# NEW YORK TECHNICAL WORKSHOP ON WIND / WILDLIFE ISSUES
# August 2-3, 2006
## *Albany, NY*

# Draft Meeting Summary

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INTRODUCTION

## Meeting Purpose & Agenda

The New York State Energy Research and Development Authority (NYSERDA) and the New York State Department of Environmental Conservation (DEC) together hosted the Technical Workshop on Wind / Wildlife Issues held in Albany, New York on August 2-3, 2006. The DEC is charged with developing a set of guidelines for wind power development in New York and wished to consult experts in the field to obtain their input on shaping those guidelines. The purpose of the workshop was to bring together experts from across the country to explore the state of the knowledge on wind power's impacts on wildlife and how that knowledge can be applied in New York. An additional goal of the workshop was to identify research needs on the interaction of birds and bats with wind power sites as well as potential impact mitigation strategies.

In order to address these issues, the workshop was organized as a series of panels that addressed specific questions posed by NYSERDA and NY DEC. The panel members collaborated to produce a presentation on the group's answers to those questions, which included a characterization of their areas of agreement and disagreement. The panel leaders were responsible for synthesizing the group's thinking around the assigned questions and presenting the results of their deliberation to the larger workshop. Each panelist had the opportunity to add more in-depth comments and then the workshop participants were invited to hold a discussion on the topic.

The agenda began with an overview of wind power in New York and was then divided into three main segments: 1) wildlife characterization and assessment of actual or potential impacts from wind development, in both pre- and post-construction stages; 2) analysis of direct impacts related to harm to species and resources, as well as of indirect impacts; and 3) decision-making. In the first segment, the panels aimed to identify the accepted protocols and methods for wildlife resource characterization at particular sites, responding to the following questions:

- What site characteristics are relevant?
- How do we characterize bird and bat species presence and activity at a site? What methods are available?
- What data exists concerning how bird and bat species may utilize possible project sites in New York, or in a similar habitat to that found in New York, where wind development is a possibility?

- Various monitoring issues, including its objectives, implemented and potential protocols, key questions, available tools, statistics on wildlife mortality, and study validation techniques.
- How do we ensure the rigor of data in both pre- and post-construction phases?

The second segment consisted of panels addressing the following questions:

- What methods are available to assess approaches for evaluating potential impact to wildlife species? How effective are these methods?
- How should data presentation be standardized for potential and actual impact?
- What methods are available to predict or measure the relationship between the presence of a species and its risk of impact with a wind facility?
- What mitigation strategies have been considered, adopted, and evaluated?
- Have they been successful?
- What is adaptive resource management? Has it been applied at wind development sites? What can we learn from sites in the cases where it has been applied?
- What should be considered for post-construction habitat management -- are there lessons, rules of thumb to consider?

In the final decision-making segment, NYSERDA and NY DEC asked the participants to consider two overarching questions:

- What are possible relevant parameters for determining acceptable risk? How should project risks and benefits be weighed?
- What decision-making options are available for use at specific sites proposed for development?

This report summarizes the panel presentations on each of these topics and the subsequent discussions. The decision-making segment of the workshop was organized into work groups that addressed the decision-oriented questions posed by the hosts of the meeting for three distinct topographical regions of New York that have the greatest potential for wind development. A summary of the ideas generated in these work groups follows the presentation synopses.

PANEL 1: OVERVIEW OF WIND POWER IN NEW YORK STATE
Panelists: Joe Visalli, NYSERDA; Jack Nasca, NY DEC; and Bill Moore, PPM Atlantic Renewable Energy

*Questions for panel:*
- *Where is wind power developed or being developed in New York State?*
- *Engineering and siting considerations for wind power developments in New York State: what characteristics do developers look for?*
- *Where are the developable wind resource areas in New York State and what is the potential for further wind development?*

As the first speaker, Joe Visalli told the group that the state of New York is making a significant effort to develop renewable sources of energy. Motivating that effort are key government policies, notably the adoption of a Renewable Portfolio Standard (RPS) that aims for the production of 25% of the state's energy from renewables by 2013. Another driver behind development of renewables is the state's participation in the Northeast Regional Greenhouse Gas Initiative, which will call for caps on carbon emissions for participating states. He noted that the challenge of achieving these goals will be compounded by the state's population growth as well as the increasing demand for energy, which underscores the need to find clean energy alternatives. Some of the advantages of pursuing clean energy options include contributing to the growth of the state's economy, particularly in rural areas, and developing a homegrown energy supply.

He pointed out, however, that wind power can have negative impacts on wildlife and, for this reason, project sites must be chosen with care. Accordingly, NY DEC is looking to the workshop participants to help inform the state guidelines in an environmentally sound manner. In addition to the impacts of wind power on wildlife, NYSERDA is examining the wildlife impacts of fossil fuel production, specifically those due to mercury emissions. Mr. Visalli also expressed the desire to see consistent standards across states.

In order to ensure there is a level playing field in the siting process, Jack Nasca assured the group that DEC understands the need to present wind power developers with a consistent message and to make reasonable requests for a consistent set of information. Accordingly, the workshop was designed so that the agency could gather the necessary information for drawing up guidelines for the siting process. Once the draft guidelines are prepared, the DEC will make them available for public review and comment for a period of 30-60 days; the agency will then produce a final guidance.

According to Bill Moore, the technical potential for wind power in New York is significant, particularly in areas of open farmland, on forested ridgelines, and at waterfront locations. Estimating New York's potential at 5,000 megawatts, he also pointed to the queue of Independent System Operators (ISO), or regulators of electricity flow who are proposing wind projects in the state, as a good indication of that potential. Currently, there are approximately 15 ISOs listed.[1]

In addition to wind resources at a particular site, Mr. Moore noted three other elements that developers look for in site evaluations: 1) utility interconnection; 2) community acceptance; and 3) environmental appropriateness. The last two factors, he said, are the most difficult challenges to confront. Another consideration when siting wind projects is the potential impact on local historic buildings, which are plentiful in the state. Recognizing of the importance of building projects that make sense from an environmental impact standpoint, Mr. Moore asserted that PPM is willing to invest the necessary time and effort to resolve potential issues. When siting projects in New York, PPM has encountered varying levels of controversy, with some communities opposing the windfarms and others welcoming the projects in their area.

[1] He noted that one drawback of the queue is that there is no prioritization of the proposed projects, so it does not indicate which projects may be accepted.

**Questions and Observations for Panel 1: Overview of Wind Power in New York State**

In the subsequent discussion, key questions concerned developer expectations of the pending DEC guidelines and the anticipated state role in the wind plant siting process. Participants also asked about the potential number and size of wind development projects in the state as well as the timeline for the development of state guidelines. The panelists made the following points in response:

- Given that New York is a home rule state and primary review of wind projects is assigned to a town or planning board, Bill Moore observed that reviews are currently very inconsistent. PPM hopes the guidelines will establish a clear and consistent process throughout the state. The company also is concerned with the number of years of pre-construction studies that will be required; it hopes there will be a standard set for risk evaluation, such that three years of studies are not necessary for every site. Other participants added that developers seek uniformity in the regulations and assurance of the government's support once all requirements are fulfilled and the project is approved.

- Jack Nasca clarified that the guidelines will address only the issues concerning birds and bats. Furthermore, the state does not currently intend to produce regulations, only guidelines for siting wind power and monitoring projects in operation. With regard to the state taking a greater leadership role vis-à-vis the municipalities, he does not anticipate that the legislature will adopt an Article 10-type bill, which gave a structured approach to power plant siting, that incorporates wind power in the near future. Mr. Visalli added, however, that NYSERDA has funded regional planning groups to help them act in conjunction with local planning boards on siting issues.

Participants also asked about the number and size of potential wind projects in New York. The panelists' responses follow:

- The expected size of wind turbines sited in New York by 2013 is approximately 2.5 megawatts.
- Thus far, four wind projects have been built in the state and ten others are in different stages of the review process. Approximately five or six are in the Environmental Impact Statement (EIS) stage, which can take from six months to a year. Timing for building wind projects depends on the local decision-making process.
- Fifty percent more wind power is produced in winter than summer. Downstate New York has more of a summer peak, while upstate has a pronounced winter peak.

WILDLIFE CHARACTERIZATION AND ASSESSMENT OF ACTUAL OR POTENTIAL IMPACTS FROM WIND DEVELOPMENT

## Panel 2: What Site Characteristics Are Relevant?

Panel leader: Jessica Kerns, Western Ecosystems Technology, Inc.
Panelists: Bill Evans, Old Bird; Adam Kelly, DeTect, Inc.; Dr. Ron Larkin, Illinois Natural History Survey; Todd Mabee, ABR, Inc.; Dr. Al Manville, U.S. Fish & Wildlife Service; and Dr. Dale Strickland, Western EcoSystems Technology, Inc.

Jessica Kerns outlined the group's thinking on site characteristics relevant to wildlife resource characterization. The group organized the characteristics into the following categories:

- *Habitat*. Important elements include the topography of the site and the turbine locations; the distribution of the turbines within the site; elevation; primary and secondary uses of the land; and vegetation type. Also important is the presence of and site proximity to the habitat of federal and state listed species. A question to ask is: How do landscape features relate to the movement of these species (for example, roost trees, caves, and perches)?
- *Wildlife*. Key questions to ask include: Are federal and state listed species or species of interest, such as grouse, present at the site? Is the site close to areas of concentration of wildlife, such as migratory routes and stopovers, hibernacula, breeding areas, and conservation areas?
- *Anthropogenic*. Another element to consider is whether the site is located near human development, particularly those that attract wildlife (e.g., lighted structures, landfills). Also, will site development create changes in the landscape that will affect wildlife by creating edge, fragmenting habitat, attracting wildlife, barring their movement, or displacing them?
- *Spatial*. What is the spatial distribution of wildlife in a site? Radar can be used to help determine the use of airspace over a site, such as passage rate, height and direction, as well as breeding display height and the variation of use within a site. Other elements to look at are spatial use at or near the surface, which include feeding, breeding channeling, staging, and stopover use.
- *Temporal*: Daily and seasonal variations in wildlife movement and site use are aspects to consider.
- *Weather*: How do weather variables such as wind speed and direction, storm fronts, and seasonality influence wildlife presence and activity?

Ms. Kerns concluded the presentation with a few questions for the workshop participants to consider:

- Are all site characteristics created equal?
- Do we have all the tools we need to assess the "relevant" site characteristics?
- Are some site characteristics better determinants of risk than others?

The panelists then added the following points to the discussion:

- Radar has not yet been used to describe spatial distribution of wildlife within or across a site; most studies have characterized the pass rate and vertical distribution at a single point within a site. In order to have a more comprehensive understanding of spatial distribution, a radar site that gives complete coverage of the area, without shadows or significant ground cover, would be needed.
- Species of interest to look for include declining species. It is important to note that the absence of observed impacts does not mean that there are no impacts on a species.
- There are many behavioral effects on wildlife to look for, including increasing nest parasitism, changes in breeding density, loss in population vigor, disturbance, and avoidance behavior.
- In the weather category, another element to look for is the effect of changes in weather and the impact of global climate change on species behavior.
- There is no evidence of channeling behavior along the Great Lakes, although some local features may have an effect. There is not enough evidence to determine if weather channeling does occur.
- Very little is known about bat migration, and bats cannot be distinguished from birds on radar. The points made in the presentation may or may not pertain to bats.
- While site characterization itself is relatively easy, predicting future conditions after the windfarm is in place is more difficult. In order to verify predictions, follow-up studies that measure disturbance need to be conducted.
- A key question is: What site characteristics concentrate use by wildlife at high risk? Not all birds and bats are equally at risk. Also, the simple presence of a species at a site does not necessarily mean it will be impacted.

**Questions and Observations for Panel 2: What Site Characteristics Are Relevant?**

In the discussion that followed, workshop participants commented on the ability to make predictions based on site characteristics; the question of whether birds and bats engage in channeling behavior; the types of habitat that are relevant to wildlife / wind power interaction; the role of observational studies; the state of the knowledge of bat behavior; and potential site sensitivity ranking systems. A participant also asked if there are observed positive impacts on species due to site construction. A summary of the key points made on these topics follows.

- A panelist defined channeling as the unequal distribution of birds and / or bats in the atmosphere as a result of some force, such as the weather or topography. This phenomenon could occur along a coastline, valley, or ridgetop, or when bats leaving hibernacula appear in high density. Not all participants were comfortable with the use of the term, however. The speaker pointed out that the concept raises the question of how birds and bats react in the case of low cloud ceilings – do they interact with topography by skirting ridges, channeling through the gaps, or passing over the ridgetops?

