



Monday, September 19, 2005

2. WIND POWER

Link between bird, bat deaths and turbines needs further study -- GAO report **Ben Geman, *Greenwire* reporter**

The link between wind energy projects and bird deaths is poorly understood and needs more study, the Governmental Accountability Office says in a new report.

"Many wind power facilities in the United States have not been studied, and, therefore, scientists cannot draw conclusions about the threat wind power poses to wildlife in general," the [report](#) says. For example, GAO found no studies -- or at least none that are publicly available -- about wind power's effects on birds and bats in Texas, the state with the second highest amount of wind generating capacity.

"Experts told us that there is a shortage of information on migratory bird routes and bat behavior, as well as the ways in which topography, weather, and turbine type affect mortality," GAO says. Investigators also note that relatively few studies have been conducted on mitigation measures.

Overall, GAO confirms that bird deaths from wind turbines are not significant compared to other causes nationwide, and bat deaths are not a major problem outside Appalachia.

The report examines two locations where bird and bat deaths have raised concerns: Altamont Pass in California, where one study has estimated as many as 1,000 bird deaths per year, and Appalachia. At the smaller 44 turbine Mountaineer project in West Virginia, a 2004 study showed over 2,000 bats killed in a seven-month period. The report notes that there are proposals for hundreds of new turbines in the Appalachian mountains. Studies suggest that the most bat kills from wind turbines occur during the July-September migratory season, the report says but cautions that much remains unknown about the interaction between bats and turbines.

The findings prompted the two West Virginia congressman who requested the study -- Democrats Nick Rahall and Allan Mollohan -- to urge caution on new projects.

"This lack of scientific data is troubling, particularly because hundreds of new turbines have been proposed for West Virginia by out-of-state and even foreign companies, subsidized by our own state and local governments through very favorable tax laws," said Mollohan in a statement last week. "Before further damage is done, governments at the local, state and federal levels need to give serious study and thought to the impacts that these facilities have on sensitive areas."

GAO also says considerable uncertainty exists regarding the relationship between newer turbine technologies, which are taller and rely more on tubular towers where birds cannot perch, and bird deaths. "Altamont Pass ... has the potential to allow researchers to determine which turbines are more hazardous because it contains many different types of turbines in one place. However, even this analysis has been complicated by confounding variables," GAO says.

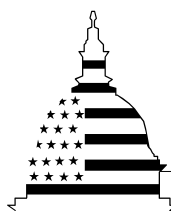
The pass, with over 5,000 turbines, has raised concern because of the deaths of many birds of prey -- which include hawks and golden eagles -- with one study suggesting over 1,000 deaths per year. But GAO notes that Altamont is atypical -- it has some of the oldest turbines in the United States, and a large number of turbines because older models produce less power per turbine.

GAO says its review of scientific literature shows that bird and bat kills have not been nearly as high elsewhere. "Our review of studies conducted in areas other than the Appalachian Mountains showed bat fatalities ranging from 0 to 4.3 bats per turbine, per

September 2005

WIND POWER

Impacts on Wildlife and Government Responsibilities for Regulating Development and Protecting Wildlife



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Highlights of [GAO-05-906](#), a report to congressional requesters

Why GAO Did This Study

Wind power has recently experienced dramatic growth in the United States, with further growth expected. However, several wind power-generating facilities have killed migratory birds and bats, prompting concern from wildlife biologists and others about the species affected, and the cumulative effects on species populations.

GAO assessed (1) what available studies and experts have reported about the impacts of wind power facilities on wildlife in the United States and what can be done to mitigate or prevent such impacts, (2) the roles and responsibilities of government agencies in regulating wind power facilities, and (3) the roles and responsibilities of government agencies in protecting wildlife. GAO reviewed a sample of six states with wind power development for this report.

What GAO Recommends

GAO recommends that FWS provide state and local regulatory agencies with information on the potential wildlife impacts from wind power and the resources available to help make decisions about where wind power development should be approved.

The Department of the Interior agreed with GAO's recommendation.

www.gao.gov/cgi-bin/gettrpt?GAO-05-906.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Robin Nazzaro at (202) 512-3841 or nazzaror@gao.gov.

WIND POWER

Impacts on Wildlife and Government Responsibilities for Regulating Development and Protecting Wildlife

What GAO Found

The impact of wind power facilities on wildlife varies by region and by species. Specifically, studies show that wind power facilities in northern California and in Pennsylvania and West Virginia have killed large numbers of raptors and bats, respectively. Studies in other parts of the country show comparatively lower levels of mortality, although most facilities have killed at least some birds. However, many wind power facilities in the United States have not been studied, and, therefore, scientists cannot draw definitive conclusions about the threat that wind power poses to wildlife in general. Further, much is still unknown about migratory bird flyways and overall species population levels, making it difficult to determine the cumulative impact that the wind power industry has on wildlife species. Notably, only a few studies exist concerning ways in which to reduce wildlife fatalities at wind power facilities.

Regulating wind power facilities is largely the responsibility of state and local governments. In the six states GAO reviewed, wind power facilities are subject to local- or state-level processes, such as zoning ordinances to permit the construction and operation of wind power facilities. As part of this process, some agencies require environmental assessments before construction. However, regulatory agency officials do not always have experience or expertise to address environmental and wildlife impacts from wind power. The federal government plays a minimal role in approving wind power facilities, only regulating facilities that are on federal lands or have some form of federal involvement, such as receiving federal funds. In these cases, the wind power project must comply with federal laws, such as the National Environmental Policy Act, as well as any relevant state and local laws.

Federal and state laws afford generalized protections to wildlife from wind power as with any other activity. The U.S. Fish and Wildlife Service (FWS) is the primary agency tasked with implementing wildlife protections in the United States. Three federal laws—the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, and the Endangered Species Act—generally forbid harm to various species of wildlife. Although significant wildlife mortality events have occurred at wind power facilities, the federal government has not prosecuted any cases against wind power companies under these wildlife laws, preferring instead to encourage companies to take mitigation steps to avoid future harm. All of the six states GAO reviewed had statutes that can be used to protect some wildlife from wind power impacts; however, similar to FWS, no states have taken any prosecutorial actions against wind power facilities where wildlife mortalities have occurred.

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Abbreviations

BLM	Bureau of Land Management
DOE	Department of Energy
FWS	U.S. Fish and Wildlife Service
MW	megawatts

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United States Government Accountability Office
Washington, D.C. 20548

September 16, 2005

The Honorable Nick J. Rahall, II
Ranking Democratic Member, Committee on Resources
House of Representatives

The Honorable Alan B. Mollohan
Ranking Democratic Member, Subcommittee on Science,
the Departments of State, Justice, and Commerce
and Related Agencies
Committee on Appropriations
House of Representatives

The production of wind power, a renewable energy source, has recently experienced dramatic growth in the United States, although it still generates less than 1 percent of the electricity used in this country. Wind power-generating facilities were first built in California about 25 years ago. Now wind power facilities can be found in over 30 states, and the industry is expected to continue to grow rapidly. The vast majority of wind power facilities are located in just 10 western and midwestern states; most are on nonfederal land. Development has slowly made its way east and is currently being pursued along the ridge tops of the Appalachian Mountains in Maryland, Pennsylvania, Virginia, and West Virginia. Once thought to have practically no adverse environmental effects, it is now recognized that wind power facilities can have adverse impacts—particularly on wildlife, and most significantly on birds and bats.

Large numbers of birds and bats are believed to follow and cross through many parts of the United States, including along mountain ridges, during their seasonal migrations. Consequently, wind power projects located in these areas could potentially impact these species. At wind power-generating facilities in Appalachia and California, wind turbines have killed large numbers of migratory birds and bats. Wind power facilities may also have other impacts on wildlife through alterations of habitat. Habitat destruction and modification is a leading threat to the continued survival of wildlife species in the United States.

In this context, we assessed (1) what available studies and experts have reported about the impacts of wind power facilities on wildlife in the United States and what can be done to mitigate or prevent such impacts, (2) the roles and responsibilities of government agencies in regulating wind

power facilities, and (3) the roles and responsibilities of government agencies in protecting wildlife.

To address these objectives, we reviewed major scientific studies and reports on direct impacts from wind power on avian species and other wildlife (we did not assess indirect impacts, such as habitat impacts). We interviewed experts from the Department of the Interior's U.S. Fish and Wildlife Service (FWS), state agencies, academia, industry, and conservation groups and obtained their views on these studies and reports. We also reviewed a nonprobability sample of six states with wind power development—California, Minnesota, New York, Oregon, Pennsylvania, and West Virginia.¹ We selected these states to reflect a range in installed wind generating capacity, regulatory processes, history of wind power development, and geographic distribution and to reflect our requesters' interests. We identified and reviewed relevant federal, state, and local laws and regulations. In addition, we interviewed federal, state, and local officials who were responsible for implementing related programs. More information about the objectives, scope, and methodology of our evaluation is presented in appendix I. We conducted our work between December 2004 and July 2005 in accordance with generally accepted government auditing standards, including an assessment of data reliability and internal controls.

Results in Brief

Recent studies and interviews with experts indicate that the impacts of wind power facilities on birds and other wildlife vary by region and by species. Wildlife mortalities in two locations in particular have elicited concerns from scientists, regulators, and the public. Specifically, a recent study shows that over 1,000 raptors are killed by wind power facilities in northern California each year. Many experts attribute this large number of fatalities to unique aspects of wind power development in northern California, such as the unusually large number of turbines (over 5,000), the type of turbines in the region, and the presence of abundant raptor prey in the area. On the other side of the country, a recent study estimated that over 2,000 bats were killed during a 1-year period at a wind power facility in the mountains of eastern West Virginia. Studies from these two locations stand in contrast to studies from other wind power facilities. These studies

¹Results from nonprobability samples cannot be used to make inferences about a population because in a nonprobability sample, some elements of the population being studied have no chance or an unknown chance of being selected as part of the sample.

show relatively lower bird and bat mortality. However, bat estimates are less precise because most of the studies were designed to estimate only bird mortality. These studies have not elicited the same degree of concern from biologists as the studies from West Virginia and California. However, significant gaps in the literature make it difficult for scientists to draw conclusions about wind power's impact on wildlife in general. For example, experts told us that there is a shortage of information on migratory bird routes and bat behavior as well as the ways in which topography, weather, and turbine type affect mortality. In addition, studies conducted at one location can rarely be used to extrapolate potential impacts or mitigation effectiveness at other locations because of differences in site-specific conditions, such as topography, the types and densities of species present, and the type of wind turbines installed. Finally, while some authors have recommended mitigation strategies for reducing bird and bat kills, there are relatively few comprehensive studies testing the effectiveness of these strategies.

Regulating wind power facilities on nonfederal land is largely the responsibility of state and local governments. In the six states we reviewed, the permitting of wind power development consisted of local-level processes, state-level processes, or a combination of the two. In California, New York, and Pennsylvania, local governments regulate the development of wind power. Local governments in these states generally require wind developers to adhere to local zoning ordinances and obtain special use permits before construction. In addition, California and New York have state environmental laws that require various studies and analyses to be conducted before a permit can be issued. West Virginia uses a state-level process, whereby its Public Service Commission is responsible for, among other things, regulating the activities of all public utilities operating in the state, including wind power. The commission has the authority to include certain conditions in wind power certificates, such as requiring wildlife studies before and after construction. In Minnesota and Oregon, local and state agencies regulate wind power development. In these two states, local agencies, such as county planning commissions or zoning boards, permit the development of wind power unless a project exceeds a certain level of electric-generating capacity; larger facilities are regulated by a state agency. While some state and local regulatory agencies require environmental assessments before construction, some state and local regulatory agency officials told us that they have little experience or expertise in addressing environmental and wildlife impacts from wind power. For example, officials in one state told us that they did not have the expertise to evaluate wildlife impacts and review studies prior to

construction. The federal government generally only has a regulatory role in wind power development when development occurs on federal land or involves some form of federal participation, such as providing funding for projects. In these cases, the development and operation of a wind power facility must comply with any state and local laws as well as federal laws, such as the National Environmental Policy Act and the Endangered Species Act—which often require preconstruction studies or analyses and possibly modifications to proposed projects to avoid adverse environmental effects.

