BIRDS AND BATS:

Potential Impacts and Survey Techniques

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Any questions about the tool kit, its use and availability should be directed to:
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In addition, other reports and information about Wind Energy can be found at www.powernaturally.org in the on-line library under "Large Wind.

NOTICE

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Table of Contents

List of Figures

List of Tables

Birds and Bats: Potential Impacts and Survey Techniques

This paper reviews the potential impacts from utility-scale wind energy development on birds and bats, how impacts can be studied, and how impacts may be mitigated. This paper also attempts to place potential impacts from wind energy development in context with potential impacts of other power generating technologies with which the reader may be more familiar.[1]

Heavy construction work, common to development of all power generating facilities, will affect the ecological resources in the vicinity of the project both during the construction activities and operation of the project. Some of the major concerns include loss or change of habitat for foraging and nesting birds, change in vegetative cover types, and death of birds and bats due to collisions with the wind turbine/tower structures. Since the potential for bird and bat mortality is a topic that receives significant attention for wind energy projects, this paper focuses on birds and bats. Potential impacts to other biotic resources would be evaluated within an environmental impact review, as appropriate.

As a town official, you may receive materials from a wide range of organizations. This paper attempts to provide an objective review of the general impacts to birds and bats from utility-scale wind energy projects. Keep in mind that while knowing general trends gathered from wind energy projects across the U.S. and the impacts from wind energy projects located in similar terrain and ecological areas may be helpful, this knowledge is typically not a substitute for knowledge gained from conducting a site-specific environmental assessment. In addition, it should be noted that there are not many published studies on this topic at present, and there are new studies currently in progress that will shed much more light on this issue.

Historical Bird Impacts

Bird deaths associated with wind turbines have received attention primarily due to the loss of raptors at wind farms in the Altamont Pass area in California. Between 1983-1986, turbines with approximately 1,000 MW of full-rated electrical capacity were installed in California, and approximately one-third were installed in Altamont Pass. The turbines ranged in size from 25 kW to 100 kW, with lattice towers that attracted roosting birds. Since the 1990s, utility-scale projects have been constructed outside of California comprised of turbines ranging in size from 500 kW to 1,500 kW which have

[1] If you would like information on how to review these issues for a specific project under the State Environmental Quality Review Act (SEQR), please either contact the New York Department of Environmental Conservation (DEC) or visit their website at www.dec.state.ny.us.

incorporated design changes to reduce the potential for avian perching and collisions. In addition, the newer turbines are much larger in capacity requiring fewer turbines at a project to achieve a desired overall capacity.

For comparison, Figure 1 presents historic bird mortality rates at several projects in California and across the U.S.[2] The estimates are based on year long studies and include extrapolation for scavenger and searcher efficiency. At California projects, bird mortality was estimated to be approximately 9 birds per MW per year for all species; whereas the average estimated mortality at projects located outside California (and using newer turbine technology) was 3.1 birds per MW per year.