- One participant noted that once the relevant site characteristics are identified, it is not always possible to predict what the impacts on wildlife will be. Although a site may be near areas that concentrate wildlife use, such as woodlots and wetlands, mortality does not necessarily correlate well to proximity. Some participants advocated for making predictions based on information gathered from previous developments or adjacent sites. Others asserted, however, that local site characteristics will be the key to determining impacts because it is very difficult to apply lessons learned from one site to a different one. Some emphasized the importance of post-construction studies to validate predictions made in pre-construction surveys.

- Relevant habitats in New York can be divided into four types: 1) coastline; 2) inland, including flat terrain and hilly or montaine areas; 3) artificial light for migrating birds; and 4) offshore. These geographic areas can overlap with the locations of priority species – for instance, flat agricultural land hosts songbirds and grassland nesting species. Some participants pointed out that from the animal's point of view, the air constitutes a habitat. It is important to keep that perspective in mind, as this concept requires researchers to rethink ideas about habitat. If birds are circumventing a low pressure system, for example, then conditions will be highly variable from year to year and longer studies will be needed to assess risk conditions. Another way to determine the importance of a site is through observing wildlife behavior at the site, particularly during certain periods, such as migration or breeding.

Other topics of discussion included the following:

- Very little is known about bat behavior and more research is needed. For example, questions include: How high do they fly? Do they prefer certain terrain? When do they migrate?
- A limitation of observational studies is that they can only address correlations. Quasi-experimental studies are more powerful and have the advantages of better design, controls, and an assessment of pre-and post-study effects. Such experiments could be conducted by turning on and off the wind turbines at key points. For example, at a site in Oaxaca, Mexico, the wind facility is operating under an agreement with the World Bank that calls for the turbines to be shut down for up to three weeks when birds are migrating through the pass where the facility is located.
- A few site sensitivity ranking systems already exist (i.e., the ones used by the U.S. Forest Service and the Canadian Wildlife Service). How useful are they as tools? Some workshop members expressed concern that ranking systems oversimplify the issues, while others felt a system designating sites as red / amber / green could be a valuable tool.
- Studies have not focused on possible beneficial impacts of wind development on wildlife thus far; therefore, if there are benefits to some species without detriment to others, they have not yet been identified.

**Panel 3: How Do We Characterize Bird and Bat Species Presence and Activity at a Site? What Methods Are Available?**

Panel leader: Dr. Tom Kunz, Center for Ecology and Conservation Biology, Boston University
Panelists: Dr. Eric Britzke, Copperhead Environmental Consulting; Bill Evans, Old Bird; Adam Gravel, Woodlot Alternatives; Adam Kelly, DeTect, Inc.; Jessica Kerns, Western Ecosystems Technology, Inc.; Dr. Ron Larkin, Illinois Natural History Survey; Todd Mabee, ABR, Inc.; Dr. Al Manville, U.S. Fish & Wildlife Service; and Dr. Dale Strickland, Western EcoSystems Technology, Inc.

Dr. Kunz reviewed the uses and limitations of various methods for assessing bird and bat presence and activity at a site. In order to obtain an accurate picture of wildlife at a site, both spatial and temporal scales need to be considered. Temporal scales to consider may be daily or nightly, seasonal, annual, or interannual. Researchers need to look at habitats, landscapes, and regional and continental scales to obtain a complete spatial understanding of wildlife activity.

Methods used to assess wildlife presence and activity levels on all these scales include mist nets, harp traps, thermal imaging, acoustic recording, radar imaging, radiotelemetry, stable isotope analysis, and DNA analysis. To assess temporal use of a site, both capture and censusing methods (e.g., mist netting), and activity and behavioral monitoring methods, such as acoustic monitoring, can be employed. To determine how birds and bats make use of the site on a spatial scale, researchers can observe wildlife behavior at a site, monitor site fatalities, or examine migratory patterns using techniques such as radiotelemetry. In monitoring the activity of animals, however, it is important to bear in mind that the influence of climatic variables (for example, variation in temperature or wind speed), can affect animal behavior and site use.

Dr. Kunz described each of the recommended methods and their limitations as follows:

- *Mist nets* can be set at ground level or erected in the tree canopy by stacking them on top of each other to maximize coverage. Mist nets have the advantage of allowing researchers to identify the species (and, in the case of bats, to confirm the identity of echolocation calls), but generally they can only cover the area below the canopy.
- *Harp trapping* is the most efficient method for capturing bats that emerge from caves and other roost sites; however, harp traps only cover a relatively small area.
- *Radiotelemetry* allows for hand-held ground tracking or tracking from aircraft, thus providing information on roost occupancy, foraging behavior, and migration.
- *Moon watching* and *portable ceilometers* give a limited view of aerial activity, but these methods only provide a small field of vision.
- While *reflectance infrared imaging* allows for recording images on video, it too offers only a limited field of vision, unless large infrared illumination is used.
- *Ultrasonic monitoring* can detect high-intensity calls relatively easily, but cannot always detect species that produce low-intensity calls. Some types of bat detectors cannot detect the full range of the echolocation call, although recent

software advances are allowing scientists to capture more complete versions of the calls. An important limitation of ultrasonic detectors is their limited detection range. Finally, it is important to ascertain that the detectors are properly calibrated before they are deployed in the field.

- *Acoustic monitoring* of bird calls permits the identification of avian species, although this method is limited to the detection of calling birds. This method has provided information needed to detect broad front bird migration and has offered evidence suggesting montane channeling occurs during migration. Acoustic monitoring does not, however, give precise quantitative information and cannot be used in some locations due to competing ambient noise. Therefore, it is best used in conjunction with other target-detection techniques, such as thermal imaging.
- *Thermal infrared imaging* is used to assess bat flight activity and behavior as well as to census colonies. This method can reliably track flying animals without the use of an external light source, but it is relatively expensive and offers low detectability under certain weather conditions.
- In making *fatality assessments*, it is important consider the effects of the search area and pattern, search frequency, and searcher efficiency in the study design. Corrections must be made for observer bias, scavenger removal, and potentially inaccurate species identification.
- *Doppler radar imaging* can help detect movement patterns at night as well as during a seasonal migration. Variables that can be measured from Doppler images include relative density, direction, velocity, and altitude of some migrating birds and dispersing bats.
- *Stable isotope analysis* allows researchers to determine where birds and bats originated and whether they are a migrating or resident species. It is more useful on a larger geographic scale and in some regions the results can be ambiguous.
- When specimens are collected, *DNA analysis* can be used to confirm the species identity. In order to undertake this analysis, however, the researcher must have access to sequencing facilities.

To conclude, Dr. Kunz offered the panel's recommendations to the group. Researchers should be careful to choose methods that are appropriate to the questions being asked. In order to ensure that results are reliable, studies should use multiple methods to the extent possible, as well as validate field methods by using other sources. Finally, it is important for researchers to be well acquainted with the instrumentation used and the methods employed.

The panel members then elaborated on the points made in the presentation. The panelists emphasized the importance of recognizing the limitations of the various methods, making the following comments:

- It is difficult to distinguish birds from bats on radar.
- It is not possible to sample an entire site with mist nets.
- Acoustic detectors have a limited range.
- With acoustics, one can verify the presence, but not absence, of a species.
- There is significant variation in the accuracy and sensitivity of bat detectors.

The panel members agreed, however, that many of these shortcomings can be reduced by using a combination of different methods at a site. One panelist pointed out that additional studies designed to assess fatalities at wind turbines are needed to determine whether pre-construction monitoring accurately predicts post-construction fatalities.

**Questions and Observations for Panel 3: How Do We Characterize Bird and Bat Species Presence and Activity at a Site? What Methods Are Available?**

The subsequent discussion focused on the types of questions that DEC should ask in a permitting process and how to frame those questions. Members of the state agencies asked the group to identify research needs across project sites. Some of the questions raised included:

- Are there geographical features we need to take into consideration? Is there channeling?
- How does fatality differ among sites?
- Are endangered species present?

Different types of questions are appropriate for distinct stages of the process – some should be used for presite selection, some once the permit has been approved, and others in the post-construction process. A participant pointed out that it is not necessary to reinvent the wheel when coming up with guidelines for developers – the state can look to the forthcoming National Wind Coordinating Committee's "Methods and Metrics for Studying the Impacts of Wind Power on Nocturnal Species (Birds and Bats)" document as well as the National Research Council's "Environmental Impacts of Wind Energy" for guidance.

Participants also discussed several options for combining different methods of monitoring birds and bats to enhance accuracy, including combining radar with banding; tagging birds and bats with passive integrated transponders (PIT) tags to code them; and using infrared LED's to monitor nocturnal flight trajectories.

**Panel 4: What Data Exists on How Bird and Bat Species May Utilize Possible Project Sites in New York, or in a Similar Habitat to that Found in New York, Where Wind Development Is a Possibility?**

Panel leaders: Todd Mabee, ABR, Inc.
Panelists: Bill Evans, Old Bird; Adam Gravel, Woodlot Alternatives; Adam Kelly, DeTect, Inc.; Jessica Kerns, Western Ecosystems Technology, Inc.; Dr. Tom Kunz, Center for Ecology and Conservation Biology, Boston University; Dr. Ron Larkin, Illinois Natural History Survey; Dr. Al Manville, U.S. Fish & Wildlife Service; and Dr. Dale Strickland, Western EcoSystems Technology, Inc.

Although there is no central repository for information on birds and bats in New York, Mr. Mabee gave an overview of the types of information available, looking at public information, primary literature (peer-reviewed), and secondary or "grey" literature. Of

the publicly available data on bird distribution, abundance, and migration, he listed the following resources:

- NY Breeding Bird Atlas
- USGS Breeding Bird Surveys
- New York Natural Heritage Program
- National Audubon Christmas bird counts
- Gap Analysis
- Bird observatories, including Braddock Bay Bird Observatory and Derby Hill Bird Observatory
- International, national, and state ornithological societies
- Regional and international shorebird monitoring
- Hawk Migration Association of North America
- Avian acoustics and nocturnal bird migration at Old Bird Inc.
- US Fish and Wildlife Service, including Waterfowl Surveys
- Cornell Laboratory of Ornithology
- American Wind Energy Association

In addition, Mr. Mabee presented a bibliography of general literature and peer-reviewed wind projects, as well as secondary literature from wind projects, communication towers, and power lines. After reviewing the available literature known to the panel members, the group had summarized the studies performed in Eastern states in tables categorized by study type. Radar studies were by far the most numerous and over half the studies cited were not publicly available. The two known pre-construction studies that used a combination of avian acoustic and radar methods in New York proved to have either a moderate or strong correlation between the techniques.

Mr. Mabee closed his remarks with a list of discussion topics that he opened to the workshop participants. The first set of questions asked if sufficient data exists to accomplish the following:

- Characterize bird and bat use in selected regions of New York?
- Minimize or eliminate pre-construction surveys?
- Extrapolate inferences from pre-construction sites to "nearby" developed sites?
- Identify the most valuable methods?
- Characterize bird and bat use of mountain ridges?
- Prioritize site selection for wind development?

He also offered several overarching questions:

- Can or should there be a single repository for all wind project data in New York? Regionally? Nationally?
- Are there ways to facilitate science-based decision-making (e.g., summarizing existing studies in New York)?
- What is the "shelf-life" of wind project data?

Panel members continued the discussion by clarifying a few key points and giving some initial thoughts in response to the questions above. A panelist noted that "peer-reviewed"

literature referred to studies that had been peer-reviewed and published in refereed scientific journals. On the subject of "grey" literature, he wondered why those studies were not made accessible to the public. Another panelist advised that policymakers should be cautious about making determinations based on studies conducted in a single season, noting that year-to-year variations can be significant. Other panelists commented on the following questions:

- *Is there enough data to minimize or eliminate pre-construction surveys?*
    - Minimizing pre-construction surveys would help to reduce the high costs of site approval. It would be useful to have a method to screen sites that would color-code particular areas or regions red, amber, or green according to the potential risk of wind development to wildlife. With such a tool, regulators could steer wind development toward low-risk sites. One challenge is how to define "risk."
    - Before pre-construction studies can be categorized as to their risk potential, however, post-construction studies must be conducted to evaluate the utility of pre-construction methods.
    - There is not yet enough data to eliminate pre-construction surveys – perhaps in part because all data has not been synthesized into a useable form. Even with this information, though, it seem unlikely that researchers understand bird and bat migration well enough to eliminate surveys, but such information could at least help focus surveys in regions of the state that have little or no information. A first step towards determining whether pre-construction surveys can be minimized could be to synthesize all the data from existing studies.
    - Whether or not pre-construction surveys can be minimized in a particular area depends on the question at the specific site. For example, sufficient data exists on spring raptor migration on Lake Ontario, but not on bat concentrations.

- *Is there enough data to characterize bird and bat use in selected regions of New York?*
    - A valid comparison would be to look at sites that are similar from the point of view of a flying animal, rather than by geographic region, something that could be done in a synthesis of studies to date.
    - This sub-question of the previous question may be answered once a summary is complete.

