

# 4

## Risk Assessment

### 4.1 Wind Energy and Bird and Bat Issues

#### 4.1.1 Overview

There are a number of beneficial impacts on bird populations that would result from an increased use of renewable energy, including wind energy. Air emissions and global climate change have been cited as serious concerns for North American bird populations (see *A Birdwatcher's Guide to Global Warming* by the National Wildlife Federation and American Bird Conservancy [Price and Glick 2004]). Increased renewable energy use has been cited as one way to slow the rate of climate change and reduce air emissions associated with the increased demand for new energy generation. In addition to the positive impacts noted above, operation of wind energy facilities also has the potential to result in some adverse impacts by causing injury or death to birds through collisions with turbines and by causing habitat loss, degradation, or displacement. While studies have shown that these negative impacts have occurred at a few sites, the results from numerous studies and reviews of impacts on birds from wind energy facilities in North America and Europe indicate that mortality rates are low, especially compared to other sources of bird mortality (Erickson et al. 2001; NWCC 2004; GAO 2005).

In November 2004, the NWCC, a consortium of consumer groups, economic development organizations, electric power, environmental organizations, federal government, green power, state government, tribal governments, and the wind industry, issued the second edition of a fact sheet, “Wind Turbine Interactions with Birds and Bats: A Summary of Research Results and Remaining Questions” (NWCC 2004). The following, taken from the fact sheet, is part of an overview on the status of bird and bat issues at wind energy facilities that aptly describes the current understanding of the issues:

Wind energy's ability to generate electricity without many of the environmental impacts associated with other energy sources (air pollution, water pollution, mercury emissions, and greenhouse gas emissions associated with global climate change) can significantly benefit birds, bats, and many other plant and animal species. However, the direct and indirect local and cumulative impacts of wind plants on birds and bats continue to be an issue.

In a September 2005 report to congressional requesters, the United States Government Accountability Office (GAO) reviewed the impacts on wildlife from wind power. The GAO report concluded that outside of the Altamont site in northern California, the research to date has not shown bird kills in alarming numbers (GAO 2005). The GAO review of post-construction mortality studies found that bird fatalities ranged from 0 to 7.28 birds per turbine per year. Similarly, the 2004 NWCC fact sheet shows an average of 2.3 birds per turbine per year (3.1 birds per MW per year) are killed at facilities outside of California. For eastern wind farms, the NWCC fact sheet average was 4.3 birds per turbine per year (3.0 birds per MW per year) based on only two studies. No wind energy facilities in New York State were included in the NWCC compilation. However, there have been several studies conducted since the time of the NWCC fact sheet including two years of study from New York State with above average bird fatality rates (see Section 4.4 for more details).

The research regarding impacts to bats from wind turbines is much more limited. Collisions involving bats are typically on the same order as expected for birds with 3.4 bat kills per turbine per year (4.6 bats per MW per year) as the national average from the NWCC fact sheet (NWCC 2004). However, much higher rates (15.3-to-41.1 bats per MW per year) were found during some studies in the Appalachian Mountains and at other locations, including New York State, in recent years (GAO 2005, NRC 2007). The significance of localized bat mortality from collisions on a population as a whole is largely not understood, and current research is being aimed at addressing this issue. The Bats and Wind Energy Cooperative (BWEC), an alliance of state and federal agencies, the wind industry, academic institutions, and non-governmental organizations, is currently researching the interactions of bats and wind turbines with the intent to develop solutions for wind farm siting and mitigation that will minimize or prevent bat mortality from wind turbines. To date, there has been no confirmed correlation between habitat availability and specific atmospheric or seasonal conditions that result in increased mortality, although preliminary data seem to indicate that mortalities occur during periods of lower wind speed and that temperature, precipitation, and humidity may also be contributors (see Section 4.1.3 for more details). No known collisions of federally endangered or threatened bat species have been documented in conjunction with wind turbines (NRC 2007).

Because of the general lack of understanding regarding the interaction of bats and wind turbines, the expectation is that continued monitoring and data analysis associated with operational and proposed windparks will contribute to the database regarding bat species and that windpark operators will need to implement management strategies that will evolve throughout the lifespan of windparks as more defined information is developed. As the breadth of knowledge regarding bat/turbine interactions increases, specific mitigation strategies can be developed to allow for the continued operation of windparks as a critical aspect of a global renewable energy approach, while reducing the potential impact on bats.

A summary of bird and bat fatality rates from post-construction studies at wind energy facilities is included in Appendix F (see Tables F-1 and F-2). There is considerable variation in the search interval, seasonal duration, searcher efficiency, scavenger uptake, wind energy facility size, and geographic location among these studies. Therefore, direct comparison of results is problematic, but the data from these studies represent the best available data for evaluation. The summary tables are derived from the NRC of the National Academy of Sciences report (spring 2007) that reviewed the environmental impacts of wind-energy projects, along with some more recent reports (e.g., Maple Ridge studies). The NRC review of effects to birds and bats included more detail than the NWCC and GAO references, especially for bats, and identified information needs and research recommendations at large. The same post-construction studies were evaluated as the previous references for birds; therefore, there are not updated avian fatality rates. The NRC presented the bat post-construction study data without developing an average fatality rate.

#### **4.1.2 Bird Collisions**

##### **4.1.2.1 Altitude and Avoidance Affects**

Direct collisions with the wind turbine rotors or tower can result in injury or mortality to birds and bats. However, the data from numerous post-construction mortality studies at wind turbine projects demonstrate that avian fatality rates are low (see Appendix F). The low fatality rates are primarily due to three factors:

- Most migrating birds fly at altitudes higher than the maximum turbine height;
- A very high percentage of birds flying toward wind turbines will detect and avoid them; and
- Of those birds that do not alter their flight path in time to avoid the rotor swept area of a turbine, a majority will still avoid a collision.

Some details on these factors are included in the sections that follow.

##### **Migration Flight Altitude**

Nocturnal avian radar studies, including those conducted in the Project Area, have routinely demonstrated that most nocturnal migrants fly above 120 meters agl, the maximum height of most modern wind turbines (see Tables 3-6 and 3-7 and Appendices A and B).

Birds migrate at varying altitudes, with most in the following ranges (Smithsonian Migratory Bird Center 2006):

- Songbirds: 500 to 6,000 feet, with 75% of songbirds migrating between 500 and 2,000 feet;

- Shorebirds: 1,000 to 13,000 feet;
- Waterfowl: 200 to 4,000 feet; and
- Raptors: 700 to 4,000 feet.

Given the typical altitude ranges of bird migration, only a small percentage of migrating birds are expected to be regularly flying lower than the maximum turbine height and to be at risk of collision with turbine rotors. Weather conditions such as precipitation, low cloud ceilings, and strong opposing winds will usually lower the altitude of migrating birds, putting more birds at risk of a collision. The relationship of poor visibility due to weather conditions and avian collisions with communications towers and buildings has been well studied (Erickson et al. 2001). During nights with low cloud ceiling, fog, and/or precipitation, collision rates at communication towers are higher than during nights with other weather conditions (e.g., Avery et al. 1980). However, fewer birds typically migrate under such unfavorable conditions.

An example of the number of nights with bird migration under unfavorable conditions is provided by a NEXRAD analysis performed for a wind project site along the Lake Erie shoreline in Lackawanna, Erie County, New York, approximately 25 miles north of the Project Area. Over a five-year study period (2002 to 2006), migration patterns in the vicinity of the Site within the rotor swept area and the frequency of unfavorable weather conditions were evaluated. There were more nights in the spring than in fall with weather conditions that could cause birds to fly at low altitudes; however, in both spring and fall, on the vast majority of these nights the amount of migration was greatly reduced (GMI 2007). Over the five years in spring, an average of 10.6 of 55 nights had conditions that might cause birds to migrate at low altitudes (low ceilings and visibility along with precipitation). Of these nights, only an average of 1.6 nights had bird movements of 25 (birds/km<sup>3</sup>) or greater (GMI 2007). Over the five years in fall, an average of seven of 71 nights had conditions that might cause birds to migrate at low altitudes (low ceilings and visibility along with precipitation). Of these nights, only an average of 0.4 nights had bird movements of 25 birds/km<sup>3</sup> or greater (GMI 2007). While these results are site-specific, they offer evidence that there are typically very few nights when birds will migrate under unfavorable conditions that could put them at increased risk of a collision.

### **Turbine Avoidance**

Various studies of birds approaching wind turbines have demonstrated that most birds detect the presence of wind turbines and react by altering their flight path to avoid them (Sterner 2002; BirdLife 2003; Desholm and Kahlert 2005). In a comparison of flight behavior, one study in Spain found that migrating birds flew at higher average altitudes (>328 feet [100 meters] versus 197 feet [60 meters]) over wind turbines than over areas without wind turbines (Janss 2000). In a study in the Netherlands, Winkelman (1994) observed that at 984 feet (300 meters) from

wind turbines, the change in flight behavior was five times more horizontal than vertical and that 75% of the reactions occurred 328 feet (100 meters) from the turbines. Kahlert et al. (2003) showed some avoidance of an offshore wind farm by birds but emphasized that not enough data had been collected to determine whether the wind farm had or did not have negative effects on migrating bird populations. Desholm and Kahlert (2005) indicated that the radar studies demonstrated a substantial avoidance by migrating waterbirds to a large offshore wind farm with less than 1% flying close enough to the turbines to be at risk of collision. In the Netherlands, Winkelman (1994) found that 1.2% of birds flying at the maximum turbine height were killed. In Belgium, Everaert et al. (2002) calculated the chance of a gull colliding with a turbine to be 0.05% and for a tern 0.2% (BirdLife 2003).

Most of the studies described above were conducted primarily on daytime flying birds and/or from offshore wind farms. Very few visual studies have been conducted at existing wind farms at night; however, the results of nocturnal radar studies can be used to show a high percentage of turbine avoidance among nocturnal migrants. It will take research projects to be conducted with post-construction radar and concurrent mortality studies, to develop a better understanding of the turbine avoidance factor. However, empirically comparing pre-construction radar results to post-construction mortality results does indicate that turbine avoidance is a key factor in the relatively low avian fatality rates exhibited at wind farms. Based on comparison of pre-construction radar passage rates and post-construction mortality results at three wind turbine facilities in the central and western United States, Erickson (2003) estimated that more than 99.99% of birds exhibited behavioral avoidance. Another example that is more recent and closer to the Project Area is the Maple Ridge site in the Tug Hill region of New York State. The turbine passage rate from the ABR pre-construction study at Maple Ridge was 0.7-4.6 nocturnal migrants per turbine per day (Mabee et al 2006b). Assuming for the point of this exercise that all of those nocturnal migrants would collide with the turbine and be found dead during the mortality study would result in approximately 42-to-276 bird fatalities per turbine over the course of the fall migration season (assuming 60 days from August 15 through October 15). The estimates from this exercise are much higher than the post-construction mortality rates of approximately six to 10 birds/turbine/study season [6 to 8 months] obtained during post-construction studies at the site in 2006 and 2007. Granted there are many caveats with such an empirical comparison; however, it demonstrates that there is a high degree of turbine avoidance by nocturnally migrating birds.

Because of site-specific differences in turbines, wind farm layout, weather, bird species, effort, and seasonal duration, these results of the various studies mentioned here cannot be universally applied; however, they demonstrate strong avoidance behavior of turbines by birds in general.

### **Rotor Avoidance**

For birds that do not alter their flight path when approaching a turbine, studies have documented low collision rates for birds flying through the rotor swept area (the area of the rotating turbine blades). In a direct visual study, Winkelman (1994) observed that 84% of the birds passing through a rotor swept area were not killed. Although there are no empirical data that predict a bird's ability to pass safely through the rotor swept area (but see Desholm et al. 2006 for methods to investigate this behavior), there is a hypothetical model (Tucker 1996). Predictive models based on physics indicate that more than half of the birds passing through a rotor swept area will survive (Tucker 1996) because so little space is occupied by the rotating rotors in relation to the speed of the bird's flight.

Because of site-specific differences in turbines, wind farm layout, weather, bird species, effort, and seasonal duration, these results of the various studies mentioned here cannot be universally applied; however, they demonstrate strong avoidance behavior of turbines by birds in general.

