Comment Letter L

VIA ELECTRONIC MAIL

December 22, 2011

Matthew Schneider
County of San Diego DPLU
5201 Ruffin Road, Suite B
San Diego, CA 92123-1666

RE: Comments on DEIR for San Diego County Wind Energy Ordinance

Dear Mr. Schneider:

The Endangered Habitats League (EHL) is a regional conservation organization with members throughout Southern California, including unincorporated San Diego County. EHL submits the following comments on behalf of itself and its members on the proposed DEIR for the San Diego County Wind Energy Ordinance (Ordinance).

I. Introduction

The proposed Ordinance is intended to facilitate the development of wind energy in the County. While EHL generally supports the development of alternative, renewable energy resources, the facilities must be sited and operated to minimize impacts to a broad suite of avian and terrestrial species (from clearing, etc.) Despite a wealth of available information concerning the devastating impact on birds and bats of badly sited and designed wind energy projects, and in spite of an abundance of ways to reconcile wind energy with biodiversity concerns, the County's Ordinance does not even mention biological considerations. Not one word. L-1

And although the County proposes to find that impacts on wildlife from both small and large wind turbines are significant and unavoidable, the DEIR does not reflect a good faith effort to identify and consider a range of feasible less harmful alternativesor develop meaningful mitigation. Indeed, the two biological mitigation measures suggested are completely ineffective in lessening impacts. L-2

Finally, as detailed in the letter submitted concurrently from wind expert and wildlife ecologist Scott Cashen (Cashen Letter), the DEIR fails to properly acknowledge and analyze numerous impacts of the proposed ordinance on biological resources. L-3

For all of these reasons, the DEIR cannot pass muster under CEQA. Moreover, the record developed so far does not permit the County to adopt a project with significant and L-4

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L-1 These introductory comments regarding biological impacts are more fully developed later in this comment letter and, therefore, more detailed responses are presented below.

L-2 For small wind turbines, mitigating measures were incorporated into the zoning verification process proposed for Section 6951 of the Wind Energy Ordinance. For large wind turbines, project-specific mitigation will be required as part of the Major Use Permit process with additional new provisions included in the proposed ordinance. Less harmful alternatives for both small and large wind turbines are analyzed in DEIR Chapter 4 for consideration by the decision makers.

The County has also added additional design and siting criteria to the draft ordinance pertaining to small wind turbines. Through discussions with the commenter and wildlife agencies, the following criteria are proposed to be added to Section 6951.a:

<u>1.ii.: No part of the wind turbine shall be closer than 300 feet or 5 times the turbine height, whichever is greater, from the following:</u>

	a. Power transmission towers and lines. b. Blue line watercourse(s) or water bodies as identified on the current United States Geological Survey Topographic Map. c. Significant roost sites for bat species as mapped on the California Natural Diversity Database and San Diego Natural History Museum maps. d. Recorded open space easement and designated preserve areas. e. Riparian vegetation as identified on the County Wetland Vegetation Map dated October 19, 2012. 1.iii: No part of a wind turbine shall be closer than 4,000 feet from a known golden eagle nest site. Parcels within 4,000 feet of known golden eagle nest sites are identified on the Small Wind Turbine Constraints Map dated October 12, 2012 based on data provided by the U.S. Fish and Wildlife Service. 2. Area of Disturbance. A small wind turbine shall not result in an area of ground disturbance (including grading, clearing, brushing, or grubbing) during installation that is larger than a 25 foot radius around the base of a tower, and an access path to the

	tower that is a maximum of four feet wide. The entire area of disturbance shall be clearly defined on the plans submitted for Zoning Verification Permit review. 12: Pre-Approved Mitigation Area. A small turbine is allowed on a legal lot designated as Pre-Approved Mitigation Area within the boundaries of the Multiple Species Conservation Program Subarea Plan only with an Administrative Permit. An Administrative Permit may be approved for a maximum of three small wind turbines if all of the requirements of subsection “a” of this section are met and the cumulative rated capacity of the turbine(s) does not exceed 50 kilowatts. Subsections 6951.b and 6951.c below do not apply to lots designated as Pre-Approved Mitigation Area within the boundaries of the Multiple Species Conservation Program Subarea Plan. In addition, the County has included two mitigation measures related to small wind turbines per requests from the wildlife agencies as follows: M-BIO-3 All ministerial permits for small wind turbines will include a notice to the permittee explicitly stating that additional state and federal regulations may apply to the construction and operation of the wind turbine including, but not limited to, U.S.

<ins>Endangered Species Act, the California Endangered Species Act, and the California Fish and Game Code related to Lake and Streambed Alteration.</ins>

<ins>M-BIO-4 A joint evaluation between the County of San Diego, the California Department of Fish and Game, and the US Fish and Wildlife Service of the permitted small turbines will be conducted five years after the ordinance goes into effect and after the first 100 small wind turbines are permitted. These evaluations will summarize where the majority of turbines are located, how many are roof-mounted, how many are vertical axis, what the average height is, etc.</ins>

L-3 The County has prepared responses to the comments in the Scott Cashen letter in responses to comments L35 through L125 below.

L-4 The County agrees that the project cannot be adopted based solely on the DEIR. Findings regarding alternatives and significant impacts are not prepared until the hearing process for the project, and the evidence to support those findings need not be in the DEIR.

County staff has prepared responses regarding specific issues from the commenter and the Cashen Letter below.

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purportedly unavoidable impacts because no substantial evidence supports the finding—required under CEQA—that no feasible alternatives or mitigation-reducing project exists. To the contrary, as described in the Cashen Letter and in the submissions accompanying this letter, numerous feasible methods are available to reduce impacts of wind energy systems—both large and small.

EHL therefore urges the County to reconsider and revise its Wind Energy Ordinance in a revised DEIR.

L-4 Cont.

II. **The DEIR Contains Significant Disclosure Gaps**

In determining an EIR's adequacy, California courts have held that

> Whether an EIR will be found in compliance with CEQA involves an evaluation of whether the discussion of environmental impacts reasonably sets forth sufficient information to foster informed public participation and to enable the decision makers to consider the environmental factors necessary to make a reasoned decision

Berkeley Keep Jets Over the Bay Com. v. Board of Port Commissioners ((2001) 91 Cal. App. 4th 1344, 1355).

L-5

The DEIR, in its current state, contains inconsistencies and disclosure gaps that preclude informed public participation and inhibits effective decision-making. These inadequacies in the disclosure and analysis of environmental impacts are described in detail in the Cashen Letter, submitted concurrently, and will not be repeated here.

L-6

III. **The DEIR's Alternatives Analysis Is Inadequate.**

CEQA requires that an EIR "shall describe a range of reasonable alternatives to the project, which would feasibly attain most of the objectives of the project but would avoid or substantially lessen any of the significant effects of the project" (See CEQA Guidelines §15126.6, subd (a).) Further, the analysis must consider alternatives "capable of eliminating any significant adverse environmental effects or reducing them to a level of insignificance, even if these alternatives would impede to some degree the attainment of project objectives." (§15126(d)(3).)

L-7

As mentioned, the DEIR's failure even to consider an alternative that would take *biologically*-based siting considerations into account in the placement, design and operation of both small and large turbines is patently unreasonable. As the suite of guidance from both state and federal agencies and other documentation submitted concurrently with this letter make abundantly clear, "proper siting of wind energy projects is the most important element in avoiding and minimizing wildlife impacts." (Petition for Rulemaking at p. 79.) As the

L-8

L-5 The County agrees with the statements regarding EIR adequacy as cited, but does not agree that the DEIR contains disclosure gaps. See response to comment L6 for further response.

L-6 The County has prepared responses to the comments in the Scott Cashen letter in responses to comments L35 through L25 below.

L-7 The County agrees with the statements regarding alternatives as cited from CEQA Guidelines, but does not agree the DEIR Alternatives Analysis is inadequate. See response to comment L8 for further details.

L-8 Siting considerations will be included in the permitting process for large wind turbines. Such considerations will take into account biological resources, as well as other environmental concerns. Site screening and pre-permit monitoring are also included in mitigation measure M-BIO-2.

The County does not agree that site selection and screening is feasible for small turbines under the proposed project. The project proposes to make permitting of small wind turbines ministerial if they meet the standards provided in Section 6951 of the draft ordinance. Ministerial describes a governmental decision involving little or no personal judgment by the public official as to the wisdom or manner of

	carrying out the project. The public official merely applies the law to the facts as presented, but uses no special discretion or judgment in reaching a decision. A ministerial decision involves only the use of fixed standards or objective measurements. Site selection and screening by staff to determine proper placement of small wind turbines would be a discretionary process that would conflict with the project objectives of the Wind Energy Ordinance. County staff has reviewed California Energy Commission (CEC) guidance and incorporated as many design features into the project as feasible while still maintaining a ministerial review process for small turbines. In addition, County staff worked with the commenter and with staff from the wildlife agencies to develop standard setbacks from known mapped, sensitive biological resources such as blue line water features, bat roosts, wetland vegetation, open space easements, preserve areas, and golden eagle nests (see draft ordinance Section 6951.a). See also responses to comments I6, I7, I8, J14, L2, DD15, and DD18.

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California Energy Commission's Guidance makes clear, "[t]he most important decision regarding impact avoidance and minimization comes early in site screening." (CEC Guidance at p. 62.)

L-8 Cont.

Instead of biologically driven site considerations, and with the minor exception of prohibiting turbines along ridges, the proposed ordinance would permit indiscriminate siting of small turbines. For example, 80-foot tall turbines could be sited next to a golden eagle nest fully consistent with the proposed ordinance. In addition, MSCP conservation areas could be littered with turbines—all with a ministerial action that takes no account of biological damage or how to avoid, minimize, or mitigate it. The environmental analysis must consider an alternative which prohibits placement of any turbines within MSHCP areas, close to other known, biologically sensitive areas, or within known migratory corridors or raptor foraging areas.

L-9

L-10

L-11

Such an alternative would permit the County to achieve most of the project's stated objectives, while greatly reducing collision risk to resident bird and bat species. An additional siting step would mandate a pre-area screening and flatly prohibit the placement of turbines in areas frequented by endangered species (such as the Coastal California Gnatcatcher, Least Bell's Vireo) or those subject to specific federal protections (the Golden Eagle).

L-12

The County may respond that an alternative containing biologically based siting restrictions for small turbines is infeasible given AB 45's strictures on a local jurisdiction's ability to prohibit small wind turbines fitting the criteria in that statute. However, nothing in AB 45 prohibits the County from imposing reasonable conditions to minimize environmental impacts. To the contrary, the law provides that a small turbine wind "ordinance *may impose conditions* on the installation of small wind energy systems that include, *but are not limited to*, notice, tower height, setback, view protection, aesthetics, aviation, and design-safety requirements." (Gov't Code § 65896, subd. (b), emphases added.)

L-13

Even if AB 45 could be interpreted to limit the County's discretion in this regard, such an interpretation would run afoul of *federal* laws mandating the protection of endangered species,[1]

L-14

[1] Section 9 of the Endangered Species Act (ESA) prohibits any "person" from "taking" any member of an endangered species. 16 U.S.C. § 1538(a). The term "take" is defined broadly to include "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect." *Id.* § 1532(19) In addition, "harm" is defined to "include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering." *Id.*

L-9 The County appreciates the concerns expressed in this comment with regard to small wind turbine impacts on biological resources. As discussed in the DEIR, the County agrees that there is the potential for significant impacts to special status species which cannot feasibly be mitigated. The comment states that an 80-foot tall small wind turbine could be sited in close proximity to a golden eagle nest. This situation could occur today under the existing ordinance, which allows for one small wind turbine with a ministerial permit. However, under the proposed ordinance, small turbines will be required to meet updated standards and design criteria, including a 4,000 foot buffer from golden eagle nests that was added to the ordinance in response to comments from EHL and wildlife agencies. The County has also added other objective siting criteria that can be applied under a ministerial process that may help reduce biological impacts (see responses to comments I6, I8, and L2).

L-10 The comment raises concerns with regard to MSCP conservation areas. No permits, including ministerial permits, are issued for development on properties or portions of properties designated as Preserve or otherwise conserved as open space. In order for a development permit to be processed on such lands, other discretionary actions (e.g., open space easement vacation, rezone, MSCP Amendment, etc.) must also be processed first or concurrently, and the

		discretionary action would trigger environmental review of the entire project. In addition, the County has added a new design feature to the draft ordinance with regard to property designated Pre-approved Mitigation Areas (PAMA) in the MSCP (see response to comment I11).
	L-11	This comment recommends an alternative that prohibits any turbines near known biologically sensitive areas, within known migratory corridors or raptor foraging areas. After review of public comments and further discussions with the commenter, the County agreed that some additional criteria could feasibly be added to the ministerial process for small wind turbines while still meeting project objectives. The following provisions are proposed within Section 6951.a: 1.ii.: No part of the wind turbine shall be closer than 300 feet or 5 times the turbine height, whichever is greater, from the following: a. Power transmission towers and lines. b. Blue line watercourse(s) or water bodies as identified on the current United States Geological Survey Topographic Map. c. Significant roost sites for bat species as

	mapped on the California Natural Diversity Database and San Diego Natural History Museum maps. d. Recorded open space easement and designated preserve areas. e. Riparian vegetation as identified on the County Wetland Vegetation Map dated October 19, 2012. 1.iii: No part of a wind turbine shall be closer than 4,000 feet from a known golden eagle nest site. Parcels within 4,000 feet of known golden eagle nest sites are identified on the Small Wind Turbine Constraints Map dated October 12, 2012 based on data provided by the U.S. Fish and Wildlife Service. 2. Area of Disturbance. A small wind turbine shall not result in an area of ground disturbance (including grading, clearing, brushing, or grubbing) during installation that is larger than a 25 foot radius around the base of a tower, and an access path to the tower that is a maximum of four feet wide. The entire area of disturbance shall be clearly defined on the plans submitted for Zoning Verification Permit review. 12: Pre-Approved Mitigation Area. A small turbine is allowed on a legal lot designated as Pre-Approved Mitigation Area within the boundaries of

		<ins>the Multiple Species Conservation Program Subarea Plan only with an Administrative Permit. An Administrative Permit may be approved for a maximum of three small wind turbines if all of the requirements of subsection “a” of this section are met and the cumulative rated capacity of the turbine(s) does not exceed 50 kilowatts. Subsections 6951.b and 6951.c below do not apply to lots designated as Pre-Approved Mitigation Area within the boundaries of the Multiple Species Conservation Program Subarea Plan.</ins> In addition, the Limited Small Wind Turbine Alternative analyzed in Chapter 4 would require small wind turbine towers to be located in disturbed or developed areas of the subject property, as opposed to naturally vegetated areas of the site. For large wind turbines, the best approach environmentally is to require site-specific evaluation and follow the latest guidelines from the CEC and the wildlife agencies (see M-BIO-1 and M-BIO-2 in DEIR Section 2.4.6.1).
	L-12	The County does not agree with this comment. For small wind turbines, the recommendation to require pre-screening and on-site determinations regarding impacts to species would require discretionary review and would conflict with the project objectives (see

	responses to comments I6 and L8). For large wind turbines, the presence of a listed species should not necessarily preclude development. The commenter recommends that the County “flatly prohibit the placement of turbines in areas frequented by endangered species.” Yet, impacts to endangered species are not prohibited by state or federal law. Through consultation with the wildlife agencies and appropriate permit conditions, a large wind project with impacts to listed species may be approved. **L-13** The County does not contend that AB 45 prohibits a local jurisdiction from imposing environmental restrictions or other conditions on small wind turbines. The scope of the County's Wind Energy Ordinance project was primarily established through direction from the County Board of Supervisors on February 25, 2009. Based on that direction, County staff developed the eight project objectives stated in Section 1.1 of the DEIR. Most biologically based siting restrictions for small turbines would be infeasible because they would be contrary to the basic project objectives (see responses to comments I6, I7, I8, L8, L12, and DD15). **L-14** The County does not contend that AB 45 or any other State regulation or mandate supersedes federal laws that protect endangered species, migratory birds, and bald and golden eagles.

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migratory birds,[2] and bald and golden eagles.[3] As the DEIR acknowledges, and as confirmed by Cashen and the abundant evidence contained in the documents submitted concurrently with this letter, species protected under all these laws would be killed or "taken" by the operation of both small and large wind turbine systems. L-14 Cont. L-15

Even if AB 45 were construed to require Counties indiscriminately to permit small turbines under the conditions defined in Government Code § 65896, subd. (b) without regard to biological impacts, federal laws, including ESA, MBTA, and BGEPA, would effectively preempt the operation of AB 45 in every case where placement of a turbine would likely result in a prohibited "take" of a protected avian species. A bedrock principle of federal constitutional law holds that the Constitution, as well as all laws and treaties made under U.S. authority, is the "supreme law of the land" and thus enjoys legal superiority over any conflicting provision of a state constitution or law (Article VI, Section 2). Specifically, under the doctrine of "obstacle preemption," application of a state law in a particular case is invalid if it "stands as an obstacle to the accomplishment and execution of the full purposes and objectives of Congress." (*Hines v. Davidowitz*, (1941) 312 U.S. 52, 67.) Here, AB 45 would stand as such an obstacle because it would require Counties to permit wind turbines despite their inconsistency with federal law. L-16

Nor does CEQA allow the artificially constrained articulation of project purposes in the DEIR to preclude development of feasible ordinance alternatives that add biological impact minimization criteria, including siting criteria, to the permitting of small turbines. (See *City of Santee v. County of San Diego* (1989) 214 Cal. App. 3rd 1438, 1455 [unnecessarily narrow project purpose invalidates EIR's treatment of alternatives]. Here, the County proposes that a purpose of the project is to allow ministerial review of small turbines "without a discretionary permit." This narrow project purpose artificially and unnecessarily precludes the development of L-17

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[2] The Migratory Bird Treaty Act (MBTA) prohibits the killing of numerous migratory birds without the authorization of the Secretary. Enacted to fulfill the United States' treaty obligations, the MBTA provides that "[u]nless and except as permitted by regulations made as hereinafter provided in this subchapter, it shall be unlawful *at any time, by any means or in any manner,* to pursue, hunt, take, capture, kill, attempt to take, capture, or kill . . . any migratory bird." (16 U.S.C. § 703(a), emphasis added.)

[3] The Bald and Golden Eagle Protection Act provides that "[w]hoever . . . shall knowingly, or with wanton disregard for the consequences of his act take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner . . . any golden eagle, alive or dead, or any part, nest, or egg thereof . . . shall be fined not more than $5,000 or imprisoned not more than one year or both." 16 U.S.C. § 668(a). Violators are also subject to civil penalties. *Id.*§ 668(b).

L-15 This comment states with certainty that protected species will be killed or "taken" by the operation of small and large turbines permitted through the proposed Wind Energy Ordinance. While the County does not agree with this conclusion, the DEIR discloses that there is a potential for significant impacts to special status species from future small and large wind turbines. See also responses to comments J5 and J7.

L-16 The County does not agree or disagree with this comment. As discussed in more detail in response to comment L13, the County does not contend that AB 45 requires Counties to indiscriminately permit small wind turbines.

L-17 The County disagrees with the commenter's assertion that the project objectives as stated in the DEIR are artificially constrained so as to preclude alternatives, such as alternatives that would include siting criteria for small turbines. As noted in responses to comments I6, L8, and L12, siting criteria for small turbines would directly conflict with the objective to allow development of small wind turbines without a discretionary permit. This project objective was established in response to the Board of Supervisors hearing on February 25, 2009 and is a reasonable objective. That hearing included much public testimony regarding the current obstacles to

	development of small wind turbines as an accessory use. The Board of Supervisors directed County staff to prepare a two-tiered ordinance that maintains the Major Use Permit requirement for large wind turbines, but allows small wind turbines without a discretionary permit. As such, the description and objectives of the Wind Energy Ordinance project have been prepared in a transparent manner with extensive stakeholder input. Without clear and focused project objectives, the County would be at greater risk of not having an adequate EIR. The clear and reasonable objectives of the project were used to develop a reasonable range of potentially feasible alternatives that foster informed decision making and which are capable of avoiding or substantially lessening significant effects of the project (CEQA Guidelines §15124 and §15126.6). The alternatives analyzed would reduce impacts to biological resources, as well as other environmental effects, and are provided in Chapter 4.0 of the DIER.

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reasonable alternative permit schemes that facilitate the development of wind energy while reducing biological impacts. L-17 Cont.

IV. **Mitigation for Biological Impacts Measures Is Absent or Ineffective in Violation of CEQA.**

Mitigation under CEQA cannot be meaningless. Rather, to be legally adequate, it "must be fully enforceable through permit conditions, agreements, or other legally-binding instruments." (Guidelines, § 15126.4, subd. (a) (2).) Moreover, mitigation as defined under CEQA must have the potential to actually reduce impacts. (Guidelines § 15370; § 15126.4, subd. (a) (1) ["EIR *shall* describe feasible measures which could minimize significant adverse impacts"] L-18

The proposed mitigation for significant biological impacts does not meet this minimum standard. A total of two measures are proposed.[4] As an initial matter, *neither of these measures even applies to small wind turbines*, even though the DEIR recognizes their significant adverse environmental effects on biological resources. M-BIO-1 by its terms is limited to Major Use Permits, while M-BIO-2 is implicitly so limited, as it would apply only to *subsequent* environmental review that the proposed ministerial process for small turbines wouldn't require. L-19 The DEIR's failure to propose or adopt *any* mitigation in connection with project-level approval of this ministerial process violates CEQA. (See Guidelines § 15126.4.) . L-20

Insofar as the EIR applies programmatically to large turbines, the measures proposed are impermissibly vague, essentially meaningless deferred mitigation. M-BIO-1 simply states that L-21

[4] **Mitigation Measures**
M-BIO-1: During the environmental review process for future Major Use Permits for wind turbines, the County Guidelines for Determining Significance for Biological Resources shall be applied. When impacts to biological resources are determined to be significant, feasible and appropriate project-specific mitigation measures shall be incorporated. Examples of standard mitigation measures within the County Guidelines include: avoidance of sensitive resources; preservation of habitat; revegetation; resource management; and restrictions on lighting, runoff, access, and/or noise.
M-BIO-2: Update the County Guidelines for Determining Significance for Biological Resources to include, or incorporate by reference, recommendations from the California Department of Fish and Game, the Avian Power Line Interaction Committee, the USFWS Draft Guidance, and the California Energy Commission (e.g., California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development). Examples of recommended mitigation measures include: site screening; pre-permitting monitoring; acoustic monitoring; buffer zone inclusion; reduction of foraging resources near turbines; specific lighting to reduce bird collisions; post-construction monitoring; and avian protection plans.

L-18 The County agrees with the statements regarding adequacy of CEQA mitigation as cited, but does not agree that mitigation for biological impacts is absent or ineffective. See responses to comments L19 and L20 for further details.

L-19 Since small wind turbines will be permitted ministerially, all feasible measures to minimize environmental impacts were included as design features within the proposed Wind Energy Ordinance (see Ordinance Section 6951). These features are further discussed DEIR Sections 2.4.3.1 and 2.4.3.4, but with the conclusion that impacts would still be potentially significant. The County has also added additional criteria in response to comments (see responses to comments I6, I8, L2, and L11).

L-20 The County agrees that proposed mitigation measures M-BIO-1 and M-BIO-2 would apply to large wind turbines permitted through the Major Use Permit process and would not apply to the ministerial permitting of small wind turbines. The majority of feasible mitigation for small wind turbines was included as design features in the proposed Wind Energy Ordinance (see Ordinance Section 6951) since this is the only feasible and enforceable way to ensure that impacts are minimized under a ministerial permitting process. It should be noted that the County added two additional mitigation measures to the DEIR

		in response to requests from the wildlife agencies. These measures pertain to the small wind turbine provisions of the proposed project. M-BIO-3 requires the County to include specific language in the permitting of small wind turbines to notify the permittees that other state and federal regulations apply. M-BIO-4 requires the County to conduct a joint evaluation with the wildlife agencies to review the locations, heights, and models of small wind turbines permitted after five years and after 100 permits issued pursuant to the ordinance. The design criteria included in the draft ordinance combined with the mitigation measures included in the DEIR demonstrate the County's good-faith effort to meet CEQA guidelines and statutes related to mitigation and minimization measures.
	L-21	The County does not agree with this comment. Mitigation measure M-BIO-1 does not state that CEQA will apply to Major Use Permits. Such a statement may not even be true depending on the circumstances. Rather, M-BIO-1 states that the County's Guidelines for Determining Significance for Biological Resources will be applied to Major Use Permit applications for wind turbines. This is something that is generally done now, but not required. Moreover, it will be applied to the permitting process even if the County is not the lead agency

	under CEQA. Application of these Guidelines will result in substantial avoidance, minimization, and compensatory mitigation requirements for future large wind turbine projects.

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CEQA will apply to the Major Use Permit process; it is not a mitigation measure, but a general statement of law. Similarly, M-BIO-2 simply commits the County to *reference* various guidance documents in the County Guidelines for Determining Significance for Biological Resources. Completely absent is *any commitment to adopt concrete mitigation, or to adhere to any particular standard.* (See *Endangered Habitats League v. County of Orange* (2005) 131 Ca. App. 4th 777, 793-794 [permissible mitigation requires adherence to performance standards or commitment to take specific action in future].) Accordingly, to constitute legally cognizable mitigation under CEQA, mitigation measure M-BIO-2 must be revised to commit the County to *apply* the cited resource agency guidance *throughout* the project approval and implementation process. This commitment can be implemented by amending the ordinance to require adherence to the cited guidance at all stages of project review and implementation. L-21 Cont. L-22

V. The County Is Precluded from Making the Finding of Overriding Considerations Required to Approve the Project Because the County Has Ignored Feasible Alternatives and Mitigation Measures Are Available that Would Lessen Impacts.

As detailed above, CEQA Guideline §15126.4(a) requires lead agencies in an EIR affirmatively to develop potentially feasible mitigation measures to avoid or substantially reduce a project's significant environmental impacts, an obligation the County has followed in the breach. This failure not only constitutes an independent CEQA violation, but also precludes the County from approving a project—such as the one here—with significant and purportedly unavoidable impacts. L-23

Here's why. In approving a project, a lead agency must make two sets of findings. The first must address how the agency responds to significant effects identified in the environmental review process, either by finding that these effects will be mitigated, or that "[s]pecific economic, legal, technological, or other considerations . . . make infeasible the mitigation measures or project alternatives identified in the final EIR." (CEQA Guidelines § 15091, subd. (a)(3).) The second set concerns any statement of overriding considerations, permitting an agency to approve a project despite the existence of significant environmental impacts. (CEQA Guidelines, § 15093.) Because the findings requirements implement CEQA's substantive mandate that public agencies refrain from approving projects with significant environmental impacts when there are feasible alternatives or mitigation measures that can lessen or avoid these impacts, an agency is prohibited from reaching the second set until it has properly addressed the first. (See CEQA Guidelines, § 15091, subd. (f), subd. (c); *Mountain Lion Foundation v. Fish & Game Commission* (1997) 16 Cal. 4th 105, 134.) These findings must be supported by substantial evidence in the record. (Pub. Res. Code § 21081.5; CEQA Guidelines, § 15091, subd. L-24

L-22 The County does not agree with this comment. However, the County is willing to enhance mitigation measure M-BIO-2 as needed to be more clear and effective. As currently written, this measure commits the County to update its Guidelines for Determining Significance for Biological Resources, which are to be applied to large wind turbine projects pursuant to M-BIO-1, so as to better address biological concerns and issues related to wind turbines. The update for the Guidelines will incorporate the latest guidance from state and federal agencies.

The County considers this mitigation to be appropriate for the impacts of the project. The project proposes an amendment to the Zoning Ordinance for the permitting of large wind turbines. The actual permitting process will not change; a Major Use Permit is currently required and will still be required under the proposed project, and the requirement for a Major Use Permit will trigger site-specific environmental review under CEQA. However, the height limits and setbacks set forth in the Zoning Ordinance amendment will be less restrictive and more easily met by large wind turbine developers. This change may result in new significant impacts to biology. To address these new impacts, the County proposes to provide updated guidelines pertaining to the assessment and mitigation of biological impacts from large wind energy projects and to apply the updated guidelines to all future large wind turbine projects. This will also allow the County to apply the latest recommendations and technology to avoid and minimize impacts. Conversely, setting rigid biological standards as regulations at the present time would likely result in applying the wrong solution to problems identified with site-specific study. And, it is County staff's experience that the setting of minimum biological standards often gets interpreted to mean the maximum standards during individual permit reviews.

The reason that potentially significant biological impacts associated with large wind turbines are not considered to be mitigated below significant with these measures is that application of all the latest guidelines may still result in some large turbine projects not being able to feasibly mitigate impacts to below significant. It is foreseeable that some large wind developments may require statements of overriding considerations for significant unavoidable impacts to biological resources. Yet, the County is including all feasible mitigation at this stage, as appropriate for an ordinance amendment project, to reduce potentially significant biological impacts.

L-23 The County agrees with stated CEQA requirements, but does not agree that the DEIR fails to meet such requirements. A major part of the CEQA process is receiving public input and evaluating all suggested

		changes, alternatives, and mitigation measures after public review of the DEIR. The County is diligently considering all public comments in order to present the best feasible options to the decision makers.
	L-24	The County agrees with this comment.

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(b).) Any finding that an alternative is infeasible must not only reflect a reasoned analysis, but must be based on specific and concrete evidence. Only if this finding of infeasibility can properly be made may a lead agency rely on a statement of overriding considerations. L-24 Cont.