As with any activity, federal and state laws afford protections to wildlife from wind power facilities. Three laws—the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, and the Endangered Species Act—are the federal laws most relevant to protecting wildlife from wind power facilities, and these laws generally forbid harm to various species of wildlife. FWS is the federal agency that has primary responsibility for implementing and enforcing these three laws. Although none of the three laws expressly require wind power developers and operators to take specific steps to ensure that wildlife will not be harmed during either the construction or operation of their facilities, wind power developers or operators are liable for any harm to protected species that may occur. In some cases, developers voluntarily consult with FWS—or a state natural resources agency—before they construct a project or they do so as a requirement of a state or local wind power regulatory agency, to identify potential impacts to wildlife. In other cases, federal involvement may consist of FWS law enforcement officials investigating instances of wildlife fatalities at a wind power facility. While significant mortality events have occurred at some wind power facilities—and, in some cases, are recurring—the federal government has not prosecuted any cases against wind power companies for violations of federal wildlife laws. In some cases, FWS has not taken action because the species killed are not federally protected, such as the bat species killed in West Virginia. In cases where violations of federal law have occurred, FWS law enforcement officials told us that before FWS pursues civil or criminal penalties, the agency prefers to work with companies to encourage them to take mitigation steps to avoid future harm. According to FWS officials, they have been reasonably successful in resolving impacts to wildlife by following this approach with the electric power industry. FWS has also referred cases against wind power developers to either the Interior's Office of the Solicitor San Francisco field office or the Department of Justice for killing raptors, but Justice was unable to comment on the specifics of its ongoing investigation. FWS has been working with the wind industry to help identify solutions and ensure that wildlife mortality at wind power

facilities is minimized. For example, FWS has participated in industry-sponsored workshops and conferences, issued voluntary guidelines for industry to use in developing new projects, and served as a member in a wildlife working group with industry. Regarding state wildlife protections, all of the six states we reviewed have statutes that can be used to protect some wildlife from wind power impacts. However, similar to FWS, no states have taken any prosecutorial actions against wind power facilities where wildlife mortalities have occurred.

To encourage potential wildlife impacts to be considered when wind power facilities are permitted, we are making a recommendation to FWS to reach out to state and local regulatory agencies with information on the potential wildlife impacts due to wind power and on the resources available to help make decisions about the siting of wind power facilities.

We received written comments on a draft of this report. The Department of the Interior stated that they generally agree with our findings and our recommendation in the report. Written comments from the department are included in appendix III.

Background

The energy used to generate our nation's electricity comes from many different sources. Currently, most electricity in the United States is generated with fossil fuel and nuclear technologies—coal (52 percent), nuclear (20 percent), natural gas (16 percent), and oil (3 percent). Fossil fuels are considered nonrenewable because they are finite and will eventually dwindle or become too expensive or environmentally damaging to retrieve. Wind, however, is one of several sources of energy known as renewable energy. Other forms of renewable energy sources include sunlight (photovoltaics), heat from the sun (solar thermal), naturally occurring underground steam and heat (geothermal), plant and animal waste (biomass), and water (hydropower).

To reduce our dependence on nonrenewable energy sources, the United States has promoted the development of renewable resources, such as wind. A key federal program supporting the development of such sources is the federal production tax credit established by the Energy Policy Act of 1992.² This law provides a tax credit for electricity generated by renewable

²26 U.S.C. § 45. Section 1301 of the Energy Policy Act of 2005, Pub. L. No. 109-58, extended the tax credit through January 1, 2008.

energy sources, such as wind turbines. The Economic Recovery Tax Act of 1981 provides an additional incentive for wind power growth.³ In some cases, this law allows a 5-year depreciation schedule for renewable energy systems. In conjunction with the tax credit, this accelerated depreciation allows an even greater tax break for renewable energy projects, such as wind projects, that have high initial capital costs.⁴

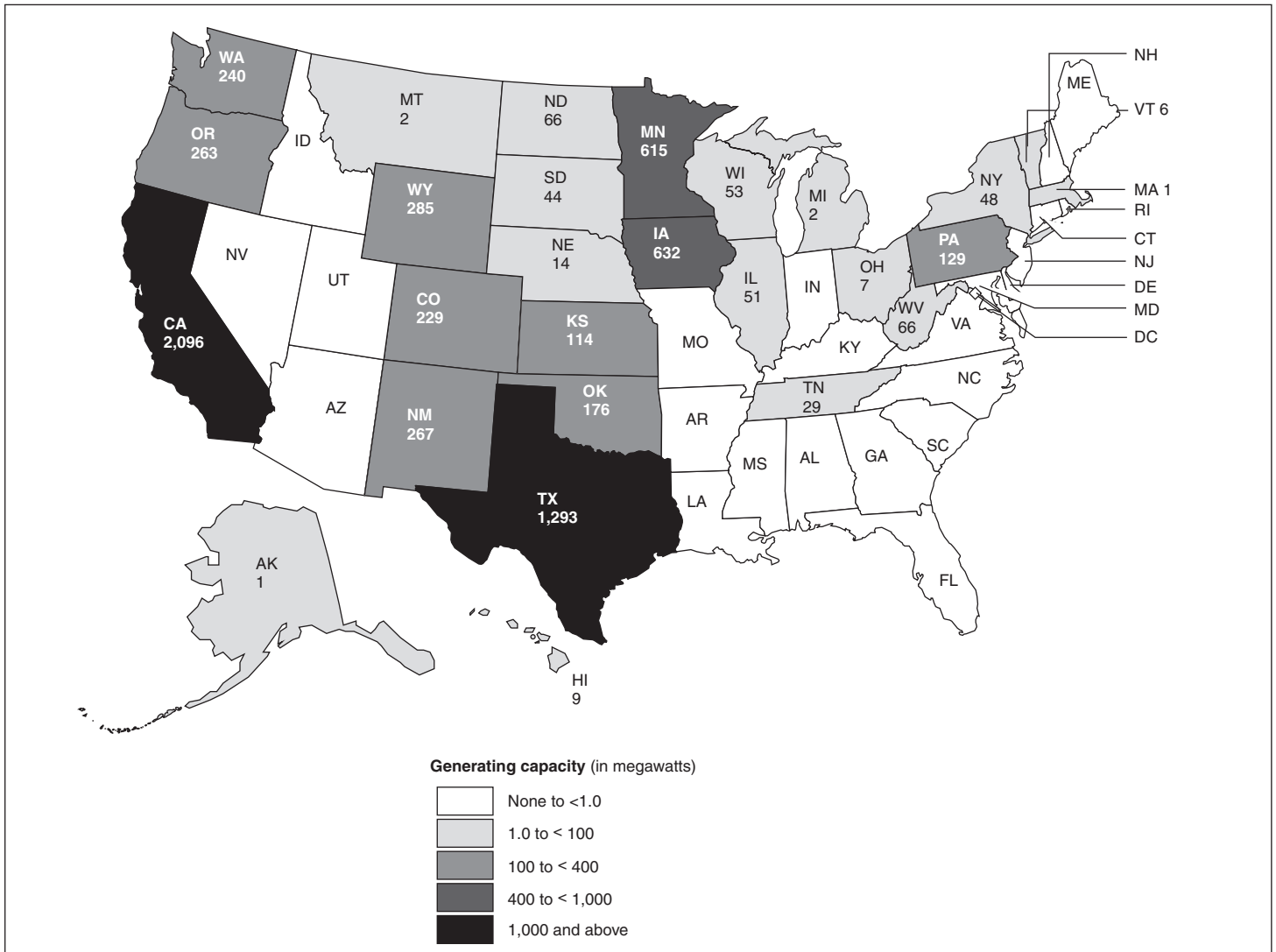
Some states also provide incentives for wind power development. One of the strongest drivers is a renewable portfolio standard. Generally, a renewable portfolio standard requires utilities operating in a state to acquire a minimum amount of their electricity supply from renewable energy sources. As of June 2005, 18 states had some form of renewable power requirements capable of being met by wind power. Other common types of incentives for renewable energy development provided by several state and local governments are income tax incentives and property and sales tax exemptions. Many states provide more than one type of incentive. In addition, 25 states have statewide wind working groups that are funded (at least partially) through grants from the Department of Energy (DOE). The purpose of these working groups is to promote more widespread development of wind power.

These federal and state programs have helped spur significant wind power development in the last 5 years. At the end of 2004, the total installed capacity from wind power in the United States was 6,740 megawatts (MW), or enough capacity to meet the electricity demand of between 1.5 and 2.0 million average American households (see fig. 1).

³26 U.S.C. § 168(e)(3)(B)(vi).

⁴See GAO, *Renewable Energy: Wind Power's Contribution to Electric Power Generation and Impact on Farms and Rural Communities*, [GAO-04-756](#) (Washington, D.C.: Sept. 3, 2004) for prior work related to this issue.

Figure 1: Installed Wind Power-Generating Capacity in Megawatts, by State, as of January 24, 2005

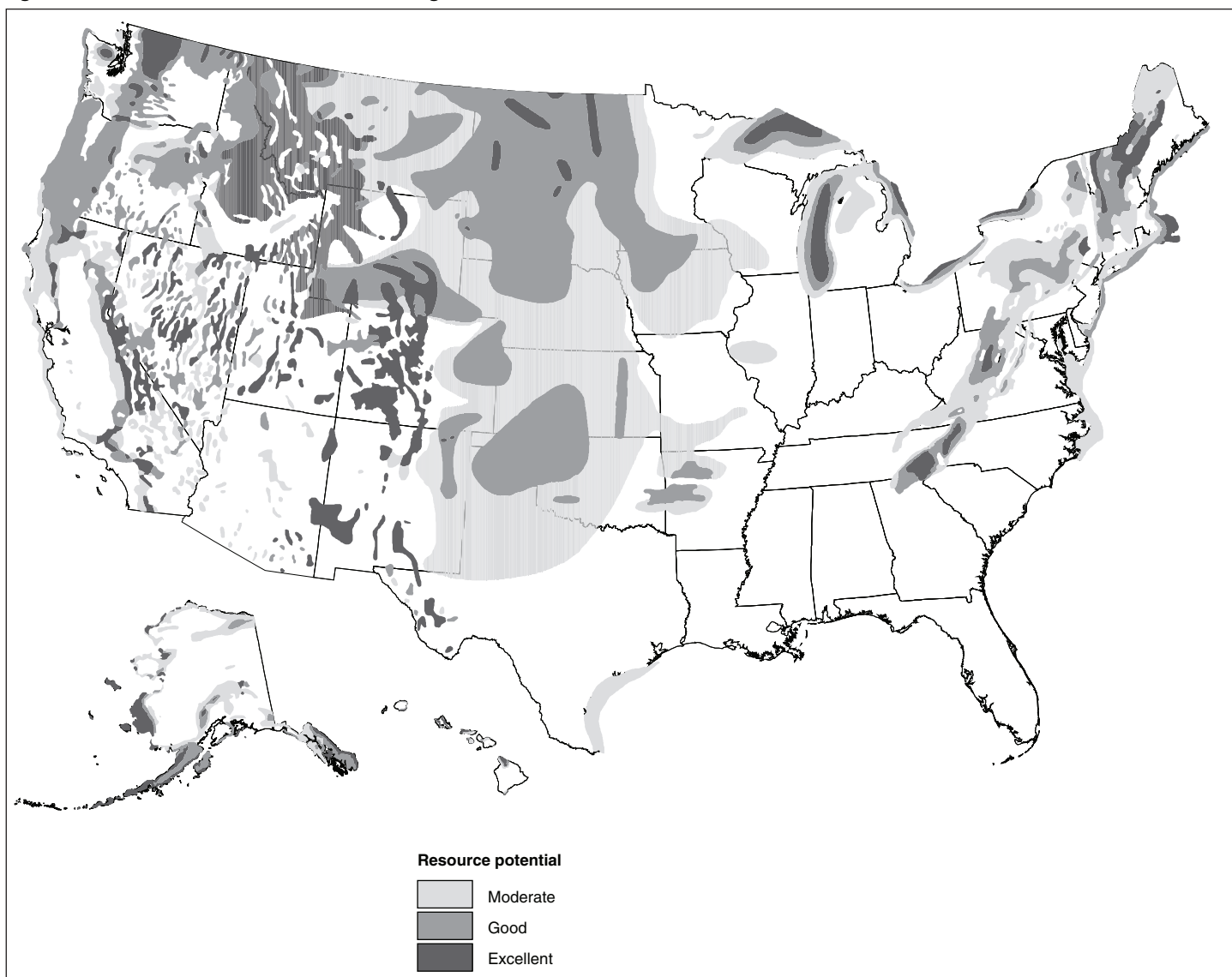


Source: American Wind Energy Association.

Between January 2000 and December 2004, installed electric-generating capacity more than doubled, adding over 4,200 MW of capacity. Although wind power generates less than 1 percent of the nation's electricity, with an average annual growth rate of over 24 percent, it is the fastest growing source of electricity generation on a percentage basis. Because wind energy is a function of wind speed, the best locations for turbines are areas

that have frequent strong winds to turn the blades of the power-generating turbines. See figure 2 for areas of the United States with high wind potential.

Figure 2: Areas of the United States with High Wind Potential



Source: Department of Energy, National Renewable Energy Laboratory.

According to DOE, 36 of the 48 continental states have wind resources that would support utility-scale wind power projects (i.e., projects that generate at least 1 MW of electric power from 1 or more turbines annually for sale to a local utility). A DOE goal for wind power is to generate 5 percent of the electricity generated in the United States by 2020; the American Wind Energy Association has a similar goal.⁵ To reach this goal, the association estimates that about 100,000 MW of installed capacity will be needed—approximately 15 times the current installed capacity. On the basis of the average MW size of wind turbines commonly being installed today (1.5 MW), more than 62,000 additional turbines will need to be added to the existing 16,000 turbines already constructed in the United States to meet such a goal.

