

Annual Report for the Noble Bliss Windpark, LLC

Postconstruction Bird and Bat Fatality Study - 2009

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EXECUTIVE SUMMARY 1

1.0 INTRODUCTION: 4

1.1 Project Description 4

1.2 Study Area 5

2.0 METHODS..... 7

2.1 Carcass Surveys 7

 2.1.1 Site Selection 7

 2.1.2 Standardized Surveys 8

 2.1.3 Adjustment Factors Applied to Raw Data12

3.0 RESULTS.....15

3.1 Search Effort.....15

 3.1.1 Summary of Search Effort15

3.2 Incidents Recorded During Standardized Surveys and Incidentally17

 3.2.1 Birds17

 3.2.2 Bats21

 3.2.3 Seasonal Distribution of Fatalities (Birds and Bats)22

 3.2.4 Distance from Turbine Bases.....24

 3.2.5 Site Conditions potentially effecting Mortality26

3.3 Adjusting Fatality Estimates29

 3.3.1 Estimates from 1 and 7-day Search Sites.....29

 3.3.2 Estimated Fatalities by Species35

4.0 DISCUSSION.....38

 4.1 Project Duration and Search Interval.....38

 4.2 Seasonal Distribution of Fatalities39

 4.3 Species Composition and Fatality Rates at Noble Bliss Windpark and Other Wind Power Facilities in the U.S.40

 4.4 Night Migrant Fatalities.....41

 4.5 Bird Population Trends and Significance of Fatalities at the Noble Bliss Windpark42

 4.6 Bat Fatalities44

5.0 REFERENCES48

APPENDICES

APPENDIX A: Noble Bliss Windpark Project Site Information Datasheet.

APPENDIX B: Noble Bliss Windpark Project Incident (Mortality) Datasheet

APPENDIX C: Noble Bliss Windpark Project Incident Location (GPS) Datasheet

APPENDIX D: Distribution of carcasses for scavenge rate tests (Sc)

APPENDIX E: Multiple tests of the efficacy of brown house mouse (*Mus musculus*) as surrogates for bats during scavenge rate and search efficiency testing

APPENDIX F: Bird and Bat raw fatality data - 2009

LIST OF TABLES

Table 1. Noble Bliss site selection indicating 23 out of 67 sites selected......7

Table 2. Number of surveys completed at all 23 survey towers from April 15 to November 15, 2009...... 16

Table 3. Number of avian incidents at each wind turbine by species group found during standardized surveys and “incidentally” from April 15 to November 15, 2009...... 17

Table 4. Wind turbine locations of bat incidents by species.21

Table 5. Number of birds and bats found per month, from April 15 to November 15, 2009.....22

Table 6. Species Size Groupings used in Analyses......25

Table 7. Contingency table showing the proportion of bat incidents noted within 40m from turbine tower base of the 8 1-day search sites, comparing wooded versus non-wooded sites......28

Table 8. Contingency table showing the proportion of bird incidents noted within 40m from turbine tower base of the 8 1-day search sites, comparing wooded versus non-wooded sites......28

Table 9. Contingency table showing the proportion of night migrant bird incidents noted at the 8 1-day search sites, comparing lit versus unlit sites.28

Table 10. Contingency table showing the proportion of bat incidents noted at the 8 1-day search sites, comparing lit versus unlit sites......29

Table 11. Contingency table showing the proportion of night migrant bird incidents noted at the 15 7-day search sites, comparing lit versus unlit sites.29

Table 12. Contingency table showing the proportion of bat incidents noted at the 15 7-day search sites, comparing lit versus unlit sites......29

Table 13. Search Intensity Area and Ws Adjustment Factor for bird and bat incidents from standardized surveys conducted at 8 1-day sites, from April 15, 2009 to June 30, 2009 and August 16, 2009 to November 15, 2009......31

Table 14. Search Intensity Area Adjustment Factor for bird and bat incidents from weekly standardized surveys conducted at 8 1-day sites from July 1, 2009 to August 15, 2009. Search intervals were switched from 1 day to 7 days for this period.32

Table 15. Search Intensity Area Adjustment Factor for bird and bat incidents from standardized surveys conducted at 15 7-day sites from April 15 to November 15, 2009.....32

Table 16. Noble Bliss scavenger removal study data for 8 1-day sites (2009)......33

Table 17. Noble Bliss scavenger removal study data for 15 7-day sites (2009)......33

NOBLE BLISS WINDPARK AVIAN AND BAT FATALITY STUDY

Table 18. Noble Bliss searcher efficiency study data for 8 1-day sites (2009).....33

Table 19. Noble Bliss searcher efficiency study data for 15 7-day sites (2009).....33

Table 20. Full season estimates (April 15 to June 30, 2009 and August 16 to November 15, 2009) for bird and bat collision mortality under 67 towers of the Noble Bliss Windpark, (without incidental finds) adjusted for Search Efficiency, Scavenge Rate, Proportion of Towers Searched, Search Intensity and Proportion of completed surveys per week, from 8 1-day Sites.34

Table 21. Estimates from 8 1-Day sites searched weekly, between July 1 and August 15, 2009, for bird and bat collision mortality under 67 towers of the Noble Bliss Windpark, (without incidental finds) adjusted for Search Efficiency, Scavenge Rate, Proportion of Towers Searched, Search Intensity and Proportion of completed surveys per week.....34

Table 22. Full season estimates (April 15 to November 15, 2009) for bird and bat collision mortality under 67 towers of the Noble Bliss Windpark, (without incidental finds) adjusted for Search Efficiency, Scavenge Rate, Proportion of Towers Searched, Search Intensity and Proportion of completed surveys per week, from 15 7-day Sites.....35

Table 23. Incidents per species found during both standardized surveys and incidentally, April 15 to November 15, 2009. Estimate of total mortality is an approximation with adjustments for Search Efficiency, Scavenge Rate, Proportion of towers Searched, Area Searched and Proportion of completed surveys per week. Estimates reported are in incidents per MW and for the total number of towers at the Noble Bliss Windpark.....36

Table 24. Bird mortality reported at U.S. wind-energy projects (from NRC 2007 and other sources)40

Table 25. BBS population trends and geographical distribution of bird species found at the Noble Bliss Windpark during standardized surveys and incidentally (April 15 to November 15, 2009).....43

Table 26. Population trends and geographical distribution of bat species found at the Noble Bliss Windpark during standardized surveys and incidentally (April 15 to November 15, 2009).....45

Table 27. Estimates of bat fatalities per turbine and per megawatt at different wind facilities in Eastern and Midwestern U.S. modified from Arnett et al. (2008).45

Table 28. Percent species composition of bat fatalities at wind facilities in Eastern and Midwestern U.S. (modified from Arnett et al. 2008).47

LIST OF FIGURES

Figure 1. Project map for the Noble Bliss Windpark 6

Figure 2. One end of a mowed transect site at the Noble Bliss Windpark..... 8

**Figure 3. Representation of carcass survey search pattern centered on a wind tower turbine
(not to scale) 10**

**Figure 4. Locations of bird incidents at the Noble Bliss Windpark found during
standardized surveys, (April 15 to November 15, 2009)..... 19**

**Figure 5. Locations of bat incidents at the Noble Bliss Windpark found during standardized
surveys, (April 15 to November 15, 2009)..... 20**

**Figure 6. Distribution of bat incidents by species, from standardized surveys conducted
from April 15 to November 15, 2009..... 21**

Figure 7. Number of birds found per month from April 15 to November 15, 2009..... 23

Figure 8. Number of bats found per month from April 15 to November 15, 2009. 23

Figure 9. Number of birds and bats found per day from April 15 to November 15, 2009. 24

**Figure 10. Density of bird incidents at 8 1-day sites, from surveys conducted from April 21
to November 14, 2008 and April 15 to November 15, 2009, in relation to distance from
towers..... 25**

**Figure 11. Density of bat incidents at 8 1-day sites, from surveys conducted from April 21 to
November 14, 2008 and April 15 to November 15, 2009, in relation to distance from
towers..... 26**

**Figure 12. Examples of searched towers showing searchable area divided into concentric
annuli 30**

EXECUTIVE SUMMARY

The Noble Bliss Windpark (Project) consists of 67 wind turbines constructed in 2007 within an area of 5,350 acres located in Wyoming County, near the town of Eagle, New York. Each turbine has a nameplate capacity of 1.5 megawatts (MW) and the project has a total capacity of the 100.5 MW. Each consists of an 80 m tall tubular steel tower, a 77 meter (253-foot) diameter rotor; and a nacelle which houses the generator, transformer, and power train. Each tower has a base diameter of approximately 5.47 meters (18 feet). The tower is topped by the nacelle which connects with the rotor hub that consists of three composite blades. With a rotor blade oriented in the 12 o'clock position, each turbine has a maximum height of approximately 389 foot (118.5 meters). All components of the turbine are painted white. Approximately 31% (21 out of 67) of the nacelles are equipped with L-864 FAA aviation obstruction beacons (lights) consisting of flashing red, strobe like lights for night.

This three-season fatality study (Spring-Summer-Fall) was conducted from April 15 – November 15, 2009. The approved protocol does not include winter studies as these are precluded by heavy snowfall and limited site accessibility. Twenty-three of 67 (34.3%) turbines in the Project were searched at one-day (N = 8 turbines and seven-day (N = 15) intervals. For a short period from July 1 to August 15, 2009, all 23 turbines were searched on a weekly basis before 8 sites reverted to daily searches. We completed a total of 1,717 individual turbine searches, equivalent to about 32 rounds of searches at the 23 sample turbines.

The planned project start date was April 15, 2009. All 1-day sites were set up and searched on the first day of the project period. Further, all 7-day sites were set up and searched within the first week, as per schedule.

The term “incident” is defined here as referring to either a fatality or injury of a bird or bat found within the wind project area and does not necessarily indicate that the cause of death or injury was wind turbine related. This term is not to be confused with the term “incidental find”, which refers to incidents found at times other than during standardized surveys and at sites outside the 23 searched towers.

A total of 25 avian incidents (carcasses) were recorded by searchers during standardized surveys, representing 11 identified species. One incident could not be identified to species because it was partially scavenged/decayed prior to being found. Of the 20 identified incidents, there were ten songbird species (One American Crow, three Blue-headed Vireos, five Bobolinks, one Brown Creeper, one Eastern Kingbird, one Hermit Thrush, one House Sparrow, one Red-eyed Vireo, one Winter Wren and two Savannah Sparrows. Besides songbirds, there was one raptor species (One Red-tailed Hawk), one columbiform species (one Mourning Dove) and one game bird species (three American Woodcocks). Also, there was one bird identified as a hummingbird species (most likely a Ruby-throated Hummingbird) and one identified only as a vireo species. We could determine migrant status for 24 incidents, out of which 22 (~91.7%) were classified as night migrants. The greatest number of bird fatalities occurred during June. A total of

seven additional avian incidents were recorded while on site, but not during standardized surveys (incidental finds). Included were one raptor species (two Red-tailed Hawks), four songbird species (one Eastern Bluebird, one Cedar Waxwing, one sparrow species, one warbler species) and one woodpecker species.

Remains of 36 bats were found by searchers during standardized surveys (April 15, 2009 to November 15, 2009), representing four species (Hoary Bat, Silver-haired Bat, Eastern Red Bat, and Little Brown Bat). Out of the 36 bats found, Hoary Bats comprised 38.9% (n = 14), Little Brown Bats comprised 16.7% (n = 6), Eastern Red Bats comprised 19.4% (n = 7), and Silver-Haired Bats comprised 16.7% (n = 6). Three carcasses (8.3%) could only be identified to *myotis* sp. The greatest number of bat incidents occurred during the fall migration period, with 25 (69.4%) bat carcasses found between August 1, 2009 and September 30, 2009. There were no incidental bat finds recorded by searchers or reported by windpark employees at times or locations other than during standardized surveys in 2009

Bat carcasses (mean = 24.0m) were found closer to turbine tower bases than bird carcasses (mean = 32.9m; data from 2008 and 2009). There was no evidence to suggest that bat fatalities were greater at turbines close to wetland areas than at turbines located farther from wetlands. There was no evidence that bat or bird fatalities were greater at wooded vs. non-wooded turbine sites. Significant differences in numbers of bat or night migrant bird fatalities were not found between lit (FAA L-864 obstruction lights) and unlit turbines.

The amount of area searchable under each tower and the numbers of towers searched per round during the project set-up stage were incorporated into calculations of final fatality estimates. In addition, carcass removal (scavenging) and searcher efficiency studies were conducted to estimate the proportion of carcasses missed by the searchers and the proportion removed by scavengers within the 1-day and 7-day search cycles. These rates, along with the proportion of towers searched and the proportion of completed surveys to scheduled surveys were used to estimate the total number of fatalities likely to have occurred during the study period at all 67 turbines at the Noble Bliss Windpark.

By dividing the estimated number of incidents by the number of turbines and by 1.5 MW per turbine searched in each period, a rate of incidents/turbine and incidents/Megawatt was calculated for the study duration. In addition, by dividing the number of incidents/turbine by the rotor swept area (m²) and multiplying that figure by 2000, we are able to show the number of incidents/2000m² rotor swept area.

The estimates for birds are:

- 1-day standardized surveys (Total period 214 days): 298 incidents/period, 2.97 incidents/Mw/period, 4.45 incidents/turbine/period and 1.91 birds per 2000m² rotor swept area/period. (Includes period from July 1, 2009 to August 15, 2009 where all 8 1-day sites were searched at 7-day intervals)
- 7-day standardized surveys (Total period 214 days): 192 incidents/period, 1.91 incidents/Mw/period, 2.87 incidents/turbine/period and 1.23 birds per 2000m² rotor swept area/period.

Migrants accounted for a large proportion of bird fatalities and the study included the peak migration period for most birds. Relatively little migration occurs during the months not searched (December-March). Thus, annual fatality rates for birds could be slightly greater. The absence of bat fatalities in the first and last few weeks of our searches indicated that the 2009 study period spanned the entire duration of bat activity (outside hibernacula/caves) in the vicinity of the Windpark. Thus, we are confident that our extrapolated results of bat mortality are ‘per year’ and directly comparable with full year studies in other regions where searching is possible throughout the year.

The estimates for bats are:

- 1-day standardized surveys (Total year 214 days): 552 incidents/year, 5.50 incidents/Mw/year, 8.24 incidents/turbine/year and 3.54 bats per 2000m² rotor swept area/year. (Includes period from July 1, 2009 to August 15, 2009 where all 8 1-day sites were searched at 7-day intervals)
- 7-day standardized surveys (Total year 214 days): 299 incidents/year, 2.97 incidents/Mw/year, 4.46 incidents/turbine/year and 1.91 bats per 2000m² rotor swept area/year.

The fatality rates and species composition of birds during the 2009 study was similar in species composition and rates of fatalities to those found at other eastern wind power project sites. Although the species composition of bats found during the study was similar to that found at other eastern sites, the numbers of bat fatalities per turbine and per megawatt of power generated were lower than at other sites, especially those from studies at Appalachian ridges. No endangered or threatened bird or bat species were found during the study.

1.0 INTRODUCTION:

This report details a post-construction collision fatality study at the 67 turbine Noble Bliss Windpark in Wyoming County, New York (Figure 1). Specifically, we describe the research design, initiation and completion of the first year of post-construction avian and bat collision fatalities. The study was done as part of conditions of the project construction permit and an agreement with the NYSDEC, as well as permits and approvals issued by NYSPSC and USACOE and the Town of Eagle Site Plan Approval. Methods used are similar to those reviewed by various wildlife agencies and academics for wind power projects in New York and other parts of the United States.

The objectives of the 2009 fatality study were to provide a quantitative estimate of the number of bird and bat fatalities that occurred at the Noble Bliss Windpark during the study period. Specifically, estimates of numbers of fatalities will be determined for:

- Birds (collective fatalities of all species),
- Bats (collective fatalities of all species),
- Bird species (species by species),
- Bat species (species by species),
- Raptors (all species collectively),
- Waterfowl (all species collectively),
- Songbirds (all species collectively), and
- Night migrants (all species collectively).

The methods described herein include searches under turbines in concert with studies of carcass removal rates (scavenging) and searcher efficiency rates. The study was conducted at a subset of 23 turbines selected randomly and on outlying perimeters from 67 total turbines on site. This study constitutes the second, and potentially final, year of a multi-year study.