**Questions and Observations for Panel 4: What Data Exists on How Bird and Bat Species May Utilize Possible Project Sites in New York, or in a Similar Habitat to that Found in New York, Where Wind Development Is a Possibility?**

New York state representatives asked the workshop members for input on what data regulators should require of developers. In response, participants posed a question in return – how confident do policymakers want to be in the risk estimate? Scientists may

be able to give a prediction of risk based on a desired confidence level, but the acceptable level of mortality is a policy question. Aside from that determination, however, there are a few general questions to ask at each site: What is using the site? How? When?

The conversation revealed that many workshop members had little confidence that the questions posed by the panelists in the discussion above could be answered. A group member observed that so little is known about bats that none of the questions on sufficient data can be answered affirmatively; another pointed out that the only known populations among birds and bats are those of endangered species. Some workshop participants also offered additional observations:

- Lessons learned from impacts at other types of sites, such as from studies of ridgetop truck stops or mountaintop removal sites, could be useful in informing projections of potential impacts at wind sites.
- In synthesizing available data, endangered species that are present in areas of potential wind development is a good place to start.
- More comprehensive analyses are needed in New York -- researchers should collect data for multiple seasons and examine more than one area of a project site, not simply the area where the radar is located.

POST-CONSTRUCTION

**Panel 5: Post-Construction Monitoring**
[This section has not been reviewed by the panel leader]

Panel leader: Dr. Paul Kerlinger, Curry & Kerlinger
Panelists: Jessica Kerns, Western Ecosystems Technology, Inc.; Dr. Tom Kunz, Center for Ecology and Conservation Biology, Boston University; Todd Mabee, ABR, Inc.; and Dr. Al Manville, U.S. Fish & Wildlife Service

Paul Kerlinger explained that the panelists organized their presentation to first answer the questions given by NYSERDA and then to outline additional questions or issues raised by the panelists. The group responded to NYSERDA's questions as follows:

- *What are the monitoring objectives and key questions that the monitoring is addressing?*
  For both birds and bats, the primary objectives of monitoring are to determine: 1) the approximate number of collision fatalities of birds and bats on a per turbine and per megawatt basis (in order to estimate comparative rates among sites); 2) whether birds avoid, or are disturbed or displaced, by turbines while nesting, foraging, resting, or migrating; 3) cumulative impacts and whether impacts are likely to be biologically significant; 4) whether the pre-assessment was valid and reliable in predicting risk; and 5) potential benefits.

- *What constitutes an effective monitoring protocol that meets the objectives?*
  First of all, how would effectiveness be determined? If it is defined in statistical terms, what are they? Mutually-agreed upon methodologies should be used, with confidence intervals as a key component.

A peer-reviewed, adequate, and generally accepted method is searching for animal fatalities. Search protocols, however, still elicit significant disagreement. Elements to consider include the size and condition of potential search areas; search duration and the interval between searches; searcher efficiency; and scavenger removal.

- *Would an avian and bat reporting system be useful? Are third-party audits needed? What other factors should be considered in designing project-specific monitoring programs?*
  Although wind facilities report all avian fatalities annually to the USFWS and NY DEC, bat fatalities may not be included. A database of fatalities by site and region would indeed be helpful for agencies and researchers. While reporting by project personnel is important, it should not be the only system used in monitoring fatalities. A potential template for a reporting system could be the Avian Power Line Interaction Committee (APLIC), which is an online system for mortality monitoring and reporting.

- *What protocols have been used in past studies and what were their strengths and weaknesses? Have these protocols met their objectives?*
  Fatality searches have been used in numerous studies – many of them have included components to account for searcher efficiency and carcass removal. Some also have been peer-reviewed. Both the search intervals and the scavenging rate have varied among studies; to account for these variables, confidence intervals should determine the optimal search interval and studies should be keyed to the scavenging rates.

- *What factors determine when the monitoring can be discontinued?*
  Regulatory agencies should agree upon when to discontinue monitoring before the studies begin, ideally basing the decision on biological standards. A recommended potential standard is to permit the discontinuation of monitoring if the upper confidence interval or limit does not suggest a significant impact, particularly with regard to target species. Other factors to consider are financial or legal constraints, such as the Endangered Species Act (ESA), and whether FAA lighting attracts or disorients night-migrating birds and bats.

- *What tools are available for experimental examination of detection rates?*
  In order to determine detection rates, researchers can conduct carcass removal and searcher efficiency studies. It is important to account for elements that can influence the study results, such as habitat type, the carcass size and type, and the use of surrogate objects in place of carcasses. As the results are likely to differ by location and the time the study was undertaken, it is not clear how many such studies would be needed.

- *What percentage of birds and bats killed are found in mortality studies?*

The find rates vary by habitat and carcass size. Due to a lack of consistent study protocols, however, it is difficult to compare rates across studies. A quantitative survey of consistent studies would reveal the range and variation in find rates. In the Michigan State Police Tower Study of Searcher Efficiency and Carcass Removal conducted by Gehring, Kerlinger, and Manville, the researchers found that the searcher efficiency rates ranged between 24 and 40 percent. On the scavenger tests, the study revealed that carcasses remained on the ground for means ranging between 5.7 and 8 days.

- *What validation of studies is needed and how is it done (e.g., searcher efficiency and carcass removal trials during post-construction surveys)?*
  In order to determine accurate fatality rates, it is critical to validate techniques for detection and removal of carcasses. Radar studies, night vision, and thermal imaging methods can be used as validation tools, and concurrent use of these methods can serve to determine the relationship of their metrics to fatality rates.

The panelists also generated an additional list of questions and issues on post-construction monitoring:

- Is there a relation between pre-construction assessments and post-construction findings?
- Tools and technology used need to be validated.
- Standard metrics for quantifying impacts are needed (e.g., fatalities per turbine, per megawatt, per rotor-swept area and distance/area of displacement or disturbance).
- What is the role of turbines in attracting wildlife?
- For how long should studies be conducted?
- What are the impacts of the loss of refugia, reduction in breeding density, and the loss of genetic variation in the population?
- What is the status of and impact upon spruce and ruffed grouse in New York State?
- What is the seasonal and annual variation in bird and bat activity? Also, what constitutes a "one-year" study?
- What do studies of displacement reveal?
- What do we need to know to potentially mitigate impacts of wind turbines? It is important to understand where, when, how, and why birds and bats are being killed. At what level of impact is mitigation warranted?
- What are the effects of changes that can be implemented at a wind plant to minimize impacts on wildlife?
- What effect do ridge setbacks and end-of-row turbine replacements have?
- What is the impact of repowering?
- What do we need to know to assess cumulative impacts? What entities should be responsible for monitoring and regulating potential cumulative impacts?
- How do the impacts of wind power on wildlife compare to those of other forms of energy generation, such as coal or nuclear power?

- Should developers and owners of wind energy facilities be required to provide access to property for pre- and post-construction studies as a part of the permitting and approval process?
- How should monitoring studies and research be funded?

The panelists discussed how some of these questions could be answered or offered a more detailed exploration of some issues. Observing that it is currently difficult to compare different studies, some panelists emphasized the importance of establishing scientifically valid, uniform protocols. Once designed, these protocols could help researchers address the critical issue of risk assessment and the question of the impacts the wind turbines are having on wildlife. One panel member pointed to documents on recommended practices on how to reduce the electrocution of birds as a useful, peer-reviewed model for a protocol.

Another panelist highlighted the importance of determining population levels in order to produce accurate risk assessments, citing the lack of funding to invest in such research as an obstacle. Picking up on the funding issue mentioned in the presentation, he suggested using an independent funding mechanism in which wind developers would contribute to a pool of funds as part of the permitting process. A government agency would the reallocate the funds to researchers according to pre- and post-construction research needs.

Panelists also added some caveats on the topics of search intervals and study duration. In order to take changes in weather patterns into account, daily site searches are necessary. Due to changes in the carcass removal rate over time as a result of scavenger learning, conducting a one-year study may be insufficient to analyze this biasing factor in the research.

**Questions and Observations for Panel 5: Post-Construction Monitoring**
[This section has not been reviewed by panel leader]

One of the main points of the discussion centered on the development of a standard study protocol. Participants pointed out that there are already some useful tools to use as guides – National Wind Coordinating Committee's "Methods and Metrics for Studying the Impacts of Wind Power on Nocturnal Species (Birds and Bats)" due to be revised and updated this fall and the National Research Council's "Environmental Impacts of Wind Energy," to be released in December 2006. A participant asked workshop members from regulatory agencies to consider requesting reporting of five different metrics (including kill rate per megawatt, per turbine, and per KwH), which would allow for the pooling of data across sites and facilitate risk assessments.

Participants also made the following points:

- In a risk assessment, it is important to use confidence intervals and to take the high value in order to be conservative.
- Studies at communication towers have shown that avian fatalities often occur after rain events when carcasses are hard to detect; therefore, studies should take the potential impact of weather events into account.

## Panel 6: How Do We Ensure Rigor of Data in both Pre- and Post- Construction Studies?

Panel leader: Wally Erickson, Western EcoSystems Technology
Panelists: Dr. Tom Kunz, Center for Ecology and Conservation Biology, Boston University; Todd Mabee, ABR, Inc.; and Dr. Al Manville, U.S. Fish & Wildlife Service

Wally Erickson gave an overview of the panel's advice on developing a protocol for research, quality control and assurance, and peer review of pre- and post- construction studies. He reviewed the three major types of study designs – experiments, which involve a random assignment of treatments, usually performed in a lab setting; quasi-experiments, or a Before-After-Control Impact (BACI) design, which can be done before and after a wind project is built; and observational studies, which entail observing a process or system over space and time and describing what is observed.

He also reviewed the steps involved in the scientific method:

1. Observe the system
2. Formulate hypotheses
3. Design study to test hypotheses
4. Conduct the study and analyze data
5. Evaluate hypotheses
6. Replicate the study to validate inference
7. Return to step 2, or possibly step 1

With these basics of scientific research in mind, the group offered some guidelines for designing a protocol. A study should clearly:

- Define its objectives
- State the hypotheses (if testing)
- State the methods, which should be accepted by peers and designed for potential replication
- Define the statistical methods
- Demonstrate understanding of statistical power and uncertainty
- Interpret parameter estimates, variances, and biological relevance
- State assumptions and inferences

Methods to use in field research include: 1) defining the study area and population of interest; 2) choosing the experimental design; 3) designing sampling protocols that are replicable and using methods that are published and verifiable. An important consideration in the study design is the study duration; for example, a one-year study of songbird displacement may be too short a time to distinguish between temporary habitat impacts and displacement.

Mr. Erickson gave an overview of the use of statistics in research. Statistical power gives the probability of rejecting the null hypothesis when the alternative is true. Uncertainty analysis allows for estimating the anticipated precision of study results, such as fatality rates or target/km estimates. He reviewed some statistical methods used in wind development research for estimating fatality rates, conducting BACI analysis, hypothesis testing and parameter estimates. For a given number of observed avian fatalities, for example, the estimate should be adjusted for detection and scavenging biases as well as other possible biases. Confidence limits should be calculated for fatality estimates. Monte Carlo methods are often utilized, given the complicated nature of the fatality estimation formulas.

To assure the quality of the research, studies should include the following components:

- Verification of the qualifications of the field biologists
- Training
- Sample checks of the data entry
- Verification of targets (through radar, thermal imaging, mist netting, etc.)
- Testing and calibration of equipment

Finally, studies should be submitted for peer review and, when appropriate, submitted for publication. Protocol or baseline studies are typically reviewed by regulatory agencies, but they should also involve a statistical review. These are often observational studies, so they do not always lend themselves to publication. Monitoring studies should be reviewed by the agencies and research studies should be submitted for peer review; to the extent possible, these studies should strive for publication, which is the key to credibility.

In the follow-up to the presentation, the panelists again mentioned consistent protocols as a critical element for allowing comparison between studies. Raising the question of study availability, a panelist asked industry representatives why many studies are kept private. Another panel member theorized that it is an issue of confidentiality for developers. Given that the projects are not publicly funded and are often sited on private land, the government cannot require that the studies be released. To change the status quo, agencies could consider tendering permits on the condition that studies are made public.

**Questions and Observations for Panel 6: How Do We Ensure Rigor of Data in both Pre- and Post- Construction Studies?**

A representative of a developer responded to the question of study availability, saying his company did indeed release its study results. Another participant assured the panelists that developers provide the information when it is requested by government agencies.

Questioning the recommendation of establishing consistent protocols, a participant asked if more could be learned from applying consistent methods and metrics but different protocols to see if the studies yield similar results. Researchers would still need to take care that the studies did not contain similar biases. Another suggestion for testing protocols was to run the protocol used in pre-construction at the same site in post-construction to see if its predictions were accurate.