The record developed so far, if the DEIR is any guide, is completely devoid of the evidence required to substantiate the first required finding—that no feasible mitigation or alternatives that would lessen impacts exist. To the contrary, as explained above, feasible alternative ordinances with less impacts on wildlife can be developed. Moreover, numerous feasible mitigation measures exist. Some examples include: L-25

- All turbines and MET towers should be prohibited within a three hundred foot vicinity of: L-26
  - Listed State or Federal threatened/endangered species (or species of special concern)
  - Wildlife nursery sites
  - Essential habitat elements for threatened and endangered species
  - Rare plant species (as specific by the California Native Plant Protection Act)
- Areas disturbed by construction should be restored to native habitat and inspected to ensure complete and appropriate restoration. L-27
- All large and small wind energy facilities should be responsible for implementing the "California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development" and all other survey and mitigation guidelines issued by State and Federal Agencies. Compliance with these guidelines should be mandatory. L-28
- Unavoidable impacts to birds and bats should be compensated. Feasible compensation measures include protecting habitat that benefits birds and bats, acquiring high-priority conservation sites, and implementing management actions that benefit species affected by wind-energy (among other potential measures). L-29
- The County should implement a scientific study designed to examine the effects of small wind turbines on birds and bats. Data obtained from the study should be used to make informed decisions on turbine siting and adaptive management practices. L-30
- The ordinance should specifically prohibit any project which does not comply with the Bald and Gold Eagle Protection Act L-31

These are just a sampling of feasible mitigation measures recommended by wildlife resource agencies or adopted by other jurisdictions in California and elsewhere. More examples are L-32

L-25 The County presented two potentially feasible alternatives in the DEIR that would reduce impacts, though not to a level below significant. Determinations of feasibility and how the County can best meet its objectives will be determined by the County Board of Supervisors. The County as lead agency may determine alternatives to be infeasible when they fail to satisfy basic project objectives and/or policy objectives. *California Native Plant Society v. City of Santa Cruz* (2009) 177 Cal.App.4th 957. The County Board of Supervisors may adopt the proposed project, choose a reduced alternative, impose additional mitigation, or may choose the No Project Alternative.

L-26 The County does not agree that the listed features in this comment could be avoided or buffered without using discretionary review of proposed small wind turbines and MET facilities. The County's project objectives for the Wind Energy Ordinance are to allow development of small wind turbines without a discretionary permit (objective 6) and to streamline and clarify the approval process for the development and operation of small wind turbines (objective 4). Determinations regarding whether or not a site contains certain species or habitats would require a biological study with site evaluation from qualified County staff who must use discretion regarding where a species territory occurs or the extent of its habitat.

This process would directly conflict with the stated project objectives. In fact, it would be more prohibitive and cumbersome than the existing Zoning Regulations as described under the No Project Alternative in the DEIR.

The measuring of a 300 foot setback from a fixed point can be done ministerially. Therefore, the County included several important setbacks from features that have been mapped. Section 6951 of the draft ordinance has been revised to include buffers from known golden eagle nests, important bat roosts, water features, mapped riparian vegetation, open space easements/preserves, and transmission towers/lines (see also responses to comments I6, I8, L2, and L11).

For large wind turbines, the County does not agree that this type of standard is the best mitigation. Large wind turbine projects will be required to prepare site-specific environmental review and to avoid, minimize, and mitigate significant impacts whenever feasible. Establishing a 300 foot buffer from specified resources may preclude better mitigation alternatives and be perceived as a maximum buffer during future permitting.

L-27 This is a standard requirement for development permitted through a Major Use Permit and would be included as a condition in the permit for large wind turbine projects. For small wind turbines and MET

		facilities, no construction or staging areas are expected. Installation of small turbines and MET towers requires minimal ground disturbance (see worst-case ground disturbance discussion in DEIR Section 2.4.3.1).
	L-28	The County does not agree with this comment. The California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development (CEC Guidelines) do not apply to ministerial permits since most of the guidance requires discretionary review. The recommendations from the CEC Guidelines that are applicable are incorporated into the proposed ordinance (e.g., prohibit guy wires. remove prey habitat around base, underground power lines, prohibit trellis style structures, etc.). The majority of the CEC Guidelines would not apply to small wind turbines under the proposed ministerial process. The County agrees that application of the CEC Guidelines should be included in the environmental review of large wind turbines. The County is proposing to incorporate this guidance into the County's Guidelines for Determining Significance for Biological Resources. However, County staff does not agree that adherence to the CEC Guidelines should be mandatory. The CEC Guidelines were written in a way to make them flexible and to prompt solution-oriented methods for specific projects. If they were meant to be

		regulations, the State would have codified them. Moreover, these and other guidelines provided for wind energy projects can quickly become outdated with emerging technology. The County seeks to apply all the latest methods for reducing impacts rather than having ordinance provisions that refer to obsolete methods. Any future changes or updates to the Ordinance, particularly with regard to a change in mitigation requirements, could result in another lengthy ordinance amendment project with new environmental review. For these reasons, it is better to include the latest biological guidelines in the County's Significance Guidelines, which will be applied to all future large wind turbines permitted by the County (see mitigation measures M-BIO-1 and M-BIO-2 in DEIR Section 2.4.6.1).
	L-29	The County agrees with this comment for large wind turbine projects. This standard will be applied to future large wind turbine projects through the Guidelines for Determining Significance, and potentially through the Resource Protection Ordinance as well. The County does not agree that compensatory mitigation for impacts to birds and bats from small wind turbines can feasibly be exacted under the proposed ordinance. Since small wind turbines would be permitted ministerially on private land, no site-

specific environmental review or site-specific mitigation will be required. Minimization measures will be implemented through the ministerial provisions in Section 6951 of the draft ordinance (e.g., setbacks from riparian vegetation). But requirements for compensatory site-specific mitigation from permittees would conflict with the objectives to allow development of small wind turbines without a discretionary permit (objective 6) and to streamline and clarify the approval process for the development and operation of small wind turbines (objective 4). The commenter's recommendation would be substantially more restrictive than the provisions of the existing ordinance and, therefore, would be contrary to the goals and objectives of the proposed project. It should also be noted that County staff met with the commenter to discuss this and other recommendations provided in the EHL letter and the parties agreed on ways to minimize impacts under a ministerial process for small wind turbines. As noted in response to comment L2, Section 6951.a of the proposed ordinance was further revised to include measures, such as setbacks from known biological resources and discretionary reviews for turbines in MSCP PAMA.

L-30 The County does not agree that this recommendation is feasible or meaningful. Small wind turbines that would be permitted by the County under the proposed ordinance would be located on private property with no on-going requirements or conditions. The County does not have legal authority to access and monitor such sites after the zoning verification process has been completed and the permit has been issued. Moreover, it is not very likely that bird and bat impacts would be identifiable if County staff or consultants could conduct site visits. Private landowners would not be motivated to report any instances of bird or bat strikes or to preserve any evidence of bird or bat mortality. Consequently, any such study would not have scientific credibility.

L-31 It is not clear what this comment means. The Bald and Golden Eagle Protection Act is a federal statute enforced by federal agencies. The statute generally prohibits the take, possession, sale, purchase, etc. of a bald or golden eagle. Even if the statute applied to the County's proposed ordinance, the comment does not explain how the County would know if a particular wind turbine would "take" a bald or golden eagle.

It should also be noted that the County added mitigation measure M-BIO-3 to the EIR at the request of the wildlife agencies. The measure ensures that the County will include a notice to permittees of small wind turbines explicitly stating that additional state and federal regulations may apply to the construction and operation of the wind turbine.

	L-32 The County acknowledges that these recommendations were made by wildlife resource agencies and adopted by other jurisdictions as part of their discretionary review process.

Matthew Schneider, DPLU
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provided in the Cashen Letter, and in the documents EHL submits concurrently with this comment letter, made part of the administrative record and incorporated herein.[5]

L-32 Cont.

In light of the precarious state of the species and habitats likely to be negatively affected by this project, every potentially feasible mitigation measure and/or alternative appearing in all the documents submitted must be fully explored. If determined to be infeasible, a specific justification must be provided in any responses to these comments.

CEQA requires no less. (See Pub. Res. Code § 21002 ["The Legislature finds and declares that it is the policy of the state that public agencies should not approve projects as proposed if there are feasible alternatives or feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects"].) Until the County has thoroughly exhausted the suite of potentially feasible alternatives and mitigation appearing in the record, it is precluded from making the finding of overriding considerations required to approve the proposed ordinance.

L-33

VI. Conclusion

EHL is not opposed to an increase in wind generated energy in San Diego County. To the contrary, we recognize the necessity of wind and other renewable energy sources in combating climate change and ensuring a healthier environment. However, CEQA mandates

L-34

[5] These documents include: National Wind Coordinating Collaborative (CWEC) Mitigation Toolbox; email dated December 6, 2011 from Albert Manville, USFWS; USFWS Comments on Summit Ridge Wind Project, September 2010; California Energy Commission (CEC) Guidelines for Reducing Impacts to Birds and Bats From Wind Energy Development, October 2007; Permitting Fees for Small Wind Turbines in California Counties, CWEC March 2009; Golden Eagles in a Perilous Landscape: Predicting the Effects of Mitigation For Wind Turbine Blade Strike Mortality, CEC July 2002; Guidelines For Siting Wind Turbines Recommended For Relocation To Minimize Potential Collision-Related Mortality Of Four Focal Raptor Species In The Altamont Pass Wind Resource Area, Alameda County May 2010; Smallwood and Thelander, "Bird Mortality in the Altamont Pass Wind Resource Area, California," *The Journal of Wildlife Management*, Vol. 72, No. 1 (Jan., 2008); Rulemaking Petition to the U.S. Fish & Wildlife Service for Regulating the Impacts of Wind Energy Projects on Migratory Birds, American Bird Conservancy, December 14, 2011; Permitting Setback Requirements for Wind Turbines in California, CEC, November 2006; Draft Eagle Conservation guidance, USFWS, January 2011; McKinsey, "Regulating Avian Impacts Under the Migratory Bird Treaty Act and Other Laws: The Wind Industry Collides With One Of Its Own - the Environmental Protection Movement," *Energy Law Journal*, Vol. 28:71; Marin County Wind Energy Ordinance, November 2009; USFWS Interim Guidance on Avoiding and Minimizing Wildlife Impacts From Wind Turbines, May 2003; Land-Based Wind Energy Guidelines, USFWS, Draft dated September 13, 2011

L-33 The County agrees that all feasible mitigation measures must be considered or explored as part of the CEQA process. As noted in responses to comments L2 and L29 above, County staff met with the commenter and other stakeholders to discuss and thoroughly consider all recommendations and to include all feasible mitigation and minimization measures in the proposed project. Many suggested alternatives to reduce impacts were also considered and discussed in the DEIR, and a reasonable range of potentially feasible alternatives was analyzed in the DEIR (see Chapter 4.0).

L-34 The County acknowledges and appreciates this comment.

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that wind energy be implemented in California in a manner that stewards and preserves the County's rich biodiversity. L-34 Cont.

Thank you for your attention to EHL's concerns.

Respectfully submitted,

Dan Silver, MD
Executive Director

Scott Cashen, M.S.—Independent Biological Resources and Forestry Consultant

December 22, 2011

Dan Silver
Executive Director
Endangered Habitats League
8424 Santa Monica Blvd., Suite A 592
Los Angeles, CA 90069-4267

Subject: Comments on the Draft Environmental Impact Report Prepared for San Diego County's Proposed Wind Energy Ordinance Amendment

Dear Mr. Silver:

This letter contains my comments on the Draft Environmental Impact Report ("DEIR") prepared for San Diego County's ("County") proposed amendments to the County's Zoning Ordinance ("Ordinance") related to wind turbines and meteorological testing ("MET") facilities. The proposed Ordinance would allow temporary MET facilities without a discretionary permit. It also would allow the installation of up to three "small" wind turbines per lot without a discretionary permit. Large wind turbines would continue to be subject to Major Use Permit procedures and requirements, and they would require separate project-specific environmental review. However, the proposed Ordinance incorporates technological changes that affect design standards for large wind turbines, and it establishes a low frequency C-weighted sound-level limit for them. L-35

I am an environmental biologist with 19 years of professional experience in wildlife ecology, forestry, and natural resource management. To date, I have served as a biological resources expert for over 35 projects, the majority of which have been renewable energy facilities. My experience in this regard includes testifying before the California Energy Commission and assisting various clients with evaluations of biological resource issues. My educational background includes a B.S. in Resource Management from the University of California at Berkeley, and a M.S. in Wildlife and Fisheries Science from the Pennsylvania State University. L-36

I have gained particular knowledge of the biological resource issues associated with the Ordinance through my work on several other wind energy projects, and through my work on several projects in San Diego County. The comments herein are based on my review of the environmental documents prepared for the Project, published scientific literature, consultations with biological resource experts, and the knowledge and experience I have acquired during more than 19 years of working in the field of natural resources management.

3264 Hudson Avenue, Walnut Creek, CA 94597 1

L-35 The County agrees with the project description provided in this comment.

L-36 The County acknowledges the commenter's expertise on biology and wind energy.

The DEIR's Failure to Provide Consistent Information on the Height of Small Turbines Prevents an Accurate Assessment of Impacts to Birds and Bats

The proposed Ordinance would allow the installation of up to three "small" wind turbines per lot without a discretionary permit. The DEIR does not provide consistent information on the height limit of these "small" turbines. Specifically,

a. Page 1-9 of the DEIR states small turbines shall not exceed 80 feet with the *blade* in a vertical position.

b. Page 1-18 of the DEIR states the *tower* of small turbines shall not exceed 80 feet.

This discrepancy has considerable consequences on the impacts of the Ordinance on bird and bat species. The collision risk to many species is believed to be a function of both the height of a wind turbine's rotor blade above ground level, and the total rotor-swept area. Because these variables are highly correlated with the height of the turbine's tower, the DEIR must clearly establish the height limit for small turbine towers and/or blades. L-37

The DEIR Must Provide Information on the Types of Facilities that Might Install Small Wind Turbines

One of the objectives of the Ordinance is to facilitate development of small wind turbines that would generate electricity primarily for use on the lots where the wind turbines are located. However, the DEIR lacks information on the types of facilities that may be powered by small wind turbines. This precludes an assessment of alternative types of renewable energy (e.g., solar and biomass utilization) that potentially could be used to power the facilities. L-38

The DEIR Must Provide Information on Lot Sizes Such That the Public and Decision Makers Can Analyze Impacts Caused by Ground Disturbance

Under the Ordinance, all transmission lines connecting turbine towers and/or generators to a structure must be installed underground. Installing transmission lines underground will result in ground disturbance, which may have an adverse effect on sensitive species and habitats.[1] The DEIR lacks any information on lot sizes, and consequently, the amount of ground disturbance that is likely to occur when transmission lines are installed underground. This information is needed to fully disclose the Ordinance's impacts to sensitive biological resources, and to enable independent analysis of the impacts associated with the installation of transmission lines. L-39

The DEIR Lacks Adequate Information on the Species That Would Be Affected by the Ordinance

The DEIR identifies several "species of concern related to wind turbine projects."[2] The DEIR's discussion of these species, however, is limited primarily to natural history information; it fails to provide: (a) the population status of each species in San Diego County, (b) any specific analysis of the anticipated levels of impacts that will occur to each species, or (c) the relative L-40

[1] DEIR, p. 2.4-28.
[2] DEIR, p. 2.4-12.

2

L-37 The County agrees with this comment and regrets the confusion regarding the height limit of small turbines as presented both in the DEIR and in the draft Ordinance. The statement provided on Draft EIR Page 1-18 was incorrect. In response to this comment, the sentence on Page 1-18 has been revised as follows:

The wind turbine ~~tower~~ height<u>, from existing grade at the base of the tower to the highest point of the turbine blade when in use,</u> may exceed the height limit of the zone in accordance with Section 4620.j, but it shall not exceed 80 feet.

In addition, County staff has made edits to the draft Wind Energy Ordinance to make absolutely clear that all height limitations regarding small wind turbines refer to the turbine height rather than the tower height.

Of the alternatives presented in this comment, the intended and actual height limitations are the more restrictive. Therefore, the revisions to the DEIR provide clarifying text only and do not result in any new significant environmental impacts, an increase in the severity of previously identified project impacts, or new feasible project alternatives or mitigation measures.

L-38 The County does not agree with this comment. Small turbines can be used to produce energy for any legal uses on a given site. This possibility is true under the

		existing ordinance and will still be true under the proposed ordinance. Assessments regarding other types of renewable energy that can be used for a given site are not required.
	L-39	It is not clear from this comment how lot size information would be useful for the analysis in the DEIR. Small wind turbines may be located on lots of any size provided the turbines will be accessory to existing uses. Within the County unincorporated area, lot sizes for privately owned land generally range from approximately 6,000 square feet to 640 acres. Within the DEIR, the County provided a worst-case ground disturbance footprint to convey the amount of impact that may occur for a given property, which includes the undergrounding of power lines.
	L-40	The County does not agree that the DEIR lacks adequate information on sensitive species. San Diego supports over 400 sensitive species, 295 of which are identified in the DEIR as potentially occurring in the project area (184 plants and 111 wildlife species). These species are incorporated by reference from Appendix C of the County's General Plan Update EIR (see DEIR Pages 2.4-10 to 2.4-11). This appendix is available at http://www.sdcounty.ca.gov/dplu/gpupdate/docs/BOS_Aug2011/ EIR/Appn_C_Bio.pdf . To provide population status,

	quantitative impact estimates, and viability/conservation analysis for each sensitive species would not only be infeasible, but would provide so much detail as to make meaningful evaluation by the public and decision makers difficult, at best. Instead, the DEIR refers to the most common and reliable references on these species (see DEIR Chapter 5.0 under "Biological Resources)."

significance of impacts on population viability and conservation. This information must be disclosed in a revised DEIR. I have the following comments in this regard: L-40 Cont.

1. The DEIR fails to disclose fundamental information on the status of golden eagles in San Diego County. Survey data indicate the golden eagle population in San Diego County has experienced a "precipitous" decline.[3] Wildlife Research Institute estimates that the county's eagle population may decline by an additional 50 percent by the year 2030.[4] The proposed Ordinance has the potential to exacerbate this decline. L-41

2. The DEIR acknowledges that there is "critical habitat" for the Peninsular bighorn sheep in San Diego County.[5] The DEIR, however, does not discuss how the proposed Ordinance would affect critical habitat, the U.S. Fish and Wildlife Service's ("USFWS") *Recovery Plan for Bighorn Sheep in the Peninsular Ranges*, or the viability of bighorn sheep populations in San Diego County.[6] L-42

3. Current data suggest burrowing owl populations are declining throughout the State. The foraging and social behavior of burrowing owls makes them highly susceptible to collisions with wind turbines, especially the small (i.e., shorter) turbines that would be promoted by the Ordinance. L-43

The DEIR also does not mention numerous special-status species that may be impacted by the Ordinance. These include special-status species identified in the California Department of Fish and Game's ("CDFG") letter to the County in response to the Notice of Preparation.[7] I agree with the CDFG that the species identified in its letter should be addressed in the DEIR. At a minimum, the DEIR must disclose and analyze impacts of the proposed Ordinance on the following species: L-44

1. The pallid bat, western red bat, western mastiff bat, and potentially other special-status bat species. Bats are known to be susceptible to collisions with wind turbines. Existing scientific information suggests that additive mortality caused by wind turbines may have severe consequences on bat populations.[8] L-45

2. Due to widespread habitat loss, fragmentation, and degradation, the flat-tailed horned lizard has been a candidate for listing under the Endangered Species Act.[9] Scientific research has demonstrated that flat-tailed horned lizard populations are extremely susceptible to "edge effects" and other indirect impacts associated with development.[10] The Ordinance will promote projects that provide perches for flat-tailed horned lizard L-46

[3] Unitt PA. 2004. San Diego County Bird Atlas. Proceedings of the San Diego Society of Natural History, No. 39.
[4] Id.
[5] DEIR, p. 2.4-13.
[6] *See* U.S. Fish and Wildlife Service. 2000. Recovery plan for bighorn sheep in the Peninsular ranges, California.
[7] California Department of Fish and Game. 2010 Oct 13. Solar Wind Energy Zoning Ordinance Amendment (POD 09-006, LOG NO. 09-00-003), San Diego County (SCH#2010091030). Letter to Matthew Schneider, County of San Diego. DEIR, Appendix C.
[8] Committee on Environmental Impacts of Wind Energy Projects, National Research Council. 2007. Environmental Impacts of Wind-Energy Projects. National Academies Press, Washington (DC). 394 pp.
[9] Id. p. 23.
[10] Young KV and AT Young. 2005. Indirect effects of development on the flat-tailed horned lizard. Final Report submitted to Arizona Game and Fish Department, Yuma. 11 pp.

3

L-41 The County believes sufficient information on golden eagles was provided on DEIR Pages 2.4-12, 2.14-19, and 2.4-29. While there is no substantial evidence that small wind turbines will have a significant direct impact on golden eagles, the County acknowledges that development of future small turbines under the proposed ordinance will likely result in significant impacts to special status species. The additional information provided in this comment will be included in the documents presented to decision makers for their consideration. However, this additional information does not identify deficiencies in the adequacy of the DEIR.

L-42 The DEIR does not address how the project may affect critical habitat because, based on the County's Guidelines for Determining Significance for Biological Resources, critical habitat designations are not used to determine whether the project may have a significant adverse effect. Generally, critical habitat designations are not useful in analyzing impacts because critical habitat designations do not affect the ability to use private property; they include areas that are already developed; and they do not regulate development unless a federal agency is involved with the action (i.e., situations where federal funding, authorization, or land is involved). Rather than relying on critical habitat designations, the County as lead agency makes determinations regarding significant

		impacts based on considerations, such as the presence of sensitive habitat type and the presence of sensitive species. The County's Guidelines for Determining Significance for Biological Resources is available at http://www.sdcounty.ca.gov/pds/docs/Biological_Guidelines.pdf.
	L-43	The County does not agree that there is substantial evidence that small wind turbines will have particularly adverse impacts on burrowing owl. Nevertheless, the DEIR acknowledges that potentially significant impacts due to bird strikes and habitat removal are foreseeable from development of small turbines permitted by the proposed ordinance.
		It should also be noted that the County is working closely with the California Department of Fish and Game on the preservation of burrowing owls in the County unincorporated area. The primary populations of concern are located in Ramona (in the Ramona Grasslands) and in East Otay Mesa. The County has made significant progress in preserving and managing the Ramona Grasslands. And development in East Otay Mesa is carefully regulated through the MSCP Amendment process. However, impacts to burrowing owl from future small wind turbines may still occur in other areas of the County.
	L-44	The County does not agree with this comment. Based on the California Department of Fish and Game

		response letter to the Notice of Preparation, nine species of particular concern with regard to wind turbines that are known to occur in the unincorporated area were discussed in detail within the document (see DEIR Pages 2.4-12 to 2.4-16). For the remaining 102 special status species that occur in the project area, Appendix C of the County's General Plan Update EIR was referenced (see DEIR Pages 2.4-10 to 2.4-11 and response to comment L40).
	L-45	The DEIR refers to a list of 111 special status wildlife species with potential to occur in the project area. This list is available in Appendix C of the General Plan Update EIR at: http://www.sdcounty.ca.gov/dplu/gpupdate/docs/BOS_Aug2011/EIR/ Appn_C_Bio.pdf. It includes the sensitive bat species mentioned in this comment and in the Department of Fish and Game response letter to the Notice of Preparation. The DEIR acknowledges that there may be significant impacts to these special status species and particularly discusses avian and bat collision. The County has also added a provision to the draft ordinance in response to comments to include a buffer for small wind turbines located near a known roosting location for bat species. For large wind turbines, bird and bat studies will be conducted during the site specific environmental review process for each proposed large wind turbine project.

	L-46	The County agrees that the project will have potentially significant effects on the flat-tailed horned lizard. This too is one of the 111 special-status wildlife species referenced in the DEIR (see response to comment L45 above). The County does not agree that a specific indirect impact analysis need be conducted for this species. The existing conditions section of the biological resources subchapter describes each vegetation type, its general regional location, and the types of species (common and sensitive) that it supports. Appendix C of the County's General Plan Update EIR is incorporated by reference and lists each sensitive species and its habitat type. DEIR Pages 2.4-12 through 2.4-16 provide detailed information on species of concern with regard to wind turbines. DEIR Section 2.4.3.1 provides impact analyses from small and large wind turbines with regard to habitat and species. Together, this information provides a very thorough overview of potential impacts to special status species. Detailed impact analyses of each sensitive species in the project area (nearly 300 plant and animal species) are neither feasible nor necessary to determine the project's overall impacts and identify appropriate mitigation measures. Therefore, no changes to the document were deemed necessary in response to this comment.

predators. Heightened predation pressure is considered a significant threat to the conservation of flat-tailed horned lizard populations.[11] As a result, indirect impacts on the flat-tailed horned lizard must be analyzed in a revised DEIR.

L-46 Cont.

The DEIR Does Not Accurately Disclose Levels of Ground Disturbance and Habitat Loss

Under the proposed Ordinance, wind turbines that are not roof-mounted must include at least 10 feet of vegetation clearance "around the base," along with placement of gravel to reduce potential habitat for prey species that would attract birds and bats.[12] It does not appear that the DEIR included these requirements in its analyses of impacts to habitat.

L-47

The DEIR estimates small wind turbines and MET towers would cause a maximum of 7,724 acres of total ground disturbance. This estimate is based on the number of foundations that may be installed to support small turbines and MET towers. The estimate does not consider the ground disturbance (i.e., trenching) that will occur to install transmission line underground (as required by the Ordinance). Although the DEIR does not quantify the amount of trenching that will be required to install transmission lines underground, it acknowledges that lots in the eastern portion of the County are "large."[13] This suggests a considerable amount of trenching may occur when small turbines are installed on large lots. The ground disturbance associated with trenching often results in habitat degradation and the colonization and spread of invasive plants. In addition, open trenches act as pitfalls for wildlife, including sensitive species. The DEIR must be revised such that it (a) quantifies the amount of ground disturbance that may be necessary to install transmission lines underground; and (b) discloses and analyzes the potentially significant impacts associated with trenching.

L-48

The DEIR Provides Misleading Information on the Impacts of Small Wind Turbines

The DEIR suggests that the height and spacing of "small" wind turbines would result in minimal impacts to birds and bats.[14] This suggestion is indefensible. Research indicates "small" wind turbines are disproportionately lethal to some species. For example, Hunt (2002) concluded turbines on 18.3-meter (60-foot) towers were disproportionately more lethal to golden eagles in the Altamont Pass Wind Resource Area than taller turbines.[15] Research has also demonstrated that even one, poorly located wind turbine can have significant impacts on birds, bats, and other sensitive resources.[16] As a result, the DEIR must be revised such that it provides decision makers with accurate information pertaining to the impacts of small wind turbines.

L-49

[11] Id. *See also* Barrows CW, MF Allen, JT Rotenberry. 2006. Boundary processes between a desert sand dune community and an encroaching suburban landscape. Biological Conservation 131:486–494. *See also* Flat-tailed Horned Lizard Interagency Coordinating Committee. 2003. Flat-tailed horned lizard rangewide management strategy, 2003 revision. 80 pp. plus appendices. p. 49.
[12] DEIR, p. 2.4-28.
[13] DEIR, p. 1-2.
[14] DEIR, p. 2.4-28.
[15] Hunt WG. 2002. Golden eagles in a perilous landscape: Predicting the effects of mitigation for energy-related mortality. California Energy Commission Report P500-02- 043F.
[16] Committee on Environmental Impacts of Wind Energy Projects, National Research Council. 2007. Environmental Impacts of Wind-Energy Projects. National Academies Press, Washington (DC). 394 pp.

4

L-47 The County does not agree that the DEIR does not accurately disclose levels of ground disturbance and habitat loss. The ten feet of vegetation clearance required around the base of small turbines is included in the estimated worse-case scenario ground disturbance footprint for small turbines. See discussion on DEIR Page 1-9 regarding the conservative ground disturbance estimate that was used. This estimate was based on turbines that would be substantially larger than those allowed by the draft ordinance.

L-48 The anticipated trenching that may occur for small wind turbines is covered by the conservative ground disturbance estimate discussed in response to comment L47 above. The worst-case scenario ground disturbance estimate accounted for all of the grading and excavation associated with three 120-foot turbines; thereby resulting in a higher estimate than expected for future small turbines (80 feet maximum) permitted under the proposed ordinance. In addition, the County has added a provision to the draft ordinance stating that a small wind turbine shall not result in ground disturbance (including grading, clearing, brushing, or grubbing) more than is necessary for the base of a tower, ten feet of clearance around the base of the tower, other authorized equipment for turbine installation and operation, and, if necessary, a 4-foot wide access path to the tower.

		There is also an inherent incentive for landowners to minimize the amount of trenching and infrastructure needed in order to keep costs low.
	L-49	The County acknowledges that small wind turbines will result in potentially significant impacts to biological resources, as is disclosed in the DEIR. The County also notes that the statements made in this comment are based on the cited references. However, much of the study that has been done, including those cited in the comment, focused solely on utility-scale "wind farms" where individual turbines produced 100kW to 1.5MW and were typically located on ridgelines. Other information provided by the Hunt (2002) paper shows that the type-13 turbines (the shorter ones that were correlated with higher mortality of golden eagles) used lattice structures that provide perching opportunities, were configured in long strings of the turbines, and were located on hunting grounds of golden eagles. In contrast, a small wind turbine permitted under the proposed ordinance would be no more than 50kW, would be an accessory structure to existing development, would be sited away from ridgelines, and would not have trellis/lattice style towers. It appears the statement in the DEIR that is referred to in this comment is as follows: "This type of setting combined with the design of the turbines would not be

	expected to result in frequent bird and bat strikes." This statement is based on all of the design features included in the draft ordinance for small turbines and the fact that these turbines would be accessories to existing development (i.e., not located in undeveloped open space areas). Therefore, it is a valid statement.

