Annual Report for the Noble Bliss Windpark, LLC

Postconstruction Bird and Bat Fatality Study - 2008

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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 had a nameplate capacity of 1.5 megawatts (MW) and the project had a total capacity of the 100MW. Each consisted of a 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 complete 3-season fatality study (Spring-Summer-Fall) was conducted from April 21–November 14, 2008. 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), three-day (N = 8), and seven-day (N = 7) intervals. We completed a total of 1,954 individual turbine searches, equivalent to about 29 rounds of searches at the 23 turbines.

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 20 avian incidents (carcasses) were recorded by searchers during standardized surveys, representing 14 identified species. The remains of six incidents could not be identified to species. Of the 14 species, there were two raptor fatalities (Red-tailed Hawk, Sharp-shinned Hawk), eight songbird species, and one game bird fatality (American Woodcock). Twelve out of 20 incidents (60%) involved songbirds of eight species. We could determine migrant status for 15 incidents, out of which 12 (80%) were night migrants. The greatest number of bird incidents occurred during August. A total of seven additional avian incidents were recorded while on site, but not during standardized surveys (incidental finds). Of these additional fatalities, there were two raptor species (Red-tailed Hawks), one songbird species (two Red-eyed Vireos), one game bird (one Ruffed Grouse) and two unidentified bird incidents.

Remains of 74 bats were found by searchers during standardized surveys (April 21, 2008 to November 14, 2008), representing six species. Little Brown Bats (39.2%) were most numerous, followed by Hoary Bat (32.4%), Silver-haired Bat (17.1%), Eastern Red Bat (8.1%), Eastern Pipistrelle Bat (1.4%) and Big Brown Bat (1.4%). The greatest number of bat incidents occurred during the fall migration period, with 57 (77.0%) bat carcasses found between August 1, 2008 and September 30, 2008. A total of 15 additional bat

incidents were recorded on site, outside of the standardized surveys. Of these fatalities, there were five Little Brown Bats, two Eastern Red Bats, four Silver-Haired Bats, three Hoary Bats and one unidentified bat.

Bat carcasses (mean = 22.9m) were found closer to turbine tower bases than bird carcasses (mean = 33.1m). There was moderate 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. There were no significant differences in bat or night migrant bird fatalities 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 adjusted for when calculating the 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, 3-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.

The planned project start date was April 15, 2008. Due to late season snowfall in March, turbine areas were not accessible or amenable to carcass searches prior to mid-April 2008. All 1-Day site surveys were established and searched on April 21, 2008 (within a week of the project start date). Searching of 8 three-day and five weekly sites began on May 9, 2008. We awaited landowner approval of the two remaining weekly sites (26 and 30) and were able to search Site 26 on June 11, 2008. During the period of August 7 to September 18, 2008, we were restricted to searching the gravel area only of these sites. Upon receiving landowner approval, we were able to include Sites 26 and 30 in the weekly schedule on September 18, 2008.

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 (m^2) and multiplying that figure by $2000m^2$, we are able to show the number of incidents/$2000m^2$ rotor swept area.

The estimates for birds are:

- 1-Day standardized surveys (Total period 207 days): 288 incidents/period, 2.86 incidents/Mw/period, 4.30 incidents/turbine/period and 1.84 birds per 2000m^2 rotor swept area/period.

- 3-Day standardized surveys (Total period 207 days): 44 incidents/period, 0.44 incidents/Mw/period, 0.66 incidents/turbine/period and 0.28 birds per 2000m^2 rotor swept area/period.

- 7-Day standardized surveys (Total period 207 days): 50 incidents/period, 0.50 incidents/Mw/period, 0.74 incidents/turbine/period and 0.32 birds per 2000m^2 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 should be slightly greater. The absence of bat fatalities in the first and last few weeks of our searches indicated that the 2008 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 207 days): 508 incidents/year, 5.05 incidents/Mw/year, 7.58 incidents/turbine/year and 3.25 bats per 2000m^2 rotor swept area/year.

- 3-Day standardized surveys (Total year 207 days): 983 incidents/year, 9.78 incidents/Mw/year, 14.66 incidents/turbine/year and 6.30 bats per 2000m^2 rotor swept area/year.

- 7-Day standardized surveys (Total year 207 days): 872 incidents/year, 8.67 incidents/Mw/year, 13.01 incidents/turbine/year and 5.59 bats per 2000m^2 rotor swept area/year.

The fatality rates and species composition of birds during the 2008 study was similar in species composition and rates of fatalities to those found at other eastern wind power project sites. The low rates found at turbines searched at 3-Day and 7-Day intervals may have been a result of the inability to search all turbines, due to landowner permission and site maintenance issues experienced during the study period. With respect to bats, the species composition was not similar to that found at other eastern project sites. Instead, little brown bats were most numerous and other species were less numerous than at other sites. The numbers of bat fatalities per turbine and per megawatt of power generated were lower than those reported from studies at Appalachian ridges.

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 2008 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 first year of a potentially multi-year study. If it is determined that modifications of the protocol and methods are required to this scope of work, revisions will be made by Curry & Kerlinger, LLC in conjunction with Noble and reviewed by the (USFWS) and (NYSDEC).

1.1 Project Description

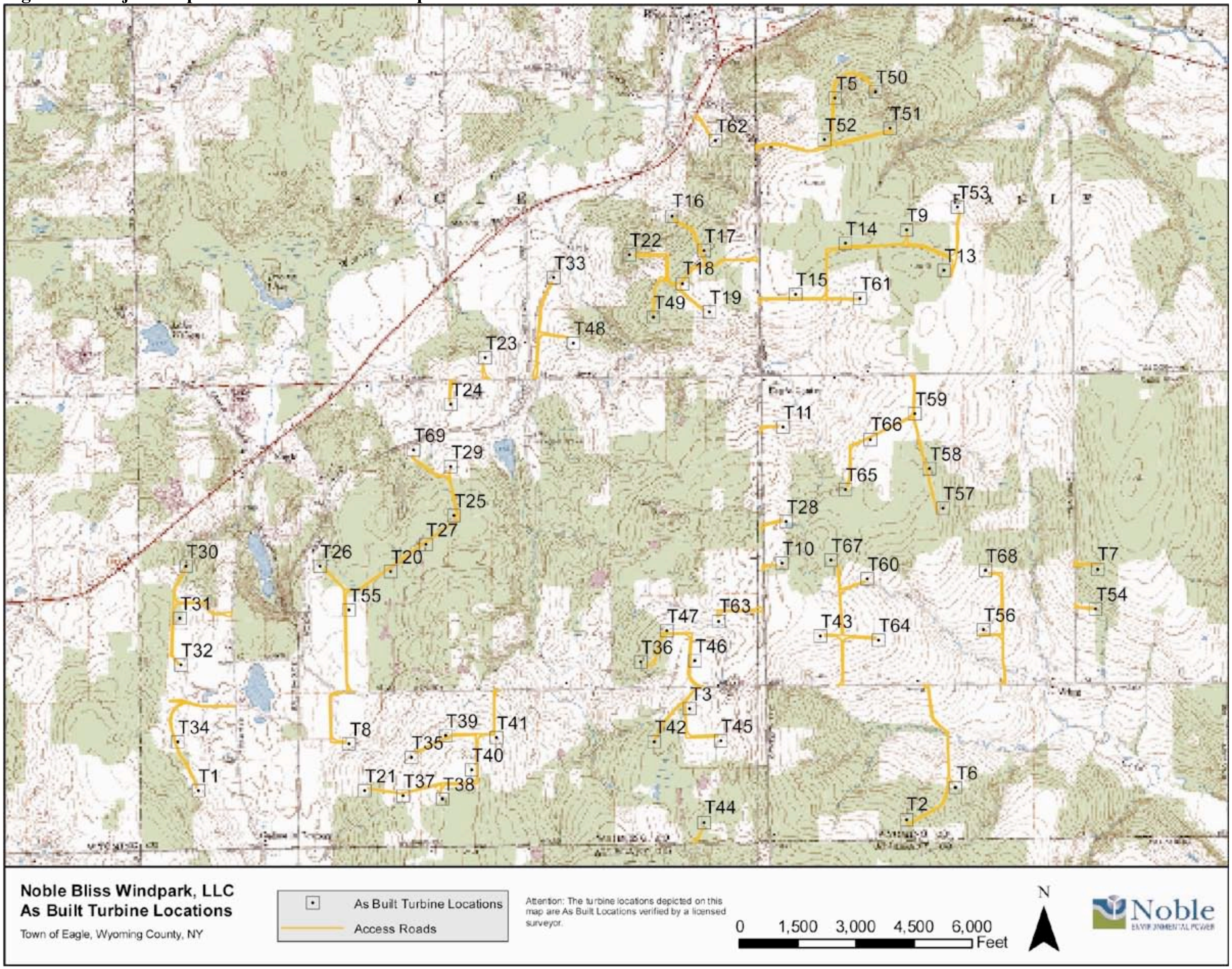
The Noble Bliss Windpark consists of 67 wind turbines located in Wyoming County, near the town of Eagle, New York. In 2007, a total of 67 General Electric 1.5 MW wind turbines were constructed within the 5,350 acre project area. The total nameplate capacity of the wind farm is 100MW. Each turbine consists of a tubular steel tower, 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). 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, McElroyand 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

Twenty-three turbine sites were chosen to be searched during the 2008 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. As this was the first year of study, the process of communicating with landowners and gaining authorization delayed the project start dates. So that the project could begin in a timely manner, sites that received authorization first were placed on the daily search schedule. These sites were also larger, on average, than sites later chosen for 3-day and weekly sites. As subsequent permissions were granted, the three-day and weekly sites were added. Daily site surveys began on April 21, 2008, within a week of April 15, 2008, the project start date agreed upon in the protocol. Searching of 7 three-day and 5 weekly sites began on May 9, 2008. The set-up and surveying of Site 44, a three-day site, was delayed due to reclamation efforts occurring onsite. Site 44 was added to the regular survey schedule on June 19, 2008. We awaited landowner approval of the two remaining weekly sites (26 and 30) and were able to search Site 26 on June 11, 2008. During the period of August 7 to September 18, 2008, we were restricted to searching the gravel area only of these sites. Upon receiving landowner approval, we were able to include Sites 26 and 30 in the weekly schedule on September 18, 2008. The primary ground cover at the various sites under which searches occurred is shown in Table 1.

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 in 2008.

