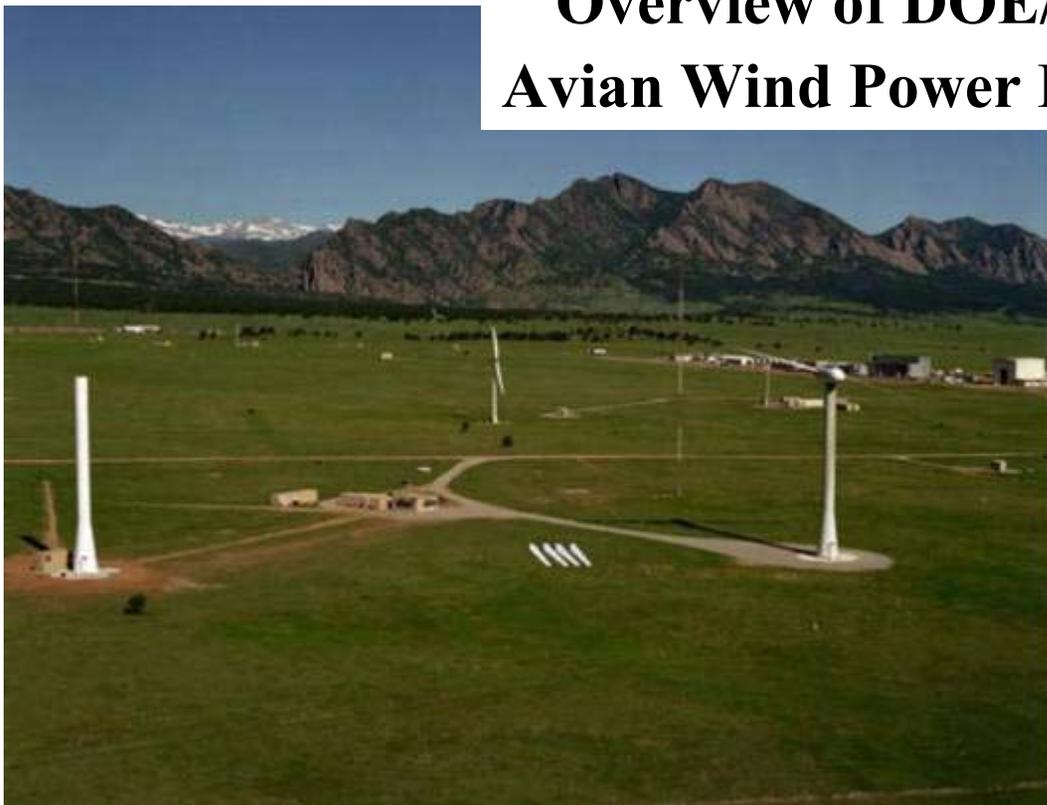




Avian Interactions with Wind Power Structures

Overview of DOE/NREL Avian Wind Power Research



Karin Sinclair

National Wind Technology Center

April 29, 2003





National Avian – Wind Power Planning Meeting I

July 1994

Objectives of the Meeting

- **To define a research program that addresses wind power-related avian mortality issues. This research program should investigate both individual site impacts and national cumulative impacts.**
- **To reach this goal, the meeting intends to:**
 - **Identify and prioritize key issues with respect to bird-wind turbine interactions**
 - **To define a research agenda to resolve scientific and technical issues**
 - **Insure transferability of results**
 - **Avoid duplications and inadequate science**
 - **Build consensus on approaches to the research needed to address the issues**





National Avian – Wind Power Planning Meeting I

Participating Organizations

- ❖ American Wind Energy Association
 - ❖ Edison Electric Institute
- ❖ Electric Power Research Institute
 - ❖ Kenetech Windpower
 - ❖ National Audubon Society
 - ❖ National Biological Survey
- ❖ National Renewable Energy Laboratory
 - ❖ Pacific Gas & Electric
 - ❖ Union of Concerned Scientists
 - ❖ U.S. Fish & Wildlife Service
- ❖ Wisconsin Department of Natural Resources





National Avian – Wind Power Planning Meeting I

Meeting Outcome: Five Major Research Areas

- **Assess mortality attributable to wind turbines at existing sites (including control data from “no turbine” sites)**
- **Predict mortality at planned wind power sites, based in part on previous bullet**
- **Predict population consequences**
- **Identify ways to reduce bird kills at wind plants**
- **Set values for off-site mitigation**