The DEIR Lacks Adequate Analysis of the Impacts of Small Turbines on the Golden Eagle

The golden eagle is a CDFG Watch List species and a USFWS Bird of Conservation Concern. It also is protected by California Fish and Game Code and the federal Bald and Golden Eagle Protection Act. The DEIR acknowledges that because of these factors, the collision risk that wind turbines pose to the golden eagle is of particular concern.[17] Nevertheless, the DEIR provides almost no analysis of the impacts that small turbines will have on the golden eagle. L-50

Indeed, the DEIR's analysis in this regard is limited to the statement that "the height of small wind turbines and MET facilities is not tall enough to be within migratory wildlife flight paths, such as that of the golden eagle."[18] This analysis is both insufficient and inaccurate. L-51

First, the DEIR ignores the fact that migrant birds, including the golden eagle, may collide with wind turbines of any size while taking off or landing. L-52

Second, data demonstrate migrating eagles are highly susceptible to collision with small (and large) wind turbines. During migration, golden eagles (and other raptors) conserve energy by using deflective updrafts or thermals to go long periods without flapping their wings. Because eagles are adapted to use even the smallest and weakest of thermals, they can migrate at elevations low to the ground. They also may fly low to the ground when weather conditions are "poor," or while they are foraging. L-53

Third, golden eagles and other migratory birds may be attracted to turbine sites where they become susceptible to collision. For example, certain birds are prone to perching on wind towers because the towers simulate trees with which the species is familiar.[19] Additionally, soil and vegetation disturbance associated with turbine installation promotes habitat for prey species, which may attract eagles and other predatory birds.[20] L-54 Thus, even though a bird may migrate above the turbine, characteristics of the turbine site may stimulate the bird to descend and enter the rotor-swept area. L-55

Fourth, and perhaps most importantly, the DEIR lacks any analysis of the collision risk to San Diego County's *resident* (i.e., non-migratory) eagle population. The foraging, breeding, and social behavior of resident golden eagles makes them highly susceptible to collision with wind turbines of all heights. This is well substantiated in scientific literature.[21] L-56 The loss of breeding (i.e., resident) birds has relatively severe consequences on the overall population given the mortality to young that is likely to occur if one of the parents dies. L-57

As a result of the issues described above, the DEIR must be revised such that it provides a thorough and accurate assessment of the potentially significant impacts that small turbines are likely to have on the golden eagle. L-58

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[17] DEIR, p. 2.4-30.
[18] DEIR, p. 2.4-28.
[19] Thelander CG, KS Smallwood, L Rugge. 2003. Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area. Prepared by BioResource Consultants for National Renewable Energy Laboratory. Ojai, California: BioResource Consultants. December 2003.
[20] Id.
[21] Id.

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L-50 The County agrees with this comment regarding regulations protecting golden eagle, but does not agree that the DEIR lacks adequate analysis of the impacts of small turbines on the golden eagle. The level of analysis and the conclusions provided in the DEIR are appropriate for the kind of project being proposed. See responses to comments L51 through L58 below for further details.

L-51 See responses to comments L40 and L41 above.

L-52 Under the discussion of small wind turbine impacts to special-status species (Section 2.4.3.1), the DEIR states "wind turbines of any size can potentially result in collisions with sensitive bat species and avian species." The County agrees that the information provided in this comment can further clarify the potential impacts. In the same DEIR section, the County has made the following revision:

In addition to ground disturbance resulting in habitat impacts, wind turbines of any size can potentially result in collisions with sensitive bat species and avian species, sometimes called bird and bat "strikes." <u>Moreover, migrant birds, including golden eagle, may collide with wind turbines of any size while taking off or landing.</u>

This information does not result in any new significant environmental impacts, an increase in the severity of previously identified project impacts, or new feasible project alternatives or mitigation measures.

L-53 The County appreciates this information. The following revision has been made to DEIR Section 2.4.3.1:

Furthermore, the height of small wind turbines and MET facilities is not tall enough to be within migratory wildlife flight paths, such as that of the golden eagle. <u>However, migrating and resident eagles (and other raptors) conserve energy by using deflective updrafts or thermals to go long periods without flapping their wings. Because eagles are adapted to use even the smallest and weakest of thermals, they can migrate at elevations low to the ground. They may also fly low to the ground when weather conditions are "poor," or while they are foraging. Therefore, significant impacts to these types of avian species may still occur.</u>

This information does not result in any new significant environmental impacts, an increase in the severity of previously identified project impacts, or new feasible project alternatives or mitigation measures.

L-54 The County does not agree that the information in this comment needs to be included in the impact analysis for small wind turbines. The design features of the small turbines to be permitted by the proposed ordinance are based on recommendations to minimize

		perching and to minimize presence of prey habitat around the turbine base (see also responses to comments I6, J7, and DD12). The study cited in this comment focused on the wind farms at Altamont Pass, which were extreme cases of large turbines using outdated technology in a critical resource area (see also response to comment L49). The factors related to golden eagle mortality at Altamont Pass include placement of turbines on ridgelines and in a migration corridor, availability of prey habitat around turbine foundations, use of lattice/trellis-style turbines that promote avian perching, and use of utility-scale turbines with outdated technology that allows blades to spin very fast by today's standards. These factors would not be present for small wind turbines allowed pursuant to this project. As an extra precaution, the County has included a 4,000 foot setback requirement from known golden eagle nests for small wind turbines. Nonetheless, as noted in the DEIR and responses to comments L49 through L54 above, impacts to special-status species, such as golden eagle, would be potentially significant.
	L-55	See response to comment L53 above.
	L-56	The County agrees that impacts to resident special-status species, such as golden eagle, could potentially be significant. However, the County does not agree that impacts from small accessory-use wind turbines

	would be comparable to those found at the wind farms studied at Altamont Pass, as suggested by this comment. To clarify that migratory and resident eagles are potentially affected by small turbines, the County added additional language to the DEIR analysis as noted in response to comment L53 above. In addition, the County has added a provision to the draft ordinance to prohibit small wind turbines within 4,000 feet of a known golden eagle nest. This regulation would be consistent with the requirements of the San Diego Multiple Species Conservation Program (MSCP) Plan. **L-57** The County agrees that potential impacts to birds from small wind turbines, such as impacts to breeding/resident birds, are potentially significant. However, the County does not agree that impacts will likely result severe consequences to overall populations. The County has added a provision to the draft ordinance to prohibit small wind turbines within 4,000 feet of a known golden eagle nest. This regulation would be consistent with the requirements of the San Diego Multiple Species Conservation Program (MSCP) Plan, and help to minimize potential impacts to breeding golden eagles. **L-58** The County agrees that more clarification needed to be added to the DEIR as a result of the issues described in these comments (see responses to comments L52 and L53).

The DEIR Presents Misleading and Erroneous Information on the Collision Risk to Golden Eagles

The DEIR states the following in regard to the collision risk that large turbines pose to the golden eagle:

> Based on studies of the flight behavior of golden eagles, they are at lower risk than species such as red-tailed hawks because only 15% of their flight behaviors put them in a vulnerable position to turbine collisions (flying at the height of the rotor plane), and they do not spend significant time within close proximity (within 50 meters or 164 feet) to turbines (Thelander et al. 2003). The golden eagle has high maneuverability and therefore may be able to use high-powered flight to avoid collisions with turbines.[22]

These statements are very misleading. Research has demonstrated that golden eagles behave as if wind turbines are non-existent.[23] Consequently, golden eagles are highly vulnerable to collisions with wind turbines, and they routinely fly right through the rotor area.[24] The substantial number of golden eagles that are killed annually in the Altamont Pass Wind Resource Area alone demonstrates the vulnerability of golden eagles to mortality from wind turbines.[25] L-59

I have the following additional comments pertaining to the aforementioned statements presented in the DEIR:

1. Scientific data <u>do not</u> support the statement that golden eagles are at lower risk than other species. Contrary to the data presented in the DEIR, Thelander et al. (2003) reported 29.5% of eagle flights were within 50 meters of a turbine, and that eagles spent significantly more time flying close to turbines than would be expected by chance.[26] Similarly, Smallwood et al. (2009) concluded golden eagles often exhibit behaviors that corresponded with higher fatality rates.[27] L-60
2. Golden eagles have long, broad wings that are adapted for soaring—not maneuverability.[28] In addition, golden eagle wingbeats are slow, which prevents eagles from sharply turning and twisting in flight to avoid turbines.[29] L-61
3. The DEIR misapplies the term "risk." A true evaluation of risk requires that estimated L-62

[22] DEIR, p. 2.4-30.
[23] KS Smallwood, personal communication to S. Cashen on 9 Dec 2011.
[24] Id.
[25] Arnett, E. B., D. B. Inkley, D. H. Johnson, R. P. Larkin, S. Manes, A. M. Manville, J. R. Mason, M. L. Morrison, M. D. Strickland, and R. Thresher. 2007. Impacts of wind energy facilities on wildlife and wildlife habitat. Wildlife Society Technical Review 07-2. The Wildlife Society, Bethesda, Maryland, USA. *See also* Smallwood KS and C Thelander. 2008. Bird Mortality in the Altamont Pass Wind Resource Area, California. Journal Wildlife Management. 72(1):215-223.
[26] *See Table 9 and p. 18* <u>In:</u> Thelander CG, KS Smallwood, L Rugge. 2003. Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area. Prepared by BioResource Consultants for National Renewable Energy Laboratory. Ojai, California: BioResource Consultants. December 2003.
[27] Smallwood KS, L Rugge, ML Morrison. 2009. Influence of Behavior on Bird Mortality in Wind Energy Developments. The Journal of Wildlife Management. 73(7): 1082-1098.
[28] Terres JK. 1980. The Audubon Society Encyclopedia of North American Birds. New York: Knopf.
[29] Id.

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L-59 As noted in the DEIR, there is evidence that golden eagles have greater ability to avoid wind turbines than other predatory birds. Yet, as noted in this comment, there is also evidence that golden eagles routinely fly through the rotor area of large turbines. The DEIR includes additional discussion that large wind turbines may have significant impacts to golden eagle and other special status species. In light of all of this conflicting evidence, the County continues to support the determination that potential impacts from large wind turbines would be significant, as stated in the DEIR. The statements in the DEIR are not meant to mislead the reader, but to provide meaningful discussion and a basis for making a determination regarding significance.

The County also agrees that large turbine wind farms in the Altamont Pass Wind Resource Area have been extremely detrimental to golden eagles. As such, future large wind turbine projects must be designed to avoid the mistakes made at Altamont Pass. The latest guidelines from State and federal agencies will be applied to large wind turbine projects in the County as part of this project (see M-BIO-1 and M-BIO-2 in DEIR Section 2.4.6.1).

L-60 The County appreciates the information in this comment. As noted in response to comment L59 above, the information from the 2003 Thelander study

		is one part of a larger discussion that concludes that impacts from large wind turbines would be potentially significant. Numerous factors can affect how golden eagles or other predatory birds may be affected by large wind turbine development. To ensure that risks to golden eagles and impacts to other avian species are addressed, the latest guidelines from State and federal agencies will be applied to large wind turbine projects in the County as part of this project (see M-BIO-1 and M-BIO-2 in DEIR Section 2.4.6.1). It should also be noted that Eagle Conservation Plans will likely be required by state and federal agencies during the permitting process for large wind turbine projects.
	L-61	The County appreciates the information provided in this comment. See responses to comments L59 and L60 above.
	L-62	The County agrees that the evaluation described in this comment is another type of risk assessment than what was specifically provided in the DEIR. The commenter has a different emphasis than the County's analysis. However, the DEIR method for presenting potential impacts is also valid. The DEIR describes the restrictions in the ordinance, the discretionary review process, and regulatory requirements including the requirements for large turbine projects to minimize impacts. The DEIR also states, "The actual locations and details

	of future projects are unknown at this time; therefore, impacts as a result of the development of future large wind turbines cannot be fully analyzed." Instead, the potential types of impacts are discussed. Quantitative impact analyses with respect to population sizes would be too speculative. These types of analyses, however, will be required for specific large wind turbine projects. During project-specific environmental review, biological studies will be required that conform to the County's Biological Report Content and Format Guidelines available at http://www.sdcounty.ca.gov/dplu/docs/ Biological_Report_Format.pdf. Population size estimates are required as part of the impact analysis to provide the risk assessment described in this comment.

> mortality be put into context with the total population size.[30] Although estimating population size is difficult, preliminary research results indicate that turbine-related fatalities might be contributing to a long-term decline in regional golden eagle populations.[31]

L-62 Cont.

Data indicate the golden eagle population in San Diego County is experiencing a precipitous decline. These data, in conjunction with data from mortality and behavior studies, suggest the Ordinance would promote projects that pose high "risk" to the golden eagle. This risk must be accurately disclosed and analyzed in a revised DEIR.

L-63

The DEIR Does Not Provide an Accurate Assessment of the Collision Risk to Bird and Bat Populations

The DEIR recognizes that the Ordinance will generate a collision risk to birds and bats, and that this risk constitutes a potentially significant impact.[32] The DEIR's analysis of this impact, however, suffers two principal flaws: (1) an inappropriate level of analysis, and (2) the provision of indefensible conclusions.

L-64

Unique suites of attributes contribute to turbine-caused fatalities of each bird and bat species.[33] *Species-specific* analysis is required to understand these attributes and the associated risk that a project poses. The DEIR does not provide this level of analysis. Instead, it lumps analysis of all potentially affected bird and bat species. This level of analysis is inappropriate for disclosing impacts of the Ordinance.

L-65

The characteristics of the populations of affected species will determine the consequences of increased mortality resulting from wind turbines.[34] Bats, for example, are relatively long-lived and have low reproductive rates compared to many other mammals.[35] These traits may seriously limit their ability to recover from persistent or repeated fatality events.[36] The Natural Academy of Sciences (2007) concluded: "[i]f migratory tree bats experience naturally high mortality during migration from such factors as inclement weather, predation, and reduced food supplies, it is possible that with their low reproductive rates they *will not be able to adjust* to the expected cumulative affects resulting from the development of wind-energy facilities proposed in the United States and elsewhere."[37]

L-66

[30] Thelander CG, KS Smallwood, L Rugge. 2003. Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area. Prepared by BioResource Consultants for National Renewable Energy Laboratory. Ojai, California: BioResource Consultants. December 2003.
[31] Id.
[32] DEIR, p. 2.4-29.
[33] Thelander CG, KS Smallwood, L Rugge. 2003. Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area. Prepared by BioResource Consultants for National Renewable Energy Laboratory. Ojai, California: BioResource Consultants. December 2003. *See also* DEIR, p. 2.4-29.
[34] Committee on Environmental Impacts of Wind Energy Projects, National Research Council. 2007. Environmental Impacts of Wind-Energy Projects. National Academies Press, Washington (DC). 394 pp.
[35] Id.
[36] Id.
[37] Id. [emphasis added].

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L-63 Concerns about the regional status of golden eagle and the potential impacts from large wind turbines are clearly presented in the DEIR (see Pages 2.4-12, 2.14-19, 2.4-29, and 2.4-30). As noted in responses L59 through L62 above, project-specific impacts that are likely to result from development of future large wind turbines cannot be fully analyzed or quantified. The degree of specificity provided in the EIR corresponds to the degree of specificity involved in the proposed project, and, here, the project is an ordinance amendment (see CEQA Guidelines Section 15146).

Future large wind turbine projects will be required to provide project-specific assessments and will have to work with the wildlife agencies to comply with regulations that protect golden eagle. The impacts from such future projects could be very high, or they could be fully avoided or mitigated. And the small wind turbines that are eligible as accessories to existing uses under the proposed ordinance are not known to have direct impacts on the golden eagle. Nonetheless, a 4,000 foot buffer will be required from known eagle nests to reduce the potential risk. Therefore, definitive conclusions regarding the effect of small wind turbine on the golden eagle would also be speculative. Nonetheless, reasonable inference from available studies and information presented in the DEIR support a determination that direct and indirect impacts to sensitive species, such as golden eagle, would be potentially significant.

It should be noted that potential impacts to special status wildlife species would also be significant under the existing ordinance (or the No Project Alternative) for both large and small wind turbines. However, under the proposed project, the County would apply current guidelines and standards for minimizing effects to biological resources, which may result in fewer direct or indirect impacts to golden eagle when compared to the existing ordinance.

L-64 The County does not agree with this comment. The level of analysis and the conclusions provided in the DEIR are appropriate for the kind of project being proposed. See CEQA Guidelines section 15146. The County is not proposing the development of specific wind turbine projects at this time, but is proposing a revised ordinance to clarify the permitting processes for future wind turbines. The County does not know with certainty where wind turbines will be located or what environmental impacts they will have. To provide a meaningful analysis, some assumptions were made and reasonably foreseeable effects were discussed in the DEIR.

L-65 The County does not agree with this comment. Refer to responses to comments L40, L46, L63 and L64 above.

	L-66	The County acknowledges that the project may have significant impacts to sensitive bat species. However, as described in the DEIR, the County does not expect small wind turbines to result in frequent bat strikes. Based on the design criteria and the expectation that construction of small turbines will occur intermittently near existing development, elimination of local bat populations would not be foreseeable. The County has also added a provision to the draft ordinance in response to comments to include a buffer for small wind turbines located near known roosting locations for sensitive bat species (see revised ordinance Section 6951). This restriction should further reduce potential impacts to local populations of sensitive bat species.

Similarly, because local populations of raptors and vultures are relatively small, they are highly susceptible to fatalities from wind-energy generation.[38] Thus, even if one accepts the DEIR's premise that small turbines "would not be expected to result in frequent bird and bat strikes," these deaths may have very significant effects on the viability of the overall population.[39] L-67

The DEIR concludes: "[s]ome birds and bats could be killed through collisions with the wind turbines and power lines; however, populations of individual species would not be eliminated, and the impacts to populations would not be irreversible."[40] <u>The DEIR has no basis for this conclusion</u>. To the contrary, the Natural Academy of Sciences (2007) has concluded that for rare species and local populations, the impacts of wind energy facilities, when combined with other sources of mortality, could affect population viability (i.e., persistence).[41] For example, researchers believe the unprecedentedly high number of bat fatalities at wind turbine sites may contribute to the extirpation of some species.[42] L-68

The conclusion that impacts to populations would not be "irreversible" is entirely indefensible. First, it assumes a thorough understanding of impacts caused by wind turbines. This is simply not the case. Virtually every publication dedicated to the topic articulates this. Second, the conclusion that impacts to populations would not be irreversible defies principles of wildlife science. In short, if all population declines were reversible every recovery effort would have been successful. Past experiences clearly have proven otherwise. L-69

As a result of the issues discussed above, the DEIR must be revised such that it provides the public and decision makers with accurate information on the threat of wind turbinesto birds and bats. L-70

The DEIR Fails to Disclose or Assess Indirect Impacts Caused by Small Turbines

Incredibly, the DEIR fails to disclose or analyze any of the indirect impacts that small wind turbines may have on sensitive biological resources. The installation and maintenance of small wind-energy facilities has the potential to alter ecosystem structure through vegetation clearing and soil disturbance.[43] This issue is particularly problematic in areas that are difficult to reclaim, such as in desert, shrub-steppe, and forested habitats—all of which are present within San Diego County. L-71

[38] Id.
[39] DEIR, p. 2-4-28.
[40] DEIR, p. 2.10-3
[41] Committee on Environmental Impacts of Wind Energy Projects, National Research Council. 2007. Environmental Impacts of Wind-Energy Projects. National Academies Press, Washington (DC). 394 pp.
[42] Id. *See also* Thelander CG, KS Smallwood, L Rugge. 2003. Bird Risk Behaviors and Fatalities at the Altamont Pass Wind Resource Area. Prepared by BioResource Consultants for National Renewable Energy Laboratory. Ojai, California: BioResource Consultants. December 2003.
[43] Committee on Environmental Impacts of Wind Energy Projects, National Research Council. 2007. Environmental Impacts of Wind-Energy Projects. National Academies Press, Washington (DC). 394 pp.

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L-67 The County agrees that there's the potential for impacts to raptor species, and that such impacts are considered to be significant. However, the County does not agree that the potential impacts from small turbines threaten the viability of whole populations. The wildlife agencies have not indicated this is the case or prohibited use of small turbines. And for reasons stated in responses to comments I6 and DD12, the County expects that the ordinance criteria in the zoning verification process will reduce potential impacts to birds and bats, though not to a level below significant.

L-68 The County regrets that Section 2.10 of the DEIR was not very clear in terms of significant irreversible environmental changes. Under 2.10.1, the DEIR states "Irreversible long-term environmental changes associated with the proposed project would include those potential significant impacts described in Chapters 2.1 through 2.9 of this EIR." This statement includes the significant impacts to biological resources as identified in Chapter 2.4. However, Section 2.10.1 goes on to provide specific examples in bullet format that did not include biological resources. To make clear that impacts to biological resources, such as special-status species, would be significant and irreversible, the following bullet was added to Section 2.10.1 in response to this comment:

		• <u>Where turbines are constructed and operational, there would be a potential for destruction of sensitive biological resources, including special-status species.</u> However, the County still agrees with the last sentence in Section 2.10.1, which is the statement quoted in this comment. For the reasons stated in L66 and L67 above, County staff does not agree that the project would significantly affect population viability. The references cited in this comment specifically focused on large wind farms. Under the proposed ordinance, large wind turbine projects will have to undergo extensive biological review and monitoring to avoid, minimize and mitigate potential impacts to sensitive bird and bat species. In addition, County staff biologists do not agree that small turbines would contribute to the extirpation of some species.
	L-69	The County does not agree with this comment. The statement in DEIR Section 2.10.1 is based on the analysis of the whole project, including design criteria and mitigation measures. The determination is based on substantial evidence provided in the DEIR. Moreover, the DEIR does not claim that population declines in general are reversible. The DEIR determines that this project's impacts to bird and bat populations would not be irreversible. See also responses to comments L57, L66, L67, and L68 above.

L-70 The County has made revisions and clarifications to the DEIR pursuant to some of the comments in this letter, as noted in responses to comments above.

L-71 The DEIR discusses direct impacts from vegetation clearing, with a worst-case scenario of 441 square feet of clearance and 61 cubic yards of excavation for one small turbine. The County has determined that this direct impact would be significant. However, the County does not agree that this type of disturbance for an accessory use would potentially alter ecosystem structure. The comment suggests that some areas would be difficult to reclaim. Yet, reclamation would not be expected for these areas of disturbance. Rather, vegetation clearing is analyzed as a permanent direct impact in areas allowed to be developed with accessory uses.

Ground disturbance associated with the installation of small wind turbines may promote the colonization and spread of invasive plant species.[44] The colonization and spread of invasive plants is a significant threat to many sensitive biological resources and overall ecosystem health. L-72

Both flying and non-flying organisms may be affected by the noise and vibration associated with wind turbine construction and operation.[45] Noise can damage an organism's hearing or increase stress hormones, leading to a reduction in reproductive output and survivorship.[46] Noise and vibration also can interfere with communication essential for reproduction, prey acquisition, and predator avoidance.[47] L-73

The noise, vibration, motion of rotor blades, and/or mere presence of turbines on the landscape may displace organisms.[48] L-74 In addition, wind turbines and associated vegetation clearance activities can influence the microclimate, which may displace organisms due to the dramatic effect that microclimate has on habitat quality.[49] L-75

The indirect impacts outlined above are potentially significant. Consequently, assessments of the effects of wind-energy facilities on organisms and their habitat should not be confined to simple estimates of the amount of ground disturbance that may occur (as was done in the DEIR). The DEIR must be revised such that it fully discloses, analyzes, and mitigates all of the potentially significant indirect impacts that may be caused by the Ordinance. L-76

The DEIR Lacks an Adequate Assessment of Impacts to Local Policies, Ordinances, and Adopted Plans

The DEIR concludes small wind turbines and MET facilities would have a less than significant impact on local policies, ordinances, and plans protecting biological resources.[50] The DEIR supports this conclusion with the following rationale: L-77

a. Impacts would occur near existing development with minimal ground disturbance, if any.[51]

b. Sensitive areas or preserves (as defined by the Multiple Species Conservation Program ["MSCP"] or other habitat conservation plan) would be avoided.[52]

This rationale is not substantial evidence supporting the conclusion that impacts would be less than significant. First, the DEIR lacks a mechanism for ensuring wind turbines would occur L-78

[44] Id.
[45] Id. *See also* Rabin LA, B McCowan, SL Hooper, DH Owings. 2003. Anthropogenic Noise and its effect on Animal Communication: An Interface Between Comparative Psychology and Conservation Biology. International Journal of Comparative Psychology Vol. 16(2/3):172-193.
[46] Manci KM, DN Gladwin, R Villella, MG Cavendish. 1988. Effects of aircraft noise and sonic booms on domestic animals and wildlife: a literature synthesis. National Ecology Research Center Report # NERC-88/29.
[47] Id.
[48] Committee on Environmental Impacts of Wind Energy Projects, National Research Council. 2007. Environmental Impacts of Wind-Energy Projects. National Academies Press, Washington (DC). 394 pp.
[49] Id.
[50] DEIR, p. 2.4-38.
[51] Id.
[52] Id.

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L-72 For small turbine impacts, the County prepared a conservative ground disturbance estimate. As a worst-case scenario, this estimate would capture anticipated edge effects, such as the potential for the introduction of exotic species. As described in DEIR Sections 2.4.3.1 and 2.4.3.2, potential impacts to biological resources from small wind turbines is considered to be significant. However, the County does not agree that the placement of small turbines would promote exotic species such that they would threaten overall ecosystem health, as suggested by this comment. As noted in responses to comments L39 and L71 above, small wind turbines can only be permitted as accessory uses and, therefore, would be co-located with existing primary uses, such as residential uses. They would not be a type of initial development in an otherwise undeveloped area. To further restrict potential disturbance from small turbines, an additional provision has been added to section 6951.a.2 of the draft ordinance as follows:

<u>Area of Disturbance. A small wind turbine shall not result in an area of ground disturbance (including grading, clearing, brushing, or grubbing) during installation that is larger than a 25 foot radius around the base of a tower, and an access path to the tower that is a maximum of four feet wide. The entire area of disturbance shall be clearly defined on the plans submitted for Zoning Verification Permit review.</u>

In addition, that County has added requirements that small wind turbines will be setback a minimum of 300 feet from open space areas, preserves, wetland habitat, and blue line features. This will help to minimize potential indirect effects to sensitive resources.

L-73 Construction and operational noise from small turbines would be less than significant as described in Chapter 2.8. Construction activities would be temporary and would not include equipment associated with the generation of excessive noise. Mechanical and aerodynamic noise from modern, small wind turbines is minimal. Project noise typically needs to reach 60 dBA before it is considered to be adverse to sensitive species (see page 13 of the County's Guidelines for Determining Significance for Biological Resources). The specifications of the small turbines certified by the California Energy Commission indicate that the small turbines permitted by this ordinance would not reach that decibel level (see Appendix B to these responses to comments). Therefore, significant effects to sensitive species from noise impacts would not be foreseeable.

L-74 The County agrees that this comment would be true of large turbines, such as those that were studied in the cited literature. However, the small turbines that would be permitted by the proposed ordinance would not result in significant noise or vibration impacts (see

	response to comment L73).
	L-75 The County does not agree with this comment. The evidence used to suggest that vegetation disturbance from turbines results in significant impacts to microclimate is based on studies of industrial-scale wind farms. Estimated vegetation impacts from future small turbines would be potentially significant, but would not be large enough to induce indirect effects, such as microclimate changes (see also response to comment L72).
	L-76 The County does not agree with this comment. Adverse effects from invasive species may sometimes occur with the installation of a small wind turbine, but would not be expected to exceed the estimated ground disturbance impacts. Significant noise and microclimate effects from modern small turbines, such as those currently certified by the CEC, are not anticipated (see responses to comments L73 through L75 above.
	L-77 The County concurs with this comment, but not with the heading in bold above the comment.
	L-78 The County agrees that some small turbines may be sited farther away from existing development on site, such as on a rural lot. However, such an instance would not conflict with any local policies or ordinances that protect biological resources, or

	adopted HCPs or NCCPs. If future small turbines were typically located in sensitive habitat areas away from existing development, then such a pattern would impede efforts to preserve contiguous sensitive habitat areas under County ordinances and adopted conservation plans. However, the small wind turbines that would be allowed by a ministerial process under the draft ordinance must be accessory uses to existing development. Consequently, the lot on which these turbines would be located would already be developed with and disturbed by a primary use, such as residential or commercial uses. There is also an inherent incentive for landowners to minimize the amount of trenching and infrastructure needed in order to keep costs low.

"near existing development." As the DEIR acknowledges, the eastern portion of the County is primarily rural, with large lot sizes and limited infrastructure.[53] This reflects the possibility that impacts would not be limited to areas "near existing development." L-78 Cont.

