.06**	**0**	**6.1**	**0**	**1.0**
unidentified shorebird	0	0.06	0	6.1	0	1.0
Raptors	**0.34**	**0.46**	**52.6**	**44.4**	**26.3**	**20.6**
Accipiters	*0.14*	*0.05*	*22.4*	*5.1*	*11.7*	*4.0*
Cooper's hawk	0.01	0.02	1.4	2.3	0.9	2.4
sharp-shinned hawk	0.13	0.03	21.0	2.8	11.7	2.9
Buteos	*0.08*	*0.27*	*12.8*	*26.6*	*7.3*	*18.9*
broad-winged hawk	0.01	0.11	1.4	10.2	0.9	6.2
red-shouldered hawk	0.03	0.01	5.0	1.0	3.2	1.0
red-tailed hawk	0.04	0.15	6.4	14.4	4.1	12.7
rough-legged hawk	0	0.01	0	1.0	0	1.0
unidentified buteo	0	0	0	0	0	0
Northern Harrier	*0.06*	*0.08*	*8.8*	*8.0*	*4.5*	*8.2*
northern harrier	0.06	0.08	8.8	8.0	4.5	8.2
Eagles	*0.02*	*0*	*3.0*	*0*	*1.9*	*0*
bald eagle	0.02	0	3.0	0	1.9	0
Falcons	*0.01*	*0*	*1.4*	*0*	*0.9*	*0*
American kestrel	0.01	0	1.4	0	0.9	0
Owls	*0*	*0.01*	*0*	*0.8*	*0*	*0.8*
barred owl	0	0.01	0	0.8	0	0.8
Other Raptors	*0.03*	*0.04*	*4.2*	*3.8*	*2.7*	*4.0*
Osprey	0.02	0.03	2.8	2.8	1.8	2.9
unidentified hawk	0.01	0	1.4	0	0.9	0
unidentified raptor	0	0.01	0	1.0	0	1.0
Vultures	**0.21**	**0**	**33.1**	**0**	**13.8**	**0**
turkey vulture	0.21	0	33.1	0	13.8	0
Passerines	**0.08**	**0.03**	**12.9**	**3.0**	**5.6**	**3.1**
American crow	0.01	0	1.6	0	1.0	0
common raven	0.07	0.03	11.3	3.0	4.6	3.1
Overall	**0.64**	**1.03**	**100**	**100**	**-**	**-**

Table 4. Flight height characteristics of all birds observed during 2008 raptor migration surveys at the Number Nine Wind Project area.

Species/Type	Number of Groups	Number of Individuals	Mean Flight Height (m)	Median Flight Height (m)	Percent in Flight	Percent within ZOR†
Waterbirds	**1**	**1**	**175.0**	**175.0**	**100**	**0**
unidentified gull	1	1	175.0	175.0	100	0
Waterfowl	**1**	**46**	**250.0**	**250.0**	**100**	**0**
Canada goose	1	46	250.0	250.0	100	0
Shorebirds	**1**	**6**	**400.0**	**400.0**	**100**	**0**
unidentified shorebird	1	6	400.0	400.0	100	0
Raptors	**78**	**81**	**361.2**	**250.0**	**100**	**23.5**
Accipiters	*20*	*20*	*158.8*	*150.0*	*100*	*45.0*
Cooper's hawk	3	3	166.7	170.0	100	33.3
sharp-shinned hawk	17	17	157.4	150.0	100	47.1
Buteos	*34*	*37*	*452.8*	*375.0*	*100*	*16.2*
broad-winged hawk	8	11	388.8	350.0	100	9.1
red-shouldered hawk	3	3	650.0	650.0	100	0
red-tailed hawk	19	19	409.7	300.0	100	26.3
rough-legged hawk	2	2	675.0	675.0	100	0
unidentified buteo	2	2	600.0	600.0	100	0
Northern Harrier	*12*	*12*	*281.3*	*262.5*	*100*	*25.0*
northern harrier	12	12	281.3	262.5	100	25.0
Eagles	*2*	*2*	*525.0*	*525.0*	*100*	*0*
bald eagle	2	2	525.0	525.0	100	0
Falcons	*1*	*1*	*100.0*	*100*	*100*	*100*
American kestrel	1	1	100.0	100	100	100
Owls	*1*	*1*	*0*	*0*	*100*	*0*
barred owl	1	1	0	0	100	0
Other Raptors	*8*	*8*	*635.0*	*665.0*	*100*	*0*
Osprey	5	5	456.0	400.0	100	0
unidentified hawk	1	1	1,000.0	1,000.0	100	0
unidentified raptor	2	2	900.0	900.0	100	0
Vultures	**15**	**18**	**406.7**	**300.0**	**100**	**16.7**
turkey vulture	15	18	406.7	300.0	100	16.7
Passerines	**8**	**11**	**128.1**	**112.5**	**100**	**0**
American crow	1	1	300.0	300.0	100	0
common raven	7	10	103.6	0	100	0
Overall	**104**	**163**	**347.4**	**250.0**	**100**	**13.5**

† Zone of risk (ZOR) of 35 to 130 m (114 to 427 ft) above ground level (AGL).