ANALYSIS OF DIRECT IMPACTS (RELATED TO HARM TO SPECIES AND RESOURCES) AND INDIRECT IMPACTS

## Panel 7: a) What Methods Are Available to Assess Approaches for Evaluating Potential Impact to Wildlife Species? What Is the Effectiveness of the Methods?[2]

Panel leader: Dr. Dale Strickland, Western EcoSystems Technology, Inc.
Panelists: Adam Gravel, Woodlot Alternatives and Dr. Ron Larkin, Illinois Natural History Survey

Dale Strickland gave an overview of approaches to estimating impacts of wind facilities on birds and bats. He first noted some of the constraints that social and financial considerations place on the conduct of scientific studies, often making it difficult to plan and coordinate a research agenda with an adequate planning horizon: examples include the reliance of wind energy projects on the short time horizon of the federal production tax credit and the two-year federal funding cycle; the influence of local permitting processes; and the confidentiality of site acquisition due to industry competition. In addition to these social constraints, there are also scientific constraints on the research. Most notably, wind sites are not randomly chosen from among those available; some data is extremely difficult to acquire; suitable methods are sometimes lacking; some of the species of concern are rare; and the data is intrinsically variable.

Several approaches have been used to estimate potential impacts from proposed wind facilities. An empirical approach to estimating impact is often used (e.g., animal use, population response, direct habitat loss, and displacement – leading to estimates of fatalities). This approach combines information from existing facilities and data on habitat and avian use from a proposed facility. Estimation of fatalities is based on species occurrence and use from the proposed wind plant combined with fatality data from existing wind plants where similar species and / or their habitats are present. This approach was used to examine potential bird and bat fatalities at the proposed Mount Storm wind facility in West Virginia, using the assumption that fatality estimates from the nearby Mountaineer wind facility were applicable to the study area. In the avian portion of this model (and in most models), estimates of bird use of the site, per turbine fatality estimates from Mountaineer, and the characteristics of the proposed wind plant were used to make an estimate of potential fatalities.

Fatalities have also been estimated using a physical model. For example, it is assumed that some number of birds that are expected to fly through a wind facility will strike a blade or turbine tower, based on the number and surface area of the blades and tower to which the birds are exposed. A major limitation of this physical model, however, is that it assumes a "dart board"-type characterization of the bird / turbine interaction that does not account for avoidance behavior. This is a significant shortcoming, given that existing

[2] Panel 7 addressed two different questions that were originally divided into separate presentations; they are represented as 7a and 7b here.

data indicates that fatalities are not directly related to abundance for all species. For example, corvids are some of the most common residents of wind farms in the western United States, yet they are seldom found in fatality studies. In addition, behavioral studies have shown that some birds respond to topography and wind characteristics, making them less likely to collide with turbines (e.g., raptors at the Foote Creek Rim site in Wyoming tend to fly along the edge of the wind site and away from turbines, thereby reducing the risk of collision).

Another approach for assessing risk is the one outlined by the U.S. Fish & Wildlife Service (FWS) voluntary guidelines. This method calls for the evaluation of multiple sites within a general geographic area under consideration for wind development. Potential development sites are evaluated to determine risk to birds by comparing the likely bird resource at the proposed site with the resource at a site where it is assumed a development would result in the maximum negative impact on birds. This latter site is designated a "reference site" and the comparison of the proposed site with the reference site results in a PII score. The sites are then ranked against each other using the highest-ranking reference site as a standard.

When evaluating wildlife impacts due to habitat disturbance, there are several types of impacts to consider. Impacts may be the physical loss of habitat or the loss of habitat due to displacement of a species. They also may be short-term, occurring only during construction (e.g., temporary construction lay-down areas and wide construction roads), or long-term, occurring throughout the life of the project (e.g., maintenance roads and turbine pads). Habitat impacts also are influenced by the turbine type, specific site characteristics, and the effectiveness of the reclamation plan. Most of the predictions of physical habitat loss have been made in the pre-construction phase with no post-construction follow-up for validation.

Studies of displacement are relatively rare. Known studies of displacement include grassland songbird displacement studies at Buffalo Ridge, Minnesota (Leddy 1999, Johnson et al. 2000); ongoing studies of bird displacement at Stateline in the Dakotas; studies of pronghorn in Wyoming; and studies of elk in Oklahoma. There also is limited data from the study of displacement resulting from similar development projects. For example, a study in Wyoming used telemetry data to record deer response to the construction of roads and gas wells. Telemetry data proved an effective approach to documenting the displacement effects on individual deer, allowing inference to population effects.

None of the methods for estimating potential fatalities have been empirically tested and all methods have limitations, including:

- With a few exceptions, fatality studies have not been subject to validation by comparing predicted to actual fatalities.
- Empirical studies of potential exposure of nocturnally active birds using radar have not been followed up with concurrent fatality studies and do not adequately distinguish between birds and bats. Radar studies also are hampered by large concentrations of insects.

- There is a lack of information in some areas that are under consideration for development (e.g., coastal areas and eastern mountain ridges) and for some areas where development has already occurred (e.g., the arid southwestern United States).
- Variation in migration timing and intensity makes extrapolation of potential impacts from one season to another difficult.

**7b) How Should Data Presentation Be Standardized for Potential and Actual Impact?**

When presenting data from a study, items to include in the summary are the following:

- Location – a description of the habitat and landscape features
- Capture rate – number of animals per capture effort
- Density – number of animals per unit area
- Observed passage rate – birds / distance / time
- Wind turbine fatalities – fatalities according to habitat and landscape features; fatalities / turbine; fatalities / megawatt; fatalities / megawatt hour produced

Corrections for searcher efficiency and scavenger removal should be incorporated into the research. When documenting searcher efficiency data, researchers should account for the influence of habitat and landscape features; search trajectory; search intervals; search rate; and search time. In corrections for carcass removal, studies need to cite the carcass placement, the type and condition of the carcasses, and the number of days the carcasses remained on the site.

**Questions and Observations for Panel 7: a) What Methods Are Available to Assess Approaches for Evaluating Potential Impact to Wildlife Species? What Is the Effectiveness of the Methods? 7b) How Should Data Presentation Be Standardized for Potential and Actual Impact?**

Workshop participants responded to the presentation on a variety of issues, ranging from suggestions on improvements to methodology to comparing the level of fatalities in the bird and bat populations. Some participants commented that bat fatalities at wind facilities are disproportionately higher than avian fatalities. Most likely fatalities for bats are even higher than current estimates because too few studies have been done in the April-November period that is the bat year.

According to some participants, measuring wind turbine output in megawatt hours is a more useful metric than megawatts per year. It facilitates comparisons to other sites as well as to other energy sources, such as coal. Another potential metric to use is rotor-swept area per rotation hour, which the wind industry might be more willing to divulge as it contains less business-sensitive information.

Workshop members discussed whether permit applicants should be required to perform post-construction studies. One participant asserted that the goal of such studies is to validate predictions, which falls into the realm of scientific research that is not necessary

for policymaking. Another responded that the information gleaned from post-construction studies serves to determine if pre-construction surveys are accurate. This is vital information that helps to evaluate whether pre-construction money was well spent.

Members also raised the following issues:

- What level of precision in the data is adequate for decision-making? Is a high level of precision really necessary for this end?
- If studies combined the use of fatality measurements and radar measurements, they could determine whether radar is making accurate predictions.
- It is important to incorporate habitat type, such as woodlots (which are crucial for migrating birds), into the methodologies used.
- When pooling data, researchers must be careful to pay attention to the detailed explanations behind the data so as not to miss the individual differences in the data sets.

Rather than "habitat loss," it is more appropriate to characterize disturbances as "habitat changes" because it is only a loss for specific species and may be a gain for others. In order to observe what happens when a disturbed site matures and if wildlife habituates to the disturbance, longer-term studies need to be done.

**Panel 8: What Methods Are Available to Predict or Measure the Relationship between the Presence of a Species and its Risk of Impact with a Wind Facility?**

Panel leader: Wally Erickson, Western EcoSystems Technology
Panelists: Dr. Jan Beyea, Consulting in the Public Interest and Dr. Al Manville, U.S. Fish & Wildlife Service

Wally Erickson presented the panel's view on the best methods for estimating impact on and risk to birds from wind facilities. The following questions frame the risk assessment model he described:

- What is the probability that a bird flying through the wind park will collide with a turbine?
- What is the probability that a bird will avoid the wind park?
- What is the expected number of fatalities for particular bird species or bird groups?
- What is the amount of potential habitat lost due to avoidance behavior?

Mr. Erickson set the stage for his comments by referring to several famous quotations regarding the art (i.e., not science) of modeling. One model for estimating the likelihood of bird / turbine collision incorporates several variables into the calculation:

- The percentage of birds flying at or below the maximum tip height (obtained from radar study)
- Percentage of birds encountering the swept area, if flying at swept area height (from area calculations and simulation)
- Percentage of birds colliding with blade if encountering the swept area (from Tucker or "dartboard" model)
- Percentage of turbines operating during migration (from wind turbine operators)

- Non-avoidance probability (an unknown)

According to the Tucker model, it is more likely that a bird will make it through a park of fewer, bigger wind turbines rather than a park of more numerous smaller ones, assuming all other factors are equal (e.g., total rotor swept area, similar use at rotor swept height of both turbines). In running the model with an example, the panel assumed that avoidance or attraction did not occur. It also was noted that mortality estimates implicitly have the avoidance factor built-in – which reinforces the need to collect such data.

Some of the factors that potentially influence the risk to birds include intensity of the use of the site, avian flight heights, and avian behavior such as foraging and courtship. The phenomena of attractance and avoidance could also potentially play a role, as could the frequency of inclement weather during migration. It is crucial, however, to validate this model with data collected from mortality studies. As in the previous presentation, Mr. Erickson enumerated the limitations of the methods employed – principally, the lack of empirical testing.

A panelist clarified that the purpose of risk assessments is to provide estimates for planning purposes because the actual risk is unknown. Policymakers need to recognize that assessments will contain a large degree of uncertainty. Since the assessments are used for screening purposes, a conservative value should be chosen. Sometimes risk assessments will be sufficient to satisfy the needs of policy decision-makers, but not in every case.

Another panelist noted some additional limitations to the risk assessment model. Species abundance may not be an appropriate measure for evaluating risk, given that some non-abundant species may be at risk. The absence of a particular species in a mortality study does not necessarily indicate that it is not at risk. Furthermore, it is difficult to incorporate the risks due to variable weather or to cumulative impacts into the risk assessment.

**Questions and Observations for Panel 8: What Methods Are Available to Predict or Measure the Relationship between the Presence of a Species and its Risk of Impact with a Wind Facility?**

Several members of the group felt that it would be difficult to apply the risk assessment model to bats because there is so much uncertainty with regard to bat populations. In addition, attraction to moving blades may come be more of a factor with bats than with birds. While risk assessments can incorporate high levels of uncertainty into the model, the resulting estimate may be so uncertain as to be effectively useless for policymaking. Risk assessments could be useful, however, for some populations of bats about which more is known, such as Indiana bats. Finally, although risk models have generally been used for estimating kills, it could be adapted to measure biological risk as well.

One option for policymakers is to take the precautionary approach in the face of uncertainty. A participant related that when decision-makers were confronted with a lack

of data on fish populations on one river project, they opted to establish a goal of 100% protection. This is one way to circumvent the problem of insufficient data on populations, which could otherwise become an intractable issue.

Another participant suggested that policymakers should consider the alternatives for land use if the wind facilities are not built. Others added that when looking at risk, one should look at the comparative risks of other sources of power generation. If the decision is made to opt for wind power, then mitigation strategies should be considered.

**Panel 9: What Mitigation Strategies Have Been Considered, Adopted, Evaluated? Have They Been Successful?**

Panelist: Ed Arnett, Bat Conservation International

Ed Arnett focused his presentation on the effects of mitigation strategies on bat populations. To frame the discussion, he reviewed the following key points from the USFWS voluntary guidelines on siting facilities and turbines:

- Avoid places where wildlife is highly concentrated.
- Avoid documented locations of any threatened and endangered (T & E) species.
- Avoid proximity to known bat hibernacula, breeding and maternity / nursery colonies, migration corridors, or flight paths between colonies and feeding areas.
- Avoid areas with a high incidence of fog, mist, low cloud ceilings, and low visibility.
- Avoid fragmenting large, contiguous tracts of wildlife habitat.

Options for mitigating the impacts of wind power development on wildlife include:

- ***Repositioning problem turbines***. Physically moving the wind turbines may help to alleviate wildlife fatalities (e.g., raptor fatalities at Foote Creek Rim, WY).