#### **4.1.2.2 Other Factors Affecting Bird Collisions**

Several other factors besides altitude, weather, and avoidance have been identified from post-construction monitoring at wind facilities as potential causes for, or associated with, bird mortality.

### **Species Groups**

Songbirds (passerines) comprise the vast majority of the fatalities associated with on-shore wind turbine projects. In a review of post-construction studies at 31 wind facilities outside of California, Erickson et al. (2001) reported that 78% of the carcasses were songbirds (NRC 2007). Much lesser numbers of species from other bird species groups (e.g., waterfowl, waterbirds, shorebirds, diurnal raptors, owls, and fowl-like birds) have been found during post-construction monitoring. This is consistent with the more-studied communications tower industry. Passerines are typically the most abundant group of birds migrating and residing in an on-shore wind energy project area. Most passerines migrate primarily at night, when collisions are most likely to occur.

### **Behavior**

The behavior of a bird species can affect the potential impacts of collision through increased exposure to the rotor swept area or by distractions. Although migrants have a brief exposure period to the wind turbines (i.e., generally one pass through the Project Area in migration, versus numerous passes per day or season for a resident bird), migrants are considered to be at somewhat higher risk than residents. Resident birds appear to become habituated to wind turbines and avoid flying in the immediate proximity of them (Winkelman 1985; Janss 2000; Percival 2001). However, some resident bird species are reported as fatalities more often than other resident species, with the primary factor being behavior. Some species (i.e., Horned Lark, Vesper Sparrow, and Bobolink) that perform aerial courtship or territorial displays that put them at an altitude within the rotor swept area have been

the most common fatalities at projects studied in the western and central United States (NRC 2007).

### **Seasonal Timing**

As migratory songbirds have made up the vast majority of documented bird fatalities at wind turbines, the seasonal timing of bird fatalities is closely connected to migratory periods. As indicated in Section 3.2.1.1, the primary periods in western New York for most songbird migration in spring are mid-April through May and in fall are late August through October.

### **Turbine Design**

As turbine designs have evolved, the maximum height has increased. Currently, most turbines proposed or installed are in the range of approximately 400 feet agl. Bird fatalities associated with communication towers generally increase with height of the tower and lighting, with greater fatalities at structures greater than 500 feet (152 meters) agl (Kerlinger 2000; Longcore et al. 2005; NRC 2007). It must be noted that most tall communication towers have guy wires installed for support, while modern turbines do not have guy wires. The presence of guy wires greatly increases the potential risk of bird collisions.

### **Speed of Rotor**

Although faster rotor speed and tip speed appear to be associated with higher mortality, the effects of other design features in comparison have not been studied (Sternner 2002). A few studies have documented that birds react more to operating turbines than stationary turbines (Winkelman 1994; DeLucas et al. 2004).

### **Turbine Position and Alignment.**

There have been several studies regarding the behavioral effects and mortality from turbine position and alignment within a wind energy facility. However, results have varied and the differences are likely due to site-specific conditions such as topography and the flight behavior of local species. BirdLife International concluded that a string of turbines parallel to the flight line of flying birds, or turbines in a loose cluster, are the best arrangements for a wind turbine farm (BirdLife 2002, 2003).

### **Lighting**

Studies at communication towers show that migrating birds are attracted to some of the lighting recommended by the Federal Aviation Administration (FAA), especially on nights of poor visibility. Continuous lighting and white lights seem to attract birds. The birds appear to become disoriented and continue to circle the lighted tower instead of continuing in a straight path for migration, greatly increasing their risk of collision. As a result, they end up colliding with the tower, guy wires, or other circling birds. Several studies have suggested that FAA obstruction beacons (slow flashing red lights) do not attract nocturnal migrants and experienced fewer fatalities than towers of similar height with other FAA lighting (Jain et al. 2007).

However, based on available data, there is little evidence to suggest a similar effect with wind turbines (NRC 2007). There have been no documented large fatality events of nocturnal migrants at wind energy facilities, with the largest limited to 27 songbirds at a floodlit substation and nearby turbines in West Virginia on a May (2002) night with heavy fog (NWCC 2004). After this event, the sodium vapor lights were turned off and no subsequent avian fatalities were documented.

#### 4.1.3 Bat Collisions

Post-construction surveys of operational wind facilities, especially in the eastern United States, have revealed greater numbers of bat fatalities in recent years. Seasonal trends are showing that migrant tree-roosting bats (Hoary Bat, Eastern Red Bat, and Silver-haired Bat) are the species impacted the most, with nearly 75% of all recovered bat carcasses belonging to these three species (NRC 2007). Impacts to resident bat populations have not been as evident as the impacts on migratory species. There are signs that populations of local bats are less vulnerable and can avoid turbines, even living within and foraging around the proximity of active turbines.

The causes for the large numbers of bat fatalities at some wind energy facilities are poorly understood as this is a relatively recent documented issue. Five factors have been identified from post-construction monitoring at wind facilities as potential causes for, or associated with, the increased bat mortality:

- **Site Characteristics and Location.** Wind turbines placed along forested ridge tops may create or coincide with favorable bat migration corridors. Linear clearings associated with the wind energy facility may be attractive to bats for foraging and put them at increased risk of collision. Several post-construction studies primarily in the mid-Atlantic Highlands of the eastern United States have found the highest reported bat fatality rates. There is uncertainty whether the high fatality rates at these sites in the eastern United States differ from other regions or whether they reflect higher risk, higher abundance of migratory bats, or more intensive search efforts than other regions. Bat kills have also occurred at sites not considered favorable for bat migration (e.g., Alberta prairie).
- **Seasonal Timing.** Bat mortality from wind turbines occurs most frequently during late summer (mid-July through August), within the fall migration period for many bat species. The seasonal distribution and migratory movements of bats are poorly understood. For the three bat species (Hoary Bat, Eastern Red Bat, and Silver-haired Bat) most impacted, the spring migration period is generally between early April and mid-June and the fall migration period is from mid-July through November (Cryan 2003). Migration is a dangerous period for bats because they become more concentrated as they move, making them vulnerable to storms, drought, contaminants, and human disturbance.

- **Weather.** Bat collisions occur with increased frequency on nights with low wind velocity, possibly because flying insects are more active (Arnett et al. 2005). Thermal inversions may also influence the altitude of foraging bats in mountainous areas and place them at greater risk of collision with wind turbines.
- **Attraction to Turbines.** There are various hypotheses that consider bats to be potentially attracted to wind turbines for foraging, roosting, or because of visual or auditory curiosity. The clearings provided by wind turbine construction may create favorable foraging areas for bats to feed on insects. Insects may be attracted to these open areas as well, and possibly, to the heat generated by the turbine nacelle (NRC 2007). Some research explains that bats may have some visual or auditory attraction to tall objects, increasing curiosity and/or the potential for turbines being used as diurnal roost habitat for migrants (Arnett et al. 2005). Some theories indicate that bats are attracted to ultrasonic sound emitted by turbines, or the motion of the blades. The “swishing” sound made by the rotation of blades may attract bats, or their prey, increasing the threat for collision (Arnett et al. 2005). Curiosity of the movement in the blades may attract bats to investigate, thus increasing collisions. Wind turbines above any landscape dwarf the surrounding habitats, leaving the suggestion of potential diurnal roost sites. Dead bats were discovered in the open plains of southern Alberta at the Summerview Wind Farm, leaving bat experts baffled as to why bats were impacted in an area not known for great numbers of bats in the first place (Barclay and Baerwald personal communication in NRC 2007). Two species recovered were tree-roosting, highly migrant species (Hoary Bats and Silver-haired Bats) and at the time the wind facility was constructed the area was not known as a migrant corridor for bats.
- **Echolocation Limitations.** There are several factors that may limit the response time and avoidance behavior of bats around turbine rotors. Research currently suggests that bats may not use echolocation capabilities during migration, or that the short distance use for echolocation is ineffective to detect an obstruction in time to react. In other words, bats out fly the return echo. The most efficient range of echolocation differs from 3 to 5 meters, in most North American bats (Arnett et al. 2005). Turbine rotors and the nacelle produce complex electromagnetic fields that may interfere with echolocation activities. Researchers are attempting to deter bats from wind turbine blades using high altitude sonar “jamming” sounds from devices placed around wind facilities. Studies have shown bats to avoid areas with high intensity sound and over time they remember and will continue to avoid the area (Szewczak and Arnett 2006).

#### 4.1.4 Habitat Loss, Degradation, or Displacement

There is also a potential that habitat disturbance from wind turbines may result in habitat loss, habitat degradation through fragmentation (i.e., the loss of quality or

quantity of habitat), or result in behavioral displacement from habitats. These impacts have occurred in certain instances at wind turbine facilities (e.g., Leddy et al. 1999, Spaans et al. 1998, and Winkelman 1992a in BirdLife 2003). The magnitude of disturbance will depend on site differences in topography, type of vegetation, presence of existing roads, historic land use, and size and arrangement of turbines (NRC 2007). The disturbances can be temporary (i.e., during construction) or permanent.

Responses of birds to changes in habitat likely vary by species (NRC 2007). For example, edge species, such as the Indigo Bunting and Mourning Warbler may benefit from habitat disturbance; whereas, forest-interior species, such as the Ovenbird, may be displaced. Some studies have documented decreased breeding densities, primarily in grassland-nesting songbirds, in proximity to wind turbines (Leddy et al. 1999). However, other studies have documented little impact on nesting birds and that some birds or species groups habituate to the areas around the turbines (e.g., Winkelman 1992b in BirdLife 2003, Brown and Shepherd 1993 in BirdLife 2003; NWCC 2004). In general, the response of displacement of forest-dwelling birds by turbines has not been well studied by the agencies, wind industry, or academia. For this Project Area, most of the forested areas have already been fragmented and/or are destined for silviculture.

Changes in vegetation may influence the behavior of bats by changing microclimatic conditions and the quality of habitat for foraging or roosting bats through the removal of vegetation (NRC 2007).

## **4.2 Potential Impacts on Birds and Bats from Construction**

Construction-related activities (i.e., clearing for road construction, infrastructure construction, equipment noise, and increased vehicle traffic) can potentially impact birds and bats by causing temporary displacement from habitat. Because these impacts are generally only temporary in nature, impacts on bird and bat populations are not significant.

### **4.2.1 Potential Impacts on Migratory Birds**

Significant adverse impacts on migratory bird populations including raptors, passerines, and waterbirds are not expected as a result of construction of the Project. The Project Area is not located along a major migratory corridor for birds. Most species are expected to avoid the area of construction during construction activities. When no construction is occurring (i.e., evenings, weekends), it is anticipated that migratory birds would continue to use the area for migration.

### **4.2.2 Potential Impacts on Breeding Birds**

Breeding bird populations are not expected to be adversely affected significantly by construction of the Project. If construction begins before the breeding season, it is anticipated that breeding birds will likely avoid areas during the active con-

struction period. If construction begins during the breeding season, breeding birds that have been exposed to similar disturbance such as farming and logging, and are accustomed to disruption of this nature will remain in the area while others will likely relocate to other adjacent suitable habitat, if available. Incidental loss of some nests, eggs, and/or young is possible when construction (land clearing, etc.) is conducted during the breeding season. Indirect impacts on breeding birds will occur as a result of habitat alteration during construction of the Project; however, these impacts are not expected to be significant because other suitable habitat that will not be disturbed exists in the Project Area. The potential for habitat loss has been minimized because of site planning (i.e., the placement of turbines in agricultural areas where possible). Outside of localized construction disturbance, no significant adverse impacts on breeding birds are anticipated.

#### **4.2.3 Potential Impacts on Threatened and Endangered Species**

Based on consultation with the USFWS, the Bald Eagle was identified as occurring in Chautauqua County, which although no longer protected under the ESA is federally protected under the Bald and Golden Eagle Protection Act. The NHP did not identify any threatened or endangered species within the Project Area (Seoane 2006, 2008). The NHP identified five state-listed and one protected bird species within 10 miles of the Project Area: Great Blue Heron, Bald Eagle, Short-eared Owl, Sedge Wren, Henslow's Sparrow, and Northern Harrier (Seoane 2008). The Short-eared Owl is a state-listed endangered species, while the Bald Eagle, Sedge Wren, Henslow's Sparrow, and Northern Harrier are state-listed threatened species. Great Blue Heron was identified by the NHP due to the Project Area's proximity to a rookery. During field surveys one state-endangered species (Golden Eagle), two state-threatened species (Bald Eagle and Northern Harrier) and seven state special concern species (Common Loon, Osprey, Sharp-shinned Hawk, Cooper's Hawk, Red-shouldered Hawk, Horned Lark, and Grasshopper Sparrow) were observed in the Project Area; all in low numbers.

