

Overview of the U.S. Department of Energy/National Renewable Energy Laboratory Avian Research Program

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ABSTRACT

As wind energy use continues to expand, concern over the possible impacts of wind farms on birds continues to be an issue. The concern includes two primary areas: the effect of avian mortality on bird populations, and possible litigation over the killing of even one bird if it is protected by the Migratory Bird Treaty Act or the Endangered Species Act or both. In order to address these concerns, the U.S. Department of Energy (DOE) and the National Renewable Energy Laboratory (NREL), working collaboratively with all stakeholders including utilities, environmental groups, consumer advocates, utility regulators, government officials, and the wind industry, has an active avian-wind power research program. DOE/NREL is conducting and sponsoring research with the expectation of developing solutions to reduce or avoid avian mortality due to wind energy development throughout the United States. This paper outlines the DOE/NREL approach and summarizes completed, current, and planned projects.

HISTORY OF DOE/NREL AVIAN-WIND POWER RESEARCH

Prior to 1992, no centralized, coordinated research program existed that examined the potential impacts of wind plants on birds. Most of the research effort in North America was being focused on the Altamont Wind Resource Area (WRA), primarily because of concern regarding the resident golden eagle (*Aquila chrysaetos*) population. Beginning in 1992, however, increasing concern from the public and conservation organizations regarding possible negative impacts of wind power caused the U.S. Department of Energy (DOE) to direct the National Renewable Energy Laboratory (NREL) to initiate a coordinated research effort. To initiate this research, NREL developed a three-pronged effort:

- Facilitate several ongoing research efforts, by providing expert guidance and funding. One such research project looked at the golden eagle population in the Altamont WRA.
- Help organize "The National Avian-Wind Power Planning Meeting," which was held in July 1994,¹ and involved stakeholders from DOE, American Wind Energy Association, National Audubon Society, Electric Power Research Institute, Union of Concerned Scientists, and other interested public and private parties. This meeting was the first time stakeholders had met with the goal of reaching consensus on ways to address avian issues pertaining to wind development.

- Develop a focused program of new research. This effort was guided by the research priorities established by stakeholders attending the second "National Avian-Wind Power Planning Meeting," held in September 1995,² and outlined in the next section.

PROGRAM APPROACH

With the support of DOE/NREL, the Avian Subcommittee of the National Wind Coordinating Committee hosted a meeting of government regulators, scientists, and other stakeholders in September 1995,³ to share ideas about research that could be helpful in predicting and reducing avian mortality resulting from wind turbines. Results of this meeting provided a prioritized list of research projects that represented a consensus among stakeholders. Priority projects included the following:

- Development of a conceptual framework of the principal causes of avian mortality at wind plants.
- Development of a common set of metrics for use in characterizing the potential or existing impact from a wind development.
- Continued development of research protocols and guidelines for data collection.
- Identification of appropriate study designs and statistical analyses.
- Application of new technologies, including the use of radar.
- Research of the cause of avian mortality in wind plants, including perching behavior.
- Testing the effectiveness of techniques designed to prevent birds from approaching or perching on turbines.

DOE/NREL have developed a research program that focuses on these priority projects. The initial set of research projects is designed to gain an understanding of the magnitude of the bird-wind power problem in a variety of geographic settings. Additional projects will then be developed that test ideas and hypotheses developed during the initial research projects and seek to reduce bird mortality in wind plants.

RESEARCH PHILOSOPHY

DOE/NREL have embarked on a research program that is based on careful consideration of stakeholder needs. To implement a project, the initial study plan must fully justify all sampling methods. This justification includes a review of the pertinent scientific literature and quantitative analyses of potential sample sizes (e.g., power analysis). As a standard, the research must produce results that are suitable for publication in peer-reviewed scientific journals. By holding to this standard, NREL ensures that stakeholders will receive recommendations that are based on rigorous research.

AVIAN RESEARCH PROJECTS

DOE/NREL's avian research program has resulted in a multifaceted approach to addressing the impacts of wind power development on birds. Each of the priority issues developed during the 1995 National Avian-Wind Power Planning Meeting are now being addressed and are outlined below. Table 1 summarizes those research projects currently under way. Table 2 summarizes research projects under negotiation.

Completed projects: The two National Avian-Wind Power Planning Meetings represent major advances in coordination among stakeholders and are largely responsible for the current cooperation evident in this area of research. Additionally, a white paper has been completed on the uses of population models and related methodologies in addressing wind power impacts.⁴ This paper develops broad guidelines for initial determination of likely influences of wind development on bird populations.

Projects nearing completion: The use of radar in examining the passage rate and heights of migrating birds was investigated at a proposed wind site in Montana by researchers at Montana State University. This research indicates that radar can be a valid approach in avian-wind research and will be particularly effective in evaluating nocturnal passages of birds.

Kenetech initiated research of the ecology of the golden eagle at their Altamont wind development. NREL assumed responsibility for the eagle research in 1994 and expanded the work to include development of models for predicting the viability of the population. This research is the first to attempt to develop population models of a bird population inhabiting a wind resource area. The results of this research will be available in fall 1997.