- ***Curtailing operations***. This option encompasses feathering the turbine blades (pitching them parallel to the wind), and curtailing operations on a seasonal basis, such as during migratory periods. Studies at wind facilities have shown a negative correlation between bat fatalities and wind speed, with higher bat fatalities occurring during lower wind periods. A study at Buffalo Mountain in Tennessee found that bat fatalities were more likely to occur on cooler nights with calmer, less variable winds. Other studies of curtailment in Canada and Europe have provisionally shown some reduction in fatalities. The effectiveness of curtailing operations warrants testing to evaluate reductions in fatalities relative to economic costs.

- ***Deterring wildlife***. This technique has a long history in wildlife management, but the methods do not always work and wildlife may become habituated to them.
    - *Painting turbine blades*. When the blades rotate at high speeds, they are difficult for animals to see. Painting the blades may reduce this "smear

effect" and increase animals' alertness, although this strategy has not been field tested.

- *Ultrasound Emissions*. The Bats and Wind Energy Cooperative (BWEC) is testing an ultrasound broadcast unit for deterring bats; currently field tests and experiments in the lab are underway. The tests have shown that the bats have responded by avoiding the device, but the extent of its range is uncertain. To be effective, it would have to be placed directly on wind turbines. Other limitations of the device are that it may not work in certain environments, and that a number of them may be necessary in order to produce the desired effect.

- ***Habitat management and modification***. This topic will be addressed in more detail in Rob Manes' presentation below.
  - *State of Washington*. Mr. Arnett highlighted the example of the state of Washington, which requires developers to acquire and manage replacement wildlife habitat. They also have the option of paying a fee of $55 / acre to the Washington Department of Fish and Wildlife. The funds are then used to purchase and manage high-value wildlife habitat in the same geographic region as the development project.
  - *Habitat enhancement / protection for bats*. While methods such as offsite cave gating may prove helpful for some species of bats (cave hibernators), they are not likely to aid the migratory, tree-roosting species that are at the greatest risk of being killed by turbines (i.e., Eastern red bats, silver-haired bats, hoary bats).

Mr. Arnett concluded his presentation by laying out the next steps to take in evaluating potential mitigation options. Extensive post-construction fatality studies need to be conducted, and curtailment options, as well as alerting and deterrence options, should be tested. Furthermore, the effectiveness of habitat management techniques has yet to be determined and should be evaluated.

**Questions and Observations for Panel 9: What Mitigation Strategies Have Been Considered, Adopted, Evaluated? Have They Been Successful?**

The participants engaged Mr. Arnett in a discussion about bat-specific characteristics to consider in mitigation strategies. Although some observations suggest that the turbines may act as an attractant to bats, that factor has not been accounted for in mitigation strategies. Furthermore, researchers do not yet have a good understanding of how bats respond when their echolocation call echoes off of wind turbines.

A participant wondered if an echolocation jamming device placed on turbines could cause the bats to avoid them, perceiving the absence of echolocation as dangerous. Mr. Arnett replied that experiments revealed that such devices had a limited range, inadequate for the length of turbine blades, and questioned whether it would affect all species. The ultrasonic device also is limited by distance – to be effective, it may be necessary to place an array of devices around turbines to create an effective, uncomfortable airspace bats

would avoid. As an alternative, one participant suggested adding ultrasonic whistles to the blades.

In response to the question of why low wind events witness greater bat mortality, Mr. Arnett related that evidence shows bats and their insect prey redistribute themselves in higher wind periods. Also, some data indicates there is lower bat activity during those periods. Although some participants expressed concern that the removal of trees and rocky outcrops for the installation of wind turbines could cause the displacement of bats, Mr. Arnett assured the group that bats generally respond favorably to small-scale forest changes and that habitat alteration at the scale of a wind facility presents less of a hazard than direct mortality.

On the avian side of mitigation strategies, infrasound experiments have been shown to work with homing pigeons, although they still need to be field-tested to evaluate the response of wild birds. Furthermore, the windfarm in Oaxaca, Mexico will be conducting an experiment on feathering during the raptor migration season. The state of New York could coordinate research activities on mitigation with that facility. One participant recommended assessing the economic impacts and potential costs of mitigation options such as feathering and curtailing operations in order to collect complete information on the tradeoffs involved.

## Panel 10: What Is Adaptive Resource Management? Has It Been Applied at Wind Development Sites? What Can We Learn from Sites in the Cases Where It Has Been Applied?

Panelist: Dr. Jan Beyea, Consulting in the Public Interest

Jan Beyea defined the term adaptive management (AM) as a management style consisting of, at a minimum, the characteristics of 1) learning from management decisions and 2) adjusting management based on learnings. It should fit into a larger framework of a structured decision process involving stakeholders. As opposed to other management styles that involve deferring action, risk aversion, dogmatically adhering to fixed positions, or learning by trial-and-error, AM "implies thoughtful experimentation, research, testing through implementation, monitoring, and redesign." Undertaking an AM strategy allows an organization to eliminate or prevent the formulation of bad hypotheses. When stakeholders are proposing different theories, AM can provide a method for resolving disputes. Use of AM can also have the advantage of attracting funding for meaningful research.

Dr. Beyea enumerated the implied components called for in an AM plan:

- Clear objective(s) (for some proponents, should require sign-off or be quantifiable)
- Objectives that adapt with new understanding
- Management committee (optional)
- Systematic learning
- Management action in response to learning
- Management as an experiment

- Closing the loop
- Iteration
- Convergence

In order to develop proper objectives, the following questions should be addressed:

- What is being managed?
- Who is doing the management? (In the New York wind power context, this could be NYSERDA, NYDEC, or USFWS.)
- Is the monitoring focused on the objectives?
- What are the politics?

If the objectives are vague, they can pose a formidable obstacle to plan implementation. In a wind context, for example, a potential objective could be to maintain or increase the populations of T & E species. In fact, there are currently two proposals to use AM at wind sites – one at Cape Wind by Mass Audubon, and another at Altamont. At Cape Wind, the objectives are to 1) correct any unanticipated and ecologically significant collision mortality; and 2) correct any ecologically significant loss of habitat due to avoidance of the wind farm.

In the literature, there are two main versions of AM – the Bayesian (model weighting or evaluation) and non-Bayesian (hypothesis formulation and testing or hypothetico-deductive) approaches. Bayesian AM involves both prediction and an assignment of uncertainty to the prediction. While the non-Bayesian school is concerned with the validity of different theories, the Bayesian school works with probabilities. The advantages of the Bayesian approach are that it allows multiple theories to be proposed and management to adjust based on the probabilities assigned to those theories. When in a situation of conflict, AM allows regulatory agencies to stand above the fray after picking the initial "best" management option. As an example, Dr. Beyea described the successful program of Bayesian AM adopted by the USFWS in 1995 in order to regulate the harvest of mid-continental mallards.

On the other hand, the Bayesian AM approach is not as familiar to researchers as the non-Bayesian type, and few computer programs are adapted to the Bayesian model. When there are multiple outcomes or objectives, one stumbling block could occur if different models perform better on different aspects of the field data, paralyzing the decision-making process.

The AM literature offers the following set of advice on how to best construct an AM program:

- Define the terms of the AM you are using;
- Start simple;
- Encourage informal networks;
- Encourage greater stakeholder involvement;
- Make the objectives explicit;
- Develop a key list of management questions for the site;
- Look at successes and failures at the site or other sites;

- Try to get agreement among stakeholders on goals (if they do not agree initially, look for mutually-agreed upon objectives);
- Work with multiple, competing, predictive models;
- Lay out a wide range of management options;
- Lay out management responsibilities at the start;
- Consider the politics of management from the beginning;
- Develop and work with conceptual models;
- Conduct monitoring relevant to the objectives (a key aspect);
- Include multiple treatments and replication; and
- Involve review committees with a wide range of experts.

According to Dr. Beyea, an appropriate AM program for wind would be a Bayesian approach with competing models within a structured decision framework that involves multiple stakeholders and an iterative approach. He suggests turning to an AM approach when it is chosen by stakeholders and a political or legal incentive is available to help close the loop. In New York, DEC might use AM to play a role in the development of conceptual impact models on key state species. NYSERDA could use it in supporting monitoring that has value beyond individual sites.

As a hypothetical example, Dr. Beyea elaborated a vision of how to implement an AM strategy in New York. As a hypothetical initial objective, he proposed to limit the impact of wind power on birds and bats to "acceptable" levels. He then delineated the possible subsequent steps in the process:

1) Bring together stakeholders to identify species of greatest concern and other objectives, to identify conflicting views of species impact, to gain understanding of developer constraints, and to gather views on "acceptable" levels.
2) Adopt an "acceptable level" definition and quantify the objective.
3) Assign an initial target kill rate for T & E species, which agencies would use for the initial siting of facilities.
4) Decide on financial liability of the developer and identify possible state contribution.
5) Establish monitoring requirements and convene a broad expert review committee.
6) Put out call for alternate conceptual models.
7) Convene a management committee.
8) Compare field data to conceptual models and determine if some models are better than others.
9) Close the loop – if any kill rates exceed target levels, call for response proposals.
10) Collect next year's data and iterate.

**Questions and Observations for Panel 10: What Is Adaptive Resource Management? Has It Been Applied at Wind Development Sites? What Can We Learn from Sites in the Cases Where It Has Been Applied?**

Asked how agencies in New York could acquire the legal authority needed to implement AM, Dr. Beyea suggested that using AM could be required of utilities in order to meet the state's Renewable Portfolio Standard (RPS). This comment elicited debate among

the participants as to whether changing the requirements for renewable sources of energy would be equitable with regard to other energy sources.

Dr. Beyea also clarified that although AM does not help with immediate decisions, its advantage is that it allows an agency to start with what it knows and improve its knowledge with each decision, aiding the longer-term decision-making process. It can also serve to circumvent political difficulties. A representative of Horizon, Antoinette Alberti, added that the company has an AM proposal for dealing with habitat loss for prairie chickens that she could circulate to the group as a model.

## Panel 11: What Should Be Considered for Post-Construction Habitat Management; Are There Lessons, Rules of Thumb to Consider?

Panelist: Rob Manes, The Nature Conservancy of Kansas

Rob Manes provided an overview of wildlife problems posed by industrial-scale wind energy infrastructure. Because wind turbines are very large, with heights exceeding 400 feet, their potential ecological impacts are significant. Key concerns involve grassland bird habitat abandonment associated with turbine sites. In addition to the towers themselves, the infrastructure needed to construct and maintain wind turbine facilities also entails habitat degradation. Problems associated with the installation of wind farms include introduction of invasive plants from extensive service road networks; interference with surface hydrology due to elevated roads; and disturbance of the soil at the base of the towers, which can result in groundwater contamination and invasive plant establishment. Industrial-scale wind energy facilities can have wildlife implications at the metapopulation level, through the disruption of wildlife movement and genetic interchange.

Studies investigating the magnitude of the "footprint," or habitat disturbance, caused by roads found that invasive plants induce habitat fragmentation in a swath of up to four kilometers on either side of the road. According to another study, ground-nesting birds avoided gravel roads at a distance of up to 2,500 feet on either side. Similarly, ground-nesting birds have been found to avoid even high-quality habitat for long distances, where wind turbines and other tall structures are present.

Conversely, wind energy could hold potential benefits for wildlife. By displacing other energy production technologies, it may help to reduce effects of global climate change. Furthermore, the presence of wind turbine arrays could create or maintain edge habitat and early seral[3] conditions, which benefit some species.

Strategies for mitigating impacts to wildlife can be implemented either on-site or off-site and can be of temporary or permanent duration. One potential goal of these strategies is off-site habitat improvement or protection. Factors to consider in a mitigation program include its cost as well as its effectiveness.

[3] In response to a question, Mr. Manes clarified that "seral" refers to the age of vegetative community.

Target species must be clearly identified in any mitigation plan. An important consideration may be identifying species that tolerate wind facilities. This may determine whether the mitigation must occur off-site or on-site. In selecting the target species and habitat management goals, the managers should address three questions:

1) Does the wind facility present risks or opportunities for the target species?
2) What are the risks for the target?
3) What are the opportunities for the target?

If the risk to the target species is collision with the turbines, the habitat manager could consider options for repelling the species from the turbines, installing off-site attractants, or reducing on-site attractants. If the danger to the species is displacement from quality habitat, creating off-site replacement habitat may be desirable. The potential for species to habituate to suitable habitat in close proximity to turbines, however, is not yet fully understood.

To illustrate the concepts of mitigation, Mr. Manes engaged the group in a discussion of ways to mitigate wind farm impacts for two sample species. The first species, the Indiana bat, is listed under the federal Endangered Species Act. A wind facility built near the bats' foraging habitat would present a collision risk. In addition to re-siting the turbines (which may not be an option), the group noted the alternative of improving habitat conditions off the site to draw bats away from the facility.