Key Research Studies Proposed to the NWCC Avian Subcommittee, June 1995

I. Avian Wind Farm Interaction Studies

- Observe and measure the effects of wind farms on avian species in the area
- Use a BACI approach where possible

	<i>Before</i>	<i>After</i>
<i>Wind Farm site</i>	<i>X</i>	<i>X</i>
<i>Reference site</i>	<i>X</i>	<i>X</i>

II. Avian Risk Reduction Studies

- Consider:*
- *Visual enhancement*
 - *Tower type*
 - *Perch guard*
 - *Acoustic*
 - *Decoys*

Compare treated and untreated turbine while measuring utilization, mortality and observing behavior





Key Research Studies Proposed to the NWCC Avian Subcommittee, June 1995

Associated research recommendations:

- **Develop standardized measurement protocols and guidelines**
 - **For comparability from different studies**
 - **To guide researchers**
 - **To be able to understand differing results**
- **Study population impacts using**
 - **Model studies to better understand the effects**
 - **Actual field measurements on a target avian population**

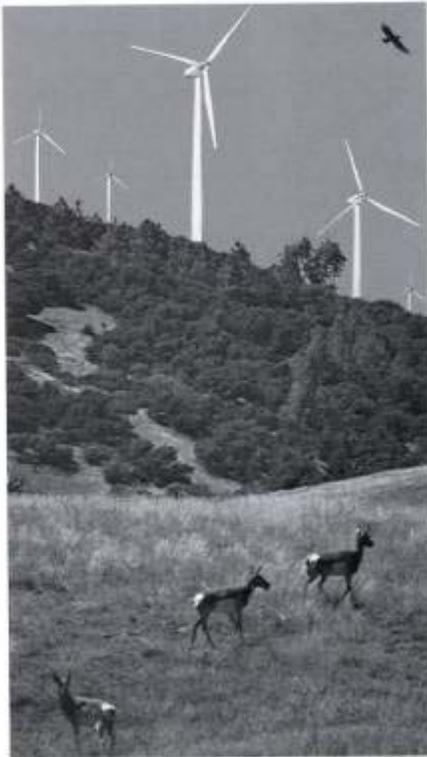




NWCC Avian Guidance Document

STUDYING WIND ENERGY/BIRD INTERACTIONS: A GUIDANCE DOCUMENT

METRICS AND METHODS FOR DETERMINING OR MONITORING POTENTIAL IMPACTS
ON BIRDS AT EXISTING AND PROPOSED WIND ENERGY SITES



Assessing the suitability of a proposed wind farm site with regard to avian concerns is an important component of overall site evaluation. This NWCC document provides guidelines for conducting avian assessments.

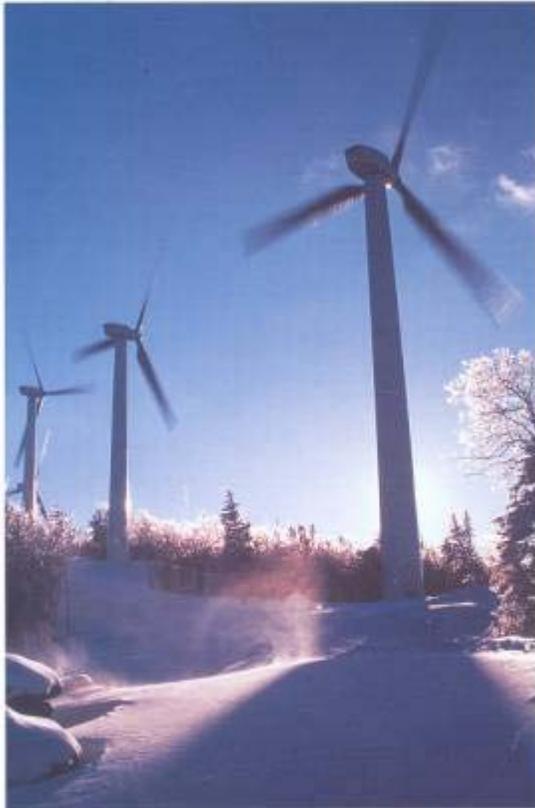
Prepared for the Avian Subcommittee and NWCC
December 1999





NWCC Permitting Handbook

Permitting of Wind Energy Facilities A HANDBOOK



Prepared by the NWCC Siting Subcommittee
Reprinted August 1999

Permitting decisions should assure necessary environmental protection and respond to public needs. This NWCC document provides information on various permitting issues which should be addressed. Revised August 2002.