Kenetech had also funded laboratory research at Boise State University that was designed to determine the ability of birds to see, and ultimately avoid, turbine blades. DOE/NREL has now funded Boise researchers to complete data analyses of this laboratory work and publish the research results in scientific journals. These papers will include research results of the ability of birds to recognize different patterns painted on turbine blades. The first of several reports documenting the results of the data analyses will be available in late summer 1997. Field trials of the ability of birds to recognize and avoid blades may be conducted as a result of the laboratory research. The exact focus of any field work, however, has not yet been determined.

Another major recommendation of the second National Avian-Wind Power Planning meeting was development of a comprehensive document outlining preferred methods of study design, data collection, and analysis. To meet this goal, a team of scientists were gathered from the fields of avian ecology, research design, and statistics to write chapters for this document.⁵ This document will allow all stakeholders to refer to a single source for guidance on evaluating potential wind developments from site selection through postdevelopment monitoring; it will be available in fall 1997.

Planned and recently implemented projects: One research project recently begun will investigate the influence of tower type (tubular versus lattice) and size (old versus new generation) on bird use and mortality. Another project still under negotiation will investigate the behavior of birds flying near, and perching on, turbines and determine the relationship between flight behavior and perching, and bird mortality. A research project to evaluate how bird flight diverters, which are installed on guy wires of turbines, affect avian behavior, use, and mortality is also under negotiation.

DOE/NREL also expects to fund multiyear avian-wind farm interaction research projects. Using before-after-control impact studies, these research projects will be designed to perform before and after construction studies of avian species at a wind farm site and a reference site. Variables to be investigated include, but will not be limited to, utilization, mortality, species composition, avian behavior, prey base, habitat changes, and wind farm characteristics; necropsies will be performed to determine cause of death. Key species population surveys and population modeling analyses may also be included, if the initial research indicates that population effects are probable and can be measured.

In addition, expert advice on avian monitoring has recently been requested by two small proposed wind developments, one of which resulted from a utility green marketing program. It is anticipated that NREL will be involved in other such projects, providing expert advice on study designs and identification of key issues which should be considered.

CURRENT AND FUTURE PROGRAM FUNDING

The projects summarized in Table 1 cover from one to three phases, with a phase representing approximately one year of work. In total, these projects represent slightly more than \$1.5 million of avian-related research.

Projects under negotiation, summarized in Table 2, are also phased projects, each one to three years in length. A total of approximately \$400,000 is budgeted for these projects, although continued funding is contingent on research results as well as funding availability.

As originally designed, the avian-wind farm interaction studies were expected to be funded at \$300,000–\$400,000 per year, for up to three years. The DOE Wind Program will provide NREL with funding guidance on how to proceed with these research projects, given the current funding limitations. The DOE Wind Program's position is that, due to the downturn in domestic wind development as a result of the electric utility restructuring, an opportunity currently exists to properly examine the avian issues. The scope of these projects will be determined in the near future.

In addition to funding specific research projects, NREL has experts in the fields of biostatistics, population modeling, epidemiology/mortality, ornithology, and statistics who are under subcontract or have consulting agreements. These experts are used to provide input to the design of new projects, provide critical review of reports on the research, and as consultants to a variety of issues related to the avian research program. Funding to support these experts is approximately \$150,000 a year.

SUCCESS OF PROGRAM

Although the avian research program has only been in existence at DOE/NREL since 1994, a major success of the program is the collaborative approach to defining the projects. By including all the stakeholders, including utilities, environmental groups, consumer advocates, utility regulators, government officials, and the wind industry, what was once a very contentious group is now able to work together more effectively in developing a program to identify the problems and develop solutions to avian-wind turbine interactions.

Another measure of success is the number of projects completed and the number of projects under way. During the next six months, several projects are scheduled for completion. The success of the program will be further defined as the results of these research projects are circulated among the various stakeholder groups and we begin to get feedback.

By next spring, DOE/NREL, working in concert with the Avian Subcommittee of the National Wind Coordinating Committee, will identify additional research projects to test ideas and hypotheses developed during the initial research projects, with the ultimate goal of reducing bird mortality in wind plants.