Based on surveys and observations of existing habitat in the Project Area, only limited use of the Project Area is anticipated by endangered, threatened, and special concern species during construction. Most occurrences would likely be related to migration or transient (i.e., limited) use. Species which may breed in the Project Area are likely to occur in very low numbers and the potential for impacts during construction will be minimized by the use of environmental monitors and adaptive management strategies. Of the listed species mentioned previously in this section, disruption during construction (e.g., land clearing) in the breeding season could potentially affect Northern Harrier, Sharp-shinned Hawk, Cooper's Hawk, Red-shouldered Hawk, and Grasshopper Sparrow because those are the listed species most likely to breed within the Project Area. It is anticipated that environmental monitoring in grasslands habitat (Northern Harrier and Grasshopper Sparrow) and forested areas (Sharp-shinned Hawk, Cooper's Hawk, and Red-shouldered Hawk) will identify nesting areas and reduce any potential impacts during construction. Transient and/or migratory use by the other listed species is not expected to result in adverse impacts during construction.

If construction takes place in suitable nesting habitat for endangered or threatened species in the spring to early summer - during breeding season - the work area will be surveyed and cleared by an environmental monitor in advance of construction as per Noble's environmental monitoring plan (see DEIS Section 2.27 and DEIS Appendix U). If nesting threatened or endangered species are found in the immediate proximity of a construction area, Noble will coordinate with the USFWS and/or NYSDEC to identify potential impacts, evaluate options, and to develop a mitigation plan to address site-specific occurrences of species of concern.

Measures that may be implemented will depend on the proximity to construction, the construction activities involved, the species involved, the date, the stage of the breeding season, and other potential factors (e.g., hay mowing). It is possible that measures may include delaying construction in the immediate area until the young have fledged from the nest or continual monitoring during the initial construction period to ensure that the birds are not impacted. With implementation of monitoring activities, no significant adverse impacts from construction on threatened or endangered species are anticipated.

#### **4.2.4 Potential Impacts on Bats**

Significant adverse impacts on bat populations are not expected during construction of the Project. There is a potential for indirect impacts on bats as a result of habitat alteration or loss in association with construction of the Project; however, these impacts are not expected to have a significant adverse affect on bat populations. Potential construction impacts on habitat would be caused by ground disturbance and tree removal activities that are also associated with farming and logging activities that are common to the area. It is anticipated that bats in the Project Area would return to temporarily disturbed areas upon completion of construction.

### **4.3 Potential Impacts on Birds and Bats from Operation of the Project**

Operation of the wind turbines can potentially impact birds and bats through collisions with the turbine blades and towers, overhead collection lines and transmission lines, displacement from habitat, or influence on migration, etc. Collisions are typically the primary concern with operation-related impacts. Potential impacts can vary among different bird and bat populations and groups.

#### **4.3.1 Potential Impacts on Migratory Birds**

The dynamics of migration and the potential impacts from the operation of wind turbines differ among groups of birds. Therefore, this section contains separate discussions of potential impacts on the migration of raptors, passerines, and waterbirds. The majority of passerines migrate during the night while raptors migrate almost exclusively during the day. Waterbirds migrate during the day and night (Richardson 1998).

### **Raptors**

Raptor migration is diffuse in the region away from the Great Lakes shorelines. There are no geographical or topographical features in the Project Area that attract or concentrate migrating raptors. The Project Area is just beyond the recognized raptor migration pathway between Lake Erie shoreline and the Portage Escarpment. No concentrated flight paths were identified in either spring or fall and the findings were consistent with the existing knowledge of the bird resources in the region. Therefore, low numbers of migrant raptors are anticipated in the Project Area.

Concerns about raptor impacts from wind turbines persist from the continued fatalities occurring at the Altamont Pass in California and other older wind farms in that state. However, several site-specific features at Altamont Pass contribute to the number of raptor deaths including older turbines that allow raptors to perch and nest on lattice structures; the large number of turbines (over 5,000); and an abundant source of prey, all of which contribute to a large number of raptors in the area (GAO 2005). Large numbers of raptor kills have not occurred at wind farms elsewhere in the United States outside of California, and raptor fatalities have ranged from 0 to 0.07 raptors per turbine per year (GAO 2005). Raptor fatalities have been limited at eastern sites where post-construction mortality monitoring has been conducted.

As raptor use in the Project Area is low and the likelihood of turbine avoidance is high, the potential for impacts is very low. No biologically significant adverse impacts on migrant raptors are anticipated from operation of the Project.

### **Passerines**

A collision risk exists for nocturnal migrant passerines at all tall structures, including wind turbines. Nocturnal migrant passerines comprised the greatest number of bird fatalities (34% to 59%) in a review of post-construction mortality studies by Erickson et al. (2001). However, there have been no documented large fatality events of nocturnal migrants at wind energy facilities, with the largest limited to 27 songbirds at a floodlit substation and nearby turbines in West Virginia on a May night with heavy fog (NWCC 2004).

There are no geographical or topographical features in the Project Area that attract or concentrate nocturnal migrant passerines. The Project Area is not immediately proximate to any large water bodies where nocturnal migrants tend to concentrate at stopover areas. Outside of such concentration areas, passerine migration is typically diffuse over a broad front. Results of the nocturnal radar study are generally consistent with this assessment. The migratory passage rates over the Project Area in fall 2006 were below average and in spring 2007 were above average but both were within the values of studies conducted at other locations.

The mean flight altitudes were 768 feet (235 meters) and 1,230 feet (375 meters) higher than the maximum turbine height in fall 2006 and spring 2007, respec-

tively; therefore, the majority of nocturnal migration occurs well above the height of the proposed turbines. The mean flight altitudes in spring and fall are similar to each other and are similar to other locations in the east where similar studies have been conducted. Approximately 9% of all nocturnal targets in fall 2006 and approximately 3% of all nocturnal targets in spring 2007 flew below 394 feet (120 meters) agl, a close approximation to the maximum turbine height. These findings are within the range of results from other radar studies in the northeast.

There are conditions when nocturnal migrants will be more susceptible to collision. There is an increase for potential impacts when adverse weather conditions cause birds to fly at lower altitudes. Studies have shown that bird collisions with communication and television towers (much taller than wind turbines) are increased during low cloud ceilings, heavy fog, and precipitation.

It is likely that nocturnal migrant passerines will make up the majority of bird kills from the Project. However, the potential mortality risk to migrant passerines is considered low based on the Project location, the passage rate and altitude data from the radar studies (and other regional radar studies), the avoidance behavior of passerines exhibited at wind energy facilities, and as demonstrated by the fatality rates from post-construction monitoring at regional wind energy facilities. No biologically significant adverse impacts are anticipated for any species from operation of the Project.

### **Waterbirds**

The Project Area is not located in an area where there are large numbers of migratory waterbirds or local movements. Post-construction studies at existing wind energy facilities have shown that waterfowl are less susceptible to collision than other species groups (Erickson et al. 2002; BirdLife 2003). Therefore, the potential risk for waterbird mortality from the Project is estimated to be very low.

Impacts to migrating birds will be identified during the post-construction study for bird and bat mortality monitoring.

#### **4.3.2 Potential Impacts on Breeding Birds**

Given the various habitats in the Project Area and site geography, there is a good diversity of breeding species; however, many turbines (e.g., approximately 66%) will be sited in agricultural fields and open areas which already have a relatively low species diversity and density (see Tables E-12 and E-13). There is a significant degree of habitat fragmentation already in the Project Area. By minimizing the Project footprint near wetlands and mature forests, potential impacts on resident birds have been reduced.

Much of the Project will be constructed in agricultural and young woodland areas, and breeding birds in these habitats may demonstrate temporary displacement. Most breeding birds are anticipated to habituate to the turbines and long-term displacement will be minimal. Grassland-nesting species may not habituate to the

turbines as much as species in other habitats, although displacement may be limited to the immediate area (e.g., surrounding field) of each turbine depending on a site-specific basis as per turbine location, habitat, size of field, hay mowing, and pesticide practices. Any potential impacts to grassland-nesting species are anticipated to be much less than the impacts from existing hay mowing and pesticide practices in the same area, as well as the conversion of previously inactive fields for agricultural production.

Project facility construction in wooded areas could result in some forest fragmentation and negatively impact some forest-dwelling species (i.e., Wood Thrush, Ovenbird); however, there are not any extensive forest tracts in the Project Area and fragmentation is already prevalent. Some avian species (i.e., Indigo Bunting, Mourning Warbler) may benefit from fragmentation. Long-term displacement in wooded areas is unlikely as breeding species are anticipated to habituate to the turbines.

There is a low risk of any substantial negative impact on habitat through loss, degradation, or displacement of breeding birds. No significant adverse impacts on breeding birds are anticipated from operation of the Project.

#### **4.3.3 Potential Impacts on Threatened and Endangered Bird Species**

Based on consultation with the USFWS, the Bald Eagle was identified as occurring in Chautauqua County, which although no longer protected under the Endangered Species Act (ESA) is federally protected under the Bald and Golden Eagle Protection Act. The NHP did not identify any threatened or endangered species within the Project Area (Seoane 2006, 2008). The NHP identified six state-listed bird species within 10 miles of the Project Area: Great Blue Heron, Bald Eagle, Short-eared Owl, Sedge Wren, Henslow's Sparrow, and Northern Harrier (Seoane 2008). The Short-eared Owl is a state-listed endangered species, while the Bald Eagle, Sedge Wren, Henslow's Sparrow, and Northern Harrier are state-listed threatened species. Great Blue Heron was identified by the NHP due to the Project Area's proximity to a rookery.

During field surveys, one state-endangered species (Golden Eagle), two state-threatened species (Bald Eagle and Northern Harrier), and seven state special concern species (Common Loon, Osprey, Sharp-shinned Hawk, Cooper's Hawk, Red-shouldered Hawk, Horned Lark, and Grasshopper Sparrow) were observed in the Project Area; all in low numbers. Only limited use of the Project Area is anticipated by endangered, threatened, and special concern species. Therefore, no significant adverse impact on these species is expected during operations. The potential impacts on these species and those additional species listed by USFWS and NYSDEC on the NHP reports (i.e., Great Blue Heron, Short-eared Owl, Sedge Wren, and Henslow's Sparrow) within 10 miles of the Project Area are discussed in detail below.

Two migrant Golden Eagles were observed in the Project Area by E & E staff during the spring raptor surveys on March 30 and April 7, 2008. There is no suitable habitat for breeding in the Project Area and there are no active nests in New York State (NYSDEC 2007c). There are no activities pertinent to the life cycle of the Golden Eagle that would regularly bring it to the Project Area except as a rare migrant or an occasional transient. With such low utilization of the Project Area, the potential direct mortality or injury of eagles colliding with wind turbines is considered remote. Similarly, as there is not suitable breeding habitat in the Project Area, the potential for harassment, displacement, or habitat impacts are also remote. Therefore, any potential adverse impacts to Golden Eagle are considered remote.

Two Bald Eagles were observed by E & E staff in the Project Area during spring raptor surveys in 2007 (one migrant on April 23, 2007 and one local bird on April 30, 2007). Two Bald Eagles were also observed during 2008 spring raptor surveys (one migrant and one local bird, both on April 7, 2008). Habitat within the Project Area is not suitable for breeding; however several nesting areas have been identified within 10 miles of the Project Area, including one nest just east of the Project Area at Lake Flavia in the Town of Dayton. Foraging potential for Bald Eagles within the Project Area is considered low given the absence of any large bodies of water in the Project Area. Based on suitable foraging habitat and relative proximity to the nearest nesting locations, Bald Eagles may visit East Mud Lake and West Mud Lake, which are both adjacent to the Project Area. Coming from the nearest nesting locations, the eagles could reach these small lakes without crossing the Project Area. There are no activities pertinent to the life cycle of the Bald Eagle that would regularly bring it to the Project Area except as a migrant or a transient. As such, the potential for direct mortality or injury to Bald Eagles from colliding with wind turbines is low. Similarly, the potential for harassment, displacement, or habitat impacts are also low. Therefore, any potential adverse impacts to Bald Eagle are considered low.