Turbine Number	Search Frequency	Wooded Ring[1]	Full Site[2]	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	3-Day	No	No	Hay
11	3-Day	No	No	Woods and hay with stream offsite
16	3-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	3-Day	Yes	No	Wooded
26	7-Day	No	No	Wooded on three sides and corn on the other
30	7-Day	Yes	No	Wooded
33	3-Day	No	No	Corn with woods to one side-northwestern perimeter site[3]

Turbine Number	Search Frequency	Wooded Ring[1]	Full Site [2]	Primary Habitat
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	3-Day	Yes	No	Wooded-southern perimeter site
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	3-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	3-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

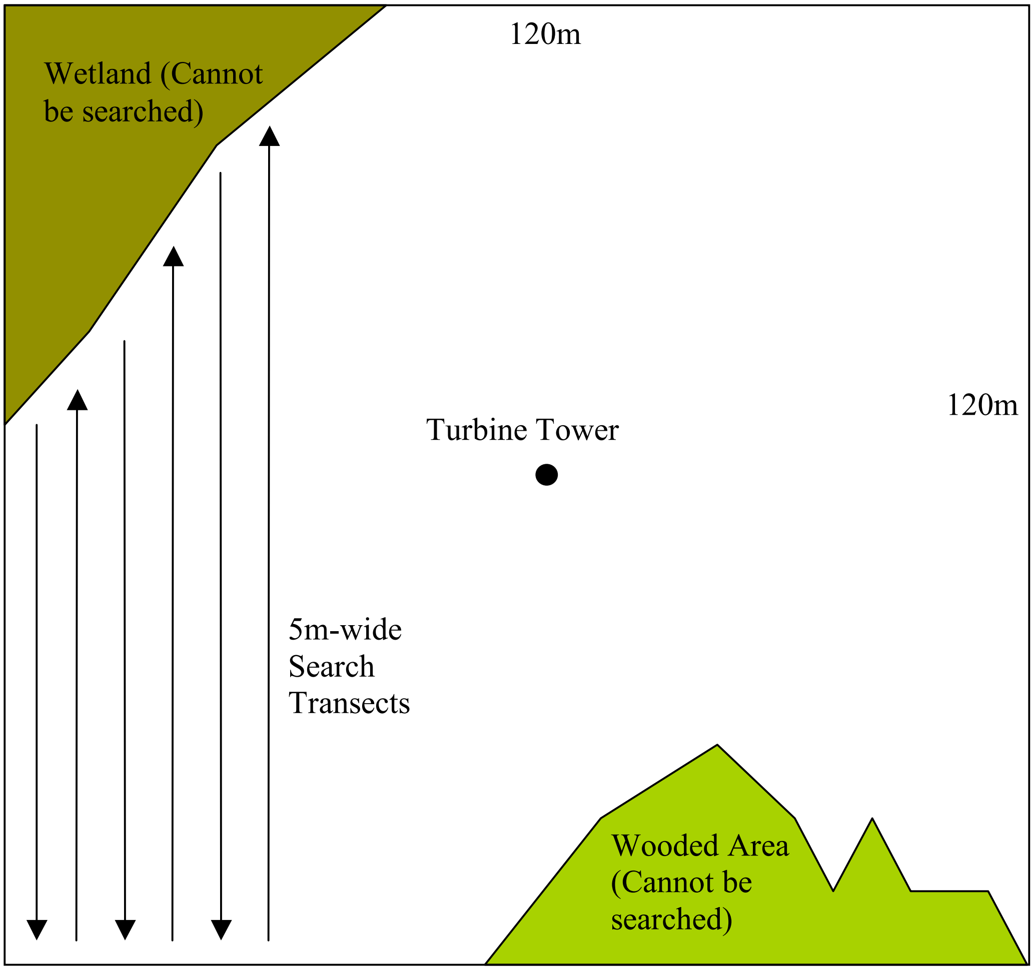
2.1.2 Standardized Surveys

Carcass surveys were conducted daily at 8 wind turbine sites, every 3 days at 8 sites and weekly at the remaining 7 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 (14,400m^2), 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. With the approval of the NYSDEC, qualified project technicians (Andy Fuerst, Jeremy Histed, Chris Hansen and Josh Meacham) identified bird carcasses. Suspected Myotis spp. bat carcasses were confirmed by 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 2008. Rabies related precautions precluded the handling and rehabilitation of injured bats in New York State. One injured bat was euthanized using cervical dislocation. A second bat was reported incidentally by a windpark employee but could not be found by our observers. The former bat was included in the final mortality estimates. Only in those cases where the animal was in proximity to a specific turbine was a turbine number 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 2008.

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 (*Ws*):

An important consideration in the accuracy of post-construction bird and bat mortality studies is the ability to search at regular planned intervals. For example, at our concurrent searches at a different (unrelated) wind project using similar protocols, we were able to complete our scheduled searches 98% of the time. To account for these disruptions, we adjusted our raw data in the following manner: For all three site types (1, 3 and 7-Day), we divided the season into two periods: 'A' (searches conducted before 8 August, 2008) and 'B' (searches conducted on or after 8 August, 2008). Period A was heavily affected by site maintenance and delays in obtaining landowner permission (Table 14). Period B saw very few disruptions to search, mostly due to weather related events. Period B missed searches were made up at the earliest possible time. The numbers of missed searches in Period B are negligible and not adjusted for. Comparatively few fatalities were recorded during Period A. By dividing the number of incidents found at 1-Day, 3-Day and 7-Day sites by *Ws*, we were able to adjust for the proportion of planned searches that were carried out. This effect of this adjustment factor is expected to be significant only in this first year of the study, when construction and site reclamation were concurrent with fatality surveys.

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 3-day and 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 2008 estimated the proportion of carcasses missed by the searchers and the proportion removed by scavengers within 1, 3 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 7 tests (19-May, 6-June, 7-July, 5-Aug, 7-Sep, 3-Oct and 22-Oct) by placing 10 bat carcasses, 29 house mice carcasses (*Mus musculus*), 26 small bird (sparrow sized) carcasses and 24 medium-large bird (American Woodcock-American Crow sized) carcasses on mortality transects at various searched sites in the Bliss Windpark. 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 (Linda Slobodnik, Director of Field Operations; DFO). 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). Also, carcasses were thrown over the DFO's shoulder to add a random element to the eventual location. Thus carcasses landed in locations independent to the center line of the transect in which it fell. 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, 3 or 7 days). Thus, the overall duration between carcass fall and discovery is approximately half the actual search cycle (0.5, 1.5 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, 2 and 4 days, for the 1 day, 3 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 having the DFO place 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 DFO 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 carcasses planted by the DFO (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 DFO, 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%. *Ps* for the 8 3-day sites was 8/67 = 11.94% and *Ps* for the 7 7-day sites was 7/67 = 10.45%.

Thus, $\widehat{C} = \dfrac{C}{Sc \times Se \times Ps}$

Where $\widehat{C}$ = 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:

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

We used this procedure for the 1, 3 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:
208 rounds (1,352 turbine searches) of standardized searching were conducted between April 21, 2008 and November 14, 2008 (Table 2). The total search period was 208 days.
All eight 1-day sites were established and searched by April 21, 2008. Searches were ended on November 14, 2008, when winter weather prevented regular search activities.

3-Day sites:
Sixty-four rounds (450 turbine searches) of standardized searches were conducted between May 9, 2008 and November 14, 2008. Six out of eight sites were established and searched in the first search round. The total search period was 189 days. One of the two remaining sites was set up by May 21, 2008, after ongoing reclamation work ended. The last site was delayed due to reclamation efforts but was set up and searched by June 19, 2008.

7-Day sites
Twenty-seven rounds (152 turbine searches) of standardized searching were conducted between May 9, 2008 and November 14, 2008. Five out of seven sites were set up and searched in the first search round. The gravel only of the two remaining sites was searched beginning on August 7, 2008. These two sites were fully set and added to the search schedule as of September 18 after landowner agreement was reached. The total search period was 189 days.

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.

As a result of ongoing site maintenance and denial of access by a landowner to search two 7-day sites until the middle of the project period, we could not conduct several planned searches during the first one-half of the project. However, the adjustment factor described in section 2.1.3.1, the proportion of complete surveys per week (*Ws*), made adjustments for these disruptions.

Over the entire season, once site permission was received, 1-day sites were searched an average number of days between successive searches of 1.23 days. 3-day sites were searched at an average number of days between successive searches of 3.20 days. 7-day sites were searched at an average number of days between successive searches of 7.88 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. From survey round 15 onward, these factors were less disruptive to scheduled searches, as evident by the increase in Total surveys per Round (last column)

Table 2. Number of surveys completed at all 23 survey towers from April 21 to November 14, 2008.

			23 Wind Turbines Surveyed			
Survey Round	Week Starting Date	Week Ending Date	8 1-Day Surveyed Sites	8 3-Day Surveyed Sites	7 7-Day Sites	Total Surveys per Round
1	April 21	April 26	48[b]	[b]	[b]	48
2	April 27	May 3	48[b]	[b]	[b]	48
3	May 4	May 10	43[ac]	1[b]	2[b]	46
3	May 11	May 17	39[ac]	14[ba]	5[b]	58
4	May 18	May 24	40[a]	14[ba]	5[b]	59
5	May 25	May 31	40[a]	13[ba]	5[b]	58
6	June 1	June 7	40[a]	14[ba]	5[b]	59
7	June 8	June 14	45[ac]	15[bac]	5[bc]	65
8	June 15	June 21	33[ac]	17[bac]	6[bc]	56
9	June 22	June 28	25[ac]	15[ac]	3[bc]	43
10	June 29	July 5	27[ac]	18[ac]	4[ba]	49
11	July 6	July 12	21[ac]	17[ac]	3[bac]	41
12	July 13	July 19	26[ac]	17[ac]	3[ba]	46
13	July 20	July 26	36[a]	12[ac]	3[ba]	51
14	July 27	August 2	41[a]	11[a]	4[ba]	56
15	August 3	August 9	54[a]	14[a]	6[a]	74
16	August 10	August 16	54[a]	19[c]	7[a]	80
17	August 17	August 23	55[a]	17[a]	7[b]	79
18	August 24	August 30	55[a]	19	5[b]	79
19	August 31	September 6	52[ac]	19	5[b]	76
20	September 7	September 13	56	18	7	81
21	September 14	September 20	54[a]	19	7	80
22	September 21	September 27	55[a]	19[a]	7	81
23	September 28	October 4	55[a]	18	7	80
24	October 5	October 11	53[a]	19	7	79
25	October 12	October 18	56	19	7	82
26	October 19	October 25	56	18	7	81
27	October 26	November 1	56	19	7	82
28	November 2	November 8	55[a]	19[a]	7	81
29	November 9	November 14	34[ac]	16[c]	6[c]	56
		Total Surveys	**1352**	**450**	**152**	**1954**
a Ongoing reclamation or tower work						
b Transect set up or awaiting landowner approval						
c Inclement weather						

3.2 Incidents Recorded During Standardized Surveys and Incidentally

During this study, a total of 27 avian fatalities/injuries (incidents) and 89 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 27 bird carcasses, 7 (25.93%) were found incidentally and of the 89 total bat carcasses, 15 (16.85%) were found incidentally.

3.2.1 Birds

A total of 20 avian incidents were recorded by searchers during standardized surveys under wind turbines, representing 14 incidents identified to 11 species. One incident was identified as a warbler only and 5 incidents that could not be identified to a taxonomic group because they were partially scavenged or decayed prior to being found (Table 3). Of the 14 identified incidents, there were 8 songbird species (One Blackpoll Warbler, one Blue-headed Vireo, one European Starling, two Magnolia Warblers, two Red-eyed Vireos, one Savannah Sparrow, one Veery and two Wood Thrushes). There was also one unidentified warbler species. Besides songbirds, there were two raptor species (One Red-tailed Hawk and one Sharp-shinned Hawk) and one gamebird species (one American Woodcock). Of the species identified, Red-eyed vireos (n = 2, 10% of 20 avian incidents), were identified as a species that were often observed at another upstate NY wind turbine study site (Jain et al. 2007, 2008).