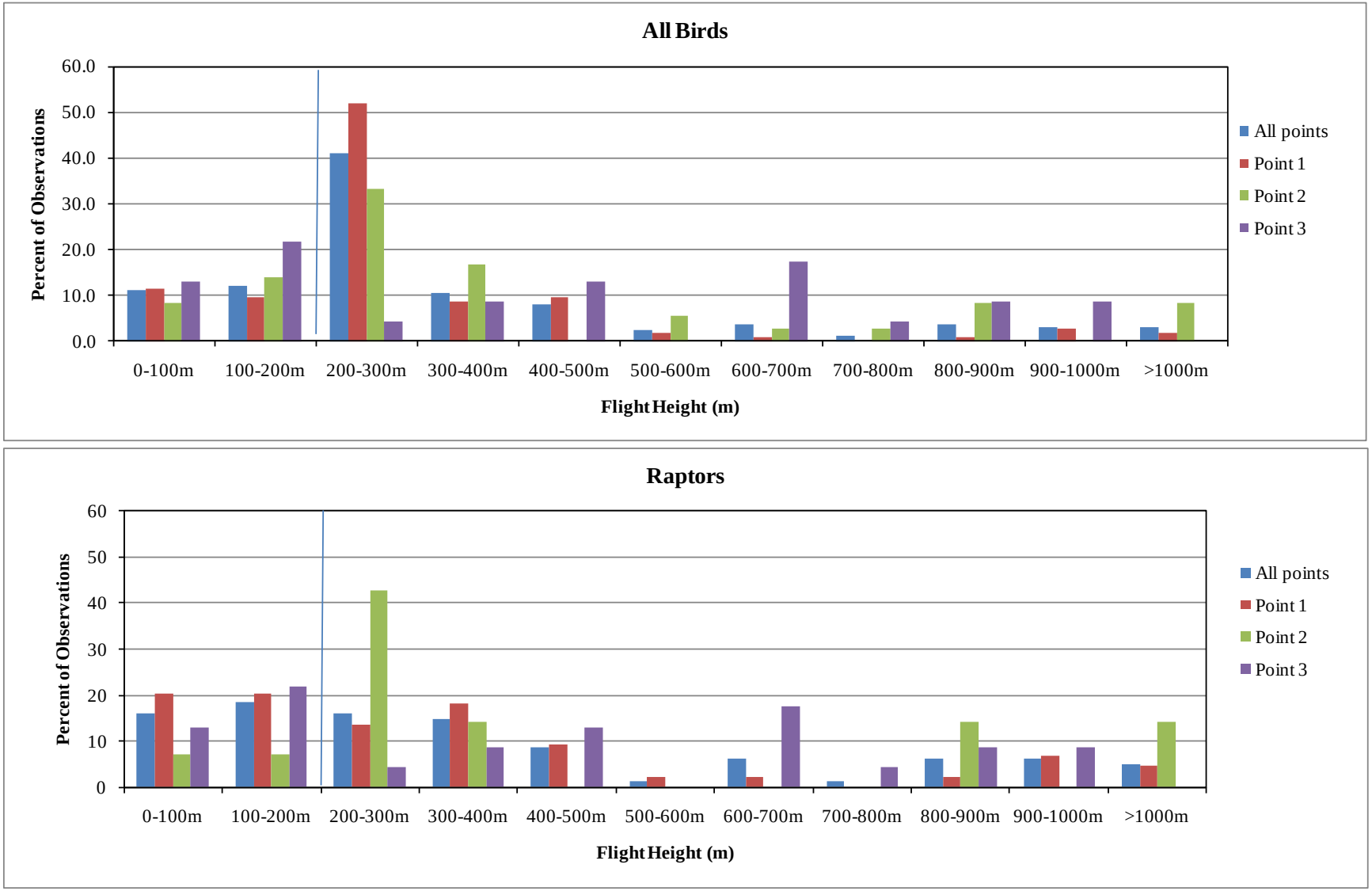


Figure 2. Flight heights of all birds and raptors during raptor migration surveys at the Number Nine Wind Project Area.