E & E staff observed Northern Harriers in the Project Area on several occasions during spring and fall raptor surveys and spring migratory surveys. It has bred in a number of locations in Chautauqua County and is a regular occurrence in many other areas of New York State. It is a confirmed or suspected breeder in or near the Project Area. Various wetland and upland habitats, including cattail marshes, wet meadows, and hayfields, are used for nesting. Unlike most raptors, it is a ground nester. It is highly visible in all seasons and has a large hunting range (Andrle and Carroll 1988). Because there is ample suitable nesting habitat in and near the Project Area, the potential risk of displacement is low. Very low Northern Harrier mortality has been documented from wind turbines, even at sites that have relatively high use by this species (Erickson et al. 2002). It is anticipated that local Northern Harriers will habituate to the presence of wind turbines; however, the collision risk is considered low-to-moderate because of the species' frequency of occurrence in the Project Area.

Short-eared Owl has been listed by NHP as occurring in the Town of Sheridan in Chautauqua County. This location is assumed to be a wintering location rather than a breeding area, because this species is a very rare breeder in western New York and no breeding has been documented in Chautauqua County. In addition to the NHP listing, two Short-eared Owls were observed in Hanover, NY in 1991. This species is categorized as endangered in New York State primarily because of its rare breeding status and decline in population. Although breeding Short-eared Owls are very rare in western New York, wintering Short-eared Owls are regular. Suitable habitat occurs throughout much of Chautauqua County, including the Project Area, for wintering Short-eared Owls. Short-eared Owls have been observed in five out of 35 years during the Dunkirk-Fredonia CBC and seven out of 66 years during the Jamestown CBC. Although this species was not observed during field surveys, it is suspected that a few birds may forage in the Project Area in some winters. The potential impact to this species is considered low.

Sedge Wren has been identified by NHP as occurring in the Town of Sheridan in Chautauqua County. Typical breeding habitat consists of moist sedge meadows, commonly with grasses and scattered shrubs (Andrle and Carroll 1988). This elusive species is unpredictable, as it often does not reappear from year to year in the same breeding location. Habitat is often temporary and replaced through plant succession (Andrle and Carroll 1988). The Sedge Wren is secretive and spends most of its time near the ground, with limited flights just above the vegetation. The potential risk of collision is considered remote and the potential risk of displacement is considered very low because suitable habitat will not be altered and the unpredictable nature of its breeding.

Henslow's Sparrow has been identified by NHP as occurring in the Town of Arkwright, Chautauqua County, approximately six miles west of the Project Area. Typical breeding habitat consists of wet grasslands with tall, dense vegetation and thick litter (Herkert et al. 2002). The Henslow's Sparrow is secretive, singing from inconspicuous perches on low forbs, shrubs, or grasses. The potential risk of collision is considered remote and the potential risk of displacement is considered very low because suitable habitat will not be altered.

Great Blue Heron has been identified by NHP because a rookery with more than 50 nests per year has been observed at Dibble Hill/Farrington Hollow in the Town of Arkwright, Chautauqua County, approximately two miles west of the Project Area. While not a federal or state listed endangered or threatened species the Great Blue Heron is protected by the federal Migratory Bird Treaty Act. The Great Blue Heron typically nests in colonies, usually near water; and is primarily a fish eater, wading along the shorelines of marshes, lakes, and rivers (Butler 1992). There are numerous foraging areas near the heronry including the Canadaway Creek WMA, Canadaway Creek and multiple tributaries, Black Pond, West Mud Lake, Fredonia Reservoir, Cassadaga Lake, and various other streams and tributaries. There are relatively few creeks and ponds within the Project Area, although herons could traverse the Project Area if they wanted to forage at East Mud Lake,

Silver Creek Reservoir, or the north branch of Conewango Creek, all located east or northeast of the Project Area. While it is not a state- or federally-listed species, Noble's environmental monitoring program (see DEIS Section 2.27 and DEIS Appendix U) would determine if they are present during the construction year in close proximity to construction and will be handled accordingly. Herons have not been prone to collisions with wind turbines and given their size, they would be easier to find than smaller birds such as passerines during post-construction mortality studies. In a review of bird collisions at wind facilities (Erickson et al. 2001) based on 31 studies, 78% of the carcasses found (outside of California) were passerines and only 3.3% were waterbirds (National Research Council 2007). The potential risks of collision and displacement is considered low, as there is little suitable breeding or foraging habitat in the Project Area.

Species of special concern are those that warrant attention and consideration because they are extremely uncommon in New York or have highly specific habitat requirements and deserve careful monitoring. Although rare, current information does not justify listing these species are either endangered or threatened. They are not warranted the same legal protection as those species which are listed as endangered or threatened. All of these species were detected in very low numbers, therefore the potential risks of collision and displacement are considered remote.

Only limited use of the Project Area is anticipated by endangered, threatened, and special concern bird species; therefore, the overall risk to threatened and endangered bird species from operation of the Project is considered low. Impacts to listed bird species will be identified during the post-construction study for bird and bat mortality monitoring.

#### **4.3.4 Potential Impacts on Bats**

Based on the habitat within the Project Area, acoustical monitoring studies performed in and near the Project Area, and the limited post-construction data associated with other similar projects, the potential for significant adverse impacts on bats from operation of the Project is considered moderate as uncertainty still remains regarding the affect of wind farms on bats. A primary reason for uncertainty is that pre-construction bat studies have not been effective at indicating post-construction impacts at many sites, including the Maple Ridge site in New York State.

The greatest concern for potential adverse impacts would be to transient individuals, especially tree-roosting bat species (Hoary Bat, Eastern Red Bat, and Silver-haired Bat) colliding with wind turbines. Preliminary data collected at sites in the eastern United States as well as several western sites (U.S. and Canada) seem to indicate that these species are susceptible to collisions with wind turbines. It is anticipated that there would be much lower risk to the resident/summering populations occurring in the Project Area than to migrants because collisions with tree-roosting migrating species have exceeded those of other bat species (e.g., 151 of

203 total dead bats found during the 2007 post-construction study at Maple Ridge were of the three tree-roosting bat species mentioned above [Jain et al. 2008]).

As the population sizes and trends and migratory patterns of most bats in New York State are unknown, it is uncertain what level of impact is made from wind projects, especially in light of the even greater mortality risk from WNS. However, it should be noted that WNS has yet to be documented in western New York and therefore at this time, is not expected to impact local bat populations.

#### **4.3.5 Potential Impacts on Threatened and Endangered Bat Species**

The known occurrence and distribution of Indiana Bats in New York State are described in Section 3.3.5. Within New York State, the Indiana Bat is known to winter only in isolated hibernacula mostly within the eastern portion of the state. Based on the known locations of hibernacula and maternity colonies in New York State, and no previous documentation of this species in western New York, it is unlikely that Indiana Bats would be found residing or migrating in the Project Area, and, therefore, any potential impacts are considered remote.

### **4.4 Bird and Bat Fatality Approximations**

#### **4.4.1 Birds**

NWCC compiled regional and overall bird fatality rates based on 12 post-construction mortality studies that were conducted for a minimum of three seasons and where scavenging and searcher efficiency biases were incorporated into the estimates (NWCC 2004). The overall national average was 2.3 birds/turbine/year, ranging from 0.6 to 7.7 birds/turbine/year. The eastern regional average, based on only two studies, was 4.3 birds/turbine/year. Many of the studies included in the evaluation are from the western United States, where there is typically less passerine migration than most locations in the eastern United States.

No wind energy facilities in New York State were included in the NWCC compilation as none of the few studies to date met the duration or methodology requirements for inclusion. The results of mortality studies conducted at several facilities in New York State or nearby are described below. The studies conducted at Maple Ridge were more rigorous than the others.

- The most extensive mortality studies in New York State with published results to date were the 2006 and 2007 studies at the Maple Ridge Wind Power Project (formerly known as the Flat Rock Power project), located on the Tug Hill Plateau of Lewis County, New York. Project construction was initiated in 2005 and the project consists of 195 turbines for a total of 322 MW. A pre-construction nocturnal radar and visual study was conducted at the site in fall 2004 by ABR (see Table 3-6 for comparison of results). A pilot post-construction mortality study was initiated in 2006 with 50 turbines and two met towers searched regularly on either a daily basis, every three days, or weekly from June 17 through November 15 (Jain et al. 2007). A total of 125

bird fatalities of a mix of 30 species were documented during the 2006 surveys (Jain et al. 2007). Fatality estimates for birds varied based on the three survey durations with 9.59 incidents/turbine (daily surveys), 4.47 incidents/turbine (every 3-day surveys), and 3.13 incidents/turbine (weekly surveys) (Jain et al. 2007). In 2007, 64 turbines and two met towers were searched weekly from April 30 through November 14 (Jain et al. 2008). A total of 64 bird fatalities of a mix of 21 species were documented. Bird fatality estimates in 2007 were 5.67 incidents/turbine.

- A one-year post-construction mortality study at the Madison County facility (seven turbines, 11.6 MW) found four dead birds, at a fatality rate of 0.42 birds/turbine/year (Kerlinger and Guarnaccia 2006).
- No dead birds were found at the Wethersfield wind farm, Wyoming County, facility (10 turbines at 290 feet agl, 6.6 MW) during a post-construction mortality study conducted by E & E in 2005. Searches were conducted approximately every other day from May 9 through June 3, 2005 and from August 15 through October 14, 2005.
- Five dead birds were found at the Steel Winds facility in Lackawanna, Erie County (8 turbines at 425 feet agl, 20 MW) during a post-construction mortality study conducted by the Buffalo Museum of Science in 2007 (Grehan 2008). Searches were conducted 16 times between April 3 and October 16, 2007. The facility turbines were not operational during a portion of the season.
- A total of 59 dead birds were found at the Erie Shores wind farm in Port Burwell, Ontario (66 turbines, 99 MW) during a two-year post-construction mortality study conducted in 2006 and 2007 (James 2008). Turbine locations are between 150 meters and 2.5 kilometers from the Lake Erie shoreline. Searches were conducted approximately at least once in March, every week for six weeks in spring (May through early June), and over 12 or more weeks in autumn (mid-August through early November). Adjusted overall estimated mortality was approximately 2 to 2.5 birds/turbine/year. Bird mortality was highest at nine turbines located 200 meters or closer to the shoreline. Excluding those nine turbines, the overall estimated mortality would be approximately 0.5 to 0.6 birds/turbine/year.
- No dead birds were found during a 6-month mortality study at the Searsburg, Vermont facility (11 turbines, 6 MW) (Kerlinger and Guarnaccia 2006).
- The Huron Wind site, five turbines located along Lake Huron in Ontario, Canada, has had only one known bird mortality since 1995 (Huron Wind 2006).

- Only two dead birds were found during a mortality study at a single turbine in the city of Toronto, Canada, along the Lake Ontario waterfront (James and Coady 2003).

It is anticipated that the bird fatality rates for the Project will be within the range of the NWCC eastern average and 2006 Maple Ridge daily results. This prediction is based on the results of the bird studies, literature review, and because there are no features in the Project Area that attract or concentrate large numbers of migrating birds.

The potential number of fatalities for the Project was estimated by multiplying the fatality rates for bird kills with the proposed number of turbines (see Table 4-1). For this approximation, the NWCC eastern average was used as a lower bound and the 2006 Maple Ridge daily results were used as an upper bound. The NWCC eastern average is only based on two studies, including one study at a site in Tennessee with only three turbines. However, it is anticipated that sites in the eastern United States will have higher avian fatality rates than sites in the western and central United States. Thus, the NWCC eastern average was used as the lower bound. The 2006 Maple Ridge daily and 3-day avian fatality rates were higher than the NWCC eastern average (and also the 2007 Maple Ridge rates) but may have resulted from more thorough surveys, among many other possible site-specific variations. With a similar post-construction survey methodology proposed for the Noble Allegany project, it is reasonable to anticipate that similar results could occur. Therefore, the 2006 Maple Ridge daily avian fatality rate is selected as the upper bound of the estimate. These are only estimates and there can be considerable variation in fatality rates. The number of bird fatalities can only be determined with post-construction mortality studies; however, this estimate allows an evaluation of the potential impacts.