We identified the migrating pattern of 15 of these incidents (night vs. day migrants and non-migrants), 12 (80%) of which were classified as night migrants. Of all 12 identified songbirds, (excluding incidental finds), 11 (91.67%) 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 12 of 20 (60%) 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 migrants, daytime migrants and non-migrant residents. Included were 2 raptor species (2 Red-tailed Hawks), 1 songbird species (2 Red-eyed Vireos), one game bird (one Ruffed Grouse) and two unidentified bird incidents.

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 21 to November 14, 2008.

Tower #	Search Frequency	Number of Bird Incidents					
		Other	**Raptor**	**Unidentified bird**	**Passerine**	**Total Std.**	**Incidental**
64	1-Day	0	0	3	2	5	0
46	1-Day	0	0	0	3	3	0
50	1-Day	0	1	1	1	3	1
40	1-Day	0	0	0	2	2	0
63	1-Day	0	0	1	1	2	1
42	1-Day	0	0	0	1	1	0
61	1-Day	0	0	0	1	1	0
33	3-Day	0	1	0	0	1	0
60	3-Day	1	0	0	0	1	0
6	7-Day	0	0	0	1	1	0
26	7-Day	0	0	0	0	0	2
13	Non-Survey	--	--	--	--	--	1
36	Non-Survey	--	--	--	--	--	1
54	Non-Survey	--	--	--	--	--	1
	Totals	**1**	**2**	**5**	**12**	**20**	**7**

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

Includes incidents associated with wind turbines found during standardized surveys and "incidentally" (April 21, 2008 to November 14, 2008).

Figure 4. Locations of bird incidents at the Noble Bliss Windpark found during standardized surveys, (April 21 to November 14, 2008).
Note: Maps include incidents considered to be associated with a wind turbine only, and not those found incidentally.

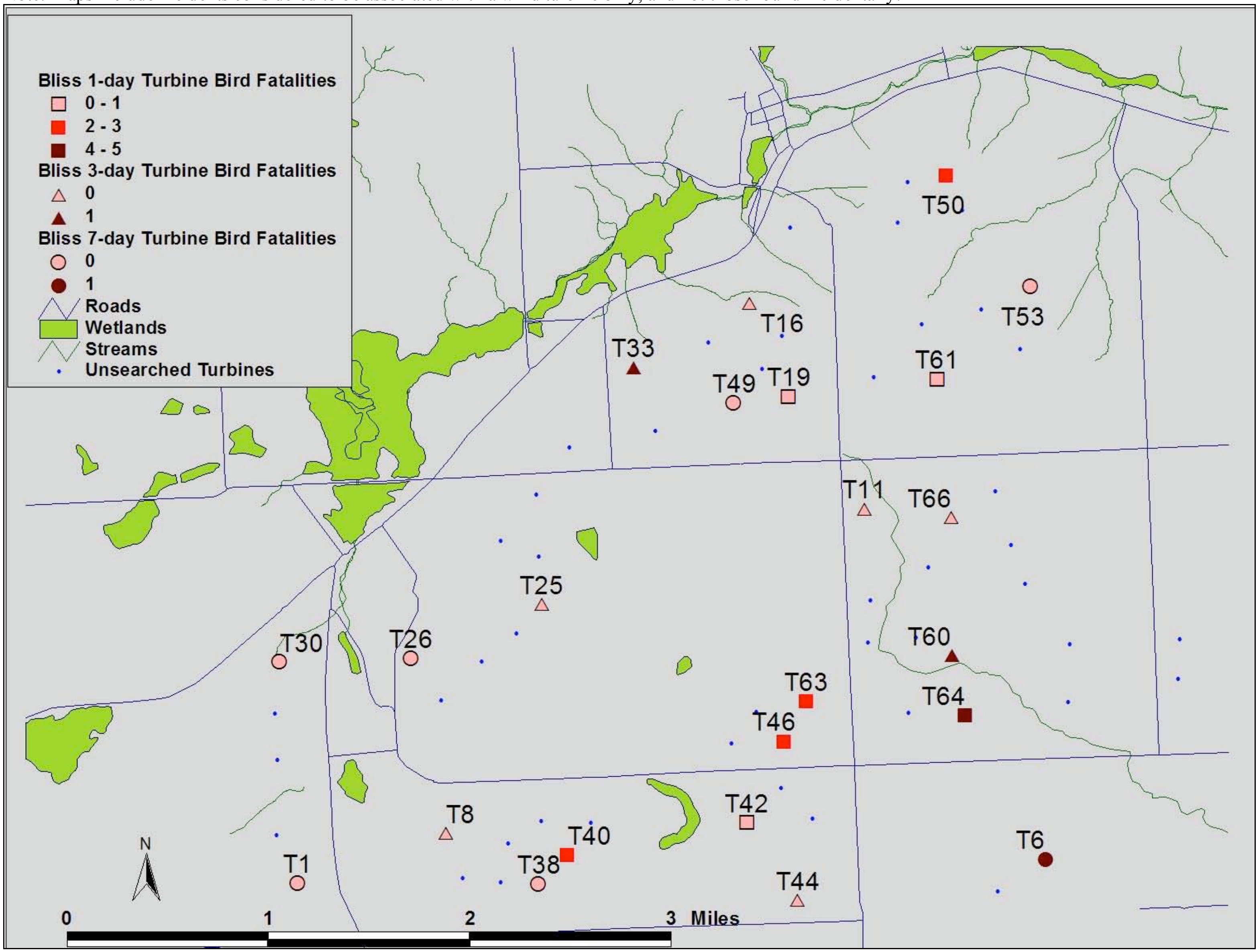
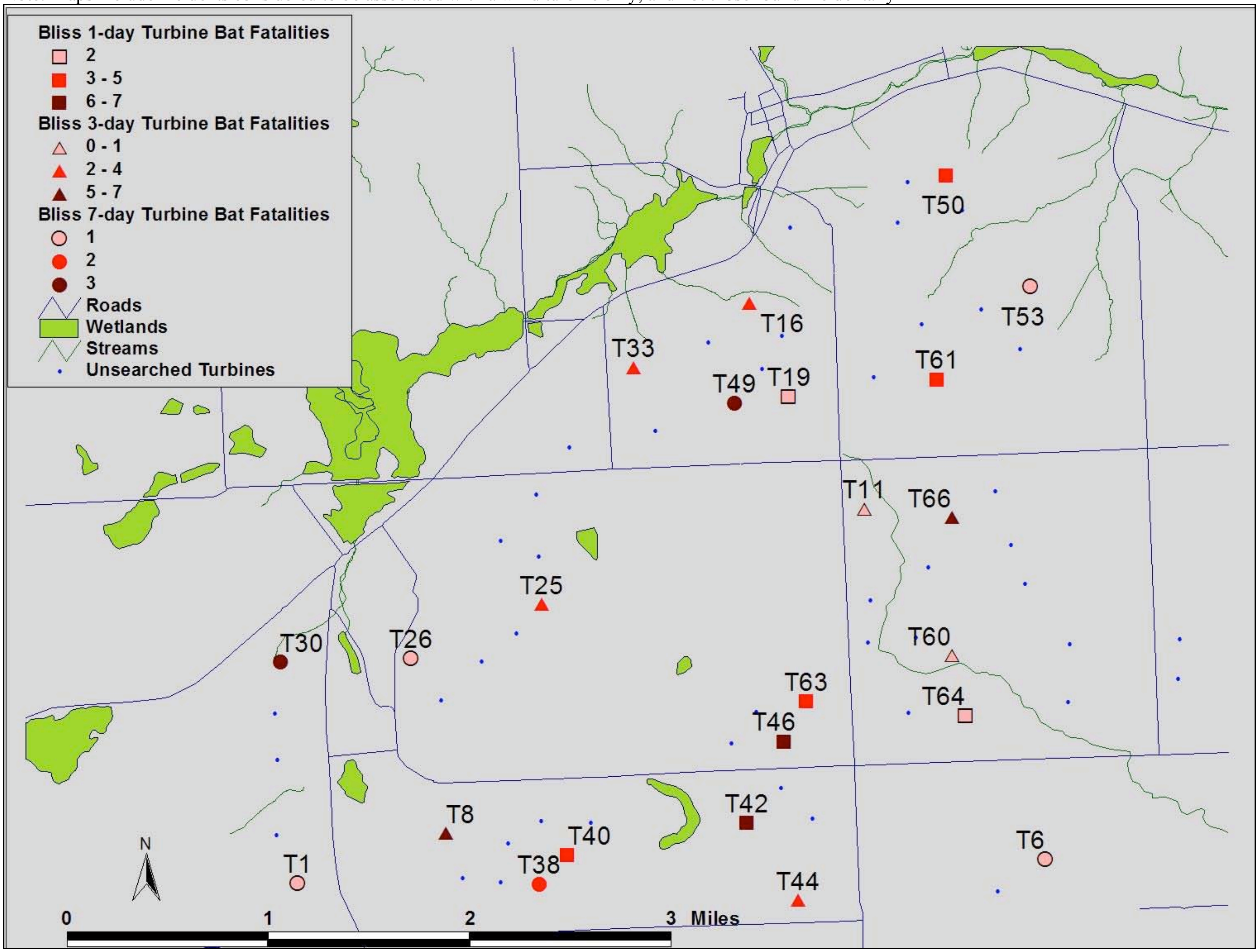


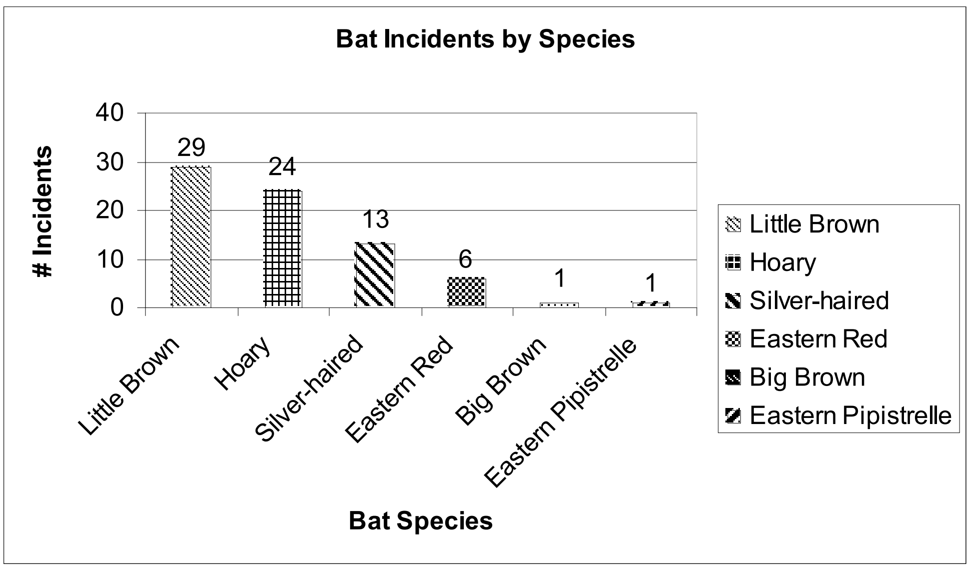
Figure 5. Locations of bat incidents at the Noble Bliss Windpark found during standardized surveys, (April 21 to November 14, 2008).
Note: Maps include incidents considered to be associated with a wind turbine only, and not those found incidentally



3.2.2 Bats

Remains of 74 bats were found by searchers during standardized surveys (April 21, 2008 to November 14, 2008), representing six species (Hoary Bat, Silver-haired Bat, Eastern Pipistrelle Bat, Eastern Red Bat, Little Brown Bat and Big Brown Bat). Out of the 74 bats found during standardized surveys (Figure 6), Little Brown Bats comprised 39.2% (n = 29), Hoary Bats comprised 32.4% (n = 24), Silver-Haired Bats comprised 17.6% (n = 13), Red Bats comprised 8.1% (n = 6), Big Brown Bats comprised 1.4% (n = 1) and Eastern Pipistrelle Bats comprised 1.4% (n = 1)

Figure 6. Distribution of bat incidents by species, from standardized surveys conducted from (April 21 to November 14, 2008).