1.1 Project Description

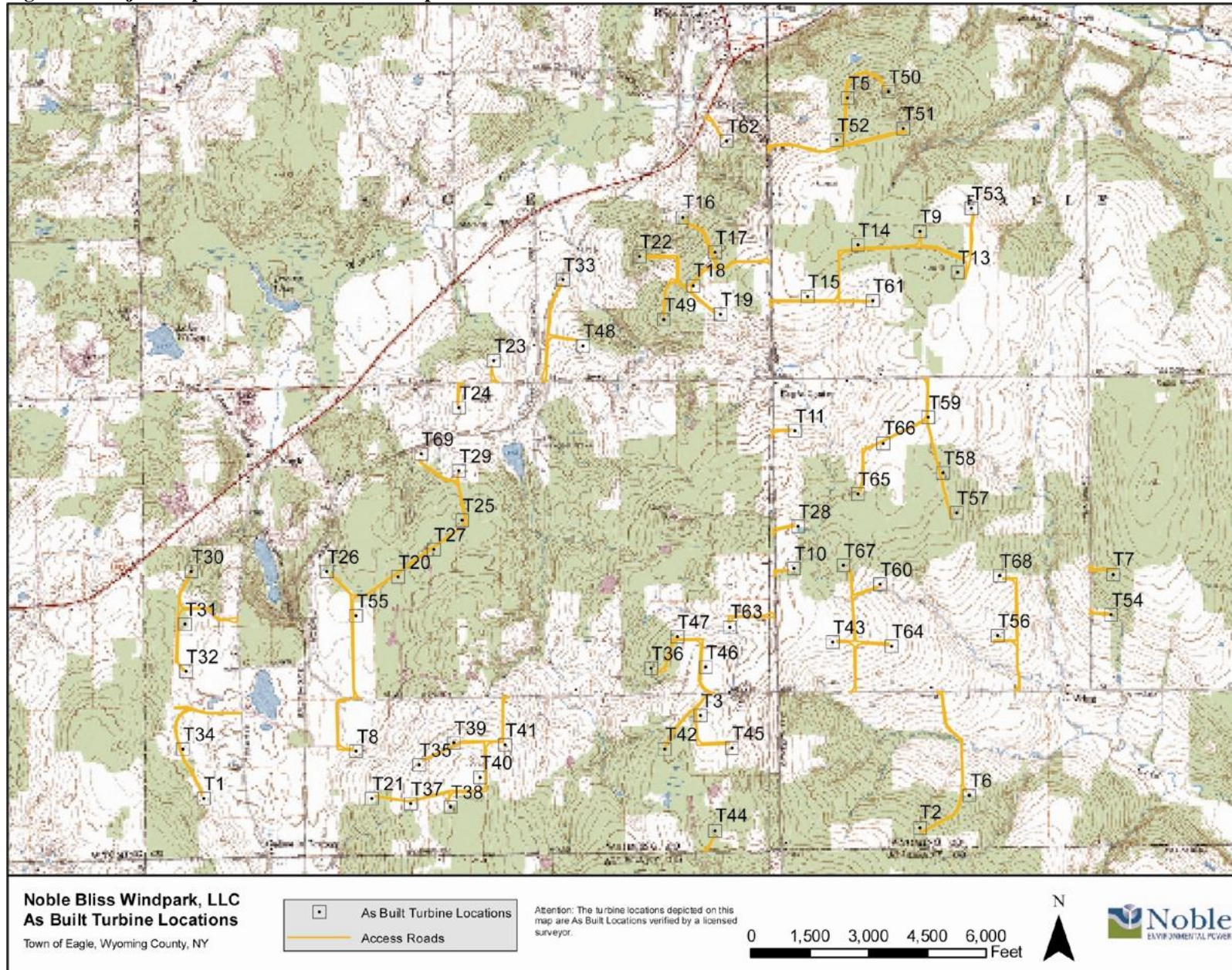
The Noble Bliss Windpark consists of 67 wind turbines located in Wyoming County, near the town of Eagle, New York. In 2007, a total of 67 General Electric 1.5 MW wind turbines were constructed within the 5,350 acre project area. The total nameplate capacity of the wind farm is 100MW. Each turbine consists of an 80 meter tall tubular steel tower, 77 meter (253-foot) diameter rotor sweep area; and a nacelle which houses the generator, transformer, and power train. Each tower has a base diameter of approximately 5.47 meters (18 feet). The tower is topped by the nacelle which connects with the rotor hub that consists of three composite blades. With a rotor blade oriented in the 12 o'clock position, each turbine has a maximum height of approximately 389 foot (118.5 meters). Approximately 30% (21 of 67) of the nacelles are equipped with L-864 FAA aviation obstruction beacons (lights) consisting of flashing strobes (red at night). At the base of each tower is a gravel pad of varying area and a gravel access road that is about 3.5–5m wide.

1.2 Study Area

The Project is located in the Town of Eagle, Wyoming County and includes a total of approximately 5,350 acres. The site is located in a rural and agricultural area with elevations ranging from less than 1,700 feet to a county-high elevation of slightly greater than 2,100 feet above mean sea level. The majority of the area consists of open crop fields (primarily hay and corn) and pastures, with forested areas generally confined to woodlots and wooded wetlands. The northern-most area of the site is densely forested. The site also includes successional old field, hedgerow, successional shrubland, yards, farms and ponds. Existing built features within the site boundaries include single-family homes, barns, silo and agricultural buildings. The substation is located in the southwestern portion of the site.

Several local paved and gravel roads are present and existed prior to construction of the wind project. The site is bordered by NYS Route 39 to the north and Washburn Road to the south. Cadwell Road is located approximately 1 mile east of the western project boundary and Lyonsburg Road is located approximately 1 mile west of the eastern project boundary. The site is bisected by Centerville, McElroy and Robinson/McCall Roads from north to south. Wing Street and Telegraph Road traverse the site from east to west. During construction, approximately 16 miles of gravel access roads were created over farmland and through forested areas to allow vehicle access to service the towers (Figure 1).

Figure 1. Project map for the Noble Bliss Windpark



2.0 METHODS

2.1 Carcass Surveys

2.1.1 Site Selection

The same twenty-three turbine sites selected in 2008 were chosen to be searched during the 2009 season. Site selection was completed primarily through a process of randomization and stratification making sure a number of project boundary sites were included. Some sites were excluded due to lack of landowner consent. All turbine locations were surveyed, and classified broadly as bare ground, shrubs, wooded, agricultural (hay) and agricultural (corn). Most sites belonged to two or more classes (e.g. agricultural (hay) with woodlot and shrubs). Of the twenty-three sites selected, 8 daily, 8 three-day and 7 weekly sites were chosen in 2008. The 8 three-day sites were converted to weekly sites in 2009 for a total of 15 weekly sites. Site surveys began on April 15, 2009, the project start date agreed upon in the protocol. All daily sites were set up and searched by April 15 and all weekly sites were set up and searched within the first week starting April 15, 2009. During the period of June 21 to August 8, 2009, we did not search the crop area of Site 26 due to farming activity. The primary ground cover at the various sites under which searches occurred is shown in Table 1. From the period July 1 to August 15, 2009, all daily sites were searched at 7 day intervals as per agreed study protocol. After this period, daily searches were continued.

Searches were conducted when weather and other conditions permitted. Surveys were not conducted during periods of tower work, lightning or ice formation on the blades.

Table 1. Noble Bliss site selection indicating 23 out of 67 sites selected.

Turbine Number	Search Frequency	Wooded Ring¹	Full Site²	Primary Habitat
1	7-day	Yes	No	Wooded with hay offsite-southwestern perimeter site
6	7-day	No	No	Wooded with hay to side-southeastern perimeter site
8	7-day	No	No	Hay
11	7-day	No	No	Woods and hay with stream offsite
16	7-day	No	No	Mixed woods and apple orchard-northwestern perimeter site
19	1-day	No	No	Meadow with trees and wetland to one side
25	7-day	Yes	No	Wooded
26	7-day	No	No	Wooded on three sides and corn on the other ³
30	7-day	Yes	No	Wooded
33	7-day	No	No	Corn with woods to one side-northwestern perimeter site
38	7-day	No	No	Wooded with hay to side-southern perimeter site
40	1-day	No	No	Hay with trees to one side
42	1-day	Yes	No	Mixed woods
44	7-day	Yes	No	Wooded-southern perimeter site

NOBLE BLISS WINDPARK AVIAN AND BAT FATALITY STUDY

Turbine Number	Search Frequency	Wooded Ring ¹	Full Site ²	Primary Habitat
46	1-day	No	No	Hay with trees to one side
49	7-day	Yes	No	Wooded
50	1-day	Yes	No	Wooded-northeastern perimeter site
53	7-day	Yes	No	Wooded-northeastern perimeter site
60	7-day	Yes	No	Wooded with wetland and hay offsite
61	1-day	No	Yes	Hay
63	1-day	No	No	Hay to one side, trees and shrubs to two sides. Wetland at the southern site edge
64	1-day	No	Yes	Hay
66	7-day	No	No	Wooded/shrubs/hay/X'mas tree farm

1 Wooded Ring indicates that turbine was constructed in a forest clearing with less area than the 120m by 120m area

2 Full site indicates full 120m by 120m search area, with some search obstructions at search boundaries.

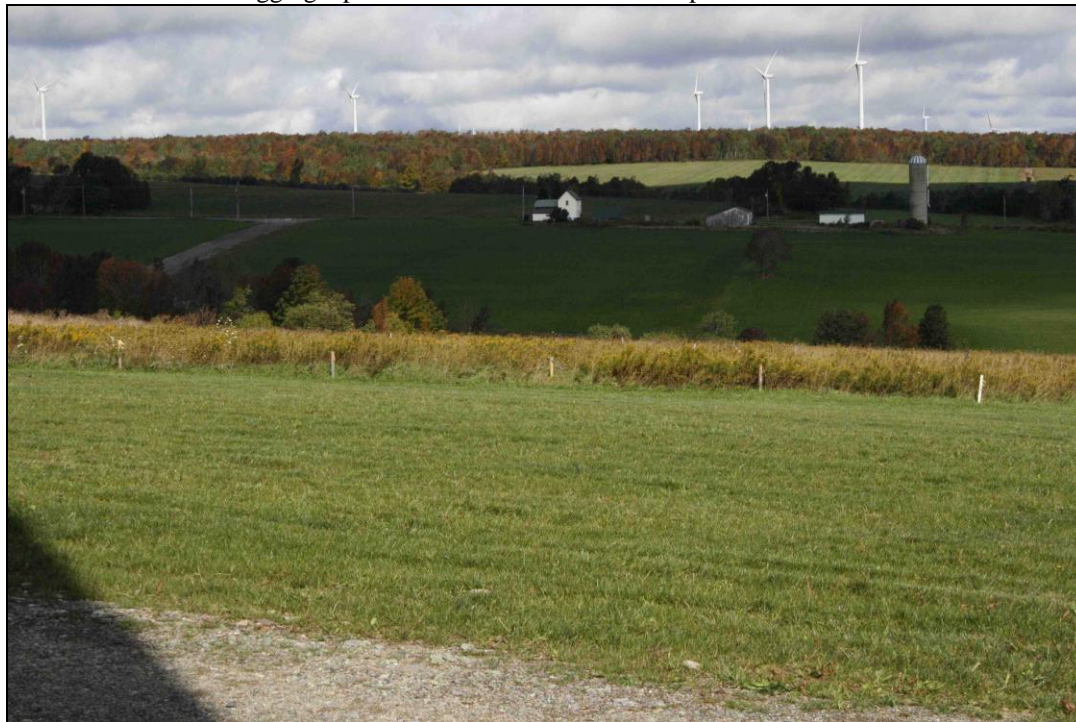
3 Transect area is decreased at knee high corn growth and increased back after harvest

2.1.2 Standardized Surveys

Carcass surveys were conducted daily at 8 wind turbine sites, and weekly at the remaining 15 sites. Searchers and search times were varied over the course of the project to reduce the chance of towers being continually surveyed at the same time of day or by the same searcher. The staffing of search teams was also varied on a daily basis.

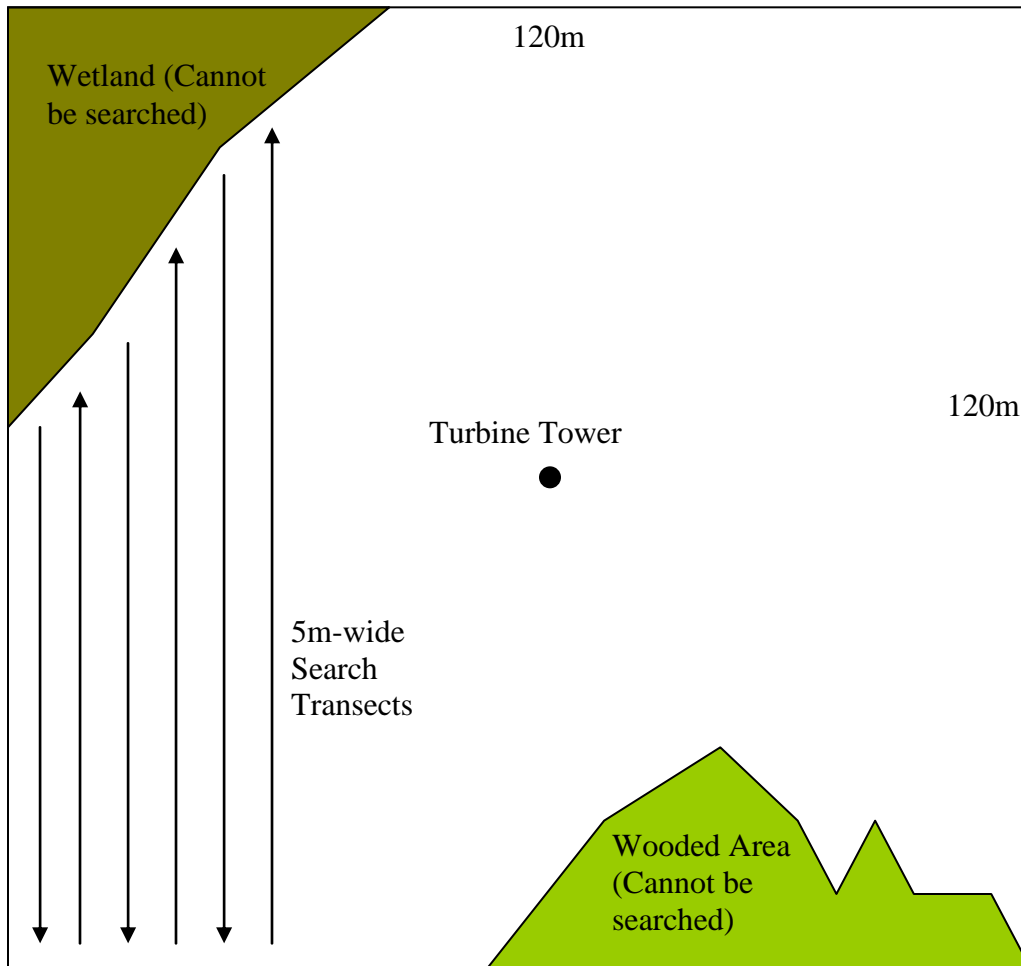
Figure 2. One end of a mowed transect site at the Noble Bliss Windpark

Wooden stakes with flagging tape indicate the ends of 5m wide parallel transects.



The survey consisted of searchers walking in parallel transects within an overall search area of 120m by 120m (14,400m²), centered on the tower. While walking in each 5m wide transect, the searcher used the unaided eye, alternately scanning an area that extended for 2.5m (compares favorably to studies conducted at other windparks as summarized in Johnson *et al.* 2003) on either side of his/her track (Figure 3). The surveyors used range finders to initially establish and flag the beginning, midpoint and end of each transect. Site by site differences did remain. Towers that were constructed by clearing wooded areas had heavily wooded areas approximately 35-45m from the tower base. These wooded sites could only be cleared and searched out to the tree line. Non-wooded sites were searched to the full extent of the designed search area, subject to local site conditions that may have been barriers to searching (un-cleared brush, wetlands, etc). A sub-meter accurate GPS Trimble XRS unit was used to measure the searchable area under each turbine. Data recorded at the beginning of the surveys included meteorological data (cloud cover, temperature and wind velocity) and ground cover information (crop type and height). In addition, the start and finish times were recorded for each tower searched (Appendix A). With respect to birds, any feathers or clumps of feathers with flesh attached were recorded as a fatality. Loose feathers were not considered fatalities unless there were several primary or tail feathers indicating more than could be lost during molting. When unattached single loose feathers were found their location was recorded and the feathers were removed and retained but not recorded as a fatality. Small feathers such as down feathers were also not recorded, since these most likely were lost as a result of normal preening. In any event, this type of remains was too scant to confirm death or assign cause of death.

Figure 3. Representation of carcass survey search pattern centered on a wind tower turbine (not to scale)



When a carcass or injured bird or bat was found, the searchers performed a thorough investigation and documentation of the incident using the practices identical to those used in previous years of research overseen by the NYSDEC and the USFWS at the Maple Ridge WRA in Lewis Co., NY, as described in Jain et al 2007, 2008. An incident report number was assigned and an incident report filled out for each find (Appendix B). A Global Positioning System unit (GPS) was used to determine geographic coordinates, and a range finder and compass were used to determine distance and bearing from the tower. Distance of the carcass from the centerline of the transect (the line the searcher walked) was also measured. The carcass was photographed in the position in which it was found, using a digital camera, and a preliminary identification was made. After identifying the animal by species (including age and sex when possible), an examination was performed to determine the nature and extent of any injuries, and whether any scavenging or insect infestation had occurred. In case of dismemberment, the surveyors searched the vicinity to locate all body parts. In case of avian incidents, all loose feathers were collected in order to avoid identifying the feathers as an additional kill during the next survey of the tower. The bird or bat carcass was then placed in a plastic bag labeled with date, species, tower number and incident report number, and taken to a freezer to be stored in accordance with the USFWS permit requirements. When carcasses were found at times and locations outside of one of the standardized surveys conducted as part of this study, the carcass was processed as above but it was classified as an “incidental” find. Unidentifiable bird and bat finds were identified at the end of the study season by Brianna Gary and Alan Hicks (NYSDEC).

When an injured bird was found, the protocol required that the searchers recorded the same data collected for a carcass, noting that it was an injury and not a fatality. The searchers were to then capture and restrain the animal in a manner to avoid either further injury to the animal or injury to the survey crew. Once the animal was secured it was to be transported to a wildlife rehabilitator or veterinarian. No such avian incidents were noted at the Noble Bliss Windpark in 2009. Rabies related precautions precluded the handling and rehabilitation of injured bats in New York State. No injured bats were found or reported by windpark employees. Only in those cases where the animal was in proximity to a specific turbine would a turbine number be recorded as the location in the report. When no corroborating information that the injury was linked to a tower was available, the animal was simply recorded as an “incidental” find.

The permits issued by the NYSDEC and the USFWS dictated that if the carcass or injured animal found was listed as a threatened or endangered species, or a species of concern, the USFWS was to be notified immediately by telephone, and collection of the dead/injured animal was to be delayed until specific direction for proceeding was received from the USFWS. No such species were noted in 2009.

As described in the protocol, the first carcass survey at each site was considered a “clean sweep” conducted at all newly installed and operational wind turbine towers. All carcass remains noted in the first search were removed and treated as incidental finds to increase the likelihood that all carcasses found during the subsequent surveys would be associated with incidents that occurred during the course of the standardized surveys. Clean sweeps were conducted using the same protocol as used in the standardized carcass surveys.