**Table 4-1 Approximate Number of Bird Fatalities for Project**

Project	Number of Turbines	Lower Bound:	Upper Bound:
		Approximate Bird Fatalities Per Year Based on NWCC Eastern Average Rate <sup>1</sup>	Approximate Bird Fatalities Per Year Based on 2006 Maple Ridge Daily Rate <sup>2</sup>
Noble Ball Hill	60	258	576

Notes:

<sup>1</sup> 4.3 birds/turbine/year (NWCC 2004).

<sup>2</sup> 9.59 birds/turbine/survey season (Jain et al. 2007).

#### 4.4.2 Bats

Historically the average number of bat kills from wind turbines has varied from facility to facility and was considered a function of a number of factors including the proximity to hibernacula, known migration corridors, and topography. Until the Mountaineer site bat kills in 2003 and 2004, the average had remained low, approximately fewer than three bats/turbine/year killed (BCI 2007). The NWCC national average grew to approximately 3.4 bats/turbine/year with the inclusion of the 2003 Mountaineer results of 47 bats/turbine/year (NWCC 2004) and this aver-

age is likely to increase as more post-construction mortality study results become available (e.g., Maple Ridge site).

No wind energy facilities in New York State were included in the NWCC compilation as none of the few studies to date met the duration or methodology requirements for inclusion. The results of mortality studies conducted at two facilities in New York State and a facility in Ontario on the Canadian shore of Lake Erie include the following:

- The most extensive mortality studies in New York State with published results to date were in 2006 and 2007 at the Maple Ridge Wind Power Project. A preconstruction nocturnal radar and visual study was conducted at the site in fall 2004 by ABR (see Section 3.3.1 for comparison of results). A pilot post-construction mortality study was initiated in 2006 with 50 turbines and two meteorological towers searched regularly on either a daily basis, every three days, or weekly from June 17 through November 15 (Jain et al. 2007). A total of 326 bat fatalities from five species were documented during the 2006 surveys (Jain et al. 2007). Approximately 70% of the fatalities were documented during the fall migration period (July and August). Fatality estimates for bats varied based on the three survey durations with 24.53 incidents/turbine (daily surveys), 22.34 incidents/turbine (every 3-day surveys), and 15.20 incidents/turbine (weekly surveys) (Jain et al. 2007). In 2007, 64 turbines and two met towers were searched weekly from April 30 through November 14 (Jain et al. 2008). A total of 202 bat fatalities of a mix of five species were documented. Bat fatality estimates in 2007 were 15.54 incidents/turbine.
- Four dead bats (two Little Brown Bats and two unidentified bats) were found at the Wethersfield wind farm, Wyoming County, facility (10 turbines at 290 feet agl) during a post-construction mortality study conducted by E & E (2006) in 2005. Searches were conducted approximately every other day from May 9 through June 3, 2005 and from August 15 through October 14, 2005.
- A total of 48 dead bats were found at the Steel Winds facility in Lackawanna, Erie County (8 turbines at 425 feet agl, 20 MW) during a post-construction mortality study conducted by the Buffalo Museum of Science in 2007 (Grehan 2008). Searches were conducted 16 times between April 3 and October 16, 2007. Most bats were found during the month of August. The facility turbines were not operational during a portion of the season.
- The overall estimated mortality for bats at the Erie Shores wind farm in Port Burwell, Ontario (66 turbines, 99 MW) during a two-year post-construction mortality study conducted in 2006 and 2007 was approximately 4.5 to 5.5 bats/turbine/year (James 2008). Searches were conducted at least once in March, every week for six weeks in spring (May through early June), and over 12 or more weeks in autumn (mid-August through early November). Bat mortality was highest at nine turbines located 200 meters or closer to the shore-

line. Excluding those nine turbines, the overall estimated mortality would be approximately 2 to 2.5 bats/turbine/year.

It is anticipated that the bat fatality rates for the Project will be above the NWCC national average (3.4 bats/turbine/year). Because the NWCC national average does not feature many eastern sites, where bat kills have been more numerous, or recent studies where more thorough search methodologies have revealed increased fatality rates (i.e., 2006-2007 surveys at Maple Ridge), it is reasonable to anticipate that fatality rates greater than the NWCC national average might occur.

To present a possible range of estimates, the NWCC national average was used as the lower bound while the 2006 daily survey rate at Maple Ridge was used as the upper bound. The 2006 daily survey rate at Maple Ridge was selected because it is the highest rate from New York State, even though migratory bat abundance in the Project Area may be less than that at Maple Ridge. Multiplying the NWCC national average and the 2006 Maple Ridge daily fatality rates for bat kills with the proposed number of turbines provides an approximate number of bat fatalities for the Project (see Table 4-2). However, this range is only an estimate and the number of bat fatalities could be higher or lower, as it is difficult to predict whether large scale fatality events will occur at a specific site based on preconstruction studies and there can be considerable variation in bat fatality rates. The number of bat fatalities can only be determined with post-construction mortality studies; however, this estimate allows an evaluation of the potential impacts.

**Table 4-2 Approximate Number of Bat Fatalities for Project**

Project	Number of Turbines	Lower Bound:	Upper Bound:
		Approximate Bat Fatalities Per Year Based on NWCC National Average Rate <sup>1</sup>	Approximate Bat Fatalities Per Year Based on 2006 Maple Ridge Daily Rate <sup>2</sup>
Noble Ball Hill	60	204	1,470

Notes:

<sup>1</sup> 3.4 bats/turbine/year (low = 0.7; high = 47) (NWCC 2004).

<sup>2</sup> 24.5 bats/turbine/survey season (Jain et al. 2007).

#### **4.5 Potential Cumulative Impacts on Birds and Bats from Regional Projects**

This section evaluates the potential cumulative impacts of the existing or proposed projects in the vicinity of the Project Area.

An approximate range of bird fatalities for the Project was identified in Section 4.4.1 by multiplying the NWCC eastern average and 2006 Maple Ridge daily survey fatality rates for bird kills with the proposed number of turbines (see Table 4-1). Likewise, an approximate number of bat fatalities for the Project was identified in Section 4.4.2 by multiplying the NWCC national average and 2006 Maple Ridge daily survey bat fatality rates with the proposed number of turbines (see Table 4-2). The same calculations are included for the five wind projects cur-

recently proposed in Chautauqua County and the existing Steel Winds project in the City of Lackawanna (Erie County), approximately 25 miles away from the Project Area, in order to demonstrate the potential cumulative impacts on birds and bats in the region (see Tables 4-3 and 4-4). These are only estimates and there can be considerable variation in fatality rates, especially for bats. The number of bird and bat fatalities can only be determined with post-construction mortality studies; however, this estimate allows an evaluation of the potential cumulative impacts. The only post-construction data available from these projects to date are from the Steel Winds post-construction mortality study conducted in 2007 (see Sections 4.4.1 and 4.4.2).

**Table 4-3 Approximate Regional Number of Bird Fatalities**

Project	Number of Turbines	Approximate Bird Fatalities Per Year Based on NWCC Eastern Average Rate <sup>1</sup>	Approximate Bird Fatalities Per Year Based on 2006 Maple Ridge Daily Survey Rate <sup>2</sup>
<b>Noble Ball Hill</b>	<b>60</b>	<b>258</b>	<b>576</b>
Horizon New Grange	47	202	451
Horizon Pomfret	49 <sup>3</sup>	211	471
Babcock & Brown – Ripley-Westfield Wind Farm	79	340	758
Babcock & Brown – State Line Wind	79 <sup>4</sup>	340	758
Steel Winds (existing)	8	35	77
<b>Total</b>	<b>313</b>	<b>1,386</b>	<b>3,091</b>

Notes:

<sup>1</sup> 4.3 birds/turbine/year (NWCC 2004).

<sup>2</sup> 9.59 birds/turbine/survey season (Jain et al. 2007).

<sup>3</sup> Project information is not publicly available, 49 turbines are assumed based on 1.5-MW turbines and the publicly available proposed MW of the Horizon Pomfret project.

<sup>4</sup> Number of turbines estimated based on 124.8 MW (same as Ripley-Westfield). This may change based on final turbine selection.

**Table 4-4 Approximate Regional Number of Bat Fatalities**

Project	Number of Turbines	Approximate Bat Fatalities Per Year Based on NWCC National Average Rate <sup>1</sup>	Approximate Bat Fatalities Per Year Based on 2006 Maple Ridge Daily Survey Rate <sup>2</sup>
<b>Noble Ball Hill</b>	<b>60</b>	<b>204</b>	<b>1,470</b>
Horizon New Grange	47	160	1,152
Horizon Pomfret	49 <sup>3</sup>	167	1,201
Babcock & Brown - Ripley-Westfield Wind Farm	79	269	1,936
Babcock & Brown – State Line Wind	79 <sup>4</sup>	269	1,936

**Table 4-4 Approximate Regional Number of Bat Fatalities**

Project	Number of Turbines	Approximate Bat Fatalities Per Year Based on NWCC National Average Rate <sup>1</sup>	Approximate Bat Fatalities Per Year Based on 2006 Maple Ridge Daily Survey Rate <sup>2</sup>
Steel Winds (existing)	8	28	196
<b>Total</b>	<b>327</b>	<b>1,097</b>	<b>7,891</b>

## Notes:

\* Project information is not publicly available, 49 turbines is assumed based on 1.5 MW turbines, and the publicly available proposed MW of the Horizon Pomfret project.

<sup>1</sup> 3.4 bats/turbine/year (low = 0.7; high = 47) (NWCC 2004).

<sup>2</sup> 24.5 bats/turbine/survey season (Jain et al. 2007).

<sup>3</sup> Project information is not publicly available, 49 turbines are assumed based on 1.5-MW turbines and the publicly available proposed MW of the Horizon Pomfret project.

<sup>4</sup> Number of turbines estimated based on 124.8 MW (same as Ripley-Westfield). This may change based on final turbine selection.

The cumulative loss of approximately 1,400 to 3,000 birds per year is not considered to be biologically significant, especially in consideration of other sources of bird mortality. The USFWS estimates that a minimum of 10 billion birds breed in North America (USFWS 2002). There are many widespread sources of bird mortality. However, it is challenging to compare predicted mortality from a proposed wind site to other sources of mortality, because it is only a prediction and local mortality rates from other sources are rarely quantified to allow comparison. On a national scale, the annual bird mortality associated with wind energy facilities (estimated at 33,000 birds per year in 2002) is slight compared to other sources of mortality, such as vehicles (60 million or more deaths per year), building windows (97 to 976 million deaths per year), power and transmission lines (conservatively tens of thousands deaths per year, possibly closer to 174 million deaths per year), communication towers (conservatively 4 to 5 million deaths per year, possibly closer to 40 to 50 million deaths per year), electrocution (estimated tens of thousands per year), pesticides (at least 72 million deaths annually, likely far more), oil spills (hundreds of thousands of deaths per year), oil and wastewater pits (up to two million deaths per year), cats (hundreds of millions of deaths per year), agricultural practices (i.e., hay mowing, pesticides; at least 72 million), and hunting (up to 120 million) (Gill 1995; Erickson et al. 2001; USFWS 2002). These sources of mortality are also present within the Project Area.

The bird kills would be from many different species. Nocturnal migrant passerines will likely make up the majority of bird kills. This is of concern because of the potential of neotropical migrants, many of which are considered in decline, to be among the fatalities. However, these are also among the species that are most harmed by global warming and air pollution (Price and Glick 2004). For example, recent research suggests that acid precipitation from air pollution is contributing to the steady decline of the Wood Thrush in New York (Hames et al. 2002), where numbers are dropping up to 5% per year. Therefore, there are impacts from both non-renewable energy production and from wind energy. Mr. John Flicker, the

president of the National Audubon Society recently (December 14, 2006) commented on this perception issue in support of wind energy (at appropriate sites), saying “When you look at a wind turbine, you can find the bird carcasses and count them. With a coal-fired power plant, you can’t count the carcasses, but it’s going to kill a lot more birds” (Levesque 2006).

