Raptors and Wind Energy Development in the Central Appalachians: Where We Stand on the Issue

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Overview

Wind is the USA's most rapidly growing renewable energy source, and is an important component of strategies to reduce dependence on fossil fuels (USGAO, 2005). In the central Appalachians, higher elevation plateaus and ridge-tops are being targeted for development of wind energy. It has been estimated that Pennsylvania alone has 5400 MW of developable wind power capacity, which corresponds to several thousand turbines (PEDA, 2006). Some of these areas, and in particular the ridges of Pennsylvania, are well-known for their concentrations of migrating raptors, including several species of special concern.

There is little current available information as to how wind energy projects in the central Appalachians area will affect bird populations (NRC, 2007). However, it is known that diurnal raptors are generally at higher risk for collision with turbines than are many other avian species (NWCC, 2004). Furthermore, potential cumulative effects on birds are broader than just those from direct collisions. In particular, increased energetic costs or migration, avoidance of preferred migration pathways, and change or loss of migration habitat are of special concern. In spite of the variety of potentially significant environmental impacts on birds and other wildlife, the impact of large numbers of turbines along Appalachian ridge-tops is not well studied. These environmental impacts need to be investigated and quantified at both the site and regional scales so that well-informed decisions can be made about where bird-friendly wind energy facilities can be constructed.

Current State of Knowledge

Madders and Whitfield (2006) review the current state of knowledge regarding raptors and wind turbines. It is well-established that some wind turbines kill large numbers of birds and other wildlife (most notably bats; Arnett et al., 2008; Cryan, 2008; Smallwood and Thelander, 2008). It is also known that other wind turbines do not kill many birds and bats. Likewise, effects can be sex or age-specific (Hunt, 2002; Stienen et al, 2008). Unfortunately, there is a scarcity of peer-reviewed studies on the effects of wind power on birds, and we are aware of only a few studies that compare the impacts of turbines on raptors at different sites (Barrios & Rodriguez, 2004; Hoover & Morrison, 2005). Other work has suggested that seabirds show behavioral responses to the presence of wind farms, although these studies did not quantify the energetic costs to birds of

avoidance and it is not clear if these studies are relevant to Appalachian raptors (Desholm & Kahlert, 2005; Larsen & Guillemette, 2007).

At present there are no peer-reviewed scientific studies that quantify risk - collision, behavioral or otherwise - to raptors from turbines in the Appalachian region. The few post-construction studies conducted have not been published in peer-reviewed journals and it is difficult to assess their quality. Furthermore, these studies provide little generalized information because when they identify turbines that kill few raptors, they do not differentiate between areas with many birds (low risk) from areas with few birds (low exposure). Thus, the existing mortality data, generated at installations away from known migration pathways and concentration areas, cannot be extrapolated beyond these specific sites (Drewitt and Langston, 2006; Madders and Whitfield 2006). In short, there is no reasonable basis to conclude that risk of new turbine development will or will not impact raptors without additional studies designed to quantify the impact of turbines.

How to Advance the State of Knowledge

Due to the lack of data discussed above, we strongly recommend a coordinated effort by raptor biologists, regulators, and developers to study the impacts of wind turbines on raptors in the Appalachian region. Valid assessments require extensive studies at proposed and existing sites using **B**efore and **A**fter **C**ontrol **I**mpact (BACI) study design, as well as regional-scale research on the potential impacts of wind energy facilities on migration and wintering behavior (NWCC, 1999). Mitigation methods such as micro-siting (e.g., setbacks from sloping terrain), improved rotor tip visibility, and/or flexible operation schedules that reduce turbine speeds during peak conditions for migration could then be developed to reduce risk to eagles and other raptors.

It seems reasonable to predict that turbines sited away from primary migration pathways and topographic “leading lines” such as ridge-tops and prominent escarpments, are relatively less likely to pose significant risk to raptors than are turbines on those pathways and leading lines. However, data are needed to confirm this hypothesis. Therefore, we believe that all wind energy sites proposed in the Appalachian Mountains must be monitored for wildlife interactions with a multiyear pre- and post-construction scheme using transparent and peer-reviewed methodology. Such an approach is the only way to provide the data required to understand the actual risk at specific sites and to identify sites that are likely to pose the least risk to golden eagles and other flying animals.

The Golden Eagle as a High-Risk Species

The size of the eastern North American population of golden eagles is small and therefore highly vulnerable to demographic perturbations. Even low levels of turbine-associated or other mortality may be significant for long-lived species with low reproductive rates and slow maturation rates (Drewitt and Langston, 2006; Katzner et al. 2006). Golden eagles tend to migrate and winter within areas of the central Appalachians that are currently under development or targeted for future development by wind energy companies. This species commonly uses

slope soaring and ridge updrafts during migration and foraging, flight patterns which are known to increase collision risk (Barrios & Rodriguez, 2004; Hoover & Morrison, 2005). It is for these reasons and others that golden eagles are therefore highly susceptible to collision with some wind turbines (Hunt, 2002; Smallwood & Thelander, 2004). Because of their demography, migration and winter flight behavior, and vulnerability to wind turbines, we consider eastern golden eagles to be the raptor species at greatest risk of population-wide impacts from wind energy development in the Appalachians.