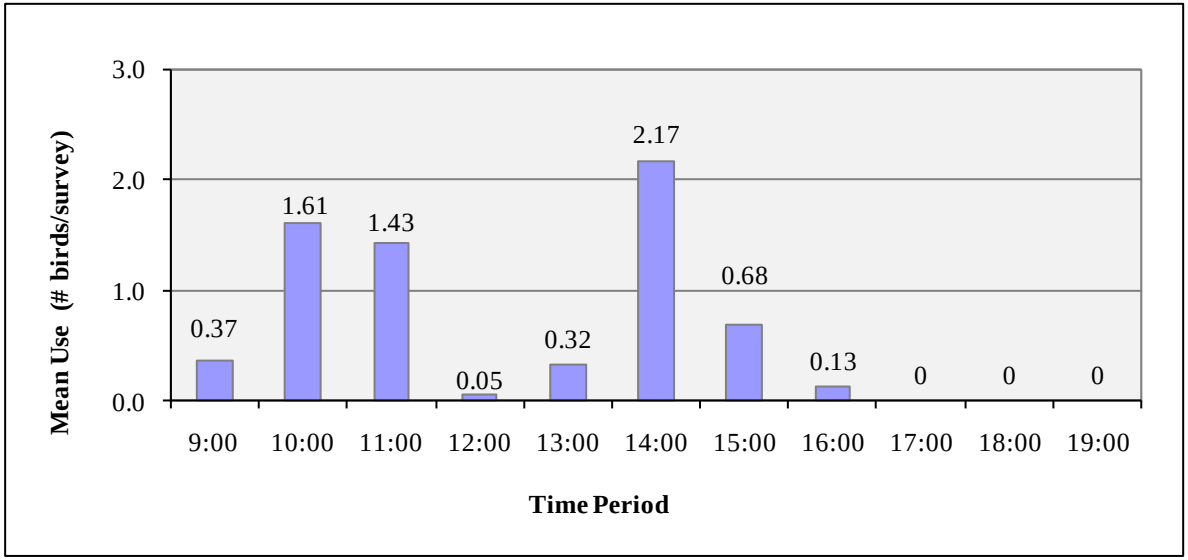


Figure 3. Temporal use by all birds during 2008 raptor migration surveys at the Number Nine Wind Project Area.