Most of the wind power development in the United States has occurred in 10 western and midwestern states—California, Colorado, Iowa, Minnesota, New Mexico, Oklahoma, Oregon, Texas, Washington, and Wyoming. In fact, these 10 states have over 90 percent of the total installed wind power capacity nationwide. Only recently have developers begun to build wind energy facilities in the eastern United States. As shown in figure 2, wind power potential in this geographic area is best along mountain ridges, primarily the Appalachian Mountains, and along the coast of the northeastern United States.

Wind power is considered a “green” technology because, unlike fossil fuel power plants, it does not produce harmful emissions, such as carbon dioxide, nitrogen oxides, sulfur dioxide, mercury, and particulate matter, which can pose human health and environmental risks such as acid rain. However, it is now recognized that wind power facilities can adversely affect the environment in other ways, specifically in impacting wildlife such as birds and bats. Wind power facilities located in migratory pathways or important habitats may harm the wildlife living or passing through the area by killing or injuring them or by disrupting feeding or breeding behaviors. But wind power is not alone in its impacts on wildlife. Millions, or perhaps billions, of wildlife are killed every year in the United States through a myriad of human activities. While sources of bat mortality are not as well known, FWS estimates that some of the leading sources of bird mortality, per year, are collisions with building windows—97 million to 976

⁵The American Wind Energy Association is a national trade association that represents wind power plant developers, wind turbine manufacturers, utilities, consultants, insurers, financiers, researchers, and others involved in the wind industry.

million bird deaths, collisions with communication towers—4 million to 50 million bird deaths, poisoning from pesticides—at least 72 million birds, and attacks by domestic and feral cats—hundreds of millions of bird deaths. Human activities also result in the destruction or modification of wildlife habitat; habitat loss and fragmentation are leading threats to the continued survival of many species.

Studies Show Wind Power Facility Impacts on Wildlife Vary, Although Notable Gaps in the Literature Remain and Few Studies Address Mitigation

Recent studies and interviews with experts reveal that the impacts of wind power facilities on birds and other wildlife vary by region and by species. Specifically, studies showing raptor mortality in California and bat mortality in Appalachia have elicited concerns from scientists, environmental groups, and regulators because of the large number of kills in these areas and the potential cumulative impact on some species. Thus far, documented bird and bat mortality from wind power in other parts of the country has not occurred in numbers high enough to raise concerns. However, gaps in the literature make it difficult to develop definitive conclusions about the impacts of wind power on birds and other wildlife. Notably, only a few studies have been conducted on strategies to address the potential risks wind power facilities pose to wildlife.

Wildlife Mortality Varies by Region and by Species

Our review of the literature and discussions with experts revealed that, thus far, concerns over direct impacts to wildlife from wind power facilities have been concentrated in two geographic areas—northern California and Appalachia.⁶ (For a discussion on how we selected these studies, see app. I.) While bird and bat kills have been documented in many locations, biologists are primarily concerned about mortality in these two regions because of the numbers of wildlife killed and the species affected.

Studies Have Found Large Numbers of Raptors Killed by Wind Turbines in California

Wind power facilities in northern California, specifically in the Altamont Pass Wind Resource Area about 50 miles east of San Francisco, have been responsible for the deaths of numerous raptors, or birds of prey, such as hawks and golden eagles, and, as a result, these deaths have elicited concern from wildlife protection groups, biologists, and regulators. Studies conducted in the last two decades have documented large numbers of raptor deaths in this area. One study in our review found estimates as high

⁶Many of these studies were conducted by consultants for wind power companies and were not scientifically peer-reviewed. In addition, protocols used in these studies may vary.

as over 1,000 raptor deaths per year. Such large numbers of raptor kills due to wind power are not seen elsewhere in the United States. A 2001 summary that examined raptor mortality rates from studies in 10 states estimated that over 90 percent of the raptors killed annually in the United States by wind power turbines occurred in California.⁷

Several unique features of the wind resource area at Altamont Pass contribute to the high number of raptor deaths. First, California was the first area to develop wind power in significant numbers and thus has some of the oldest turbines still in operation in the United States. Older turbines produce less power per turbine, so it took many turbines to produce a certain level of energy; today, newer facilities producing the same amount of energy would have much fewer turbines. For example, Altamont Pass has over 5,000 wind turbines—many of which are older models—whereas, newer facilities generally have significantly fewer turbines (see figs. 3 and 4). Some experts told us that the sheer number of turbines in Altamont Pass has been a major reason for the high number of fatalities in the area.

⁷Erickson, Wallace P., Gregory D. Johnson, M. Dale Strickland, David P. Young Jr., Karyn J. Sernka, and Rhett E. Good. *Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States*. A National Wind Coordinating Committee Resource Document, August 2001. Because summaries of studies generally do not present detailed information about the methodologies of the studies they include, these results should be considered with caution.

Figure 3: Example of Older Generation Wind Turbines in Altamont Pass, Northern California



Source: California Energy Commission.

Figure 4: Example of a Newer Generation Wind Power Facility



Source: Department of Energy, National Renewable Energy Laboratory.

Secondly, some scientists believe that the design of older generation turbines, like those found in Altamont Pass, are more fatal to raptors. Specifically, early turbines were mounted on towers 60 feet to 80 feet in height, while today's turbines are mounted on towers 200 feet to 260 feet in height. Experts told us that the older turbines at Altamont Pass have blades that reach lower to the ground, and thus can be more hazardous to raptors as they swoop down to catch prey. Experts also reasoned that the relative absence of raptor kills at newer facilities with generally taller turbines supports the notion that these turbines are less lethal to raptors. Third, the location of the wind turbine facilities at Altamont Pass may have contributed to the high number of raptor deaths. Studies show that there are a high number of raptors that pass through the area, as well as an abundance of raptor prey at the base of the turbines. In addition, the location of wind turbines on ridge tops and canyons may increase the likelihood that raptors will collide with turbines. Some experts note that one reason why other parts of the country may not be experiencing high levels of raptor mortality is partly because wind developers have used information from Altamont Pass to site new turbines in hopes of avoiding similar situations.

Studies Have Found Large Numbers of Bats Killed by Wind Turbines in Appalachia

Recent studies conducted in the eastern United States in the Appalachian Mountains have found large numbers of bats killed by wind power turbines. A 2004 study conducted in West Virginia estimated that slightly over 2,000 bats were killed during a 7-month study at a location with 44 turbines. More recently, a 2005 report that examined wind resource areas both in West Virginia and Pennsylvania estimated that about 2,000 bats were killed during a much shorter 6-week study period at 64 turbines. Lastly, a study conducted of a small 3-turbine wind facility in Tennessee estimated that bat mortality was about 21 bats per turbine, per year, raising concerns about the potential impact on bats if more turbines are built in this area.

Various species of bats have been killed at these wind power facilities and experts are concerned about impacts to bat populations if large numbers of deaths continue. For example, one expert noted that “it is alarming to see the number of bats currently being killed coupled with the proposed number of wind power developments” in these areas. He explained that bats live longer and have lower reproductive rates than birds, and, therefore, bat populations may be more vulnerable to impacts. In addition, there are proposals for hundreds of new wind turbines along the Appalachian Mountains. A recent report from Bat Conservation International estimated that if all ridge-top turbines are approved and the mortality rates continue at their current rate, these turbines might kill tens of thousands of bats in a single season. Although none of the bats killed by wind power to date have been listed as endangered species, FWS—recognizing the seriousness of the problem—has initiated a study with the U.S. Geological Survey to study bat migration and to develop decision tools to provide assistance in identifying locations for wind turbines and communication towers.

Studies Show That Bird and Bat Mortality from Wind Power in Other Parts of the Country Is Comparatively Lower Than in California and Appalachia

Results from studies on bird and bat mortality from wind power conducted in areas other than northern California and Appalachia have not caused the same degree of concern as in these two locations. Our review of studies conducted in areas other than the Appalachian Mountains showed bat fatality rates ranging from 0 to 4.3 bats per turbine, per year—compared with rates as high as 38 bats per turbine, per a 6-week study period, in the Appalachian Mountains (see app. II). Raptor fatalities outside Altamont Pass ranged from 0 to 0.07 raptors per turbine, per year, whereas, rates in Altamont Pass ranged from 0.05 to 0.24. Our review of studies found that overall bird fatalities from wind power ranged from 0 to 7.28 birds per turbine, per year. In addition, a 2004 National Wind Coordinating Committee fact sheet shows that an average of 2.3 birds per turbine, per

year are killed at facilities outside of California.⁸ However, it is important to also look at the number of turbines and the vulnerability of the species affected when interpreting these rates. For example, the high rate of 7.28 overall bird fatalities per turbine was found at a facility of only 3 wind turbines. Therefore, if no additional turbines are built in this area, the overall impact to the bird populations may be minimal; whereas, a lower fatality rate may cause impacts if there are many turbines in that particular area. In addition, comparing study findings can be difficult because researchers may use differing metrics and many areas of the country remain unstudied with regard to avian and bat impacts from wind power. While interpreting these statistics can be complicated, the experts we spoke with agreed that outside of California and Appalachia at the current level of wind power development, the research to date has not shown bird or bat kills in alarming numbers.

While the studies we reviewed showed relatively low levels of mortality in many locations, there are also indirect impacts to wildlife from wind power facilities. For example, construction of wind power facilities may fragment habitat and disrupt feeding or breeding behaviors. According to FWS, the loss of habitat quantity and quality is the primary cause of declines in most assessed bird populations and many other wildlife species. However, this review focuses on the direct impacts of avian and bat mortality.

Several Gaps Exist in Research on Wind Power Facility Impacts on Wildlife

While experts told us that the impact of wind power facilities on wildlife is more studied than other comparable infrastructure, such as communication towers, important gaps in the research remain. First, relatively few postconstruction monitoring studies have been conducted and made publicly available. It appears that many wind power facilities and geographic areas in the United States have not been studied at all. For example, a bird advocacy group expressed concern at a recent National Wind Coordinating Committee meeting that most of the wind projects that have been monitored for bird impacts are in the west. The American Wind Energy Association reports that there are hundreds of wind power facilities currently operating elsewhere in the country. However, we were able to

⁸National Wind Coordinating Committee, *Wind Turbine Interactions with Birds and Bats: A Summary of Research Results and Remaining Questions*. Fact sheet: Second Edition. November 2004. Because summaries of studies generally do not present detailed information about the methodologies of the studies that they include, these results should be considered with caution.

locate only 19 postconstruction studies that were conducted to assess direct impacts to birds or bats in 11 states.⁹ Texas, for example, is second only to California in installed wind power capacity, but we were unable to find a single, publicly available study investigating bird or bat mortality in that state.

Lack of comprehensive data on bird and bat fatalities from wind turbines makes it difficult to make national assessments of the impact of wind turbines on wildlife. A 2001 analysis of studies estimated that wind turbines in the United States cause roughly 33,000 avian deaths per year.¹⁰ However, the authors noted that making projections of the potential magnitude of wind power-related avian fatalities is problematic, in part, because of the lack of long-term data. The authors further noted that the data collected at older sites may not be representative of newer facilities with more modern turbine technology. In addition, FWS considers this estimate to be a “minimum” to “conservative” estimate due to problems of data collection and uneven regional representation. In addition to limiting assessments of national impacts, a lack of data on actual mortality impacts siting decisions for new facilities. Specifically, the conclusions of postconstruction studies are often used when making preconstruction predictions about the degree of harm to wildlife that is likely expected from proposed facilities. If there are no local postconstruction studies available, predictions of future mortality at a proposed site must be based on information from studies conducted in areas that may have different wildlife species, topography, weather conditions, climate, soil types, and vegetative cover.

A second important research gap is in understanding what factors increase the chances that turbines will be hazardous to wildlife. For example, it can be difficult to discern, among other things, how the number, location, and type of turbine; the number and type of species in an area; species behavior; topography; and weather affect mortality and why. Drawing conclusions about the degree of risk posed by certain factors—such as terrain, weather, or type of turbine—is difficult because sites differ in their combination of factors. For example, according to experts, data are inadequate about what turbine types are most hazardous and to what species. This is partly because most wind power facilities use only one

⁹See appendix I for the criteria we used for including studies in our review.

¹⁰Erickson, Wallace P., Gregory D. Johnson, M. Dale Strickland, David P. Young Jr., Karyn J. Sernka, and Rhett E. *Avian Collisions with Wind Turbines*.

turbine type. Therefore, even if one facility proved more hazardous than another, it would be difficult to attribute the difference to turbine type alone because other variables, such as topography or migratory patterns, are also likely to vary among the sites. Additionally, comparisons between studies are difficult because researchers may use different study methodologies. Therefore, even if two sites had similar bird populations, topography, and weather characteristics but different turbines, it would be difficult to isolate the effect of the turbine if the scientists collecting the information used differing methodologies.