2.1.3 Adjustment Factors Applied to Raw Data:

2.1.3.1 Adjustment for Proportion of Complete Surveys per Week (W_s):

An important consideration in the accuracy of post-construction bird and bat mortality studies is the ability to search at regular planned intervals. We adjusted our raw data in the following manner: We divided the number of incidents found at 1-day and 7-day sites over the entire study period by the ratio (W_s) of searches scheduled to searches completed at the 8 and 15 sites searched, respectively, to obtain adjusted figures. See Sections 3.3.1.1 for the effect of this adjustment factor.

2.1.3.2 Area Searched: Search Sites Limited by Mowing Obstacles:

Because the areas searched under turbines in the Noble Bliss Windpark were limited by habitat conditions such as trees, shrubs and wetlands that could not be cleared, we applied an area adjustment factor to the number of incidents found at partially searched sites. We used a sub-meter accuracy GPS Trimble unit to measure the cleared search area within each search site. We analyzed the extent of searchable area within the 120m by 120m area with ESRI ArcGIS software. The total number of incidents (separately for size classes: small, medium-large birds and bats) was separated into 10-m incremental annuli (0-10m, 10.1-20m, etc.) that fell within the 120m by 120m search area for all turbines (Tables 15, 16 and 17, Figure 12). Then, the fatality numbers for each annulus were divided by the percent area searched in that annulus. For example, if 5 bat fatalities were found in the 40.1-50 meter annulus (at all daily turbine sites), and if 50% of the available area in that annulus was searchable, then 5 would be only half of the total number of bats in that annulus. Therefore, $(5/0.50) = 10$ area-adjusted bat fatalities for that annulus. Similar calculations were applied to weekly sites. Searcher efficiency and Scavenger removal adjustments were applied after this area adjustment process. We based our adjustment factor on prior work in Fiedler et al. (2007).

2.1.3.3 Searcher Efficiency, Scavenger Removal, Proportion of Operational Towers Searched

In addition to the earlier adjustments made, it is generally recognized that the number of carcasses found under the towers is lower than the total number of birds and bats likely to have been killed due to three additional adjustment factors. The first is the possibility that the searchers will miss carcasses due to the amount of ground cover or the size and camouflage of the species. A second possibility is that the carcasses are removed prior to the time the searchers arrive on location after the collision event occurred. Finally, the estimate of incidents must be adjusted by the ratio of the number of towers searched to the number of operational towers in the windpark. Applying these adjustment factors to the actual number of carcasses found during standardized surveys reduces underestimation of mortality due to these factors. Several scavenger removal and searcher efficiency studies conducted throughout the study duration in 2009 estimated the proportion of carcasses missed by the searchers and the proportion removed by scavengers within 1 and 7-day search cycles.

We made the following adjustments to extrapolate the mortality counts to estimated mortality for the entire wind farm. We adjusted the number of incidents found, previously corrected for

Project Set-up Period and Area Searched, (C), for Scavenger efficiency (Sc), Search efficiency (Se) and Proportion of towers searched to the total of 67 operational towers in the windpark (Ps).

a) Proportion of test carcasses left by scavengers within the search period (Sc).

The scavenge rate (Sc) was measured over 9 tests (10-June, 22-June, 12-July, 28-July, 30-July, 8-Aug, 3-Sep, 4-Sep and 26-Sep) by placing 33 bat carcasses, 23 house mice carcasses (*Mus musculus*), 24 small bird (sparrow sized) carcasses and 20 medium-large bird (American Woodcock-Canada Goose sized) carcasses on mortality transects at various searched sites in the Bliss Windpark. Placements were made without the knowledge of the search crew by an individual not involved in the surveying. Carcasses were distributed among searched sites during the late afternoon-early evening before Day 1 of the test (Appendix D). Latex gloves and plastic bags were used to ensure that carcasses did not come into direct contact with the person placing them on site. Placement bias prevention measures included dropping carcasses at varied distances to tower base, and at all types of searched ground cover (gravel, grass/hay and corn stubble). Carcasses were dry and partially thawed when placed. Field technicians monitored carcasses daily for evidence of scavenging until all carcasses were scavenged or deemed too decomposed/picked clean by insects, typically from 10 days to 4 weeks. The status of each carcass was reported as completely intact (CI), partially scavenged with carcass or large group of feathers remaining (PSC/PSF) or no remains (NR). Movement of carcasses was noted, although this could not always be distinguished from weather related events. The probability of a collision event is equally distributed over all days of the search cycle (1 or 7 days). Thus, the overall duration between carcass fall and discovery is approximately half the actual search cycle (0.5 or 3.5 days respectively). For example, if a carcass was discovered at a 7-day search site, it had an equal probability of having hit the tower on each of the previous 7 nights. The average time between impact and discovery is $(1 + 2 + 3 + 4 + 5 + 6)/6 = 3.5$ days (rounded to 4 days). Thus, the scavenge rate was calculated for the number of test carcasses that remained visible (body of carcass not removed or severely scavenged) after 1 and 4 days, for the 1-day and 7-day search sites, respectively.

b) Proportion of carcasses not missed by observers in the search efficiency trials (Se).

The carcasses used to test for Search Efficiency were a subset of the ones used to test for the Scavenge Rate (the carcasses that were not scavenged before the technicians arrived onsite). The dates of search efficiency trials coincided with the start dates of scavenging trials. Search efficiency trials were conducted for each observer by placing bat carcasses, tail-less brown house mouse (*Mus musculus*) carcasses as well as bird carcasses of different sizes, small and medium-large, under towers in the Bliss Windpark, without the knowledge of the searchers. Carcasses were placed during the late afternoon-early evening before Day 1 of the test. The individual placing carcasses did not walk directly from the gravel access area to the carcass location, and took care not to leave obvious tracks in grass/mud. The searchers recorded all carcasses that they discovered, including planted carcasses (which were identifiable by a small tag attached to and hidden below the carcass). Some test carcasses that were not found during the initial search were found in subsequent searches. Technicians were not informed as to their location during subsequent searches. Counting these “late finds” allowed us to more accurately model actual search conditions, where some collision related carcasses were found that showed evidence of decomposition and weathering from lying on the ground for over a week, and had probably been missed in initial searches. Thus, we incorporated into

our model those carcasses that were not found in the first search after collision mortality occurred, but were found during subsequent searches prior to a scavenging event. This marks an improvement over the Se rate used in the adjustment model in Jain et al 2007, 2008. The effect of this change on the results from adjustments to weekly searches is small, as most carcasses were scavenged before a second round of searches, a week later. Planted evidence of collisions was later removed from the database and a mean search efficiency rate (Se) was calculated as the ratio of test carcasses found prior to scavenging to test carcasses not scavenged. Carcasses that were missed were checked immediately after searches, by the individual that placed the carcasses, to ascertain whether they had already been scavenged.

Proportion of towers searched to the total of 67 operational towers in the windpark (Ps). Ps for the 8 1-day sites was $8/67 = 11.94\%$ and Ps for the 15 7-day sites was $15/67 = 22.39\%$.

$$\text{Thus, } \hat{C} = \frac{C}{Sc \times Se \times Ps}$$

Where \hat{C} = Adjusted total number of kills estimated at the windpark.

The variance of the number of kills found was first calculated per tower using standard methods (Ramsey and Schafer, 2002). Then, we calculated the variance due to the adjustment factors Sc and Se , using the variance of a product formula (Goodman, 1960). The variance of the product of Sc and Se is:

$$\text{Var}(\hat{C}) = \hat{C}^2 \times \left[\frac{\text{var } C}{C^2} + \frac{\text{var}(Sc \times Se)}{Sc \times Se} \right]$$

We used this procedure for the 1 and 7-day search frequencies to get an estimate of mortality for birds and bats.

3.0 RESULTS

3.1 Search Effort

3.1.1 Summary of Search Effort

As described in the study protocol and methods, the first carcass survey at each site was considered a “clean sweep” of all newly installed and operational wind turbine towers. All carcass remains noted in the first search were removed to increase the likelihood that carcasses found during subsequent surveys would be associated with incidents that occurred during the course of standardized surveys. Clean sweeps were conducted using the same protocol as used in the standardized carcass surveys (see below).

1-day Sites:

179 rounds (1,220 turbine searches) of standardized searching were conducted from April 15, 2009 to June 30, 2009 and August 15, 2009 to November 15, 2009 (Table 2). The total search period was 179 days.

All eight 1-day sites were established and searched by April 15, 2009. Searches were ended on November 15, 2009, as per the study protocols.

7-day sites

Thirty-one rounds (497 turbine searches) of standardized searching were conducted between April 15, 2009 and November 15, 2009. All 15 search sites were set up and searched in the first search round. The total search period was 214 days. Also, between July 1, 2009 and August 15, 2009, all 1-day sites were searched on a weekly basis, as per study protocols.

Most turbines were searched as frequently as the protocol described, although minor weather and significant human related disruptions occurred. If a scheduled search could not be conducted, field technicians accessed the sites at the earliest available date before the next search round was to occur.

Over the entire season, 1-day sites were searched an average number of days between successive searches of 1.11 days. 7-day sites were searched at an average number of days between successive searches of 7.15 days. When 1-day sites were temporarily switched to the 7-day search cycle (between July 1 – August 15, 2009), all 8 of those sites were searched once a week, as per schedule, with no missed searches (average number of days between searches of 7.00 days). Table 2 provides greater details on number of searches per tower. The footnotes “a, b and c” denote reclamation/tower work, landowner approval/site set up delay and inclement weather, respectively, as three primary reasons why all searches were not carried out as scheduled during a particular week.

NOBLE BLISS WINDPARK AVIAN AND BAT FATALITY STUDY

Table 2. Number of surveys completed at all 23 survey towers from April 15 to November 15, 2009.

Survey Round	Search Period		Daily Survey Sites (8)	Weekly Survey Sites (15)	Total Surveys per Round
	Start Date	End Date			
Round 1 ^(1,2)	4/15/09	4/18/09	31	10	41
Round 2	4/19/09	4/25/09	56	15	71
Round 3 ⁽²⁾	4/26/09	5/2/09	54	15	69
Round 4 ⁽²⁾	5/3/09	5/9/09	55	15	70
Round 5 ^(2,3)	5/10/09	5/16/09	40	14	54
Round 6 ^(4,5)	5/17/09	5/23/09	52	13	65
Round 7	5/24/09	5/30/09	56	15	71
Round 8 ⁽²⁾	5/31/09	6/6/09	55	15	70
Round 9	6/7/09	6/13/09	56	15	71
Round 10 ^(2,3)	6/14/09	6/20/09	49	15	64
Round 11 ^(2,3,4)	6/21/09	6/27/09	45	15*	60
Round 12 ^(1,3)	6/28/09	7/4/09	16	17*	33
Round 13	7/5/09	7/11/09	23*		23
Round 14	7/12/09	7/18/09	23*		23
Round 15	7/19/09	7/25/09	23*		23
Round 16	7/26/09	8/1/09	23*		23
Round 17	8/2/09	8/8/09	23*		23
Round 18 ⁽¹⁾	8/9/09	8/15/09	8	21*	29
Round 19 ⁽³⁾	8/16/09	8/22/09	48	14*	62
Round 20 ⁽³⁾	8/23/09	8/29/09	55	15*	70
Round 21 ⁽²⁾	8/30/09	9/5/09	54	14*	68
Round 22	9/6/09	9/12/09	56	15*	71
Round 23 ⁽²⁾	9/13/09	9/19/09	54	15*	69
Round 24 ⁽²⁾	9/20/09	9/26/09	54	15*	69
Round 25 ^(2,3)	9/27/09	10/3/09	46	15*	61
Round 26 ^(2,3)	10/4/09	10/10/09	47	15*	62
Round 27 ^(2,3)	10/11/09	10/17/09	36	9*	45
Round 28 ⁽⁶⁾	10/18/09	10/24/09	52	15	67
Round 29 ^(2,3)	10/25/09	10/31/09	46	13	59
Round 30 ^(2,3)	11/1/09	11/7/09	35	15	50
Round 31	11/8/09	11/14/09	56	15	71
Round 32 ⁽¹⁾	11/15/09	-----	8	2	10

1. Partial week surveyed or transition between dailies and weeklies and all weekly

2. Turbine maintenance

3. Weather conditions

4. Surveys cancelled by directive of Noble

5. Mowing not complete/site not set

6. Survey cancelled due to crew shortage

*Site 26 field not surveyed due to crop growth

Note from 7/1/09 to 8/15/09 all sites were searched weekly

3.2 Incidents Recorded During Standardized Surveys and Incidentally

During this study, a total of 36 avian fatalities/injuries (incidents) and 32 bat fatalities/injuries (incidents) were recorded during standardized surveys at turbine towers as well as incidentally reported. Incidentally reported carcasses included finds by windpark employees at any of the 67 turbine sites and finds by field technicians not in standardized search plots or not during standardized searches. Of these 32 bird carcasses, we found 7 (21.88%) incidentally. We found no incidental bat carcasses.

3.2.1 Birds

A total of 25 avian incidents were recorded by searchers during standardized surveys under wind turbines, representing 22 incidents identified to 13 species. Two incidents were identified as a hummingbird species only (most likely a Ruby-throated Hummingbird) and a vireo species only, respectively. One incident could not be identified to a taxonomic group because it was partially scavenged or decayed prior to being found (Table 3). Of the 22 identified incidents, there were 10 songbird species (One American Crow, three Blue-headed Vireos, five Bobolinks, one Brown Creeper, one Eastern Kingbird, one Hermit Thrush, one House Sparrow, one Red-eyed Vireo, one Winter Wren and two Savannah Sparrows. Besides songbirds, there was one raptor species (one Red-tailed Hawk) one Columbiform species (one Mourning Dove) and one game bird species (three American Woodcocks).

We identified the migrating pattern of 24 of these incidents (night vs. day migrants and non-migrants), 22 (91.7%) of which were classified as night migrants. All 18 identified songbirds, (excluding incidental finds), were night migrants. While these birds are classified as ‘night migrants’ we could not ascertain that they were in the process of migration at the time of collision. Thus, a minimum of 22 of 25 (88%) avian incidents belonged to species known to migrate at night although not all were necessarily migrating when the collisions occurred.

3.2.1.1 Incidental Finds:

A total of 7 avian incidents were recorded by searchers or reported by windpark employees at times or locations other than during standardized surveys on weekly searched sites (Table 3). The mix of taxa represents night and daytime migrants. Included were 2 raptor species (2 Red-tailed Hawks), 4 songbird species (one Eastern Bluebird, one Cedar Waxwing, one sparrow species and one warbler species) and one woodpecker species.

In Table 3, the incidental finds (those not found during regularly scheduled turbine searches) are listed in a separate column by species, but are not included in either the totals or calculations.

Table 3. Number of avian incidents at each wind turbine by species group found during standardized surveys and “incidentally” from April 15 to November 15, 2009.

Tower #	Search Frequency	Number of Bird Incidents					Incidental
		Other	Raptor	Unidentified bird	Passerine	Total Std.	
64	1-day	1	0	0	5	6	0
63	1-day	1	0	0	2	3	0

NOBLE BLISS WINDPARK AVIAN AND BAT FATALITY STUDY

Tower #	Search Frequency	Number of Bird Incidents					
		Other	Raptor	Unidentified bird	Passerine	Total Std.	Incidental
19	1-day	1	0	0	1	2	1
46	1-day	0	0	0	2	2	0
40	1-day	0	0	0	1	1	0
50	1-day	0	0	0	1	1	0
61	1-day	0	0	0	1	1	1
38	7 Day	0	1	0	1	2	0
6	7 Day	0	0	0	1	1	0
16	7 Day	0	0	1	0	1	1
25	7 Day	0	0	0	1	1	0
26	7 Day	0	0	0	1	1	0
30	7 Day	0	0	0	1	1	1
49	7 Day	0	0	0	1	1	1
53	7 Day	1	0	0	0	1	0
34	Non-Survey	--	--	--	--	--	1
66	Non-Survey	--	--	--	--	--	1
	Totals	4	1	1	19	25	7

1. Sorted by Search frequency and total number of avian fatalities (Total Std.).

2. Includes incidents associated with wind turbines found during standardized surveys and “incidentally.”

Figure 4. Locations of bird incidents at the Noble Bliss Windpark found during standardized surveys, (April 15 to November 15, 2009).

Note: Maps include incidents considered to be associated with a wind turbine only, and not those found incidentally.

