Developing Methods to Reduce Bird Fatalities in the Altamont Pass Wind Resource Area

Contract #: 500-01-019
Contractor: BioResource Consultants
Contract Amount: $420,670
Match Funding: $420,670
Contractor Project Manager: Carl Thelander
Commission Contract Manager: Linda Spiegel

The Issue

California wind turbines provide approximately 3 billion kilowatthours (kWh) of electricity annually. If fossil-fuel power plants were used to generate that amount of electricity, they would produce 2.25 million tons of carbon dioxide (CO_2) emissions—about equal to the amount that could be absorbed by an 1,100 square-mile forest.[1] However, avian fatalities and the associated public perceptions, state and federal laws, and potential fines and lawsuits are a few of the factors that limit the construction and repowering of more wind facilities in California.

Photo by Daniel Driscoll

Since the 1980s, studies have shown that wind turbines—among the most cost-effective non-combustion renewable technologies currently available—have the potential to kill birds. At the 50,000 acre, 7,000-turbine Altamont Pass Wind Resource Area (APWRA), researchers estimate that more than 1,000 birds are killed annually. About half of the birds killed are raptors (golden eagles, red-tailed hawks, burrowing owls, and American kestrels) that are protected by the Migratory Bird Treaty Act, Bald Eagle and Golden Eagle Protection Act, and/or California codes. Each violation of these acts can result in civil and/or criminal violations and extensive fines or penalties.

Avian fatalities occur at most wind farms, but the problem appears to be particularly acute at the APWRA. Part of the cause of this high fatality rate is that the area supports abundant numbers of raptors.[2] However, other factors contribute to increased collision risk, such as prey concentration,

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[1] American Wind Energy Association (AWEA). 1998. "CO_2 Emissions: Wind vs. Trees." www.awea.org/faq/co2trees.html.
[2] Curry, Richard C., and Paul Kerlinger. 1998. "Avian Mitigation Plan: Kenetech Model Wind Turbines, Altamont Pass WRA, California." www.nationalwind.org/pubs/avian98/04-Curry_Kerlinger-altamont.pdf.

turbine design, the position of a turbine in a string of turbines, and topographic features.[3] One three-year study of major California wind power facilities found that most avian fatalities involved raptors, and the great majority occurred in the Altamont Pass area.[4] However, even there, the fatalities could be traced to a minority of turbines, as evidenced by a study that found only about 25% of the APWRA turbines to be responsible for all of the avian fatalities in the study year.[5]

As an example from one study, the table below shows causes of death among 100 radio-tagged golden eagles in the APWRA.

Causes of Death Among 100 Radio-Tagged Golden Eagles in APWRA

Mortality Agent	Juveniles (17 fatalities) (%)	Subadults (49 fatalities) (%)	Floaters (22 fatalities) (%)	Breeders (12 fatalities) (%)	Total Fatalities
Turbine Blade Strike	5.9	63.2	36.4	16.7	42
Electrocution	22.5	10.2	13.6	-	12
Fledging Mishap	35.3	-	-	-	6
Hit by Car	-	6.1	4.5	-	4
Wire Strike	5.9	4.1	4.5	-	4
Eagle	-	-	9.1	16.7	4
Lead Poisoning	-	4.1	-	8.3	3
Botulism	-	-	-	8.3	1
Brodifacoum Poisoning	-	-	-	8.3	1
Shot	-	-	4.5	-	1
Hit by Train	5.9	-	-	-	1
Unknown	23.5	12.2	27.3	41.7	21

Source: California Energy Commission. 2002. *Golden Eagles in a Perilous Landscape.* p. 30.

Whatever the causes, this high incidence of avian fatalities at Altamont has led to a negative perception of wind turbine technology's contribution to avian deaths in general, and has attracted a great deal of research at the site, in an effort to identify and remediate the problems.

Alameda County, where much of APWRA is located, will not approve additional permit applications to increase current electrical production (583 megawatts [MW]) at the wind resource area until research demonstrates significant progress toward solving the bird fatality issue. Such

[3] Ibid.
[4] Haussler, R. 1988. "Avian mortality at wind turbine facilities in California." Paper presented at 1988 American Wind Energy Association National Conference, Honolulu, Hawaii.
[5] Thelander, C., and L. Rugge. 2001. *Examining Relationships between Bird Risk Behaviors and Fatalities at the Altamont Wind Resource Area: A Second Year's Progress Report.* From the proceedings of the National Avian-Wind Power Planning Meeting IV Carmel, California. May 16–17, 2000.

a capacity increase could likely be achieved by repowering existing sites with fewer, larger, and more-efficient turbines; however, the impact of these larger turbines on birds has not been fully evaluated. In addition, the economic factors associated with increasing capacity could help spur developer investment on the aging site, where many of the old, inefficient turbines no longer function. Although the current generating capacity of turbines at the site is under 600 MW, the site is permitted for 800 MW, and the estimated potential capacity could eventually exceed 1,200 MW,[6] meeting the electricity needs of 900,000 to 1.2 million California households.