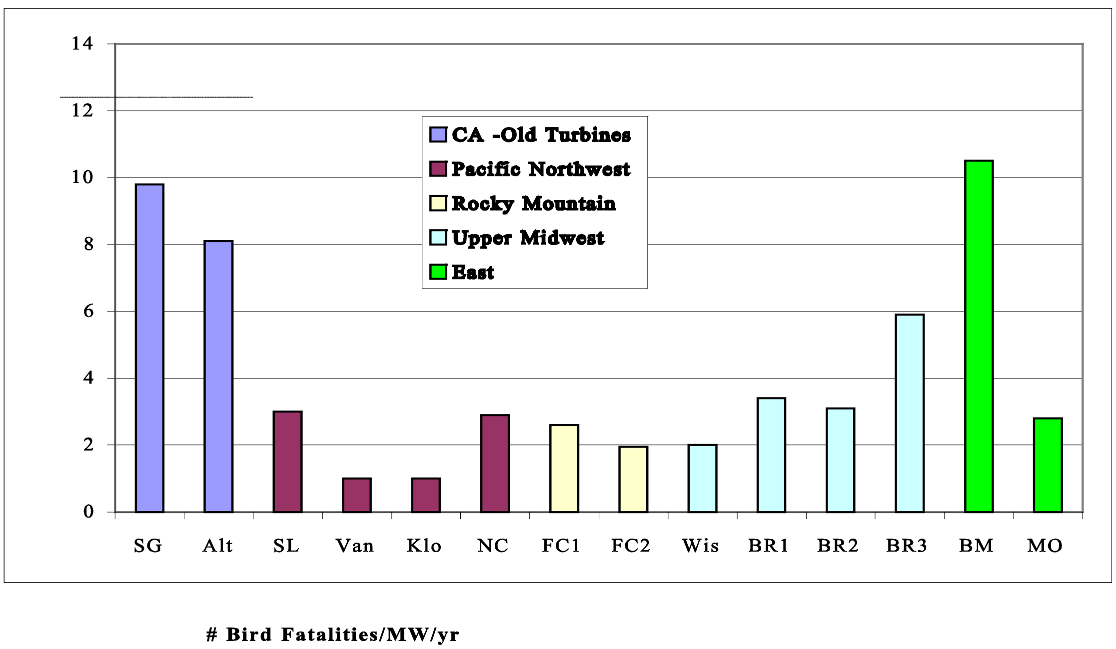

Figure 1 Estimated Bird Fatalities

Figure 2 presents raptor specific fatalities at wind energy projects across the U.S.[3] Raptor fatalities have dropped significantly since the experiences at Altamont Pass, in part due to better siting, pre-construction bird studies, and deployment of newer turbine technology. In addition, the projects with very low-to-no raptor mortality have been located in areas with lower raptor populations than at Altamont Pass.

[2] Based on information from Erickson, W. (2005) Wildlife Impact and Risk Assessment Methods for Wind Energy Projects. Presented at AWEA Wind Power Conference: Denver.
[3] Based on information from Erickson, W. (2005) *Wildlife Impact and Risk Assessment Methods for Wind Energy Projects*. Presented at AWEA Wind Power Conference: Denver.

Since the Altamont Pass experience, the wind industry, scientists and state and federal agencies have been working together to understand the relationship of birds with wind turbines and how to better site turbines while still receiving an adequate wind resource. Lessons learned from that time are being applied to today's proposed projects.

Bird mortality, however, is not limited to wind turbines. Studies show that wind turbines, on average, are the least harmful when compared to more common human structures, as shown in Figure 3.[4] It is not the intent of this graphic to diminish the impact wind turbines have on local bird populations; however, it does put the impact in perspective with the impact other human activities have on birds.

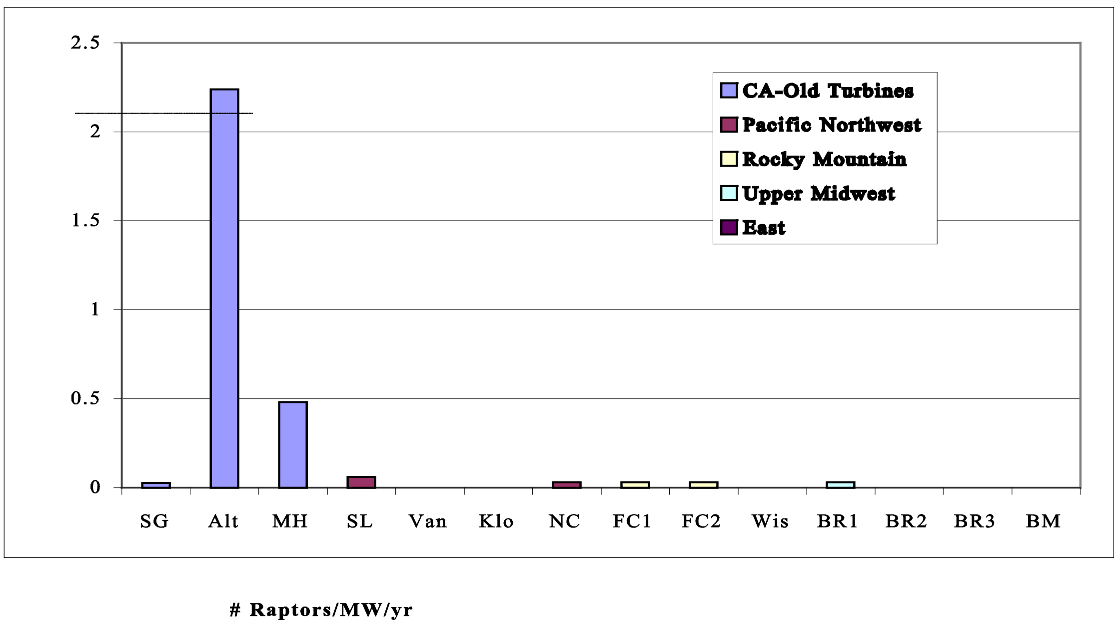

Figure 2 Estimated Raptor Fatalities

[4] Erickson, W. (2004) *Update of Bird and Bat Mortality and Collision Risk at Wind Projects, the Latest Data and Science*. Global Wind Power Conference: Chicago.