Altamont Pass, however, has the potential to allow researchers to determine which turbines are more hazardous because it contains many different types of turbines in one place. However, even this analysis has been complicated by confounding variables. For example, according to experts, at one time it was commonly thought that turbines with lattice towers killed more birds than turbines with tubular towers in Altamont Pass; however, some studies have reached the opposite conclusion. One study noted that although the authors found higher mortality associated with lattice towers, this relationship might be explained by factors such as the fact that lattice towers were found to be in operation more frequently than were other towers, including tubular towers, rather than the difference in the design of the towers. Complicating matters still, some factors may be more hazardous for some species than others. One study found that red-tailed hawk fatalities occurred more frequently than expected at turbines located on ridgelines than on hillsides. The authors found the reverse to be true for golden eagles, demonstrating the difficulty of understanding interactions between turbines and bird mortality from bird mortality estimates alone.

A third research gap is the lack of complete and definitive information on the interaction of bats with wind turbines. As previously noted, bats have collided with wind turbines in significant numbers in some parts of the United States, but scientists do not have a complete understanding regarding why these collisions occur. Bats are known to have the ability to echolocate to avoid collision with objects, and they have been able to avoid colliding with comparable structures such as meteorological towers.¹¹ Therefore, their collision with wind turbines remains a mystery. The few studies that have been conducted show that most of the kills have taken

¹¹Meteorological towers are used to assess weather conditions, including wind speed and direction.

place during the migratory season (July through September), and this suggests that migrating bats are involved in most of the fatalities. In addition, one study showed that lower wind speeds were associated with higher fatality rates. However, experts admit that much remains unknown about why bats are attracted to and killed by turbines and about what conditions increase the chances that bats will be killed. One expert noted that there is still very little known about bat migration in general and about the way in which bat interactions with turbines are affected by weather patterns. This expert further noted that there still has not been a full season of monitoring bat mortality from which patterns can be identified.

Although scientists still do not know why bats are being killed in large numbers by wind power turbines in some areas, several hypotheses have been offered. One hypothesis states that the lighting on turbines attracts insects, which in turn attracts bats, but studies have not demonstrated differences in fatalities between lit turbines and unlit turbines. Other hypotheses include the notions that bats may be investigating wind turbines as potential roosting sites, that open spaces around turbines create favorable foraging habitats, and that migrating bats do not echolocate and thus are less able to avoid collision. One thing bat experts agree on is the need for more research.

In addition to these research gaps regarding bird and bat interactions with turbines, very little is known about bird and bat populations in general, such as their size and migratory pathways. An FWS official told us that data are available regarding the migration routes and habitat needs of only about one-third of the more than 800 bird species that live in or pass through the United States each year. In addition, bat researchers stressed to us that very little is known about the pathways and behavior of migratory bats. This lack of information, among other factors, makes it difficult to assess the cumulative impacts from wind power on species populations. One expert noted that many bird populations are in decline in general and additional losses due to wind power may exacerbate this trend. However, it is very difficult to attribute a decline in bird populations to wind power specifically or to get good data on overall populations that span international borders. Our literature search was only able to find one study in the United States that examined the impact of fatalities from wind power on a particular species population—golden eagles—and those results have been described as relatively inconclusive, or mixed, by other scientists. Without this kind of information, it can be difficult to determine the appropriate public policy responses to wildlife impacts due to wind power.

Although there are currently several gaps in the study of wind power's direct impacts on birds and bats, FWS and the U.S. Geological Survey have recently initiated a study of bird and bat migration behaviors to address some of these data gaps. This study will use radar technology to characterize daily and seasonal movements and habitat and landform associations of migrating birds and bats, and will seek to develop decision support tools to provide assistance in identifying locations for wind turbines and communication towers. In addition, Congress has appropriated funds for a National Academy of Sciences study on the environmental impacts of wind power development in the Mid-Atlantic Highlands that will include developing criteria for the siting of wind turbines in this area. Finally, the Bats and Wind Energy Cooperative, a partnership of Bat Conservation International, the American Wind Energy Association, FWS, and the National Renewable Energy Laboratory, continues to sponsor research on bats and wind turbines focusing on acoustic deterrence methods and pre- and postconstruction risk assessment at a planned wind farm in the Appalachian region.

Few Studies Have Been Conducted on Mitigation Measures

Overall, there is much to be learned about mitigation strategies for reducing impacts from wind power facilities on birds and bats, and some strategies that once looked promising are now proving ineffective. Specifically, we found that relatively few studies have examined strategies for reducing the potential impacts of wind power on birds and bats. Some of these studies were based on information collected from birds in a laboratory setting, and, therefore, their conclusions still need to be verified by conducting studies at actual wind power facilities. One study examined the idea of addressing motion smear—the inability of birds to see moving blades—by painting turbine blades to make them more visible. This study indicated that color contrast was a critical variable in helping birds to see objects like moving turbine blades and recommended painting stripes on blades as a way to test whether this could be an effective deterrent. Some developers adopted this strategy; however, a recent study found that turbines with painted blades were ineffective in reducing bird kills. Another laboratory-based study tested bird reactions to noise and sound pressure and suggested that whistles could make blades more audible to birds, while making no measurable contribution to overall noise levels. However, the authors of this study made no predictions about changes in bird flight in response to hearing the noise and noted that field tests would be required to test this hypothesis.

Although there have been relatively few laboratory-based experiments on mitigation strategies, some strategies have already been attempted in Altamont Pass. A recent 4-year study conducted by the California Energy Commission in Altamont Pass tested some of these mitigation efforts attempted by industry and suggested possible future mitigation strategies. This study found that some of the strategies adopted by industry, such as perch guards on turbines and rodent control programs that reduce prey availability, were ineffective in reducing kills. Another study compared the differences between turbines painted with ultraviolet reflectant or nonultraviolet reflectant to see whether one would act as a visual deterrent, but the study found no evidence of a difference in mortality between the two treatments.

While there is less than adequate information on the effectiveness of mitigation strategies from existing scientific research, the experts with whom we spoke were hopeful about several strategies on the basis of their experience in the field. Some of these experts noted that because birds have been found to collide with electrical wires, wind facilities should bury their transmission lines under ground and avoid using guywires on their meteorological towers; such fixes have generally been adopted. Although some studies have shown that there are no differences in mortality rates for lit turbines versus unlit turbines, some experts argue that, regardless, it is best to use low lighting to avoid attracting birds that migrate at night. In addition, researchers recommended that sodium vapor lights should never be used at or near wind power facilities because they have commonly been shown to attract birds to other structures. They noted that the largest number of birds killed at one time near wind turbines was found adjacent to sodium lights after a night of dense fog. No fatalities have been discovered near these turbines since the lights were subsequently turned off. Some researchers have observed that many bird and bat kills occur during the time of year that has the lowest wind production. For example, most bats are killed during the fall migration season on low wind nights. Consequently, researchers suggested turning off some turbines during these times in order to reduce kills. Perhaps most importantly, many experts have noted that using preconstruction studies on wildlife and their habitats can help identify locations for wind turbines that are less likely to have adverse impacts.

Regulating Wind Power Facilities on Nonfederal Land Is Largely the Responsibility of State and Local Governments

Since most wind power development has occurred on nonfederal land, regulating wind power facilities is largely a state and local government responsibility. In the six states we reviewed, wind power development is subject to local-level processes, state-level processes, or a combination of the two. For example, in three of the six states, local governments regulate the development of wind power and generally require wind developers to adhere to local zoning ordinances and to obtain special use permits before construction. The federal role in regulating wind power development is limited to projects occurring on federal lands or those that have some form of federal involvement, such as projects that receive federal funding; to date, there have been relatively few wind power projects on federal land. In these cases, wind power projects must comply with federal laws as well as any relevant state and local laws.

State and/or Local Governments Regulate Wind Power on Nonfederal Lands

State and/or local governments regulate the development and operation of wind power facilities on nonfederal lands. The primary permitting jurisdiction for wind power facilities in many states is a local planning commission, zoning board, city council, or county board of supervisors or commissioners. Typically, these local jurisdictional entities regulate wind projects under zoning ordinances and building codes. In some states, one or more state agencies play a role in regulating wind power development, such as natural resource and environmental protection agencies, state historic preservation offices, industrial development and regulation agencies, public utility commissions, or siting boards. In addition, some states have environmental laws that impose requirements on many types of construction and development, including wind power, that state and local agencies must follow. The regulatory scheme for wind power in the six states we reviewed included all of these scenarios (see table 1).

Table 1: Type of Regulatory Process and Responsible Agency in Select States

State	State/Local processes	Regulatory agency/authority
California	Local-only	Local governments (are subject to the state’s environmental quality act, which requires assessment of environmental impacts of proposed actions)
Minnesota	State and local	Local governments regulate facilities under 5 megawatts, Minnesota Public Utility Commission regulates facilities 5 megawatts or larger
New York	Local-only	Local governments (are subject to the state’s environmental quality review act, which requires assessment of environmental impacts of proposed actions)
Oregon	State and local	Local governments regulate facilities under 105 megawatts (peak capacity), Oregon Energy Facility Siting Council regulates facilities 105 megawatts or larger
Pennsylvania	Local-only	Local governments
West Virginia	State-only	Public Service Commission (though local authorities could have some regulatory impact through zoning and subsidies)

Source: GAO analysis of state and local data.

In the six states we reviewed, we found that approval for the construction and operation of a wind power facility is typically provided in permits that are often referred to as site, special use, or conditional use permits or certificates. Such permits often include various requirements, such as “setback” provisions—which stipulate how far wind power turbines must be from other structures, such as roads and residences—and decommissioning requirements that are intended to ensure that once a wind power facility ceases operation, its structures are removed and the landscape is restored according to a specific standard. State and local regulations may require postconstruction monitoring studies to assess a facility’s impact on the environment. In one state we reviewed, facilities are required to submit periodic reports on issues related to its operation and impact on the surrounding area.

In most of the six states we reviewed, state and local regulations related to wind power are evolving as the industry has developed in the states because government agencies realized that their existing authorities were not applicable to wind power. For example, when wind power began to emerge in Minnesota, an advisory task force held public meetings to determine how to proceed in permitting development. In part based on concerns raised from counties during these meetings, responsibility for permitting larger facilities was given to the state. In addition, West Virginia finalized new regulations for electric-generating facilities in May 2005 that include provisions specific to wind power facilities. Prior to this, the state made decisions on a case-by-case basis. Similarly, the Pennsylvania Game

Commission is developing a policy for wind power development on its lands in response to private interest in promoting renewable energy sources on state property. Officials with the state's Department of Environmental Protection also told us that they are examining a number of options, including developing statewide rules and model ordinances that could be adopted by local authorities.

Some state and local regulatory agencies we reviewed generally had little experience or expertise in addressing environmental and wildlife impacts from wind power. For example, officials in West Virginia told us that they did not have the expertise to evaluate wildlife impacts and review studies prior to construction, although such studies are required. Instead, they said they rely on the public comment period while permits are pending for concerns to be identified by others, such as FWS and the state Division of Natural Resources. In addition, Alameda County officials in California told us that they did not have the expertise to assess the impacts of wind facility construction but rely on technical consultants during the permitting stage, and that they are planning to form a technical advisory committee for assistance with postapproval monitoring. In some of the states we reviewed, state agencies were conducting outreach efforts with local governments since wind power development is still a relatively new industry for regulators. These efforts typically focus on educating local regulators about the issues that are often encountered during wind power development and about how permitting can be handled. These efforts may also include providing sample zoning ordinances and permits.

California

California had the most installed wind power in the country, with 2,096 MW of generating capacity as of April 2005 and an additional planned capacity of 365 MW. California was the first state in which large wind farms were developed, beginning in the early 1980s. It is also one of the few states with significant wind power development on federal land, with over 250 MW on land owned by the Bureau of Land Management (BLM). Aside from the facilities on BLM land, the state relies on local governments to regulate wind power. In addition to the local permitting process, the California Environmental Quality Act requires all state and local government agencies to assess the environmental impacts of proposed actions they undertake or permit.¹² This law requires agencies to identify significant environmental effects of a proposed action and either avoid or mitigate significant environmental effects, where feasible.

¹²California Environmental Quality Act, Cal. Pub. Res. Code § 21100.