3.2.2.1 Incidental Finds

A total of 15 bat incidents were recorded by searchers or reported by windpark employees at times or locations other than during standardized surveys on weekly searched sites. There were 5 Little Brown Bats, 2 Eastern Red Bats, 4 Silver-Haired Bats, 3 Hoary Bats and one unidentified bat.

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	Red	Big Brown	Eastern Pipistrelle	Total	Incidental
42	1-Day	3	0	4	0	0	0	**7**	0
46	1-Day	2	1	3	0	0	0	**6**	3
40	1-Day	1	1	3	0	0	0	**5**	0
50	1-Day	1	2	2	0	0	0	**5**	0
63	1-Day	3	1	0	1	0	0	**5**	0
61	1-Day	1	0	2	1	0	0	**4**	0
19	1-Day	1	0	1	0	0	0	**2**	0
64	1-Day	1	0	1	0	0	0	**2**	0
8	3-Day	0	3	3	1	0	0	**7**	0
66	3-Day	2	0	1	1	0	1	**5**	0
44	3-Day	1	1	1	1	0	0	**4**	0
16	3-Day	2	1	0	0	0	0	**3**	0
25	3-Day	2	1	0	0	0	0	**3**	0
33	3-Day	2	0	0	0	0	0	**2**	1
11	3-Day	0	0	1	0	0	0	**1**	1
30	7-Day	1	0	3	0	0	0	**4**	0
49	7-Day	1	0	1	0	1	0	**3**	2
38	7-Day	0	1	1	0	0	0	**2**	0
1	7-Day	0	0	0	1	0	0	**1**	1
6	7-Day	0	0	1	0	0	0	**1**	2
26	7-Day	0	1	0	0	0	0	**1**	1
53	7-Day	0	0	1	0	0	0	**1**	0
36	Non-Survey	--	--	--	--	--	--	--	2
27	Non-Survey	--	--	--	--	--	--	--	1
57	Non-Survey	--	--	--	--	--	--	--	1
	Totals	**24**	**13**	**29**	**6**	**1**	**1**	**74**	**15**

3.2.3 Seasonal Distribution of Fatalities (Birds and Bats)

This project was conducted during three seasons; from mid-April until snow made searching impossible in mid-November. During this period there were occasional interruptions to surveys due to site reclamation, especially before to August 2008. However, we were still able to discern distinct patterns in seasonal mortality. The greatest number of bat incidents occurred during the fall migration period, with 57 (77.0%) bat carcasses found between August 1, 2008 and September 30, 2008 (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 8, 2008.

The greatest number of bird incidents occurred during September (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 21 to November 14, 2008.

Species Group	Apr[1]	May	June	July	August	September	October	November[1]
Raptor	0	0	1	0	1	0	0	0
Passerine	0	0	0	0	1	8	2	1
Other Bird	0	0	0	0	1	0	0	0
Unknown	0	0	0	2	1	2	0	0
Total Birds	0	0	1	2	4	10	2	1
Bats	0	2	3	8	31	26	4	0

[1]Searches began on April 21, 2008 and were concluded on November 14, 2008.

Figure 7. Number of birds found per month from April 21 to November 14, 2008.

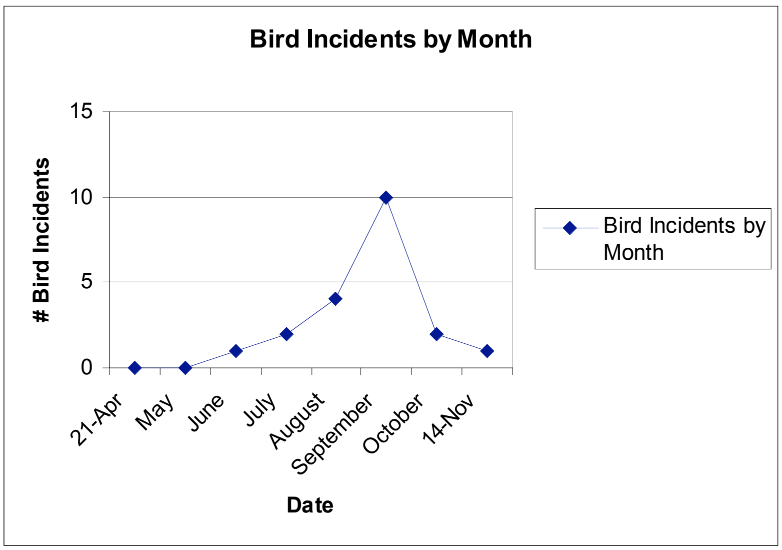


Figure 8. Number of bats found per month from April 21 to November 14, 2008.

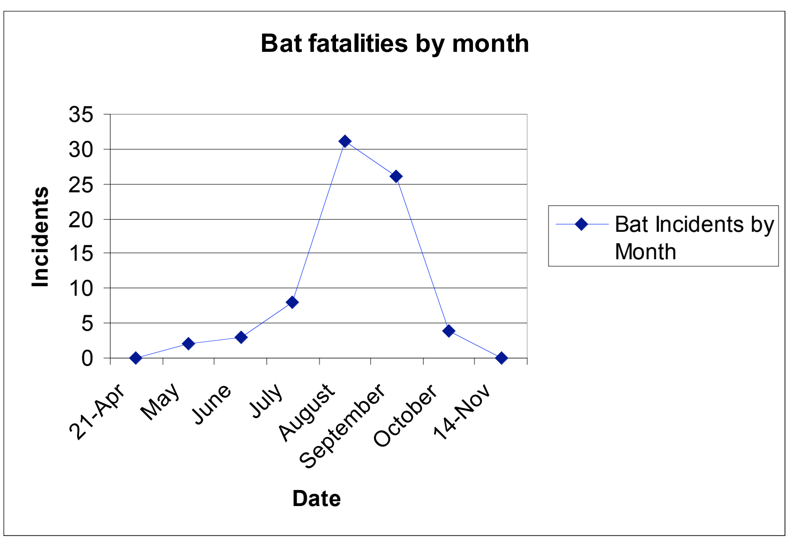
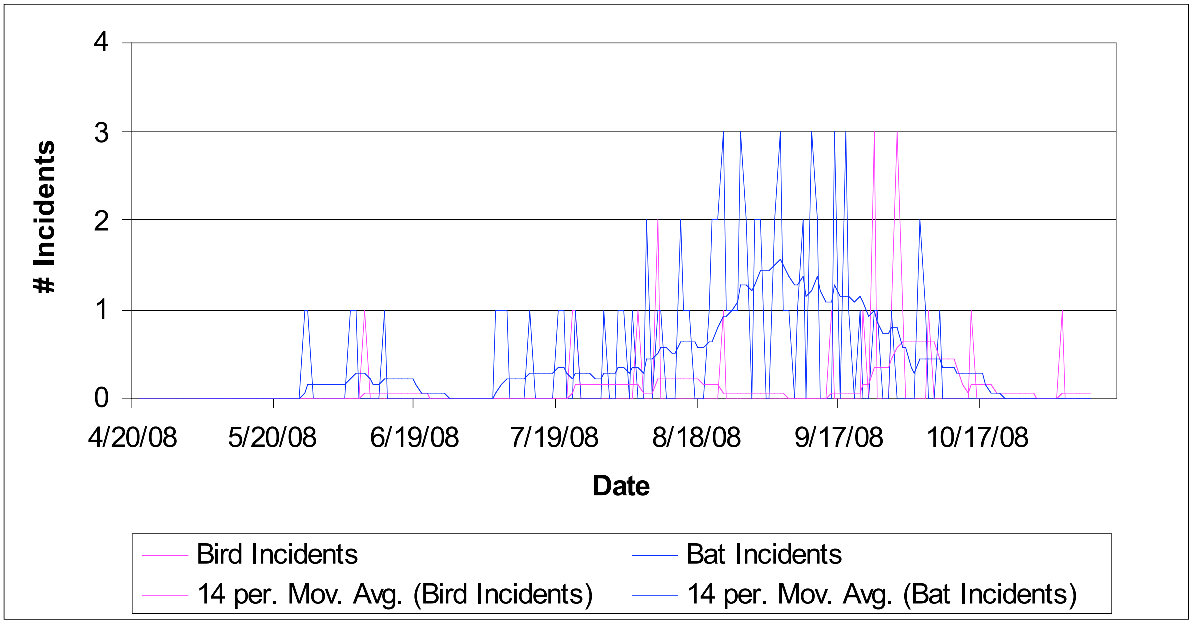


Figure 9. Number of birds and bats found per day from April 21 to November 14, 2008.
Note: Trend lines indicating a 14 day moving average.



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. Of the 16 small and unidentified bird incidents found during standardized surveys at 1-Day sites, the mean distance to the turbine tower base was 33.1m and the median distance was 33m. Of the 36 bat incidents found during standardized surveys at 1-Day sites, the mean distance to the turbine tower base was 22.9m and the median distance was 21m. Thus, bat incidents were concentrated closer to towers than birds.

Thirty-six bat incidents and 16 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 R^2 (goodness-of-fit) value for both trend lines are shown (R^2= 1.0 indicates perfect fit – 100% of variance explained). The R^2 for bird incidents was 0.80 and for bat incidents was 0.92.

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 approximate zero at ~85m from the turbine base. The current available data indicate that the current 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, in relation to distance from towers.
Note: Polynomial trend line approximates distance at which density crosses zero.