TABLE 1
CURRENT AVIAN RESEARCH PROJECTS

Project Title	P. I.*/ Organization	Project Objective	Location	Start	End
Population Study of Golden Eagles in the Altamont Wind Resource Area ^{6,7}	G. Hunt/ University of California - Santa Cruz	Determine survival and reproductive rate of golden eagle population; collect data necessary to develop population model to predict trend in survival of population	Altamont WRA, California	1994	1997
Avian Use of Norris Hill Wind Resource Area (pre-construction survey) ⁸	A. Harmata/ Montana State University	Establish WRA baseline avian utilization and mortality; determine # of swans, water fowl, neotropical migrants and resident raptors using the area; evaluate usefulness of radar in identifying bird migrations	Norris Hill WRA, Montana	1995	1997
Potential Impacts of an Operating Wind Turbine on the Flight Behavior of Migrating and Breeding Birds at the Green Mountain Power Searsburg Wind Turbine Project	P. Kerlinger/ Vermont Department of Public Service	Investigate the impacts of wind turbines on migrating birds during both pre- and post-construction periods in eastern North America	Green Mountain, Vermont	1996	1998
Wind/Avian Mortality Research and Model Development	R. Anderson/ California Energy Commission	Determine if the development and operation of a WRA would result in an increased risk of bird mortality	Tehachapi and San Geronio WRA, California	1997	1999
Raptor Visual Capacities and Blade-Pattern Conspicuity - Report of Studies Completed	H. McIsaac/ Boise State University	Analyze data collected over 2-1/2 years and write up results of those analyses	Boise, Idaho	1997	1998
Biostatistical and Population Modeling Analysis for Avian Wind Power Research ⁹	K. Pollock/ North Carolina State University	Development of a modeling framework for evaluating bird-wind power interactions	Raleigh, North Carolina	1996	1997
Comparing Differential Bird Risk Between Types: Tehachapi and San Geronio	M. D. Strickland/ Western EcoSystems Tech (WEST) & R. Anderson/ California Energy Commission	Compare bird use, behavior, and mortality at small and large turbines; compare tubular and lattice towers; develop recommendations for reducing bird mortality in wind farms.	Tehachapi and San Geronio WRA, California	1997	1998

* Principal Investigator

TABLE 2
 AVIAN RESEARCH PROJECTS UNDER NEGOTIATION

Project Title	P. I.* / Organization	Project Objective	Location	Start	End
Effects of Bird Flight Diverters Installed on Guy Wires of Turbines	B. Wolff/ Conservation and Renewable Energy System (CARES) & M. D. Strickland/ Western EcoSystems Tech (WEST)	Evaluate the effects of bird flight diverters installed on guy wires of turbines on avian behavior, use and mortality	Klickitat County, Washington	1997	1999
Reducing Bird Perching and Mortality at the Altamont Wind Resource Area, California	H. McIsaac/ Boise State University	Determine the behavior of birds flying near, and perching on, turbines; determine the relationship between flight behavior and perching and bird mortality; explore factors responsible for bird-turbine interactions and bird deaths; develop recommendations for reducing bird-turbine interactions	Altamont WRA, California	1997	1999

* Principal Investigator

REFERENCES

1. *Proceedings of National Avian-Wind Power Planning Meeting, Denver, Colorado, 20-21 July 1994.* NREL/SP-441-7814. Golden, Colorado: National Renewable Energy Laboratory. April 1995. Prepared by RESOLVE, Inc., Washington, DC, and LGL Ltd., King City, Ontario.
2. *Proceedings of National Avian-Wind Power Planning Meeting II, Palm Springs, California, 20-22 September 1995.* RESOLVE, Inc., Washington, DC, and LGL Ltd., King City, Ontario.
3. Ibid.
4. Morrison, M.L.; Pollock, K.H.. *Development of a Practical Modeling Framework for Estimating the Impact of Wind Technology on Bird Populations.* NREL/SR-440-23088. Golden, Colorado: National Renewable Energy Laboratory. Publication pending. Work performed by California State University, Sacramento, California, and North Carolina State University, Raleigh, North Carolina.
5. Anderson, R. L.; Davis, H.; Kendall, W.; Mayer, L. S.; Morrison, M. L.; Sinclair, K. C.; Strickland, D.; Ugoretz, S. *Standard Metrics and Methods for Conducting Avian/Wind Energy Interaction Studies.* Golden, Colorado: National Renewable Energy Laboratory. Publication Pending.
6. Hunt, G. *A Pilot Golden Eagle Population Study in the Altamont Pass Wind Resource Area California.* NREL/TP-441-7821. Golden, Colorado: National Renewable Energy Laboratory. May 1995. Work performed by Predatory Bird Research Group, Long Marine Laboratory, University of California, Santa Cruz, California..
7. Hunt, G. *A Population Study of Golden Eagles in the Altamont Pass Wind Resource Area: Second-Year Progress Report.* NREL/SR-440-23087. Golden, Colorado: National Renewable Energy Laboratory. Publication pending. Work performed by Predatory Bird Research Group, Long Marine Laboratory, University of California, Santa Cruz, California.
8. Harmata, A. R.; Zelenak, J.R.; Podruzny, K.M.. *Avian Use of Norris Hill Wind Resource Area, Montana.* Golden, Colorado: National Renewable Energy Laboratory. Publication pending. Work performed by Fish and Wildlife Program, Montana State University, Bozeman, Montana.
9. Morrison, M. L.; Pollock, K.H. *Development of a Practical Modeling Framework for Estimating the Impact of Wind Technology on Bird Populations.* NREL/SR-440-23088. Golden, Colorado: National Renewable Energy Laboratory. Publication pending. Work performed by California State University, Sacramento, California, and North Carolina State University, Raleigh, North Carolina.