The second example species, the Henslow's sparrow, is a rare grassland bird that requires taller, residual native grasses. For this sparrow, a wind facility could present both risk and opportunities. Designing a program to mitigate this species' habitat could include managing grazing and burning cycles to foster an appropriate environment for the sparrow. Large patches of unburned and ungrazed grassland could be created around the towers in order to attract more members of the species. Like other ground-nesting birds, Henslow's sparrows may avoid even high-quality habitat near turbines, which would require off-site habitat improvement and /or protection.

DECISION-MAKING

Abby Arnold of RESOLVE, meeting facilitator, drew the group's attention to the task of answering the questions posed by the hosts of the meeting, NY DEC and NYSERDA. The agencies wished the group of experts to help them form guidelines for wind development by addressing the question of how to design pre-construction surveys for specific sites in different types of landscapes. To organize the discussion, Ms. Arnold asked workshop members to divide into three task groups focused on geographic areas relevant to wildlife and wind power development in New York state: coastal; grasslands; and forest / montane / hilly areas. She instructed the task groups to consider three questions: 1) What's there? 2) How does it use the site? 3) When does it use the site?

Upon returning from the task group sessions, rapporteurs relayed to the larger workshops the task groups' responses for their respective areas. Some elements were common to all of the groups and there were some general observations applicable across geographical

areas. As a first step in pre-construction surveys, the groups concurred in their advice to research existing data and what is known about the area by conducting literature surveys, identifying local T & E species, and talking to local experts and regulators. They all recommended validating the data collected by using multiple methods, such as combining radar with other techniques to "ground truth" the data. The groups also suggested coordinating studies with other research at nearby sites.

Transcending the task group's particular geographic region, one group advised installing detection devices at multiple locations throughout the site to understand the variability of wildlife presence. Other general advice included: forming predictions of habitat disruption and avoidance in addition to fatalities; gathering sufficient data in the pre-construction stage to be able to make comparisons with displacement and mortality assessments during post-construction; and reporting the data gaps that emerge from the coarse and fine screen EIS studies. Finally, data should be collected and pooled in a uniform way so it can be used across multiple locations.

## Coastal Task Group

Rapporteurs: Brianna Gary, NY DEC and Tim Sullivan, USFWS

The group characterized the site as comprising coastal, flat, and agricultural lands, as well as wooded swamps. They focused on a site two miles inland from the coast and did not consider offshore development in their discussion. The taxa of concern in this area include: raptors, bats, shorebirds, waterfowl, and migrating songbirds. The group then proceeded to describe the components of a pre-construction survey for each species of concern.

*Raptors*
After reviewing the existing data (breeding bird surveys, hawkwatch data, local experts), the study should involve spring and fall visual surveys, which can be correlated to hawkwatch data. Breeding grounds for hawks and, if needed, winter migration areas for the bald eagle should be identified.

*Bats*
First, researchers should determine if bats are using the area by considering whether there are roosting trees in proximity to the project site or a hibernaculum within 15 miles. The group noted that Indiana bats may be present at these sites. If bats are present, roosting and foraging sites need to be identified. Monitoring activities to conduct include acoustical monitoring, telemetry monitoring, habitat surveys, and mist netting. Multi-season observational studies should be conducted August through November as well as April to June, if conditions warrant.

*Shorebirds*
The piping plover may be a species to consider at this site. The gradient of birds' site use will be a function of the distance from the coastline. For these species, radar and seasonal observational studies should be conducted.

*Songbirds*
Spring and fall radar studies should be complemented with other monitoring techniques such as night vision goggles, thermal monitoring, and acoustical monitoring. To get statistical validity, a study duration of more than one or two years may be necessary. There should be long-term surveys of weather patterns to correlate observations to weather events. A factor to consider is whether the site is within 30 kilometers of a Nexrad site.

## Grasslands Task Group

Rapporteur: Christina Dowd, NY DEC, Bureau of Habitat

The harrier may be a species of concern in this area, and, if there wetlands on the site, herp species could be as well. Bats also may be present. To begin to characterize the site for a phase one avian risk assessment, researchers should review the existing data and conduct a site walk-through. An on-site met tower should be equipped with an anabat detector, which will be operated April through October, and visibility sensor.

Multiple methods should be employed in collecting site data. Radar surveys, searches under the met towers, roadside bird counts, and small mammal surveys (to understand the prey base) should be conducted. For the harrier, researchers should conduct diurnal raptor surveys and observe aerial displays. For bats, acoustical monitoring, mist netting, radiotelemetry, and thermal imaging should be used. Some group members recommended that studies aim to produce estimates of species density at the site.

## Forest / Montane / Hilly Task Group

Rapporteurs: Todd Mabee, ABR, Inc. and Dr. Tom Kunz, Center for Ecology and Conservation Biology, Boston University

As a first step, the group advised that researchers identify species of concern that are present at the site for a fine-screen analysis. In a phase I assessment, wildlife to study include diurnal birds, nocturnal birds, and bats. For diurnal birds, point counts should be conducted (with greater intensity for species of interest such as raptors) and nest surveys undertaken for raptors. In surveying nocturnal birds, it is important to consider what might happen during migration.

In the case of bats, studies should identify their roosting and foraging areas. Multiple methods may be appropriate to monitor the population, although it is important to suit the methods used to the question under consideration. For example, radar would not be appropriate to detect the presence of bats in the rotor-swept area; rather, bat detectors are needed.

With regard to study duration and timing, the group recommended conducting studies from mid-April to November and covering the spring and fall migratory periods.

Analyses of the site should consider residents and migratory animals separately. Although the group questioned whether a study duration of one year is sufficient to account for variability, they advised that the timeframe should reflect the purpose of the data and could range from one to three years.

**Group discussion**

Workshop members identified several key points arising from the small group presentations. One conclusion was that guidelines developed by the regulatory agencies could be useful if they established uniformity, predictability, and validity for wind development studies. EIS surveys should give the agencies enough valid information to make a siting decision, and that information should be used to avoid or mitigate wildlife impacts to the maximum extent possible.

Centralizing and pooling data across the state was recognized as a key issue. Radar studies are important for establishing a baseline, and a member noted that a centralized game plan for radar studies would be a better use of funds. A mechanism needs to be developed to create funding for gathering data across the state and coordinating a long-term research needs; one way to do this is to tie research funding to the RPS.

## CONCLUSION

To draw the workshop to a close, Ms. Arnold reviewed the list of research questions generated by the group members (attached). As a next step, the workshop planning committee will determine how best to make use of the list. They may email the larger group to ask them to rank their top three research questions for the state of New York. Once the questions are prioritized, NYSERDA will come up with a conceptual research agenda; the details of how to accomplish the research, however, will be left to the research community.

In closing, representatives of the host organizations thanked the participants for their contributions. NYSERDA will take the suggested research items emanating from the workshop to develop a research agenda in conjunction with industry and stakeholders. Having benefited from the information and recommendations conveyed in the workshop, NY DEC hopes to use its learnings to develop draft guidelines for siting wind power facilities in New York state.

## Appendix A. New York Technical Workshop on Wind/Wildlife Issues
## August 2-3, 2006
## *Albany, NY*

## Proposed Agenda

*Workshop Purpose*:

To explore what is known about the impacts to wildlife from wind power, how this knowledge can be applied to New York, and what needs to be researched in New York State (and the region) regarding:

- How to characterize the bird and bat resource in areas where wind development might occur
- How to accurately predict adverse impact to birds and bats at proposed wind sites
- How to monitor impact to birds and bats at existing wind sites
- On- and off-site mitigation strategies where needed or appropriate, and
- Information gaps and research that would be useful to fill these gaps in the Northeast region of the United States.

### Day 1 August 2, 2006

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| 8:00 – 8:30 | **Registration & Breakfast** | |
| 8:30 – 9:15 | **Welcome**<br>• Welcome and Introductions<br>• Review purpose of meeting and agenda | Abby Arnold, RESOLVE |
| 9:15-9:45 | **Overview of Wind Power in New York State**<br>• Where is wind power developed or being developed in New York State?<br>• Engineering and siting considerations for wind power developments in New York State: what characteristics do developers look for?<br>• Where are the developable wind resource areas in New York State and what is the potential for further wind development? | Joe Visalli, NYSERDA, Jack Nasca, NY DEC & Bill Moore, PPM Atlantic Renewable Energy |
| 9:45 – 10:45 | **A. Wildlife Characterization and** | |

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| | **<u>Assessment of Actual or Potential Impacts From Wind Development</u>**<br><br>**What are accepted protocols and methods for wildlife resource characterization at a particular site?**<br><br>A. <u>Siting</u><br><br>1. *What Site Characteristics Are Relevant?*<br><br>- Topography<br>- Weather<br>- Elevation of a site (ridgetop, flat land)<br>- Proximity to certain features (mountain ranges, coastlines, population centers)<br>- Other | <u>Panel: Jessica Kerns,</u> Wally Erickson, Bill Evans, Adam Kelly, Ron Larkin, Todd Mabee, Al Manville and Dale Strickland |
| 10:45 – 11:00 | **Break** | |
| 11:00 – 11:30 | *Group discussion* | |
| 11:30 – 12:30 | *2. How Do We Characterize Bird And Bat Species Presence And Activity At A Site? And What Methods Are Available?*<br><br>- Presence of various species<br>- Species use of a site (passage rates, flight elevation, density, predator-prey relationships)<br>- Local or migratory species (seasonal variations)<br>- Other | <u>Panel: Tom Kunz (bats), Todd Mabee (birds),</u> Eric Britzke, Wally Erickson, Bill Evans, Adam Kelly, Jessica Kerns, Ron Larkin, Al Manville, Adam Gravel and Dale Strickland |
| 12:30 – 1:15 | **Lunch** | |
| 1:15 – 1:50 | *Group discussion* | |
| 1:50 – 2:50 | 3. *What Data Exists Concerning How Bird And Bat Species May Utilize Possible Project Sites In New York, or In A Similar Habitat to That Found In New York, Where Wind Development Is A Possibility?* | <u>Panel: Tom Kunz and Todd Mabee,</u> Bill Evans, Adam Gravel, Adam Kelly, Jessica Kerns, Ron Larkin, Al Manville and Dale Strickland |
| 2:50 – 3:20 | *Group discussion* | |
| 3:20 – 3:35 | **Break** | |
| 3:35 – 4:15 | B. <u>Post-Construction</u> | <u>Panel: Paul Kerlinger,</u> Jessica Kerns, Tom Kunz, |

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| | *1. Monitoring*<br><br>- What are the monitoring objectives?<br>- What is an effective monitoring protocol to meet the objectives? Would an avian impact reporting system be useful, are third -party audits needed, and what other factors should be considered in designing project-specific monitoring programs?<br>- What protocols have been used in past studies and what were their strengths and weaknesses? Have these protocols met their objectives?<br>- What are the key questions that the monitoring is addressing and what factors determine when the monitoring can be discontinued?<br>- What tools are available for experimental examination of detection rates?<br>- What percentage of birds and bats killed are found in mortality studies?<br>- What validation of studies is needed and how is it done (e.g. searcher efficiency trials, carcass removal trials during post construction surveys)? | Todd Mabee and Al Manville |
| 4:15 – 4:40 | *Group discussion* | |
| 4:40 – 5:10 | *C. How Do We Ensure The Rigor Of Data In Both Pre And Post-Construction?*<br><br>- Statistical analysis?<br>- Accuracy, precision, etc.?<br>- Are there models that offer explicit confidence intervals?<br>- What QA/QC is needed?<br>- What form of peer review is needed prior to public release of the reports? | Panel: Wally Erickson, Tom Kunz, Todd Mabee and Al Manville |
| 5:10 – 5:45 | *Group discussion* | |
| 5:45 | **Adjourn Day 1** | |
| 6:30 | **Dinner hosted by NYSERDA** | |

## Day 2 August 3, 2006

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| 8:00 – 8:15 | **Welcome and Review From Day 1** | Abby Arnold, RESOLVE |
| 8:15 – | **Analysis of direct impacts related to harm to** | Panel: Dale Strickland and |

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| 8:40 | **species and resources and indirect impacts**<br><br>A. *What Methods Are Available To Assess Approaches For Evaluating Potential Impact To Wildlife Species? What Is The Effectiveness Of The Methods?*<br><br>- Which uses were found to be predictors of risk: summer breeding, winter use, migration flyover, and/or migration stopover, and foraging (raptors)?<br>- What can we learn from the existing studies about how the listed characteristics of a site relate to risk for birds and bats? | Ron Larkin |
| 8:40 – 9:10 | *Group discussion* | |
| 9:10 – 9:40 | B. *How Should Data Presentation Be Standardized For Potential And Actual Impact?* (Review From Day 1)<br>- Comparable statistical analysis<br>- Graphs/charts/tables<br>- Standard measures<br>- What metrics are most relevant (swept area, MW, MW-hr)? | TBD |
| 9:40 – 10:10 | *Group discussion* | |
| 10:10 – 10:25 | **Break** | |
| 10:25 – 11:00 | C. *What Methods Are Available To Predict Or Measure The Relationship Between The Presence Of A Species And Its Risk Of Impact With A Wind Facility?*<br><br>- What is the relationship between the activity of birds and bats, the height of the turbine, and the potential for blade strike?<br>- What are methods to quantify actual mortality or injury to birds and bats?<br>- Are methods available to compare bird abundance and factors influencing bird behavior? | Panel: Wally Erickson, Jan Beyea and Al Manville |