Second, the DEIR's rationale fails to consider the numerous, potentially significant indirect impacts that small wind turbine and MET facilities may have on sensitive areas or preserves, including MSCP areas. These indirect impacts include noise and vibration, fugitive dust, night lighting, the spread of invasive plants, and alterations to hydrology (among potentially other indirect impacts). For example, at the Altamont Pass Wind Resource Area, wind turbines upslope of a preserve have caused severe erosion and sedimentation, which have affected the preserve's red-legged frog and California tiger salamander populations.[54] L-79

Impacts to Critical Habitat, Core Habitat Areas, Landscape Linkages, and Federal Recovery Plans

San Diego County contains designated "critical habitat" for several federally listed plant and animal species.[55] It also contains core habitat areas and linkages that have been identified in the MSCP.[56] The DEIR lacks any analysis of impacts to critical habitat, or core habitat areas and linkages. L-80

Recovery plans have been approved for several federally listed threatened and endangered species occurring in San Diego County. Each recovery plan establishes the conservation and management actions needed to (a) reverse the decline of the species; and (b) reduce the threats to the species' survival to the point where protections under the Endangered Species Act are no longer needed. The DEIR does not provide any information on the Ordinance's consistency with the various recovery plans or the MSCP, nor does it provide any analysis of the Ordinance's impact on the recovery of potentially afflicted threatened or endangered species. L-81

The DEIR Lacks Adequate Analysis of Cumulative Impacts

The DEIR concludes the Ordinance would contribute to cumulatively considerable impacts to (1) special-status species; (2) riparian habitats and other sensitive natural communities; and (3) wildlife movement corridors and nursery sites.[57] The DEIR, however, fails to provide any substantive analyses of cumulative impacts to these resources. This precludes an evaluation of the Ordinance's contribution to cumulative impacts, and thus, the anticipated consequences of cumulative impacts on the conservation of each resource. To enable independent analysis of the Ordinance's contribution to cumulative impacts to sensitive biological resources, the DEIR must: L-82

1. identify the number, size (i.e., footprint and MW), and location of existing and reasonably foreseeable future wind energy projects in San Diego County. L-83

[53] DEIR, p. 1-2.
[54] Contra Costa County. 2011 October. Final Environmental Impact Report for the Tres Vaqueros Windfarm Repowering Project. SCH No. 2009032077. County File No. LP09-2005.
[55] DEIR, p. 2.4-11.
[56] DEIR, p. 2.4-17.
[57] DEIR, p. 2.4-40 through 2.4-43.

10

L-79 The County does not agree that future small wind turbines will have significant indirect impacts on the MSCP. Potential indirect impacts would not exceed the worst-case scenario impacts analyzed in the DEIR (see response to comment L72). Noise, vibration, dust, lighting, hydrology pattern, and erosion would be minimal based on the zoning verification process in Section 6951 which requires small turbines to meet certain criteria, including the following:

-Noise restrictions set forth in the County Noise Ordinance

-Area of disturbance restrictions

-Lighting restrictions

Moreover, any extensive land modification would require a discretionary grading or clearing permit. And to further ensure that sensitive areas within the MSCP are not significantly affected, a provision has been added to Section 6951.a.12 of the draft ordinance requiring a discretionary Administrative Permit for small wind turbines located in the pre-approved mitigation area of the MSCP (see response to comment I11).

Potential impacts from future small wind turbines permitted by the proposed ordinance are not comparable to impacts that have been observed at the

		Altamont Pass Wind Resources Area where large industrial-scale wind turbines were sited along ridgelines in large numbers. Severe erosion and sedimentation, for example, would not result from the permitting of small wind turbines given the proposed limitations on the amount of area that may be disturbed and the fact that even under the worst-case scenario of ground disturbance, the amount of earthwork would be so small that it would not require a grading permit under the County's grading ordinance.
	L-80	The County did not analyze potential impacts to critical habitat, nor is this analysis required (see response to comment L42). Direct impacts to linkages and corridors from small wind turbines are determined to be potentially significant as discussed in DEIR Section 2.4.3.4. Critical biological resource areas in the MSCP are designated as pre-approved mitigation areas (PAMA) or as preserve. The County has added the following provisions to Section 6951.a of the draft ordinance to minimize or mitigate potential impacts to these areas: 1.ii.d: No part of the wind turbine shall be closer than 300 feet or 5 times the turbine height, whichever is greater, from recorded open space easement and designated preserve areas. <u>12: Pre-Approved Mitigation Area. A small</u>

	<u>turbine is allowed on a legal lot designated as Pre-Approved Mitigation Area within the boundaries of the Multiple Species Conservation Program Subarea Plan only with an Administrative Permit.</u> Despite the inclusion of these measures to minimize impacts to sensitive biological areas, impacts to linkages/corridors and sensitive natural communities would still be significant and unavoidable as clearly provided in the analysis in the DEIR (see DEIR Sections 2.4.3.2 and 2.4.3.4. **L-81** Section 2.4.3.5 of the DEIR describes the project's consistency with adopted HCPs and NCCPs. By complying with the applicable HCPs and NCCPs, including the County's MSCP Subarea Plan, the County is meeting the goals of the Recovery Plans for species covered under those regulatory programs. See also responses to comments L77 through L80 above. **L-82** The County does not agree with this comment. For each environmental issue, the DEIR includes specific discussion of potential cumulative impacts. For biological resources, this discussion is provided in Section 2.4.4. **L-83** Past and present projects considered in the cumulative analysis are provided in Section 1.7 of the DEIR. Reasonably foreseeable wind energy projects in the County unincorporated constitute the <u>proposed</u>

	project, not the cumulative projects. Reasonably foreseeable projects in other jurisdictions that were considered in the cumulative analysis are provided in Section 1.7 of the DEIR. Other reasonably foreseeable projects in the County unincorporated area are discussed in DEIR Section 1.7 and include the development projections of the recently approved General Plan Update.

2. identify the number, size, and location of all other types of past, present, and reasonably foreseeable future projects that may contribute to cumulative impacts to sensitive biological resources in San Diego County. L-83 Cont.

3. conduct cumulative impacts analyses at an ecologically appropriate level. It is not appropriate to lump analysis of all potentially afflicted species (as was done in the DEIR). The type and severity of cumulative impacts varies considerably among species due to inherent variability in threats and population status. L-84

4. put cumulative impacts into context. For example, how would the Ordinance, in conjunction with other projects, affect the regional golden eagle population (e.g., contribute to additional population declines)? L-85

The DEIR Fails to Incorporate All Feasible Mitigation Measures for Significant Impacts to the Golden Eagle

The DEIR acknowledges that the Ordinance would have a potentially significant impact on the golden eagle. The DEIR further acknowledges: "for eagle management populations that cannot sustain additional mortality, any remaining take must be offset through compensatory mitigation such that the net effect on the eagle population is, at a minimum, no change."[58] L-86 Nevertheless, the DEIR lacks any mitigation for impacts to the golden eagle. L-87 Data indicate the golden eagle population in San Diego County is rapidly declining, and that the population cannot sustain additional mortality.[59] The lack of any attempted mitigation for impacts to the golden eagle has serious implications on a decision about the Ordinance. L-88 New provisions of the Bald and Golden Eagle Protection Act prohibit the USFWS from authorizing a project that would result in a net take of eagles. Therefore, because wind turbines of all sizes have the potential to cause take of eagles, and because the Ordinance does not provide mitigation for compensating that take (i.e., ensuring no-net-loss), the Ordinance would permit projects that may not comply with federal law. L-89

The USFWS's Draft Eagle Conservation Plan Guidance discusses several mitigation measures for impacts to eagles. The measures recommended by the USFWS are feasible, and they should be incorporated into a revised DEIR to demonstrate a good-faith effort to comply with federal law and achieve a no-net-loss standard for the regional eagle population.[60] L-90

The DEIR Fails to Incorporate All Feasible Mitigation Measures for Potentially Significant Impacts to Special-Status Bird and Bat Species

The DEIR concludes the Ordinance would result in potentially significant impacts to sensitive bird and bat species. I agree with this conclusion. However, the DEIR fails to impose all feasible mitigation measures to avoid, minimize, and mitigate impacts to birds and bats. I outline feasible mitigation in a subsequent section of this letter. L-91

[58] DEIR, p. 2.4-19.
[59] Unitt PA. 2004. San Diego County Bird Atlas. Proceedings of the San Diego Society of Natural History, No. 39.
[60] U.S. Fish and Wildlife Service. 2011 Jan. Draft Eagle Conservation Plan Guidance. Available at: http://www.fws.gov/windenergy/.

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L-84 The County does not agree that this type of detailed analysis, which would include 295 sensitive species, is feasible or required (see also response to comment L40 and CEQA Guidelines sections 15146 and 15130(b)). A qualitative cumulative analysis is provided in the DEIR with regard to special-status species impacts.

L-85 The County does not agree that this type of specific population analysis is required as part of the cumulative analysis. The County is working on MSCP Plans for North and East County that will include this type of conservation analysis. The DEIR evaluates the potential project-level impacts to special status species and also provides a cumulative analysis of potential impacts in DEIR Section 2.4.4. Moreover, regional golden eagle information is not readily available. However, the County is making every effort to minimize potential project impacts to golden eagle from small and large wind turbines. Small wind turbines will be prohibited within 4,000 feet of known golden eagle nests; and large wind turbines will be required to follow the latest bird and bat guidelines provided by the CEC and the wildlife agencies.

L-86 The County does not agree with this comment. The sentence cited in the comment is taken out of context. This sentence is a description of the Draft Eagle Conservation Plan Guidance. It is not a blanket

		regulatory requirement (see DEIR Section 2.4.2 for full discussion on the USFWS Draft Eagle Conservation Plan Guidance).
	L-87	The County does not agree with this comment. The County has included design features for small ministerial wind turbines to reduce potential impacts to special status species. These features are discussed in the DEIR that was circulated for public review. In response to comments, the County has also included a provision to prohibit small wind turbines within 4,000 feet of a known golden eagle nest. For large wind turbines that will have site-specific environmental review, the County has included two mitigation measures (M-BIO-1 and M-BIO-2) to reduce potential impacts to special status species. Any additional mitigation for golden eagle impacts as part of this project is not feasible. Since small wind turbines would be permitted ministerially on private land, no site-specific environmental review or site-specific mitigation would be feasible. Requirements for compensatory site-specific mitigation from permittees would conflict with the objectives to allow development of small wind turbines without a discretionary permit (objective 6) and to streamline and clarify the approval process for the development and operation of small wind turbines (objective 4). Any requirement for project-specific mitigation would be substantially more restrictive than the provisions of

the existing ordinance and, therefore, would be contrary to the goals and objectives of the proposed project. Since future large wind turbines will be required to conduct site-specific environmental review and provide appropriate mitigation, no additional measures over M-BIO-1 and M-BIO-2 can be achieved at this stage without speculating about where future turbines may be located, how tall they will be, what effects they will have, and what measures would mitigate estimated effects.

L-88 The County appreciates this information regarding the severity of impacts to golden eagle in San Diego. This information will be provided to decision makers for consideration when evaluating the potential impacts of the project. The County will also consider recommendations from the wildlife agencies, particularly with regard to golden eagle impacts. However, the County may approve a project in spite of significant and unavoidable impacts if certain findings can be made. See comment L87 above regarding mitigation for golden eagle.

L-89 The County does not agree with this comment. Future discretionary wind turbine projects must undergo site-specific environmental review and,, possibly, consultation with the US Fish and Wildlife Service (USFWS) to ensure no net loss of bald and golden eagles. However, the County also has the ability to

		issue ministerial development permits without individual environmental reviews. Under the existing Zoning Ordinance provisions, a single small turbine is allowed with a ministerial permit. The County is proposing to expand that provision to allow for three free-standing turbines or five roof-mounted turbines. Based on the County's review of federal and State regulations, the project does not conflict with federal law. In addition, based on meetings with the wildlife agencies, the County has added mitigation measure M-BIO-3 to include a notice with all future small turbine permits explicitly stating that additional state and federal regulations may apply to the construction and operation of the wind turbine including, but not limited to, U.S. Endangered Species Act, the California Endangered Species Act, and the California Fish and Game Code.
	L-90	The County is including all feasible design features in the draft Wind Energy Ordinance for small wind turbines that will help to reduce impacts to birds based on recommendations from the wildlife agencies and the public. The USFWS Draft Eagle Conservation Plan (ECP) Guidance is geared toward industrial scale wind farms rather than small turbines to generate energy for use on site. It would not be feasible for the County to include the Draft ECP Guidance in the proposed ordinance as standards for issuing ministerial permits for small wind turbines since the Guidance

		requires discretionary review. The measures in the Draft ECP Guidance are appropriate for future large wind turbine projects which will be subject to a discretionary review process. The County is proposing to include or incorporate by reference all the latest recommendations from the wildlife agencies and the CEC in its Guidelines for Determining Significance for Biological Resources. In addition, the County will consult with the wildlife agencies during the permitting process for large wind turbine projects.
	L-91	The County is including all feasible measures to minimize impacts to special status species from both small and large wind turbines. Specific responses to recommended measures are provided in responses to comments L96 through L125 below.

The DEIR Fails to Incorporate All Feasible Mitigation Measures for Potentially Significant Impacts to Wildlife Corridors and Nursery Sites

The DEIR recognizes that the Ordinance would cause potentially significant impacts to wildlife corridors and nursery sites.[61] The DEIR offers no mitigation to avoid and minimize these impacts. There are feasible measures for mitigating impacts to wildlife corridors and nursery sites. I discuss these measures in a subsequent section of this letter. L-92

The DEIR Fails to Incorporate All Feasible Mitigation Measures for Potentially Significant Impacts to Riparian Habitat and Other Sensitive Natural Communities

The Ordinance would allow development of small wind turbines and temporary MET facilities that would have potentially significant impacts to riparian habitat and other sensitive natural communities.[62] According to the DEIR, proposed mitigation measures could reduce these potentially significant impacts, but not below a significant level.[63] However, the DEIR lacks the basis for this conclusion because it does not impose *all* feasible measures to avoid, minimize, and mitigate impacts. In the subsequent section I discuss feasible mitigation measures for impacts to riparian habitat and other sensitive natural communities. L-93

Recommended Mitigation for Potentially Significant Impacts Caused by the Ordinance

The Ordinance would have potentially significant impacts on several sensitive biological resources. Under CEQA, the County is obligated to adopt all feasible mitigation to avoid or lessen significant impacts. The DEIR is deficient in this regard because it fails to demonstrate a substantive attempt to formulate feasible mitigation measures that could reduce impacts to a level considered less than significant. The following mitigation measures are feasible, and they must be incorporated into the Ordinance's mitigation program. L-94 In addition, these measures will minimize a permittee's civil and potential criminal liability for violations of the Endangered Species Act, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act—federal protections that preempt state law, including AB 45. L-95

General standards-

1. Turbines should be sited on disturbed land when practical. L-96
2. Existing roads should be used to the maximum extent feasible. L-97
3. Construction should be scheduled to avoid disruption of wildlife reproductive activities or other important behaviors. L-98
4. As has been adopted by Marin County, a Bird and Bat Study should be conducted for each proposed wind energy facility. A County-approved biologist should conduct the L-99

[61] DEIR, p. 2.4-36 and 2.3-37.
[62] DEIR, p. 2.4-45.
[63] Id.

12

L-92 The County does not agree with this comment. Measures to avoid and minimize impacts from small wind turbines to corridors and nursery sites are included as design features in the draft ordinance, and additional measures are included in response to comments (see responses to comments I6, I8, L2, and L11). Mitigation measures to reduce potential impacts from large wind turbines to wildlife corridors and nursery sites are proposed in DEIR Section 2.4.6.

L-93 The County is including all feasible measures to minimize impacts to riparian habitat and other sensitive natural communities from both small and large wind turbines. Specific responses to recommended measures are provided in responses to comments L96 through L125 below.

L-94 The County agrees that all feasible mitigation must be included to avoid or lessen significant environmental impacts. The County does not agree that the DEIR is deficient in this regard. The County has made every effort to include all feasible design features and measures to minimize and mitigate significant impacts while still meeting the project objectives. It should be noted that County staff met with the commenter multiple times to develop feasible design criteria for small turbines, which were included in Section 6951.a of the draft ordinance (see responses to comments I6 and L2).

L-95 This comment introduces recommended mitigation measures. Specific responses to each suggestion are provided in the responses to comments below.

L-96 The Limited Small Wind Turbine Alternative would allow small wind turbines only in disturbed areas. The feasibility of this approach will be evaluated by decision makers.

For future large wind turbine projects, siting considerations will be part of the environmental review and application of the County's Guidelines for Determining Significance for Biological Resources.

L-97 For small wind turbines, no new roads would be allowed under the ministerial permit. Road improvement plans are discretionary projects that require environmental review.

For large wind turbines, road improvements will be evaluated as part of the Major Use Permit (MUP) process. As part of that process, the County will apply the General Plan Policies in the Mobility Element. Goal M-9 of the Mobility Element states: "Reduce the need to widen or build roads through effective use of the existing transportation network and maximize the use of alternative modes of travel throughout the County." Should new roads need to be built as part of a large wind turbine project, the policies in the Mobility Element also require environmentally

	sensitive road design (e.g., policies M-2.3 and M-2.5).
L-98	Construction activities for small wind turbines would typically last one day and would generally involve the delivery of component parts and equipment (if the turbine is too large for the individual property owner to manage), and the pouring of a concrete foundation. These activities would usually not last more than a single day and would not be expected to have a significant effect on wildlife reproductive activities. Pursuant to the County of San Diego Guidelines for Determining Significance for Biological Resources, future large wind turbine projects must address the potential need to avoid construction during the breeding seasons of applicable sensitive wildlife species (see Sections 4.1 and 5.1 of the Guidelines).
L-99	The County reviewed the Marin County Development Code for Wind Energy Conversion Systems, including Section 22.32.180(B), Development Standards, which requires a bird and bat study for small wind turbine projects. These standards apply to discretionary permits for small Wind Energy Conversion Systems. One of the County of San Diego's primary objectives is to allow small wind turbines with a ministerial permit. This objective would not be attainable if the Marin County development standards, which involve a discretionary process, were included in the Zoning Ordinance amendments for small turbine projects and

MET facilities in San Diego County. However, the County does agree that bird and bat studies should be required for discretionary permit applications, such as Major Use Permit applications for large wind turbines. Mitigation measures M-BIO-1 and M-BIO-2 would ensure that future large turbine projects conduct bird and bat studies in accordance with the latest guidelines from the wildlife agencies and the CEC.

See also responses to comments I6 through I9.

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Bird and Bat Study according to California Energy Commission and CDFG guidelines.[64]

L-99 Cont.

5. If the Bird and Bat Study for a proposed ministerial project finds that there is a potential for impacts to any (a) listed State or Federal threatened or endangered species; or (b) bird or bat "species of special concern" found to nest or roost in the area of the proposed project site, the project should become discretionary.

L-100

6. Wind turbines, MET towers, and supporting infrastructure should be prohibited near sensitive biological resources, as determined by a County-approved biologist and/or the CDFG and USFWS. At a minimum, wind turbines, MET towers, and supporting infrastructure should be prohibited within 5 times the height or 300 feet, whichever is greater, of:

L-101

a. a known nest or roost of a listed State or Federal threatened or endangered species or "species of special concern."

b. a known or suspected migratory concentration or stopover point.

c. known or suspected corridors that enable movement of special-status species, especially narrow corridors (e.g., a culvert), or corridors that are essential to landscape-level connectivity.

d. wildlife nursery sites.

e. an essential habitat element (e.g., burrow) for any threatened or endangered species.

f. any plant listed as threatened or endangered, or that is a candidate for future listing as threatened or endangered, under the California Endangered Species Act ("ESA") or federal ESA.

g. any plant listed as rare under the California Native Plant Protection Act, or as a "List 1" or "List 2" species by the California Native Plant Society.

h. all water courses, ponds, lakes, and other wetlands.

i. all riparian habitat.

j. previous and pending mitigation lands, conservation reserves, and lands encumbered by a conservation easement.

k. State and Federal parks, refuges, wilderness areas, and other designated wildlife management areas.

l. in any areas where impacts would threaten the persistence of a special-status species population.

L-102

[64] *See* Marin County Development Code Title 22. *See also* California Energy Commission and California Department of Fish and Game. 2007. California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development. Commission Final Report. California Energy Commission, Renewables Committee, and Energy Facilities Siting Division, and California Department of Fish and Game, Resources Management and Policy Division. CEC_700_2007_008_CMF.

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L-100 The County does not agree with this comment. A bird and bat study is not a "yes-or-no" type of study for which it will be quickly evident whether or not there will be potential impacts to a species of concern. Preparation and review of the study would require a certain amount of discretion (e.g., determining whether habitat is "occupied" by sensitive species, determining the extent of wildlife usage or territories, determining whether habitat is intact or disturbed, etc.). As such, the preliminary determination of whether small wind turbine permits would be subject to a discretionary or ministerial review process would, itself, be based on a discretionary review process. The County's Zoning Ordinance does not currently require this type of preliminary determination for any proposed use, and the County does not agree that it is appropriate for small wind turbines.

Moreover, the requirement for a biological study prior to consideration of a small wind turbine application would defeat the County's objective to streamline and clarify the approval process for the development and operation of small wind turbines. In most cases, it would complicate the process since no such requirement exists under the current ordinance regulations for small, medium or large turbines

Therefore, including a mandate for a biological study that could result in the permit being ministerial or

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discretionary would directly conflict with project objectives #4 and #6. Since this recommended mitigation conflicts with the project objectives, it would be infeasible.

L-101 Specific on-site review of biological resources would not be feasible as part of the ministerial permit process for small wind turbines (see responses to comments I6, I7, I8, J14, L2, L99, L100, DD15, and DD18). However, County staff worked with the commenter to consider all of the recommendations that follow this comment and to include all feasible objective impact minimization measures as design criteria for small turbines (see response to comment L102 below).

For large wind turbines, the County agrees that proximity to sensitive biological resources should be evaluated, though not necessarily prohibited. The County will be applying Guidelines for Determining Significance for Biological Resources to future large wind turbine projects to determine the best way to avoid, minimize and/or mitigate significant impacts to biological resources. Depending on existing conditions, it is sometimes better to permit development with direct impacts and allow for off-site mitigation that contributes to an open space network. The County's Resource Protection Ordinance allows for mitigation over avoidance when mitigation provides an equal or greater benefit to the affected species.

	L-102	For large wind turbines, the County does not agree that this type of standard is the best mitigation. Large wind turbine projects will be required to avoid, minimize, and mitigate significant impacts whenever feasible. Establishing a 300 foot buffer (or five times height setback) from specified resources may preclude better mitigation alternatives and be perceived as a maximum buffer during future permitting. With regard to recommended distance from sensitive resources, the CEC's Guidelines For Reducing Impacts To Birds And Bats From Wind Energy Development state: "Determine the extent of the buffer zone in consultation with CDFG, USFWS, and biologists with specific knowledge of the affected species.” For small wind turbines and MET facilities, the County does not agree that site-specific-review and setbacks from identified resources could be established through a ministerial process. Ministerial describes a governmental decision involving little or no personal judgment by the public official as to the wisdom or manner of carrying out the project. The public official merely applies the law to the facts as presented, but uses no special discretion or judgment in reaching a decision. A ministerial decision involves only the use of fixed standards or objective measurements. Based on countless reviews of biological studies for other projects in the County unincorporated area, determinations regarding the

presence or extent of sensitive resources requires the exercise of discretion.

For example, the determination as to whether or not listed species occur on a given property, or where they occur in order to establish a setback, would be discretionary based on biological surveys and the judgment of the staff biologist. Similarly, the presence and width of a wildlife movement corridor, the presence of a wildlife nursery site, and the presence and extent of a wetland are all determinations that would require the use of discretion by County staff.

However, the County can establish setbacks from mapped locations that can be measured objectively. As such, the following provisions have been added to Section 6951.a of the draft ordinance:

<u>1.ii.: No part of the wind turbine shall be closer than 300 feet or 5 times the turbine height, whichever is greater, from the following:</u>

<u>a. Power transmission towers and lines.</u>

<u>b. Blue line watercourse(s) or water bodies as identified on the current United States Geological Survey Topographic Map.</u>

<u>c. Significant roost sites for bat species as mapped on the California Natural Diversity</u>

	Database and San Diego Natural History Museum maps. d. Recorded open space easement and designated preserve areas. e. Riparian vegetation as identified on the County Wetland Vegetation Map dated October 19, 2012. 1.iii: No part of a wind turbine shall be closer than 4,000 feet from a known golden eagle nest site. Parcels within 4,000 feet of known golden eagle nest sites are identified on the Small Wind Turbine Constraints Map dated October 12, 2012 based on data provided by the U.S. Fish and Wildlife Service. 2. Area of Disturbance. A small wind turbine shall not result in an area of ground disturbance (including grading, clearing, brushing, or grubbing) during installation that is larger than a 25 foot radius around the base of a tower, and an access path to the tower that is a maximum of four feet wide. The entire area of disturbance shall be clearly defined on the plans submitted for Zoning Verification Permit review. 12: Pre-Approved Mitigation Area. A small turbine is allowed on a legal lot designated as Pre-Approved Mitigation Area within the boundaries of the Multiple Species Conservation Program Subarea

	<u>Plan only with an Administrative Permit. An Administrative Permit may be approved for a maximum of three small wind turbines if all of the requirements of subsection "a" of this section are met and the cumulative rated capacity of the turbine(s) does not exceed 50 kilowatts. Subsections 6951.b and 6951.c below do not apply to lots designated as Pre-Approved Mitigation Area within the boundaries of the Multiple Species Conservation Program Subarea Plan.</u> There is no guarantee that these provisions will result in reduced biological impacts for any given site, but overall they should help to minimize potential adverse effects to sensitive species. See also responses to comments I6, I7, I8, I9, J6, J9, and L26.

Information on the resources listed above should be obtained through a biological field study in conjunction with a review of previously completed field studies; consultation with state and federal resource agencies and local experts; and queries of the California Natural Diversity Database, California Partners in Flight Database, and California Consortium of Herbaria Database. L-103

7. Areas disturbed during construction should be restored to the native habitat and subject to inspection. Habitat restoration should begin as soon as possible after the completion of construction. The County, in conjunction with the resource agencies, should develop success standards for all restoration efforts. If restoration sites do not meet success standards within five years following construction, the wind turbine operator should be responsible for funding remedial actions conducted by a County-approved contractor or purchasing credits at an approved habitat conservation bank. L-104
8. All wind turbines operators should provide compensation for permanent impacts to native habitat. Compensation could be achieved through: (a) the acquisition and permanent protection of replacement habitat; (b) purchasing credits at an approved habitat conservation bank; or (c) contribution to a mitigation fund established by the County.[65] L-105
9. The wind turbine operator should be responsible for erosion and sediment control on slopes disturbed during construction. Disturbed slopes should be subject to inspection, and the wind turbine operator should be responsible for funding remedial actions conducted by a County-approved contractor if the wind turbine site does not meet water quality standards. L-106
10. The County should conduct and document the aforementioned inspections at the frequency necessary to ensure compliance. L-107
11. All large wind energy facilities should be responsible for implementing the "California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development," and all other survey and mitigation guidelines issued by the State and Federal resource agencies.[66] The Ordinance must specify that compliance with these guidelines is mandatory. L-108

Birds and Bats-

1. Projects should not be located in areas with a high incidence of fog and mist, or other meteorological conditions that cause low visibility. L-109
2. All large wind energy facilities should develop an (a) Avian and Bat Protection Plan; and (b) Adaptive Management Plan. These plans should conform to guidelines issued L-110

[65] *See* National Wind Coordinating Collaborative. 2007 May. Mitigation Toolbox. Available at: http://www.nationalwind.org/publications/wildlifewind.aspx
[66] California Energy Commission and California Department of Fish and Game. 2007. California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development. Commission Final Report. California Energy Commission, Renewables Committee, and Energy Facilities Siting Division, and California Department of Fish and Game, Resources Management and Policy Division. CEC_700_2007_008_CMF.

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L-103 This comment recommends collecting data regarding resources listed in comment L102. Reliance on some data can be used to map known locations and establish buffers as described in response to comment L102 above. The County will utilize its Geographic Information Systems (GIS) to implement the proposed setbacks from mapped golden eagle nests, significant bat roosts, water bodies, and transmission towers.

Additional mapping and site-specific review could not be achieved with the ministerial process. Based on countless reviews of biological studies in the County unincorporated area, determinations, such as where a wetland begins or ends, how wide a wildlife corridor is, whether habitat on site is used by a sensitive species off site, or whether an isolated rare plant is part of a larger population, are all determinations that require discretionary review. The County's project objectives for the Wind Energy Ordinance include allowing development of small wind turbines without a discretionary permit (objective 6) and streamlining and clarifying the approval process for the development and operation of small wind turbines (objective 4). The County does not agree that it can achieve those objectives with the type of biological data collection and reviews suggested by the commenter.

For large wind turbines that will undergo discretionary review, site-specific mapping will be required and potential impacts to sensitive resources will be addressed through application of the latest guidelines from State and federal agencies.