Available monitoring data and modeling strongly suggest that eastern golden eagles migrate through a narrow corridor in south-central Pennsylvania (particularly during spring; Brandes & Ombalski, 2004). This corridor includes portions of Bedford, Blair, Centre, Fulton, Huntingdon, Mifflin, and Somerset Counties and likely extends southward through Maryland into West Virginia. Thus, we consider the Allegheny Front and the five adjacent ridges to the east to be a zone of high risk for potential impacts to golden eagles. A primary area for potential development of wind energy is exactly in this same corridor that golden eagles use so heavily (USFWS, 2005). In addition to this corridor, the Kittatinny Ridge (Blue Mountain) is well known as a significant migration pathway for golden eagles and many other raptor species and is also an area of high risk for conflict between birds and wind turbines.

Audubon Christmas Bird Count data and a great deal of anecdotal information suggest that some regions of Virginia (Highland County, Tazewell County) and West Virginia (Pendleton County, Grant County) are important wintering areas for golden eagles. There also is mounting evidence that immature golden eagles regularly summer in these areas. In addition, our preliminary telemetry data and remote camera surveys suggest that many more golden eagles winter in Pennsylvania than indicated by CBC data. Studies suggest that raptors are at highest collision risk when foraging (Hunt, 2002; Hoover & Morrison, 2005), thus wind energy projects in wintering areas should include pre- and post-construction monitoring throughout the year, not just during migration periods.

Our Research

The over-arching objective of our research is to develop a quantitative understanding of where, when and how migrating golden eagles and other raptors traverse the Appalachian Mountains. Currently, we are pursuing this on three fronts: (1) the use of state-of-the art telemetry to collect detailed data on individual golden eagle movements throughout the region, (2) collaboration with existing hawk migration monitoring sites to collect additional data on flight patterns and behavior, and (3) the development of quantitative spatially-explicit migration models using both theoretical and empirical approaches. Our work focuses in particular on the interactions between topography, weather, and golden eagle movements at local and regional scales. Currently we are not involved with studies to determine the behavioral response of raptors to turbines at wind energy sites. However, under certain conditions we would consider collaborations with wind energy developers, wildlife advocacy organizations or state or federal agencies on such studies.

Our Funding

Our work is presently funded through our home institutions (National Aviary, Carnegie Museum of Natural History, and Lafayette College) and state and federal grants. As an objective and impartial research collaborative, we will only accept funding from stakeholders in wind energy or advocacy organizations if we obtain an explicit agreement that we control the data and retain exclusive rights to publish our findings in the peer-reviewed literature. That is, if we accept funding from any source, donors must understand that they do not have the ability or right to influence or restrict our research objectives, methods, data collection, data, interpretation of results, or our publications.

It is also currently our policy that for the duration of our research project we do not provide data or give opinions or expert testimony regarding the siting of specific wind energy facilities, except as stated in this summary paper and in our publications. Likewise, collaboration with any donor will not imply support for or against any of the donor's policies, statements or activities, except as explicitly stated in our publications.

Our Data

We retain exclusive rights to all data generated during our research and do not release the data to third parties. However, we can provide answers to specific questions such as "Did telemetry locations from eagle x occur in region y?" Such answers are provided to any inquiring party (wildlife advocates, energy developers, state or federal agencies, private citizens, etc.) except if we believe that their use may violate our policy on providing opinions or testimony as stated above. Those asking such questions should understand that at times we receive many such requests and all questions will be answered based on the availability of our analysts.

Maps summarizing results of our telemetry work are provided at the National Aviary website (www.aviary.org) – these maps are updated regularly. We will make available to the public a more detailed version of our telemetry data after completion and publication of our research.

Conclusions

Our current understanding of the interaction between raptors, wind energy development and society leads us to the following conclusions:

- Risks posed by wind turbines to raptors depend on a variety of site-specific, species-specific, meteorological, and seasonal factors;
- Existing data presently are insufficient to make any conclusion about the magnitude of the risks posed to raptors by wind turbines;
- Wind energy sites on leading lines within the high potential risk area for golden eagles discussed above should not be constructed until scientifically valid peer-reviewed studies quantify potential impacts and appropriate mitigation methods are

implemented. Studies that are not subject to peer review are substantially less credible and have less value for resolving these important issues;

- On migration routes of high ecological significance (the Kittatiny Ridge and others) wind energy facilities should be constructed only if replicated studies show conclusively that there will not be harm to natural resources - birds, bats, habitat, etc. In these cases there must be an especially high burden of proof to show that harm will not be caused;
- We strongly recommend a coordinated effort by raptor biologists, regulators, and developers to study the issue comprehensively. Wind energy can provide an important and clean source of energy, with minimal environmental impact, if these impacts are properly researched. Our work is a step in that direction.

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