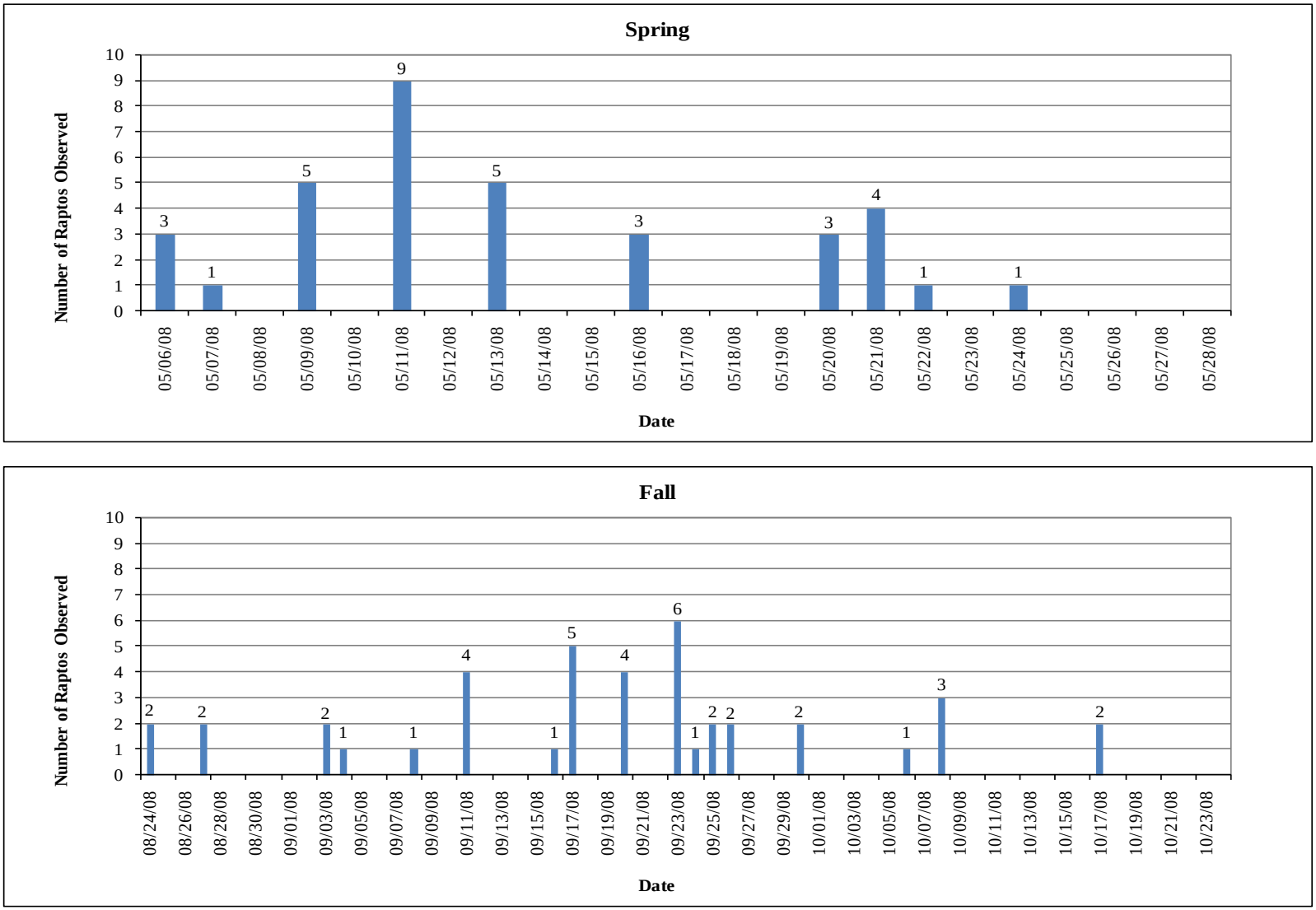


Figure 4. Raptor numbers by date for 2008 raptor migration surveys at the Number Nine Wind Project Area.

Appendix E. Publicly Available Spring Raptor Migration Study Results from Wind Projects in the Northeastern U.S.

Summary provided by Stantec Consulting Services, Inc. November 1, 2014

Summary of publicly available spring raptor data at proposed wind sites in the East (2005-present)