L-104 The County does not agree with this comment as it pertains to large or small wind turbines. For large wind turbine projects, impacts from and mitigation/revegetation for construction and staging areas will be identified during the site-specific environmental review for each specific project. Treatment of such areas following construction will be determined on a case-by-case basis. The County agrees that in most cases native habitat that is disturbed will need to be revegetated and that success criteria should be developed in consultation with the wildlife agencies. This type of revegetation requirement is a typical mitigation measure included the County's Guidelines for Determining Significance for Biological Resources (see Section 5.1 of the Guidelines). Since the need for revegetation will be determined through site-specific evaluation and agency consultation, the County does not agree that it should be established as a requirement in all cases. For some large turbine projects, it may be determined that the staging area should be kept free of vegetation, or that it should be revegetated with particular plant species that do not attract prey species for raptors

For small wind turbines, construction and staging areas are not expected to be needed. Construction activities for small wind turbines would typically last one day and would generally involve the delivery of component parts and equipment (if the turbine is too large for the individual property owner to manage), and the pouring of a concrete foundation. These activities would usually occur near existing on-site development and would not be expected to result in a substantial area of disturbance. In addition, the County has added the following provision to the small wind turbine provisions in the ordinance:

<u>Area of Disturbance. A small wind turbine shall not result in an area of ground disturbance (including grading, clearing, brushing, or grubbing) that is larger than a 25 foot radius around the base of a tower, and an access path to the tower that is a maximum of four feet wide. The entire area of disturbance shall be clearly defined on the plans submitted for Zoning Verification Permit review.</u>

Therefore, land disturbance from construction of small wind turbines will be kept to the minimum necessary and will not result in the need for restoration plans.

L-105 The County agrees with this recommendation as it pertains to large wind turbines. The County's Guidelines for Determining Significance for Biological Resources establishes mitigation measures

		for temporary or permanent impacts to native or non-native sensitive habitat (see Guidelines Section 5). In addition, the County's Resource Protection Ordinance requires avoidance of or mitigation for impacts to Sensitive Habitat Lands. The County does not agree that impacts to habitat from small wind turbines can be mitigated as part of this project. The County's project objectives for the Wind Energy Ordinance are to allow development of small wind turbines without a discretionary permit (objective 6) and to streamline and clarify the approval process for the development and operation of small wind turbines (objective 4). The County does not agree that it can achieve those objectives with a requirement that each small turbine be reviewed for potential impacts to habitat and include conditions of approval requiring applicants to provide habitat mitigation.
	L-106	The County agrees with this recommendation as it pertains to large wind turbines. The County's Resource Protection Ordinance requires Major Use Permits to protect steep slopes. In addition, the County's Grading Ordinance and Watershed Protection Ordinance have strict requirements for erosion and sediment control, as well as remedial measures for disturbed slopes. The County does not agree that significant impacts related to water quality or erosion will occur from the installation of small wind turbines (see DEIR Section

3.1.2.3.3).

L-107 The County will inspect, monitor, and document compliance with Major Use Permit conditions for large wind turbine projects. For small wind turbines with ministerial permits, the County does not agree with the suggested requirements and inspections (see responses to comments L96 through L106 above).

L-108 The County does not agree with this comment. See response to comment L28.

L-109 Based on the CEC Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development, this recommendation will be a consideration during the environmental review of large wind turbine projects. Though it should be noted that, depending on the results of consultations with the California Department of Fish and Game, low visibility conditions may not necessarily require relocation of the project.

The County does not agree that this standard should be applied to the ministerial permitting of small wind turbines. It is not clear from the comment what would be considered "high incidence" or how meteorological conditions for a given property could be determined or measured objectively. Rather, such determinations would require judgment from County staff. Therefore, it could not be applied in a ministerial process (see also responses to comments I6, I7, I8, J14, L2, L8,

		L102, DD15, and DD18). The County's project objectives for the Wind Energy Ordinance include allowing development of small wind turbines without a discretionary permit (objective 6) and streamlining and clarifying the approval process for the development and operation of small wind turbines (objective 4). The County does not believe that it can achieve those objectives with a requirement that turbines be prohibited if certain weather conditions potentially affect an applicant's property.
	L-110	The County agrees with the intent of this comment; however, it is not a foregone conclusion at this time that all future large wind turbines will have a significant impact on sensitive bat and avian species. The County would apply the latest guidelines for reducing impacts to birds and bats in the environmental review process for specific proposed large wind turbine projects. These guidelines first emphasize siting considerations to minimize impacts, followed by environmentally sensitive project design. In many cases, it is anticipated that the potential for impacts to sensitive birds and bats will still remain. However, this determination must be made before requiring a bird and bat protection plan and adaptive management plan. In other words, there must first be a nexus to require these measures. Therefore, implementation of such plans should not be mandated before a determination has been made that a plan is necessary.

Comment letter excerpt	Response
by the USFWS. The Ordinance must specify that preparation and implementation of the plans is mandatory. (L-110 Cont.) 3. Wind turbines of any size should be prohibited: a. at the edge of a steep slope, on a steep slope, or in a saddle, ravine, or canyon. b. along ridgelines, in saddles of ridges, in saddles between ridges, and especially where saddles form the apex of ravines that face a prevailing wind direction. c. on benches of hill slopes or ridges, or at the base of shoulders of hills (i.e., in locations of sudden elevation changes). (L-111) d. next to artificial rock piles or natural rock formations. (L-112) e. next to transmission towers, electric distribution poles, or litter control fences around a landfill . (L-113) f. where slope-accelerated winds would likely position a raptor at the height domain of the rotor plain of functional turbines, including where lips in the slope can locally accelerate winds.[67] (L-114) 4. Facilities shall be designed to discourage their use as perching or nesting substrates for birds. (L-115) 5. Ground disturbance should be conducted outside of the avian breeding season. If vegetation clearing cannot occur outside the avian breeding season, a County-approved biologist should conduct a preconstruction survey for nesting birds no more than seven days prior to vegetation clearing. (L-116) 6. Unavoidable impacts to birds and bats should be compensated. Feasible compensation measures include protecting habitat that benefits birds and bats, acquiring high-priority conservation sites, and implementing management actions that benefit species affected by wind-energy (among other potential measures).[68] (L-117) 7. The County should implement a scientific study designed to examine the effects of small wind turbines on birds and bats. Data obtained from the study should be used to make informed decisions on turbine siting and adaptive management practices. (L-118) 8. The County should develop a program that encourages wind turbine operators to report bird and bat fatalities. Fatality data should be kept in a County-maintained database. (L-119) 9. The County, in conjunction with state and federal wildlife professionals, should establish acceptable mortality thresholds for target bird and bat species. (L-120) [67] *See* Scientific Review Committee for the Altamont Pass Wind Resource Area. 2010 May 23. Guidelines for siting wind turbines recommended for relocation to minimize potential collision-related mortality of four focal raptor species in the Altamont Pass Wind Resource Area. Available at: www.altamontsrc.org/alt_doc/p70_src_relocation_guidelines.pdf [68] Smallwood KS, C Thelander. 2004. Developing Methods to Reduce Bird Mortality in the Altamont Pass Wind Resource Area. Prepared by BioResource Consultants for the California Energy Commission Public Interest Energy Research (PIER) Program, Report #500-04-052. 15	**L-111** The County does not agree with this comment. This recommendation would prohibit placement of turbines in most of the County unincorporated area. Future large wind turbines will have to address the latest guidelines regarding siting considerations, in particular to minimize bird and bat impacts. Future small wind turbines will be prohibited on ridgelines and must be sited so as to minimize landform modification. To address other features associated with ridgelines, the County updated the ridgeline prohibition to prohibit turbine blades that exceed the height of the ridgeline in an area within 150 feet of a ridgeline. This restriction will further minimize impacts without having to use discretion to determine whether the turbine would be near a saddle, apex, ravine, etc. **L-112** The presence of rock piles or natural rock formations may indicate roosting or foraging areas. These features are not specifically called out in the CEC or USFWS guidelines; however, all site-specific characteristics will be evaluated and species surveys will be conducted during the review of specific proposed large turbine projects to minimize potential biological impacts. The County does not agree with establishing a rigid prohibition on turbines near rock piles or rock formations when better alternatives or mitigating measures may be identified through consultation with the wildlife agencies.

		The County would not feasibly be able to regulate the proximity of small wind turbines to rock piles or rock formations. Artificial rock piles or similar features can be established on a private property at any time before or after a ministerial permit is issued. And the determination as to whether or not natural rock formations are of concern near a small wind turbine site would take discretion on the part of County staff. The County's project objectives for the Wind Energy Ordinance include allowing development of small wind turbines without a discretionary permit (objective 6) and streamlining and clarifying the approval process for the development and operation of small wind turbines (objective 4). The County does not agree that it can achieve those objectives if the ordinance includes regulations related to the presence of undefined features, such as rock piles or rock formations.
	L-113	The County agrees that a buffer between proposed small wind turbines and existing transmission towers is feasible. Locations of transmission towers are readily available and a setback from them can be measured objectively to maintain a ministerial permitting process. The County has added the following provision to the draft ordinance: <u>1.ii.a: No part of the wind turbine shall be closer than 300 feet or 5 times the turbine height, whichever is</u>

	<u>greater, from the following: Power transmission towers and lines.</u> The County does not agree that setbacks would be needed from litter control fences around landfills because there is no evidence that this would reduce potentially significant impacts. In addition, the locations of such fences are not readily available on County maps to allow for fixed standards and objective measurements in a ministerial permit process. **L-114** The conditions stated in this comment can only be identified with a technical study combined with species surveys which would then be evaluated by local specialists, such as staff from the California Department of Fish and Game. For large wind turbine projects, this type of analysis will be conducted since it is noted in the CEC Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development. The County would not feasibly be able to regulate the proximity of small wind turbines to areas where slope-accelerated winds would position a raptor at the height domain of the rotor plain of functional turbines, including where the lips in the slope can locally accelerate winds. The determination of whether or not this condition occurs near the proposed site of the small turbine would require technical study and

		discretion on the part of County staff. The County's project objectives for the Wind Energy Ordinance include allowing development of small wind turbines without a discretionary permit (objective 6) and streamlining and clarifying the approval process for the development and operation of small wind turbines (objective 4). The County does not agree that it can achieve those objectives if it includes regulations related to the presence of slope-accelerated winds.
	L-115	The County agrees with this comment. For large wind turbine projects, the design of the turbines will be evaluated in terms of the potential for perching or nesting. This issue is addressed in the CEC Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development under *Reduce Impacts with Appropriate Turbine Design* and includes guidelines for developers. Therefore, the latest recommendations and guidelines for turbine design will be applied to large wind turbine projects during the environmental review process, with particular emphasis given to minimizing perching and nesting opportunities. For small wind turbines, the proposed Wind Energy Ordinance specifies that use of trellis style towers and guy wires is prohibited (see draft Section 6951.a.10). These design limitations were specifically included to reduce the potential for perching and nesting near the turbine.

	L-116	See responses to comments L98 and L104.
	L-117	The County agrees with this comment for large wind turbine projects. This standard will be applied to future large wind turbine projects through the Guidelines for Determining Significance, and potentially through the Resource Protection Ordinance as well. The County does not agree that compensatory mitigation for impacts to birds and bats from small wind turbines can feasibly be exacted under the proposed ordinance. Since small wind turbines would be permitted ministerially on private land, no site-specific environmental review or site-specific mitigation will be required. Minimization measures will be implemented through the ministerial provisions provided in Section 6951 of the draft ordinance (e.g., setbacks from riparian vegetation). But requirements for compensatory site-specific mitigation from permittees would conflict with the objectives to allow development of small wind turbines without a discretionary permit (objective 6) and to streamline and clarify the approval process for the development and operation of small wind turbines (objective 4). The commenter's recommendation would be substantially more restrictive than the provisions of the existing ordinance and, therefore, would be contrary to the goals and objectives of the proposed

project. (See also responses to comments L29 and DD23).

L-118 The County does not agree with this comment. See response to comment L30.

L-119 For large wind turbine projects, post-construction surveys and monitoring will be required as necessary to evaluate and mitigate significant impacts to sensitive bird and bat species.

With regard to small wind turbines, the County has considered this comment in great depth and has had multiple meetings with the commenter to discuss it. To date, no feasible method for implementing such a program has been identified. There is no incentive for residential-scale turbine owners to report bird or bat fatalities that may occur on their properties. In fact, there would be a potential for punitive consequences if it were determined that a small wind turbine was affecting protected species.

L-120 It is not clear what is meant by this comment or how the thresholds would be used. The CEC Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development discuss what to do if bird and bat collisions that result from the project exceed the impacts that were anticipated before construction. In such cases, additional mitigation and adaptive management is required. If this is what is meant by the comment, the County agrees with this approach, but does not agree that there should be pre-established thresholds. Rather, each large turbine project should have a post-construction monitoring plan and contingency measures for unexpected impacts as necessary

For small wind turbines, on-going monitoring and adaptive management is not feasible since the turbines would be permitted ministerially. See also responses to comments I6, J5, J20, J21, L30, L107, and L119.

10. The County should conduct a scientifically defensible monitoring study to estimate fatality levels associated with wind turbines.
11. The County must establish a contingency plan to implement if operational monitoring shows unacceptable impacts to birds and bats or their habitat.
12. If significant mortality rates cannot be resolved, then turbines should be shut down during periods of peak risk to birds or bats.

L-121

Golden Eagle-

1. Wind turbines should be located at least six miles from a golden eagle nest.[69] L-122
2. All large wind energy facilities should develop an Eagle Conservation Plan that conforms to the guidelines issued by the USFWS. The Ordinance must specify that preparation and implementation of the plan is mandatory. L-123
3. The County should not approve any project that does not comply with the Bald and Golden Eagle Protection Act. L-124
4. Individuals that propose turbines that may impact the golden eagle should be required to provide compensatory mitigation such that the net effect on the eagle population is, at a minimum, no change. Feasible compensation measures are described in the USFWS's Draft Eagle Conservation Plan Guidance. These include retrofitting "lethal" power poles and provision of funding for eagle conservation. L-125

Sincerely,

Scott Cashen, M.S.
Senior Biologist

[69] USFWS. 2010 Sep 20. Request for Comments on the Application for Site Certification for the Proposed Summit Wind Ridge project, Wasco County, Oregon.

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L-121 See responses to comments I6, J5, J20, J21, L107, L119, and L120.

L-122 The County does not agree that six mile buffers from golden eagle nests for the siting of wind turbines is feasible for the project. For large turbine projects, siting will be based on site-specific environmental review, including guidance from the CEC Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development, the USFWS Wind Energy Guidelines, and the USFWS draft Eagle Conservation Plan Guidance. Prohibiting small wind turbines from being located in a six mile buffer around known golden eagle nests combined with the other buffer criteria (from wetlands, open space/preserves, bat roosts, ridgelines, etc.) would leave very little of the project area (unincorporated area) where small wind turbines would be allowed. This would also be contrary to the following project objectives:

1. Facilitate the use of renewable wind energy within the County pursuant to existing and future statewide goals.

2. Maximize the production of energy from renewable wind sources to assist the County in furthering federal goals under Section 211 of the Energy Policy Act of 2005.

3. Reduce the potential for energy shortages

		and outages by facilitating local energy supply. 4. Streamline and clarify the approval process for the development and operation of small wind turbines. In response to comments, the County has added a provision to the draft ordinance to prohibit small turbines within 4,000 feet of known golden eagle nest locations. The 4,000 foot distance is consistent with the provisions of the San Diego MSCP Plan. See also responses to comments L54, L59, and L60.
	L-123	The County agrees with the intent of this comment; however, it is not a foregone conclusion at this time that all future large wind turbines will have a significant impact on eagles. The County is proposing to apply the latest guidelines (including the USFWS draft Eagle Conservation Plan Guidance) for reducing impacts to birds during the environmental review process for large wind turbines. These guidelines first emphasize siting considerations to minimize impacts, followed by environmentally sensitive project design. In many cases, it is anticipated that the potential for impacts to eagles will still remain. However, this impact must be apparent before requiring an Eagle Conservation Plan. In other words, there must first be a nexus to require these measures; therefore, implementation of such plans should not be mandatory.

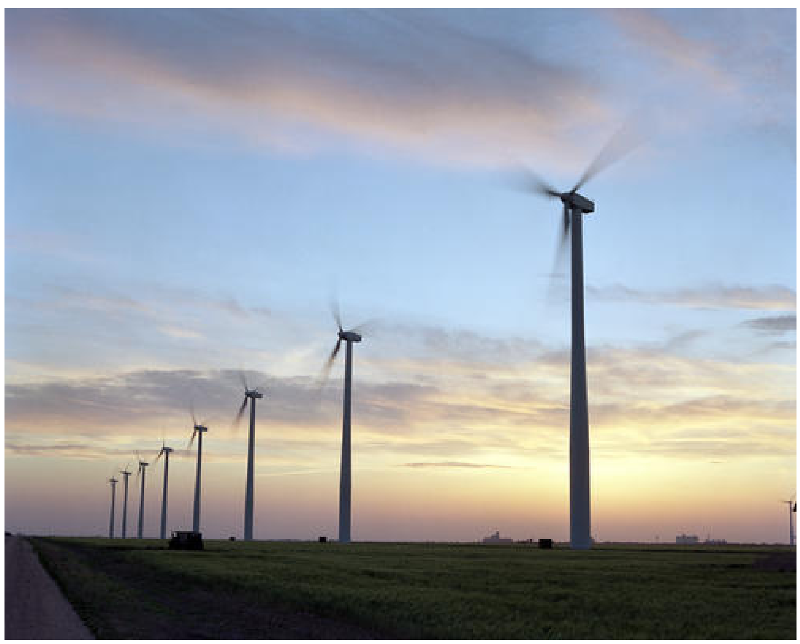
	L-124 The County agrees that compliance with federal law is mandatory. Future large wind turbine projects will require consultation with the USFWS to ensure compliance. In addition, County staff has worked closely with USFWS staff on the proposed project for small wind turbines to minimize potential effects to golden eagle. The following measures were included to satisfy USFWS concerns: avoidance of ridgelines; 4,000-foot buffers from golden eagle nests; setbacks from open space/preserves; the inclusion of specific language in the permit of small wind turbines to notify the permittees that other state and federal regulations apply (M-BIO-3); and the requirement that the County conduct a joint evaluation with the wildlife agencies to review the locations, heights, and models of small wind turbines permitted after five years and after 100 permits issued (M-BIO-4). **L-125** The County agrees with this comment as it pertains to discretionary permits. Compensatory mitigation for impacts to golden eagle will have to satisfy California Fish and Game requirements and be consistent the USFWS draft Eagle Conservation Plan Guidance. The County will apply the latest guidelines and consult with the wildlife agencies during the review of large wind turbine projects with potential impacts to sensitive species, particularly with regard to golden eagle impacts.

	Compensatory mitigation for impacts that result from ministerial small wind turbine permits cannot be mandated or enforced. A ministerial decision involves only the use of fixed standards or objective measurements. And once the ministerial permit is issued, there are no on-going or follow-up actions between the County and the developer. See also responses to comment L29, L117, and DD23.

ATTACHMENT TO LETTER L

NATIONAL WIND COORDINATING COLLABORATIVE

MITIGATION TOOLBOX



Compiled by:
NWCC Mitigation Subgroup &
Jennie Rectenwald, Consultant

First published as a living document in May 2007.

Table of Contents

Executive Summary

Human disturbances to the landscape have often led to increased fatality rates for wildlife. Mitigation techniques have been applied in an effort to reduce or eliminate the harmful effects of human disturbance. This “mitigation toolbox” was created to provide direction for future wind development projects by presenting an assortment of mitigation measures that can be used to minimize or eliminate the negative impacts to wildlife that result from the design, construction, and operation of wind farms. However, there are relatively few instances where research has been done to validate whether mitigation strategies have reduced impacts as expected, specifically in relation to wind development. The following ‘mitigation toolbox’ is a compilation of mitigation policies, guidelines, and research that are either directly or indirectly applicable to the wind industry.

The information in this toolbox was obtained through Internet, library, and database searches; literature reviews; and interviews of experts in the field. Although there is considerable research on mitigation, and there are many tools that might be applied in the context of wind power, few scientifically proven mitigation strategies are currently available to the wind industry. Numerous mitigation strategies are proving to be successful in certain situations in the field, however, and a significant amount of promising research is currently underway that could result in new techniques.

Intended to improve current and future mitigation efforts, this toolbox is a living document that will grow and change as new information becomes available to fill in the gaps between existing policies or guidelines and current research, as well as within the research itself.

Introduction

U.S. wind development is expected to increase from about 10,000 MW in 2007 to 50,000 MW by 2020. As a result, government groups at all levels are beginning to publish wind turbine siting and mitigation policies and guidelines to minimize the effects of future wind power development on wildlife. Suggested mitigation techniques range from general strategies (e.g., avoid locations used heavily by migrating bats and birds) to specific ones (e.g., reduce motion smear by painting the blades). The development of mitigation policies and guidelines may be an important step for minimizing the impacts of development on wildlife; however, in order to be truly successful, the suggested strategies must work.

The Mitigation Toolbox

The National Wind Coordinating Committee's (NWCC) Mitigation Subgroup has compiled a number of mitigation strategies in this "mitigation toolbox." The toolbox provides guidance and direction for future wind development by describing various mitigation measures or tools that can be used in the decision-making process. For the purposes of the toolbox, 'tools' are defined as effective approaches to mitigating avian and bat fatalities, as well as habitat impacts, as proven through statistically significant research. Since differences in habitat, topography, and landscape among wind facilities often make it difficult to generalize findings from one geographic region to another, the toolbox is intended to house a wide variety of tools rather than a single, 'all-purpose' one. The toolbox is also intended to be a living document that will be periodically updated as new mitigation research and tools become available.

There are relatively few instances where research has been done to validate whether mitigation strategies have reduced impacts as expected, specifically in relation to wind development. As a result, the toolbox currently contains few verifiable tools. There are, however, numerous guidance documents that have been developed for the wind industry that incorporate a wide variety of mitigation strategies.

Information for Decision Makers

To help guide future decision making, this toolbox provides information about existing mitigation policies and guidelines, as well as on whether strategies are based on sound scientific research. It indicates the effectiveness of various methods of avoiding, minimizing, or compensating for direct and indirect impacts on wildlife caused by wind power facilities (recognizing, however, that avoiding wildlife mortality completely is probably not possible).

The toolbox contains four main sections:

- A comparison of existing mitigation policies and guidelines from the United States, Canada, Europe, and Australia that examines policies at both local and federal levels
- An Annotated Bibliography that includes research on wind development mitigation, as well as general habitat mitigation studies that could be applicable to wind sites
- Case studies that focus on exceptional mitigation strategies and currently available tools
- A matrix illustrating gaps and overlaps between existing policies or guidelines and current research.

The information presented here is intended to improve overall mitigation efforts by illustrating the gaps between current policies and guidelines and the research supporting them. Identifying the gaps makes it possible to tailor future research and policies to better meet goals for both wildlife and development. However, since each type of habitat is different, the results of mitigation research in one area might not apply in another area.

Defining Mitigation

The NWCC Mitigation Subgroup acknowledges the definition of mitigation established by the United States Fish and Wildlife Service, for all resources:

> "The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act regulations to include:
> '(a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; (e) compensating for the impact by replacing or providing substitute resources or environments.' [40 CFR Part 1508.20(a-e)].
>
> The Service supports and adopts this definition of mitigation and considers the specific elements to represent the desirable sequence of steps in the mitigation planning process."[1]

The toolbox exists in the context of this definition. However the emphasis is on the tools available to mitigate impacts after developers and decision makers determine that a wind power project will be built.

[1] U.S. Fish and Wildlife Service Mitigation Policy, FR 46 (15) Jan 81, 7656, at www.fws.gov/policy/A1501fw2.html.

Methods

Literature Review

The literature review included a general review of existing wind siting policies, guidelines, and research pertaining to wildlife mitigation both nationally and internationally. Information was acquired by conducting Internet searches, conducting library searches, contacting ornithological societies, interviewing experts in the field (see Appendix A) via phone and e-mail, and searching numerous databases. The National Wind Coordinating Committee (NWCC) provided an initial list of existing policies. Previous literature reviews—including those of Gerson and Klute (2006), Johnson and Arnett (2004), Kerlinger (2000), Manville (2005), Spellerberg (1998), and Herbert et al. (1995)—were also used (see the Annotated Bibliography).

Research methods included searching the National Renewable Energy Laboratory's (NREL) Avian Literature Database, the National Wind Technology Center's EBSCO Database, the Colorado State University (CSU) EBSCO Database, the CSU JSTOR Database, the CSU Web of Science Database, Google, and Google Scholar, as well as compiling citations in relevant review articles. Most published articles were acquired from the CSU library.

Research and Analysis

From a significant amount of existing literature, the studies reviewed were limited to those deemed relevant, i.e., that examined the effects of specific changes to wind farm characteristics on birds or bats as well as those that examined more general habitat mitigation efforts and their effects on wildlife, which may be applicable to wind power development. Relevant studies included research that examined the effectiveness of mitigation strategies on wildlife, certain avian or bat behavior studies conducted at wind sites, studies comparing the effects of wind site alterations on wildlife, studies that examined mitigation strategies suggested in policies or guidelines, and studies mentioned by experts in the field. Research was not included that focused on avian or bat ecology, searcher efficiency rates, scavenging rates, avian or bat mortality estimates, study design, or modeling.

The mitigation studies selected represented those reflecting the views of the scientific community overall but also numerous studies in which scientific opinions differed. Selections focused on recent literature (1995 and later), unless that was not possible. Some earlier literature was included if it was cited often in other studies because of its historical foundations. A number of interesting studies could not be obtained from either the NREL or CSU library, online, or in personal communications, and this was further complicated by cost and time limitations.

Reviews included determining the goals of the research, its location and habitat types, the length of the study, and the general methodology used. Also researched were any conclusions, results, and management suggestions that would mitigate negative effects on wildlife. Earlier literature reviews (e.g., by Orloff in Erickson et al. 1999) were used occasionally because of time constraints and difficulty in attaining original papers. They are footnoted in the Annotated Bibliography.

The studies were then divided into two matrixes. One matrix illustrates the type of review process used (peer, none, or unknown) and the other combines existing research with policies and guidelines on mitigation. Due to difficulties in ascertaining the difference between credible peer reviews and non-credible peer reviews, studies were divided into journals and reports under an umbrella section entitled 'Reviewed'. Further analysis is required to differentiate studies into more specific categories.

For the matrix comparing policy or guideline recommendations with research results, mitigation strategies were divided into nine general categories: lighting, siting, turbine type, turbine configuration, power lines, habitat enhancement, revegetation, disturbance during construction, and operation. Individual studies were then analyzed to determine whether or not they supported the mitigation strategies suggested within any of the categories.

A Review of Existing Policies and Guidelines

The following is a compilation of existing policies and guidelines pertaining to wind power development, impacts on wildlife and habitats, and mitigation efforts. Guidelines are categorized according to their scope, i.e., Local, State, Federal, International, and Other. Within each category, guidelines are alphabetized by author and then organized into design-stage, construction-stage, and operational-stage mitigation efforts, when possible. A more comprehensive summary of policies and guidelines that allows for easier comparisons is in Appendix A. The information presented here is also in the Guidelines Spreadsheet, which allows for easier comparisons of guidelines among policies.

Local Policies and Guidelines

Washington Department of Fish and Wildlife: Wind Power Guidelines

Date Established: August 2003

Location: East of the Cascades

Contact: Dr. Jeff Koenings, Director of WDFW, 360-902-2200

See: http://wdfw.wa.gov/hab/engineer/windpower/wind_power_guidelines.pdf

General Principles for Siting and Mitigation

- Implementation of mitigation measures is presumed to fully mitigate for habitat losses for all species; state or federal *endangered* or federal *threatened* species may require additional mitigation efforts.
- Developers should be encouraged to place linear facilities[1] in or adjacent to existing disturbed corridors in order to minimize habitat fragmentation and degradation.
- Developers should be encouraged to site wind power projects on disturbed lands.
- Developers should be discouraged from using or degrading high-value habitat areas.
- Developers are responsible for acquiring replacement habitat under this proposal and for management of such lands for the life of the project,[2] unless otherwise indicated.

Conventional Mitigation Policies and Guidelines

Permanent Habitat Impacts

A. No mitigation required for cropland, developed or disturbed areas
B. All other areas require the acquisition of replacement habitat that is:
    - Like-kind (e.g., shrub-steppe for shrub-steppe; grassland for grassland) and/or of equal or higher habitat value than the impacted areas (alternative ratio may be negotiated)
    - Given legal protection
    - Protected from degradation for the life of the project
    - In the same geographical region as the impacted habitat
    - Jointly agreed upon by the wind developer and WDFW

Ratios: Replacement Habitat Subject to Imminent Development – 1:1

[1] Examples include collector cable routes, transmission line routes, or access roads.
[2] "Life of project" is defined as beginning at the end of the first year of commercial operation and ending with implementation of the project decommissioning plan.

Grassland, CRP Replacement Habitat – 1:1
Shrub-Steppe, or Other High-Value Replacement Habitat[3] – 2:1

Temporary Habitat Impacts (anticipated to end when construction is complete and land has been restored)

A. No mitigation required for cropland, developed, or disturbed areas
B. Mitigation options for other land types include:
    - Implementing a WDFW-approved restoration plan for the impacted area, including site preparation, reseeding with appropriate vegetation, noxious weed control, and protection from degradation.
    - Acquiring suitable replacement habitat for every acre temporarily impacted by the project (see ratios below).
    - A good faith effort to restore the impacted area. However, long-term performance targets should not be imposed since temporal losses and the possibility of restoration failure are incorporated into the acquisition and improvement of replacement habitat.
    - WDFW and a wind developer may agree on other 'customized' or 'alternative' ratios and terms where doing so is mutually beneficial, and accepted methodologies are used, such as a natural resource damage assessment (NRDA) or an alternative mitigation option.

Ratios: Acquisition of Grassland, CRP Replacement Habitat – 0.1:1
Acquisition of Shrub-Steppe Habitat – 0.5:1

<u>Alternative Mitigation Policies and Guidelines</u>

The goal of the Wind Power Alternative Mitigation Pilot Program is to provide an optional and streamlined approach to mitigation that results in better habitat value and is more attractive to wind developers than conventional on-site mitigation.