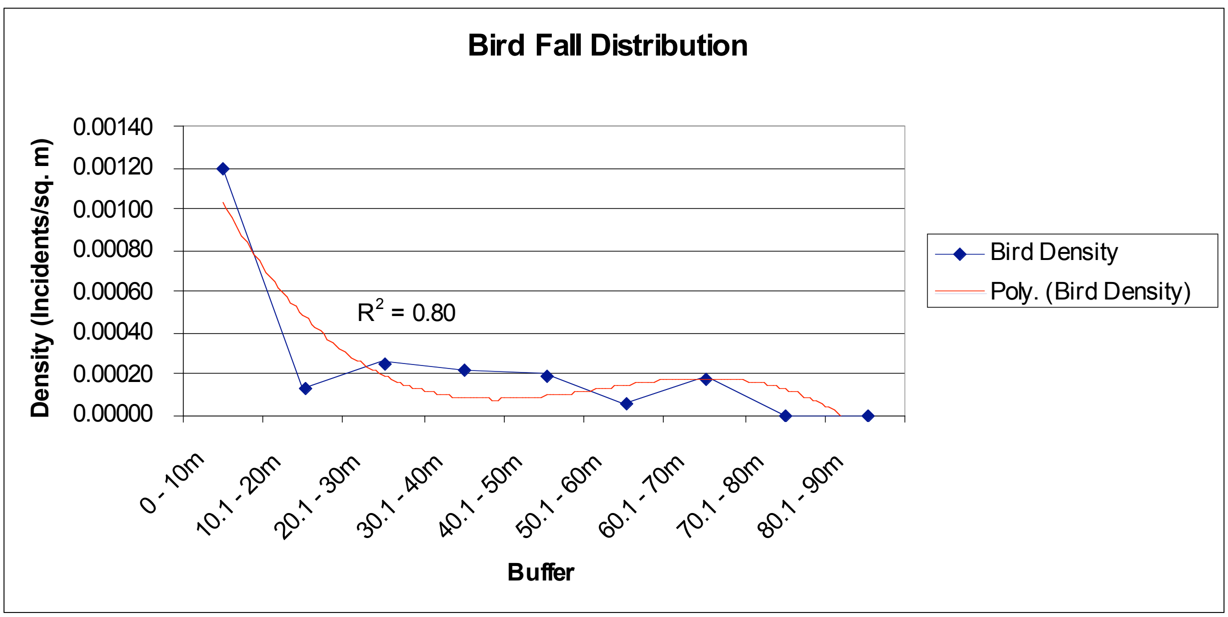
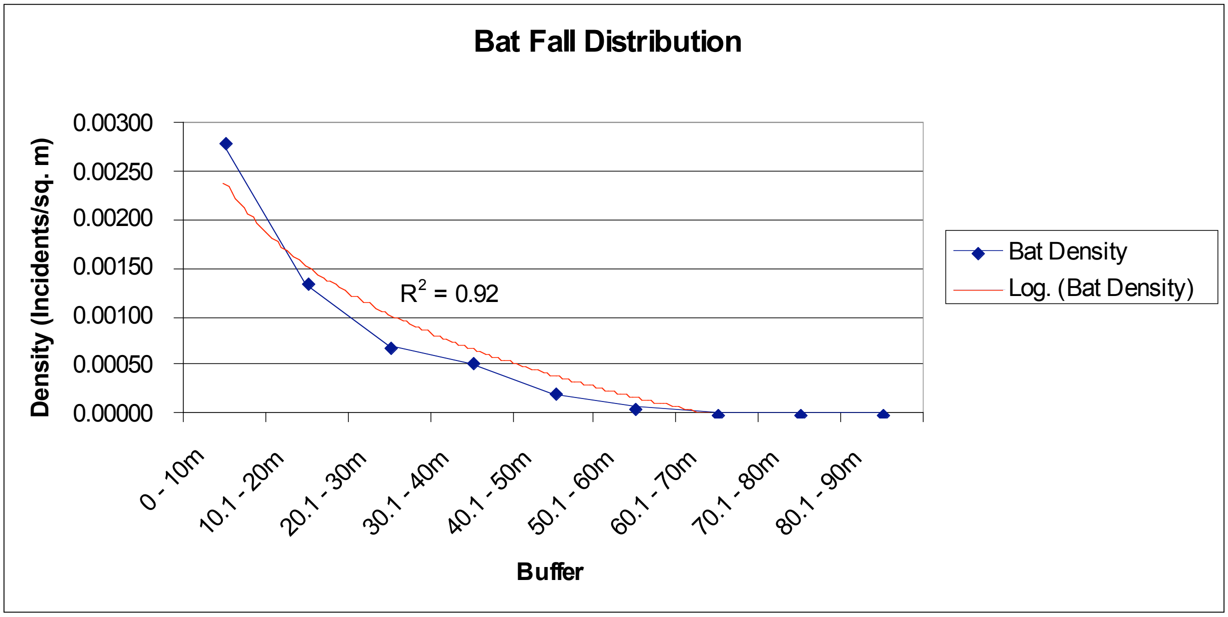


Figure 11. Density of bat incidents at 8 1-Day sites, from surveys conducted from April 21 to November 14, 2008, in relation to distance from towers.
Note: Logarithmic trend line approximates distance at which density crosses zero.



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, 3 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 eight 3-Day towers searched, seven were classified as wooded and 1 was classified as a non-wooded site. All of the 7-Day sites were wooded sites, precluding this type of analysis for both birds and bats found at 7-Day sites.

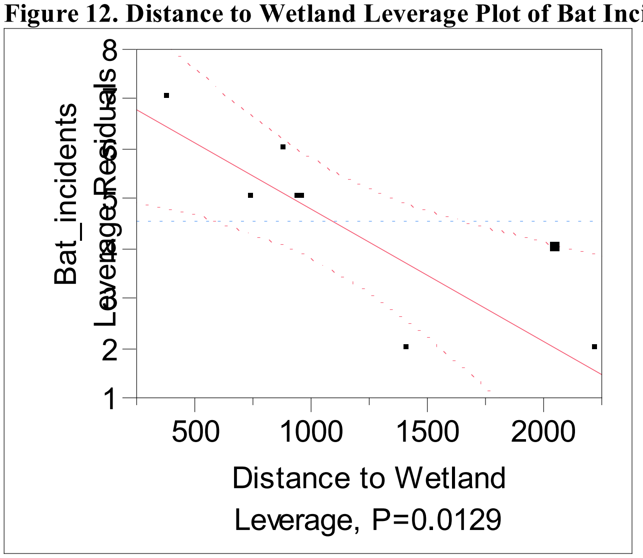
Dist_wetland: All of the six bat species found at the Bliss Windpark are known to forage over water bodies to some extent (Erickson 2002, Furlonger *et al.* 1987, Genter and Jurist 1995, Zinn and Baker 1979) and to use wetlands for some of their daily water intake needs (Kurta 2000). We determined the distance of each searched turbine site to the nearest wetland, using wetland delineation provided by Seneca Todd (Noble Environmental Power GIS Department). 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 F-tests for the one, three and seven-day sites. The sample size was low (N=8, 8 and 7, respectively.

1-Day Sites:
There was a significant negative relationship between the number of bat incidents recorded at the 1-Day sites and distance to the nearest wetland (F –Test Analysis of Variance, F = 12.20, p = 0.01, df = 1, 6). The relationship is represented in Figure 12.

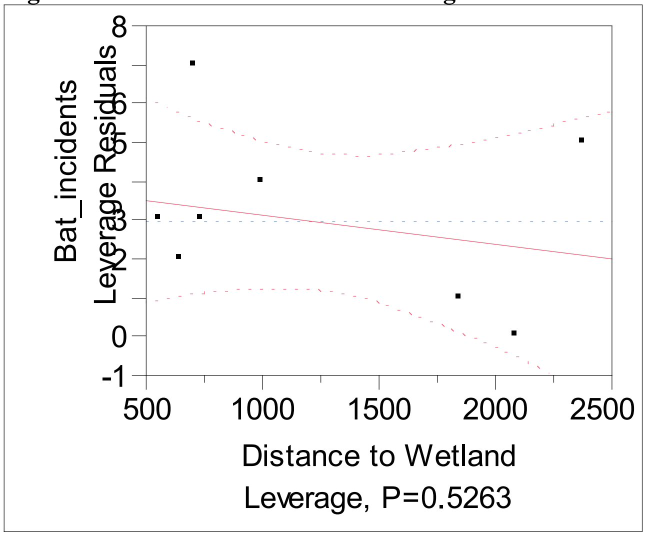
Figure 12. Distance to Wetland Leverage Plot of Bat Incidents By Distance to Nearest Wetland (1-Day sites)



The broken red lines in Figure 12 indicate 95% confidence intervals for the negative relationship. As distance to wetland increased, the number of bat fatalities noted decreased.

3-Day Sites:
There was no significant negative relationship between the number of bat incidents recorded at the 3-Day sites and distance to the nearest wetland (F –Test Analysis of Variance, F = 0.45, p = 0.53, df = 1, 6). The relationship is represented in Figure 13.

Figure 13. Distance to Wetland Leverage Plot of Bat Incidents By Distance to Nearest Wetland (3-Day sites)



The broken red lines in Figure 13 indicate 95% confidence intervals for the negative relationship. Similar to 1-Day sites, as distance to wetland increased, the number of bat fatalities noted decreased. However, this relationship was not significant.

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 (χ^2 = 0.14, df = 1, p = 0.71).

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 eight towers searched on a 3-day basis, seven were classified as wooded and one was classified as non-wooded. 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. The number of birds was too low for statistically valid tests at 3-Day sites.

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' χ^2 = 0.011 ,*df* = 1, P = 0.91, 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 (χ^2 = 0.003 ,*df* = 1, P = 0.96, 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 Turbines	# Bats (within 40m)	Sum
Non-wooded Towers	2	7	37
Wooded Towers	6	27	33
Sum	8	32	40

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 Turbines	# Birds (within 40m)	Sum
Non-wooded Towers	2	6	8
Wooded Towers	6	11	17
Sum	8	17	25

3-Day sites

A chi-square test (Table 9) 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' χ^2 = 0.155, df = 1, P = 0.69, ns). We were unable to perform this test for bird incidents at 3-Day sites due to the low number of incidents.

Table 9. Contingency table showing the proportion of bat incidents noted within 40m from turbine tower base of the 8 3-day search sites, comparing wooded versus non-wooded sites.

	# 3-Day Turbines	# Bats (within 40m)	Sum
Non-wooded Towers	1	7	8
Wooded Towers	7	17	24
Sum	8	24	32

Finally, all 7-Day sites were wooded, thus we were not able to perform these tests for either birds or bats found at 7-Day sites.

3.2.5.3 Lit versus Un-Lit Turbine sites:

We examined the numbers of incidents of night migrating bird and bat fatalities at turbines with FAA lights vs. turbines without such lights. Chi-square tests were performed at the 1-Day sites for both birds and bats, and at the 3-Day and 7-Day search sites for bats only, as data were insufficient for similar tests for night migrant birds at 3-Day and 7-Day sites. We tested whether the actual proportion of incidents at lit versus unlit towers differed significantly from expected proportion, but no significant difference was seen. If the FAA lights did not attract birds/bats, the proportion of incidents should be the same as the proportion of lit to unlit towers.