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| 11:00 – 11:40 | *Group discussion* | |
| 11:40 – 12:40 | **Lunch** | |
| 12:40 – 1:00 | D. *What Mitigation Strategies Have Been Considered, Adopted, Evaluated? Have They Been Successful?*<br><br>- Operational strategies<br>- Potential use of off-site mitigation and/or avian enhancement options<br>- Traditional and alternative mitigation (fees to support high-value habitat) | Panel: Ed Arnett |
| 1:00 – 1:30 | *Group discussion* | |
| 1:30 – 2:10 | E. *What Is Adaptive Resource Management? Has It Been Applied At Wind Development Sites? What Can We Learn from Sites In The Cases Where It Has Been Applied?* | Panel: Jan Beyea |
| 2:00 – 2:40 | *Group discussion* | |
| 2:40 – 3:10 | F. *What Should Be Considered For Post Construction Habitat Management; Are There Lessons, Rules Of Thumb To Consider?* | Panel: Rob Manes |
| 3:10 – 3:40 | *Group discussion* | |
| 3:40 – 3:50 | **Break** | |
| 3:50 – 4:15 | **II. Decision making**<br><br>*A. What Are Possible Relevant Parameters For Determining Acceptable Risk? How Should Project Risks And Benefits Be Weighed?* | Abby Arnold, RESOLVE |
| 4:15 – 4:45 | B. *What Decision Making Options Are Available For Use At Specific Sites Proposed For Development?*<br><br>- How would site-specific data be incorporated?<br>- Is there a particular metric that should be relied upon? | Abby Arnold, RESOLVE |

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| | - Can the data be synthesized into an integrated topic?<br>- What are the strengths and weaknesses of each framework? | |
| 4:45 – 5:15 | **III. Summary of discussion and desired outcomes from this meeting**<br><br>*What Research Is Needed To Increase Our Knowledge of Statewide Bird And Bat Resources With A Focus On Improving The Ability To Predict The Nature Of Site-specific Bird And Bat Interactions?(review list that came out of workshop- discuss next steps)* | Abby Arnold, RESOLVE |

# Appendix B. New York Technical Workshop on Wind/Wildlife Issues
# August 2-3. 2006
# *Albany, NY*

## Speaker Biographies

### Ed Arnett
### Conservation Scientist, Bat Conservation International

Education: Associates in Natural Resources Mgt., Colorado Mountain College; Bachelor of Science in Fish and Wildlife Management, Montana State University; Master of Science in Zoology and Physiology, University of Wyoming; Currently a Ph.D. Candidate in Forest Ecology, Oregon State University.

Ed has worked as a wildlife biologist for the US Forest Service and the US Fish and Wildlife Service in eastern Oregon, and was a wildlife research biologist for Weyerhaeuser Timber Company in Oregon prior to beginning his Ph.D. program at Oregon State University. He then accepted his current position as Conservation Scientist and Coordinator for the Bats and Wind Energy Cooperative with Bat Conservation International. He has studied bats for the past 11 years, focusing primarily on habitat ecology and resource selection of forest bats, which is the topic of his dissertation research. Ed led the field research efforts to investigate bat fatality at the Meyersdale, PA and Mountaineer, WV Wind Energy Centers. He continues to lead research efforts on pre- and post-construction bat monitoring and the efficacy of using deterrents to reduce bat fatality at wind facilities. Ed is a Certified Wildlife Biologist through The Wildlife Society (TWS) and currently is chairing a committee for TWS reviewing the impacts of wind energy development on wildlife.

### Jan Beyea
### Senior Scientist, Consulting in the Public Interest

Dr. Jan Beyea is a regular member of panels and boards of the National Research Council of the National Academy of Sciences. He received his Ph.D from Columbia University, taught environmental studies at Holy Cross College, did research at Princeton University, and spent 15 years at the National Audubon Society as Senior Scientist, eventually becoming Vice President. Currently, he is senior scientist at Consulting in the Public Interest.

Dr. Beyea is the author of over 100 articles and reports in a wide variety of fields, all of which deal, in one way or another, with the impacts of human development on human health and wildlife sustainability. His involvement in the avian/wind issue dates back to the formation of the Avian Wind Subcommittee of AWEA and the development of consensus guidelines for monitoring avian mortality. In his view, utilization of these guidelines has transformed the avian debate from the desirability of wind in general to issues associated with (a limited number of) specific sites.

## Eric Britzke
## Independent Contractor, Copperhead Environmental Consulting

Eric Britzke has studied the ecology of bats since 1995. He received his Ph.D. from Tennessee Technological University in May 2003. His dissertation was entitled, "*Use Of Ultrasonic Detectors For Acoustic Identification And Study Of Bat Ecology In The Eastern United States*." As part of the study on acoustic identification, he has traveled throughout the eastern United States to record known call from a variety of different species to assess variation in echolocation calls. In addition to work with ultrasonic detectors, he has been involved with capturing bats and using radio telemetry in New York, Vermont, Kentucky, North Carolina, Tennessee, and Arkansas. Recently, he has investigated the use of stable isotopes to determine the migratory pathways of bats in the eastern United States.

## Bill Evans
## Executive Director, Old Bird

Bill Evans has spent 20 years studying the nocturnal flight calls of migrating birds in North America. He initiated the Cornell Laboratory of Ornithology's avian night flight call research in 1994 and in 1998 founded the nonprofit called Old Bird. The current focus of this organization is in using acoustics for long-term monitoring of various songbird species and for mitigating bird mortality at tall man-made structures. The latter work includes avian acoustic monitoring studies at seven wind turbine projects (2 post-construction; 5 pre-construction) in the eastern United States. Bill's avian acoustic research has been described in *The New York Times*, *New Scientist*, *NPR*, *BBC*, *PBS*, *Science* and many popular conservation and birding magazines.

## Paul Kerlinger
## Principal, Curry & Kerlinger

Paul Kerlinger received a Ph.D. and M.S. in biology, specializing in bird migration studies using radar and other techniques. He taught and conducted research at the university level before serving as the director of the New Jersey Audubon Society's Cape May Bird Observatory for seven years. Kerlinger has published dozens of peer reviewed papers in scientific journals, chapters in texts, as well as several books, including two on bird migration. Since 1994 he has been a principal in the environmental consulting firm of Curry & Kerlinger, LLC, providing a variety of avian research and permitting services for the wind power and communication tower industries, as well as federal and state agencies, and non-profit environmental organizations. Kerlinger has assisted in permitting of wind projects, conducting pre and post construction monitoring at projects in more than a dozen states, as well as in Puerto Rico, Canada, and Spain. He has been a member of the National Wind Coordinating Committee's Wildlife Working Group since 1996.

## Jessica Kerns
## Wildlife Biologist, Western Ecosystems Technology, Inc.

Jessica Kerns is involved primarily in wildlife/wind energy research in the Midwest, mid-Atlantic, and Northeast. Jessica began working on wind-wildlife related projects in 2003 as a biologist at the University of Maryland Center for Environmental Science conducting pre-construction avian surveys on proposed wind sites in western Maryland. In 2003, she was hired to conduct the first year of post-construction fatality monitoring at the Mountaineer Wind Energy Center (MWEC) in West Virginia and eventually co-authored the final report. Jessica was invited to present those findings at the "Bats and Wind Power Generation Technical Workshop" organized by Bat Conservation International and the USFWS and hosted by Florida Power and Light Energy. Jessica was hired in 2004 as a principal investigator for the Bats and Wind Energy Cooperative to research patterns of bat fatality at wind energy facilities. The findings of this collaborative research, "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" were released in 2005. Jessica holds a B.S. in wildlife biology and an M.S. in applied ecology and conservation biology. She works as WEST's northeast component based in Ithaca, NY.

## Thomas H. Kunz
## Professor of Biology and Director of the Center for Ecology and Conservation Biology, Boston University

Thomas H. Kunz is Professor of Biology and Director of the Center for Ecology and Conservation Biology at Boston University, where he has been on the faculty for the past 35 years. His research focuses on the ecology, behavior, evolution, and conservation biology of bats. He is the author or co-author of over 200 publications and is the editor of *Ecology of Bats (*Plenum Press, 1982) and *Ecological and Behavioral Methods for the Study of Bats* (Smithsonian Institution Press, 1988); and co-editor of *Bat Biology and Conservation* (Smithsonian Institution Press, 1998), *Bat Ecology* (University of Chicago Press, 2003), *Functional and Evolutionary Ecology of Bats* (Oxford University Press, 2006), and the 2nd edition of *Ecological and Behavioral Methods for the Study of Bats* (Johns Hopkins University Press, In Press). He is an elected Fellow of the American Association for the Advancement of Science, Past-President of the American Society of Mammalogists, and a recipient of the Gerrit S. Miller Jr. Award for outstanding research on bats and the C. Hart Merriam Award for outstanding contributions to the discipline of mammalogy. His current research is funded by grants from the National Science Foundation and the National Park Service, where his work focuses on assessing the ecological and economic impact of Brazilian free-tailed bats on agroecosystems and the influence of environmental factors on the prevalence of rabies in two species of North American insectivorous bats. He had developed numerous methods for the ecological study of bats and has recently pioneered applications of infrared thermal imaging in ecology and behavior.

He is currently a member of a National Research Council committee investigating *Environmental Impacts of Wind Energy,* and is leading a National Wind Coordinating

Committee charged with preparing a document entitled *Methods and Metrics for Studying the Impacts of Wind Power on Nocturnal Species*.

## Ronald P. Larkin
## Wildlife Ecologist, Illinois Natural History Survey

Ronald P. Larkin, Wildlife Ecologist at the Illinois Natural History Survey and Affiliate a biology department at the University of Illinois, carries out research related to animal conservation. Dr. Larkin has studied animal movements since the early 1970's, including nocturnal migration, kills at large structures, bird/aircraft collisions, and local movements of animals with West Nile Virus, using techniques such as observation with spotlights, acoustic triangulation, atmospheric echo sounding, radio tracking, and especially radar including tracking radar, stationary narrow-beam radar, and Doppler radar. His chapter in the 2005 edition of the Techniques manual published by The Wildlife Society is an introduction to radar for observing flying wildlife. See http://detritus.inhs.uiuc.edu/~rlarkin/

## Todd Mabee
## Senior Scientist, ABR, Inc.

Todd Mabee is a Senior Scientist with ABR, Inc.—Environmental Research & Services in Forest Grove, Oregon. He received a B.A. degree in Environmental, Population, and Organismic Biology from the University of Colorado, Boulder and an M.S. degree in Zoology from Colorado State University. His research interests include the study of nocturnal bird migration throughout the U.S., the breeding biology of shorebirds in the Midwest and Alaska, and the ecology of headwater amphibians in Oregon. Todd has authored 13 peer-reviewed articles on topics including nocturnal bird migration, shorebird ecology, and stream amphibian ecology.

## Rob Manes
## Director of Conservation, The Nature Conservancy – Kansas

Rob Manes is a 26-year wildlife management professional whose career has included heading operations for a state wildlife agency, serving as Midwest representative for the Wildlife Management Institute (WMI), and presently working for the Nature Conservancy of Kansas as Director of Conservation. His work has afforded him experience in a variety of grassland and forest habitats across the Great Plains and in the forests of the Upper Midwest and Great Lakes states. Equally important, he has a long record of success in dealing with a wide variety of issues that involve the interaction of science and policy. Manes is recognized as one of the first wildlife professionals to initiate a formal scientific discussion of potential wildlife impacts resulting from wind energy facilities. He lead WMI's efforts in fostering and coordinating the Great Plains Wind Energy and Wildlife Conference in March of 2003, which included both wildlife and wind energy experts. He has published several popular and technical articles regarding wind energy and wildlife issues. Manes can be contacted at 1220 Larimer, Pratt, KS 67124, 620-672-5677.