Alternative: Applicant will pay an annual fee[4] for the life of the project,[5] which is based on an alternative mitigation fee rate of $55/acre/year for each acre of replacement habitat that would be owed using the ratios and analysis discussed in the section titled Conventional Mitigation Policies and Guidelines.

General Provisions:

- The fee is based on habitat in average condition and can be increased or decreased by 25% to account for differences in habitat quality.
- The applicant is required to implement an approved restoration plan for temporarily impacted areas.
- In cases in which the project impacts a mixture of habitat types, the fee schedule will be applied accordingly (to the nearest acre).
- The annual fee will be used primarily to support stewardship of high-value habitat in the same ecological region as the project.
- If the applicant and the WDFW cannot agree on a mutually advantageous package under the alternative mitigation program, conventional mitigation guidance will be applied to the project.

[3] Habitat considered to be in excellent condition will require developers to engage in additional consultation with WDFW regarding suitable mitigation requirements.
[4] The fee will be reviewed annually and adjusted as necessary by WDFW.

State Policies and Guidelines

California Energy Commission & California Department of Fish and Game: ***DRAFT*** Guidelines for Reducing Wildlife Impacts from Wind Energy Development

Date Established: Draft released December 2006; Final expected June 2007.

Location: State of California

Contact: Rick York, California Energy Commission, 916-654-3945, ryork@energy.state.ca.us

See[6]: www.energy.ca.gov/2006publications/CEC-700-2006-013/CEC-700-2006-013-SD.PDF

Every wind energy project site is unique, and no one recommendation will apply to all prepermitting site selection and layout planning. The following elements, however, should be considered in site selection, in turbine layout, and in developing infrastructure for the facility.

Design-Stage Mitigation

- Good macro-siting decisions are essential for choosing an acceptable site or portion of a site.
- Once a site is selected, micro-siting efforts can avoid or reduce potential impacts to birds, bats and other biological resources.
- Minimize fragmentation and habitat disturbance.
- Establish buffer zones around areas of high bird or bat use in which no disturbance is allowed in order to minimize the risk of collisions.
- Avoid guy wires.
- Reduce impacts with appropriate turbine layout based on micro-siting decisions.
- Place power lines underground, unless burial would result in greater impacts to biological resources.
- Ensure that all above-ground lines, transformers, or conductors comply with Avian Power Line Interaction Committee (APLIC) standards, including the use of deterrents.

Operation-Stage Mitigation

- Decommission nonoperational turbines so they no longer present a collision hazard to birds and bats. Developers should submit a decommissioning and reclamation plan that describes the expected actions when some or all of the turbines at a wind site are nonoperational as part of the permitting application. Decommissioning typically involves removal of turbine foundations to 1 meter below ground level and removing access roads and unnecessary fencing and ancillary structures.
- Avoid lighting that attracts birds. Until more is known, lights with short flash durations that emit no light during the "off phase" should be used—those that have the minimum number of flashes per minute and the briefest flash duration allowable.
- Use lights on auxiliary buildings near turbines and meteorological (met) towers that are motion-sensitive rather than steady burning; they should be downcast.
- Limited and periodic feathering during low-wind nights may help avoid impacts to bats.

[6] Since the drafting of this document, the California Energy Commission released a second draft staff report on April 2007, it can be viewed at at http://www.energy.ca.gov/renewables/06-OII-1/documents/index.html#041607.

- Note that high fatality levels may require removal of problem turbines or seasonal shutdowns of turbines.
- Apply adaptive management and effectiveness monitoring processes to better achieve management objectives.
- Modify habitat to make the site less attractive to at-risk species.

Off-Site Activities
- Provide for long-term conservation of the target species and its habitat.
- Ensure that the site is large enough to be ecologically self-sustaining and/or part of a larger conservation strategy.
- Before the property is sold or credits are sold at a mitigation bank, have a resource management plan approved by all appropriate agencies or nongovernment organizations involved in property management.
- Protect the site permanently through a fee title and/or a conservation easement.
- Provide for long-term management of the property after the project is completed or after all mitigation credits have been awarded for the mitigation bank.
- Ensure the implementation of the resource management plan in the event of nonperformance by the owner of the property or nonperformance by the mitigation bank owner and/or owner.
- Provide a sufficient level of funding with acceptable guarantees to fully ensure the operation and maintenance of the property, as may be required.
- Provide for monitoring and reporting on the identified species/habitat management objectives, with an adaptive management/effectiveness monitoring loop to modify management objectives as needed.

The Kansas Renewable Energy Working Group: Siting Guidelines for Windpower Projects in Kansas

Date Established: January 22, 2003

Location: State of Kansas

Contact: Jim Plogger, Kansas Corporation Commission, j.ploger@kcc.state.ks.us

See: www.krewg.org/reports/KREWGSitingGuidelines.pdf

The Environmental and Siting Committee of the Kansas Renewable Energy Working Group (KREWG) has drafted these guidelines for wind power project stakeholders to use as they consider potential project sites in the State of Kansas. Wind energy siting and permitting requirements vary from county to county, depending largely on whether or not a county is zoned. Currently, statewide regulations for siting wind projects do not exist.

Design-Stage Mitigation
- Use biological and environmental experts to conduct preliminary reconnaissance of the prospective site area. If a site has a large potential for biological and/or environmental conflicts, it may not be worth the time and cost of conducting detailed wind resource evaluation work.
- Involve local environmental/natural resource groups as soon as practical.
- Use landscape-level examinations of key wildlife habitats, migration corridors, staging/concentration areas, and breeding and brood-rearing areas to develop general siting strategies.
- Situate turbines in a way that does not interfere with important wildlife movement corridors and staging areas.

- Do not allow any perches on the nacelles of turbines. Towers should not utilize lattice-type construction or other designs that provide perches.
- In regions where grassland burning is practiced, make sure that the infrastructure is able to withstand periodic burning of vegetation.
- Consider potential cumulative regional impacts from multiple wind energy projects when making environmental assessments and mitigation decisions.
- Take care to avoid damage to unfragmented landscapes and high-quality remnants in the Sandsage, Mixed Grass, and Shortgrass prairies in central and western Kansas. Allowing for an undeveloped buffer adjacent to intact prairies is desirable.
- When feasible, locate wind energy development on already altered landscapes.

Construction-Stage Mitigation

- Bury power lines, when feasible.
- Minimize roads and fences, and take care to avoid sensitive habitats.
- Ideally, implement construction and maintenance when the ground is frozen or when soils are dry and native vegetation is dormant.

Operational-Stage Mitigation

- Address potential adverse affects of turbine warning lights on migrating birds.
- If significant ecological damage results from siting, consider mitigation for habitat loss, including ecological restoration, long-term management agreements, and conservation easements to enhance or protect sites with an ecological quality that is similar to or higher than that of the developed site.
- Use native vegetation of local ecotypes to reseed disturbed areas.
- Consider wildlife and plant composition in determining the frequency and timing of mowing near turbines.

Wind Energy Technical Advisory Group: ***DRAFT*** Siting Guidelines to Mitigate Avian and Bat Risks from Windpower Projects

Date Established: July 6, 2006

Location: State of Maryland

Contact: Michael Dean, 410-767-8149; mdean@psc.state.md.us

Applicants should consult with the Department of Natural Resources Power Plant Research Program (PPRP) well in advance of filing an application with the Public Service Commission; failure to do so may result in project delays. Applicants are required to consult with Department of Natural Resources Natural Heritage Program (NHP) biologists to ensure that construction is scheduled to avoid or minimize disruptions to bird and bat breeding seasons, as well as to determine the boundaries of allowed physical disturbance during construction. Applicants are then required to submit a request for environmental review from the state's Wildlife and Heritage Service, which includes the project site and boundaries, results from 1 year of monitoring on the proposed site for impacts to bats and birds, an assessment of potential bat habitat on the site, the results of a Phase 1 avian risk assessment, and breeding bird survey results. The PPRP will establish a peer review group composed of relevant experts to assess monitoring plans and data, and the applicant undertakes a post-construction study of mortality rates for at least 3 years. Any mitigation plans should be graded in their implementation so as to reasonably reflect the level of the observed impact and the probability of successful mitigation.

Design-Stage Mitigation

- Use tubular towers, as opposed to lattice towers.

- Construct no permanent towers, including met towers, that are supported by guy wires.
- Avoid locations that have been identified to have potentially high risk to birds or bats, have unique habitat features, or are occupied by species of particular concern (as determined by the applicant or the state).

Construction-Stage Mitigation

- Bury on-site electrical collector cables when possible.
- Avoid or minimize disruptions during bird and bat breeding seasons.
- Reestablish any disturbed nesting/maternity areas, as feasible.

Operational-Stage Mitigation

- Minimize lighting of turbines by lighting the fewest possible number of turbines, synchronizing the flashing cycles of all strobes, installing red strobes (as opposed to white strobes) with the longest possible cycle, and not installing high-intensity lamps for area lighting (e.g., sodium vapor lamps).
- In the event that a larger-than-expected number of fatalities occurs, contact the NHP as soon as possible, at least within 24 hours. If the impacts to bird or bat populations are considered adverse, the state will seek corrective actions from the applicant to avoid, minimize, or mitigate the adverse impact. Mitigation plans may involve either on-site or off-site activities, or both.

Massachusetts Executive Office of Environmental Affairs: ***DRAFT*** Guidance on the Siting of Wind Turbines

Date Established: In progress; expected to be released by end of 2006

Location: State of Massachusetts

Contact: Josh Bagnato, MA Executive Office of Environmental Affairs, 617-626-1041; Josh.Bagnato@state.ma.us

State of Michigan Department of Labor & Economic Growth: Michigan Siting Guidelines for Wind Energy Systems

Date Established: December 14, 2005

Location: Rural areas; not meant for On-Site Use or Utility Grid

Contact: John Sarver, Energy Office, 517-241-6280

See: www.michigan.gov/documents/Wind_and_Solar_Siting_Guidlines_Draft_5_96872_7.pdf

(1) The applicant shall have a third-party, qualified professional conduct an analysis to identify and assess any potential impacts on the natural environment or wildlife and endangered species.

(2) The applicant shall take appropriate measures to minimize, eliminate, or mitigate adverse impacts identified in the analysis.

(3) The applicant shall identify and evaluate the significance of any net effects or concerns that will remain after mitigation efforts.

(4) Sites requiring special scrutiny include wildlife refuges, other areas where birds are highly concentrated, bat hibernacula, wooded ridge tops that attract wildlife, sites that are frequented by federally and/or state-listed endangered species of birds and bats, significant bird migration pathways, and areas that have landscape features known to attract large numbers of raptors.

(5) The analysis shall include a thorough review of existing information regarding species and habitats, as well as the potential effects on species listed under the federal Endangered Species Act and Michigan's Endangered Species Protection Law.

(6) The analysis shall indicate whether a post-construction wildlife mortality study will be conducted and, if not, the reasons why such a study does not need to be conducted.

(7) Power lines should be placed underground, when feasible, to prevent avian collisions and electrocutions. All above-ground lines, transformers, or conductors should comply with APLIC published standards.

(8) The applicant shall be responsible for making repairs to any public roads damaged by the construction of the utility grid wind energy system.

Montana Department of Fish and Wildlife

Date Established: N/A

Location: State of Montana

Contact: T.O. Smith, 406-444-3889; TOSmith@mt.gov

There is no regulatory authority over wind development in Montana; however, Montana Environmental Protection Agency requires developers on public and state lands to obtain input from the Montana Department of Fish and Wildlife (MDFW). MDFW has established an internal draft strategy for working with wind development on private lands to minimize environmental impacts to the extent possible. While the draft strategy has not yet been released to the public, the main points pertain to the following:

1. Coordination with county commissioners
2. Location of transmission lines
3. Staff education
4. Research
5. Coordination with the wind industry
6. Working with environmental assessments and environmental impact statements

In addition, the MDFW advocates locating turbines near transmission lines and in areas that are not visible from critical recreation areas, as close as possible to where the power will be used, and in areas that are not composed of native shortgrass prairie. The MDFW also advocates minimizing road traffic to and from sites, minimizing the loss of topsoil, replanting disturbed areas with native seeds, conducting preassessment surveys for impacts to bats and birds, and avoiding major migratory routes (waterbird, waterfowl, and raptor).

New York State Department of Agriculture and Markets: Guidelines for Agriculture Mitigation for Windpower Projects

Date Established: March 25, 2003

Location: Construction areas in county-adopted, state-certified agricultural districts.

See: http://www.agmkt.state.ny.us/AP/agservices/constructWind.html

Operational-Stage Mitigation

The following actions are to occur following construction until October 1. For areas to be restored after that date, provision should be made to restore any eroded areas in the springtime.

- All disturbed agricultural areas will be decompacted to a depth of 18 inches with a deep ripper or heavy-duty chisel plow.[7]
- All rocks 4 inches and larger will be removed before and after the replacement of topsoil.
- Topsoil will be replaced to original depth and original contours will be reestablished where possible.
- Access roads will be regraded, and original surface drainage patterns will be restored.
- Restored agricultural areas will be seeded with the seed mix specified by the landowner.
- All construction debris will be removed from the site.

Monitoring and Remediation

The Project Sponsor will provide a monitoring and remediation period of no less than two years immediately following the completion of initial restoration. General conditions to be monitored include topsoil thickness, relative content of rock and large stones, trench settling, crop production, and drainage and repair of severed fences.

- Topsoil deficiency and trench settling shall be mitigated with imported topsoil that is consistent with the quality of the topsoil on the affected site.
- Excess rocks and large stones will be removed and disposed of by the project sponsor.
- Appropriate rehabilitation measures will be determined and implemented when subsequent crop productivity within the affected area is less than that of the adjacent unaffected agricultural land.
- Where representative subsoil density of the affected area exceeds the representative subsoil density of the unaffected area, shattering of the soil profile will be performed. Deep shattering will be applied during periods of relatively low soil moisture, and any oversized stone or rock material will be removed that was uplifted to the surface.

Oregon Department of Fish and Wildlife: Fish and Wildlife Habitat Mitigation Policy For Siting Non-Nuclear Energy Facilities (635-415-0000)

Date Established: September 1, 2000

Location: State of Oregon

Contact: 503-947-6000

See: http://www.dfw.state.or.us/OARs/415.pdf

[7] In areas where the topsoil was stripped, soil decompaction shall be conducted prior to topsoil replacement.

The fish and wildlife habitat mitigation policy of the Oregon Department of Fish and Wildlife requires or recommends mitigation for losses of fish and wildlife habitat resulting from development actions. Whether it is a requirement or a recommendation depends on the habitat protection and mitigation opportunities provided by specific statutes. Priority for mitigation actions is given to habitat for native fish and wildlife species. Mitigation actions for nonnative fish and wildlife species may not adversely affect habitat for native fish and wildlife.

- Departmental recommendations or requirements for mitigation are based on the following:
  - The location, physical and operational characteristics, and duration of the proposed development action.
  - The alternatives to the proposed development action.
  - The fish and wildlife species and habitats that will be affected by the proposed development action.
  - The nature, extent, and duration of impacts expected to result from the proposed development action.
- The Department may recommend or require the posting of a bond, or other financial instrument acceptable to the Department, to cover the cost of mitigation actions based on the nature, extent, and duration of the impact and/or the risk of the mitigation plan not achieving mitigation goals.
  - The Department may only use mitigation banks and payment to provide mitigation for habitat categories 2-6 (see below).
  - The amount of payment to provide mitigation will include, at a minimum, the cost of property acquisition, mitigation actions, maintenance, monitoring, and any other actions needed for the long-term protection and management of the mitigation site.
- The Department requires the submission of a mitigation plan, which includes:
  - Protocols and methods, and a reporting schedule for monitoring the effectiveness of mitigation measures. Performance measures include success criteria and long-term protection and management provisions
- The project proponent is responsible for the expenses of developing, evaluating, and implementing the mitigation plan and monitoring the mitigation site.

To issue a site certificate, the Council must find that the design, construction, operation and retirement of the facility, taking into account mitigation, are consistent with the fish and wildlife habitat mitigation goals and standards.

All Habitat Category mitigation strategies must first seek to avoid impacts through alternatives to the proposed development action. If that does not work, then the following mitigation strategies will be pursued:

<u>Habitat Category 1</u>: Irreplaceable, essential habitat for a fish or wildlife species, population, or a unique assemblage of species and is limited on either a physiographic province or site-specific basis, depending on the individual species, population or unique assemblage.
MITIGATION = no loss of either habitat quantity or quality, requiring:

- No authorization of the proposed development action if impacts cannot be avoided.

<u>Habitat Category 2</u>: Essential habitat for a fish or wildlife species, population, or a unique assemblage of species and is limited on either a physiographic province or site-specific basis, depending on the individual species, population, or unique assemblage.
MITIGATION = no net loss of either habitat quantity or quality, and the provision of a net benefit of habitat quantity or quality, requiring:

- In-kind, in-proximity habitat mitigation to achieve no net loss of either predevelopment habitat quantity or quality. In addition, a net benefit of habitat quantity or quality must be provided.

- If neither of the above can be achieved, the Department shall recommend against or shall not authorize the proposed development action.

Habitat Category 3: Essential habitat for fish and wildlife, or important habitat for fish and wildlife that is limited either on a physiographic province or site-specific basis, depending on the individual species or population.

Habitat Category 4: Important habitat for fish and wildlife species.
MITIGATION = no net loss of either habitat quantity or quality.
- In-kind, in-proximity habitat mitigation to achieve no net loss of either predevelopment habitat quantity or quality. Habitat Category 4 also includes out-of-kind and off-proximity habitats.
- If neither of the above can be achieved, the Department shall recommend against or shall not authorize the proposed development action.

Habitat Category 5: Habitat for fish and wildlife having high potential to become either essential or important.
MITIGATION = provide a net benefit in habitat quality or quantity.
- Actions that contribute to essential or important habitat.
- If neither of the above can be achieved, the Department shall recommend against or shall not authorize the proposed development action.

Habitat Category 6: Habitat has low potential to become essential or important for fish and wildlife.
MITIGATION = to minimize impacts.
- The Department shall recommend or require actions that minimize direct habitat loss and avoid impacts to off-site habitat.

South Dakota Bat Working Group & South Dakota Game, Fish and Parks: Siting Guidelines for Wind Power Projects in South Dakota

Date Established:

Location: Entire state

Contact: Alyssa Kiesow, 605-773-2742

See: http://www.sdgfp.info/wildlife/Diversity/windpower.htm

The guidelines outlined in this document are neither mandates nor regulations. They have been compiled and developed to encourage developers to select potential wind sites using a process that is acceptable to all stakeholders, to protect South Dakota's rare and unique areas, to minimize deleterious effects to wildlife, to help provide information to all involved and interested parties, and to promote a responsible, guided, uniform approach to the siting of wind power projects in South Dakota.

Design-Stage Mitigation
- Use biological and environmental experts to conduct a preliminary biological reconnaissance of the likely site area.
- Involve wildlife agency personnel, universities, and local environmental and natural resource groups and agencies; their involvement will provide resource information as well as minimize potential conflicts.
- Situate turbines so they do not interfere with important wildlife movement corridors and staging areas.
- Avoid large, intact areas of native vegetation.

- Avoid lattice-designed towers or other designs providing perches for avian predators.
- Develop a stringent plan for preventing the introduction or establishment of nonnative or invasive flora.
- Consider turbine designs.

Construction-Stage Mitigation
- Bury power lines and/or place turbines near existing transmission lines and substations.
- Minimize the number of roads and fences.
- Consider the timing of construction and maintenance activities (including mowing). Avoid construction and maintenance activities during breeding season (April to July) and, if possible, during migrations (April to June and August to October).

Operational-Stage Mitigation
- Mitigate for habitat loss through ecological restoration, long-term management agreements, conservation easements, or fee title acquisitions.
- Address potential adverse affects of turbine warning lights on migrating birds and bats.

Vermont Fish and Wildlife Department: ***DRAFT*** Guidelines for the Evaluation and Mitigation of Impacts to Wildlife Associated with Wind Energy Development in Vermont

Date Established: April 20, 2006

Location: Entire state

Contact: Julie Moore, 802-241-3687

See: http://www.energy.ca.gov/renewables/06-OII-1/documents/other_guidelines/VERMONT_GUIDELINES_2006-04.PDF

In general, habitat disturbance should be minimized, as well as the risk of collision mortality for both resident and migratory bird and bat species. In addition, permittees should be required to establish an escrow fund to support the necessary post-construction monitoring.

Design-Stage Mitigation
- The applicant should establish the presence or absence of different wildlife species and significant habitats, well in advance of any construction activities, so that appropriate mitigation and avoidance practices can be used.
- Studies need to be completed during breeding and migratory seasons.
- The Department will review all survey results to determine if the project will result in undue adverse impacts,[8] and may seek revisions to the project.

Construction-Stage Mitigation
- Construction activities should be scheduled to avoid important periods of wildlife courtship, breeding, and nesting.
    - Any clearing of montane spruce-fir must take place outside the breeding period for Bicknell's Thrush.

[8] Fatality rate exceeds the national average (2.3 birds/turbine/year and 3.4 bats/turbine/year) or some of the species affected are considered threatened or endangered by the state or federal government.

    - Construction activities within ¼ mile of significant black bear hard mast habitat or spring feeding areas should take place outside the feeding periods September 1–November 21 and May 1–July 15.
- Noise-reduction devices should be maintained in good working order on vehicles and construction equipment.

Operation-Stage Mitigation

- Habitat restoration activities should be initiated as soon as possible after construction is complete.
- A minimum of three years of rigorous post-construction bird and bat mortality surveys are necessary for any utility-scale wind project in Vermont.
    - Monitoring is to be conducted from April 15 to October 31.
- If a project is considered to have undue adverse impacts, mitigation measures will be required that may include the following:
    - Modified Operations – additional monitoring or research, technological improvements, adjustment of operations during periods of highest risk, or suspension of operation during periods of highest risk.
    - Modified Lighting – alternative aircraft warning lighting, reduction in number of lit turbines, altering the arrangement of lights, using LED fixtures, or providing baffling around the lights.
    - On-site Habitat Management – modifying the type or extent of vegetation cover, forest openings, perching and nesting sites, or cover for prey species.
    - Habitat Protection – compensatory mitigation measures such as protection or enhancement of wildlife habitat.

Wisconsin Department of Natural Resources: Wind Farm Siting Guidance

Date Established: August 31, 2005

Contact: Steve Ugoretz, 608-266-6673

See: http://www.dnr.state.wi.us/org/es/science/energy/wind/studies.htm

A baseline wildlife evaluation should be conducted for each site under serious consideration for wind farm development. To allow comparison with other studies, this evaluation should follow accepted standard protocols for wind farm evaluations (such as the NWCC study guidelines). If the U.S. Fish and Wildlife Service guidelines are used, they should also incorporate Wisconsin Department of Natural Resources (DNR) considerations.

Design-Stage Mitigation

- Bird and bat use and interactions with wind turbines and supporting facilities should be monitored for an adequate period (at least two years is recommended) after installation, using accepted standard methods. This should be done for the first wind farms in any ecological region of the state.
    - If no problems are determined by the DNR's evaluation of the results, it is likely that later installations with similar characteristics will not require as much detailed study as the initial wind farms.
- Mitigation measures proven to minimize collisions and mortality should be designed into the wind farm.
- An adaptive management approach to planning, design, construction, and operations is highly recommended.

Construction-Stage Mitigation

- Placing electric lines underground is highly recommended.
- The use of perch guards on above-ground poles and other APLIC-endorsed technologies is recommended.

Federal Policies and Guidelines

Bureau of Land Management – Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States

Date Established: June 2005

Location: All wind energy development projects on BLM-administered lands

See: https://www.eh.doe.gov/nepa/otheragency/fes0511/index.html

The BLM proposes the following best management practices (BMPs) be applied to all wind energy development projects:

Design-Stage Mitigation

- The area disturbed by installation of met towers shall be kept to a minimum.
- Individual towers shall not be located in sensitive habitats or in areas where ecological resources known to be sensitive to human activities are present.
- Installation of towers shall be scheduled to avoid disruption of wildlife reproductive activities or other important behaviors.
- Existing roads shall be used to the maximum extent feasible.
- Avian and bat use of the project area should be evaluated using rigorous survey methods.
- Turbines shall be configured to avoid landscape features known to attract raptors.
- Disturbance to any population of federally listed plant species is prohibited.
- A habitat restoration plan shall be developed to avoid, minimize, or mitigate negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species, including revegetation, soil stabilization, and erosion-reduction measures.
- Procedures shall be developed to mitigate potential impacts to special status species.
- Locations heavily utilized by migratory birds and bats should be avoided, especially migration corridors or known flight paths, raptor nest sites, and areas used by bats as colonial hibernation, breeding, and maternity/nursery colonies, if studies show that they would pose a high risk to species of concern.
- Facilities shall be designed to discourage their use as perching or nesting substrates for birds.
- Operators shall develop a plan to control noxious weeds and invasive species.
- Habitat disturbance should be minimized by locating facilities in previously disturbed areas.
- Projects should not be located in areas with a high incidence of fog and mist.
- The use of sodium vapor lights should be minimized or avoided.

Construction-Stage Mitigation

- The area disturbed by construction and operation will be kept to a minimum.
- Topsoil from all excavations and construction activities shall be salvaged and reapplied during reclamation, along with weed-free native grasses, forbs, and shrubs.
- Guy wires on permanent towers shall be avoided.
- Habitat restoration will begin as soon as possible after the completion of construction.

- Access roads should be located to follow natural contours of the topography and minimize side hill cuts, and they should minimize stream crossings.
- The creation of, or increase in, the amount of edge habitat between natural habitats and disturbed lands should be minimized.
- Stream crossing should be designed to provide in-stream conditions that allow for and maintain the uninterrupted movement and safe passage of fish.
- Construction activities should be scheduled to avoid important periods of wildlife courtship, breeding, nesting, lambing, or calving.
- Buffer zones should be established around raptor nests, bat roosts, and biota and habitats of concern, if facilities are believed to pose a significant risk to avian or bat species of concern.
- Noise-reduction devices should be maintained in good working order on vehicles and construction equipment.
- Explosives should be used only within specified times and at specified distances from sensitive wildlife or surface waters.
- Dust abatement techniques should be used on unpaved, unvegetated surfaces.
- Construction materials and stockpiled soil should be covered if they are a source of fugitive dust.
- Refueling should occur in a designated fueling area that includes a temporary berm to limit the spread of any spill.
- Drip pans should be used.
- Construction equipment should be visually inspected to identify and remove seeds that may be adhering to tires and other surfaces.
- Fill materials that originate from areas with known invasive vegetation problems should not be used.
- Certified weed-free mulch should be used when stabilizing areas of disturbed soil.
- Pesticide use should be limited to nonpersistent, immobile pesticides.

Operation-Stage Mitigation

- Measures to reduce raptors' use of the project site shall be considered, including minimization of road cuts and maintenance of either no vegetation or nonattractive plant species around the turbines.
- All unnecessary lighting should be turned off at night to limit attracting migratory birds.
- Higher-height vegetation should be encouraged along transmission corridors to minimize foraging in these areas by raptors, to the extent that local conditions will support this vegetation.

Federal Aviation Administration Advisory Circular: Obstruction Marking and Lighting, Chapter 13

Date Established: February 1, 2007

Location: Any terrestrial location within the United States

Contact: Scott Larwood, 503-752-7479; smlarwood@ucdavis.edu

Wind turbine farms are defined as a wind turbine development that contains more than three turbines that measure more than 200 feet high above ground level. The recommended marking and lighting of wind turbines is intended to provide day and night conspicuity and to assist pilots in identifying and avoiding these structures. There was no mention of the effects of these guidelines on wildlife, and no sign of plans to research this topic in the future.

Operational-Stage Lighting Requirements

- Maximum separation gap between lights along a row $\leq$0.5 miles.

- Omission of lighting within clusters (unless turbines are taller than peripheral units); lighting of end turbines or end rows necessary.
- Synchronization of lights for entire project.
- No daytime lighting necessary if white or light off-white paint is used. Daytime lighting should be used if darker paint is used.
- Omit steady burning lights; use of Federal Aviation Administration (FAA) L-864 aviation red-colored flashing lights is recommended for nighttime lighting (and found to be most effective); however, white strobe fixtures (FAA L-865) may be used in lieu of L-864 lights if they are used alone without any red lights and positioned in the same manner as red flashing lights would be.
- Light fixtures should be placed as high as possible on the turbine's nacelle, so as to be visible from 360 degrees.
- Turbines that protrude from the general limits of the turbine farm should be lit.
- High concentrations of lights should be avoided.

United States Fish and Wildlife Service: Service Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines

Date Established: July 10, 2003

Location: Any terrestrial location within the United States

Contact: For general use of guidance, and contacts with Ecological Services Field Offices, contact: David Stout, Chief, Division of Habitat and Resource Conservation, 703-358-2555
For avian-wind issues, research protocols, and technical issues contact:
Robert Blohm, Chief, Division of Migratory Bird Management, 703-358-1714

See: http://www.fws.gov/habitatconservation/wind.pdf

The Potential Impact Index (PII) represents a first-cut analysis of the suitability of a site proposed for development by estimating wildlife species' use of the site. The PII is derived from the results of three checklists: physical attributes, species occurrence and status, and ecological attractiveness. The PII ranking is intended to guide developers by estimating the level of impact that may be expected if a site is developed.