1-Day sites:

There was no significant deviation (Table 10) from the expected number of night migrant bird incidents at turbines with L-864 red flashing FAA beacons as opposed to unlit turbines (Chi-Squared Test, $\chi^2 = 0.087$, $df = 1$, P = 0.77, ns). Additionally, there was no significant deviation (Table 11) from the expected number of bat incidents at turbines with L-864 red flashing FAA beacons as opposed to non-lit turbines (Chi-Squared Test, $\chi^2 = 0.204$, $df = 1$, P = 0.65, ns) among the eight towers searched on a daily basis (1-day sites).

Table 10. 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 Turbines	# Bats	Sum
Lit Towers	2	3	5
Unlit Towers	6	7	13
Sum	8	10	18

Table 11. Contingency table showing the proportion of bat incidents noted at the 8 1-day search sites, comparing lit versus unlit sites.

	# 1-day Turbines	# Birds	Sum
Lit Towers	2	9	11
Unlit Towers	6	27	33
Sum	8	36	44

3-Day sites:

There was no significant deviation (Table 12) from the expected number of bat incidents at turbines with L-864 red flashing FAA beacons as opposed to non-lit turbines (Chi-Squared Test, $\chi^2 = 0.06$,$df = 1$, P = 0.80, ns), amongst the eight 3-Day towers. As the average area searched differed significantly between the lit and unlit towers for 3-Day sites, we used data from bat incidents within 40m of the tower based to eliminate bias. Bird numbers were insufficient for a similar analysis at 3-Day sites.

Table 12. Contingency table showing the proportion of bat incidents noted at the 8 3-day search sites, comparing lit versus unlit sites.

	# 3-day Turbines	# Bats (40m)	Sum
Lit Towers	2	5	7
Unlit Towers	6	19	25
Sum	8	24	32

7-Day sites:

There was no significant deviation (Table 13) from the expected number of bat incidents at turbines with L-864 red flashing FAA beacons as opposed to non-lit turbines (Chi-Squared Test, $\chi^2 = 0.11$,$df = 1$, P = 0.74, ns), amongst the seven 7-Day towers. Bird numbers were insufficient for a similar analysis at 7-Day sites.

Table 13. Contingency table showing the proportion of bat incidents noted within 40m from turbine tower bases of the 7 7-day search sites, comparing lit versus unlit sites.

	# 7-day Turbines	# Bats	Sum
Lit Towers	3	6	9
Unlit Towers	4	7	11
Sum	7	13	20

3.2.6 Extraordinary Maintenance Activities

During the 2008 project year, the Noble Bliss Windpark experienced high levels of site reclamation as part of the post-construction process. Further, turbine maintenance occurred throughout the year, for varying amounts of time. While we hypothesized that inactive turbines may be correlated with a decrease in fatalities, we had no way of coordinating searches with inactive turbines, as maintenance work was not according to a standardized schedule. In addition, downtime occurred for differing periods of the day (and night) at individual towers. An experimental study with searches designed to coincide with tower downtime would be better suited to explore this relationship. As it currently stands, our study estimates mortality based upon the level of operation of the Windpark in its first year, encompassing periods of site reclamation and tower maintenance.

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, 3 and 7-day Search Sites

3.3.1.1 Proportion of complete surveys per week (*Ws*)

We began searches concurrently with site set-up. As this was the first year of study, the process of communicating with landowners and gaining authorization delayed the project start dates.
So that the project could begin in a timely manner, the sites that received authorization first were placed on the daily search schedule. As subsequent permissions were granted, the 3-day and 7-Day sites were added. 1-Day site surveys began on April 21, 2008. Searching of 8 3-day and 5 7-Day sites began on May 9, 2008. Further, during the course of the project period, extensive landscaping and site maintenance activities on the part of the windpark technicians affected searches at some of our tower sites. The disruption to regular searches was primarily restricted to the first half of the field season (Period A). To account for these disruptions, we adjusted our raw data in the following manner: For all three site types (1, 3 and 7-Day), we divided the season into two periods, A (searches conducted before 8 August, 2008) and B (searches conducted on or after 8 August, 2008). See Table 14 for the proportion of completed searches to scheduled searches during periods A and B at 1-Day, 3-Day and 7-Day sites.

In Period A, we obtained the ratio of actual searches conducted to searches scheduled (*Ws*). We divided the numbers of birds and bats found during Period A by *Ws* (Table 14) to adjust for missed surveys during that Period. We did this separately for 1-Day, 3-Day and 7-Day sites. The effect of this adjustment factor will be negligible in subsequent years, as site reclamation largely concluded by the month of August, 2008.

1-Day sites:
Period A: The mean proportion of the 8 towers searched per day ($Ws_{1\text{-DayA}}$) was 0.72 i.e. we missed 28% of scheduled searches per week, on average, over the study period.
Period B: The mean proportion of the 8 towers searched per day ($Ws_{1\text{-DayB}}$) was 0.97, i.e. we missed 3% of scheduled searches per week, on average, over this period.

3-Day sites:
Period A: The mean proportion of the 8 towers searched every 3 days ($Ws_{3\text{-DayA}}$) was 0.76 i.e. we missed 24% of scheduled searches per week, on average, over the study period.
Period B: The mean proportion of the 8 towers searched every 3 days ($Ws_{3\text{-DayB}}$) was 0.99 i.e. we missed 1% of scheduled searches per week, on average, over this period.

7-Day sites:
Period A: The mean proportion of the 7 towers searched every 7 days ($Ws_{7\text{-DayA}}$) was 0.59 i.e. we missed 41% of scheduled searches per week, on average, over the study period.
Period B: The mean proportion of the 7 towers searched every 7 days ($Ws_{7\text{-DayB}}$) was 0.98 i.e. we missed 2% of scheduled searches per week, on average, over the study period.

Table 14. Proportion of completed searches to schedules searches, Periods A and B, at the Noble Bliss Windpark, from April 21, 2008 to November 14, 2008.

	Period A			Period B		
Search Frequency	Completed Searches	Scheduled Searches	Prop. Of completed Surveys (Ws)	Completed Searches	Scheduled Searches	Prop. Of completed Surveys (Ws)
1-Day	590	816	**0.72**	762	784	**0.97**
3-Day	188	248	**0.76**	262	264	**0.99**
7-Day	54	91	**0.59**	96	98	**0.98**

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 15, 16 and 17, Figure 14) 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 four size classes: small, medium and 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, 3-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 prior to the creation of Tables 15, 16 and 17.

Figure 14. Examples of searched towers showing searchable area divided into concentric annuli

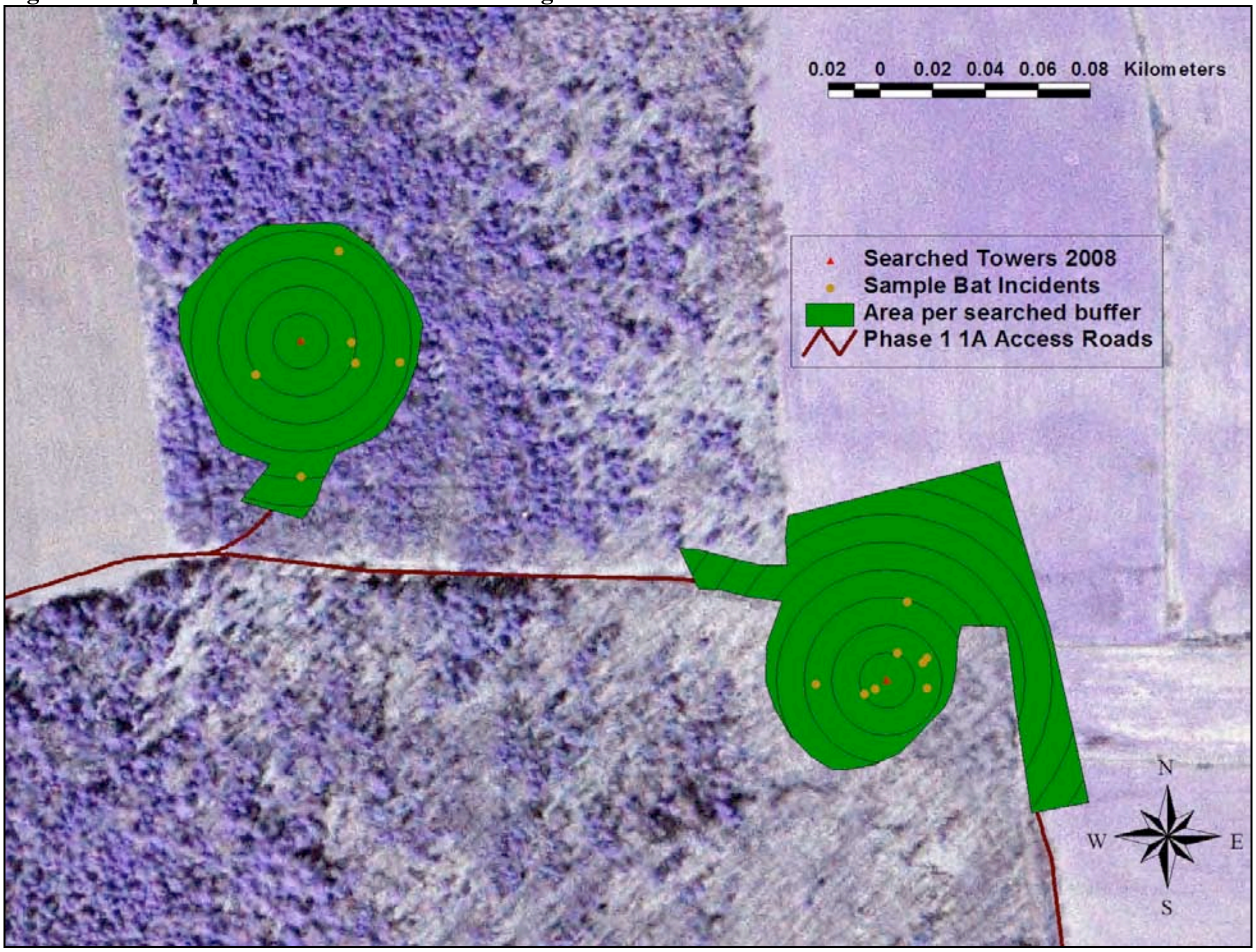


Table 15. Search Intensity Area Adjustment Factor for bird and bat incidents from standardized surveys conducted at 8 1-Day sites, from April 21 to November 14, 2008.