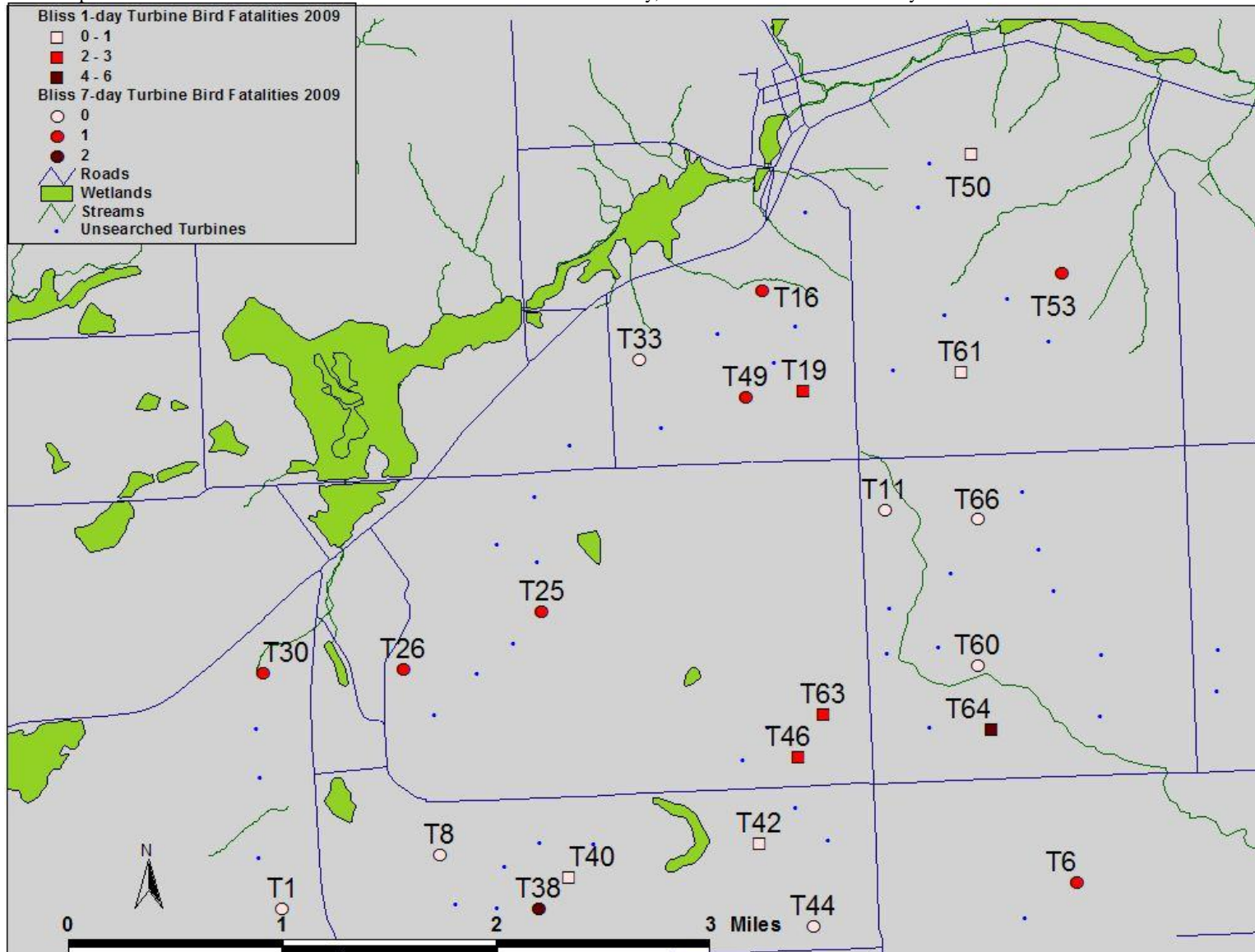
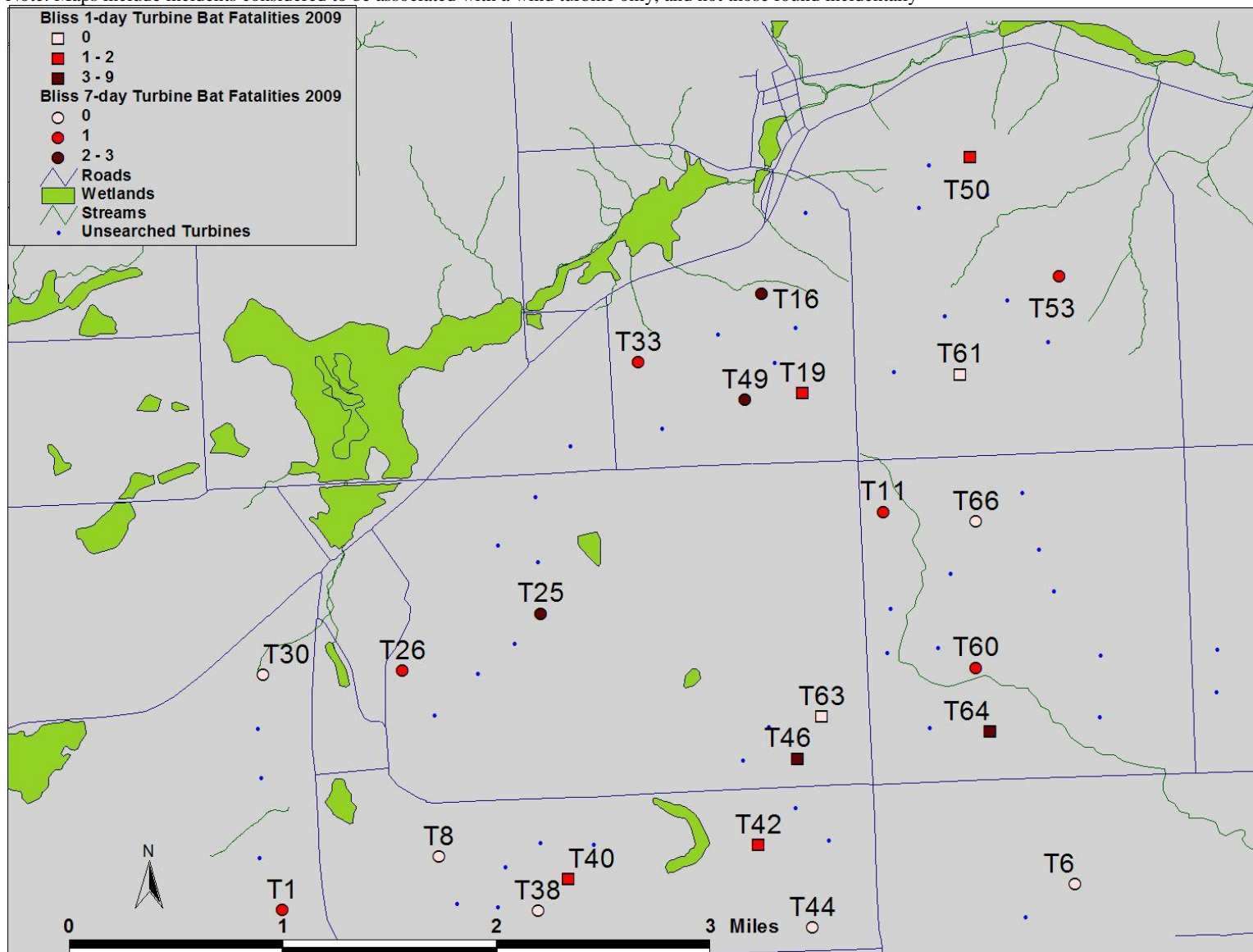


Figure 5. Locations of bat incidents at the Noble Bliss Windpark found during standardized surveys, (April 15 to November 15, 2009).

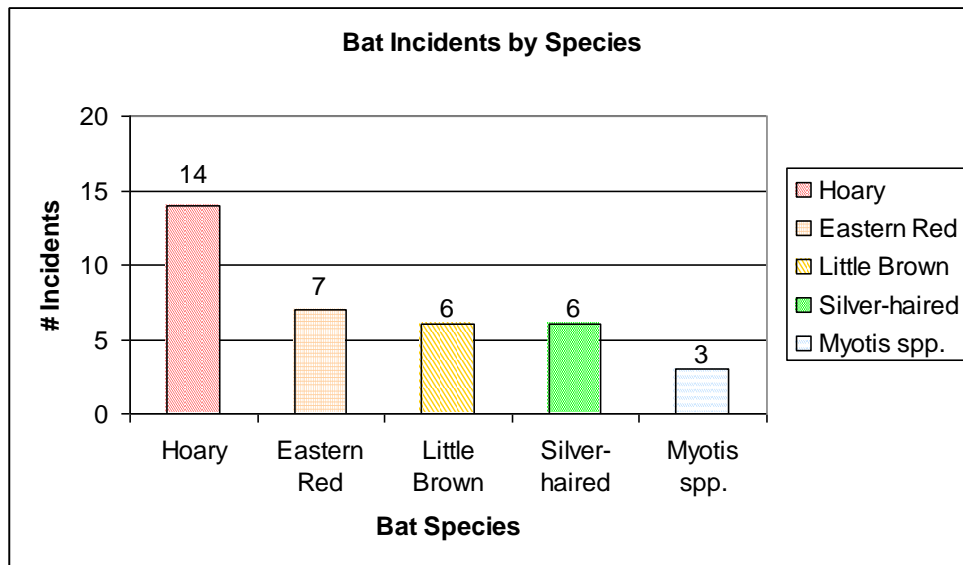
Note: Maps include incidents considered to be associated with a wind turbine only, and not those found incidentally



3.2.2 Bats

Remains of 36 bats were found by searchers during standardized surveys (April 15, 2009 to November 15, 2009), representing four species (Hoary Bat, Silver-haired Bat, Eastern Red Bat, and Little Brown Bat). Out of the 36 bats found during standardized surveys (Figure 6), Hoary Bats comprised 38.9% (n = 14), Little Brown Bats comprised 16.7% (n = 6), Eastern Red Bats comprised 19.4% (n = 7), and Silver-Haired Bats comprised 16.7% (n = 6). Three carcasses (8.3%) could only be identified as Myotis sp.

Figure 6. Distribution of bat incidents by species, from standardized surveys conducted from April 15 to November 15, 2009.



3.2.2.1 Incidental Finds

There were no incidental bat finds recorded by searchers or reported by windpark employees at times or locations other than during standardized surveys in 2009

Table 4 shows the number of bat incidents associated with specific wind turbines found during standardized surveys as well as incidental finds.

Table 4. Wind turbine locations of bat incidents by species.

Turbine #	Search Frequency	Hoary	Silver	Little Brown	Eastern Red	Myotis Sp.	Total	Incidental
46	1-Day	3	2	2	3	0	10	0
64	1-Day	2	2	1	0	0	5	0
19	1-Day	0	1	1	0	0	2	0
40	1-Day	1	0	0	1	0	2	0
42	1-Day	1	0	1	0	0	2	0
50	1-Day	1	0	0	0	0	1	0
61	1-Day	0	0	0	0	0	0	0

NOBLE BLISS WINDPARK AVIAN AND BAT FATALITY STUDY

Turbine #	Search Frequency	Hoary	Silver	Little Brown	Eastern Red	Myotis Sp.	Total	Incidental
63	1-Day	0	0	0	0	0	0	0
16	7-Day	1	0	0	1	1	3	0
49	7-Day	2	0	0	1	0	3	0
25	7-Day	1	0	1	0	0	2	0
1	7-Day	1	0	0	0	0	1	0
11	7-Day	0	0	0	0	1	1	0
26	7-Day	0	1	0	0	0	1	0
33	7-Day	0	0	0	0	1	1	0
53	7-Day	0	0	0	1	0	1	0
60	7-Day	1	0	0	0	0	1	0
6	7-Day	0	0	0	0	0	0	0
8	7-Day	0	0	0	0	0	0	0
30	7-Day	0	0	0	0	0	0	0
38	7-Day	0	0	0	0	0	0	0
44	7-Day	0	0	0	0	0	0	0
66	7-Day	0	0	0	0	0	0	0
	Totals	14	6	6	7	3	36	0

3.2.3 Seasonal Distribution of Fatalities (Birds and Bats)

This project was conducted during three seasons; from mid-April until the scheduled project end in mid-November. We were able to discern distinct patterns in seasonal mortality for bats. The greatest number of bat incidents occurred during the fall migration period, with 25 (69.4%) bat carcasses found between August 1, 2009 and September 30, 2009 (Table 5 and Figures 8 and 9). The number of incidents declined sharply in subsequent months, as fall migration concluded and temperatures became colder. The last bat incident was noted on October 18, 2009.

The greatest number of bird incidents occurred during June (Table 5, Figures 7 and 9) but numbers were too small to determine if this was by chance or if there was really a seasonal pattern of fatalities.

Table 5. Number of birds and bats found per month, from April 15 to November 15, 2009

Species Group	Apr ¹	May	June	July	August	September	October	November ¹
Raptor	0	0	0	1	0	0	0	0
Passerine	1	2	8	2	1	1	2	1
Other Bird	1	1	0	0	1	1	1	0
Unknown	0	0	0	0	0	0	0	1
Total Birds	2	3	8	3	2	2	3	2
Bats	2	2	5	1	16	9	1	0

¹Searches began on April 15, 2009 and were concluded on November 15, 2009.

Figure 7. Number of birds found per month from April 15 to November 15, 2009.

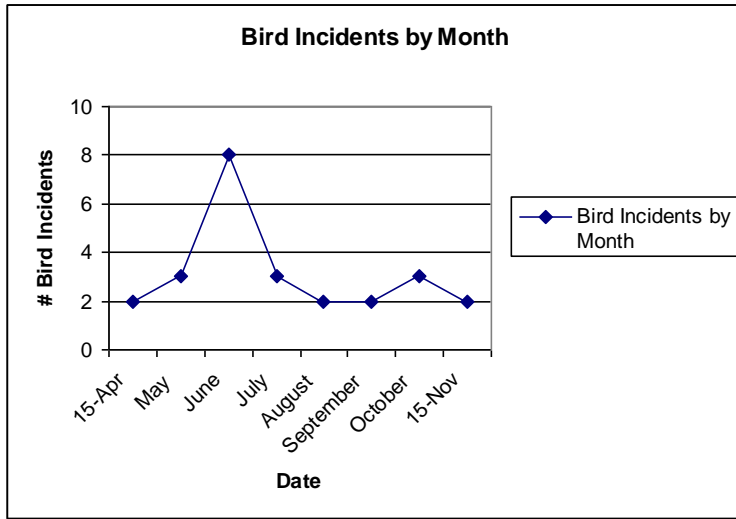


Figure 8. Number of bats found per month from April 15 to November 15, 2009.

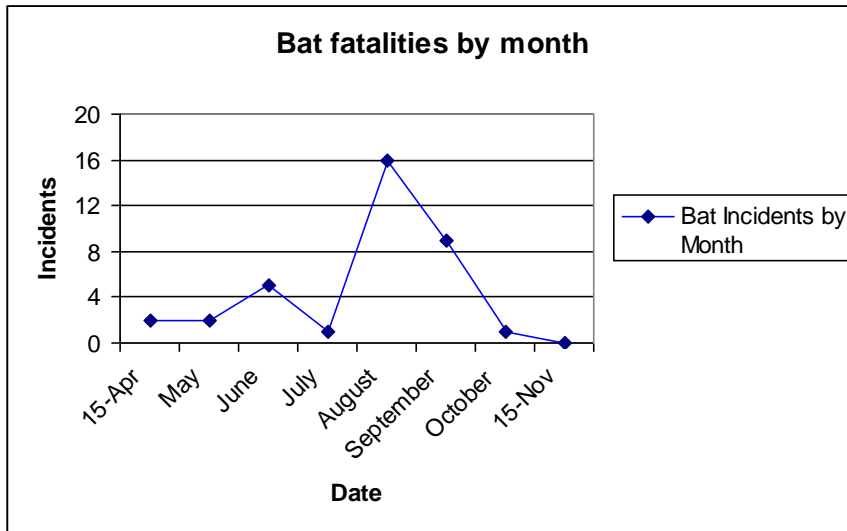
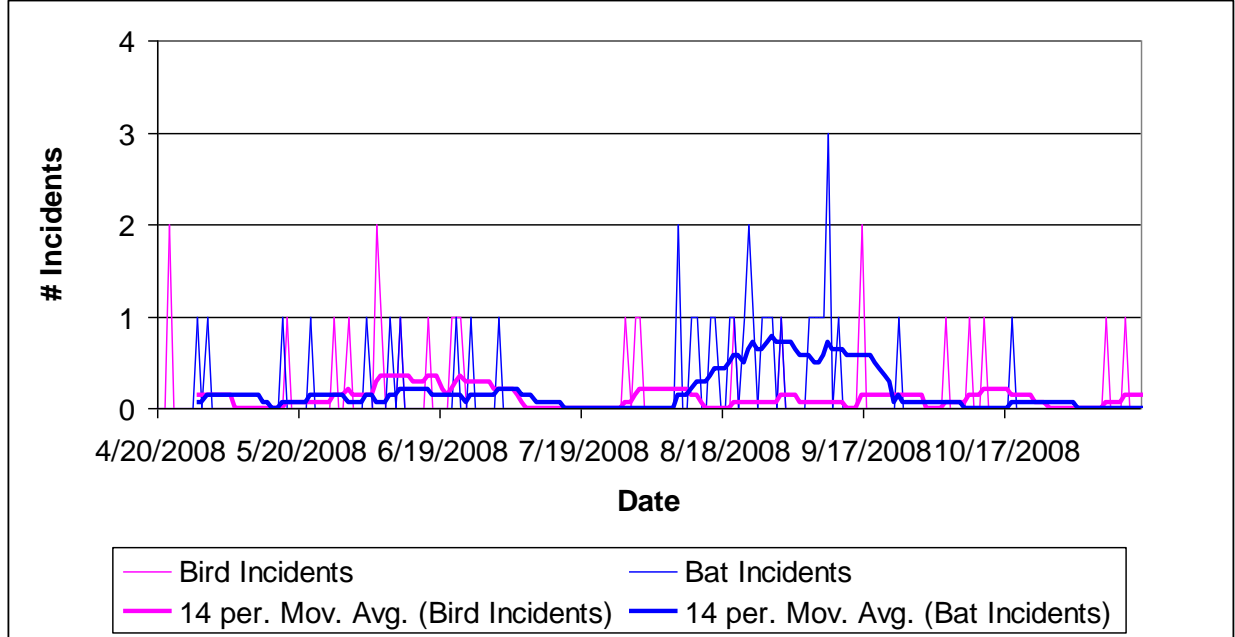


Figure 9. Number of birds and bats found per day from April 15 to November 15, 2009.

Note: Trend lines indicating a 14 day moving average.



3.2.4 Distance from Turbine Bases

There were primarily two classes of animals involved with tower collisions: small birds and bats. These two unrelated groups of species are similar in size and general shape. While the weight and size of small birds and bats can be similar, there are differences in the flight speed and aerodynamics of these groups. In general, bats tend to be more maneuverable in small areas and birds tend to be stronger, swifter fliers. The small sample size of larger birds was not considered in the following analyses because of the paucity of data available. We included unidentified birds along with small birds. We used data from standardized searches at 1-day sites collected in both 2008 and 2009, to maximize sample size. Of the 29 small and unidentified bird incidents found during standardized surveys at 1-day sites, the mean distance to the turbine tower base was 32.9m and the median distance was 33m. Of the 56 bat incidents found during standardized surveys at 1-day sites, the mean distance to the turbine tower base was 24.0m and the median distance was 22m. Thus, bat incidents were concentrated closer to towers than birds.