Design-Stage Mitigation

- Predevelopment evaluations should be conducted by a team that includes federal and/or state agency wildlife professionals with no vested interest (e.g., monetary or personal business gain) in the sites selected. Teams may also include academic and industry wildlife professionals, as available. Any site evaluations conducted by teams that do not include federal and/or state agency wildlife professionals will not be considered valid evaluations by the Service.
- Avoid placing turbines or towers in documented locations of any species of wildlife, fish, or plant protected under the Federal Endangered Species Act, or where species reside that are sensitive to human disturbance (e.g., prairie grouse).
- Avoid locating turbines or towers in known local bird and bat migration pathways or in areas where birds and bats are highly concentrated, unless the mortality risk is low.
- Avoid known daily movement flyways and areas with a high incidence of fog, mist, low cloud ceilings, and low visibility.
- Configure turbines to avoid potential avian mortality where feasible (e.g., group turbines rather than spreading them out widely, orient rows of turbines parallel to known bird movements).
- Avoid fragmenting large contiguous tracts of wildlife habitat.
- Where practical, place turbines on disturbed habitats.

- Reduce the availability of carrion by practicing responsible animal husbandry.
- Develop a habitat restoration plan for the proposed site that avoids or minimizes negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species.
- Collocate the communications equipment on an existing communication tower or other structure. If this is not feasible, construct towers no more than 199 feet above ground level, using construction techniques that do not require guy wires (e.g., monopole), if possible.

Construction-Stage Monitoring

- Road access and fencing should be minimized
- If significant numbers of breeding, feeding, or roosting birds are known to habitually use the proposed tower construction area, relocation to an alternate site should be recommended. If this is not an option, seasonal restrictions on construction may be advisable to avoid disturbance during periods of high activity among birds.
- Minimize roads, fences, and other infrastructure. Infrastructure should be capable of withstanding periodic burning of vegetation.

Operational-Stage Monitoring

- The Service recommends that all sites be monitored for impacts on wildlife after construction is completed; monitoring is not expected to exceed 3 years.
- Where feasible, turbines should be shut down at times when birds are highly concentrated.
- Daytime visual markers should be on any guy wires used to support towers that are located in known raptor or waterbird concentration areas or daily movement routes, or in major diurnal migratory bird movement routes or stopover sites.
- Where feasible, power lines should be underground or if on the surface, should be insulated, shielded wire.
- The minimum amount of pilot warning and obstruction avoidance lighting required by the FAA should be used.
    - The use of solid red or pulsating red warning lights at night should be avoided.
    - White strobe lights should be used at night; the minimum number, minimum intensity, and minimum number of flashes per minute allowable by FAA.
    - Security lighting for on-ground facilities and equipment should be down-shielded to keep light within the boundaries of the site.
- When the height of the rotor-swept area poses a high risk for wildlife, the tower height should be adjusted, where feasible.
- Older turbines that have been shown to cause high rates of mortality should be retrofitted or relocated.

A Federal Advisory Committee Act (FACA) process and call for committee nominations were published in the Federal Register on March 13, 2007, with the receipt of nominations accepted through April 12, 2007. A FACA committee intended to review the Service's interim guidelines is anticipated to begin meeting later in 2007.

United States Forest Service: ***DRAFT*** 36 CFR 251, Special Use Permits

Date Established:	Currently being drafted; expected release date is fall 2006
Location:	Any development taking place on Forest Service land
Contact:	Kristen Nelson, (202) 205-1406, kristennelson@fs.fed.us

- The proposed land use must be consistent with standards and guidelines in the applicable forest land and resource management plan prepared under the National Forest Management Act (NFMA) and 36 CFR part 219: National Forest System Land and Resource Management Planning (219.20, ecological sustainability, is below).
  - The planning process must include the development and analysis of information regarding ecological components at a variety of spatial and temporal scales, as determined by the responsible official.
  - Plan decisions affecting ecosystem or species diversity must provide for maintenance or restoration of the characteristics of ecosystem compositions and structure within the range of variability that would be expected to occur under natural disturbance regimes in accordance with paragraphs (b)(1)(i) through (v) of this section.
- The proposed activity cannot materially impact the characteristics or functions of the environmentally sensitive resources or lands identified in Forest Service Handbook 1909.15, chapter 30.

Note: To date, only two wind power projects have occurred on forest service lands—one in Vermont, the other in Michigan. The Forest Service is in the process of revising current permitting guidelines to include issues specific to wind power. The updated guidelines were not available as of 2/15/07.

International Policies and Guidelines

Australian Wind Energy Association: Best Practice Guidelines for Wind Energy Projects

Date Established: March 2002

Location: Australia

See: www.auswea.com.au

Developers must submit to development approval authorities documentation demonstrating how the design has taken into account the need to mitigate potential impacts, and how mitigation measures will be implemented during construction and operation. The development application must include details of impact mitigation measures incorporated into the design, construction, and operation of the development to address regulatory or legislative requirements and to meet general best practice environmental management targets.

Design-Stage Mitigation

- Avoid development sites and turbine sites with high bird usage.[9]
- Locate turbines and roads well away from wetlands and other bird-rich habitats
- Consider widening the spacing between turbines to permit movement of birds around and between the turbines.
- Design roads and tracks to avoid changes to surface water runoff and to not cause erosion.
- Route power cable to avoid the need to remove native vegetation and habitat
- Ensure that power cables are not placed across regular bird flight paths.
- Locate the switchyard to avoid areas of native vegetation or habitat.

Construction-Stage Mitigation

[9] A radius of up to 30 km from the potential site should be used when gathering information on flora and fauna present within the site.

- Monitor for any downslope deposition of material from construction areas, and ensure that weeds are controlled and areas are revegetated.
- Implement strict speed limits where tracks are within 200 meters of wetlands or other habitats where birds could be disturbed.
- Locate storage areas and vehicle standing areas away from native vegetation and habitat and at least 200 meters from wetlands.
- Avoid building roads and placing turbines on areas of native vegetation and fauna habitat
- Avoid construction during the most sensitive times of the year, and/or stage construction work to ensure adequate distances between work and sensitive habitats.

Operation-Stage Mitigation

- Avoid human disturbances to any wetlands or other habitats that hold bird groups potentially vulnerable to collision.
- Undertake an extensive rabbit control program to minimize the attractiveness of the site to birds of prey.
- Clear away sheep and cattle carcasses rapidly.
- Provide alternative habitat off site to attract at-risk birds from near turbines.
- Monitor and repair any erosion and reduce surface water pooling or concentration of runoff.
- Do not illuminate wind turbines as this can attract insects and confuse night-flying birds.
- Bird and bat utilization studies should be continued for at least 2 years after operation begins.

Environment Canada, Canadian Wildlife Service: Wind Turbines and Birds – A Guidance Document for Environmental Assessment

Date Established: July 2005

Location: Canada

Contact: 819-997-1095; cws-scf@ec.gc.ca,

See[10]: http://www.energy.ca.gov/renewables/06-OII-1/documents/other_guidelines/CANADIAN_GUIDELINES_2005.PDF

These guidelines are intended to be used in consultation with regional Canadian Wildlife Service biologists and Environment Canada (EA) experts. The guide should not be regarded as exhaustive or restrictive, and should serve as the starting point for discussions with EA staff on each project.

These guidelines include a level of concern matrix (low to very high) based on site sensitivity and facility size: very high concern (2+ years of baseline data and 3+ years of follow-up required), high concern (comprehensive surveys to gather baseline and 2+ years of follow-up), medium concern (basic baseline information surveys and 2-year basic follow-up), and low concern (minimum amount of baseline information and 1-year follow-up).

Design-Stage Mitigation

- Preliminary information must be gathered to determine site sensitivity.
- Any turbine taller than 150 meters in height should be subject to closer scrutiny, especially for sites close to arrival and departure sites of nocturnal migrants, on mountain tops or in foggy areas.

[10] Since the drafting of this document, Environment Canada and the Canadian Wildlife Service finalized their guidance document in April 2007. The April 2007 version can be downloaded at http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm.

- A smaller number of larger turbines may pose less of a risk to birds than a larger number of smaller turbines.
- Tubular and met towers without guy wires are recommended in commercial wind energy projects.
- Configuration should avoid creating barriers to bird movement. Spacing between the turbines should be greater than 200 meters to avoid inhibiting movement.
- Perching opportunities such as lattice towers, guy wires, hydro poles or other structures should be reduced or removed whenever possible.

Construction-Stage Mitigation

- Focus intense construction outside the core breeding and migration seasons to reduce disturbance to birds.
- Keep the number of access roads constructed to a minimum. When roads need to be constructed, minimize habitat destruction, fragmentation, and disturbance of breeding and wintering grounds as much as possible.
- Bury all lines, when possible. When that is not possible, consider the following mitigation techniques:
    - Line visibility should be increased by using bird flappers or other bird flight diverters and by increasing the size of the wire
    - Lines should not be built over water or other areas with high concentrations of birds.
    - Small lightning shield wires should be eliminated where lines cross wetlands and migration routes.
    - Lines should be made parallel to the direction of prevailing winds.
    - Place lines crossing rivers at oblique rather than right angles.
    - Place lines as close to trees as practical and below the level of tree tops, wherever possible.
- All wastes should be collected and disposed of.

Operation-Stage Mitigation

- Access roads that are not used after construction should be allowed to revegetate (with native and not invasive plant species).
- Lighting should be used only where required by Transport Canada regulations. Use strobe lights only, with the minimum number of flashes per minute and the briefest flash duration allowable. Avoid steady-burning or other bright lights such as sodium vapor or spotlights on turbines and other structures.
- Take measures to minimize motion smear.
- If a moving blade appears to be causing high bird mortality along a particular flight path, the turbine can be shut down, which may reduce the number of direct hits.
- If mortality is due to attraction to lights, other lighting options may need to be considered. It may be possible to reduce the amount of lighting, or even to turn lights off during periods of high risk.
- If there are high densities of raptors in the area, implement a prey control program and/or remove other raptor food sources at the site.
- In agricultural sites, the area under the turbines can be planted in a crop that is less attractive to birds.
- If grassland birds are being killed during aerial displays, it may be possible to offset losses in productivity if hay cutting can be delayed at adjacent sites.

When wind farms are found to cause an unacceptable number of bird kills, and various mitigation strategies prove unsuccessful, other options should be considered, such as encouraging the proponent to purchase and then protect a parcel of land of similar size and habitat type. Other “last-resort” methods include decommissioning or moving problem turbines to a new location.

Department for Environment, Food and Rural Affairs: Nature Conservation Guidance on Offshore Windfarm Development (Version 1.9)

Date Established: March 2005

Location: England

See: http://www.defra.gov.uk/WILDLIFE-COUNTRYSIDE/ewd/windfarms/windfarmguidance.pdf

This document has been produced by the Department for Environment, Food and Rural Affairs to provide developers with a greater understanding of the potential nature conservation impacts of offshore wind farms and the steps they are legally obliged to follow to comply with the requirements of the European Commission's Habitats and Wild Birds Directives, including steps to avoid harming the Natura 2000 network.

Design-Level Mitigation

- The whole wind farm area plus surrounding buffer of 1-2 kilometers should be surveyed; observers should be trained by ornithologists.
- Survey data from at least 2 years are necessary, and more survey data (preferably 3 years) will be required in circumstances where important concentrations of birds occur.
- Avoid areas with concentrations of important conservation species or important migratory paths.
- Ensure that siting and design are appropriate in terms of orientation, spacing, and location:
    - Allow wide corridors between clusters of turbines, with a line formation parallel to the main flight direction.
    - Lines of turbines should be broken up.
- Construction of larger turbines may provide greater visibility.

Construction-Level Mitigation

- Time construction work and methods to avoid critical periods such as molting.
- Use high contrast patterns on turbine blades to reduce motion smear.
- Postpone maintenance of turbine(s) during critical periods.
- Employ methods of chemical use that minimize the release of polluting materials into the water column and use only chemicals selected from the List of Notified Chemicals.
- Do not undertake construction between December 16 and March, to minimize impacts on the over-wintering common scoter.
- Cable laying along the beach from October to April should avoid the sensitive period 2 hours either side of high water for over-wintering wader species. Cable laying should also occur outside of the molting period for the common scoter (July to September).
- Piling work for turbine foundations should only be carried out between high tide minus 3 hours and high water plus 3 hours to minimize disturbance to little terns.
- No work should be carried out near nesting and breeding areas between May 1 and August 1.

Operation-Stage Mitigation

- Use intermittent rather than continuous navigation lighting, particularly strobing lights. Clusters of turbines will reduce the single point source and provide a more diffuse light distribution. Avoid floodlighting of turbines, particularly in periods of bad weather. White lights are preferable to red.
- Surveys should be carried out for at least 3 years following construction, and some monitoring may be required for the lifetime of the development.

Other Policies and Guidelines

American Birding Conservancy: Wind Energy Policy

Date Established: October 12, 2004

See: http://www.abcbirds.org/policy/windpolicy.htm

The American Birding Conservancy (ABC) supports alternative energy sources, including wind power. However, ABC emphasizes that before approval and construction of new wind energy projects proceeds, potential risks to birds and bats should be evaluated through site analyses, including assessments of the abundance of birds and bats, the timing and magnitude of migrations, and habitat use patterns. Wind energy project location, design, operation, and lighting should be carefully evaluated to prevent, or at least minimize, bird and bat mortality and adverse impacts through habitat fragmentation, disturbance, and site avoidance.

Design-Stage Mitigation

- Compile a minimum of 1 year of monitoring data; 2 years of data are suggested. Seasonal observations and detailed evaluation of the site should be conducted by qualified professionals with no vested interest in the project.
- Wind energy project location, design, operation, and lighting should be carefully evaluated to prevent, or at least minimize, bird and bat mortality and adverse impacts through habitat fragmentation, disturbance, and site avoidance.
- Sites requiring special scrutiny include those that are frequented by federally listed endangered species of birds and bats, are in known bird migration pathways, have high concentrations of birds, and have landscape features known to attract large numbers of raptors.
- Wind turbines, associated communication towers, and permanent met towers should be monopoles, not of lattice construction, and use no guy wires.

Construction-Stage Mitigation

- All connecting power transmission lines should be underground; if above-ground lines are required, the lines and poles should comply with APLIC standards.
- When disturbance is temporary, such as from construction impacts, disturbed areas should be fully reclaimed to approximate the same habitat functions for wildlife that existed before the disturbance.

Operational-Stage Mitigation

- The number of turbines that are lit should be minimized.
- Lit turbines should use only simultaneously pulsing white or red strobes, preferably at 20 pulses per minute.
- If significant mortality rates cannot be resolved, then turbines should be shut down during periods of peak risk to birds or bats.
- Two years of monitoring data should be collected after construction is complete. If legitimate mortality concerns arise, then studies should continue until monitoring demonstrates that concerns have been resolved.

Audubon Washington: Wind Power Policy for Washington State

Date Established: September 23, 2002

Location: State of Washington

Contact: Nina Carter, Executive Director Audubon Washington, 360-786-8020 x208

See: http://www.audubon.org/chapter/wa/wa/DOCs/Sept2002_WindPowerPolicy_ExecSummary.doc

The following policy statement applies to the siting, development, operation, and monitoring of wind power generation facilities. Although wind power generation generally has less detrimental impact than other forms have, this focus on wind power results from recent, high-profile developments in Washington. Furthermore, because the construction and operation of wind turbines has immediate, quantifiable impacts on birds, the public looks to Audubon for guidance on reducing or mitigating these impacts. This policy on wind power facilities is part of a more comprehensive energy policy, the remainder of which will be developed at a later date.

Design-Stage Mitigation

- At least 2 years of baseline monitoring of bird use of the project area and a surrounding buffer zone need to be completed. This requirement may be reduced to 1 year if monitoring is conducted using radar systems such as BIRDRAD.
    - Monitoring activities should span all seasons and be carried out during the night as well as during daylight hours, be conducted by professional ornithologists, and follow standard protocols.[11]
- Designs need to include technologies that are known to reduce detrimental impacts on birds (e.g., tubular towers, absence of guy wires, absence of lights that may attract night-migrating birds).
- A contingency plan must be established to be implemented when operational monitoring shows detrimental effects to birds and/or bird habitat.
- Wind power developers should encourage the involvement of local Audubon chapters and the environmental community during the initial project development phase.

Operational-Stage Mitigation

- Maximum speed of turbines is less than 30 rpm.
- Environmental monitoring must be conducted to assess the level of bird mortality caused by collisions, and it must follow standard protocols.
- Monitoring reports and data must be submitted quarterly to the Washington State Energy Facility Site Evaluation Council and the Washington Department of Fish and Wildlife for the first 2 years following commencement of operations and annually thereafter.

Clean Energy States Alliance: Model State Guidance Document Governing Avian and Bat Impacts from Wind Facilities

Date Established: October 2006

Location: State and federal agencies

[11] If the environmental impact study, site ranking process, or adaptive management results reveal areas with low bird density or use, or areas where substantial detrimental impacts to birds would not likely occur, these requirements could be reduced or waived.

Contact: Mark Sinclair, Deputy Director, Clean Energy States Alliance, 802-223-2554; msinclair@cleanegroup.org

The following "model" guidelines are recommendations for consideration by state and federal agencies to use in avoiding or minimizing impacts to avian and bat species from the construction and operation of wind-energy facilities. The purpose of the proposed guidelines is to outline the types and extent of the information needed to adequately identify, assess, mitigate, and monitor the potential adverse effects of wind energy projects on birds and bats. These guidelines are intended to be used in consultation with state wildlife biologists. A technical advisory committee should be established to review monitoring results and make suggestions to the permitting agency regarding the need to adjust mitigation and monitoring requirements.

Design-Stage Mitigation

- At least 1 year of preassessment monitoring should be conducted for micrositing (and more in areas with particularly high uncertainty about level of impacts and/or high site sensitivity). Survey methods used should be based on the objectives of the study, the species of interest, and the landscape. Studies should be conducted as seasonally and spatially appropriate; the intensity and frequency of monitoring is determined in consultation with the state wildlife agency.
- Avoid locations identified to have the potential for high risk to birds or bats or that are occupied by species of particular concern.
- Site projects on disturbed lands where possible.
- Avoid using or degrading high habitat areas.
- Avoid areas with high concentrations of birds through micrositing alternatives.
- Use tubular towers (as opposed to lattice towers) or best available technology to reduce the ability of birds to perch and the risk of collision.
- Turbine configurations should avoid creating barriers to bird movement, to the extent possible.
- Constraint mapping should be undertaken to assess where roads should or should not be located.

Construction-Stage Mitigation

- Minimize road cuts and the number of access roads.
- Power lines in open or high-elevation exposed locations should be buried, where possible. Overhead lines may be acceptable if they follow tree lines or are otherwise screened from potential collisions.
- Habitat destruction and fragmentation and disturbance of breeding, staging, and wintering birds should be minimized, to the extent possible.

Operational-Stage Mitigation

- Use the minimum number of pilot warnings and obstruction avoidance lighting recommended by the FAA. No high-intensity lighting should be permanently installed. Site lighting generally should be turned off unless needed for specific tasks.
- A decommissioning condition should be established for wind projects that require the creation of a plan and fund for the removal of the turbines and infrastructure when they cease operation, and for restoration of the site to approximate preproject conditions.
- Postconstruction operations monitoring is recommended at sites that support high densities of native breeding birds, concentrations of migrating birds, or threatened and endangered species. When the risk of fatalities is of concern, or considered likely for a species of concern, mortality surveys should be recommended for 1-2 years (and more if significant mortality concerns are identified) at a fairly modest level of sampling and intensity to determine possible effects.
- Determinations of carcass losses, scavenging trails, and searcher efficiency trials should be conducted in order to assess fatality rates as accurately as possible.

Annotated Bibliography

The literature included in this section was selected for its relevance to this mitigation study. Selections were limited to studies that examine the effects of specific changes to wind farm characteristics on birds and bats, as well as those on general habitat mitigation that appeared applicable to wind development. Studies were deemed relevant that examined one of several areas:

- The effectiveness of mitigation strategies on wildlife
- Avian/bat behavior studies conducted at wind sites along with management suggestions
- Studies comparing the effects of wind site alterations on birds or bats
- Studies that examined mitigation strategies suggested in policies and guidelines
- Studies mentioned by experts in the field.

Research was not included that focused on avian or bat ecology, searcher efficiency rates, scavenging rates, avian or bat mortality estimates, study design, classes of wildlife other than birds or bats, and modeling.

Referenced mitigation studies were representative of the current body of literature, and when scientific opinions differed, numerous studies were included. In general, selections were made from recent literature (published since 1995), but in some cases this was not possible. Some earlier literature was included if it was cited repeatedly within other studies because of its historical foundations. Previously conducted literature reviews (e.g., Appendix G by Orloff in Erickson et al. 1999) were used occasionally because of time constraints and difficulties in obtaining original papers; these are marked by a footnote within the annotated bibliography.

The literature is categorized according to the primary topic of the mitigation effort and research (e.g., location of the turbine on the site vs. habitat alterations). The bold type at the end of each citation indicates the type of publication (e.g., report, journal) as well as whether or not a peer review process was used (based on information gathered from the Acknowledgements section). Remaining categories include literature reviews and current research that has not yet been published. See also Appendixes B and C.

Turbine Location / Turbine Type

1. Anderson, R., N. Neuman, et al. (2004). *Avian Monitoring and Risk Assessment at the Tehachapi Pass Wind Resource Area.* Prepared for National Renewable Energy Laboratory: 1-102.

    This study was conducted to examine bird utilization, fatality rates, and collision risk indices between bird species, turbine types and turbine locations within the Tehachapi Pass WRA. Research was conducted between October 1996 and May 1998. Results indicated very few differences in the effects of turbine characteristics. There was a pattern of higher fatality rates at larger turbines, but when the fatality rates and collision risks were adjusted by rotor swept area (RSA) or turbine density, those differences were reduced, and in some cases the fatality rates for smaller turbines were higher than those for the larger turbines, on an RSA equivalence basis. Tubular towers were found to have lower estimated fatality rates than lattice towers in general, but the true cause of the difference cannot be determined because the two types of turbines were in different geographic locations. Results from this study and others conducted at the Altamont suggest that tower type is not likely to be related to collision risk where perch sites are abundant; however, the data indicate a higher rate of perching behavior on small and large lattice turbines, and on small tubular turbines compared with tall tubular turbines. Most perching occurs on turbines that are not operating. Structures such as lattice turbines and overhead lines that provide perches could lead to higher mortality because of an increase in the use of sites. Recommendations include higher search frequencies (e.g., monthly or twice monthly, at a minimum), a larger sample size (N=127, with 75 found on search plots), and searching entire turbine strings as opposed to individual ones when turbines within strings are closer together than two times the fatality plot search radius. **Report; review process used.**

2. Barrios, L., and A. Rodriguez (2004). "Behavioral and environmental correlates of soaring-bird mortality at on-shore wind turbines." *Journal of Applied Ecology* **41**: 72-81.

This study measured bird mortality, analyzed the factors that led birds to fly close to turbines, and proposed mitigation measures at two wind farms installed in the Straits of Gibraltar. Research was conducted between December 1993 and December 1994 at the wind farms, E3 and PESUR, which are located on hills and ridges composed of scrubland, rangeland, and forest habitat. Bird vulnerability and mortality were found to reflect a combination of site-specific, species-specific, and seasonal factors. Mortality was found to be much lower at E3 than at PESUR, as were risk indices (0.059 vs. 0.198, respectively). The frequency of risk situations at PESUR varied significantly with wind speed; the risk index was 0.343 between 4.6-8.5 m/s winds and decreased with increasing wind speed (0.037 in strong winds). Risk was observed to increase in autumn and winter. Mortality caused by turbines was higher than that caused by power lines, but it was not significantly associated with either structural attributes of wind farms (lattice vs. tubular) or visibility. The absence of thermals is believed to cause birds (specifically vultures) to use slopes for lift, and this could be a prominent factor in the high mortality rates observed. All species affected by the turbines were listed as threatened or vulnerable in Spain; thus, mitigation measures are necessary. Results indicate the most sensible approach is to suspend the operation of the small number of turbines that cause most deaths only under the wind speeds that lead to risk situations. A more general recommendation is that all new wind power facility projects should include a detailed study of bird behavior at the proposed construction site. **Journal; no mention of review process.**

3. Brown, W. M., R. C. Drewien, et al. (1985). *Mortality of Cranes and Waterfowl from Power Line Collisions in the San Luis Valley, Colorado*. 4th Crane Workshop, Grand Island, Nebraska, Platte River Whooping Crane Habitat Maintenance Trust.

The authors recommend that no new transmission lines be placed within two kilometers of traditional roost or feeding sites. The static wire (the nonconducting topmost wire on a power line used to minimize power outages from lightning strikes) is normally smaller than the conductors and appears to be the wire most often struck by birds in flight. Static wire removal is recommended whenever possible, but modification or better marking are preferred methods. **Unable to relocate study for review information.**

4. Erickson, W. P., G. D. Johnson, et al. (1999)*. Baseline Avian Use and Behavior at the CARES Wind Plant Site, Klickitat County, Washington.* Prepared for the National Renewable Energy Laboratory**:** 1-75.

This report summarizes the avian research conducted at the Columbia Wind Farm #1 in Klickitat County, Washington. This report documents only the preconstruction data collected because development of the site was indefinitely postponed and the field surveys were suspended at the end of one year. After one year of data collection, spatial use data indicated that avian use of the CARES study area tends to be concentrated near the rim edge, indicating that risk may be reduced by placing turbines away from the rim edge. High use of rim edges by raptors has also been documented at other sites. **Report; review process used.**

5. Hoover, S. (2002). *The Response of Red-tailed Hawks and Golden Eagles to Topographical Features, Weather, and Abundance of a Dominant Prey Species at the Altamont Pass Wind Resource Area, California*. Prepared for the National Renewable Energy Laboratory: 1-64.

The goals of this study were to determine which characteristics of the landscape influence hawk and eagle habitat selection within the Altamont Pass Wind Resource Area (WRA). The study period was June 9, 1999, to June 20, 2000; observations were conducted weekly. The variables showing the strongest relationship for red-tailed hawks (RTHA) were wind speed, wind direction, and slope aspect. There was a significant relationship between kiting or gliding activity and elevation; 90% of RTHA kiting occurred on only 3 of the 24 slopes in the steepest incline category and 14% of all mortalities found on 4% of the slopes. Kiting behavior was found to be used in high winds and was seen significantly more often at 11-50 m from the ground, the height of the rotating turbine blades. RTHA flight activity did not increase in areas with progressively higher squirrel density, suggesting that favorable wind currents have a stronger appeal because they make foraging more energy efficient. Golden eagles were noted as using narrow corridors that transect large hills, specifically ones that are oriented east to west with steep (>23% average grade) and tall (peak elevations of 170-205 m) hills located on the north and south sides. All 7 eagle fatalities occurred where these 'canyons' opened up onto the valley floor (Rugge 2001). Closing down the turbines that are constructed on valley plateaus or along the rim where the plateau meets the sloping hillsides is recommended. It is also recommended that turbines be powered down atop hazardous slopes (RTHA) and where high winds are perpendicular to the slope. This well-done study illustrates numerous significant relationships to support recommendations. **Report; review process used.**

6. Hoover, S. L., and M. L. Morrison (2005). "Behavior of red-tailed hawks in a wind turbine development." *Journal of Wildlife Management* **69**(1): 150-159.

Between June 1999 and June 2000, the flight behaviors of RTHA were recorded in relation to characteristics of the topography (e.g., slope aspect, elevation, and inclination) and to various weather variables (e.g., wind speed and direction). RTHA behavior and their use of slope aspect was found to differ according to wind speed; hawks perched or soared more often in low winds and showed kiting behavior in strong winds. Results indicate that red-tailed hawk behavior is strongly influenced by a combination of wind conditions and topography. Strong winds from the south-southwest resulted in kiting behavior on south-southwestern facing slopes with inclines greater than 20% and peak elevations greater than adjacent slopes. Because topographical features and weather variables have been shown to predict the strength and location of deflection updrafts necessary for kiting behavior, it is essential that a detailed site assessment and behavioral study be conducted to identify locations where the topographical/weather interaction may produce dangerous conditions for foraging RTHA and other raptors. Mitigation measures to decrease fatalities should be directed specifically to these areas and others fitting the general model. It is suggested that turbines be powered down at the top of these hazardous slopes when they pose the greatest danger, i.e., strong winds facing perpendicularly to the slope. No significant relationships were specifically mentioned within results to support management considerations. **Journal; review process used.**

7. Hunt, W.G. (2002). *Golden Eagles in a Perilous Landscape: Predicting the Effects of Mitigation for Wind Turbine Blade-Strike Mortality*. Prepared for the California Energy Commission**:** 1-72.

This study was initiated in June 1998 to provide information to the California Energy Commission's Public Interest Energy Research (PIER) Program before an extensive repowering project was carried out to replace approximately 1300 Type-12 turbines with larger turbines on tubular towers at a ratio of 7:1. The objectives of this study were to increase the number of radio-tagged eagles and to continue monitoring them to further understand demographics, track the net result of repowering, and explore other mitigation measures to reduce golden eagle mortality rates. Density comparisons of eagle relocations and fatalities in the two northern polygons, both of which contained relatively high numbers of relocations, suggested that the one containing Type-13 turbines was more lethal (19 mortalities) than that containing Type-28 turbines (2 mortalities). Reducing the number of Type-13s as part of the repowering would very likely benefit eagles, especially in areas where they concentrate. The turbines that caused lower mortality rates had blades higher off the ground, towers that were spread apart more widely, and tubular towers that offered little opportunity for perching. Other suggestions include reducing ground squirrel density around the turbines through live-trapping and relocation, a recommendation based on surveys indicating golden eagles use of high-density squirrel areas over low ones at a ratio of 7:1. **Report; reviewed by four referees (incl. Erickson, Strickland, and Manly).**

8. Johnson, G. D., M. K. Perlik, et al. (2004). "Bat activity, composition, and collision mortality at a large wind plant in Minnesota." *Wildlife Society Bulletin* **32**(4): 1278-1288.