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Average Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Spring 2005									
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%[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.
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)[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.
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)[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.
Spring 2006									
Mars Hill, Aroostook Cty, ME	Forested ridge	April 12 to May 18	10	60.25	64	9	1.06	(120 m) 48%[1]	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.
Lempster, Sullivan County, NH	Forested ridge	Spring 2006	10	78	102	n/a	1.3	(125 m) 56%[1]	The Louis Berger Group. 2006. Pre and Post-construction Avian Survey, Monitoring, and Mitigation at the Lempster, New Hampshire Wind Power Project. Prepared for Lempster Wind, LLC.
Spring 2007									
Stetson, Penobscot Cty, ME	Forested ridge	April 26 to May 4	9	59	34	10	0.6	(125 m) 65%[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.
Laurel Mountain, Preston Cty, WV	Forested ridge	March 30 to May 17	10	63.75	266	12	4.17	(125 m) 55%[2]	Stantec Consulting. 2008. 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, Aroostook Cty, ME	Forested ridge	April 25 to May 30	12	79	58	9	0.7	(120 m) 80%[2]	Stantec Consulting. 2008. 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.
Record Hill, Oxford Cty, ME	Forested ridge	March 11 to May 27	15	97	118	12	1.2	n/a	Stantec Consulting. 2008. 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.
Greenland, Grant Cty, WV	Forested ridge	March 21 to May 14	10	68	212	9	3.12	(125 m) 68%[2]	Stantec Consulting. 2008. 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.
Allegany, Cattaraugus Cty, NY	Forested ridge	March 23 to May 8	10	75	134	10	1.8	(150 m) 87%[2]	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar, and Acoustic Bat Surveys for the Allegany Wind Project. Prepared for EverPower Renewables
Rollins Mountain, Penobscot Cty, ME	Forested ridge	April 3 to June 3	15	108	122	12	1.1	(125 m) 76%[2]	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind, LLC.
Spring 2009									
Groton Wind, Grafton Cty, NH	Forested ridge	March 26 to May 23	11[3]	125[3]	175[3]	11	1.4[3]	(121 m) 25%[2]	Stantec Consulting Services Inc. 2009. 2009 Spring, Summer, and Fall Avian and Bat Surveys for the Groton Wind Project. Prepared for Groton Wind, LLC
Highland, Somerset Cty, ME	Forested ridge	March 25 to May 19	20	139	260	10	1.87	(130.5 m) Whitham 80% Briggs 86%[2]	Stantec Consulting Services Inc. 2009. Spring 2009 Ecological Surveys. Prepared for Highland Wind LLC.
Kingdom Community, Orleans Cty, VT	Forested ridge	April 15 to June 1	10	74	134	10	1.81	(125 m) 67%[1]	Stantec Consulting Services Inc. 2009. Spring and Summer 2009 Raptor Surveys for the Kingdom Community Wind Project. Prepared for Vermont Environmental Research Associates
Spring 2010									
Granite Reliable Power, Coos County, NH (Dixville peak)	Forested ridge	April 1 to May 11	10	67.52	14	8	0.21	(125 m) 64%[1]	Stantec Consulting Services Inc., 2010. Fall 2009 and Spring 2010 Raptor Migration Surveys For the Granite Reliable Power Project. Prepared for Granite Reliable Power, LLC
Granite Reliable Power, Coos County, NH (Owl head mtn)	Forested ridge	April 1 to May 11	10	62.45	29	8	0.46	(125 m) 76%[1]	Stantec Consulting Services Inc. 2010. Fall 2009 and Spring 2010 Raptor Migration Surveys For the Granite Reliable Power Project. Prepared for Granite Reliable Power, LLC
Bull Hill, Hancock Cty, ME	Forested ridge	March 19 to May 23	15	104.25	55	9	0.53	(145 m) 100%[2]	Stantec Consulting Services Inc. 2010. Spring 2010 Avian and Bat Survey Report for the Bull Hill Wind Project. Prepared for Blue Sky East Wind, LLC
Bingham, Somerset Cty, ME (Kingsbury Ridge)	Forested ridge	March 19 to May 21	10	70	19	9	0.27	(152 m) 77%[2]	Stantec Consulting Services Inc. 2010. Spring 2010 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind LLC.
Bingham, Somerset Cty, ME (Johnson Ridge)	Forested ridge	March 19 to May 21	5	35	37	9	1.06	(152 m) 95%[2]	Stantec Consulting Services Inc. 2010. Spring 2010 Avian and Bat Survey Report for the Bingham Wind Project. Prepared for Blue Sky East Wind LLC.
Bowers, Washington Cty, ME	Forested ridge	April 21 to May 26	12	84	131	9	1.56	(131 m) 75%[2]	Stantec Consulting Services Inc. 2010. 2010 Spring Avian and Spring/Summer Bat Surveys for the Bowers Wind Project. Prepared for Champlain Wind Energy, LLC
Melvin Mountain, Grafton and Merrimack Counties, NH	Forested ridge	April 15 to May 26	11 (simultaneous with Grants Pond Field)	75.5	62	9	0.82	(150 m) 83%[2]	Stantec Consulting Services Inc. 2013. 2010 Spring and Fall Raptor Migration Surveys for the Wild Meadows Wind Project, Grafton and Merrimack Counties, New Hampshire. Prepared for Atlantic Wind LLC.
Spring 2011									
Antrim, Hillsborough Cty, NH	Forested ridge	March 25 to May 15	9	65	441	11	6.78	(unknown) 37% between 50-500 ft above ground[1]	TRC Engineers and Stantec Consulting Services Inc. 2011. Avian and Bat Protection Plan for the Antrim Wind Energy Project. Prepared for Antrim Wind Energy, LLC.
Passadumkeag, Grand Falls Twp, ME	Forested ridge	April 29 to May 27	12	84	67	6	0.8	(140 m) 46%[1]	Stantec Consulting Services Inc. 2011. Spring and Summer 2011 Avian and Bat Survey Report for the Passadumkeag Wind Project in Grand Falls Township, Maine. Prepared for Noble Passadumkeag Windpark LLC.
Spring 2012									
South Mountain, Delaware Cty, NY	Forested ridge	March 6 to May 29	13	97	236	8	2.43	(150 m) 61%[2]	Stantec Consulting Services Inc. 2013. Spring 2012 Avian and Bat Survey Report for the South Mountain Wind Project in Delaware County, New York. Prepared for South Mountain Wind LLC.
Spring 2013									
South Mountain, Delaware Cty, NY	Forested ridge	March 6 to May 29	13	97	236	8	2.43	(150 m) 61%[2]	Stantec Consulting Services Inc. 2013. Spring 2012 Avian and Bat Survey Report for the South Mountain Wind Project in Delaware County, New York. Prepared for South Mountain Wind LLC.
Groton Wind, Grafton Cty, NH	Forested ridge	March 11 to May 30	11	146.75	96	6	0.65	(121 m) 33%[2]	Stantec Consulting Services Inc., Western EcoSystems Technology Inc. 2014. 2013 Post Construction Avian and Bat Survey Report Groton Wind Plant Grafton County New Hampshire. Prepared for Groton Wind LLC.

[1] Percent below turbine height calculated for all observations within study area.

[2] Percent below turbine height calculated for those observations within project area (locations within study area where turbines could possibly be located)

[3] 5 of the 11 survey days were conducted simultaneously by 2 observers at 2 survey locations; however, results are combined for both sites which inflates the number of raptors observed for this site.

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

Calculated for spring and fall combined.

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

Appendix F. North American Raptor Fatality Summary Tables

Table F1. Wind energy facilities in the Northeast region of North America with publicly-available and comparable raptor use and fatality data.