These fifty-six bat incidents and 29 bird incidents from 1-day sites were used to evaluate “fall” distance from tower base. The number of incidents of species (found during standardized surveys only) falling into each size group (Table 6) was then tabulated based on distance (range) from the base of wind turbines. With a square search plot of side = 120m, there were areas outside of 60m from the turbine base that lay partially within the four corners of the search area, i.e. areas that fell from >60m to <85m were partially searched. Thus distance from the turbines alone was not adequate to evaluate the spread of bird and bat carcasses at searched sites. Further, as searchable area varied between sites, we used data from GPS Trimble measurements and analysis in ArcView GIS 3.3 to calculate the area searched per 10m concentric annulus around each of the

eight 1-day turbine sites. We divided the number of birds and bats found within each 10m annulus by the total searched area that fell within that annulus to arrive at an incident density.

Table 6. Species Size Groupings used in Analyses.

Category	Description
Small Bird	≤ 8" length (most smaller passerines)
Bats	≤ 6" length (some bats may be as small as 2")

These densities were plotted (Figures 10 and 11) along with the best fitting trend line to approximate the distance at which density drops to zero, indicating no more incidents would be found at that distance. The R² (goodness-of-fit) value for both trend lines are shown (R²= 1.0 indicates perfect fit – 100% of variance explained). The R² for bird incidents was 0.81 and for bat incidents was 0.94.

The trend-line derived from that data was in accordance with our expectation that bird incidents approximate zero at a point farther out than bat incidents (densities of bat incidents approximate zero at ~65m from the turbine base and bird incidents approach but do not reach zero within the parameters of the graph). The current available data indicate that the search area of 120m by 120m was adequate to detect most bird and bat collision fatalities, but a negligible number of bat fatalities and, perhaps, a very small number of bird fatalities may have been overlooked. The current analysis is limited by the small number of incidents, especially for birds.

Figure 10. Density of bird incidents at 8 1-day sites, from surveys conducted from April 21 to November 14, 2008 and April 15 to November 15, 2009, in relation to distance from towers.

Note: Polynomial trend line approximates distance at which density crosses zero.

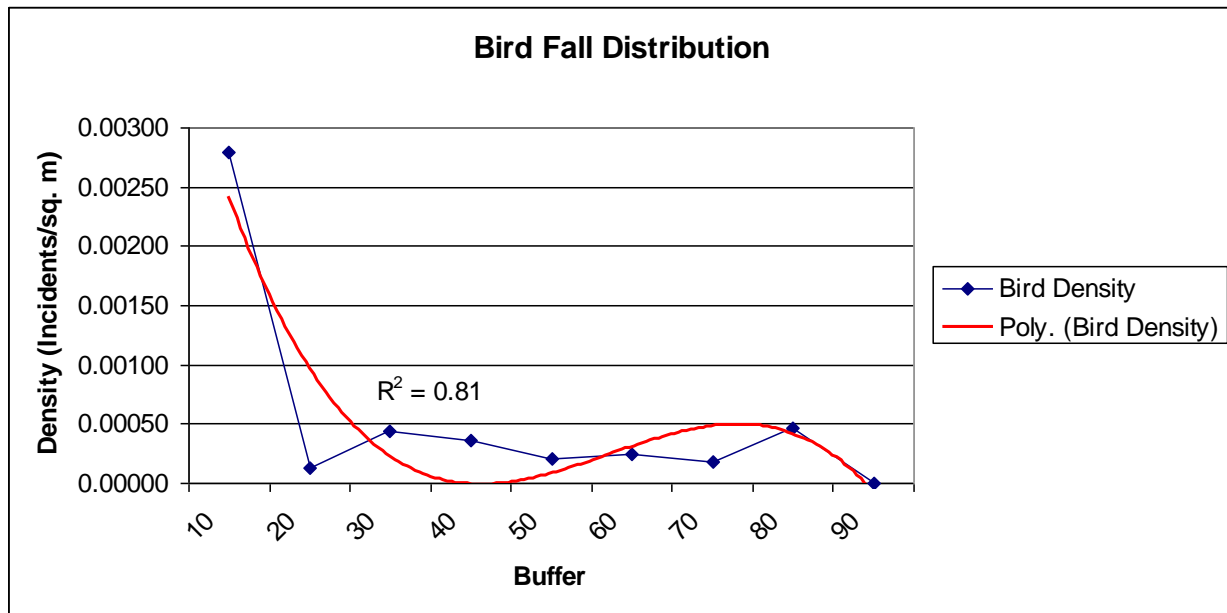
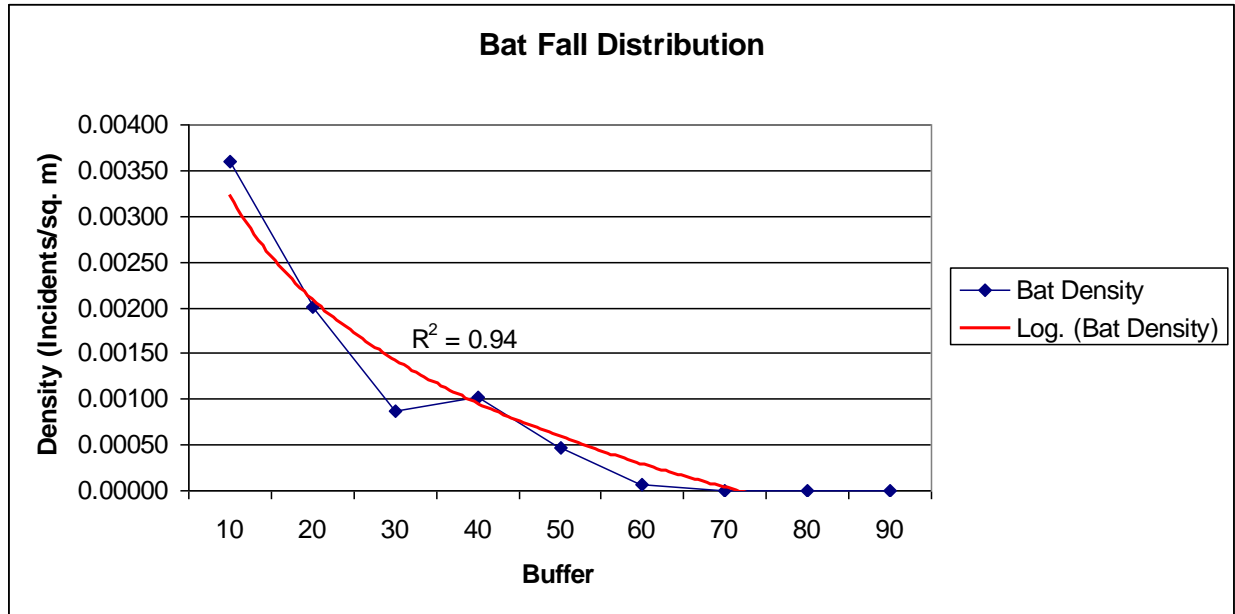


Figure 11. Density of bat incidents at 8 1-day sites, from surveys conducted from April 21 to November 14, 2008 and April 15 to November 15, 2009, in relation to distance from towers.

Note: Logarithmic trend line approximates distance at which density crosses zero.



3.2.5 Site Conditions potentially effecting Mortality

We collected data on several site conditions (factors) at turbines in an effort to determine whether they were correlated with numbers of bird and bat fatalities. Factors included the presence of wooded areas on sites (Wooded), the presence or absence of FAA tower lighting (L-864 red flashing strobe like beacons) and, for bats only, the distance to nearest wetland (Dist_Wetland). Separate analyses were conducted for 1 and 7 day sites.

Wooded: The area within the Bliss Windpark includes a mix of agricultural/grassland (non-wooded) and wooded land. Out of the eight 1-day towers searched, 6 were classified as wooded and two were classified as non-wooded sites. Out of the 15 7-day towers searched, fourteen were classified as wooded and 1 was classified as a non-wooded site.

Dist_wetland: All of the six bat species found at the Bliss Windpark are known to forage over water bodies to some extent (Erickson 2002, Furlonger *et al.* 1987, Genter and Jurist 1995, Zinn and Baker 1979) and to use wetlands for some of their daily water intake needs (Kurta 2000). We determined the distance of each searched turbine site to the nearest wetland, using wetland delineation provided Noble. Dist_Wetland was not a factor in bird models. We weighted the number of incidents per site by the inverse of the total area searched under each site (**Area_searched_inv**) as this varied between sites. Where necessary, we transformed data to achieve normal distributions.

3.2.5.1 Distance to Nearest Wetland (Bats):

We performed Chi-squared tests for the one and seven-day sites. The sample size was low (N = 8 and 15, respectively).

1-day Sites:

The numbers of bat incidents noted at 1-day sites were not distributed normally, necessitating the use of a Generalized Linear Model using Poisson regression. There was no significant negative relationship between the number of bat incidents recorded at the 1-day sites and distance to the nearest wetland (Chi-Square $\chi^2 = 0.05$, df = 1, p = 0.82).

7-day Sites:

The numbers of bat incidents noted at 7-day sites were not distributed normally, necessitating the use of a Generalized Linear Model using Poisson regression. There was no significant negative relationship between the number of bat incidents recorded at the 7-day sites and distance to the nearest wetland (Chi-Square $\chi^2 = 0.03$, df = 1, p = 0.87).

3.2.5.2 Wooded versus Non-wooded Turbine sites

The area within the Bliss Windpark is a mix of agricultural/grassland (non-wooded) and wooded land. Out of the eight towers searched on a 1-day basis, six were classified as wooded and two were classified as non-wooded sites. Out of the 15 towers searched on a 7-day basis, 14 were classified as wooded and one was classified as non-wooded. The lack of sufficient non-wooded sites thus precluded this analysis for 7-day sites. At 1-day sites, we performed non-parametric tests (chi-squared) to determine whether a disproportionate number of bird and bat incidents were found at wooded versus non-wooded sites. However, we had to adjust for the fact that wooded sites could only be searched out to approximately 40m from the tower base, whereas non-wooded sites were searched out to greater distances. Thus, to insure more equivalent search areas and detectability, we compared the number of incidents at both types of sites that fell within the 40m search area.

1-day sites:

A chi-square test (Table 7) revealed that there was not a significant deviation from the expected number of bat incidents within 40m of the turbine tower base at wooded as opposed to non-wooded turbine sites (Yates' $\chi^2 = 0.23$, df = 1, P = 0.63, ns). Further, a chi-square test (Table 8) revealed that there was not a significant deviation from the expected number of bird incidents within 40m of the turbine tower base at wooded as opposed to non-wooded turbine sites ($\chi^2 = 0.2$, df = 1, P = 0.64, ns).

Table 7. Contingency table showing the proportion of bat incidents noted within 40m from turbine tower base of the 8 1-day search sites, comparing wooded versus non-wooded sites.

	# 1-day Towers	# Bats (within 40m)	Sum
Non-wooded Towers	2	5	7
Wooded Towers	6	15	21
Sum	8	20	28

Table 8. Contingency table showing the proportion of bird incidents noted within 40m from turbine tower base of the 8 1-day search sites, comparing wooded versus non-wooded sites.

	# 1-day Towers	# Birds (within 40m)	Sum
Non-wooded Towers	2	7	9
Wooded Towers	6	9	15
Sum	8	16	24

3.2.5.3 Lit versus Un-Lit Turbine sites:

We examined the numbers of incidents of night migrating bird and bat fatalities at towers with L-864 flashing red (strobe) FAA lights vs. towers without such lights. Chi-square tests were performed at the 1-day and 7-day sites for both birds and bats. We tested whether the actual proportion of incidents at lit versus unlit towers differed significantly from expected proportions. No significant differences were found. If the FAA lights did not attract birds/bats, the proportion of incidents should be similar or the same as the proportion of lit to unlit towers.

1-day sites:

There was no significant deviation (Table 9) from the expected number of night migrant bird incidents at towers with L-864 red flashing FAA beacons as opposed to unlit towers (Yates' Chi-Squared Test, $\chi^2 = 0.02$, df = 1, P = 0.88, ns). Additionally, there was no significant deviation (Table 10) from the expected number of bat incidents at towers with L-864 red flashing FAA beacons as opposed to non-lit towers (Yates' Chi-Squared Test, $\chi^2 = 0.04$, df = 1, P = 0.84, ns) among the eight towers searched on a daily basis (1-day sites).

Table 9. Contingency table showing the proportion of night migrant bird incidents noted at the 8 1-day search sites, comparing lit versus unlit sites.

	# 1-day Towers	# Birds	Sum
Lit Towers	2	6	8
Unlit Towers	6	10	16
Sum	8	16	24

Table 10. Contingency table showing the proportion of bat incidents noted at the 8 1-day search sites, comparing lit versus unlit sites.

	# 1-day Towers	# Bats	Sum
Lit Towers	2	6	8
Unlit Towers	6	14	20
Sum	8	20	28

7-day sites:

There was no significant deviation (Table 11) from the expected number of bird incidents at towers with L-864 red flashing FAA beacons as opposed to non-lit towers (Yates' Chi-Squared Test, $\chi^2 = 0.01$, $df = 1$, $P = 0.91$, ns), amongst the 15 7-day towers. Further, there was no significant deviation (Table 12) from the expected number of bat incidents at towers with L-864 red flashing FAA beacons as opposed to non-lit towers (Yates' Chi-Squared Test, $\chi^2 = 0.09$, $df = 1$, $P = 0.76$, ns), amongst the 15 7-day towers. Pooling the data from 1-day and 7-day search intervals reveals that 32.0% of bird carcasses were found at lit turbines and that lit turbines accounted for 30.4% of turbines searched. This is a difference of only 1.6%. For bats, 27.3% of carcasses were found at lit turbines. This percentage is 3.1% lower than the percentage of turbines that were lit. From both analyses, it is obvious that lit turbines do not attract night migrating birds or bats.

Table 11. Contingency table showing the proportion of night migrant bird incidents noted at the 15 7-day search sites, comparing lit versus unlit sites.

	# 7-day Towers	# Birds	Sum
Lit Towers	5	2	7
Unlit Towers	10	7	17
Sum	15	9	24

Table 12. Contingency table showing the proportion of bat incidents noted at the 15 7-day search sites, comparing lit versus unlit sites.

	# 7-day Towers	# Bats	Sum
Lit Towers	5	3	9
Unlit Towers	10	11	11
Sum	15	13	20

3.3 Adjusting Fatality Estimates

Our search protocols were designed to search a subset ($n = 23$) of the 67 turbines at the Noble Bliss Windpark.

3.3.1 Estimates from 1 and 7-day Search Sites**3.3.1.1 Proportion of complete surveys per week (W_s)**

We began searches concurrently with site set-up. As this was the second year of study, sites were set-up and searched immediately and as per schedule on the project start date. All 1-day sites were searched on the first day and all 7-day sites were searched in the first week. Over the course

of the study period, Ws for 1-day and 7-day sites was 0.91 and 0.98 respectively. These adjustment factors were applied as described, in section 3.3.1.2 below.

3.3.1.2 Area Searched (Search Sites Limited by Mowing Obstacles)

After dividing the area searched under the 23 turbines into 8 concentric buffers or annuli (Tables 13, 14 and 15, Figure 12) of 10m increments in size (i.e. 0-10m, 10.1m-20m etc.), we examined the fall distribution of the bird and bat incidents in these annuli. The total number of incidents (separately for all three size classes: small, medium-large birds and bats) in each 10m increment search annulus and the percent area searched in that annulus are reported below for the 1-day and 7-day sites (Tables 15, 16 and 17). Adjustments from Section 3.3.1.1 (Proportion of complete surveys per week) were applied within Tables 13, 14 and 15.

Figure 12. Examples of searched towers showing searchable area divided into concentric annuli

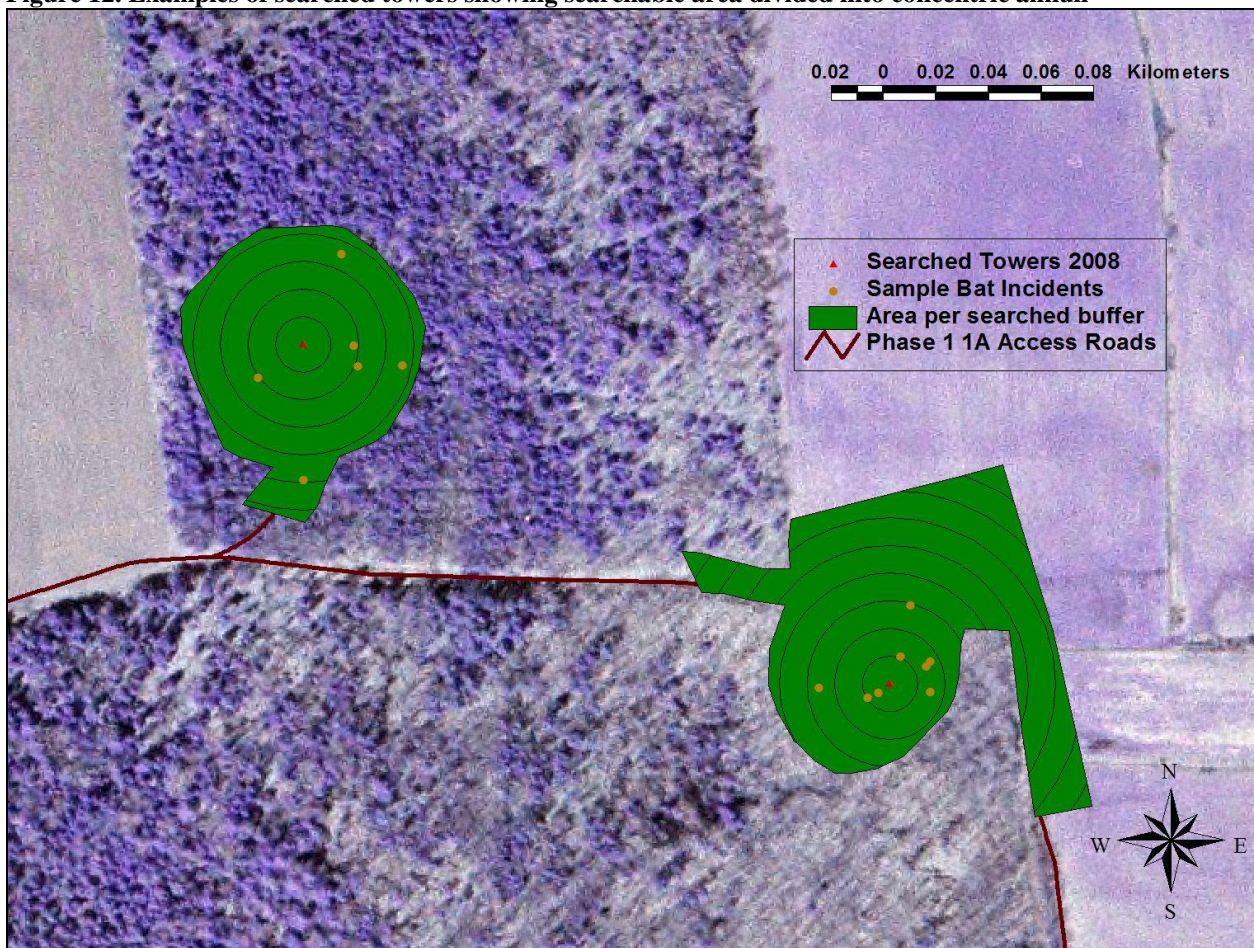


Table 13. Search Intensity Area and Ws Adjustment Factor for bird and bat incidents from standardized surveys conducted at 8 1-day sites, from April 15, 2009 to June 30, 2009 and August 16, 2009 to November 15, 2009.