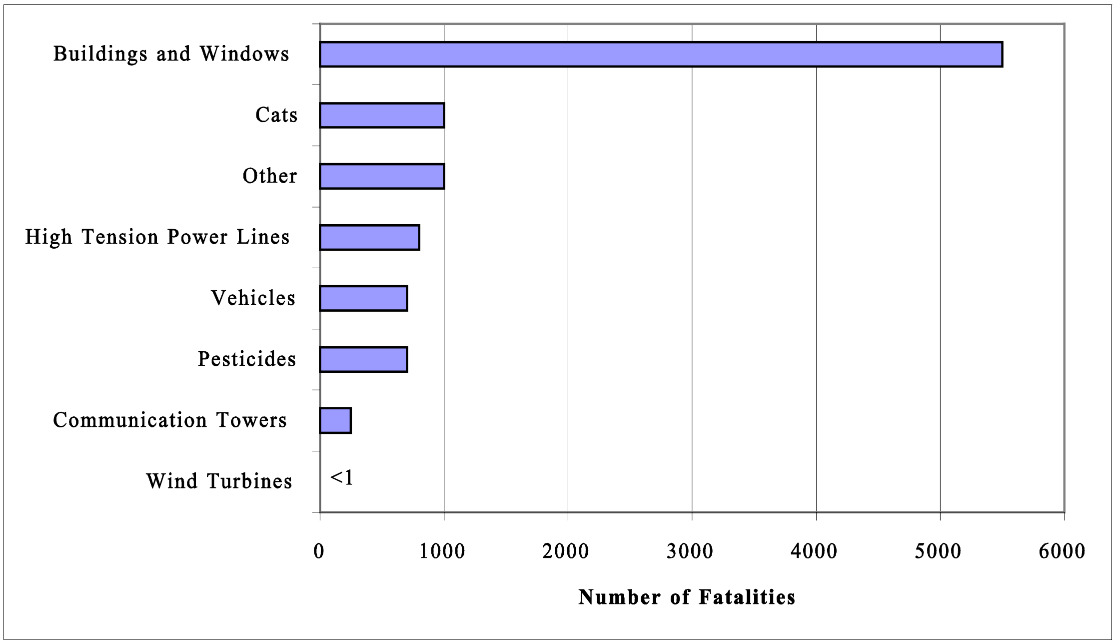

Figure 3 Source of Bird Fatalities per 10,000 Fatalities

Pre- and Historical Bat Impacts

As wind turbine installations expanded to the eastern states, a new issue developed – the potential for bat collisions with wind turbines. Bats have collided with other man-made structures such as lighthouses, television towers, communication towers, large windows, tall buildings, power lines, and barbed-wire fences. The numbers of bats killed from specific incidents at these types of structures appear to be small. Similar mortality rates were experienced with wind turbine projects in the Western and mid-Western States. However, higher mortality rates are being experienced at windpower projects built in the east/mid-Atlantic regions. Although these documented kills were at windpower projects associated with long treed ridgelines, the higher rate of bat mortality in the east may in part be attributed to other factors. Table 1 shows the estimated average bat mortality rate per turbine per year. The values are estimated based on the count of carcasses found that is corrected for estimated scavenger uptake rates, and estimated searcher efficiency. Most values also do not take into account background or reference mortality.[5]

[5] Johnson, G. A Review of Bat Collision Mortality at Wind Farms. Presentation at the 2005 AWEA Wind Power Conference. Denver, CO. May 2005.

Table 1 Estimated Average Bat Mortality Rate

Region	# studies	#/turbine/yr	#/MW/yr
Northwest	4	1.2	1.7
Rocky Mountains	2	1.2	1.9
Upper Midwest	4	1.7	2.7
East	2	46.3	32.0
Overall	12	3.4	4.6

Source: Johnson, G. *A Review of Bat Collision Mortality at Wind Farms*. Presentation at the 2005 AWEA Wind Power Conference. Denver, CO. May 2005.

Bat mortality has been documented but not quantified at windpower projects in New York. Mortality surveys have been conducted at smaller wind energy facilities in Massachusetts, Pennsylvania, and Vermont. The Pennsylvania sites are in farmland and the projects in Massachusetts and Vermont are in forested habitats. As of November 2004, the only bat fatality occurred at the Pennsylvania site, according to Johnson.[6] The findings at these smaller sites, as well as the information in Table 1 indicate the potential variability of bat mortality in different regions and among projects in the east. It is therefore important to understand the potential impacts at each specific proposed wind energy project location.