## Albert M. Manville, II, Ph.D.
## Senior Wildlife Biologist, U.S. Fish & Wildlife Service

As a Wildlife Biologist with the Division of Migratory Bird Management, U.S. Fish & Wildlife Service, Arlington, VA, Al serves as the national lead on anthropocentric causes of bird mortality from structures and fishery impacts. He chairs the Communication Tower Working Group, a Service wind working group, a Service electric power line committee, and a waterbird bycatch working group, he co-chairs the Interagency Seabird Working Group, represents the Service on the Wildlife Workgroup (Natl. Wind Coordinating Cmt.), on the Avian Power Line Interaction Cmt., and on the Technical Advisory Committee for Audubon Natl. Wildlife Refuge.

He received a B.S. in zoology (Allegheny College), an M.S. in natural resources and wildlife management (Univ. Wisconsin, Stevens Point), and a Ph.D. in wildlife ecology and management (Michigan State Univ.). He conducted 6 summers of research in the Aleutian Islands on the impacts of marine debris on seabirds, sea lions, and seals; and studied impacts of the *Exxon Valdez* oil spill on seabirds for 5 years. He was a Mandarin Chinese interpreter at the National Security Agency (U.S. Navy service) and was designated a "Certified Wildlife Biologist" by the Wildlife Society. Al has served as Big Game Records Coordinator for the Boone and Crockett Club, VP/Director of Science Policy for Defenders of Wildlife, a member of the U.S. Scientific Delegation on High Seas Driftnetting, Executive Director of the Adirondack Mountain Club, a member of the Steering Committee for the Endangered Species Coalition, a branch chief with the Division of Migratory Bird Management, and leads bird strike, policy, and international migratory bird issues for his Division. In 1999, Al received the Conservation Service Award from the Secretary of the Interior for bird conservation efforts with the electric utility industry. He currently serves on the Board of Managers of the Washington Biologists' Field Club and was nominated for membership in the Cosmos Club.

He has testified over 36 times before Congress and related bodies, conducted numerous research efforts globally, published more than 120 professional and popular papers and chapters, and given more than 130 invited presentations. He served on the Editorial Advisory Board of the *Nature Conservancy* Magazine, was the wildlife consultant for the Walt Disney/Touchstone Pictures movie *White Fang* (Jack London), and has conducted hundreds of radio, television, and print media interviews. He is an Adjunct Professor for Johns Hopkins Univ. teaching graduate evening ecology courses. Al also is a private pilot, wildlife photographer, kayaker, and dog aficionado.

## Dale Strickland
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Dale Strickland is Vice-President and Senior Ecologist with Western EcoSystems Technology, Inc. (WEST) in Cheyenne, Wyoming. He received a B.S. in Zoology (1969) and an M.S. in Wildlife Management (1972) from the University of Tennessee and a Ph.D in Zoology from the University of Wyoming (1975). Prior to his employment with WEST he served as a scientist and administrator with the Wyoming Game and Fish

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He has over thirty years of experience in ecological research and wildlife management. Specialties include the design, conduct, and analysis of field studies of terrestrial and avian wildlife, threatened and endangered species, wildlife management, impact, risk, and injury assessment studies and resolution of conflicts over natural resources. He is author of more than 75 papers and technical reports in the scientific and popular literature on wildlife research and natural resource conservation and management. He is the lead author of a chapter on harvest management in the 5th edition of the Wildlife Techniques Manual, co-author of the text "Wildlife Study Design" published in 2001, and authored a chapter in a guidance document on the conduct of research on avian wind power interactions for the National Wind Coordinating Committee. Dr. Strickland is currently serving as the Executive Director of the Platte River Endangered Species Partnership. He and his staff provide technical and administrative support for the Governance Committee, which oversees the development of The Platte River Recovery Implementation Program (Program). Dr. Strickland is also currently on The National Academies, National Research Council, Committee on Environmental Impact of Wind Energy Projects. He is a member of the American Statistical Association, The Ecological Society of America, Certified Senior Ecologist, The Wildlife Society, Certified Wildlife Biologist, Wyoming Chapter, The Wildlife Society, Past President and is currently serving as an Associate Editor for the Journal of Wildlife Management.

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## Vice President & Senior Mediator

Abby S. Arnold is a Senior Mediator and Vice President as well as Director of RESOLVE's Energy Program. She has been a practicing mediator and trainer in conflict resolution for nearly twenty years, specializing in energy resources, energy efficiency, environmental issues, natural resources, and other public policy issues.

Ms. Arnold has mediated numerous collaborative endeavors, exploring issues and policies that support emerging technologies, distributed resources and energy efficiency. She has facilitated policy dialogues, regulatory negotiations and commercial private sector cases for a full variety of federal agencies and private parties on a range of topics: state and federal policy on distributed resources, transmission of electricity, new power plants, and other natural resource issues, including watershed protection, marine mammals, commercial fisheries, non-point source waters, and water quality. She also has facilitated dialogues on public policy issues such as health risk, hazardous waste, marine and coastal resources, and toxic substances. Ms. Arnold's specific interest is the design of processes that successfully integrate research and science into decision-making processes.

Since 1994, Ms. Arnold has designed and mediated four distinct multi-party collaboratives on the obstacles, concerns and issues associated with biofuels, geothermal

and wind energy for production of electricity. These mediations have involved utilities and transmission owners, private industry, federal and state agencies, consumer and environmental interest groups.

Ms. Arnold has authored articles on the application of dispute resolution in natural resource issues. She earned a B.A. in Environmental Planning and Politics with Honors at University of California Santa Cruz, and a Master's in Public Administration from the Kennedy School of Government, Harvard University. Ms. Arnold was raised in California and spent ten years in Alaska working on land use and coastal management issues. She now resides in Washington, DC with her three children and husband.

## Dana Mason
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Dana Mason is a program associate in RESOLVE's Washington, DC office where she assists in convening and facilitating consensus building and policy dialogues. Ms. Mason provides support in meeting logistics, communication with participants, agenda development, issue identification, and production of written materials. Her current projects include supporting the EPA's Children's Health Protection Advisory Committee and the National Marine Fisheries Service's Atlantic Trawl Gear Take Reduction Team. She is also the work group coordinator for Association for Conflict Resolution's Diversity Mentoring Pilot Project.

Prior to joining RESOLVE, Ms. Mason worked on international conflict resolution projects as a researcher at the Peace Research Institute-Frankfurt and as a conference coordinator and trainer at the Center for Constitutional Studies and Democratic Development in Bologna, Italy. She currently mediates at Multi-Door, the family mediation division of the Superior Court of the District of Columbia.

She received a Master's degree in International Relations and International Economics from the Johns Hopkins School of Advanced International Studies (SAIS), where she focused on Conflict Management, conducting field research and writing her thesis on the experience of the Colombian peace communities. She also holds a graduate degree from the Institut d'Etudes Politiques in Paris, France, and is fluent in French and proficient in both Spanish and Italian.

## Madeleine West
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Madeleine West is a Program Associate in RESOLVE's Washington, DC office where she assists in convening and facilitating consensus-building and policy dialogues. Madeleine provides support with meeting logistics, participant outreach, agenda development, issue identification, and the production of written materials. Her current projects include supporting the Department of Energy sponsored National Wind Coordinating Committee, the National Marine Fisheries Service's Atlantic Large Whale Take Reduction Team, the New York Wind/Wildlife Dialogue, and assisting in facilitating a collaborative community stormwater management project in Fairfax County, Virginia.

Prior to joining RESOLVE, Ms. West worked on international environmental policy in the U.S. Department of State's Bureau of Oceans and International Environmental and Scientific Affairs (OES). She has also worked on domestic environmental policy issues at the U.S. Environmental Protection Agency, New England. Ms. West received a Bachelor of Science in Environmental and Natural Resource Policy from Bates College, ME where she prepared an undergraduate thesis developing criteria for successful environmental policy-making.

## Appendix C. New York Wind/Wildlife Technical Workshop
## August 2-3, 2006
## *Albany, NY*

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# Appendix D. New York Wind/Wildlife Technical Workshop
# August 2-3, 2006
## *Albany, NY*

## Research Questions

- Radar studies have given us a pretty good view of how the passage rate varies across NYS summing up the targets in the lower 1-KM of atmosphere
    - But we need more resolution of how passage rate varies in the lower stratum, less than 200 M. to address this we need simultaneous sampling of the airspace from multiple points/sectors in a region/project area
    - This should be done using multiple methods to eliminate bias of any one method.
    - It should be carried out in different topographical regions (e.g. coastline, montane/hilly terrain).
- Identify, amongst public lands, areas where wind energy is potentially a problem (only looking in high wind areas).
- Determine local/state/Federal continent-wide bat numbers and trends in those numbers, by species.
- Delineation of migratory bird and bat flyways in NY and timing of use (including offshore).
- Identify concentration areas for birds and bats.
- Studies to examine pre-construction data collected vs. mortality observed during post-construction surveys. What pre-construction information best predicts mortality of raptors, bats, passerines?
- Funding of NY to synthesize all existing information (on birds, bats, etc.) in NY and existing wind mortality studies to develop some initial maps of areas DEC thinks are of highest risk to wildlife and lowest risk to wildlife.
- Identify stopover habitats and concentration areas of birds.
- Connect post-construction radar surveys in a manner which can be adequately compared to pre-construction radar surveys.
- Perform turbine feathering study in NY focused on nighttime neotropical bird migration, but also looking at diurnal raptor migration, especially during inclement weather. Coordinate with research effort in Oaxaca, Mexico through Universities and Mexican government.
- Perform complete seasonal mortality study using continuous early-morning carcass searches for birds and bats form April – October. Use scientifically recognized search techniques, with scavenger removal and searcher efficiency bias corrections factors.

- Long-term research of a wind turbine in farmland, forest and other significant habitats representative of wind farms in NYS studying bird, bat and other wildlife (pre-and post-construction) looking at entire animal presence and fatality.
- Assessment of the cumulative impact of wind turbine potential in NYS and in the Northern Hemisphere for wildlife present or migrating through NYS.
- Establish baseline population estimates of NY bats.
    - Method 1 – use stable isotope and DNS sequencing
    - Design and implement a statewide acoustical survey
- Risk assessment for bats; determine resident bat mortality rates using a banding/band recovery study and selected wind sites.
- Regional/statewide research funding pool and coordination ($/MW) – pay to play.
- A combined pre – and post-construction radar and fatality study with a control site. The objective of which would be to set up an observational study to learn how to use pre-construction data to estimate post-construction fatalities.
- Perform an observational study to learn about bat interactions at multiple sites in NY.
    - Pre-construction estimates from site usage by bats using radar/acoustics/thermal imaging etc., with a control site.
    - Post-construction determines fatalities.
    - At high-impact sites look at methods/tools for reducing the impact.
- Using species selected as representatives of their genus of habitat guilds, determine and define degrees of displacement, behavioral avoidance, and habituation.
- Determine factors that are critical to allow prediction of bird and bat fatalities.
- Develop and verify models that predict bird and bat fatalities.
- Mitigation effectiveness for birds and bats.
- Linkage of fatality and non-fatality impacts to population dynamics and biological significance.
- More post-construction monitoring studies.
- More research on bat deterrence.
- Developing a consensus on what information is needed by decision-makers and how that information should be used.
- Develop a detailed synthesis and meta-analysis for NY radar studies to make it readily available to decision-makers.
- Conduct radar and fatality studies concurrently to test/validate radar.

- Simultaneous comparison of methods (x ban radar, s band radar, avian acoustics) to determine strengths and weaknesses of each method.
- Develop a metric to compare wildlife effects across all types of power generation. Useful metric for advocacy groups and policy makers would be # bird kills/MWh/year to compare wildlife risk with coal and wind.
- Create a GIS and data repository for all relevant wildlife around power generation data. Put this data into a data clearing house like the Cornell CUGIR or the NY state GIS data clearing house.
- Determine if turbine feathering is a realistic option to the NY ISO. Can you take 300MW offline in 1-minute and not adversely affect the grid?
- Basic bird and bat population and migration studies.
- Use results of bird and bat population and migration studies along with landscape variables (rare species, community information, connectivity data and important habitat features for other species) to map highest conservation value/risk from wind development in high wind areas of NY.
- Development of GIS tool that can be used to identify ecologically suitable areas in wind resource regions.
- Research on behavioral avoidance by species and by turbine types and how alignment correlates post-construction monitoring with collision.
- Evaluate and identify databases and studies other than radar that can be used in permitting decisions. Different levels of risk assessment require different tools (i.e. Tier 1, Tier 2 etc. or qualitative vs. quantitative RA).
- Synthesize European data on a regular basis (i.e. kinetics of a bird/bat collision with a turbine).
- Adopt a case/control methodology to fatality analysis.
- Use infrared cameras looking down blades.
- Look for more aesthetic arrangements of turbines in the landscape (including synchronization of blade movements).
- Study the effects of mounting an ultrasonic whistle on blades to deter bats.
- Experimental testing of mitigation techniques.
- Determine seasonal and annual variation in bird migration patterns across potential development areas or regions of NY. Use multiple methods.