Wind Energy Facility	Spring Use (number per hour)	Fall Use (number per hour)	Raptor Fatality Estimate[A]	No. of Turbines	Total MW
Number Nine, ME (2014)	0.77	0.67			
Munnsville, NY (2008)			0.59	23	34.5
Noble Ellenburg, NY (2009)			0.25	54	80
Noble Clinton, NY (2009)			0.16	67	100
Noble Wethersfield, NY (2010)			0.13	84	126
Noble Bliss, NY (2009)			0.12	67	100
Noble Ellenburg, NY (2008)			0.11	54	80
Noble Bliss, NY (2008)			0.10	67	100
Noble Clinton, NY (2008)			0.10	67	100
Mount Storm, WV (2010)	0.89	2.12	0.10	132	264
Noble Chateaugay, NY (2010)			0.08	71	106.5
Cohocton/Dutch Hills, NY (2010)			0.08	50	125
Mountaineer, WV (2003)			0.07	44	66
High Sheldon, NY (2010)			0.06	75	112.5
Mount Storm, WV (2011)	0.89	2.12	0.03	132	264
Maple Ridge, NY (2007-2008)			0.03	195	321.75
Criterion, MD (2011)			0.02	28	70
Beech Ridge, WV (2012)	1.25	1.47	0.01	67	100.5
Lempster, NH (2009)	1.3	3.3	0	12	24
Lempster, NH (2010)	1.3	3.3	0	12	24
Stetson Mountain II, ME (2010)	0.6	2.1	0	17	25.5
Casselman, PA (2008)			0	23	34.5
Casselman, PA (2009)			0	23	34.5
Mars Hill, ME (2007)	1.06	1.52	0	28	42
Mars Hill, ME (2008)	1.06	1.52	0	28	42
Stetson Mountain I, ME (2009)	0.6	2.1	0	38	57
Stetson Mountain I, ME (2011)	0.6	2,1	0	38	57
Noble Altona, NY (2010)			0	65	97.5
Locust Ridge, PA (Phase II; 2009)			0	51	102
Locust Ridge, PA (Phase II; 2010)			0	51	102
High Sheldon, NY (2011)			0	75	112.5
Cohocton/Dutch Hill, NY (2009)			0	50	125
Mount Storm, WV (2009)	0.89	2.12	0	132	264
Weighted Mean			0.057		

A=number of fatalities/MW/year

Data from the following sources:

Wind Energy Facility	Use Estimate	Fatality Estimate	Wind Energy Facility	Use Estimate	Fatality Estimate
Number Nine, ME	This study				
Beech Ridge, WV (12)		Tidhar et al. 2013	Mount Storm, WV (10)		Young et al. 2010a, 2011b
Casselman, PA (08)		Arnett et al. 2009	Mount Storm, WV (11)		Young et al. 2011a, 2012b
Casselman, PA (09)		Arnett et al. 2010	Mountaineer, WV (03)		Kerns and Kerlinger 2004
Cohocton/Dutch Hill, NY (09)		Stantec 2010	Munnsville, NY (08)		Stantec 2009b
Cohocton/Dutch Hill, NY (10)		Stantec 2011	Noble Altona, NY (10)		Jain et al. 2011b
Criterion, MD (11)		Young et al. 2012a	Noble Bliss, NY (08)		Jain et al. 2009d
High Sheldon, NY (10)		Tidhar et al. 2012a	Noble Bliss, NY (09)		Jain et al. 2010a
High Sheldon, NY (11)		Tidhar et al. 2012b	Noble Chateaugay, NY (10)		Jain et al. 2011c
Lempster, NH (09)		Tidhar et al. 2010	Noble Clinton, NY (08)		Jain et al. 2009b
Lempster, NH (10)		Tidhar et al. 2011	Noble Clinton, NY (09)		Jain et al. 2010b
Locust Ridge, PA (Ph. II; 09)		Arnett et al. 2011	Noble Ellenburg, NY (08)		Jain et al. 2009a
Locust Ridge, PA (Ph. II; 10)		Arnett et al. 2011	Noble Ellenburg, NY (09)		Jain et al. 2010c
Maple Ridge, NY (07-08)		Jain et al. 2009c	Noble Wethersfield, NY (10)		Jain et al. 2011a
Mars Hill, ME (07)		Stantec 2008	Stetson Mountain I, ME (09)		Stantec 2009c
Mars Hill, ME (08)		Stantec 2009a	Stetson Mountain I, ME (11)		Normandeau Associates 2011
Mount Storm, WV (09)		Young et al. 2009, 2010b	Stetson Mountain II, ME (10)		Normandeau Associates 2010

Table F2. Publicly-available and comparable fatality estimates and habitat types from wind-energy facilities in the Northeast region of North America.