A risk sensitivity model that could be used to identify and reduce collision risk to birds and determine locations of high, moderate, and low risk at the site could help regulators and developers site new or repowered turbines at the APWRA. One recent study indicated that effective solutions for avian collisions with wind turbines at the site could prevent a significant number of turbine-related bird kills per year there.[7]

Project Description

In this project, PIER-EA and BioResource Consultants surveyed portions of the APWRA and developed an association model to identify how and where to reduce collision risk for birds at the APWRA. BioResource Consultants identified and assessed the significance of risk factors such as turbine design, topography, prey density, and vegetation; and the model is based on the statistical importance of these factors.

Prior to this study, during 1998 to 2001, BioResource Consultants conducted avian fatality surveys for a portion of the APWRA (under a separate contract from the National Renewable Energy Laboratory). This project surveyed a greater percentage of the APWRA to include turbine designs not previously studied.

Funding for the project began in February 2002.

PIER Program Objectives and Anticipated Benefits for California

This project offers numerous benefits and meets the following PIER program objectives:

- **Providing environmentally sound and safe electricity.** The results of this work will help researchers determine the extent of avian fatalities associated with the new, larger (repowered) turbines at the APWRA. The sensitivity model will enable researchers to predict fatality risk at particular locations within the APWRA, and allow new turbines to be placed in low-risk locations. As the model's use decreases avian collisions and deaths in the WRA, it will help the wind industry and the Alameda County bring the APWRA into compliance with state codes and federal laws pertaining to existing violations. The model could also be adapted for use in other WRAs.

[6] Dave Sterner. July 2002. *A Roadmap for PIER Research on Avian Interactions with Wind Turbines in California.* Draft.

[7] Thelander, Carl, and Shawn Smallwood. 2002. "The Altamont Pass Wind Resource Area's Effects on Birds: A Case History." p.13.

- **Providing affordable electricity.** This research will improve the energy cost and value of California's electricity by siting the new, more efficient turbines in low-risk locations that result in fewer bird fatalities, and enable power producers to achieve more megawatts per turbine and reduce maintenance costs.

- **Providing reliable electricity.** A model that can help significantly reduce turbine-caused avian fatalities could also enable Alameda County to approve permits for an increase in productive capacity, which would provide more of this emissions-free electricity to more California households.

Results

This project contributed to the mapping and characterization of 4,074 of the 5,400 wind turbines at the APWRA. From that group, researchers concluded that bird fatalities at the APWRA result from various attributes of wind turbine configuration and placement, and that species-specific behavior plays a large role in how each contributory factor affects mortality. Researchers identified and proposed measures to mitigate bird mortality in the APWRA. They also developed a predictive model based on the causal factors underlying the observed fatalities.

The project researchers offered recommendations to discontinue or modify some current management actions, to implement new ones immediately, and to experiment with others. Data presented in the report support these recommendations. The results suggest that repowering with carefully placed, modern wind turbines mounted on taller towers may be the preferable means to substantially reduce bird mortality.

The following mitigation measures were recommended:

- Cease the rodent control program
- Acquire conservation easements offsite
- Replace the Wildlife Reporting and Response System with a scientifically defensible monitoring program
- Install flight diverters
- Paint blades using the Hodos scheme
- Remove broken and non-operating wind turbines
- Relocate wind turbines
- Install wind turbine designs appropriate to the APWRA
- Retrofit Avian Power Line Interaction Committee non-compliant power poles
- Reduce vertical and lateral edges
- Move rock piles
- Exclude cattle from around the bases of wind turbines
- Retrofit tower pads to prevent under-burrowing by small mammals
- Install accelerometers to learn when to shutdown wind turbines
- Implement the means to effectively monitor each wind turbine's operation

Final Report

The final report for this project, entitled *Developing Methods to Reduce Bird Mortality in the Altamont Pass Wind Resource Area* (500-04-052), is posted on the Energy Commission website, at www.energy.ca.gov/pier/project_reports/500-04-052.html.

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