We met with officials from Alameda County and Contra Costa County, which are home to the Altamont Pass Wind Resource Area—at one time the largest wind energy facility in the world. In both counties, local land use ordinances allow wind power development on agricultural lands. These counties originally issued conditional or land use permits to various wind power developers in the 1980s that contained approval conditions, including requirements for setbacks from property lines and noise limits. As previously discussed, the Altamont Pass Wind Resource Area was subsequently found to be responsible for the deaths of numerous raptor species. The counties are currently renewing or amending some of the permits for facilities in this area and will add permit conditions in an attempt to reduce avian mortality. Alameda County officials were working with various federal and state agencies, environmental groups, and wind energy companies to agree on specific permit conditions. At the time of this report, Alameda County has recently approved a plan that is aimed at reducing bird deaths at Altamont Pass by removing some existing turbines, turning off selected turbines at certain times, implementing other habitat modification and compensations measures, and gradually replacing existing turbines with newer turbines. In addition, Contra Costa County had completed the permitting for a wind power facility that included a number of conditions to reduce avian mortality.

Minnesota

Minnesota had 615 MW of installed wind generating capacity as of April 2005 and an additional planned capacity of 213 MW. Wind power development in Minnesota is subject to either local or state permitting procedures, depending on the size of the project. Local governments generally issue conditional use permits or building permits to wind power developers for facilities under 5 MW. We spoke with officials in Pipestone County, which was the first in the state to adopt a wind power ordinance. This ordinance focuses mainly on setbacks and decommissioning requirements. In southwestern Minnesota—which includes Pipestone County and most of the wind power development in the state—a 14-county renewable energy board is working to adopt a “model” wind power permitting ordinance that would provide uniformity for regulating development in the region. Two factors that officials cited in pursuing such guidance is the recognition that development is likely to occur under the 5 MW threshold for state permitting, and that wind power developers would benefit from uniform regulations.

Between 1995 and the first half of 2005, the Minnesota Environmental Quality Board—comprised of 1 representative from the governor’s office, 5 citizens, and the heads of 10 state agencies—was responsible for regulating

large wind energy systems that are 5 MW or larger, studying environmental issues, and ensuring state agency compliance with state environmental policy.¹³ Effective July 1, 2005, authority for permitting these large wind energy systems was transferred to the Minnesota Public Utilities Commission. The commission requires, among other things, an analysis of the proposed facility's potential environmental and wildlife impacts, proposed mitigative measures, and any adverse environmental effects that cannot be avoided. Instead of requiring individual wind developers to conduct their own assessments of impacts to wildlife, Minnesota took a different approach. Since much of the wind power development is concentrated in the southwestern part of the state, the state determined that it would be more efficient to conduct one large-scale study, rather than requiring each developer to conduct individual studies. Thus, the state required wind developers to participate in a 4-year avian impact study at a cost of about \$800,000 as well as a subsequent 2-year bat study. The studies concluded that the impacts to birds and bats from wind power are minimal. Therefore, on the basis of the results of the state-required studies, state and local agencies in Minnesota are not requiring postconstruction studies for wind power development in this portion of the state. The costs for these studies were charged back to individual wind developers on the basis of the number of megawatts built or permitted within a specified time frame.

New York

New York had three operating wind power facilities, with 49 MW of installed wind generating capacity as of April 2005. An additional 350 MW of wind power capacity is planned for the state. According to state officials, local governments permit the development of wind power in the state using their zoning authorities. In addition to this local permitting, the state has an environmental quality review act that requires all state and local government agencies to assess the environmental impacts of proposed actions, including issuing permits to wind power facilities.¹⁴ This law requires that an environmental impact statement be conducted if a proposed action is determined to have a potentially significant adverse environmental impact. Because wind power is still new to the state and there are a significant number of proposed facilities, a state agency focused on promoting energy development is beginning a program for educating local communities about regulating wind power. This program includes examples of zoning ordinances that have been used in other counties.

¹³Minn. Stat. §§ 116C.691 - 116C.697.

¹⁴State Environmental Quality Review Act, N.Y. Env'tl. Conserv. Law § 8-0109.

We met with officials from the Town of Fenner—in north-central New York—which has the largest wind power facility in the state. On the basis of complaints about noise from the first facility permitted by the town, the local planning board now requires that turbines be located a certain distance from residences. In order to comply with the state’s environmental law, the town conducted an environmental assessment to determine the potential impacts of the proposed facility and determined that the project would not have any significant adverse environmental impacts or pose a significant risk to birds. However, elsewhere in New York, approval of one wind power project is under review given concerns expressed by environmental groups and the state environmental and conservation agency about potential impacts to migratory birds.

Oregon

Oregon had five large wind projects, with a total of 263 MW of installed wind power generating capacity as of April 2005 (see fig. 5).

Figure 5: Wind Power Facility in Sherman County, Oregon



Source: GAO.

Wind turbine blade prior to being installed at expansion of the facility in Sherman County (left) and the wind power facility in Sherman County (right).

Several new wind projects and expansions are under way or being planned that would take total capacity in Oregon to more than 700 MW. Similar to Minnesota, wind power regulation in Oregon is subject to either local or state permitting procedures, depending on the size of the project. Local governments issue conditional use permits for facilities capable of generating up to 105 MW peak capacity. For example, in Sherman County, the planning commission approved a 24 MW wind power project near Klondike in north-central Oregon. Under its zoning authority, the county attached various conditions to the project's permit, including an avian postconstruction study, and decommissioning and removal requirements. If projects exceed 105 MW peak capacity, they are permitted by the Oregon Energy Facility Siting Council, which makes decisions about issuing site certificates for energy facilities. The siting council is a seven-member citizen commission that is appointed by the governor. Wind power projects

that are subject to the council’s jurisdiction must comply with the council’s standards and applicable statutes. Some of the standards are specific to wind power, such as design and construction requirements to reduce visual and environmental impacts.¹⁵ The council also ensures that wind power facilities are constructed and operated in a manner consistent with state rules, such as state fish and wildlife habitat mitigation goals and standards, and local agency ordinances. In addition, regulations protect against impacts on the surrounding community by requiring that minimal lighting be used to reduce visual impacts, and protect some bird species by requiring that developers avoid creating artificial habitat for raptors or raptor prey. Also in Oregon, energy development—including wind power—must not adversely impact scenic and aesthetic values and is prohibited in certain areas, such as state parks.

Pennsylvania

Pennsylvania had 129 MW of installed wind generating capacity as of April 2005 and applications for an additional 145 MW to be developed (see fig. 6).

Figure 6: Wind Power Facility in Somerset County, Pennsylvania



Source: GAO.

¹⁵Oregon Revised Statutes (ORS) § 469.300 et seq.; Oregon Administrative Rules (OAR) Chapter 345, Divisions 1, 15, 20-23, 26, 27, and 29.

In Pennsylvania, wind power is regulated by local governments; no state agency has the authority to specifically regulate wind power development. For example, in Somerset County, which is home to the first wind power facility in the state, the county's planning commission regulates wind power development through an ordinance that allows for subdividing existing land. This ordinance contains requirements for setbacks and decommissioning. Some county and state officials have suggested that the state should provide a consistent framework for wind power development. The state, through its Pennsylvania Wind Working Group, is currently discussing whether there should be uniform state-level siting guidelines or regulations for wind power development. Pennsylvania was the only state of the six we reviewed that did not have state-level requirements for environmental assessments. However, one state official told us that many developers have done some environmental studies—generally including wildlife, noise, and protection of scenic vistas (i.e., viewshed)—in an attempt to head off criticism or opposition to a proposed project.

West Virginia

West Virginia had one operating wind power facility, with 66 MW of installed wind power generating capacity and a planned additional capacity of 300 MW for the state (see fig. 7). The state's Public Service Commission has been the only agency involved in regulating wind power to date, although state officials noted that local governments could get involved through their zoning authorities. Prior to 2005, West Virginia permitted construction and operation of wind power facilities under laws and regulations designed to regulate utilities providing electrical service directly to its citizens. Wind power facilities are wholesale generators and do not provide service to consumers, and according to commission officials, several provisions of these regulations were not relevant to wind power facilities. As a result, in 2003, the state amended the legislation to specifically address the permitting of wholesale electric generators, such as wind power.

Figure 7: Wind Power Facility in Tucker County, West Virginia



Source: GAO.

West Virginia followed the regulations in place before the legislation was amended to approve construction of the two wind power facilities in the state; one of these facilities has yet to be constructed. During the public comment periods for these facilities, concerns were raised regarding potential impacts to wildlife. As a result, certain conditions were required of the developers, such as prohibiting turbines in certain locations and

requiring postconstruction wildlife studies.¹⁶ In May 2005, the state finalized new regulations for wholesale electric-generating facilities that include provisions specific to wind power facilities.¹⁷ For permitting wind power facilities, West Virginia regulations now require spring and fall avian migration studies, avian and bat risk assessments, and avian and bat lighting studies.

Federal Government's Role in Regulating Wind Power Is Generally Limited to Facilities on Federal Land

The federal government's role in regulating wind power development is limited to projects occurring on federal lands or projects that have some form of federal involvement. While the Federal Energy Regulatory Commission regulates the interstate transmission of electricity, natural gas, and oil, it does not approve the physical construction of electric generation, transmission, or distribution facilities; such approval is left for state and local governments. Certain standards issued by the Federal Aviation Administration apply to wind power facilities and other tall structures, on all lands. These standards are intended to protect aircraft and specify the type of lighting that should be used for structures of a certain height.

Since the majority of wind development to date has been on nonfederal land or has not required federal funding or permits, the federal government has had a limited role in regulating wind power facilities. In those cases where federal agencies do regulate wind power, projects must comply both with state and local requirements and with any applicable federal law. At a minimum, these laws will include the National Environmental Policy Act and the Endangered Species Act.¹⁸ These laws often require preconstruction studies or analyses of proposed projects, and possibly project modifications to avoid adverse environmental effects. For example, if the development of a proposed wind power project on federal land could impact wildlife habitat and/or species protected under the Endangered Species Act, permitting of the project would involve coordination and consultation with FWS and/or the National Marine Fisheries Service to

¹⁶Developers of these two facilities voluntarily conducted some preconstruction wildlife studies.

¹⁷The West Virginia Public Service Commission adopted *Rules Governing Siting Certificates for Exempt Wholesale Generators* (WV 150 C.S.R. 30) on May 25, 2005, effective July 25, 2005.

¹⁸Other federal laws may apply to wind power development on federal land, such as the Federal Land Policy and Management Act, which provides BLM with a framework for managing its land.

determine the potential harm to species and the steps that may be necessary to avoid or offset the harm.

To date, BLM has been the only federal agency with wind energy production, with about 500 MW of installed wind power capacity.¹⁹ This wind energy development is located in Southern California in the San Geronio Pass and Tehachapi Pass areas, and in the Foote Creek Rim and Simpson Ridge areas of Wyoming.²⁰ According to BLM officials, as of June 2005, they had authorized 88 applications for wind energy development on their land and had 68 pending applications—most of which are in California and Nevada. Energy development on BLM-administered lands is regulated through its process for granting private parties access to federal lands, which is referred to as granting a “right-of-way authorization.” BLM’s Interim Wind Energy Development Policy establishes the requirements for granting these authorizations to wind energy facilities. This policy requires that all proposed facilities conduct the necessary assessments and analyses required by the National Environmental Policy Act, the Endangered Species Act, and other appropriate laws. In one case, some changes have been made to the location of some wind power turbines because of potential impacts to avian species that were identified during these preconstruction studies.

Because of an increased focus on developing energy sources on public lands, BLM has proposed revising their interim policy by developing a wind energy development program that would establish comprehensive policies and best management practices for addressing wind energy development. As a part of this effort, BLM issued a programmatic environmental impact statement in June 2005 that assesses the social, environmental, and economic impacts of wind power development on BLM land. This document also identifies best management practices for ensuring that the impacts of wind energy development on BLM lands are kept to a minimum. While subsequent proposed wind power facilities will still need to conduct some environmental assessments, they can rely on BLM’s programmatic assessment for much of the needed analyses. BLM hopes that the availability of this assessment will enable wind power development to

¹⁹At the time of this report, a developer had submitted an application to build what would be the first wind power project on U.S. Forest Service land.

²⁰Postconstruction wildlife studies in these areas of California and Wyoming found low avian mortality. The California study in Tehachapi Pass was not included in appendix II because estimating fatality rates was not a primary goal of that study.

proceed more quickly on its lands, assuming that such development complies with needed requirements.

Federal and State Laws Protect Wildlife

As with any other activity, federal and state laws afford protections to wildlife from wind power. Three federal laws—the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, and the Endangered Species Act—generally forbid harm to various species of wildlife. While each of the laws allows some exceptions to this, only the Endangered Species Act includes provisions that would permit a wind power facility to kill a protected species under certain circumstances. While wildlife mortality events have occurred at wind power facilities, the federal government has not prosecuted any cases against wind power companies under these wildlife laws, preferring instead to encourage companies to take mitigation steps to avoid future harm. Regarding state wildlife protections, all of the six states we reviewed had statutes that can be used to protect some wildlife from wind power impacts. However, similar to FWS, no states have taken any prosecutorial actions against wind power facilities where mortalities have occurred.