At the present time, it is unknown whether the cumulative annual loss of approximately 1,100 to 7,900 bats is considered to be biologically significant. However, there are ongoing bat mortality studies to determine the overall effects on bat populations. There are increasing concerns about the cumulative impacts of bat fatalities to specific species as the number of wind projects increase and as bats continue to be found during mortality studies at more wind sites, in addition to the White Nose Syndrome situation. As the population sizes and trends of most bats in New York State are unknown, it is uncertain what level of impact is made from wind projects. While bird species populations have been studied and estimated, we are not aware of similar studies for bats and estimates for bat populations are not available and/or highly uncertain. Even with this limited current state of knowledge on bat populations and migration, some researchers have expressed concern that there is the potential for significant cumulative population impacts to bats (Kunz et al 2007; Arnett et al 2008). Only after construction of several wind projects in the northeast and implementation of long-term monitoring protocols would the significance of potential cumulative impacts be assessable.

Post-construction monitoring programs have been established at each of Noble’s wind power projects to determine if bird and/or bat collision fatalities occur as a result of project operation, if so, the rate of mortality. Other wind projects will develop similar monitoring programs. These data will be correlated with pre-construction data, including radar data, to determine whether the mortality rates are consistent with the identified impacts. This information can also be used to develop possible means of migration. Information from these studies will also be a valuable resource for wildlife agencies and will provide needed data that can be used to assess the siting of future wind power projects.

# 5

## Mitigation

### 5.1 Overview

In May 2007, the NWCC Mitigation Subgroup conducted a literature review of wind siting policies, guidelines, and research about mitigation measures for wind projects and produced a document titled, “Mitigation Toolbox.” This work compiles national and international mitigation strategies at local and federal levels, provides an annotated bibliography on wind mitigation, summarizes a number case studies, and provides a matrix illustrating the gaps and overlaps between existing policies/guidelines and current research (NWCC 2007). The purpose of the document is to, “...Catalog existing mitigation measures and to further explore others, and bring them to light for discussion, research, and innovation.” The authors acknowledge that the proposed mitigation measures are based on the best available information and understanding of the ecosystems in which the wind projects have been placed and that many of the proposed measures have not yet been adequately studied and validated as to whether they reduce impacts as expected (NWCC 2007). The authors provided a number of mitigation “tools” and cautioned generalizing findings from one geographic region to another because of differences in habitat, topography, and landscape among wind projects.

Mitigation can occur during the design, construction, and operation stages of development. Mitigation can also occur both on and off the site. In the Mitigation Toolbox document, nine general mitigation categories were created: siting, lighting, turbine type, turbine configuration, power lines, habitat enhancement, revegetation, disturbance during construction, and disturbance during operation (NWCC 2007). Each of these categories has a number of strategies that depend on a variety of factors. For example, the optimal height of the rotor to avoid migrating birds and bats may be dependent on the local habitat and topography. Noble has used mitigation measures during the design process and proposes construction and operation mitigation measures, on an as needed basis. Some of the mitigation measures identified for the Project are included in the sections below.

### 5.2 Siting Approach

The primary mitigation measure to avoid or reduce potentially significant bird and bat impacts was Noble’s approach to siting. Initially, a study was conducted to identify whether the Project Area held any potential issues related to birds and

bats, among many other categories, that could result in unfavorable impacts. In the siting phase, Noble selected available and appropriate locations for turbines that minimized potential impacts on wetlands, habitat, and land use. As indicated in this document and based on studies conducted for this Project and for projects nearby, Noble has also sited the project in an area that avoids landscape features that attract raptors and migrating birds. These considerations will minimize potential impacts on birds and bats. See Section 1.3 of the DEIS for details on the siting approach and Project alternatives.

### **5.3 Construction Considerations**

Clearing for road construction, infrastructure construction, equipment noise, and increased vehicle traffic could affect birds and bats during construction of the Project. Possible mitigation measures during these construction-related activities could include: minimizing the area of impact, reducing erosion, limiting noise and dust, prevention of the invasion of weeds, and minimizing the use of chemicals. During construction, Noble will minimize the area of impact during construction, limit noise and other disturbance, and be cognizant of nesting birds. An environmental monitoring plan is discussed in DEIS Section 2.27 and included in DEIS Appendix U.

### **5.4 Mitigation Measures during Operation**

Collisions are often the primary concern with operation-related impacts, but displacement from habitat, and influence on migration, are also potential impacts on birds and bats during operation of the Project. Mitigation measures during operation to reduce these impacts could include: minimal lighting to reduce potential risk of collision at the facility, reseeded of native vegetation, habitat enhancement, and post-construction monitoring.

During nights of inclement weather and/or poor visibility, passerines may fly at lower altitudes and may be attracted to lights, especially steady (i.e., not blinking) lights. While the reasons for this attraction to lights are not certain, it coincides with evidence from tall structures (e.g., communication/television towers and buildings) that events of increased bird collisions occur on nights with poor visibility at structures with steady light. In order to reduce this potential, Noble will avoid using steady burning lights.

In addition, Noble will:

- Provide the minimum allowable lighting and off-cycle as per FAA recommendations;
- Avoid using any flood lights at any structures on site or steady light sources near the turbines;

- Jacket and insulate all overhead collection line conductors; all power carrying hardware for the overhead electrical collection lines will be covered; and
- Install modern turbines (i.e., solid tubular structures) that are designed to prevent birds from perching or nesting on them. No guy wires will be required for these turbines.

Post-construction mortality monitoring will be implemented by Noble to evaluate the actual impacts of the Project on birds and bats. This will help assess the significance of the impacts and, potentially, what the weather or environmental conditions or other circumstances are that contribute to such impacts. Based on real-time, site-specific data collected during the post-construction mortality monitoring, Noble will coordinate closely with NYSDEC to identify and assess potential mitigation strategies that can be implemented to reduce potentially significant adverse impacts, if any. This approach will allow mitigation measures to be developed/modified during the course of Windpark operation that are responsive to site-specific conditions and to the growing and evolving database of information regarding bird/bat interactions with turbines. Noble's work plan for proposed post-construction bird and bat mortality studies is included in Appendix G. The work plan methodology is consistent with previous work plans that Noble has developed through coordination and cooperation with NYSDEC.



# 6

## References

- Andrle, R. and J. Carroll, 1988, *The Atlas of Breeding Birds in New York State*, Cornell University Press, Ithaca, New York.
- Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, R.D. Tankersley, Jr., 2008, Patterns of Bat Fatalities at Wind Energy Facilities in North America. *Journal of Wildlife Management* 72(1): 61-78.
- Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn, 2005, Relationships Between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. Final report prepared for the Bats and Wind Energy Cooperative by Bat Conservation International, Austin, Texas, June 2005.
- Avery, M.L., P.F. Springer, N.S. Dailey, 1980, *Avian Mortality at Man-made Structures: An Annotated Bibliography (revise)*, Washington D.C.: U.S. Fish and Wildlife Service, Biological Services Program, FWS/OPS-80/54, 152pp.
- Bat Conservation International (BCI), 2007, website was reviewed for specific information regarding the status and research of bats in the New York State and the region <http://www.batcon.org/home/default.asp>, accessed in September 2007.
- BirdLife International on Behalf of the Bern Convention (BirdLife), 2003, R. H. W. Langston and J. D. Pullan, editors, *Windfarms and Birds: An Analysis of the Effects of Windfarms on Birds, and Guidance on Environmental Assessment Criteria and Site Selection Issues*, Convention on the Conservation of European Wildlife and Natural Habitats, Standing Committee, 23<sup>rd</sup> Meeting, Strasbourg; 1-4 December 2003, T-PVS/Inf (2003) 12.

- BirdLife International, on Behalf of the Bern Convention (BirdLife), 2002, R.H.W. Langston, Pullan JD, editors. Windfarms and Birds: An analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues. Convention on the Conservation of European Wildlife and Natural Habitats; Standing Committee; 22nd meeting; Strasbourg. T-PVS/Inf (2002), 30 revised.
- Brown, A. F. and K. Shepherd, 1993, A Method for Censusing Upland Breeding Waters, *Bird Study* 40: 189-195.
- Buffalo Ornithological Society, 2006, Database of sightings, Buffalo Ornithological Society, Inc., Buffalo, New York.
- Burger, M. and J. Liner, 2005, *Important Bird Areas of New York*, Audubon New York.
- Butler, Robert W. 1992. Great Blue Heron (*Ardea herodias*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/025>.
- Cooper, B. A. and T. Mabee, 2000, *Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York*. Report prepared for Niagara Mohawk Power Corporation, Syracuse, New York.
- Cooper, B. A., R. H. Day, R. J. Ritchie, and C. L. Cranor, 1991, An improved marine radar system for studies of bird migration, *Journal of Field Ornithology* 62: 367-377.
- Cooper, B. A., A. A. Stickney, and T. J. Mabee, 2004, A radar study of nocturnal bird migration at the proposed Chautauqua wind energy facility, New York, fall 2003. Final report prepared for Chatauqua Windpower L.L.C., April 2004.
- Cooper, B. A., C. B. Johnson, and R. J. Ritchie, 1995, Bird migration near existing and proposed wind turbine sites at the eastern Lake Ontario Region. Report prepared for Niagara Mohawk Power Corporation, Syracuse, New York.
- Cooper, B. A., T. J. Mabee, A. A. Stickney, and J. E. Shook, 2004a, A visual and radar study of 2003 spring bird migration at the proposed Chautauqua wind energy facility, New York. Final report prepared for Chatauqua Windpower L.L.C., April 2004.

- Cooper, B. A., T. Mabee, and J. Plissner, 2004b, Radar study of nocturnal bird migration at the proposed Mount Storm wind power development, West Virginia, fall 2003. Appendix in: Baseline avian studies Mount Storm wind power project, Grant County, West Virginia, final report, April 2004. Prepared for NedPower Mount Storm, L.L.C.
- Cooper, B. A., A. A. Stickney, and T. J. Mabee, 2004c, A Radar Study of Nocturnal Bird Migration at the Proposed Chautauqua Wind Energy Facility, New York, Fall 2003. Final report prepared for Chatauqua Windpower L.L.C., April 2004.
- Corwin, K, 2008, Personal communication with M. Morgante, July 22, 2008.
- Cryan, P.M., 2003, Seasonal Distribution of Migratory Tree Bats (*Lasiurus* and *Lasionycteris*) in North America. *Journal of Mammalogy* 84(2):579-593.
- Curtis, P. D. and K. L. Sullivan, 2001, Wildlife Management Fact Sheet Series: Bats, Cornell Cooperative Extension, Ithaca, New York.
- DeLucas, M., G. Janss, and M. Ferrer, 2004, The Effects of a Wind Farm on Birds in a Migration Pont: The Strait of Gibraltar. *Biodiversity and Conservation* 13:395-407.
- Desholm, M., A. D. Fox, P. Beasley, and J. Kahlert, 2006, Remote Techniques for Counting and Estimating the Number of Bird-wind Turbine Collisions at Sea: A Review. In *Wind, Fire, and Water: Renewable Energy and Birds*. *Ibis* 148 (Supplement 1): 76-89.
- Desholm, M. and J. Kahlert, 2005, Avian Collision Risk at an Offshore Wind Farm, *Biology Letters*, published online, doi:10.1098/rsbl.2005.0336.
- Ecology and Environment Inc. (E & E), 2006a, *Work Plan for Bird and Bat Studies at Two Proposed Windparks: Noble Arkwright Windpark and Noble Ball Hill Windpark, Chautauqua County, New York*, prepared for Noble Environmental Power, L.L.C., September 2006.
- \_\_\_\_\_, 2006b, *Avian and Bat Risk Assessment Bliss Windpark Town of Eagle, Wyoming County, New York*, prepared for Noble Environmental Power, L.L.C., February 2006.
- \_\_\_\_\_, 2006c, *Bird and Bat Risk Assessment Centerville Windpark Town of Centerville, Allegany County, New York*, prepared for Noble Environmental Power, L.L.C., in progress.