					Pre-Area Adjusted				Area Adjusted			
Annulus	Total Area Searched -8 towers	Area of Full Annulus per tower (inside 120 x 120m sq.)	Total Searchable area/annulus	Search Intensity Prop. of annulus searched (Si)	Small birds	Med-Large birds	Unid birds	Bats	Small birds	Medium-Large birds	Unid birds	Bats
0-10	2501	313	2501	1.00	3	0	0	8	3	0	0	7.94
10.1-20	7450	943	7543	0.99	1	0	0	11	1.01	0	0	11.08
20.1-30	11540	1571	12571	0.92	3	1	0	9	3.27	1.6	0	9.74
30.1-40	13611	2200	17600	0.77	2	0	1	7	2.59	0	1.29	9.66
40.1-50	14896	2829	22629	0.66	2	0	1	3	3.04	0	1.52	5.27
50.1-60	15951	3457	27657	0.58	0	0	1	1	0	0	1.73	1.73
60.1-70	10886	2164	17309	0.63	0	0	2	0	0	0	3.93	0
70.1-80	4318	878	7021	0.62	0	0	0	0	0	0	0	0
				Totals	**11**	**1**	**5**	**40**	**12.9**	**1.6**	**8.47**	**45.43**

For example, when examining Table 15 we see that the number of bats in the first row (8), when divided by **Si** (1), remains unchanged. 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 = 11/0.9877 = 11.08 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. Finding even a small number of bats (2) at the penultimate annulus (60.1 – 70m) yields a proportionately higher adjustment (2/0.6289 = 3.93).

Thus, in Table 15, the number of bat incidents found (40) was corrected for area to 45.43. The number of birds found (16) has been corrected for area to 23. Table 16 shows that the number of bat incidents found (27) was then adjusted for area to 30.39. The number of birds found (2) has been adjusted for area to 4.19. Additionally, Table 17 shows the number of bat incidents found (15) adjusted for area to 29.53. The number of birds found (1) has been adjusted for area to remain at 1.

Table 16. Search Intensity Area Adjustment Factor for bird and bat incidents from standardized surveys conducted at 8 3-Day sites from April 21 to November 14, 2008

					Pre-Area Adjusted				Area Adjusted			
Annulus	Total Area Searched -8 towers	Area of Full Annulus per tower (inside 120 x 120m sq.)	Total Searchable area/annulus	Search Intensity Prop. of annulus searched **(Si)**	Small birds	Med-Large birds	Unid birds	Bats	Small	Med-Large birds	Unid birds	Bats
0-10	2501	313	2501	1.00	0	1	0	11	0	1	0	10.95
10.1-20	7095	943	7543	0.94	0	0	0	4	0	0	0	4.25
20.1-30	10594	1571	12571	0.84	0	0	0	7	0	0	0	8.68
30.1-40	12628	2200	17600	0.72	0	0	0	3	0	0	0	4.62
40.1-50	12016	2829	22629	0.53	0	0	0	1	0	0	0	1.88
50.1-60	11418	3457	27657	0.41	0	1	0	0	0	3.19	0	0
60.1-70	7735	2164	17309	0.45	0	0	0	0	0	0	0	0
70.1-80	2895	878	7021	0.41	0	0	0	0	0	0	0	0
				Totals	**0**	**2**	**0**	**27**	**0**	**4.19**	**0**	**30.39**

Table 17. Search Intensity Area Adjustment Factor for bird and bat incidents from standardized surveys conducted at 7 7-Day sites from April 21 to November 14, 2008

					Pre-Area Adjusted				Area Adjusted			
Annulus	Total Area Searched -7 towers	Area of Full Annulus per tower (inside 120 x 120m sq.)	Total Searchable area/annulus[1]	Search Intensity Prop. of annulus searched **(Si)**	Small birds	Med-Large birds	Unid. birds	Bats	Small	Med-Large birds	Unid birds	Bats
0-10	2188	313	2188	1.00	1	0	0	6	1	0	0	6.39
10.1-20	5878	943	6600	0.89	0	0	0	2	0	0	0	2.25
20.1-30	7595	1571	11000	0.69	0	0	0	3	0	0	0	4.35
30.1-40	6854	2200	15400	0.45	0	0	0	0	0	0	0	0
40.1-50	4923	2829	19800	0.25	0	0	0	3	0	0	0	10.84
50.1-60	4235	3457	24200	0.17	0	0	0	1	0	0	0	5.71
60.1-70	2671	2164	15145	0.18	0	0	0	0	0	0	0	0
70.1-80	1180	878	6143	0.19	0	0	0	0	0	0	0	0
				Totals	**1**	**0**	**0**	**15**	**1**	**0**	**0**	**29.53**

3.3.1.3 Scavenger Removal and Search Efficiency

Tables 18, 19 and 20 provide the results of the scavenger study (for 1-Day, 3-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, 2 and 4 days for the 1-Day, 3-Day 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, 2 and 4 days for the 1-Day, 3-Day and 7-Day sites, respectively, was used to adjust the number of bat incidents that were discovered by our searchers.

Table 18. Noble Bliss scavenger removal study data for 1-Day sites (2008).

Size Class	**# Carcasses**	**# Scavenged.**	**Prop. not scavenged (Sc)**
Small Birds – 1-Day	26	5	0.81
Medium & Large Birds – 1-Day	24	5	0.79
Bats and mice– 1-Day	37	5	0.86

Table 19. Noble Bliss scavenger removal study data for 3-Day sites (2008).

Size Class	**# Carcasses**	**# Scavenged.**	**Prop. not scavenged (Sc)**
Small Birds – 3-Day	26	9	0.65
Medium & Large Birds – 3-Day	24	5	0.79
Bats and mice– 3-Day	37	14	0.62

Table 20. Noble Bliss scavenger removal study data for 7-Day sites (2008).

Size Class	# Carcasses	# Scavenged.	Prop. not scavenged (Sc)
Small Birds – 7 day	26	16	0.38
Medium & Large Birds – 1-Day	24	14	0.42
Bats and mice– 7 day	37	19	0.49

Tables 21, 22 and 23 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).

Table 21. Noble Bliss searcher efficiency study data for 8 1-Day sites (2008).

Size Class	# Carcasses	# Carcasses not found	Prop. found (Se)
Small Birds	11	2	0.82
Medium & Large Birds – 1-Day	12	0	1.00
Bats	15	2	0.87

Table 22. Noble Bliss searcher efficiency study data for 8 3-Day sites (2008).

Size Class	# Carcasses	# Carcasses not found	Prop. found (Se)
Small Birds – 3-Day	8	5	0.38
Medium & Large Birds – 3-Day	6	0	1.00
Bats and mice– 3-Day	12	7	0.42

Table 23. Noble Bliss searcher efficiency study data for 7 7-Day sites (2008).

Size Class	# Carcasses	# Carcasses not found	Prop found (Se)
Small Birds – 7 day	2	1	0.50
Medium & Large Birds – 7-Day	3	0	1.00
Bats and mice– 7 day	6	1	0.67

We gave priority to Sc and Se testing at 1-Day and 3-Day sites over the 7-Day sites due to the limited numbers of bird and bat carcasses available for testing. However, the limited testing at 7-Day sites produced results within the range of those seen at 1 and 3-Day tests. Thus, we did not feel it necessary to pool our test data across site types.

Tables 24, 25 and 26 show estimates of the number of bird and bat fatalities attributed to collisions with the wind turbines at the Noble Bliss Windpark in the 2008 study period. The tables reflect search and scavenging rates as determined in tables 19, 20 and 21 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 3.3.1.2 and 3.3.1.1, respectively. 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 24. Full season estimates (April 21 to November 14, 2008) 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	16	1	40	
# After Area Adjustment Search Intensity (**Si**)	21.38	1.60	45.43	31
Prop. of completed surveys/week (**Ws**) before 8/8/08	72%	72%	72%	
% Not Scavenged **(Sc)**	81%	79%	86%	
Search Efficiency **(Se)**	82%	100%	87%	
Proportion of Towers Searched (**Ps**)	11.94%	11.94%	11.94%	
Adjusted Total	**271**	**17**	**508**	**795**
95% CI (±)	10	0	106	
Per Tower	4.04	0.25	7.58	
Per MW	2.70	0.17	5.05	
Per 2000m2 Rotor Swept Area	1.74	0.11	3.25	

Table 25. Full season estimates (April 21 to November 14, 2008) 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 3-day Sites.

Correction Factors	**Birds**		**Bats**	**Total Carcasses**
	Small	Medium-Large	Bats	
# Found	0	2	27	
# After Area Adjustment Search Intensity (**Si**)	0	4	30	34
Prop. of completed surveys/week (**Ws**) before 8/8/08	76%	76%	76%	

Correction Factors	Birds		Bats	Total Carcasses
% Not Scavenged **(Sc)**	65%	79%	62%	
Search Efficiency **(Se)**	38%	100%	42%	
Proportion of Towers Searched (**Ps**)	11.94%	11.94%	11.94%	
Adjusted Total	**0**	**44**	**983**	**1027**
95% CI (±)	-	1	620	
Per Tower	-	0.66	14.66	
Per MW	-	0.44	9.78	
Per 2000m2 Rotor Swept Area	-	0.28	6.30	

Table 26. Full season estimates (April 21 to November 14, 2008) 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 7 7-day Sites.

Correction Factors	Birds		Bats	Total Carcasses
	Small	Medium-Large	Bats	
# Found	1	0	15	16
# After Area Adjustment Search Intensity (**Si**)	1	0	30	
Prop. of completed surveys/week (**Ws**) before 8/8/08	59%	59%	59%	
% Not Scavenged **(Sc)**	50%	100%	67%	
Search Efficiency **(Se)**	50%	100%	67%	
Proportion of Towers Searched (**Ps**)	10.45%	10.45%	10.45%	
Adjusted Total	**50**	**0**	**872**	**922**
95% CI (±)	8	-	576	
Per Tower	0.74	-	13.01	
Per MW	0.50	-	8.67	
Per 2000m2 Rotor Swept Area	0.32	-	5.59	

3.3.2 Estimated Fatalities by Species

We adjusted the number of incidents of birds and bats per species, in Table 27 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 Black-polled Warbler 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 (large, medium 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 1-Day, 3-Day and 7-day search sites. The next three columns show the number of incidents per megawatt, and the last four numerical columns show the estimate of mortality over the entire 67 turbines of the Noble Bliss Windpark, calculated for that species as well as the incidental species (last column).