Project	Raptor Fatalities (raptors/MW/ year)[A]	Predominant Habitat Type	Citation
Beech Ridge, WV (2012)	0.01	Forest	Tidhar et al. 2013
Casselman, PA (2008)	0	Forest	Arnett et al. 2009
Casselman, PA (2009)	0	Forest, pasture, grassland	Arnett et al. 2010
Cohocton/Dutch Hill, NY (2009)	0	Agriculture/forest	Stantec 2010
Cohocton/Dutch Hills, NY (2010)	0.08	Agriculture, forest	Stantec 2011
Criterion, MD (2011)	0.02	Forest, agriculture	Young et al. 2012a
High Sheldon, NY (2010)	0.06	Agriculture	Tidhar et al. 2012a
High Sheldon, NY (2011)	0	Agriculture	Tidhar et al. 2012b
Lempster, NH (2009)	0	Grasslands/forest/rocky embankments	Tidhar et al. 2010
Lempster, NH (2010)	0	Grasslands/forest/rocky embankments	Tidhar et al. 2011
Locust Ridge, PA (Phase II; 2009)	0	Grassland	Arnett et al. 2011
Locust Ridge, PA (Phase II; 2010)	0	Grassland	Arnett et al. 2011
Maple Ridge, NY (2007-2008)	0.03	Agriculture/forested	Jain et al. 2009c
Mars Hill, ME (2007)	0	Forest	Stantec 2008
Mars Hill, ME (2008)	0	Forest	Stantec 2009a
Mount Storm, WV (2009)	0	Forest	Young et al. 2009, 2010b
Mount Storm, WV (2010)	0.1	Forest	Young et al. 2010a, 2011b
Mount Storm, WV (2011)	0.03	Forest	Young et al. 2011a, 2012b
Mountaineer, WV (2003)	0.07	Forest	Kerns and Kerlinger 2004
Munnsville, NY (2008)	0.59	Agriculture/forest	Stantec 2009b
Noble Altona, NY (2010)	0	Forest	Jain et al. 2011b
Noble Bliss, NY (2008)	0.1	Agriculture/forest	Jain et al. 2009d
Noble Bliss, NY (2009)	0.12	Agriculture/forest	Jain et al. 2010a
Noble Chateaugay, NY (2010)	0.08	Agriculture	Jain et al. 2011c
Noble Clinton, NY (2008)	0.1	Agriculture/forest	Jain et al. 2009b
Noble Clinton, NY (2009)	0.16	Agriculture/forest	Jain et al. 2010b
Noble Ellenburg, NY (2008)	0.11	Agriculture/forest	Jain et al. 2009a
Noble Ellenburg, NY (2009)	0.25	Agriculture/forest	Jain et al. 2010c
Noble Wethersfield, NY (2010)	0.13	Agriculture	Jain et al. 2011a
Stetson Mountain I, ME (2009)	0	Forest	Stantec 2009c
Stetson Mountain I, ME (2011)	0	Forested	Normandeau Associates 2011
Stetson Mountain II, ME (2010)	0	Forested	Normandeau Associates 2010