NREL Avian Studies Available at:

http://www.nrel.gov/wind/avian_lit.html

- **An Assessment of the Impacts of Green Mountain Power Corporation's Wind Power Facility on Breeding and Migrating Birds in Searsburg, VT**
- **Avian Hearing and the Avoidance of Wind Turbines**
- **Avian Risk and Fatality Protocol**
- **Avian Risk Behavior and Fatalities at the Altamont Wind Resource Area**
- **Avian Use of Norris Hill Wind Resource Area, Montana**
- **Baseline Avian Use and Behavior at the CARES Wind Plant Site, Klickitat County, Washington**
- **Comparison of Avian Responses to UV-Light-Reflective Paint on Wind Turbines**
- **Development of a Practical Modeling Framework for Estimating the Impact of Wind Technology on Bird Populations**





NREL Avian Studies Available at:

http://www.nrel.gov/wind/avian_lit.html

- **National Avian-Wind Power Planning Meeting I, 1994**
- **National Avian-Wind Power Planning Meeting II, 1995**
- **National Avian-Wind Power Planning Meeting III, 1998**
- **National Avian-Wind Power Planning Meeting IV, 2000**
- **Overview of the US Dept. of Energy/NREL Avian Research Program (1997)**
- **Permitting of Wind Energy Facilities: A Handbook**
- **A Pilot Golden Eagle Population Study in the Altamont Pass Wind Resource Area, California**
- **Ponnequin Wind Energy Project – Reference Site Avian Study**
- **A Population Study of Golden Eagles in the Altamont Pass Wind Resource Area: Second-Year Progress Report**





NREL Avian Studies Available at:

http://www.nrel.gov/wind/avian_lit.html

- **A Population Study of Golden Eagles in the Altamont Pass Wind Resource Area: Population Trend Analysis 1994-1997**
- **Predicting the Response of Bird Populations to Wind Energy-Related Deaths**
- **Searcher Bias and Scavenging Rates in Bird/Wind Energy Studies**
- **Status of Avian Research at the National Renewable Energy Laboratory (2001)**
- **Status of the US Dept. of Energy/NREL Avian Research Program (1999)**
- **Studying Wind Energy/Bird Interactions: A Guidance Document**
- **The Response of Red-Tailed Hawks and Golden Eagles to Topographical Features, Weather, and Abundance of a Dominant Prey Species at the Altamont Pass Wind Resource Area, California**





Altamont Pass Wind Resource Area





One Interaction Study in Altamont Pass

Highlights:

For fresh kills ($n = 562$)

- **267 (48%) Raptors (i.e., eagles, hawks, falcons, owls)**
 - **291 (52%) Non-raptors (i.e., all other birds)**
 - **4 (<1%) Hoary Bats**
- 0.19 fatalities/turbine/year (combined average)**

From: *Bird Risk Behaviors and Fatalities at the Altamont Pass WRA*;
Carl G. Thelander, et al