Annulus	Total Area Searched at 8 Daily towers	Full Buffer Per tower (inside square)	Total Searchable area/annulus ¹	Prop. of annulus searched (Pa)	Ws	Pre-Area and Ws Adjusted			Area and Ws Adjusted		
						Small birds	Med-Large birds	Bats	Small Birds	Med.-Large Birds	Bats
0-10	2501	313	2501	1.00	0.91	4	1	2	4.38	1.10	2.19
10-20	7450	943	7543	0.99	0.91	0	0	5	0.00	0.00	5.55
20-30	11540	1571	12571	0.92	0.91	2	1	2	2.39	1.19	2.39
30-40	13611	2200	17600	0.77	0.91	2	0	7	2.84	0.00	9.92
40-50	14896	2829	22629	0.66	0.91	0	0	4	0.00	0.00	6.66
50-60	15951	3457	27657	0.58	0.91	3	0	0	5.70	0.00	0.00
60-70	10886	2164	17309	0.63	0.91	0	1	0	0.00	1.74	0.00
70-80	4318	878	7021	0.62	0.91	1	1	0	1.78	1.78	0.00
Totals						12	4	20	17.09	5.82	26.71

For example, when examining Table 13 we see that the unadjusted number of bats in the first row (2), when divided by **Si** (1) and the **Ws** factor (0.91), changes slightly to 2.19. This is because, at all 8 1-day turbine sites, the entire 10m innermost annulus was searched. In row 2, the number of bats/(**Si*****Ws**) = 5/(0.9877*0.91) = 5.55 bats. As the distance from the tower base increases, more obstructions to searches, such as wetlands and wooded areas, prevented mowing and searching. Thus **Si** decreases with the increase in distance. **Ws** remains the same across all rows. Finding even a small number of bats or birds (1) at the outermost annulus (70 – 80m) yields a proportionately higher adjustment (1/(0.6150*0.91) = 1.78).

Thus, in Table 13, the number of bat incidents found (20) was adjusted for area and **Ws** to 26.71. The number of birds found (16) has been corrected for area and **Ws** to 22.91. Table 14 shows that the number of bat incidents found (2) was adjusted for area and **Ws** to 2.38. No birds were found. Additionally, Table 15 shows the number of bat incidents found (14) adjusted for area and **Ws** to 17.16. The number of birds found (9) has been adjusted for area and **Ws** to 15.81. Please note that Table 14 contains estimates from the short period where all 8 1-day sites were searched on a weekly basis, between July 1, 2009 and August 15, 2009. Final reported estimates of fatality at these eight towers combines data from all searches at these sites.

Table 14. Search Intensity Area Adjustment Factor for bird and bat incidents from weekly standardized surveys conducted at 8 1-day sites from July 1, 2009 to August 15, 2009. Search intervals were switched from 1 day to 7 days for this period.

						Pre-Area and Ws Adjusted			Area and Ws Adjusted		
Annulus	Total Area Searched weekly at 8 Daily towers	Full Buffer Per tower (inside square)	Total Searchable area/ annulus ¹	Prop. of annulus searched (Pa)	Ws	Small birds	Med-Large birds	Bats	Small Birds	Med.-Large Birds	Bats
0-10	2501	313	2501	1.00	1.00	0	0	0	0	0.00	0.00
10-20	7450	943	7543	0.99	1.00	0	0	0	0	0.00	0.00
20-30	11540	1571	12571	0.92	1.00	0	0	1	0	0.00	1.09
30-40	13611	2200	17600	0.77	1.00	0	0	1	0	0.00	1.29
40-50	14896	2829	22629	0.66	1.00	0	0	0	0	0.00	0.00
50-60	15951	3457	27657	0.58	1.00	0	0	0	0	0.00	0.00
60-70	10886	2164	17309	0.63	1.00	0	0	0	0	0.00	0.00
70-80	4318	878	7021	0.62	1.00	0	0	0	0	0.00	0.00
Totals						0	0	2	0	0.00	2.38

Table 15. Search Intensity Area Adjustment Factor for bird and bat incidents from standardized surveys conducted at 15 7-day sites from April 15 to November 15, 2009

						Pre-Area and Ws Adjusted			Area and Ws Adjusted		
Annulus	Total Area Searched at 15 7-day towers	Full Buffer Per tower (inside square)	Total Searchable area/ annulus ¹	Prop. of annulus searched (Pa)	Ws	Small birds	Med-Large birds	Bats	Small Birds	Med.-Large Birds	Bats
0-10	4689	313	4689	1.00	0.98	4	1	6	4.10	1.02	6.15
10-20	12973	943	14143	0.92	0.98	0	0	2	0	0.00	2.23
20-30	18189	1571	23571	0.77	0.98	1	0	4	1.33	0.00	5.31
30-40	19482	2200	33000	0.59	0.98	0	0	2	0	0.00	3.47
40-50	16939	2829	42429	0.40	0.98	1	0	0	2.57	0.00	0.00
50-60	15652	3457	51857	0.30	0.98	1	1	0	3.39	3.39	0.00
60-70	10406	2164	32454	0.32	0.98	0	0	0	0	0.00	0.00
70-80	4075	878	13164	0.31	0.98	0	0	0	0	0.00	0.00
Totals						7	2	14	11.39	4.42	17.16

3.3.1.3 Scavenger Removal and Search Efficiency

Tables 16 and 17 provide the results of the scavenger study (for 1-day and 7-day sites, respectively) as described in the Methods section. The proportion of small, medium and large birds not scavenged (Sc) within 1 and 4 days for the 1 and 7-day sites, respectively, was used to adjust the number of small birds and medium to large size bird incidents that were discovered by our searchers during standardized surveys. Similarly, the proportion of bats and house mice not

scavenged (Sc) within 1 and 4 days for the 1-day and 7-day sites, respectively, was used to adjust the number of bat incidents that were discovered by our searchers.

Table 16. Noble Bliss scavenger removal study data for 8 1-day sites (2009).

Size Class	# Carcasses	# Scavenged.	Prop. not scavenged (Sc)
Small Birds – 1-day	24	6	0.75
Medium & Large Birds – 1-day	20	5	0.75
Bats and Mice– 1-day	56	12	0.79

Table 17. Noble Bliss scavenger removal study data for 15 7-day sites (2009).

Size Class	# Carcasses	# Scavenged.	Prop. not scavenged (Sc)
Small Birds – 7-day	24	13	0.46
Medium & Large Birds – 7-day	20	8	0.60
Bats and Mice – 7-day	56	35	0.38

Tables 18 and 19 show the results of the search efficiency study as described in the Methods. The proportion of carcasses found (Se) was used to adjust the number of incidents that were discovered by our searchers, in each size class (Small, Medium-Large and Bats). Please note that for the period where the 8 1-Day sites were searched on a weekly basis (July 1 – August 15, 2009), adjustment factors from tables 17 and 19 were applied.

Table 18. Noble Bliss searcher efficiency study data for 8 1-day sites (2009)

Size Class	# Carcasses	# Carcasses not found	Prop. found (Se)
Small Birds – 1-day	11	2	0.82
Medium & Large Birds – 1-day	12	0	1.00
Bats and Mice – 1-day	15	2	0.60

Table 19. Noble Bliss searcher efficiency study data for 15 7-day sites (2009)

Size Class	# Carcasses	# Carcasses not found	Prop found (Se)
Small Birds – 7 day	7	2	0.71
Medium & Large Birds – 7-day	9	1	0.89
Bats and Mice – 7 day	19	6	0.68

Tables 20, 21 and 22 show estimates of the number of bird and bat fatalities attributed to collisions with the wind turbines at the Noble Bliss Windpark in the 2009 study period. The tables reflect search and scavenging rates as determined in tables 16-19 and adjustments for Si and Ws, the number of birds/bats found during standardized searches, the number of birds/bats, and the subsequent estimate adjustment made using the formula described in the Methods. The first row contains the number of incidents noted (# Found). The second and third rows contain those numbers after Search intensity (Si) and Proportion of completed surveys per week (Ws) as described in Section 3.3.1.1 and 3.3.1.2. Finally, the numbers are adjusted by the adjustment factors Se, Sc and Ps to get the adjusted total. The 95% confidence intervals are calculated as mentioned in the Methods, and included here.

Table 20. Full season estimates (April 15 to June 30, 2009 and August 16 to November 15, 2009) for bird and bat collision mortality under 67 towers of the Noble Bliss Windpark, (without incidental finds) adjusted for Search Efficiency, Scavenge Rate, Proportion of Towers Searched, Search Intensity and Proportion of completed surveys per week, from 8 1-day Sites.

Correction Factors	Birds		Bats	Total Carcasses
	Small	Medium-Large	Bats	
# Found	12	4	20	
# After Si and Ws Adjustments	17	6	27	50
% Not Scavenged (Sc)	75%	75%	79%	
Search Efficiency (Se)	82%	100%	60%	
Proportion of Towers Searched (Ps)	11.94%	11.94%	11.94%	
Adjusted Total	233	65	552	851
95% CI (±)	75	15	178	
Per Tower	3.48	0.97	8.24	
Per MW	2.32	0.65	5.50	
Per 2000m2 Rotor Swept Area	1.49	0.42	3.54	

Table 21. Estimates from 8 1-Day sites searched weekly, between July 1 and August 15, 2009, for bird and bat collision mortality under 67 towers of the Noble Bliss Windpark, (without incidental finds) adjusted for Search Efficiency, Scavenge Rate, Proportion of Towers Searched, Search Intensity and Proportion of completed surveys per week.

Correction Factors	Birds		Bats	Total Carcasses
	Small	Medium-Large	Bats	
# Found	0	0	2	
# After Si and Ws Adjustments	0	0	2.38	2.38
% Not Scavenged (Sc)	46%	60%	38%	
Search Efficiency (Se)	71%	89%	68%	
Proportion of Towers Searched (Ps)	11.94%	11.94%	11.94%	
Adjusted Total	-	-	78	78
95% CI (±)	-	-	31	
Per Tower	-	-	1.16	
Per MW	-	-	0.77	
Per 2000m2 Rotor Swept Area	-	-	0.50	

Table 22. Full season estimates (April 15 to November 15, 2009) for bird and bat collision mortality under 67 towers of the Noble Bliss Windpark, (without incidental finds) adjusted for Search Efficiency, Scavenge Rate, Proportion of Towers Searched, Search Intensity and Proportion of completed surveys per week, from 15 7-day Sites.

Correction Factors	Birds		Bats	Total Carcasses
	Small	Medium-Large	Bats	
# Found	7	2	14	23
# After Si and Ws Adjustments	11	4	17	
% Not Scavenged (Sc)	46%	60%	38%	
Search Efficiency (Se)	71%	89%	68%	
Proportion of Towers Searched (Ps)	22.39%	22.39%	22.39%	
Adjusted Total	155	37	299	491
95% CI (±)	47	7	64	
Per Tower	2.32	0.55	4.46	
Per MW	1.55	0.37	2.97	
Per 2000m2 Rotor Swept Area	1.00	0.24	1.91	

3.3.2 Estimated Fatalities by Species

We adjusted the number of incidents of birds and bats per species, in Table 23, by the same extrapolation factors described in the methods. Estimate of total mortality includes adjustment for Search Efficiency, Scavenge Rate, Proportion of Towers Searched, Area Searched and Project Start-up Adjustment. The resulting estimate of 16 American Crow fatalities does not have confidence intervals calculated and should serve only as an indicator of impact per species. The table rows are classified by bird size (medium-large and small) and by bats. The species within the rows are in alphabetical order. The first three numerical columns show the number of incidents recorded at the 8 1-day (daily searches), the same 8 sites (weekly searches) and the 15 7-day search sites. The next three columns show the number of incidents per megawatt. The penultimate three numerical columns show the estimate of mortality over the entire 67 turbines of the Noble Bliss Windpark, calculated for that species as well. The last column shows the unadjusted number of the incidental species.

Table 23. Incidents per species found during both standardized surveys and incidentally, April 15 to November 15, 2009. Estimate of total mortality is an approximation with adjustments for Search Efficiency, Scavenge Rate, Proportion of towers Searched, Area Searched and Proportion of completed surveys per week. Estimates reported are in incidents per MW and for the total number of towers at the Noble Bliss Windpark

Species Name	2009			Estimated # Incidents/Mw				Estimate of mortality (67 towers)			Incidental Finds
	8 1-Day sites	8 1-Day weekly search period	15 7-Day Sites	8 1-Day sites	8 1-Day weekly search period	15 7-Day Sites		8 1-Day sites	8 1-Day weekly search period	15 7-Day Sites	
<i>Birds (Medium - Large)</i>											
American Crow	1	0	0	0.16	0.00	0.00		16	0	0	0
American Woodcock	2	0	1	0.32	0.00	0.18		32	0	19	0
Red-tailed Hawk	0	0	1	0.00	0.00	0.18		0	0	19	2
Northern Flicker	0	0	0	0.00	0.00	0.00		0	0	0	1
Mourning Dove	1	0	0	0.16	0.01	0.00		16	1	0	0
Total Medium - Large	4	0	2	0.48	0.00	0.37	Total Estd. Medium - Large	49	0	37	3
<i>Birds (Small)</i>											
Blue-headed Vireo	0	0	3	0.00	.	0.66		0	.	67	.
Bobolink	4	0	1	0.77	.	0.22		78	.	22	.
Brown Creeper	1	0	0	0.19	.	0.00		19	.	0	.
Eastern Kingbird	1	0	0	0.19	.	0.00		19	.	0	.
Hermit Thrush	0	0	1	0.00	.	0.22		0	.	22	2
House Sparrow	1	0	0	0.19	.	0.00		19	.	0	.
Hummingbird Spp. (Prob. Ruby-Throat)	1	0	0	0.19	.	0.00		19	.	0	.
Red-eyed Vireo	1	0	0	0.19	.	0.00		19	.	0	.
Savannah Sparrow	2	0	0	0.39	.	0.00		39	.	0	.
Vireo Sp.	0	0	1	0.00	.	0.22		0	.	22	.
Winter Wren	0	0	1	0.00	.	0.22		0	.	22	.
Unidentified Bird	1	0	0	0.19	.	0.00		19	.	0	2
Total Small Birds	12	0	7	2.32	0.00	1.55	Total Estd. Small Birds	233	0	155	4
Total Birds	16	0	9	2.81	0.00	1.91	Total Estd. Birds	282	0	192	7

NOBLE BLISS WINDPARK AVIAN AND BAT FATALITY STUDY

Species Name	2009			Estimated # Incidents/Mw				Estimate of mortality (67 towers)			Incidental Finds
	8 1-Day sites	8 1-Day weekly search period	15 7-Day Sites	8 1-Day sites	8 1-Day weekly search period	15 7-Day Sites		8 1-Day sites	8 1-Day weekly search period	15 7-Day Sites	
<i>Bats</i>											
Hoary Bat	6	2	6	1.65	0.77	1.27		166	78	128	.
Eastern Red Bat	4	0	3	1.10	.	0.64		110	0	64	.
Silver-haired Bat	5	0	1	1.37	.	0.21		138	0	21	.
Little Brown Bat	5	0	3	1.37	.	0.64		138	0	64	.
Unknown Species	0	0	1	.	.	0.21		.	.	21	.
Total Bats	20	2	14	5.50	0.77	2.97	Total Est. Bats	552	78	299	0
Total (Birds & Bats)	36	2	23				Total Est. (Birds & Bats)	834	78	491	7

Note: Due to low sample sizes per species, this table should serve as an approximate indication of per species fatalities. Adjustment formulae per species are approximate values and totals are not expected to match exactly by size class with Tables 20, 21 and 22.

4.0 DISCUSSION

4.1 Project Duration and Search Interval

The 2009 study at the Noble Bliss Windpark included seasons of the year during which weather and ground conditions were suitable for regular site maintenance and carcass searches. Establishment of search areas beneath turbines began immediately and site searches commenced on schedule. Protocols used for conducting fatality searches were reviewed by the NYSDEC (Brianna Gary) prior to commencement of research. Those protocols were similar to practices employed elsewhere (Kerns and Kerlinger 2004, Jain et al 2007, 2008) that have been approved by USFWS and various state agencies, as well as Audubon of New York. In fact, our study efforts and protocols were more intensive than those used for most wind power fatality studies. Most fatality studies at wind turbines have used a seven to 30 day search cycle (Erickson *et al.* 2001), although at sites in the Midwest (Howe *et al.* 2002, Jain 2005,) and at sites in the east (Arnett *et al.* 2005, Nicholson 2002) search intensity was similar to our study. Those studies, however, were conducted during limited periods during spring, summer and fall (mostly migration seasons). Arnett *et al.* (2005) searched at one and 7-day frequencies at wind power sites in Meyersdale, Pennsylvania and Mountaineer, West Virginia. However, they only searched during August and part of September (~45 day period), focusing on the primary season of bat mortality. Nicholson (2005) searched every day during spring and fall because he was primarily interested in migrating birds, but that study included only three turbines so daily searches were relatively easy to accomplish. Jain (2005) searched every two days, from late spring to early winter over a two year period, but cleared less area under each tower as compared to this study.