Various Wildlife Protections Are Provided by Three Federal Laws

The primary federal regulatory framework for protecting wildlife from impacts from wind power includes three laws—the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, and the Endangered Species Act. (See table 2.)

Table 2: Federal Wildlife Protection Laws

Federal wildlife law	Protections	Permits	Penalties for violations
Migratory Bird Treaty Act	Prohibits the taking, killing, possession, transportation, and importation of over 860 migratory birds, their eggs, parts, and nests, except when specifically authorized by FWS	Authorizes permits for some activities, including but not limited to, scientific collecting, depredation, propagation, and falconry No permit provisions for “incidental take”	Only criminal penalties are possible, with violators subject to fine and/or imprisonment
Bald and Golden Eagle Protection Act	Prohibits the taking and sale of bald and golden eagles and their eggs, parts, and nests, except when specifically authorized by FWS	Authorizes permits for scientific or exhibition purposes, or religious purposes by Indian tribes; and for other purposes No permit provisions for “incidental take”	Civil and criminal penalties are possible, with violators subject to civil penalties, fines, and/or imprisonment
Endangered Species Act	Protects about 1,265 species that have been determined to be at risk for extinction, referred to as threatened or endangered species; prohibits the taking of protected animal species, including actions that “harm” or “harass”; federal actions may not jeopardize listed species or adversely modify habitat designated as critical	Authorizes permits for the “taking” of protected species if the permitted activity is for scientific purposes, is to establish experimental populations, or is incidental to an otherwise legal activity, such as construction of wind turbines	Civil and criminal penalties are possible, with violators subject to civil penalties, fines, and/or imprisonment

Source: GAO analysis of federal laws.

FWS is primarily responsible for ensuring the implementation and enforcement of these laws.²¹ In general, these laws prohibit various actions that are deemed harmful to certain species. For example, each law prohibits killing or “taking” a protected species, unless done under circumstances that are expressly allowed by statute and authorized via issuance of a federal permit. The Endangered Species Act may also prohibit actions that harm a protected species’ habitat. In addition, each federal agency that takes actions that have or are likely to have negative impacts on migratory bird populations are directed by Executive Order 13186, “Responsibilities of Federal Agencies to Protect Migratory Birds,” to work with FWS to develop memorandums of understanding to conserve those species. While the executive order was signed on January 10, 2001, no memorandums have yet been signed. Wildlife species that fall outside the

²¹FWS shares responsibility for enforcing the Endangered Species Act with the National Marine Fisheries Service, which is responsible for protecting ocean-dwelling species and anadromous species, such as salmon.

scope of these three laws, such as many species of bats, are generally not protected under federal law. However, FWS is not only responsible for ensuring the survival of species protected by specific laws, but also for conserving and protecting all wildlife.

All three of the federal wildlife protection laws prohibit most instances of “take,” although each law provides for some exceptions, such as scientific purposes. The Endangered Species Act is the least restrictive of these laws in that it authorizes FWS to permit some activities that take a protected species as long as the take meets several requirements, including a requirement that the take be incidental to an otherwise legal activity. Wind power facilities may seek an incidental take permit under this act for facilities sited on private land or where no federal funding is used or federal permit is required. The Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act also allow permits for take, but incidental take of migratory birds is not allowed. Under all three statutes, unauthorized takings may be penalized, even if the offender had no intent to harm a protected species.²²

Although not required by these federal laws, in some cases, state or local entities that regulate wind power, or wind power developers themselves, will consult with FWS for information on protected species or advice on how to ensure that wind power facilities will not harm wildlife. For example, in the Altamont Pass Wind Resource Area, Alameda County officials and the companies operating wind facilities there have asked FWS for technical assistance related to renewing permits for existing wind power facilities. FWS officials told us that their technical assistance in Altamont Pass is aimed at avoiding or minimizing potential impacts to threatened or endangered species under the Endangered Species Act. In addition, FWS officials from the New York field office told us that they are asked to provide input on wind power proposals during the state’s environmental review process. These officials noted that they will likely not be able to review all of the wind power development proposals in the state due to staffing constraints. Similarly, FWS officials in five of the six states we reviewed told us that they have not conducted outreach to state or local regulators to inform them of the potential for wildlife impacts from wind power primarily because of workload constraints. If state and local regulators do not consult with FWS during the regulatory process, it can be

²²FWS identifies violations of federal wildlife laws in several ways, including by receiving citizen complaints and self-reporting by industry or individuals.

difficult for FWS to encourage actions that might reduce wildlife deaths before wind turbines are sited.

Federal Government Uses Prosecutorial Discretion in Dealing with Wildlife Mortality

Although FWS investigates all “take” of federal trust species, the government has elected not to prosecute wind energy companies for violations of wildlife laws at this time. In most of the states we reviewed, there were relatively few law enforcement officials, and they told us that they often had higher priority violations of federal wildlife laws than mortality events due to wind power, particularly given the relatively low levels of mortality that have occurred in most wind power locations. In West Virginia, the agent-in-charge told us that most of his time is spent on the commercialization of wildlife, such as the illegal import and export and interstate commerce of protected species; illegal hunting is also a major problem, particularly for bears and eagles. FWS law enforcement officials in all of the six states we reviewed told us that in cases of violations, they prefer to work cooperatively with the owners of wind power facilities to try to get them to take voluntary actions to address impacts on wildlife, rather than pursuing prosecution; however, other cases of wildlife violations, such as illegal trade in protected species, are pursued via prosecution.

FWS has been investigating and monitoring avian mortality at Altamont Pass for nearly 20 years, including the mortality of many protected species, such as golden eagles and other raptors.²³ Since that time, FWS has opened investigations and tried to work with the owners of wind power facilities to reduce the level of mortality. In the earlier years, some avian mortality was due to electrocutions along power lines. FWS had been working with electrical utility companies to resolve this problem elsewhere, and several relatively easy “fixes” were known to reduce electrocutions. As a result of official correspondence and conversations between FWS and company officials, many companies implemented these fixes, and avian mortality due to electrocutions has been reduced. However, large numbers of birds, particularly raptors, were still being killed due to actual collisions with wind turbines. On several occasions, FWS expressed concern about these mortalities to wind power companies and Alameda County—the county government with the most wind power development in California. In response, Alameda County and some wind power companies have conducted avian monitoring studies and tested several mitigation

²³Of all the species that have been killed, only two endangered species kills have been documented—a peregrine falcon in 1996 and a brown pelican in 2002.

measures, including painting turbine blades, installing perch guards on lattice-work towers, and conducting rodent control. However, these actions appear to have no significant impact on reducing avian mortality. Since January 2004, the wind power companies have worked together to develop an adaptive management plan for reducing avian mortality at Altamont Pass. The plan contains various mitigation measures, such as (1) removing old turbines and replacing them with fewer, new turbines and (2) implementing a partial seasonal shutdown of turbines.

Over the past 6 years, FWS has referred about 50 instances of golden eagles killed by 30 different companies in Altamont Pass either to the Interior Solicitor's office for civil prosecution or to the Department of Justice for criminal prosecution. Officials noted that, in general, prosecutions by both the Departments of the Interior and Justice focus on companies that kill birds with disregard for their actions and the law, especially when conservation measures are available but have not been implemented. Despite the recurring nature of the avian mortality in Altamont Pass and concerns from federal, state, and local officials, no prosecutions pursuant to federal wildlife laws have been taken against any wind power companies. Justice has not pursued prosecution in these cases, although they currently have an open investigation on avian mortality in Altamont Pass. As a matter of policy, Justice does not discuss the reasons behind specific case declinations, nor does it typically confirm or deny the existence of potential or actual investigations. However, Justice officials told us that, in general, when deciding to prosecute a case criminally, they consider a number of factors, including the history of civil or administrative enforcement, the evidence of criminal intent, and what steps have been taken to avoid future violations. Regarding the matters that FWS referred for civil enforcement, Interior's regional solicitor has also not pursued prosecution in any of these cases. Interior's Office of the Solicitor San Francisco field office declined to pursue the most recent civil referrals because Justice agreed to review turbine mortalities for possible criminal prosecution. Some citizen groups remain concerned about the lack of enforcement of federal and state wildlife protections. For example, in November 2004, the Center for Biological Diversity filed a lawsuit against the wind power companies in Altamont Pass to seek restitution for the killing of raptors.²⁴

²⁴*Center for Biological Diversity v. FPL Group*, No. RG04183113 (Calif. Super. Ct., Alameda County, filed Nov. 1, 2004).

In addition to the avian mortalities at Altamont Pass, significant wildlife mortality has also occurred at wind power locations in the Appalachian Mountains in West Virginia and Pennsylvania in 2003 and 2004. FWS has reviewed high numbers of bat kills; however, these bat species are not protected under federal law. Several studies have been completed or are under way in these regions to better determine the potential causes of the mortality events and how future events might be mitigated. The FWS law enforcement agent-in-charge in West Virginia told us that he has contacted wind power developers of some of the proposed facilities in the state about potential violations of federal wildlife laws should an endangered bat or other protected species be killed. The agent said that he prefers to have early involvement with wind power facilities, rather than wait for violations to occur.

FWS law enforcement officials told us that the way they have handled avian mortalities at wind power facilities is similar to how they deal with wildlife mortality caused by other industries. These officials explained that FWS recognizes that man-made structures will generally result in some level of unavoidable incidental take of wildlife and, as a result, FWS reserves a level of “enforcement discretion” in determining whether to pursue a violation of federal wildlife law. Law enforcement officials told us that before FWS pursues civil or criminal penalties, the agency prefers to work with a company to encourage them to take mitigation and conservation steps to avoid future harm. If a company shows a good-faith effort to reduce impacts, FWS will likely not refer such a case for prosecution. If, however, a company repeatedly refuses to take steps suggested by FWS, officials said they are likely to refer it for prosecution.

Work that FWS has done with the electric power industry illustrates this approach to resolving impacts to wildlife. FWS began working with the electric power industry in the early 1980s to reduce significant avian mortality due to collisions with and electrocutions at power lines, particularly mortality events involving eagles and other large birds. Pursuant to investigations of avian mortality at power lines and conversations with individual companies, solutions were identified that reduced mortality events. Because these solutions were relatively inexpensive and generally easy to install based on scientific testing—and were known to work—FWS law enforcement officials expected other electric line companies to install them. According to law enforcement officials, the threat of a potential conviction under the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act was generally enough to get companies to voluntarily install the fixes without FWS

prosecuting them. However, by the late 1980s, some electric companies were aware of mortalities due to electrocutions but were not taking actions to resolve the causes. The federal government in 1998 charged an electric utility cooperative—the Moon Lake Electric Association in Colorado and Utah—with criminal violations of these two laws. This is the first and only instance of a federal criminal prosecution of an electric power line company under any of the three federal wildlife protection laws. Civil cases have been filed and out-of-court agreements have been reached with other electric utilities for similar cases of wildlife mortalities.

FWS Has Taken Some Proactive Steps to Help Minimize the Impacts of Wind Power on Wildlife

Even though FWS does generally not have a direct role in determining whether and how wind power facilities are permitted, FWS has been involved for about 20 years with the wind power industry to help avoid and minimize impacts to wildlife from wind power development. FWS's work has been in the following three main areas—participating on a national wind working group and in technical workshops, and issuing guidance.

Working Group

An FWS senior management official has been a member of the National Wind Coordinating Committee since 1997. The wildlife workgroup serves as an advisory group for national research on wind-avian issues and a forum for defining, discussing, and addressing wind power-wildlife interaction issues. The workgroup has facilitated five national avian-wind power planning workshops to define needed research and explore current issues. The most recent workshop also included discussions of bat-wind turbine interactions. In addition, the working group released a report in December 1999, *Studying Wind Energy/Bird Interaction: A Guidance Document*, that includes metrics and methods for determining or monitoring potential impacts on birds at existing and proposed wind energy sites.

Workshops

FWS officials have participated in industry-sponsored workshops and conferences. For example, a senior FWS official presented information on cumulative impacts on wildlife from wind power at a 2004 workshop cosponsored by the American Wind Energy Association and the American Bird Conservancy. Another FWS official presented information on the agency's experience and expectations for regional wildlife issues at a national workshop on wind power siting sponsored by the wind association. FWS also helped to sponsor and organize, and participated in, a 2004 bats and wind power technical workshop attended by both wind industry representatives and researchers. As a result, FWS was

instrumental in establishing the Bats and Wind Energy Cooperative discussed elsewhere in the report.