Table 27. Incidents per species found during both standardized surveys and incidentally, April 21 to November 14, 2008. 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. Results are reported in incidents per MW and for the total number of towers at the Noble Bliss Windpark

	2007			**Estimated # Incidents/Mw**				**Estimate of mortality (67 towers)**			Incidental Finds
Species Name	**8 1-Day sites**	**8 3-Day Sites**	**7 7-Day Sites**	**8 1-Day sites**	**8 3-Day Sites**	**7 7-Day Sites**		**8 1-Day sites**	**8 3-Day Sites**	**7 7-Day Sites**	
Birds (Medium - Large)											
Red-tailed Hawk	1	---	---	0.11	---	---		12	---	---	2
Ruffed Grouse	---	---	---	---	---	---		---	---	---	1
Sharp-shinned Hawk	---	1	---	---	0.19	---		---	19	.	.
Woodcock	---	1	---	---	0.19	---		---	19	.	.
Total Medium - Large	**1**	**2**	**0**	0.11	0.38	0.00	**Total Estd. Med. - Large**	**12**	**38**	**0**	**1**
Birds (Small)											
Black-polled Warbler	1	---	---	0.16	---	---		16	---	---	.
Blue-headed Vireo	1	---	---	0.16	---	---		16	---	---	.
European Starling	1	---	---	0.16	---	---		16	---	---	.
Magnolia Warbler	2	---	---	0.33	---	---		33	---	---	.
Red-eyed Vireo	1	---	1	0.16	---	0.50		16	---	50	2
Savannah Sparrow	1	---	---	0.16	---	---		16	---	---	.
Veery	1	---	---	0.16	---	---		16	---	---	.
Warbler spp.	1	---	---	0.16	---	---		16	---	---	.
Wood Thrush	2	---	---	0.33	---	---		33	---	---	.
Unidentified Bird	5	---	---	0.82	---	---		82	---	---	2

	2007			**Estimated # Incidents/Mw**				**Estimate of mortality (67 towers)**			Incidental Finds
Species Name	**8 1-Day sites**	**8 3-Day Sites**	**7 7-Day Sites**	**8 1-Day sites**	**8 3-Day Sites**	**7 7-Day Sites**		**8 1-Day sites**	**8 3-Day Sites**	**7 7-Day Sites**	
Total Small Birds	**16**	**0**	**1**	2.62	0.00	0.50	**Total Estd. Small Birds**	**263**	**0**	**50**	**4**
Total Birds	**17**	**2**	**1**	2.73	0.38	0.50	**Total Estd. Birds**	**275**	**38**	**50**	**5**
Bats	-	-									
Hoary Bat	13	9	2	1.65	3.31	1.15		166	333	116	3
Eastern Red Bat	2	3	1	0.25	1.10	0.57		26	111	58	2
Silver-haired Bat	5	6	2	0.64	2.21	1.15		64	222	116	4
Little Brown Bat	16	6	7	2.03	2.21	4.02		204	222	404	5
Big Brown Bat	---	---	1	---	---	0.57		---	---	58	
Eastern Pipistrelle Bat	---	1	---	---	0.37	---		---	37	---	
Unknown Species	---	---	---	---	---	---		---	---	---	1
Total Bats	**36**	**25**	**13**	4.57	9.20	7.47	**Total Estd. Bats**	**459**	**924**	**751**	**15**
Total (Birds & Bats)	**53**	**27**	**14**				**Total Estd. (Birds & Bats)**	**734**	**962**	**801**	**22**

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 24, 25 and 26.

4.0 DISCUSSION

4.1 Project Duration and Search Interval

The 2008 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 after snow cleared enough for site access and search areas were ready within about two weeks.
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 at most other wind power sites. 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 worries of 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 <u>Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects, Jan 2009</u>). 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 5 large birds and 19 medium sized birds over 5 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, the GPS 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. As explained in section 3.3.1.1, the calculations were adjusted to the best of our ability to deal with the tower maintenance issues experienced by the windpark owner prior to August 8, 2008.

4.2 Seasonal Distribution of Fatalities

Similar to other western, Midwestern and eastern wind energy facility sites, the greatest mortality for both birds and 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 2008 study period spanned the entire duration 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.

Both bird and bat fatalities had declined to very low levels by November 2008, indicating that had the search season been extended few additional incidents would likely have been noted.

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 refer to results presented by the National Research Council (NRC 2007) recent review (Table 29). 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 United States. The studies also agree that there are very few waterbirds or shorebirds killed and that raptors are also rare among the fatality lists. 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 28. 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 28. Bird mortality reported at U.S. wind-energy projects (from NRC 2007 and other sources)*

					All Bird Mortality		
Wind Project	**Study Period**	**# Turbines**	**Turbine MW**	**Project MW**	**Turbine per period**	**MW per period**	**Reference**
Pacific Northwest							
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
Rocky Mountain							
Foote Creek Rim, WY, Phase I[2]	Nov 1998 – Dec 2000	72	0.60	43	1.50	2.50	Young et al. 2001
Foote Creek Rim, WY, Phase II[2]	June 2001 – June 2002	33	0.75	25	1.49	1.99	Young et al. 2003
Upper Midwest							
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–15 Nov 1996–1999	73	0.30	33	0.98	3.27	Johnson et al. 2002
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
East							
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
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*. 2009b
Noble Clinton, NY[3,4]	26 Apr 2008 - 13 Oct 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*. 2009a
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	**This Study**

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. Those 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). We conducted tests of night migrant incidents found at lit and unlit turbines for the 64 7-day search sites. We found no relationship between the numbers of night migrant fatalities and the presence of L-864 red flashing beacons on turbines. These results correspond to results from all other wind power sites where such tests could be 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 something on the order of 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 to do not occur at wind turbines.

We also observed no significant evidence of a higher proportion of bat fatalities at FAA lit turbines in 2008. 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 29 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 27 and 29 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 of the most common species for which we found fatalities (Magnolia Warbler, n = 2 carcasses and Wood Thrush, n = 2 carcasses, both extrapolated to 33 incidents each in the 1-Day extrapolation for 2008, Table 27) are listed as stewardship species (Magnolia Warbler) and as Yellow WatchList (declining) species. These species have estimated overall population levels of about 32 million and 14 million (Rich et al. 2004), respectively. 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.

A note with respect to Wood Thrush (listed as "Declining" in Table 29) is needed to clarify the significance of the fatalities of this species at Bliss. Perhaps the most important reason this species is declining is related to the burning of coal for electricity. Acid precipitation, which originates largely from coal burning, has been reported as a causal factor in the decline of Wood Thrushes in New York and elsewhere (Hames et al. 2002). The study, conducted by Cornell University researchers, concluded that Wood Thrush, and likely other species that inhabit deciduous forests have declined in forested areas where acid precipitation is greatest. Such species would include Magnolia Warbler, American Woodcock and even Sharp-shinned Hawks, species which were killed in very small numbers at Bliss.

It is important here to note that regulated harvests of declining 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 – ~8-10% of the North American population are harvested annually by hunters in the eastern United States (not including Canada). The NYSDEC permits up to three woodcock per day to be shot with an annual total harvest in the state of about 10,000 ± ~30% (Richkus et al. 2008). This means that the actual fatalities could total as high as 13,000 per year. A single woodcock fatality was found at 3-Day searched sites at this Windpark.

One European Starling was among the incidents noted during standardized surveys in 2008, accounting for 5.9% 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. 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, ~16 out of 275 (~5.8%) estimated birds from 1-Day searches were non-MBTA species. By including European Starlings, we have been conservative regarding estimating the number and significance of bird deaths at Noble Bliss Windpark turbines.

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 wind turbine fatality numbers like those that occurred at the Noble Bliss Windpark. One incident involving a Sharp-shinned Hawk, a New York species of special concern, was noted (August 6, 2008).

Table 29. BBS population trends and geographical distribution of bird species found at the Noble Bliss Windpark during standardized surveys and incidentally (April 21 to November 14, 2008) Sauer *et al*. 2005

Species	Night Migrant Species	North America Population	2007 WatchList	Geographic Range
Blackpoll Warbler	Yes	21 million	No	Boreal Forest
Blue-headed Vireo	Yes	6.9 million	No	North Temp.(and Boreal) Forests E of Rockies
European Starling	No	Non-MBTA species	N/A	Most of North America
Magnolia Warbler	Yes	32 million	Stewardship	Boreal and North Temp. Forest (Mostly E of Rockies)
Red-eyed Vireo	Yes	140 million	No	Temp. and Boreal Forests
Red-tailed Hawk	No	2.2 million	No	North America
Savannah Sparrow	Yes	82 million	No	Vast areas of Temperate, Boreal, and Arctic Grasslands
Sharp-shinned Hawk	No	1.1 million	No	North America
Veery	Yes	14 million	No	Temperate Forests
Wood Thrush	Yes	14 million	Yellow - Declining	E Temperate Forests
American Woodcock	Yes	4-5 million	No	Eastern & Midwestern 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.

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, while acknowledging 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 30).

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 30. Population trends and geographical distribution of bat species found at the Noble Bliss Windpark during standardized surveys and incidentally (April 21 to November 14, 2008).

Species	Tree-Roosting	Population Trends	Geographic Range
Hoary Bat	Yes	Unknown	North America
Eastern Red Bat	Yes	Poss. Decreasing	Central and Eastern North America
Eastern Pipistrelle Bat	Poss.	Poss. Decreasing in NY	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
Big Brown Bat	No	Poss. Increasing in North America. Possibly Decreasing in NY.	North America

Tables 31 and 32 show the comparison of the fatalities per turbine, per MW and per $2000m^2$ 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 and Midwestern U.S., and generally lower than those rates reported from the Appalachian mountains in the eastern U.S.

Table 31. 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

Study Area Location	Study Period	Est. Mean Fatality/ Turbine	Estimated Mean Fatality/MW	Estimated Mean Fatality/ $2000m^2$ rotor Swept Area	Reference
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	30 Apr-14 Nov 2007	15.54-18.53	9.42-11.23	5.88-7.02	Jain *et al.* 2008
Noble Ellenburg, NY (2008)	28 Apr-13 Oct 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.* 2009
Noble Clinton, NY (2008)	26 Apr-13 Oct 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.* 2009
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	**(This Study)**
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.

Table 32. 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
Noble Bliss, NY (2008)	1.35	8.11	32.43	17.57	39.19	-	1.35	-	74
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 - Unidentified species

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APPENDICES

APPENDIX A: NOBLE BLISS WINDPARK PROJECT SITE INFORMATION DATASHEET.

A similar log was kept for each site as well as the two meteorological towers) detailing site conditions at each search and the number of incidents noted.

Date	Time Surveyed	Temp °F	% Cloud Cover	Survey Weather Conditions	Wind Direction	Wind	Prior Evening Conditions	Bird Carcasses	Bat Carcasses	Observer	Habitat Conditions and Site Repairs Needed

APPENDIX B: NOBLE BLISS WINDPARK PROJECT INCIDENT (MORTALITY) DATASHEET

Details for each incident (bird or bat) were recorded by observers in an individual row of this datasheet. Additional information such as presence of predator sign, evidence of mowing damage, additional carcass condition information etc. was recorded in the last column.

Turbine #	Date	Time	Bird / Bat #	Habitat	Vegetation Length	Species/Age/Sex	Carcass Condition	Time on Ground	Dir-Dist Transect	Observer	Additional Information

APPENDIX C: NOBLE BLISS WINDPARK PROJECT INCIDENT LOCATION (GPS) DATASHEET

In addition to Incident (Mortality) sheet, observers noted GPS coordinates to the towers for future use in GIS analyses. However, Distance and Bearing to the turbine base were also recorded for increased accuracy.

Bird/Bat #	Location (Longitude)	Location (Latitude)	Elevation	Distance	Bearing

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

Tower #	# Tests (Bird)	# Tests (Bats/Mice)
1	0	2
6	0	2
8	4	2
11	2	2
16	0	3
19	5	2
25	3	2
30	3	2
33	2	0
40	4	2
42	4	2
44	0	4
46	3	4
50	3	2
53	2	0
60	4	2
61	3	2
63	3	2
64	3	2
66	2	0

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):
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.