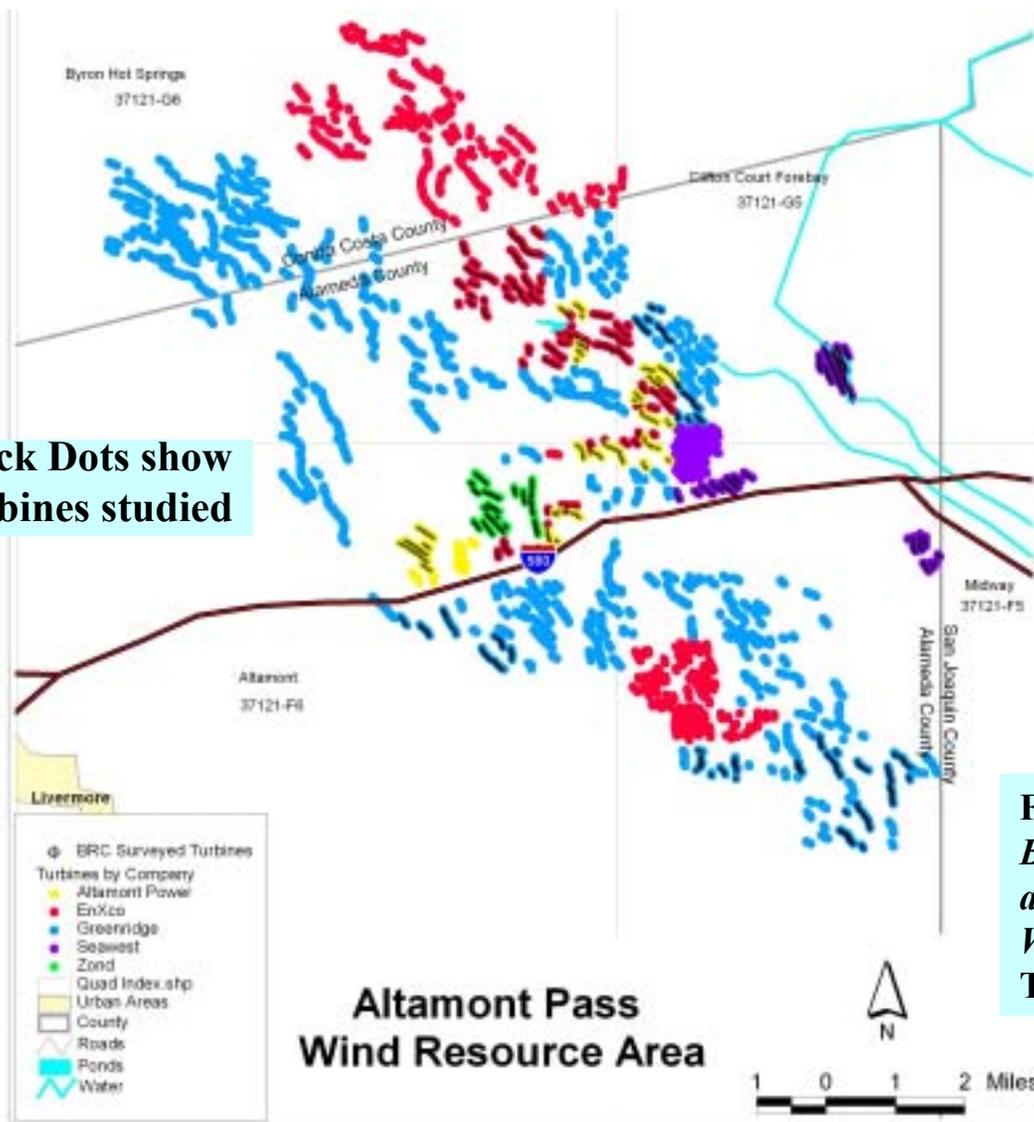




One Interaction Study in Altamont Pass

Highlights:

● Black Dots show turbines studied



From: *Bird Risk Behaviors and Fatalities at the Altamont Pass WRA*; Carl G. Thelander, et al