Guidance

In July 2003, in an effort to inform wind power developers about the potential impacts to wildlife and encourage them to take mitigating actions before construction, FWS issued interim voluntary guidelines for industry to use in developing new projects. FWS developed the interim guidelines in response to the Department of the Interior's push to expand renewable energy development on public lands. The wind power interim guidelines are intended to assist FWS staff in providing technical assistance to the wind energy industry to avoid or minimize impacts to wildlife and their habitats through (1) proper evaluation of potential wind energy development sites, (2) proper location and design of turbines, and (3) pre- and postconstruction research and monitoring to identify and assess impacts to wildlife. The voluntary guidelines were open for public comment for a 2-year period that ended on July 10, 2005. At the time of this report, FWS had received numerous comments from the wind industry on the guidelines. In general, industry representatives thought that the guidelines were overly restrictive—to a degree not supported by the relative risk that wind power development poses to wildlife compared with other sources of mortality. FWS also had received comments from other groups—such as the Ripley Hawk Watch, the Clean Energy States Alliance, the Humane Society of the United States, the Massachusetts and Pennsylvania Audubon, the American Bird Conservancy, Defenders of Wildlife, and Chautauqua County Environmental Management Council—that were generally in support of the guidance or recommended that it be put into regulation. BLM also provided comments and expressed some concerns over the review process outlined in the guidelines. FWS will be reviewing and incorporating the public, industry, and agency comments received on the interim guidelines as appropriate in order to revise and improve them, and will solicit additional public input before disseminating a final version.

In addition, FWS recently began developing a template for a letter to be sent to wind power project applicants to alert them to federal wildlife protection laws, FWS's interim guidance, and FWS's role in protecting wildlife. FWS officials told us that they hope the letter will assist developers in making informed decisions regarding site selection, project design, and compliance with applicable laws. The availability of a ready-to-use template is important because most field officials told us that working with the wind power industry is just one of many responsibilities in FWS offices that often do not have enough staff, given their workloads.

Field officials also noted that if wind power developers, their consultants, or state or local regulatory agencies do not contact them, they may not know about wind power projects until there is a problem with an operating facility.

All Six States We Reviewed Have Wildlife Protections

Although federal jurisdiction for migratory birds has not been delegated to the states and primary responsibility for the protection of these birds resides with Interior, all states we reviewed had additional wildlife protections. Responsibility for protecting species and implementing wildlife laws and regulations is typically found in a state's natural resource protection agency. In some states, however, responsibility is assigned according to the type of species addressed. For example, in some states, agriculture departments address plant issues, while in other states, fish and boat commissions address fish, amphibian, and reptile issues; in these cases, wildlife agencies typically address the remaining species.

In all six states, the most common laws related to wildlife protection—and likely the most utilized wildlife laws—are those that govern hunting and fishing. These laws and regulations may include limits on the type and number of species that can be killed and the manner in which they can be taken. In addition to identifying the species that can be hunted or fished, the six states we reviewed identify as threatened or endangered specific species that are at risk for extinction or extirpation in their state. These states also identify “species of concern” or rare species. Such species are identified as a way to provide an early warning signal for species that are not yet endangered or threatened, but could become so in the future.

All of the six states we reviewed have laws that provide at least some degree of protection for species that are at risk of extinction or extirpation in their state. These protections generally go beyond what the federal Endangered Species Act provides by protecting more species than are protected under the federal law, although the protections may not be as extensive. In the five states that have specific protections, protection is provided through prohibitions on taking a protected species. In some cases, these protections are only applicable under certain circumstances. For example, in Oregon, protections apply only to state actions or on state-owned or -managed lands. All of the state laws or regulations that include take prohibitions, also include exceptions for when permits can be issued in order to allow the take to occur. Such permits are issued according to prescribed conditions or on a case-by-case basis. Two of the six states also provide protections for habitat. In West Virginia, the primary

protection for wildlife, aside from hunting and fishing regulations, is a prohibition on the commercial sale of wildlife and specific protection for bald and golden eagles.

Most of the states' wildlife protection laws for threatened and endangered species include enforcement provisions. In some cases, these laws identify violations as misdemeanor crimes. Similar to FWS law enforcement's approach to wind power, we found that state agencies had not taken any prosecutorial actions in response to wildlife mortalities at wind power facilities. Instead, many state officials told us that they prefer—like FWS—to work with developers to try to identify solutions to the causes of mortality. For example, in Minnesota, after impacts to native prairie grass caused by a wind power facility were discovered, the state natural resource agency required the facility to purchase additional habitat elsewhere to compensate for the loss. In California, Alameda County has worked with wind power facilities and others, and recently approved a plan that is aimed at reducing bird deaths at Altamont Pass by having wind power companies turn off selected turbines at certain times and replace some turbines with newer turbines.

State natural heritage programs serve as key sources of information on wildlife for federal and state wildlife protection agencies. All six of the states we reviewed have natural heritage programs that manage information on natural resources, including threatened and endangered species (all 50 states have such programs). These programs are part of an international effort to gather and share information on biological resources. This effort has slightly different designations and criteria for identifying imperiled species and habitat than the federal Endangered Species Act. In five of the states we reviewed, the natural heritage program is run by the states' natural resource agencies; in the sixth state, Oregon, it is run by a university. Although West Virginia does not have a state endangered species law and protects only bald and golden eagles, it does identify other imperiled species through its natural heritage program.

State natural resource agencies—which typically house the natural heritage programs—are sometimes consulted by a state or local wind power regulator or a wind power developer during the permitting process for help in identifying potentially sensitive species or concerns about possible impacts to wildlife in general. For example, staff from West Virginia's natural resources agency were involved in reviewing wildlife monitoring studies conducted by the first wind power facility in the state. During the consultation process on another proposed facility in the state,

agency staff requested that certain studies be conducted because of concerns about impacts on bat populations. Similarly, in Minnesota, natural resource agency staff requested changes in the location, construction, and operation of certain proposed wind power turbines through the state's environmental review process. However, in some cases, the process for regulators or wind power developers to consult with natural resource agency staff on wildlife is often an informal one and is not necessarily required by states' species protections or laws and regulations used to permit wind power.

Conclusions

In the context of other sources of avian mortalities, it does not appear that wind power is responsible for a significant number of bird deaths. While we do not know a lot about the relative impacts of bat mortality from wind power relative to other sources, significant bat mortality from wind power has occurred in Appalachia. However, much work remains before scientists have a clear understanding of the true impacts to wildlife from wind power. Scientists, in particular, are concerned about the potential cumulative impacts of wind power on species populations if the industry expands as expected. Such concerns may be well-founded because significant development is proposed in areas that contain large numbers of species or are believed to be migratory flyways. Concerns are compounded by the fact that the regulation of wind power varies from location-to-location and some state and local regulatory agencies we reviewed generally had little experience or expertise in addressing the environmental and wildlife impacts from wind power. In addition, given the relatively narrow regulatory scope of state and local agencies, it appears that when new wind power facilities are permitted, no one is considering the impacts of wind power on a regional or "ecosystem" scale—a scale that often spans governmental jurisdictions. FWS, in its responsibility for protecting wildlife, is the appropriate agency for such a task and in fact does monitor the status of species populations, to the extent possible. However, because wildlife, federally protected birds in particular, face a multitude of threats, many of which are better understood than wind power, FWS officials told us that they generally spend a very small portion of their time assessing the impacts from wind power. Nonetheless, FWS has taken some steps to reach out to the wind power industry by, among other things, issuing voluntary guidelines to encourage conservation and mitigation actions at new wind power facilities. In addition, FWS and the U.S. Geological Survey are initiating some studies to capture data on migratory flyways to help determine where the most potential harm from wind power might occur and to gather data for use in assessing wind power's cumulative impacts on

species. Although these are valuable steps in educating industry and improving science, FWS has conducted only limited outreach to state and local regulators about minimizing impacts from wind power on wildlife and informing them about species that may be particularly vulnerable to impacts from wind power. Such outreach is important because these are the entities closest to the day-to-day decisions regarding where wind power will be allowed on nonfederal land.

Recommendations for Executive Action

Given the potential for future cumulative impacts to wildlife species due to wind power and the limited expertise or experience that local and state regulators may have in this area, we recommend that the Secretary of the Interior direct the Director of the FWS to develop consistent communication for state and local wind power regulators. This communication should alert regulators to (1) the potential wildlife impacts that can result from wind power development; (2) the various resources that are available to help them make decisions about permitting such facilities, including FWS state offices, states' natural resource agencies, and FWS's voluntary interim guidelines—and any subsequent revisions—on avoiding and minimizing wildlife impacts from wind turbines; and (3) any additional information that FWS deems appropriate.

Agency Comments and Our Evaluation

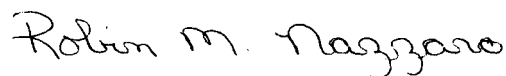
We provided copies of our draft report to the Department of the Interior and received written comments. (See app. III for the full text of the comments received and our responses.) Interior officials stated that they generally agree with our findings and our recommendation in the report. We also sent portions of the report to state and local regulators and state wildlife protection agencies. Many of these entities provided technical comments, which we incorporated as appropriate. Interior also provided technical comments, which we incorporated where appropriate.

Interior officials agreed in most part with our recommendation to develop consistent communication to deliver to state and local wind power regulators. However, they stated that because the comment period on the FWS voluntary interim guidelines has closed and final guidelines have yet to be developed, it would be inappropriate to include these in such communication. However, because FWS is currently disseminating the voluntary interim guidelines on wind power to its field offices to share with regulators and developers, we believe that it is appropriate to include reference to this document in communications to local and state

regulators. As Interior noted, these voluntary guidelines are currently undergoing review and revision. Therefore, it would be appropriate to draw attention to this fact in any such communication and to provide information about how the most current version might be accessed.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to the Secretary of the Interior, as well as to appropriate congressional committees and other interested Members of Congress. We also will make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>.

If you or your staffs have questions about this report, please contact me at (202) 512-3841. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report are listed in appendix IV.



Robin M. Nazzaro
Director, Natural Resources
and Environment

Objectives, Scope, and Methodology

On the basis of a June 22, 2004, request from the Ranking Democratic Members—House Resources Committee and the House Appropriations Subcommittee on Science, the Departments of State, Justice, and Commerce and Related Agencies—and of subsequent discussions with their staffs, we reviewed wind energy development and impacts on wildlife. Specifically, we assessed (1) what available studies and experts have reported about the impacts of wind power facilities on wildlife in the United States and what can be done to mitigate or prevent such impacts, (2) the roles and responsibilities of government agencies in regulating wind power facilities, and (3) the roles and responsibilities of government agencies in protecting wildlife from the risks posed by wind power facilities.

To determine what available studies and experts have reported about the direct impacts of wind power facilities on wildlife, we reviewed scientific studies and reports on the subject that were conducted by government agencies, industry, and academics. Our review focused on wildlife mortality as opposed to indirect impacts, which include habitat modification and disruption of feeding or breeding behaviors due to wind power facilities. We used several criteria to select studies for review. We chose studies that included original data analyses (rather than summaries of existing literature) conducted in the United States since 1990, and we primarily focused on the impact of wind power on birds and bats and/or ways in which to mitigate those impacts. We did not include preconstruction assessments of wildlife impacts in our review. We excluded studies that had preliminary findings when there was a more recent version available. We located studies using a database search with keywords of “wind power” and “birds,” “bats,” or “wildlife” in the following databases: AGRICOLA, DOE Information Bridge, National Environmental Publications Information, Energy Citations Database, Energy Research Abstracts, Environmental Sciences and Pollution Management, and JSTOR. In addition, we located studies using bibliographies of other studies and through publicly available lists of studies from the National Wind Coordinating Committee, the California Energy Commission, the National Renewable Energy Laboratory, and Bat Conservation International. We shared our list of studies with experts and asked them to identify any studies missing from our list. When studies were not publicly available, we contacted the authors and attempted to obtain copies. Using these methods and criteria, we obtained 31 studies. We reviewed the studies’ methodology, assumptions, limitations, and conclusions for the purposes of excluding

studies that did not ensure a minimal level of methodological rigor.¹ We excluded 1 study, leaving 30 studies that are used in this work. In addition to these studies, we also reviewed two summaries of studies produced by the National Wind Coordinating Committee. Generally, we did not directly use these two summary studies, we did use them as a check for our conclusions and findings in relation to the studies we reviewed.² We also interviewed experts and study authors from the Department of the Interior's U.S. Fish and Wildlife Service (FWS), state government agencies, academia, wind industry, and conservation groups and obtained their views on the risks of wind power facilities to migratory birds and other wildlife and on ways in which to minimize these risks.

To determine the roles and responsibilities of government agencies in regulating wind power facilities, we identified and evaluated relevant federal laws and regulations for wind power development. We reviewed a nonprobability sample of six states with wind power development—California, Minnesota, New York, Oregon, Pennsylvania, and West Virginia. We selected these states to reflect a range in installed capacity, different regulatory processes, a history of wind power development, and geographic distribution and to reflect our requesters' interests. For these states, we identified and evaluated relevant state and local laws and regulations for wind power development. We interviewed federal officials from FWS, Bureau of Land Management, and Interior's Office of the Solicitor as well as officials from the Department of Justice. We interviewed officials from FWS headquarters and from field office locations in the six states that we selected. We also interviewed officials from various state agencies, such as the Oregon State Siting Council and the West Virginia Public Service Commission, and from local and county governments that were responsible for issuing permits or certificates for the development of wind power facilities in their states. Finally, we visited wind power facilities in California, New York, Oregon, Pennsylvania, and West Virginia and interviewed wind industry company officials.