Post-Construction Monitoring

Environmental assessments of wind energy projects now commonly require pre-construction and post-construction monitoring of the project area. Surveys include researching the biological resources within the project area, migration patterns of birds/bats passing through the project area, and the protective status of migratory and nesting/resident species in an area where turbines are being considered. Bird and bat surveys are often conducted during the spring and fall seasons to identify the migratory patterns of birds and/or bats as they pass through the project area. The following outlines some of the survey techniques used to conduct these studies. For more information on the bird and bat survey methods and tools outlined in this paper please see Mabee, Todd. (2004) Nocturnal Wildlife Study Techniques at Wind Power Sites. AWEA Wind Project Siting Workshop or Woodlot Alternatives, Inc. (2004) Birds Don't Have to be Wind Park 'Show Stoppers.' Published in North American Windpower, August 2004.

Pre-construction surveys often include a combination of resident breeding bird and bat surveys, point count surveys, diurnal surveys including migrating songbirds, waterbirds and raptors, and nocturnal migration surveys. The breeding surveys are usually

[6] Johnson, G. (2004) Overview of Available Bat Mortality Studies at Wind Energy Projects. National Avian-Wind Power Planning Meeting-V. National Wind Coordinating Council.

conducted as close as possible to the proposed site to identify the resident species and provide approximate counts for each species. Diurnal point count surveys estimate the relative abundance of resident and migratory (raptors) birds, species composition, spatial use, and flight behaviors. This survey method identifies species and estimate populations based on visual sightings and identifying bird songs and calls. Nocturnal migration studies using radar attempt to identify numbers of migrating birds/bats, and the heights at which the targets are migrating. Supplemental surveys using acoustics can provide additional information on species identification, although somewhat limited. Raptor and large bird surveys estimate spatial and temporal use. The NYS Department of Environmental Conservation (DEC) has also requested species specific diurnal surveys (e.g. rare, threatened, endangered species) when warranted.

Post-construction studies are often conducted for multiple years after construction to access the impact of the wind turbines on the environment. Post-construction surveys may include some of the surveys listed for pre-construction to compare before/after construction abundance levels. This information will help determine whether the project results in indirect impacts to birds and bats from habitat avoidance, disruption, and displacement. Mortality studies are also conducted concurrently during this post-construction monitoring. These studies estimate the number of birds/bats killed by the turbines. The surveys are conducted by trained investigators who systematically search predefined areas below and around the turbines, met towers, other project structures to find and identify any bird or bat carcasses. Information collected from the carcasses typically would includes species identification, type of injury, age, sex, and estimated day of death (e.g. night before, 2-3 nights, week). These mortality findings are adjusted to account for searcher efficiency and scavenger bias (both tested at the project site). At least one of these studies should include necropsy, when the procedure can be performed on the carcasses. Necropsies may help scientists pinpoint the relationship, if any, between bird/bat deaths at wind turbines and wind turbine presence or operation.

Bird and Bat Survey Techniques

As most birds and bats in North America migrate at night, nocturnal surveys are conducted to estimate the number and kinds of birds and bats migrating. Survey techniques for nocturnal wildlife studies include radar, visual, acoustic/ultrasonic, and mist netting. Each approach has pros and cons, as outlined in Table 2. Though several techniques are available, the X-band radar appears to be the best method since the numbers of bats and/or birds, their flight altitude and direction, and passage rates can be determined. The significant drawback is the inability to identify the target as a bat or bird; therefore, it may be necessary to use this method in conjunction with either visual or acoustic methods for species identification.

When working with wind developers, the DEC has supported the use of raptor and diurnal migration surveys, marine radar surveys, breeding bird/resident bird surveys, and acoustical/ultrasonic bird and bat surveys.