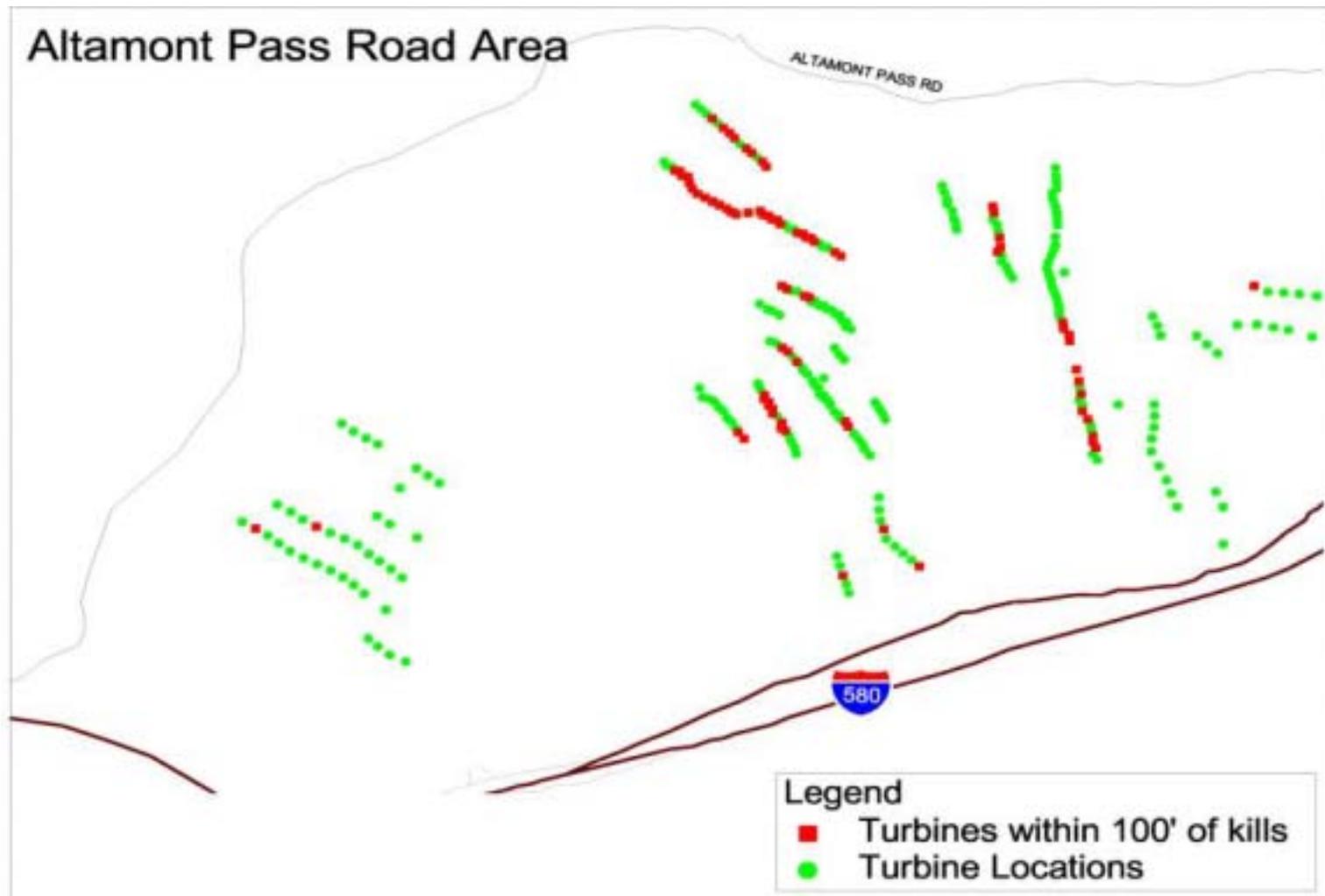




One Interaction Study in Altamont Pass

Highlights:

- Topographical features, turbine locator and prey appear to play roles
- Not all turbines appear to contribute to fatalities





One Interaction Study in Altamont Pass

Highlights:

Raptor Fatalities and Sightings

	<u>Fatalities</u>	<u>Sightings</u>	<u>Rel. Risk F/S</u>
Burrowing Owl	38	56	0.68
American Kestrel	22	429	0.51
Red-tailed Hawk	100	1,780	0.06
Golden Eagle	10	401	0.02
Northern Harrier	2	114	0.02
Prairie Falcon	1	63	0.02
Turkey Vulture	0	756	0
Common Raven	0	792	0

From: *Bird Risk Behaviors and Fatalities at the Altamont Pass WRA*,
Carl G. Thelander, et al