One of the differences between our study at the Bliss Windpark and many of the studies listed above was a greater effort to not over or under estimate search efficiency. Tests were scheduled without the knowledge of the searchers, using appropriately sized carcasses. Small birds were primarily kinglets, sparrows and juncos, ranging from ~ 3.5 inches, (10 cm) to ~ 6.5 inches (17 cm) in length. For bats, we used Hoary Bats, Eastern Red Bats and Silver-haired Bats. Limitations by the NYSDEC on the use of bats due to concern regarding the unrelated White-nose Syndrome, affecting bats in the North-East US, meant that we had access to very few bats for search efficiency and scavenger testing. Instead, we used brown house mice (*Mus musculus*) with body length of 60-65mm (tail removed) and width of 20-23mm. These acted as surrogates for bats to increase our total test numbers (follows NYSDEC adopted Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects, Jan 2009). Our comparison of search efficiency and scavenge rates between bats and mice was extensively addressed in Appendix E and will help in project management decisions at other wind energy facility study sites. Large and medium birds were difficult to procure. Although we were only able to conduct tests using 4 large birds and 16 medium sized birds over 9 different test dates, the search efficiency and scavenge rates remained consistent or trended as expected across the different search frequencies.

In additions to precautions regarding search efficiency and carcass removal studies, a GPS unit was also used to precisely measure the searchable area at each turbine site, so that we could weight the number of incidents found at a site with the proportion of searchable area.

It is important to note that the difference in fatality rates for birds and bats was slightly greater at turbines searched daily as opposed to turbines searched at seven day intervals. For birds, the difference amounted to 1.1 bird per megawatt and 1.65 birds per turbine for the study period. For bats, the differences were slightly greater: 2.53 bats per megawatt and 3.78 bats per turbine for the study period. These differences are minor and may not justify the additional cost and difficulties of conducting searches at one-day intervals. With this in mind, it may be more cost effective in the future to eliminate one-day searches and increase the number of seven-day searched turbines to a slight degree. In addition, an adjustment factor of one bird per megawatt and per turbine, as well as 2-3 bats per megawatt and per turbine might be a conservative means of dealing with these minor differences. Certainly, the seven-day searches provide a robust and useful indication as to the number and type of birds and bats impacted by the turbines.

4.2 Seasonal Distribution of Fatalities

Similar to other western, midwestern and eastern wind energy facility sites, the greatest mortality for bats occurred during the late summer migration season. An increase in fatalities (Figures 7 and 9) commenced in early August and declined in late September-early October, suggesting that temporal mortality patterns at Noble Bliss Windpark mirrored findings in upstate New York (Jain et al. 2007, 2008), West Virginia (Arnett *et al.* 2005, Kerns and Kerlinger 2004), as well as studies in the Midwestern and western United States (Jain 2005, Johnson 2003). Fall bat mortalities are hypothesized to be primarily due to migration activity, although migration related activity such as staging or pre-migration flocking/foraging may also play a role.

The absence of bat fatalities in the first and last weeks of our searches indicated that the 2009 study period spanned the entire annual period of bat activity (outside caves) in the vicinity of the Windpark. Thus, we are confident that our extrapolated results of bat (but not bird) mortality are ‘per year’ and directly comparable with full year studies in other regions where searching is possible throughout the year. With respect to bird fatalities, annual fatality rates are likely to be only slightly greater. The rationale for this statement is that migrants accounted for a large proportion of bird fatalities and the study included the peak migration period for most birds and relatively little migration occurs during the months not searched (December-March). In addition, overall bird activity in winter at the project site is much reduced in comparison to the seasons we studied. The Noble Bliss Windpark is largely not searchable during the winter because of frequent heavy snowfall and very cold temperatures, a fact reflected in the study design.

Bird mortality was greatest in June, although fatalities were recorded over most of the study period, at relatively low levels. Thus, there did not appear to be a large peak of mortality during the autumn migration season. The higher mortality in June may be a function of the birds being killed during the late part of spring migration, which extends into early-mid June in upstate New York.

Both bird and bat fatalities declined to very low levels by November 2009, strongly suggesting that had the search season been extended few additional incidents would likely have been noted.

For most bird species and all bats, the migration season ended or nearly ended by mid-November.

4.3 Species Composition and Fatality Rates at Noble Bliss Windpark and Other Wind Power Facilities in the U.S.

In an effort to determine whether fatalities at the Noble Bliss Windpark are similar, both in numbers and species composition, to other wind power facilities in the United States, we compare our findings to those presented by the National Research Council (NRC 2007) recent review (Table 24). For the most part, the types of fatalities at wind plants reviewed by NRC as being thorough studies, suggests that night migrating songbirds are the species most often killed at wind plants in the eastern and midwestern United States. The studies also agree that very few waterbirds or shorebirds are killed and that raptors are also rare among the fatality lists. In fact, during regular surveys, no waterfowl were found and only a single Red-tailed Hawk was found dead. With respect to shorebirds, three American Woodcock carcasses were found. None of the species found dead are federally or state endangered or threatened.

There appears to be a slightly greater proportion of night migrant fatalities in the Midwest and East as opposed to the west. Overall, there are fewer fatalities at western facilities as compared to eastern facilities. The fatality rates of birds killed per turbine and per megawatt at the Noble Bliss Windpark fall within the range of studies listed in Table 24. It should be noted that the methods differ among studies and the reader is cautioned to keep these differences in mind. However, the results presented reflect the best data collected to date on fatalities at operating North American wind energy facilities and, overall, demonstrate remarkably similar fatality rates.

Table 24. Bird mortality reported at U.S. wind-energy projects (from NRC 2007 and other sources)

Wind Project	Study Period	# Turbines	Turbine MW	Project MW	All Bird Mortality		Reference
					Turbine per period	MW per period	
<i>Pacific Northwest</i>							
Stateline, OR/WA ¹	July 2001 – Dec 2003	454	0.66	300	1.93	2.92	Erickson et al. 2004
Vansycle, OR ¹	Jan 1999 – Dec 1999	38	0.66	25	0.63	0.95	Erickson et al. 2004
Combine Hills, OR ¹	Not Available	41	1.00	41	2.56	2.56	Young et al. 2005
Klondike, OR ¹	Feb 2002 – Feb 2003	16	1.50	24	1.42	0.95	Johnson et al. 2003
Nine Canyon, WA ¹	Sep 2002 – August 2003	37	1.30	62	3.59	2.76	Erickson et al. 2003
<i>Rocky Mountain</i>							
Foot Creek Rim, WY, Phase I ²	Nov 1998 – Dec 2000	72	0.60	43	1.50	2.50	Young et al. 2001
Foot Creek Rim, WY, Phase II ²	June 2001 – June 2002	33	0.75	25	1.49	1.99	Young et al. 2003
<i>Upper Midwest</i>							
Wisconsin ³	Late July 1999 – May 2001	31	0.66	20	1.30	1.97	Howe et al. 2002
Buffalo Ridge, MN, Phase I ³	Apr 1994–Dec 1995; 15 Mar–	73	0.30	33	0.98	3.27	Johnson et al. 2002

NOBLE BLISS WINDPARK AVIAN AND BAT FATALITY STUDY

Wind Project	Study Period	# Turbines	Turbine MW	Project MW	All Bird Mortality		Reference
					Turbine per period	MW per period	
	15 Nov 1996–1999						
Buffalo Ridge, MN, Phase I ³	15 Mar 1998 – 15 Nov 1999; 15 Jun 2001–15 Sep 2002	143	0.75	107	2.27	3.03	Johnson et al. 2002
Buffalo Ridge, MN, Phase II ³	15 Mar 1999 – 15 Sep 1999; 15 Jun 2001 – 15 Sep 2002	139	0.75	104	4.45	5.93	Johnson et al. 2002
Top of Iowa ³	15 Mar 2003 – 15 Dec 2004	89	0.90	80	1.29	1.44	Koford et al. 2005
<i>East</i>							
Buffalo Mountain, TN ⁴	1 Sep 2000 – 30 Sep 2003	3	0.66	2	7.70	11.67	Nicholson 2001, 2002
Mountaineer, WV ⁴	4 Apr 2003 – 22 Nov 2003	44	1.50	66	4.04	2.69	Kerns and Kerlinger 2004
Mount Storm, WV ⁴	18 July – 17 October 2008	82	2.00	164	1-day: 3.81 7-day: 2.41	1-day: 1.91 7-day: 1.21	Young et al. 2009
Maple Ridge, NY ^{3,4}	30 Apr 2007 - 14 Nov 2007	195	1.65	322	5.67-6.31	3.44-3.82	Jain et al. 2008
Maple Ridge, NY ^{3,4}	15 Apr 2008 - 9 Nov 2008	195	1.65	322	3.42-3.76	2.07-2.28	Jain et al. 2009a
Noble Ellenburg, NY ^{3,4}	28 Apr 2008 - 13 Oct 2008	54	1.5	81	1-day: 2.09 3-Day: 1.37 7-day: 1.18	1-day: 1.40 3-Day: 0.91 7-day: 0.78	Jain et al. 2009d
Noble Ellenburg, NY ^{3,4}	15 Apr 2009 - 15 Nov 2009	54	1.5	81	1-day: 5.69 7-day: 2.29	1-day: 3.79 7-day: 1.53	Jain et al 2010c
Noble Clinton, NY ^{3,4}	21 Apr 2008 - 14 Nov 2008	67	1.5	100.5	1-day: 1.43 3-Day: 3.26 7-day: 2.48	1-day: 0.96 3-Day: 2.17 7-day: 1.65	Jain et al. 2009c
Noble Clinton, NY ^{3,4}	15 Apr 2009 - 15 Nov 2009	67	1.5	100.5	1-day: 1.50 7-day: 1.76	1-day: 1.00 7-day: 1.17	Jain et al 2010b
Noble Bliss, NY ^{3,4}	21 Apr 2008 - 14 Nov 2008	67	1.5	100.5	1-day: 4.30 3-Day: 0.66 7-day: 0.74	1-day: 2.86 3-Day: 0.44 7-day: 0.50	Jain et al 2009b
Noble Bliss, NY ^{3,4}	15 Apr 2009 - 15 Nov 2009	67	1.5	100.5	1-day: 4.45 7-day: 2.87	1-day: 2.97 7-day: 1.91	This study (Jain et al 2010a)

1 Agricultural/grassland/Conservation Reserve Program (CRP) lands

2 Short-grass prairie 3 Agricultural 4 Forest

* Note: a) Where studies include more than one year, final estimates were reported on a per year basis.

b) Also included in this table are results from the Maple Ridge Wind Resource Area (not from the original NRC 2007 document).

4.4 Night Migrant Fatalities

Determining the exact number of night migrants among bird mortalities at the Noble Bliss Windpark is difficult, as some of the birds involved may have been resident breeders or individuals dispersing during the post-breeding season. It should be noted that a species that typically migrates at night may also breed on site, and could collide with a turbine during the breeding season, perhaps during daylight hours. However, two years of monitoring daytime flight patterns at the Top of Iowa wind power facility showed that only 0.043% of observed daytime flight occurred at rotor height in proximity to the rotors (Jain 2005).

The numbers of fatalities of night migrating birds were small in comparison with fatality rates of these birds at tall, guyed communication towers in the Midwestern and eastern United States

where fatalities sometimes involve hundreds or even thousands of birds in a single night or migration season. The numbers are also small in comparison with numbers of birds killed at tall buildings, including some federal buildings such as the Morgan Mail building in Manhattan. That building kills on the order of nearly 1,000 birds per year according to a study conducted by New York City Audubon. Those structures have either lights or reflective glass that attracts the birds. The communication towers have two types of Federal Aviation Administration lighting (steady burning red L-810 and flashing red incandescent beacons – L-864), multiple sets of guy wires, and are almost always in excess of 500 feet (152m). Our tests of night migrant incidents found at lit and unlit turbines for the 64 7-day search sites found no relationship between the numbers of night migrant fatalities and the presence of L-864 red flashing lights on turbines. These results correspond to results from all other wind power sites where such tests have been conducted (Kerlinger et al. 2006). The results also corroborate results at tests conducted at communication towers (Gehring et al. 2009) which did not indicate that red flashing L-864 beacons attract night migrating birds. These results replicate those found at other wind power sites where a subset of turbines has FAA lights (Kerns and Kerlinger 2004, Jain et al. 2007, 2008). With approximately 50,000 individual searches of wind turbines at more than 20 project sites across the country, the weight of evidence strongly suggests that such large-scale events do not occur at wind turbines.

We also observed no significant evidence of a higher proportion of bat fatalities at FAA lit turbines in 2009. Thus, there is no evidence for bats or birds that FAA lighting in the form of flashing red beacons attracts or disorients these animals resulting in greater numbers of fatalities than at unlit turbines. The fact that the Noble Bliss turbines are about 389 feet (118.5 m) in height, do not have guy wires, and have only flashing red strobe-like lights may also help to explain the smaller numbers of night migrant fatalities at those turbines as compared to fatalities at tall communication towers (>500ft, 152m).

4.5 Bird Population Trends and Significance of Fatalities at the Noble Bliss

Windpark

Table 25 details the geographic range (source area) and estimated North American population of the species found dead during the study. Those populations come from large geographic ranges to the north of the Noble Bliss Windpark, including far upstate New York, Quebec, and Ontario, as well as the Northwest Territories. It is also possible that some birds originate as far west as Manitoba or even Saskatchewan, but those would account for a smaller portion of the migrants that fly over the Noble Bliss Windpark.

Most of the species listed in Tables 23 and 25 are stable or increasing, as described by the North American Breeding Bird Survey (BBS) trends from 1966-2005 (Sauer *et al.* 2005; National Audubon WatchList 2007). While it is difficult to estimate the effect of local sources of mortality (such as wind turbine collision) on entire populations, the estimated total number of incidents overall and per species at the Noble Bliss Windpark is very small compared to the overall populations of the species involved. The populations (Table 23) of the most common species for which we found fatalities (Bobolink, n = 5 carcasses, Blue-headed Vireo, n = 3 carcasses and American Woodcock, n = 3 carcasses), relatively common species (Table 25) with North

American populations numbering between about three and 11 millions of individuals. Given the overall population level of these species, it is difficult to fathom how the level of collision mortality at the Noble Bliss Windpark could have a significant adverse effect on population levels, even with respect to cumulative impacts of fatalities from many wind plants.

It is important here to note that regulated hunting harvests of stable and declining gamebirds, waterfowl and shorebird species occur on an annual basis, without significant negative impacts to populations. Even species that are declining at rates of more than 1% per year are harvested without impacting populations. For example, about 300,000 American Woodcock, approximately 8-10% of the North American population, are harvested annually by hunters in the United States. The NYSDEC regulations permit a daily harvest of up to three woodcock per hunter, with an annual total harvest in the state of about 10,000 ± approximately 30% (Richkus et al. 2008). This means that the actual fatalities could total as high as 13,000 per year. Three woodcock fatalities were identified at searched sites at this Windpark. The three known Woodcock mortalities at Bliss are comparable to the impact of a single hunter on a single day, assuming that hunter killed his legal limit.

One American Crow fatality was recorded during the survey period. The American Crow is another game bird hunted in New York State. The season for hunting this species is approximately six months and there is no daily bag limit. Finally, the New York State Department of Environmental Conservation does not appear to keep track of the numbers of crows shot each year.

One House Sparrow was among the incidents noted during standardized surveys in 2009, accounting for 4.0% of fatalities found. These birds are alien, invasive species that are not protected by the Migratory Bird Treaty Act (MBTA). They are considered pests and sometimes targeted for population reduction. They may be killed without permits from any wildlife agencies. While the estimates of birds/MW and birds/turbine include extrapolations from this incident, when considering the significance of the annual mortality at the Noble Bliss Windpark it should be noted that, in terms of extrapolated figures, approximately 20 out of 495 (4.0%) estimated birds from 1-day and weekly searches were non-MBTA species. By including House Sparrows, we have been conservative regarding estimating the number and significance of bird mortalities at Noble Bliss Windpark turbines.

As with a vast majority of the post-construction studies at wind power facilities, none of the bird carcasses that were found and identified during standardized or incidental surveys are state or federally listed species. Virtually all birds killed by the turbines are relatively common species whose populations are not likely to be impacted by fatality numbers like those that occurred at the Noble Bliss Windpark. This applies to cumulative impacts from wind turbines in the eastern and Midwestern United States as well.

Table 25. BBS population trends and geographical distribution of bird species found at the Noble Bliss Windpark during standardized surveys and incidentally (April 15 to November 15, 2009). From Sauer et al. 2005, Rich et al. 2004.

Species	Night Migrant Species	North America Population	2007 WatchList	Geographic Range
American Crow	Yes	31 million	No	North America

Species	Night Migrant Species	North America Population	2007 WatchList	Geographic Range
American Woodcock	Yes	4-5 million	No	Eastern & Midwestern North America
Blue-headed Vireo	Yes	6.9 million	No	North Temp.(and Boreal) Forests E of Rockies
Bobolink	Yes	11 million	No	Central and Eastern North America
Brown Creeper	Yes	5.4 million	No	North Temp. Forest
Eastern Kingbird	Yes	13 million	No	Central and Eastern North America
Hermit Thrush	Yes	56 million	No	Boreal and North Temp. Forest North America
House Sparrow	Yes	No Estimate Available	No	Temperate North America
Red-eyed Vireo	Yes	140 million	No	Temp. and Boreal Forests
Red-tailed Hawk	No	2.2 million	No	North America
Ruby-throated Hummingbird	No	7.3 million	No	Eastern Temperate North America
Savannah Sparrow	Yes	82 million	No	Vast areas of Temperate, Boreal, and Arctic Grasslands
Northern Flicker	Yes	16 million	No	Temperate North America

4.6 Bat Fatalities

The few population estimates for bats in North America are limited mostly to cave-dwelling bat species that live in large colonies. Due to the nocturnal habits of this group of mammals, as well as their cryptic habits while roosting, it is extremely difficult to study populations and geographic distribution. Consequently, it is even more difficult to assess the impact of collision mortality on the populations of these species (Arnett et al 2008). All bat species found during searches at the Noble Bliss Windpark are widely distributed and, while possibly uncommon in New York State, are not listed as state or federally threatened or endangered. However, Kunz et al. 2007 stated that the Eastern Red Bat (*Lasiurus borealis*) may be in decline throughout much of its range, making it more susceptible to cumulative fatality rates associated with projected wind energy development. The effect of white-nosed syndrome among bats makes it even more difficult to assess biological significance of the impacts of wind turbines.