Table 2 Pros and Cons of Nocturnal Survey Methods

Technique/Tool	Purpose	Pros	Cons
Radar			
X-band Radar / Marine Radar	Document and quantify nocturnal bird/bat migration – surveillance (horizontal) and vertical modes	Portable; detect individual birds or bats within ~1 mile radius; flight directions and altitudes; passage rates; effective in fog; data can be displayed in topographic terrain models	Cannot differentiate between birds and bats; insects can confound data; ineffective in rain
NEXRAD	Once weather data is filtered out, can quantify broad, regional migrations of biotargets (birds, bats & insects)	Landscape view of migration; predict major migration nights; potentially can identify major stopover habitats	Low resolution; limited low altitude coverage; insects confound data
Visual			
Spotlights (Ceilometers)	Count targets observed, estimate overall passage rates, direction of flight	Inexpensive; can differentiate between birds and bats	Small sampling area and range; attraction/ repulsion bias
Moon watching	Same as spotlights	Excellent during full moon	Limited good sampling nights
Night vision optics	Same as spotlight	Goggles effective with spotlights; spotlights need red or infrared lens to reduce or eliminate attraction bias	Effective to only 100-150 m; costly (~$2,500); not effective in fog or rain
Thermal imaging devices	Count the number of bats flying in the project site	No attraction/repulsion bias	Similar detectability as night vision optics; poor in heavy fog; very costly (~$60,000-$100,000)
Mist Nets	Species identification	Species ID; determine resident species	Limited to low (~10m) altitudes; probably not suitable for migratory species
Recorders			
Acoustic recorders (birds)	Species identification	Single microphone: species ID and call rates; Microphone array = species ID, call rates, and altitudes; Detects warbles to ~1000ft, thrushes to ~2000ft	Background noise (e.g. insects) can be problematic; unknown and variable proportion of birds calling; not all bird species calls are known.
Ultrasonic recorders / echolocation detectors (bats)	Species identification	Flexible (e.g. locate at ground or altitude); collect data in remote locations	Limited species identification (only some of those vocalizing); detection limit ~<25m

Sources: Mabee, Todd. (2004) *Nocturnal Wildlife Study Techniques at Wind Power Sites*. AWEA Wind Power Project Siting Workshop. Woodlot Alternatives, Inc. (2004) *Birds Don't Have to be Wind Park 'Show Stoppers.'* North American Windpower

The bird and bat studies at these sites not only serve to estimate abundance and fatalities but also seek to answer questions on what specific characteristics seem to promote or deter bird and/or bat fatalities. With this data, better impact avoidance, minimization, and mitigation can occur.[7]

For example, certain lights may attract nocturnal migrants. Researchers reviewed mortality data from several studies at wind projects, and the results show no difference in bat and nocturnal migrant mortality at lit and unlit turbines. With this information, researchers can focus on other questions. As another example, scientists are trying to discover the mechanisms bats use to navigate. Initial hypotheses believed bats used echolocation, like they use to hunt food. But some recent research indicates that, at least for one bat species, echolocation may not be used for navigation. While survey counts are conducted, additional research is on-going to determine navigation mechanisms, migration patterns, and breeding habits of various species. Researchers hope that as studies continue at existing projects and new studies start at projects being developed and constructed, the larger pool of data will provide clues to solving these mysteries. Once these types of mechanisms are understood, scientists can study how those mechanisms interact with wind turbines, and ultimately, propose appropriate mitigation measures.

Where proposed projects are located in similar type terrain with similar species and/or usage patterns, the data to be collected at windpower projects in New York may lend itself useful for extrapolation to other proposed sites in order to get a preliminary understanding of any potential impacts. However, site specific studies will still be needed for each proposed project.

Species Listings

United States Fish and Wildlife Service (USF&WS) maintains a list of all threatened species, endangered species, and critical habitats by state in which they occur. As of August 2005, 20 animals and 6 plants found in New York are listed as either threatened or endangered by the USF&WS. New York State also maintains its own list of endangered and threatened species that may contain different species than the USF&WS. An environmental consultant can determine if any of the species listed on either list exist at a proposed development site and the extent of the habitat supporting the species.

The New York State Natural Heritage Program maintains a database on the locations of rare plants, rare animals, and significant natural communities found within New York State. Proposed development sites should be screened against the database. The screening focuses on identifying rare species and significant natural communities at or in

[7] The review hierarchy for environmental assessments is first to avoid potential impacts if possible, then minimize potential impacts, then mitigate potential impacts.

the vicinity of the proposed project site, and on identifying rare species of birds and bats within a larger area around the proposed project site. The DEC staff can also provide useful insight as to the occurrence of listed species or species of concern in a proposed development area. Local birding groups may also provide information on migrant and resident bird species in a local area.

Habitat

Loss of habitat and vegetation can occur during the construction process as a result of increased human presence, noise, motion, and alteration of the terrain for roads, buildings, foundations or other site infrastructure elements. Although developers try to select sites with minimal tree cover, tree removal does occur at some projects for construction needs and access roads. Selective tree removal to improve exposure to the wind also can result in a loss of forested habitat.