- \_\_\_\_\_, 2007, *Bird and Bat Risk Assessment Wethersfield Windpark Towns of Wethersfield and Eagle, Wyoming County, New York*. Prepared for Noble Environmental Power, L.L.C., January 2007.
- Erickson, W. (at WEST, Inc.), 2003, Updated Information Regarding Bird and Bat Mortality and Risk at New Generation Wind Projects in the West and Midwest [PowerPoint Presentation to NWCC Workshop].
- Erickson W., G. Johnson, D. Young, D. Strickland, R. Good, M. Bourassa, K. Bay, and K. Sernka, 2002, Synthesis and Comparison of Baseline Avian and Bat Use, Raptor Nesting and Mortality Information from Proposed and Existing Wind Developments. Prepared for Bonneville Power Administration, 124 p.
- Erickson, W., G. Johnson, M. Strickland, K. Sernka, and R. Good, (at WEST, Inc.), 2001, Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States, a guidance document for National Wind Coordinating Committee (NWCC), Washington, D.C., 67pp.
- Everaert J., K. Devos, and E. Kuijken, 2002, Windturbines en vogels in Vlaanderen: Voorlopige onderzoeksresultaten en buitenlandse bevindingen, [Wind turbines and birds in Flanders (Belgium): Preliminary study results in a European context.] Instituut voor Natuurbehoud, Report R.2002.03, Brussels, Belgium, 76 pp.
- Gannon, W.L., R.E. Sherwin, and S. Haymond, 2003, On the importance of articulating assumptions when conducting acoustic studies of habitat use by bats, *Wildlife Society Bulletin* 31(1):45-61.
- Gardner, J.E. and E.A. Cook, 2002, Seasonal and Geographic Distribution and Quantification of Potential Summer Habitat. In *The Indiana Bat: Biology and Management of an Endangered Species*, A. Kurta and J. Kennedy (editors), Bat Conservation International, Austin, Texas.
- Gary, B., 2007, Email dated October 31, 2007, from Ms. Brianna Gary, Avian Ecologist, NYSDEC, Albany, New York, to Mr. Michael Morgante, Ecology and Environment, Inc., Lancaster, New York.
- Geo-Marine Incorporated (GMI), 2007, Spring and Fall Bird Migration Over the Steel Winds Energy Project in Lackawanna, New York: A WSR-88D radar analysis. Prepared for BQ Energy, L.L.C., July 2007.
- Gill, F.B., 1995, *Ornithology*, Second Edition. W.H. Freeman and Company, New York.

- Grehan, J.R., 2008, Steel Winds Bird Mortality Study, Final Report, Lackawanna, New York. Prepared for Steel Winds LLC, April 2008.
- Hall, J. S., 1962, A Life History and Taxonomic Study of the Indiana Bat, *Myotis sodalis*. Reading Public Museum and Art Gallery, Scientific Publications 12:1-68.
- Hames, R.S., K.V. Rosenberg, J.D. Lowe, S.E. Barker, and A.A. Dhondt, 2002, Adverse Effects of Acid Rain on the Distribution of the Wood Thrush *Hylocichla mustelina* in North America, *Proceedings of the National Academy of Sciences* 99:11235-11240.
- Harmata, A.R., K.M. Podruzny, J.R. Zelenak, and M.L. Morrison, 1999, Using marine surveillance radar to study bird movements and impact assessment, *Wildlife Society Bulletin*, 27: 44-52.
- HawkCount, 2007, "HawkCount: A project of the Hawk Migration Association of North America," Website accessed at <http://www.hawkcount.org>, in January 2007.
- \_\_\_\_\_, 2008, "HawkCount: A project of the Hawk Migration Association of North America," Website accessed at <http://www.hawkcount.org>, in June 2008.
- Herkert, James R., Peter D. Vickery and Donald E. Kroodsma. 2002. Henslow's Sparrow (*Ammodramus henslowii*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/672>.
- Huron Wind, 2006, Fact Files: Do wind turbine harm birds? Website accessed at <http://www.huronwind.com/huronwind/factfiles.asp>, in January 2007.
- Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik, 2007, Annual Report for the Maple Ridge Wind Power Project Post-construction Bird and Bat Fatality Study - 2006. Report prepared for PPM Energy and Horizon Energy and Technical Advisory Committee for the Maple Ridge Project Study, May 2007.
- \_\_\_\_\_, 2008, Annual Report for the Maple Ridge Wind Power Project Post-construction Bird and Bat Fatality Study – 2007. Report prepared for PPM Energy and Horizon Energy and Technical Advisory Committee for the Maple Ridge Project Study, May 2008.

- James, R., 2008, Case Study: Erie Shores Wind Farm. Presented at the Windmatters 2008: Wind Energy Project Siting Seminar, April 9-10, 2008, Calgary, Alberta, Canada. Website accessed at [http://www.visualmediagroupinc.com/CanWEA/2008/08\\_Windmatters/040908/pdf/April%209/PM/Ross%20James.pdf](http://www.visualmediagroupinc.com/CanWEA/2008/08_Windmatters/040908/pdf/April%209/PM/Ross%20James.pdf) on July 22, 2008.
- James, R. D. and G. Coady, 2003, Exhibition Place Wind Turbine Bird Monitoring Program in 2003. Report prepared for Toronto Hydro Energy Services Inc. and WindShare, December 2003.
- Janss G., 2000, Bird Behavior in and Near a Wind Farm at Tarifa, Spain: Management Considerations. In *Proceeding of the National Avian – Wind Power Planning Meeting III*, May 1998, San Diego, California, Washington D.C.: RESOLVE, Inc., p. 110-4, website accessed at <http://www.nationalwind.org/pubs/default.htm>.
- Kahlert, J., I.K. Petersen, A.D. Fox, M. Desholm, and I. Clausager, 2003, Investigations of Birds During Construction and Operation of Nysted Offshore Wind Farm at Rødsand. Commissioned by Energi E2 A/S 2004.
- Kerlinger, P., 2006, Proposed scope of work for a post-construction avian and bat fatality study at the Maple Ridge wind power project, Lewis County, New York. Prepared for Flat Rock Wind Power L.L.C., March 2006.
- \_\_\_\_\_, 2004, Phase I avian risk assessment for the High Sheldon wind farm, Wyoming County, New York. Prepared for Invenergy Wind L.L.C., November 2004.
- \_\_\_\_\_, 1989, *Flight Strategies of Migrating Hawks*, University of Chicago Press, Chicago, Illinois.
- Kerlinger, P. and J. Guarnaccia, 2006, Avian risk assessment, Marble River wind project, Clinton County, New York. Report prepared for Marble River L.L.C., March 2006.
- \_\_\_\_\_, 2000, Avian Mortality at Communication Towers: A Review of Recent Literature, Research, and Methodology. Prepared for USFWS, Office of Migratory Bird Management, by Curry & Kerlinger L.L.C., Cape May Point, New Jersey, March 2000.
- Kerns, J., D. P. Young, C. S. Nations, and V. K. Poulton, 2008, Avian and Bat Studies for the Proposed New Grange Wind Project, Chautauqua County, New York. Final report prepared by WEST, Inc. for New Grange Wind Farm LLC.

- Kerns, J., D. Young, C. Nationa, and V. Poulton, 2007, Avian and Bat Studies for the Proposed St. Lawrence Windpower Project, Jeffereson County, New York. Report prepared for St. Lawrence Windpower, L.L.C., August 2007.
- Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R. W. Thresher, and M.D. Tuttle, 2007, Ecological Impacts of Wind Energy Development on Bats: Questions, Research Needs, and Hypotheses. *Front Ecol Environ* 5(6): 315-324.
- Leddy, K., K. Higgins, and D. Naugle, 1999, Effects of Wind Turbines on Upland Nesting Birds in Conservation Reserve Program Grasslands, *Wilson Bulletin* 111(1): 100-104.
- Levesque, C., 2006, News Highlight - For the Birds: Audubon Society Stands up in Support of Wind Energy, Website accessed at <http://www.awea.org>, in December 2006.
- Longcore, T., C. Rich, and S.A. Gauthreaux, 2005, Scientific Basis to Establish Policy Regulating Communications Towers to Protect Migratory Birds: Response to Avatar Environmental, L.L.C., report regarding migratory bird collisions with communications towers, WT Docket No. 03-187, Federal Communications Commission Notice of Inquiry. Prepared for American Bird Conservancy, Defenders of Wildlife, Forest Conservation Council, The Humane Society of the Unites States, by Land Protection Partners, Los Angeles, California, and Clemson University, Clemson, South Carolina, February 2005.
- Mabee, T. J., J. H. Plissner, and B. A. Cooper, 2006a, A radar and visual study of nocturnal bird and bat migration at the proposed Centerville and Wethersfield windparks, New York, spring 2006. Report prepared for E & E and Noble Environmental Power L.L.C., July 2006.
- \_\_\_\_\_, 2006b, A radar and visual study of nocturnal bird and bat migration at the proposed Centerville and Wethersfield windparks, New York, fall 2006. Report prepared for E & E and Noble Environmental Power L.L.C., December 2006.
- Mabee, T., J. Plissner, B. Cooper, and J. Barn, 2006c, A radar and visual study of nocturnal bird and bat migration at the proposed Clinton County windparks, New York, spring and fall 2005. Prepared for Noble Environmental Power, L.L.C. and Ecology and Environment, Inc., January 2006.
- Mabee, T. J., J. H. Plissner, and B. A. Cooper, 2005a, A radar and visual study of nocturnal bird and bat migration at the proposed Flat Rock Wind Power

project, New York, fall 2004. Prepared for Atlantic Renewable Energy Corporation, March 2005.

\_\_\_\_\_, 2005b. A radar and visual study of nocturnal bird and bat migration at the proposed Prattsburgh-Italy wind power project, New York, fall 2004. Final report prepared for Ecogen L.L.C., March 2005.

\_\_\_\_\_, 2005c, A radar and visual study of nocturnal bird and bat migration at the proposed Prattsburgh-Italy wind power project, New York, spring 2004. Final report prepared for Ecogen L.L.C., August 2005.

Menzel, M. A., J. M Menzel, T. C. Carter, W. M. Ford, and J. W. Edwards, 2001, Review of the forest habitat relationships of the Indiana bat (*Myotis sodalis*), General Technical Report NE-284, Newtown Square, Pennsylvania, U.S. Department of Agriculture, Forest Service, Northeastern Research Station, 21 p.

National Audubon Society, 2008, Christmas Bird Counts Data, website accessed at [http://audubon2.org/birds/cbc/hr/count\\_table.html](http://audubon2.org/birds/cbc/hr/count_table.html), in June 2008.

\_\_\_\_\_, 2005, Christmas Bird Count: History and Objectives, website accessed at <http://www.audubon.org/bird/cbc/history.html>, in September 2007.

National Research Council (NRC), 2007, Environmental Impacts of Wind-energy Projects. Committee on Environmental Impacts of Wind Energy Projects Board on Environmental Studies and Toxicology, Division on Earth and Life Studies. National Academies Press, Washington, D.C.

National Wind Coordinating Committee (NWCC), 2007, Mitigation Toolbox. Compiled by: NWCC Mitigation Subgroup and Jennie Rectenwald, Consultant, May 2007. Website accessed at [http://www.nationalwind.org/publications/wildlife/Mitigation\\_Toolbox.pdf](http://www.nationalwind.org/publications/wildlife/Mitigation_Toolbox.pdf) in June 2008.

\_\_\_\_\_, 2004, Wind Turbine Interactions with Birds and Bats: A Summary of Research Results and Remaining Questions, National Wind Coordinating Committee.

New York State Department of Environmental Conservation (NYSDEC), 2008, New York State Breeding Bird Atlas 2000-2005, Website accessed at <http://www.dec.state.ny.us/website/dfwmr/wildlife/bba/index.html> in June 2008.