Recent reviews of bat fatalities at wind resource areas (Arnett et al. 2008, Johnson 2005, Kunz et al. 2007) have stated that the potential for significant cumulative population impacts, especially for migrating, tree-roosting bat species, is an important concern. At the same time these reviews acknowledge that the dearth of information of baseline population estimates and demographics remains a key challenge. O’Shea and Bogan (2003) speculate that changes in forest management (i.e. roost availability) may be a limiting factor for some species of tree-roosting bat species (hoary and red bats) in the U.S. A recent collapse in numbers of cave-dwelling little brown and big brown bats (Alan Hicks, personal communication) has been connected to a fungal infection of the respiratory system (though the cause of this collapse is unknown). Thus, while the significance of bat fatalities at the Noble Bliss Windpark cannot be determined, bat fatalities remain a source of concern (Table 26).

The period during which the peak of fatalities occurred corresponded to the peak periods reported in studies in the eastern, Midwestern, and western United States (Gruver 2002, Jain 2005, Jain et al. 2007, 2008, Johnson *et al* 2003a, Kerns and Kerlinger 2004, Young *et al.* 2003),

suggesting that some of the mechanics of these fatalities are independent of geography and topography. Similar to Jain et al. 2007, 2008, we saw moderate evidence to support the idea that bat fatalities may increase in proximity to wetlands. We found no evidence pointing towards increased fatalities near wooded sites. Further studies should continue to examine the relationship between bat fatalities and proximity to wetlands and wooded areas.

Table 26. Population trends and geographical distribution of bat species found at the Noble Bliss Windpark during standardized surveys and incidentally (April 15 to November 15, 2009).

Species	Tree-Roosting	Population Trends	Geographic Range
Hoary Bat	Yes	Unknown	North America
Eastern Red Bat	Yes	Poss. Decreasing	Central and Eastern North America
Silver-Haired Bat	Yes	Unknown	North America (Except Mexico)
Little Brown Bat	No	Poss. Increasing in North America. Possibly Decreasing in NY.	North America

Tables 27 and 28 show the comparison of the fatalities per turbine, per MW and per 2000m² rotor Swept Area at the Noble Bliss Windpark and other wind energy facilities in the Eastern and Midwestern U.S. Bat fatality rates at the Noble Bliss Windpark are greater than those reported in the western U.S, similar to or slightly greater than reported in the Midwest, and generally lower than those rates reported from the Appalachian mountains and elsewhere in the eastern U.S.

Table 27. Estimates of bat fatalities per turbine and per megawatt at different wind facilities in Eastern and Midwestern U.S. modified from Arnett et al. (2008).

Study Area Location	Study Period	Est. Mean Fatality/Turbine	Estimated Mean Fatality/MW	Estimated Mean Fatality/2000m ² rotor Swept Area	Reference
Eastern U.S.					
Buffalo Mountain, TN (phase 1) ^a	1 Sep 2000–30 Sep 2003	20.8	31.5	24.0	Nicholson 2001, 2002
Buffalo Mountain, TN (phase 2) ^a	1 Apr–31 Dec 2005	35.2	53.3	40.6	Nicholson 2001, 2002
Buffalo Mountain, TN (phase 2) ^b	1 Apr–31 Dec 2005	69.6	38.7	27.7	Nicholson 2001, 2002
Meyersdale, PA ^c	2 Aug–13 Sep 2004	23	15.3	11.3	Arnett et al. 2008
Mountaineer, WV 1	4 Apr–11 Nov 2003	48	32	23.6	Arnett et al. 2008
Mountaineer, WV ^c	31 Jul–11 Sep 2004	38	25.3	18.7	Arnett et al. 2008
Mount Storm, WV ^g	18 July – 17 October 2008	1-day: 3.81 7-day: 2.41	1-day: 1.91 7-day: 1.21	1-day: 1.52 7-day: 0.96	Young et al. 2009
Maple Ridge, NY (2007)	30 Apr-14 Nov 2007	15.54-18.53	9.42-11.23	5.88-7.02	Jain et al. 2008
Maple Ridge, NY (2008)	15 Apr-9 Nov 2008	8.18-8.92	4.96-5.41	3.10-3.38	Jain et al. 2009a
Noble Bliss, NY (2008)	21 Apr-14 Nov 2008	1-day: 7.58 3-Day: 14.66 7-day: 13.01	1-day: 5.05 3-Day: 9.78 7-day: 8.67	1-day: 3.25 3-Day: 6.30 7-day: 5.59	Jain et al. 2009b
Noble Bliss, NY (2009)	15 Apr-15 Nov 2009	1-day: 8.24 7-day: 4.46	1-day: 5.50 7-day: 2.97	1-day: 3.54 7-day: 1.91	This Study (Jain et al 2010a)

NOBLE BLISS WINDPARK AVIAN AND BAT FATALITY STUDY

Study Area Location	Study Period	Est. Mean Fatality/Turbine	Estimated Mean Fatality/MW	Estimated Mean Fatality/2000m ² rotor Swept Area	Reference
Noble Clinton, NY (2008)	21 Apr-14 Nov 2008	1-Day: 5.45 3-Day: 4.81 7-Day: 3.76	1-Day: 3.63 3-Day: 3.21 7-Day: 2.50	1-Day: 2.34 3-Day: 2.07 7-Day: 1.61	Jain et al, 2009c
Noble Clinton, NY (2009)	15 Apr-15 Nov 2009	1-Day: 9.72 7-Day: 5.16	1-Day: 6.48 7-Day: 3.44	1-Day: 4.18 7-Day: 2.21	Jain et al 2010b
Noble Ellenburg, NY (2008)	21 Apr-14 Nov 2008	1-Day: 8.17 3-Day: 6.94 7-Day: 4.19	1-Day: 5.45 3-Day: 4.63 7-Day: 2.79	1-Day: 3.51 3-Day: 2.98 7-Day: 1.80	Jain et al, 2009d
Noble Ellenburg, NY (2009)	15 Apr-15 Nov 2009	1-Day: 8.01 7-Day: 3.70	1-Day: 5.34 7-Day: 2.47	1-Day: 3.44 7-Day: 1.59	Jain et al, 2010c
Midwestern U.S.					
Buffalo Ridge, MN 1 ^d	Apr - Dec 1994–1995; 15 Mar–15 Nov 1996–1999	0.1	0.2	0.2	Johnson et al. 2002
Buffalo Ridge, MN 2 ^e	15 Mar–15 Nov 1998–1999; 15 Jun–15 Sep 2001–2002	2.0	2.7	2.4	Johnson et al. 2002
Buffalo Ridge, MN 3 ^f	15 Mar–15 Sep 1999; 15 Jun–15 Sep 2001–2002	2.1	2.7	2.3	Johnson et al. 2002
Lincoln, WI	Jul 1999–Jul 2001	4.3	6.5	5.0	Howe et al. 2002
Top of Iowa, IA	15 Mar–15 Dec 2003, 2004	7.8	8.7	7.4	Koford et al. 2005

- a - Estimated bats killed by 3 Vestas V47 0.66 megawatt turbines.
- b - Estimated bats killed by 15 Vestas V80, 1.8 megawatt turbines.
- c - Estimated bats killed from daily searches conducted at these facilities.
- d - Estimated bats killed by 73 Kenetech 33 0.33 megawatt turbines based on 4 years of data.
- e - Estimated bats killed by 143 Zond 0.75 megawatt turbines based on 4 years of data.
- f - Estimated bats killed by 138 Zond 0.75 megawatt turbines based on 3 years of data.
- g - Estimated bats killed by 80 Gamesa 2 megawatt turbines based on 12 weeks of data.

NOBLE BLISS WINDPARK AVIAN AND BAT FATALITY STUDY

Table 28. Percent species composition of bat fatalities at wind facilities in Eastern and Midwestern U.S. (modified from Arnett et al. 2008).

STUDY LOCATION	EPFU ^a	LABO	LACI	LANO	MYLU	MYSE	PISU	Other	Total No. Bats Found
Eastern U.S.									
Buffalo Mountain, TN (phase 1)	0.9	60.5	9.6	1.8	-	-	25.4	1.8 ^b	114
Buffalo Mountain, TN (phase 2)	0.4	60.9	13.0	7.6	-	-	17.2	0.8 ^b	238
Meyersdale, PA	6.9	27.5	45.4	5.7	2.7	0.7	8.0	0.5	262
Mountaineer, WV (2003)	0.4	42.1	18.5	5.9	12.6	1.3	18.3	0.8	475
Mountaineer, WV (2004)	2.5	24.1	33.7	4.8	9.8	-	24.6	0.5	398
Maple Ridge, NY (2007)	8.4	9.9	49.5	15.84	15.3	-	-	1.0	202
Maple Ridge, NY (2008)	5.0	11.4	43.6	20.7	17.1	-	-	2.1	140
Noble Bliss, NY (2008)	1.35	8.11	32.43	17.57	39.19	-	1.35	-	74
Noble Bliss, NY (2009)	0	19.4	38.9	16.7	16.7	-	0	8.3^b	36
Noble Clinton, NY (2008)	-	2.6	23.1	28.2	33.3	-	2.94	-	39
Noble Clinton, NY (2009)	-	2.8	50.0	25.0	22.2	-	-	-	36
Noble Ellenburg, NY (2008)	-	2.9	17.7	20.6	55.9	-	2.9	-	34
Noble Ellenburg, NY (2009)	3.7	7.4	37.0	11.1	37.0	-	3.7	-	28
Midwestern U.S.									
Buffalo Ridge, MN 1-3	3.6	17.4	65.0	4.8	1.9	-	1.7	5.7	420
Lincoln, WI	1.4	38.9	34.7	16.7	-	-	-	8.3	72
Top of Iowa, IA	10.7	24.0	28.0	12.0	24.0	-	1.3	-	75

a - EPFU = big brown bat; LABO = Eastern red bat; LACI = hoary bat; LANO = silver-haired bat; MYLU = little brown bat; MYSE = northern long-eared bat; PISU = Eastern pipistrelle; b - Myotis sp.

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APPENDICES

NOBLE WINDPARK AVIAN AND BAT FATALITY STUDY

APPENDIX D: Distribution of carcasses for scavenge rate test (Sc)

Tower #	# Tests (Bird)	# Tests (Bats/Mice)
1	0	2
6	1	2
8	1	1
11	1	2
16	1	2
19	3	3
25	2	2
26	2	0
30	2	2
33	1	2
38	1	2
40	3	4
42	3	4
44	2	3
46	3	4
49	2	2
50	3	3
53	1	2
60	1	0
61	3	4
63	3	3
64	2	4
66	0	2

APPENDIX E: MULTIPLE TESTS OF THE EFFICACY OF BROWN HOUSE MOUSE (*MUS MUSCULUS*) AS SURROGATES FOR BATS DURING SCAVENGE RATE AND SEARCH EFFICIENCY TESTING

Scavenge Rate (Sc):

In 2008, we conducted 3 paired tests of scavenge rates for bats and mice at several upstate NY Wind Resource Areas. Habitat conditions under towers were as described in Jain et al. 2006, 2007 (mowed ground and gravel under wind turbine towers in a mixed agricultural and wooded setting). For each paired tests, several pairs, consisting of one bat and one tail-less brown house mouse (*Mus musculus*), were placed in mowed ground under several turbines in the same afternoon. Care was taken to place the carcasses apart from each other. Carcasses were examined daily for signs of scavenging for up to 4.5 weeks. The response variable was average number of days until carcasses were no longer visible due to scavenging. The results are presented below.

Test 1: Noble Bliss WRA

We found no significant evidence for a difference in mean days until scavenge event between bat and mouse carcasses (Paired t-test, $t = 1.43$, $df = 8$, $p = 0.19$)

Test 2: Noble Clinton-Ellenburg WRA

We found no significant evidence for a difference in mean days until scavenge event between bat and mouse carcasses (Paired t-test, $t = -0.64$, $df = 18$, $p = 0.53$)

Search Efficiency (Se):

Test 1: Noble Bliss WRA ($n = 33$)

There was no significant difference between the odds of finding a bat over a mouse (Chi-Square Test, $\chi^2 = 2.23$, $df = 1$, $p = 0.14$)

Test 2: Noble Clinton WRA ($n = 30$)

There was a significantly lower chance of finding a bat over a mouse (Chi-Square Test, $\chi^2 = 4.31$, $df = 1$, $p = 0.04$)

Test 3: Noble Ellenburg WRA ($n = 34$)

There was no significant difference between the odds of finding a bat over a mouse (Chi-Square Test, $\chi^2 = 0.93$, $df = 1$, $p = 0.33$)

Results:

Scavenge Rate (Sc):

Both paired tests showed no significant difference between the average number of days before scavenging occurred for mice and bats. Further, one test showed that, on average,

bat carcasses remained on the ground for slightly longer than mouse carcasses, but the other test showed the opposite, (both non-significant differences) indicating no clear evidence that either bats or mice remain on the ground for longer periods of time before scavenging occurs. We tentatively conclude that, given the scarcity of bats available for testing due to White-nose Syndrome, Brown house mouse carcasses are an acceptable substitute for scavenger studies.

Search Efficiency (Se):

Two out of three tests showed no significant difference in the odds of finding a bat over a mouse. One test found that there was a significantly lower chance of finding a bat versus a mouse. Thus, though there is no strong evidence to contraindicate the use of mice as surrogates for Search efficiency tests, more comparisons and testing is advised.

NOBLE WINDPARK AVIAN AND BAT FATALITY STUDY

APPENDIX F: BIRD AND BAT RAW FATALITY DATA - 2009

Bliss Windpark Bird Mortalities 2009			
Turbine #	Date	Subspecies	Find Status
6	7/28/09	blue-headed vireo	Survey Find
16	5/23/09	Eastern bluebird	Incidental
	11/11/09	bird	Survey Find
19	4/22/09	brown creeper	Survey Find
	8/1/09	red-tailed hawk	Incidental
	9/16/09	hummingbird sp.	Survey Find
25	9/16/09	hermit thrush	Survey Find
26	8/20/09	blue-headed vireo	Survey Find
30	7/10/09	yellow-shafted flicker	Incidental
	7/30/09	vireo sp.	Survey Find
34	6/22/09	red tailed hawk	Incidental
38	6/5/09	bobolink	Survey Find
	7/31/09	red-tailed hawk	Survey Find
40	6/22/09	American crow	Survey Find
46	10/9/09	savannah sparrow	Survey Find

NOBLE WINDPARK AVIAN AND BAT FATALITY STUDY

Bliss Windpark Bird Mortalities 2009			
	11/7/09	house sparrow	Survey Find
49	5/30/09	blue-headed vireo	Survey Find
	9/26/09	warbler sp.	Incidental
50	6/23/09	red-eyed vireo	Survey Find
53	5/17/09	woodcock	Survey Find
61	9/4/09	sparrow spp.	Incidental
	10/4/09	winter wren	Survey Find
63	4/22/09	woodcock	Survey Find
	6/21/09	Eastern kingbird	Survey Find
	10/12/09	morning dove	Survey Find
64	5/27/09	bobolink	Survey Find
	6/5/09	savannah sparrow	Survey Find
	6/6/09	bobolink	Survey Find
	6/10/09	bobolink	Survey Find
	6/16/09	bobolink	Survey Find
	8/30/09	woodcock	Survey Find
66	8/8/09	cedar waxwing	Incidental

NOBLE WINDPARK AVIAN AND BAT FATALITY STUDY

Bliss Windpark Bat Mortalities 2009			
Turbine #	Date	Subspecies	Find Status
1	8/24/09	hoary	Survey Find
11	9/8/09	myotis sp.	Survey Find
16	7/1/09	hoary	Survey Find
	9/9/09	myotis sp.	Survey Find
	9/9/09	Eastern red (male)	Survey Find
19	4/30/09	little brown (female)	Survey Find
	9/7/09	silver-haired (male)	Survey Find
25	6/3/09	little brown (female)	Survey Find
	8/19/09	hoary (male)	Survey Find
26	6/25/09	silver-haired (male)	Survey Find
33	10/18/09	myotis sp.	Survey Find
40	6/8/09	hoary (male)	Survey Find
	9/5/09	Eastern red (male)	Survey Find
42	8/11/09	hoary (male)	Survey Find
	9/9/09	little brown (male)	Survey Find
46	5/22/09	little brown (female)	Survey Find
	6/22/09	silver-haired (male)	Survey Find

NOBLE WINDPARK AVIAN AND BAT FATALITY STUDY

Bliss Windpark Bat Mortalities 2009			
	8/20/09	hoary (male)	Survey Find
	8/23/09	hoary	Survey Find
	8/23/09	little brown (female)	Survey Find
	8/26/09	Eastern red (male)	Survey Find
	8/27/09	Eastern red (female)	Survey Find
	8/12/09	hoary (male)	Survey Find
	9/6/09	silver-haired	Survey Find
	9/24/09	Eastern red (male)	Survey Find
49	8/8/09	Eastern red (male)	Survey Find
	8/8/09	hoary	Survey Find
	8/15/09	hoary (female)	Survey Find
50	8/22/09	hoary (male)	Survey Find
53	8/30/09	Eastern red	Survey Find
60	8/16/09	hoary (male)	Survey Find
64	4/28/09	hoary (female)	Survey Find
	5/16/09	little brown (male)	Survey Find
	6/10/09	silver-haired (female)	Survey Find
	8/28/09	silver-haired (female)	Survey Find
	9/11/09	hoary	Survey Find