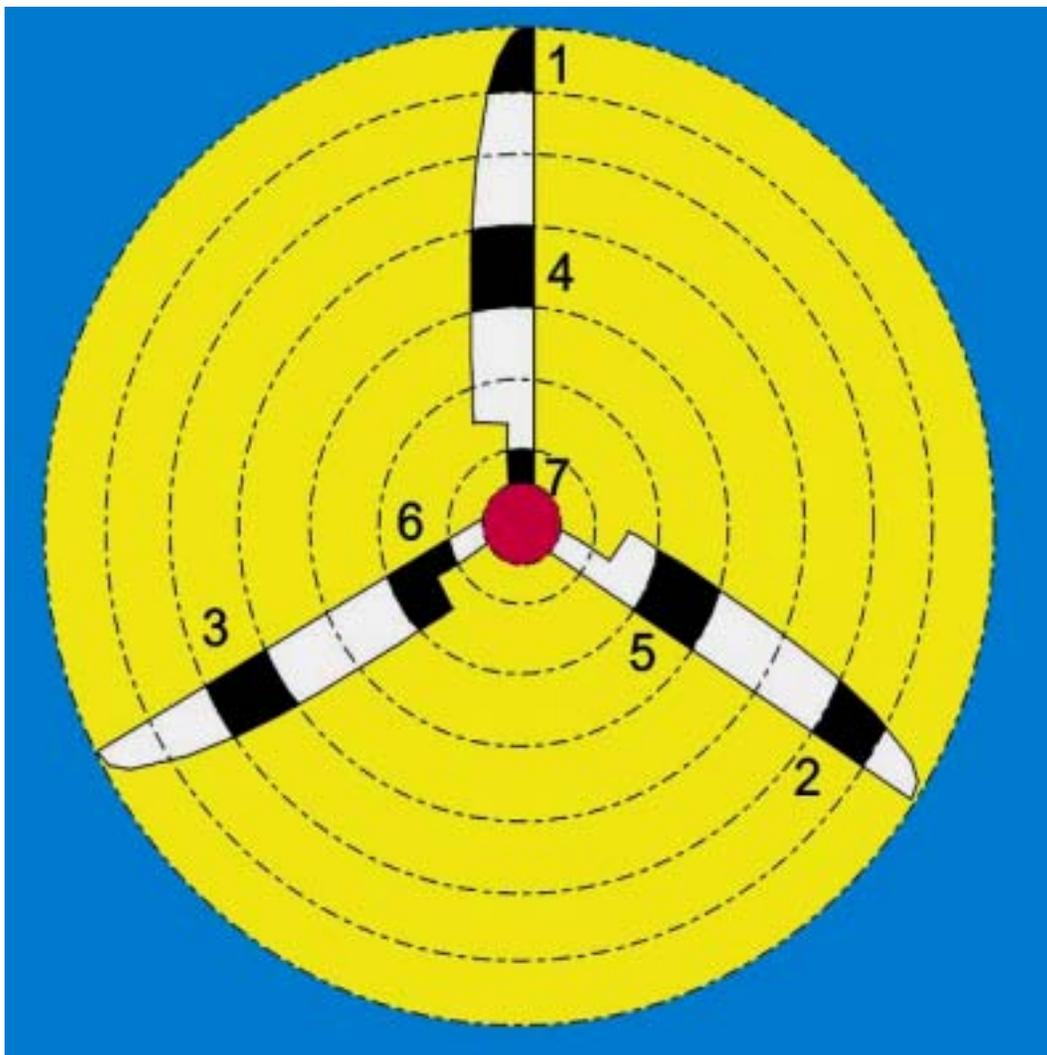
An Example of Motion Smearing



Source: *The Role of Visual Deterrents in Reducing Avian Collisions*; William Hodos, University of Maryland