Site topography and project layout have the largest impact on loss of habitat issues. Construction in steep areas can produce more disturbances due to the need for more 'cut and fill' excavation work. Loss of habitat can be mitigated through re-vegetation actions or through setting aside other sections of land from development. Plans for site work should be reviewed to ensure sufficient soil and water quality control measures, similar to those required for other construction projects, are in place.[8]

Surveys of habitat and vegetation often focus on the condition of the habitat, if any vegetation listed as threatened or endangered exists in the proposed development area, if the area is already fragmented,[9] and what species are thought or known to require that habitat or vegetation for survival (critical habitat).

Mitigation Strategies

Depending on the level and type of impact estimated during the pre-construction monitoring, appropriate avoidance, minimization, or mitigation strategies can be developed. Some strategies include the following:

- Turbine relocation (depending on topography, wind resource, and access to land) or removal from the proposed project layout if suitable alternative locations cannot be found.

[8] See Other Environmental Impacts section of the NYSERDA Toolkit for more information on these types of potential impacts.
[9] Wind turbines, access roads, transmission lines, and operation and maintenance building(s) occupy a fraction of the land that's leased for the project due to spacing requirements between the turbines for wind exposure purposes. By contrast, much more contiguous land is occupied by golf courses, housing developments, business centers, or shopping malls. If an area is already fragmented, a wind energy project may help preserve the remaining sensitive areas by including them within the project area, but not building on or near those areas.

- Best Management Practices – electrical lines: several methods have been developed at power projects for minimizing the impact to birds from electrical wires. Methods include burying cable when practical and installing bird diverters on overhead lines.
- Minimal lighting at operation and maintenance buildings, substation, and interconnection facilities.
- Bird diverters: bird diverters are devices used on guy-wires that prevent birds from flying into guy wires, which may be present if the project uses a guyed meteorological tower. (However, these are not applicable for turbine towers.)
- Operational alterations during bird and/or bat migration season in an effort to reduce turbine strikes.

Additional Resources

Bat and Wind Energy Cooperative. http://www.batcon.org/wind. The Bat Conservation International has teamed up with government agencies, industry organizations, and academic organizations study the interaction of bats with wind turbines and help develop siting practices that will minimize bat deaths resulting from collision with wind turbines.

The California Energy Commission report Effects of Wind Energy Development: An Annotated Bibliography contains a good listing of sources for further review.

Erickson, Wallace P. et. al. (2001) Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States. National Wind Coordinating Committee resource document.

Johnson, G. A Review of Bat Collision Mortality at Wind Farms. Presentation at the 2005 AWEA Wind Power Conference. Denver, CO. May 2005.

Mabee, Todd. (2004) Nocturnal Wildlife Study Techniques at Wind Power Sites. AWEA Wind Power Project Siting Workshop, Oregon.

National Wind Coordinating Council's National Avian-Wind Power Planning Meetings. This site lists several presentations on survey techniques, research questions, and monitoring survey results.
http://www.nationalwind.org/publications/avian/avian04/default.htm

New York Department of Environmental Conservation.
Main website: http://dec.state.ny.us/
Listed Animals: http://dec.state.ny.us/website/dfwmr/wildlife/endspec/etsclist.html.
Listed Plants: http://dec.state.ny.us/website/regs/part193b.html.

New York Natural Heritage Program. To request a screening, submit a letter with a brief description of the project and the location, along with a map of the location to New York Heritage Program, Information Services, 625 Broadway, Albany NY 12233-4757. For more information visit http://www.dec.state.ny.us/website/dfwmr/heritage/index.

United States Fish and Wildlife Service.
Main website: http://www.fws.gov
Threatened and Endangered Species:
http://www.fws.gov/endangered/wildlife.html#Species
New York Field Office's List: http://nyfo.fws.gov/es/list.htm.
Interim Guidelines on Avoiding and Minimizing Wildlife Impacts from Wind Turbines. These voluntary, interim guidelines provide guidance to regional field offices when they participate in evaluating a wind energy project. Projects are evaluated on a case-by-case basis. Each field office has wide flexibility in following the suggestions in the guidelines based on the specific merits of each case. http://www.fws.gov/r9dhcbfa/windenergy.htm

Woodlot Alternatives, Inc. (2004) Birds Don't Have to be Wind Park 'Show Stoppers.' Published in North American Windpower, August 2004, available at http://www.woodlotalt.com/publications/NorthAmericanWindpowerArticle2004.pdf.