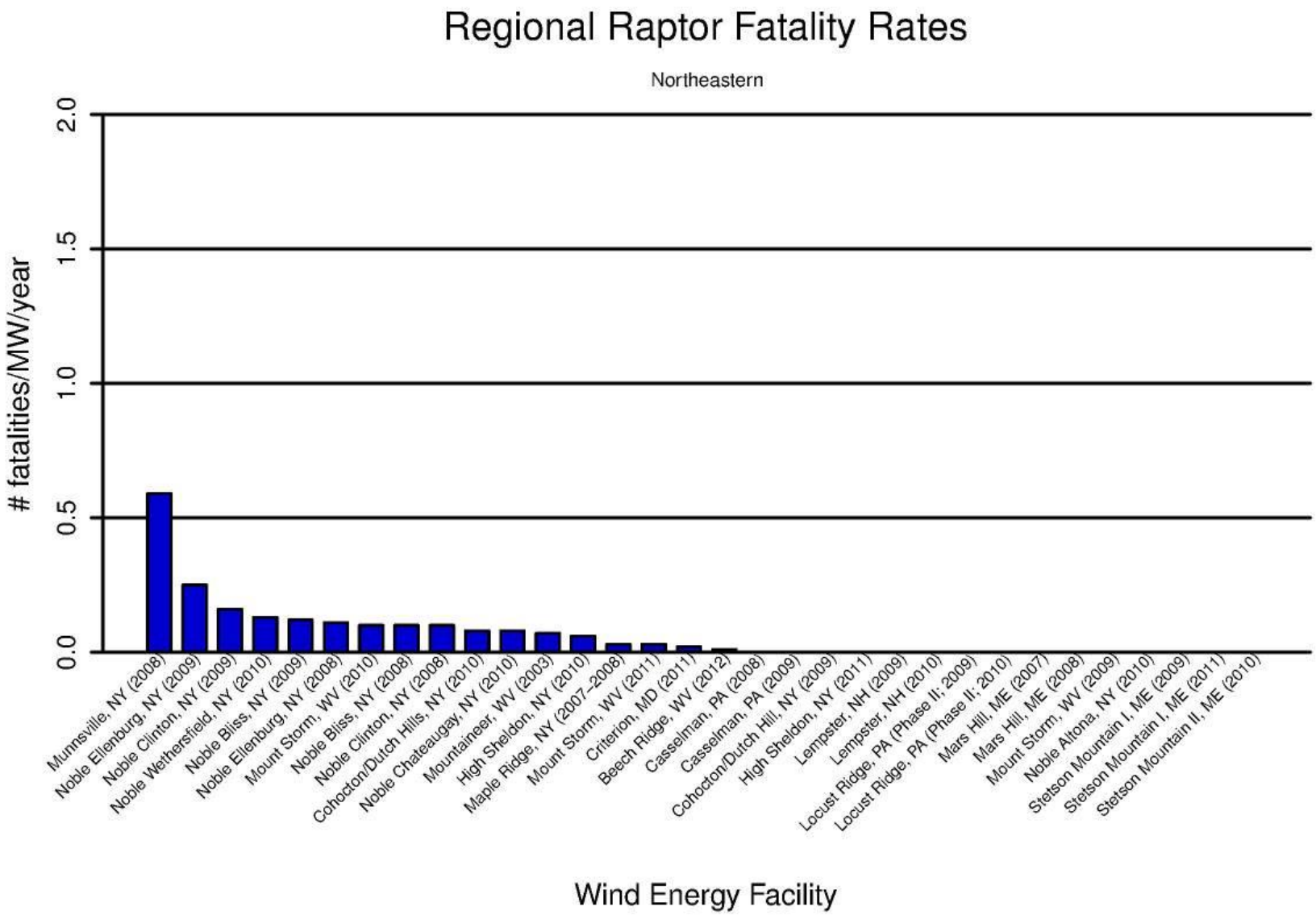


Figure E1. Fatality rates for raptors (number of raptors per megawatt per year) from publicly-available wind energy facilities in Northeastern North America.

Figure E1 (continued). Fatality rates for raptors (number of raptors per megawatt per year) from publicly-available wind energy facilities in Northeastern North America.

Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Number Nine, ME	This study.				
Munnsville, NY (08)	Stantec 2009b	Mountaineer, WV (03)	Kerns and Kerlinger 2004	Lempster, NH (10)	Tidhar et al. 2011
Noble Ellenburg, NY (09)	Jain et al. 2010c	High Sheldon, NY (10)	Tidhar et al. 2012a	Locust Ridge, PA (Phase II; 09)	Arnett et al. 2011
Noble Clinton, NY (09)	Jain et al. 2010b	Maple Ridge, NY (07-08)	Jain et al. 2009c	Locust Ridge, PA (Phase II; 10)	Arnett et al. 2011
Noble Wethersfield, NY (10)	Jain et al. 2011a	Mount Storm, WV (11)	Young et al. 2011a, 2012b	Mars Hill, ME (07)	Stantec 2008
Noble Bliss, NY (09)	Jain et al. 2010a	Criterion, MD (11)	Young et al. 2012a	Mars Hill, ME (08)	Stantec 2009a
Noble Ellenburg, NY (08)	Jain et al. 2009a	Beech Ridge, WV (12)	Tidhar et al. 2013	Mount Storm, WV (09)	Young et al. 2009, 2010b
Mount Storm, WV (10)	Young et al. 2010a, 2011b	Casselman, PA (08)	Arnett et al. 2009	Noble Altona, NY (10)	Jain et al. 2011b
Noble Bliss, NY (08)	Jain et al. 2009d	Casselman, PA (09)	Arnett et al. 2010	Stetson Mountain I, ME (09)	Stantec 2009c
Noble Clinton, NY (08)	Jain et al. 2009b	Cohocton/Dutch Hill, NY (09)	Stantec 2010	Stetson Mountain I, ME (11)	Normandeau Associates 2011
Cohocton/Dutch Hill, NY (10)	Stantec 2011	High Sheldon, NY (11)	Tidhar et al. 2012b	Stetson Mountain II, ME (10)	Normandeau Associates 2010
Noble Chateaugay, NY (10)	Jain et al. 2011c	Lempster, NH (09)	Tidhar et al. 2010		