New York State Department of Environmental Conservation (NYSDEC), 2007a, Draft Guidelines for Conducting Bird and Bat Studies at Commercial

- Wind Energy Projects, Website accessed at [http://www.dec.ny.gov/docs/fish\\_marine\\_pdf/drwindguide1207.pdf](http://www.dec.ny.gov/docs/fish_marine_pdf/drwindguide1207.pdf), in February 2008.
- \_\_\_\_\_, 2007b, New York State bird conservation area program, Website accessed at <http://www.dec.ny.gov/animals/25341.html>, in December 2007.
- \_\_\_\_\_, 2007c, Golden Eagle Fact Sheet, website accessed at <http://www.dec.ny.gov/animals/7096.html>, in August 2007.
- \_\_\_\_\_, 2008, Bat Die-off Prompts Investigation, website accessed at <http://www.dec.ny.gov/environmentdec/41767.html>, in July 2008.
- Northrop, Devine, and Tarbell, Inc., 1995, New England wind energy station: Spring 1994 nocturnal songbird migration study report, January 1995. Report prepared for Kenetech Windpower, Portland, Maine.
- Percival, S. M., 2001, Assessment of the Effects of Offshore Wind Farms on Birds, DTI Sustainable Energy Programs, DTI/Pub URN 01/1434.
- Pliessner, J. H., T. J. Mabee, and B. A. Cooper, 2005, A radar study of nocturnal bird and bat migration at the proposed Casselman and Martindale Wind Power projects, Pennsylvania, fall 2004. Prepared for Atlantic Renewable Energy Corporation, Dickerson, Maryland, June 2005.
- Price, J. and P. Glick, 2004, *The Birdwatcher's Guide to Global Warming*, American Bird Conservancy, National Wildlife Federation.
- Richardson, J. W., 1998, *Bird Migration and Wind Turbines: Migration Timing, Flight Behavior, and Collision Risk*, proceedings from the National Avian-Wind Power Planning Meeting III.
- Roy, B., 2006, Interim Results form Fall 2006 Surveys at Dutch Hill. Memo to John Hecklau of EDR, Inc., November 2006. Website accessed in December 2007 at <http://www.dutchhillwind.com/>.
- Roy, R. D. and S. K. Pelletier, 2005, Fall 2004 migration surveys at the proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for Vermont Environmental Research Associates and enXco, Inc.
- Sauer, J. R., J. E. Hines, and J. Fallon, 2008, The North American Breeding Bird Survey, Results and Analysis 1966 - 2007, Version 5.15.2008, USGS Patuxent Wildlife Research Center, Laurel, Maryland, website accessed at <http://www.mbr-pwrc.usgs.gov/bbs/bbs.html> in July 2008.

- Seoane, T., 2006, Letter dated October 17, 2006, from Ms. Tara Seoane, Information Services, New York Natural Heritage Program, Albany, New York, to Ms. Christine Sousa, Ecology and Environment, Inc., Lancaster, New York.
- \_\_\_\_\_, 2008, Letter dated June 3, 2008, from Ms. Tara Seoane, Information Services, New York Natural Heritage Program, Albany, New York, to Ms. Laurie Weaver, Ecology and Environment, Inc., Lancaster, New York.
- Smithsonian National Zoological Park Migratory Bird Center (Smithsonian Migratory Bird Center), 2006, Fact Sheets: Neotropical Migratory Bird Basics, Website accessed at [http://nationalzoo.si.edu/ConservationAndScience/MigratoryBirds/Fact\\_Sheets/default.dfm?fxsht=9](http://nationalzoo.si.edu/ConservationAndScience/MigratoryBirds/Fact_Sheets/default.dfm?fxsht=9), on December 18, 2006.
- Spaans, A., L. vanden Bergh, S. Dirksen, and J. van der Winden, 1998, Windturbines en vogles: Hoe hiermee om te gaan? *Levende Natuur* 99:115-121.
- Sterner, D., 2002, *A Roadmap for PIER Research on Avian Collisions with Wind Turbines in California*, California Energy Commission, P500-02-070F, 54 p.
- Szewczak, J.M. and E. B. Arnett, 2006, An Acoustic Deterrent with the Potential to Reduce Bat Mortality from Wind Turbines. In North American Bat Research Symposium (36, 2006, Wilmington), abstracts. *Bat Research News* 47(4): 151-152.
- Tetra Tech EC, Inc., 2006a, 2005 breeding season bird survey report, Wyoming County, New York. Prepared for Invenergy, January 2006.
- \_\_\_\_\_, 2006b, 2005 diurnal migrating bird survey report, High Sheldon wind farm, Wyoming County, New York. Prepared for Invenergy, January 2006.
- Tucker, V. A., 1996, A Mathematical Model of Bird Collisions with Wind Turbine Rotors. *Journal of Solar Energy Engineering* 118: 253-62.
- U.S. Fish and Wildlife Service (USFWS), 2008a, The White-Nose Syndrome Mystery: Something is Killing Our Bats, website accessed at [http://www.fws.gov/northeast/white\\_nose.html](http://www.fws.gov/northeast/white_nose.html), in July 2008.
- \_\_\_\_\_, 2008b, Title 16. Conservation Chapter 5a. Protection and conservation of wildlife bald and golden eagle protection act, website accessed at <http://www.fws.gov/permits/mbpermits/regulations/BGEPA.PDF>, in January 2008.

- \_\_\_\_\_, 2007a, Northeast Region, Ecological Services, New York Field Office Endangered Species, website accessed at <http://www.fws.gov/northeast/nyfo/es/section7.htm>, in September 2007.
- \_\_\_\_\_, 2007b, U.S. Division of Migratory Bird Management: Bald Eagle, website accessed at <http://www.fws.gov/migratorybirds/baldeagle.htm>, in September 2007.
- \_\_\_\_\_, 2007c, Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision, Fort Snelling, Minnesota, U.S. Department of Interior, Fish and Wildlife Service, Region 3, 260 pp.
- U.S. Geological Survey National Wildlife Health Center, 2008, White-Nose Syndrome (WNS), website accessed at [http://www.nwhc.usgs.gov/disease/information/white-nose\\_syndrome/](http://www.nwhc.usgs.gov/disease/information/white-nose_syndrome/), in July 2008.
- U.S. Geological Survey (USGS), 2007, North American Breeding Bird Survey Home Page, website accessed at <http://www.pwrc.usgs.gov/bbs>, in September 2007.
- \_\_\_\_\_, 2002, Migratory Bird Mortality: Many Human-Caused Threats Afflict our Bird Populations, USFWS fact sheet, January 2002.
- U.S. Government Accountability Office (GAO), 2005, Wind Power: Impacts on Wildlife and Government Responsibilities for Regulating Development and Protecting Wildlife, a report to Congressional Requesters, GAO-05-906, September 2005.
- Williams, K., R. Mies, D. Stokes, and L. Stokes, 2002, *Stokes Beginner's Guide to Bats*. Little, Brown, and Company, Boston, Massachusetts.
- Winkelman, J.E., 1994, Bird/Wind Turbine Investigations in Europe, In Proceedings of the National Avian-Wind Power Planning Meeting, Denver, Colorado, 1994, website accessed at <http://www.nationalwind.org/publications/wildlife.htm>, in December 2006.
- \_\_\_\_\_, 1992a, [The Impact of the Sep Wind Park Near Oosterbierum (Fr.), the Netherlands, on Birds, 1: Collision Victims], RIN-rapport 92/2, DLO-Instituut voor Bos-en Natuuronderzoek, Amhem, The Netherlands, [Dutch, English summary], [www.alterra.nl](http://www.alterra.nl).
- \_\_\_\_\_, 1992b, [The Impact of the Sep Wind Park Near Oosterbierum (Fr.), the Netherlands, on Birds, 4: Disturbance], RIN-rapport 92/5, DLO-Instituut voor Bos-en Natuuronderzoek, Amhem, The Netherlands, 106 p. plus Appendixes, [Dutch, English summary], [www.alterra.nl](http://www.alterra.nl).

- \_\_\_\_\_, 1985, Impact of Medium-sized Wind Turbines on Birds: A Survey on Flight Behavior, Victims, and Disturbance. *Netherlands Journal of Agricultural Science* 33:75-78.
- Whitaker, J.O., Jr., V. Brack, and J.B. Cope, 2002, Are Bats in Indiana Declining? *Proceedings of the Indiana Academy of Science* 1:95-106.
- Woodlot Alternatives, Inc. (Woodlot), 2008a, Fall 2006 Radar Surveys at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment, Inc., January 2008.
- \_\_\_\_\_, 2008b, A Spring 2007 Radar, Visual, and Acoustical Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment, Inc., July 2008.
- \_\_\_\_\_, 2006a, Spring 2006 Bat Detector Surveys at the Proposed Centerville and Wethersfield Windparks in Western New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment, Inc., September 2006.
- \_\_\_\_\_, 2006b, Fall 2006 Bat Detector Surveys at the Proposed Centerville and Wethersfield Windparks in Western New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment, Inc., December 2006.
- \_\_\_\_\_, 2006c, A Fall 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Farm in Sheldon, New York. Report prepared for Invenergy, L.L.C., March 2006.
- \_\_\_\_\_, 2006d, Spring 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Noble Environmental Power, L.L.C. and Ecology and Environment, Inc., August 2006.
- \_\_\_\_\_, 2006e, Spring 2006 Surveys of Birds and Bats at the Proposed Howard Wind Project in Howard, New York. Report prepared for Howard Wind, L.L.C. and EverPower Global, September 2006.
- \_\_\_\_\_, 2006f, Fall 2006 Radar Surveys at the Proposed Chateaugay Windpark in Chateaugay, New York. Prepared for Noble Environmental Power, L.L.C. and Ecology and Environment, Inc., December 2006.
- \_\_\_\_\_, 2006g, A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton

and Ellenburg, New York. Report prepared for Marble River, LLC and Horizon Wind Energy, March 2006.

\_\_\_\_\_, 2006h, A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Report prepared for Marble River, LLC and Horizon Wind Energy, March 2006.

\_\_\_\_\_, 2006i, A Spring and Summer 2005 Radar and Acoustic Survey of Bat Migration at the Proposed High Sheldon Wind Farm in Sheldon, New York. Report prepared for Tetra Tech EC and Invenergy LLC, March 2006.

\_\_\_\_\_, 2006j, Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, L.L.C.

\_\_\_\_\_, 2006k, A Spring and Summer 2005 Radar and Acoustic Survey of Bat Migration at the Proposed High Sheldon Wind Farm in Sheldon, New York. Report prepared for Tetra Tech EC, Inc. and Invenergy, L.L.C., March 2006.

\_\_\_\_\_, 2006l, A Spring and Summer 2005 Radar and Acoustic Survey of Bat Migration at the Proposed High Sheldon Wind Farm in Sheldon, New York. Report prepared for Tetra Tech EC, Inc. and Invenergy, L.L.C., March 2006.

\_\_\_\_\_, 2005a, A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Howard Wind Project, in Howard, New York. Report prepared for EverPower Global, December 2005.

\_\_\_\_\_, 2005b, A Fall 2005 Radar Survey of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.

\_\_\_\_\_, 2005c, A Fall 2005 Radar and Acoustic Survey of bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.

\_\_\_\_\_, 2005d, A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, L.L.C.

\_\_\_\_\_, 2005e, A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.

- \_\_\_\_\_, 2005f, A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Report prepared for PPM Atlantic Renewable.
- \_\_\_\_\_, 2005g, A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Report prepared for PPM Atlantic Renewable.
- \_\_\_\_\_, 2005h, A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Report prepared for PPM Atlantic Renewable.
- \_\_\_\_\_, 2005i, A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Report prepared for PPM Atlantic Renewable.
- \_\_\_\_\_, 2004, A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
- \_\_\_\_\_, 2007, A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy LLC.
- Yonker, T. L. and L. Landon, 2005, Nocturnal Radar Study of Bird Migration at the Proposed Noble Environmental Power, L.L.C., Wind Generating Project, Bliss, New York. Report prepared for Noble Environmental Power, L.L.C. and Ecology and Environment, Inc., December 2005.
- Young, D.P., C.S. Nations, V.K. Poulton, J. Kerns, and L. Pavilonis, 2006, Avian and bat studies for the proposed Dairy Hills wind project, Wyoming County, New York. Prepared for Horizon Wind Energy, April 2006.
- Zalles, J.I. and K.L. Bildstein, 2000, *Raptor watch: A global directory of raptor migration sites*, BirdLife International, Cambridge, United Kingdom and Hawk Mountain Sanctuary, Kempton, Pennsylvania, BirdLife Conservation Series, No. 9, joint publication with Hawk Mountain Sanctuary.