Avian Visual Enhancement



Visual Patterns

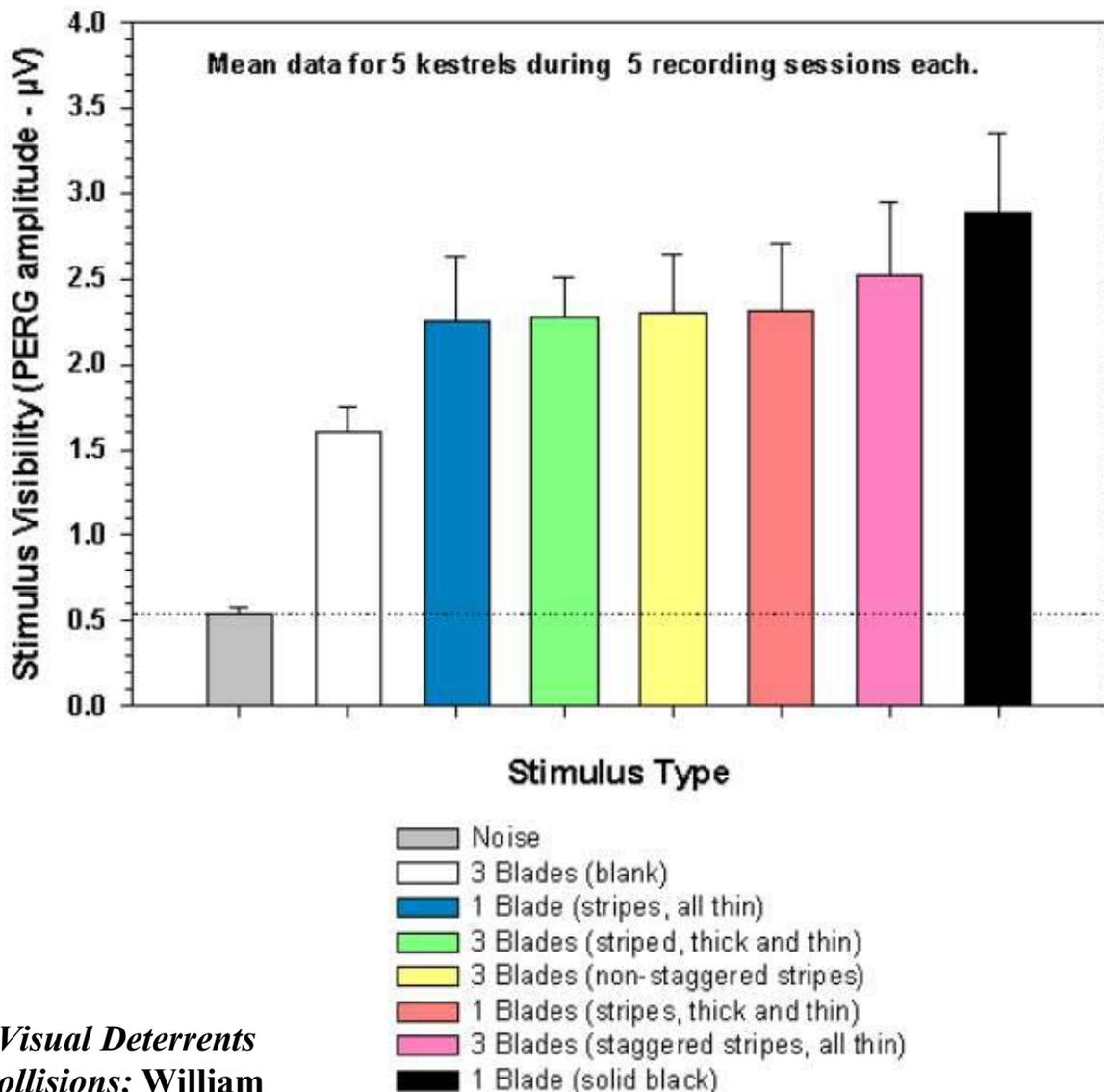


American Kestrel

Source: *The Role of Visual Deterrents in Reducing Avian Collisions*; William Hodos, University of Maryland



Example Visual Enhancement Results



Source: *The Role of Visual Deterrents in Reducing Avian Collisions*; William Hodos, University of Maryland





Informed Micrositing is Critical

A Major Conclusion

Facilities developed following the NWCC guidelines have not experienced significant avian impact issues.





Avian Program Close-out

NREL Score Card

Objectives Identified in 1994 Planning Meeting

Results in 2002

- | | |
|--|----------------------------------|
| <ul style="list-style-type: none">• Assess mortality attributable to wind turbines at existing sites (including control data from “no turbine” sites) | Accomplished |
| <ul style="list-style-type: none">• Predict mortality at planned wind power sites, based in part on previous bullet | Estimates are available |
| <ul style="list-style-type: none">• Predict population consequences | Initial studies available |
| <ul style="list-style-type: none">• Identify ways to reduce bird kills at wind plants | Several means identified |
| <ul style="list-style-type: none">• Set values for off-site mitigation | Not done |





Some Thoughts on Future Research

- Altamont Pass provides field test opportunities to reduce avian risk due to wind turbines
 - Population field studies
 - Turbine size effects
 - Visual treatments
 - Terrain and prey base effects

- The development of even larger turbines associated with offshore wind farms presents a different situation where we may be able to learn from European experience