To determine the roles and responsibilities of government agencies in protecting wildlife from the risks posed by wind power facilities, we identified and evaluated relevant federal, environmental, and wildlife

¹Many of these studies have not been scientifically peer-reviewed, and the protocols in each study may vary.

²We referenced one of these studies in two places in this report. In each of these places, a source and associated caveat are presented in a footnote.

protection laws and regulations. We interviewed FWS law enforcement officials from headquarters and the six states that we reviewed. For the six states that we selected, we identified and evaluated relevant state and local environmental and wildlife protection laws. We also interviewed officials from state environmental and wildlife agencies in California, Minnesota, New York, Oregon, Pennsylvania, and West Virginia.

We conducted our work between December 2004 and July 2005 in accordance with generally accepted government auditing standards, including an assessment of data reliability and internal controls.

Studies of Bird, Bat, and Raptor Fatality Rates, by Region

Table 3 includes only studies where calculating bird or bat mortality was a primary goal. Some studies may contain more than one study location.

Table 3: Studies of Bird, Bat, and Raptor Fatality Rates, by Region

Region	Location and year	Number of turbines	Fatalities per turbine, per year		
			Birds	Bats	Raptors
Pacific NW	Stateline, OR - 2003	181	1.93	1.12	0.06
	Nine Canyon, OR - 2003	37	3.59	3.21	0.07
	Klondike, OR - Phase I - 2003	16	1.16 ^a	1.16	0
	Vansycle, OR - 2000	38	0.63	0.74	0
West	Foote Creek Rim, WY - 2003	69	1.5	1.34	0.03
	National Wind Tech Center, CO - 2003	Varies	0	0	0
California	Altamont Pass, CA - (Thelander et al) - 2003	5,400	0.19 [`]	***	***
	Altamont Pass, CA - (CEC) - 2004	5,400	0.87	0.004	0.24
	Altamont Pass and Solano County, CA - 1992	7,340	***	***	0.058 (1989) 0.025 (1990)
	Altamont Pass, CA - 1991	3,000	***	***	0.047 ^b
	Montezuma Hills, CA - 1992	600	0.074 ^b	***	0.047 ^b
Midwest	Buffalo Ridge, MN - P1 - 2000	73	0.98	0.26	***
	Buffalo Ridge, MN - P2 - 2000	143	2.27	1.78	***
	Buffalo Ridge, MN - P3 - 2000	138	4.45	2.04	***
	Buffalo Ridge, MN - (Osborn et al) - 2000	73	0.33-0.66	***	***
	Buffalo Ridge, MN - (Bats) - 2004	281	***	3.02 (2001) 1.3 (2002)	***
	Northeastern, WI - 2002	31	1.29	4.26	0
	Top of Iowa - 2004	89	0.12 ^c	1.88 ^c	***
Northeast	Searsburg, VT - 2002	11	0	***	0
Appalachian Mt. Region	Mountaineer, WV - 2004	44	4.04 ^d	47.53 ^d	***
	Tennessee - 2005	3	7.28	20.8	***
	Mountaineer, WV - 2005	44	***	38.0 ^e	***
	Meyersdale, PA - 2005	20	***	23.0 ^e	***

Source: GAO analysis of various scientific studies and reports.

Notes:

*** indicates that the study authors did not calculate a mortality rate for that category.

Some of the studies that presented a bird/turbine/year mortality rate also included raptors in that calculation. With the exception of the studies conducted in the Appalachian region, most of the studies listed were designed and timed to focus on bird mortality. Bats were found only incidentally to the study

Appendix II
Studies of Bird, Bat, and Raptor Fatality
Rates, by Region

objectives; therefore, rates of bat mortality reported from those studies may not represent a reliable measure.

^aFatality rate applies to small birds only.

^bFatality rate not adjusted for both searcher efficiency and scavenging rate.

^cFatality rate represents number of birds and bats killed per turbine per *8-month* study period.

^dFatality rate represents number of bats killed per turbine per *7-month* study period.

^eFatality rate represents number of birds and bats killed per turbine per *6-week* study period; however, bat mortality has been shown to be concentrated in the season during which these study periods took place.

Comments from the Department of the Interior

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



United States Department of the Interior

OFFICE OF THE ASSISTANT SECRETARY
POLICY, MANAGEMENT AND BUDGET
Washington, DC 20240



SEP - 2 2005

Ms. Robin Nazzaro
Director, Natural Resources and the Environment
U.S. Government Accountability Office
441 G Street, N.W.
Washington, D.C. 20548

Dear Ms. Nazzaro:

Thank you for providing the Department of the Interior (Department) the opportunity to review and comment on the draft U.S. Government Accountability Office (GAO) report entitled, "Wind Power: Impacts on Wildlife and Government Responsibilities for Regulating Development and Protecting Wildlife," GAO-05-906, dated July 28, 2005. In general, we agree with the findings and concur in part with the recommendation in the report.

A number of the studies used by GAO in the report, investigating direct mortality impacts on migratory birds and bats, were conducted by consultants for companies developing the wind energy facilities being studied. These studies have not been scientifically peer-reviewed, and the protocols used have varied and are in some cases unknown. We believe that use of literature that has not been peer-reviewed should be noted in the report.

We believe that the report accurately describes the Office of Law Enforcement (OLE) U.S. Fish and Wildlife Service (FWS), approach to addressing the impact of wind power facilities on protected wildlife. We would stress, however, that OLE has investigated and continues to investigate "take" of Federal trust species by wind turbines. Companies that violate the Migratory Bird Treaty Act (MBTA) by killing birds face fines of up to \$15,000.00 and/or imprisonment for up to six months. Higher penalties can be involved if the birds killed are bald or golden eagles or a species protected under the Endangered Species Act (ESA). Prosecutions by OLE and the Department Justice (DOJ) focus on companies that kill birds with disregard for their actions and the law, especially when conservation measures are available but have not been implemented. At this time, there have been no prosecutions of any wind energy development company for violations involving "take" of these species. The OLE protects migratory birds not only through investigating violations of the MBTA, but also by fostering relationships with individuals, companies, and industries that seek to eliminate impacts on these species. The OLE recognizes that some birds may be killed even if all reasonable measures to prevent such deaths are taken; however, it is important that industries continue to work toward eliminating these losses of migratory birds. While it is not possible under the MBTA to absolve individuals, companies, or agencies from liability if they follow recommended conservation practices, the

See comment 1.

See comment 2.

Ms. Robin Nazzaro

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OLE and DOJ have used enforcement and prosecutorial discretion in the past toward those who have made good faith efforts to avoid the take of migratory birds. These efforts are exemplified by the 25 years of work in collaboration with the electric power industry to identify ways to prevent bird electrocutions and power line collisions.

The FWS's effort to assist in proper location and design of wind energy facilities through the voluntary Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines, released for public review and comment in July 2003, is adequately described in the report. The FWS stressed that the guidelines were interim in nature pending public review and comment, were voluntary, flexible, and were not intended to be used as a set of rigid requirements that should be applied in every situation. There has been some concern that local and State regulatory agencies were using the voluntary guidelines as regulatory requirements in their local permitting processes, creating unreasonable demands on developers. Several interested parties have requested that the Interim Guidelines be rescinded for this reason. GAO informed the FWS during the review that it had investigated these allegations during the development of the current report, and found no evidence of any local or State regulatory entity using the Interim Guidelines as regulation. We recommend that this finding be included in the report. We believe this would help to dispel the perception that inappropriate use of the voluntary Interim Guidelines has had a negative effect on the wind industry.

See comment 3.

The State-by-State-review of laws and regulations regarding wind power development is fairly complete for the States visited by GAO. However, we believe the report could better synthesize how well the various local controls provide for consistent treatment and protection of individual animals and species that are interjurisdictional in their life cycles and are protected under Federal law. The report would also benefit from a discussion of the difficulties deriving from inconsistencies in regulatory requirements and frameworks that now exist among States. We believe the report should address that the responsibility for the protection of migratory birds continues to reside with the Federal Government (DOI), even though State and local laws and regulations have also been established for the protection of migratory birds. It should also be clarified that Federal jurisdiction for migratory birds has not been delegated to the States

See comment 4.

We concur with the recommendation that the FWS should develop consistent communication to deliver to State and local wind power regulators alerting them to potential wildlife impacts and to the resources that are available to assist them in decision-making. However, it would be inappropriate to include the FWS voluntary Interim Guidelines in such communication, as the comment period on the interim guidelines has closed and final guidelines have not yet been developed. The FWS will be reviewing and considering the public, industry, and agency comments received on the interim guidelines, and will solicit additional public input before making a decision on whether or how to finalize them.

Appendix III
Comments from the Department of the
Interior

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The enclosure provides comments from the U.S. Fish and Wildlife Service and Bureau of Land Management. We hope these comments will assist you in preparing the final report.

Sincerely,



P. Lynn Scarlett
Assistant Secretary
Policy, Management and Budget

Enclosure

The following are GAO's comments on the Department of the Interior's letter dated September 2, 2005.

GAO Comments

The Department of the Interior raised one issue with our recommendation that we have addressed in the Agency Comment and Our Evaluation section in the report. We address below the four other points the department raised in its letter. In addition, the department provided technical comments that we have incorporated into the report, as appropriate.

1. We agree that it is important to point out that many of these studies were not scientifically peer-reviewed and have added a footnote to this effect in the body of the report. However, we disagree that in some cases protocols used in the studies were unknown. As we explain in appendix I, we only included studies that were determined to have reasonably sound methodologies. We did not include any study for which we were unable to assess the protocols or methodology.
2. We believe the section on law enforcement reflects continued investigation of "take" of federal trust species by wind turbines and FWS's and the Department of Justice's enforcement and prosecutorial discretion, although we have added some clarification on these points.
3. We did not find any instances where state or local agencies that regulate wind power included in our review had incorporated or adopted the interim guidelines into their own jurisdictional requirements for approving wind power facilities. We did, however, find agencies in two states that had used the guidelines to inform either their development of regulations or their monitoring of the wildlife impacts at operating wind power facilities.
4. We did not assess how various local controls provide for protection of individual animals that are interjurisdictional in their life cycles. The section of the report that pertains to state wildlife laws is descriptive in nature and serves to highlight the fact that state laws sometimes provide additional protections to species, beyond federal laws, that may be affected by wind power. We added language to highlight that federal jurisdiction for migratory birds has not been delegated to the states, and that primary responsibility for the protection of these birds resides with the federal government (Interior).

GAO Contact and Staff Acknowledgments

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Staff Acknowledgments

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year -- compared with rates as high as 38 bats per turbine, per a 6-week study period, in the Appalachian Mountains," the report says. Bird of prey fatalities outside of Altamont Pass ranged from 0 to 0.07 raptors per turbine per year, while at the California site they ranged from 0.05 to 0.24 per turbine per year.

Regarding bird fatalities overall, GAO review of available studies showed a range of 0 to 7.28 bird deaths per turbine, per year across the country, and the 7.28 rate came at a site with only three turbines. It also cites U.S. Fish and Wildlife Service estimates that collisions with windows kill 97 million to 976 million birds annually, and poisoning from pesticides kills tens of millions more. Still, the study says scientists are concerned about the "cumulative impacts" of wind power development on species as the industry expands -- it notes that if wind power were to reach 5 percent of U.S. electricity generation, more than 62,000 new turbines would be needed, based on the average 1.5 megawatt size commonly being installed.

The report comes amid a growing interest in wind power domestically. Wind power now accounts for less than 1 percent of domestic electricity generation, GAO notes, but the American Wind Energy Association estimates that 2,500 megawatts of capacity will be installed this year. Total U.S. capacity at the end of 2004 was 6,740 MW, according to the group.

Increasing adoption of renewable electricity standards in states, and the recently signed energy bill's extension of the wind energy production tax credit, are expected to boost the industry in coming years.

Citing the potential for cumulative effects and limited expertise and experience state and local regulators may have, the report calls for greater FWS communication with local and state regulators about potential effects on wildlife, resources available to make permitting decisions and other information.

The report drew a welcome response from AWEA, which lauded the findings on birds and said bat collisions need more review and mitigation. "The report confirms what the data has shown for a long time, and that is that many fewer birds fly into wind turbines than into other manmade structures such as buildings, radio towers, and vehicles," said AWEA executive director Randall Swisher in a prepared statement today.

"The report also shows that we need to learn more about wind-bat interactions, an issue about which the industry remains concerned even if further research eventually shows that the impact on bat populations is not significant. The industry believes that bats and wind turbines can and must coexist, and is working with stakeholder groups and experts to understand the issue and try to find ways to avoid or at least reduce collisions," he added.

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