Bat activity levels, species composition, and collision mortality were examined at a large wind plant in southwest Minnesota from June 15-September 15, 2001, and again in that period in 2002. Peak bat activity at turbines followed the same trend as bat mortality, occurring from mid-July through the end of August. It is believed that most bat mortality (151 individuals) involved migrating bats, because of the species involved in collision fatalities (hoary, eastern red, and silver-haired bats). There was no significant relationship between bat activity at turbines and the presence of lights or number of fatalities at turbines. Bat activity decreased with increasing distance from woodlands; however, this relationship may reflect only the high bat activity (>10 bat passes/night) recorded at a small number of turbines within 100 m of woodlands rather than a true relationship between bat activity as a function of distance from woodlands. **Journal; two reviewers (incl. R. Osborn).**

9. Osborn, R. G., C. D. Dieter, et al. (1998). "Bird flight characteristics near wind turbines in Minnesota." *American Midland Naturalist* **139**(1): 29-38.

This study was conducted at Buffalo Ridge Wind Resource Area (BRWRA), where the habitat consists of agricultural and CRP fields. Data suggests that birds avoid flying in areas with wind turbines. Most birds observed (75% in 1994; 70.2% in 1995) flew below blade height, with only 16% (1994) and 17.5% (1995) seen flying between 21-51 m. Birds seen flying through tower string often adjusted their flight patterns when turbine blades were rotating and often made no adjustments when turbine blades were not rotating, suggesting that birds could detect blade movement either by sight or sound (80% in 1994 & 74.8% in 1995 seen flying 31 m or further from turbine at time of sighting). The absence of raptor mortality at the site is believed to be the result of the small number of raptors frequenting the area and the tubular tower design which discourages perching and nesting on turbines. The availability of alternative perching sites is also believed to have reduced the attractiveness of wind turbines as perching sites for raptors at this location. 75% of passerine mortality occurred during migration periods. Baseline data noted as being essential for establishing initial abundance, migration patterns, identifying species of concern, and evaluating post-construction effects of turbines on bird populations. It is unclear how tower design conclusions were reached based on study design. **Journal; no mention of review process.**

10. Osborn, R. G., K. F. Higgins, et al. (2000). "Bird mortality associated with wind turbines at the Buffalo Ridge Wind Resource Area, Minnesota." *The American Midland Naturalist* **143**(1): 41-52.

The purpose of this research was to determine the degree of avian mortality resulting from collisions with wind turbines and to assess the influence of biases affecting our ability to detect avian mortality at Buffalo Ridge in Minnesota. Research occurred in 1994 and 1995 (1994 considered a pilot year & methodologies modified in 1995), and turbines were located in agricultural and Conservation Reserve Program (CRP) fields. Because of the small number of dead birds found (12l), it was not possible to determine if any particular species or group of birds is more susceptible to collisions with turbines. Observer efficiency was found not to differ by year or cover type, but to be influenced by the size of the bird. Consideration of potential impacts on avian communities before designing and siting of a facility may be a best first step to reduce mortality at wind power resource projects involving wind turbines (citing Nelson and Curry 1995). The recommendation is to avoid building wind plants near areas with large concentrations of birds (e.g., high-density breeding or wintering areas), known migration corridors, or refuges until further research is done. Recommendations also include conducting mortality searches on a 2- to 3-day-rotation to minimize the impacts of scavenging and decomposition on recovery numbers; however, biases affecting bird recovery are expected to be unique for each wind plant, so bias assessments must be made on a site-by-site basis. Unable to find definitive information within paper pertaining to significance of results or if recommendations are supported by research. Also, very small sample size. **Journal; reviewed by six referees (incl. S. Ugoretz, J. Schladweiler, S. Cooper).**

11. Orloff, S., and A. Flannery. (1992). *Wind Turbine Effects on Avian Activity, Habitat Use, and Mortality in Altamont Pass and Solano County Wind Resource Areas Tiburon, California.* Prepared for the Planning Departments of Alameda, Contra Costa, and Solano Counties and the California Energy Commission.

This study was conducted at the Altamont Pass WRA over six seasons between 1989 and 1991 to determine the relationships among bird use, fatalities, turbine characteristics, and physical variables associated with the site. Of 182 bird carcasses found, 119 (65%) were raptors (55% killed by turbines, 8% electrocuted, 11% collided with wires, and 26% unknown). Lattice turbine types were associated with a higher mortality rate than all other turbine types combined; however, mortality rates at tubular towers were found to increase 12.5% when located in end rows and close to a canyon. A discriminate analysis indicated three turbine characteristics were significantly associated with raptor mortality: end-row turbines, turbines close to canyons, and the number of steep-sided slopes (0-4). Using the same analysis, these characteristics were not found to have a significant association with raptor mortality: first turbine row, degree of slope, slope aspect, length of turbine row, position on slope, and ground squirrel density. Elevation was also deemed significant, although the authors question the biological significance because (1) mean elevation difference was only 157 ft, (2) distribution of elevations between killing and nonkilling turbines was similar, and (3) elevation was associated with canyon proximity and number of steep slopes, which were related to mortality. None of the characteristics were found to be significant for nonraptors, but the authors note this may have been caused by the low sample size. Mortality did not appear related to abundance. **Report; review process used.**

12. Smallwood, K.S., and C.G. Thelander. (2004). *Developing Methods to Reduce Bird Mortality in the Altamont Pass Wind Resource Area.* Prepared for the California Energy Commission: 1-363.

This study involved a five-year research effort to better understand bird mortality at the Altamont WRA. Bird behaviors, raptor prey availability, wind turbine and tower design, interturbine distribution, landscape attributes, and range management practices were studied to explain variations in bird mortality. Researchers recommended the following mitigation measures: relocate selected, highly dangerous wind turbines; move rock piles away from wind turbines (prey cover for kit fox); retrofit tower pads to prevent burrowing by small mammals; remove broken and nonoperating wind turbines; implement means to effectively monitor the output of each turbine; and retrofit noncompliant power poles to minimum Avian Power Line Interaction Committee (APLIC) guidelines. Researchers recommend the following measures be abandoned because of their ineffectiveness in reducing avian mortality rates: rodent control program, installation of perch guards, provision of alternative perches, and barricading of rotor blades. The following mitigation measures are unproven but believed to be highly effective: exclude cattle from around wind turbines through fencing (decreasing cattle pats and associated grasshopper populations may decrease Burrowing Owl population because of perching preference); install flight diverters (poles placed 5-10 m apart and just beyond the rotor plane of the wind turbine at end of string); paint blades using scheme of Hodos et al.; reduce vertical and lateral edge in slope cuts and nearby roads (to decrease pocket gopher population); and use devices to identify when to operate problem wind turbines with the least effect on birds (accelerometers). Turbine strings were found to be most dangerous when some turbines are on and others off; wind turbines at the ends of strings and at the edges of clusters were found to kill disproportionately more birds. Access roads should be minimized, along with buried pipelines near wind turbines. Also, the APWRA could be repowered with fewer wind turbines mounted on taller towers with larger individual output capacities (turbines should have blades no closer to the ground than 29 m). Researchers found that at least 3 years of carcass searches are needed before the sample of wind turbines sufficiently stabilizes. **Report; review process used (five referees).**

13. Smallwood, K.S. (2006). *Biological Effects of Repowering a Portion of the Altamont Pass Wind Resource Area, California: The Diablo Winds Energy Project*.

This paper provides a review of the WEST, Inc. (2006) report on the Diablo Wind Energy Project, in which 169 vertical-axis wind turbines were replaced with 31 larger horizontal-axis wind turbines in the Altamont Pass WRA. The author found WEST, Inc., to have inappropriately analyzed bird mortality rates because the study area was increased (800-m radius) compared with the initial smaller area (300-m radius). Adjusted mortality estimates from 1 year of monitoring data indicated a 70% reduction in overall bird mortality, a 62% reduction in raptor mortality, and an 85% reduction in burrowing owl mortality. RTHA mortality, however, was shown to have increased nearly 300%, and some mortalities were not recorded during prereplacement studies (e.g., golden eagles and bats). Analysis of utilization and mortality indicated a decline in utilization over the past 8 years and a decrease in mortality since repowering. Mortality adjustments include uncertainties and potential statistical bias. Several years of monitoring will be needed more accurately compare mortality before and after the project. **No review process.**

14. Thelander, C. G., and L. Rugge. (2000). *Avian Risk Behavior and Fatalities at the Altamont Wind Resource Area*. Prepared for the National Renewable Energy Laboratory: 1-22.

In this progress report, mortality data were collected during an 11-month period to meet these objectives: (1) to relate bird flight and perching behaviors to mortality risk, and (2) to identify any relationships between these behaviors and turbine or tower type, weather, topography, habitat features, and other factors that may predict high degrees of risk to birds, especially raptors. Findings indicated that there may be no significant difference between the frequency of fatalities associated with turbines at the ends of turbine strings when compared with those within turbine strings (contrary to Orloff and Flannery 1996). Findings also indicated that, to date, 57% of all bird fatalities had been associated with tubular towers (50% of all turbines included in fatality searches were on tubular towers). This is significant because it implies that tubular towers may represent as significant a risk to birds as do horizontal-lattice turbine towers (contrary to Orloff and Flannery 1992). This paper also pointed out the difficulty of finding a universal management solution when underlying risk factors vary greatly from species to species. **Report; review process used.**

Lighting

15. Erickson, W. P., J. Jeffrey, et al. (2004). *Stateline Wind Project Wildlife Monitoring Final Report, July 2001-December 2003.* Prepared for FPL Energy, the Oregon Energy Facility Siting Council, and the Stateline Technical Advisory Committee**:** 1**-**105.

Nocturnal migrant and bat fatality rates for lit turbines, turbines adjacent to lit turbines, and other unlit turbines were collected and compared from July 2001-December 2003. Observed fatality rates at lit turbines were slightly higher than at unlit turbines, although none of the differences were statistically significant ($p > 0.10$). This suggests that lights on Stateline turbines did not attract large numbers of bats or birds during the study (supported by Erickson et al. 2003b and Johnson et al. 2002). One factor that may cause this lack of association is the height of turbines and rotors (74 m [242 ft]), which is significantly lower than tall communication towers associated with large fatality events. Light type (solid, flashing, strobe), color (red, white), and intensity (low, medium, high) may be important factors in attracting birds, but these factors are not well understood. Nearly all bat fatalities were found in late summer and fall, at times when silver-haired and hoary bats are migrating; these two species comprised 96.1% of fatalities. A common resident of the area, the horned lark, had the largest fatality rate (40%), but the next most abundant fatality rate was for the golden-crowned kinglet, not a local breeder but believed to have been affected while migrating through the area at night. Fatality estimates per turbine may be lower for smaller turbines than for larger ones, but could be misleading since it takes more small turbines to generate the same amount of electricity. The true cause of death is unknown for most of the 2002-2003 fatalities; several are believed to be caused by vehicles (e.g., maintenance personnel) and not wind turbines, given the location of the finds. Preliminary results suggest a relatively small-scale impact on nesting birds; the majority is due to direct loss of habitat from pads and roads. Grassland bird displacement studies, fatality monitoring, raptor nest monitoring, and the Wildlife Reporting and Response System (WRRS) components of this study will be continued. **Report; five reviewers (J. White, T. Meehan, M. Kirsch, K. Blakley, G. McEwen)**

16. Howell, J. A., J. Noone, et al. (1991). *Visual Experiment to Reduce Avian Mortality Related to Wind Turbine Operations.* Prepared for Altamont U.S. Windpower, Inc.: 1-25.

Three hypotheses about bird collisions and wind turbines in the Altamont Pass were tested from August 1988 to August 1989: birds cannot see the blades under specific conditions, collisions tend to occur at ends of turbine strings, and collisions tend to occur at swales or hill shoulders. During the study, 10 dead birds were found beneath turbines. Increasing turbine blade visibility (alternating patterns of red and white) appeared to reduce the number of collisions, since only one bird was recovered under a painted tower. It was not clearly determined that specific locations in the turbine string are foci for mortality, although site-specific variation did exist. No significant differences were found as a result of the three studies; however, the authors say that lower p-values for the paint experiment may suggest a significant effect would be detected if the sample size were larger. **Report; unsure of review process.**

17. Johnson, G. D., W. P. Erickson, et al. (2003). "Mortality of bats at a large-scale wind power development at Buffalo Ridge, Minnesota." *American Midland Naturalist* **150**: 332-342.

This study was conducted from 1996-1999 to assess the effects of wind power development on wildlife. A total of 184 bat collision fatalities were documented (97% of carcasses found $\leq$ 20 m from a turbine); hoary and eastern red bats constituted most of the fatalities. There was a near absence of mortality in June and early July when resident bats are breeding, indicating that resident populations are not being impacted by the wind plant. The timing of mortalities, among other factors, suggests that most mortality involves migrant rather than resident breeding bats. Lighting on turbines did not increase the number of bat collision fatalities at the Buffalo Ridge wind plant. The potential for wind plants to impact bat populations should be addressed when siting new facilities, especially in areas where threatened or endangered bat species may be found. **Journal; no mention of peer review.**

18. Kerlinger, P., and J. Kerns (2004). *A Study of Bird and Bat Collision Fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003*. Prepared for FPL Energy and Mountaineer Wind Energy Center Technical Review Committee**:** 1-39.

A postconstruction bird and bat fatality study was conducted between April 4 and November 11, 2003, at the Mountaineer Wind Energy Center (MWEC) in Tucker County, West Virginia. A total of 69 avian carcasses representing 24 known species were found; the majority were nocturnal migrant songbirds or songbird-like species (70.8%). Of the 69 fatalities, 33 (47.8%) were found on May 23, 2003, and determined to have been caused by the combination of heavy fog and several sodium vapor lights at a substation located near turbine 23. No avian fatality events occurred at the site after the sodium vapor lights were extinguished. A total of 475 bat carcasses representing 7 species were detected, mostly between August 18 and September 30, 2003 (92.5%). Correlation between weather during fall migration and new bat fatalities reveal no strong relation between fatalities and wind speed, wind direction, temperature, or fog/precipitation at the site. Bats killed at the MWEC might have collided with the turbine itself rather than the blades. No difference in numbers of birds or bat fatalities was found at lit versus unlit turbines. This suggests that FAA lighting (L-864 red strobes) did not attract nocturnal migrants, unlike the lighting on communication towers (which include steady-burning red, L-810 lights). Recommendations include conducting weekly searches of turbines in the eastern United States, particularly during avian/bat migration periods. Ideally, daily searches of all turbines or a random subset during fall migration should be conducted to examine correlations between weather conditions and bat fatalities. **No review process; statistical reviews by Erickson and Shoenfeld.**

19. Larwood, S. (2005). *FAA Obstruction Lighting Standards for Wind Energy Plants*. Prepared for the California Wind Energy Collaborative, sponsored by the California Energy Commission Public Interest Energy Research (PIER) program.

This project report established lighting standards for wind turbine sites as an issue of pilot safety. Proposed guidelines include establishing a maximum separation gap of 0.5 mile between lights along a row; omitting lights within clusters; no daytime lighting; synchronizing lights for entire project; using red or white flashing lights if possible; omitting steady-burning lights; lighting end row turbines; and using a single light mounted above the hub radius. No research was conducted on the effects of this lighting scheme on wildlife. These guidelines are based on the outcomes of airplane flight evaluations conducted by J. Patterson (2004). **Report; no review process**.

20. U.S. Fish and Wildlife Service. (2007). *"Effects of Communication Towers on Migratory Birds."* Comments of the U.S. Fish and Wildlife Service submitted electronically to the FCC on 47 CFR Parts 1 and 17, WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking: 32, 12-18.

These comments and recommendations assess a compilation of past and very recent (through 2006) peer-reviewed studies conducted most recently in Michigan and New York on the impacts of various lighting regimes (i.e., steady-burning red [L-810] and white lights, white strobe lights [L-865], red strobe lights [L-864 red strobes], and red blinking incandescent lights [L-864 flashing beacons]) on night-migrating avifauna. Where steady-burning L-810 lights were completely extinguished in the Michigan study (Gehring et al. 2007), avian collision injury and mortality with the communication towers were reduced by 71%. USFWS also provisionally recommended use of red strobe and/or red blinking lighting regimes as a secondary option if white strobes cannot be used. This recommendation is predicated on the use of no steady-burning lights. The results from these communication tower studies are also applicable to lighting regimes on wind turbine facilities. Recommendations to the Federal Communications Commission based on peer-review of the Michigan research protocol (2 independent reviewers), and independent peer review of the preliminary research results; peer review of the New York study to be published in North American Birds independently peer-reviewed by anonymous professionals.

Visual Blades

21. Hodos, W. (2003). *Minimization of Motion Smear: Reducing Avian Collisions with Wind Turbines*. Prepared for the National Renewable Energy Laboratory**:** 1-43.

This study evaluated the pattern electroretinogram (PERG) visibility of 7 blade velocities from 36-144 rpm. To reduce motion smear, eight blade patterns, a serious of blade tip devices, and various chromatic and achromatic single blade types were devised and tested. Thin, staggered black stripes were found to have a visibility approximately 4x greater than blank blades at 130 degrees of visual angle per second (dva/sec). At 170 dva/s, all the patterns had about the same visibility. By 240 dva/s, all the patterns essentially had no visibility as individual blades appeared blurry or transparent. No data suggest the optimum ratio of black to white stripe thickness. Tests using a 20-m diameter turbine rotating at 45 rpm against a neutral background found that blank blades, thin-stripe blades, and thick-stripe blades would all be visible at a distance of 21 m; thin-striped blades were the most visible. By 19 m, the anti-motion-smear patterns lost advantage over blank blades; by 17 m, visibility for all three blade types was close to zero. A combination of blade diameter, rotation rate, and viewing distance resulting in velocities of the retinal-image of the blade tip exceeding 130 dva/s will result in motion smear. No data illustrate how these stimuli retain their improved visibility under suboptimal viewing conditions (e.g., mist, rain). A single, solid-black blade or a thin-striped blade paired with two blank blades would probably be the most visible visual deterrent. Colored blades are not recommended because of cost and possible problems with background contrast. Data showed that two-tip devices were superior to blades with no devices, but single and three-tip devices were found to be ineffective. However, two-tip devices became less visible against naturalistic backgrounds, thereby making the results rather ambiguous. The size of tip devices was arbitrary. This study has not been field-tested; results are based on lab data to date. **Report; review process used**.

22. Young, D. P., W. P. Erickson, et al. (2003). *Comparison of Avian Responses to UV-Light-Reflective Paint on Wind Turbines*. Prepared for the National Renewable Energy Laboratory: 1-67.

This study examined the effects on bird use and mortality of painting wind turbine blades with UV-reflective gel at Foote Creek Rim Wind Plant in Carbon County, Wyoming. Data were collected from six permanent stations within the study area (33 conventionally painted turbines and 72 turbines painted with UV-reflective paint) using avian point count surveys and carcass searches. A total of 3,501 bird observations were made between July 1, 1999, and December 31, 2000. Passerine use was similar between the two areas; raptor use was significantly higher in the UV area. Of 84 fatalities found within the search plots, 57 (68%) were found at the UV turbines, 13 (15%) at the non-UV turbines, and 14 (17%) at the 7 meteorological (met) towers. Although other studies (Hurlbert 1984, Morrison et al. 2001) found significant differences between UV and non-UV turbines, this study found no significant difference between bird mortality, use, or risk between turbine blades painted with a UV-light-reflective paint and those with conventional paint. Although two times more passerine fatalities were found at the UV-painted turbines, statistical inferences are limited because of the low level of avian mortality observed and the lack of a controlled experimental design. Better spatial representation, accomplished by providing a larger sample size of turbines and more observations, would have improved this study. **Report; review process used.**

Microwaves

23. Kreithen, M.L. (1996). "Development of a pulsed microwave warning system to reduce avian collisions with obstacles." *Second International Conference on Raptors*. Urbino, Italy.

In this study, 20 homing pigeons were tested for their ability to detect pulsed microwaves. For 707 trials, 84.3% of the birds responded to pulsed microwaves, and 17.1% responded to control trials. Study results should not be used to make statistical inferences for species of birds other than homing pigeons.[1]

Sound

24. Dooling, R. (2002). *Avian Hearing and the Avoidance of Wind Turbines*. Prepared for the National Renewable Energy Laboratory: 1-17.

This report describes hearing measurement in birds, the effects of noise on hearing, and the relationship between avian hearing and the general noise levels around wind turbines. A review of the literature on the ability of birds to hear in noisy (windy) conditions suggests that birds cannot hear the noise from wind turbine blades as well as humans can (humans can hear blades 2x further away). Because some blades whistle as a result of blade defects, minor modifications to the acoustic signature of a blade might make them more audible to birds (between 1 and 5 kHz) while making no measurable contribution to overall noise. The hypothesis that louder blade noises (to birds) results in fewer fatalities remains untested. **Report; review process used.**

Marking Power Lines

25. Alonso, J.C., J.A. Alonso, and R. Munoz-Pulido. (1994). "Mitigation of bird collisions with transmission lines through groundwire marking." *Biological Conservation* **67**: 129-134.

This study was conducted in southwestern Spain during two winters (1990 and 1991) to evaluate the effectiveness of groundwire marking in reducing bird collisions with transmission lines. The habitat studied included agricultural lands alternating with oak forests, and markers were placed at sites frequently crossed by birds of several species during daily flights between roosting and feeding areas. A significant decrease in collision frequency ($p = 0.029$) was found between spans marked with red PVC spirals (18 birds found) compared with the same spans before marking (45 birds found). Bird mortality at unmarked spans increased (19 to 25 birds), but this change was found to be insignificant ($p = 0.461$). The percentage of birds flying between the cables decreased, and those flying above the cables increased, suggesting that the birds saw the groundwire markers. **Journal; reviewed by three referees (incl. E. Duffey).**

26. Brown, W. M., and R. C. Drewien (1995). "Evaluation of two power line markers to reduce crane and waterfowl collision mortality." *Wildlife Society Bulletin* **23**(2): 217-217.

This study evaluated two power line markers for reducing crane and waterfowl mortality in the San Luis Valley, Colorado, and examined factors contributing to collisions and marker effectiveness. Collision mortality rates at 8 segments (about 0.8 km each) of power lines marked with either yellow spiral vibration dampers or yellow fiberglass swinging plates were compared with 8 adjoining unmarked segments. During 3 spring and 3 fall migration periods (1988-1991), estimated mortality on study segments was 706, affecting 35 species or more. Waterfowl and cranes constituted >80% of mortality. Both marker types reduced mortality ($P < 0.005$). Birds reacted to marked lines at greater distances and increased their altitude compared with unmarked lines ($P < 0.0001$). Factors affecting collisions or marker effectiveness included wind, nocturnal flights and disturbance, and age of sandhill cranes. Neither marker performed better in all study seasons; each may have had unique benefits.

[1] Cited by Sue Orloff in Erickson et al. (2002). *Baseline Avian Use and Behavior at the CARES Wind Plant Site, Klickitat County, Washington*. Prepared for the National Renewable Energy Laboratory: 1-75.

Plates damaged distribution lines, precluding their continued use; however, a new marker from Europe that incorporates the benefits of both plates and dampers should be evaluated, because it may protect best against collision losses.[2] **Journal; no mention of review.**

27. Janss, G. F. E., and M. Ferrer (1997). "Rate of bird collision with power lines: effects of conductor-marking and static wire-marking." *Journal of Field Ornithology* **69**(1): 8-17.

This study tested the ability of different markers to reduce bird collisions by comparing marked spans with unmarked spans along three different power line types in west-central Spain. The study consisted of two periods over 4 years. The first period (1991-1993) had no markers; the second (1993-1995) had markers in some of the study spans. No statistical differences were detected among the three power lines in collision frequency per survey ($P = 0.86$). The spiral marker was found to significantly reduce collisions for all birds by 81% ($P = 0.0198$). Black crossed bands were also found to be effective, resulting in a decrease in collisions of 76% for all birds. However, when the vulnerable great bustard is included in the analysis, markers were found to have no effect ($P = 0.080$). The third marker, consisting of thin black strips, showed no significant reduction in mortality ($P = 0.052$). Overall reduction in mortality for both the spiral and the crossed bands was more than 75% (excluding the great bustard), deemed an encouraging result compared with other studies where reductions in mortality are about 50%. **Journal; no mention of review.**

28. Morkill, A. E., and S. H. Anderson (1991). "Effectiveness of marking power lines to reduce sandhill crane collisions." *Wildlife Society Bulletin* **19**(4): 1-8.

This study was conducted near the Platte River in portions of Dawson, Buffalo, and Kearney Counties in south-central Nebraska to evaluate the effectiveness of marking power lines to reduce collisions with sandhill cranes. Nine segments of static wires were divided into spans that were either marked or unmarked with yellow aviation balls containing vertical black stripes. Of the 36 carcasses, 25 had died from collisions with unmarked spans. No significant difference between the number of birds flying over marked and unmarked transmission lines was found, but significantly more cranes were killed in collisions with unmarked spans because cranes reacted sooner to marked spans. Although this study was deemed appropriate and strong (see Orloff in Erickson et al. 1999), it is unclear how the segments or spans were selected. **Journal; reviewed by six referees (W. Hubert, E. Williams, F. Lindzey, M. Czaplewski, J. Lewis, C. Faanes)**.

29. Organ, C. A., M. Timewell, et al. (2003). *Bird Surveys along the Proposed Musselroe Wind Farm Transmission Line - Ringarooma Ramsar Area, North-east Tasmania*. Prepared for Hydro-Electric Corporation**:** 1**-**62.

This study is a preassessment for a proposed transmission line easement. Surveys were conducted in areas up to 300 m from the proposed easement and occurred over two seasons, one day during winter and several days in spring 2002. Overall, potential impacts on birds are expected to be low, as the route selected largely avoids areas of high bird activity. Bird flight diverters where transmission lines cross the Ringarooma River and the Marsh Creek Dam are recommended. The study also recommended that the power line be kept high where it crosses the Marsh Creek Dam to minimize the potential for collisions with birds taking off or landing. **No mention of review.**

[2] Cited by Sue Orloff in Erickson et al. (2002). *Baseline Avian Use and Behavior at the CARES Wind Plant Site, Klickitat County, Washington*, Prepared for the National Renewable Energy Laboratory: 1-75.

Perch Guards

30. Nelson, H. K., and R. C. Curry (1995). "Assessing avian interactions with wind plant development and operations." *61st North American Wildlife and Natural Resources Conference*. Washington, D.C.

This study was conducted to assess whether perch guards reduced the number of birds perching on turbines at Altamont Pass, California. Wires or wire screens were installed to prevent perching and nesting on 50 turbines. A 54% reduction in perching was estimated; however, no power analyses were conducted to evaluate sample size and no confidence intervals were calculated.[3] **Unsure of review process.**

Curtail Turbines

31. Huppop, O., J. Dierschke, et al. (2006). "Bird migration studies and potential collision risk with offshore wind turbines." *Ibis* **148**: 90-109.

This study was begun in 2003 to investigate year-round bird migration over the North Sea in Germany to determine avian behavior in regard to wind farms (flight distances, evasive movements, influence of lights, collision risk). Data were collected from a platform holding a 100-m mast located at the proposed construction site. Results show weather severely impacting variations in intensity, time, altitude, and species of migration. Most offshore bird migration was confined to a few nights, when tailwinds were above a certain strength. More than half of the cadavers were collected in two nights; most birds clearly collided with the tower rather than died from starvation. Terrestrial birds, especially passerines, were attracted by illuminated offshore obstacles, especially in poor visibility conditions. Disoriented birds flew around the platform repeatedly, increasing the risk of collision and energy consumption. Inland findings are not believed applicable to offshore ones because birds tend to migrate at lower altitudes over sea than land, particularly night migrants on dark nights, in headwinds, or when there is precipitation. The study suggests that turbines be turned off and rotor blades adjusted during the few nights in which numerous bird strikes are expected (e.g., in adverse weather conditions with high migration intensities). It also recommends that turbines not be placed in dense migratory zones or between resting and foraging grounds, that they be aligned in rows parallel to the main migratory direction, and that do not feature large-scale continuous illumination. This research was conducted before the establishment of an actual wind farm, so it cannot be directly applied to offshore wind farms. Recommendations need to be field-tested. **Journal; three reviewers (R. Langston, K. Huppop, S.A. Gauthreaux, Jr.)**

Habitat

Habitat Alterations

32. Grindal, S.D., and R.M. Brigham. (1998). "Short-term effects of small-scale habitat disturbance on activity by insectivorous bats." *Journal of Wildlife Management* **62**(3): 996-1003.

This study examined the effect of small-scale disturbances (creation of small cutblocks) and an access road in a forest setting on bats' habitat use. This before-after control impact (BACI) study occurred in a low-elevation forest in the southern interior of British Columbia, Canada, in 1993 and 1994. Forest harvesting was found to have a significant effect on bat activity but not on insect availability. Bat activity increased in cutblocks after harvesting

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[3] Cited by Sue Orloff in Erickson et al. (2002). *Baseline Avian Use and Behavior at the CARES Wind Plant Site, Klickitat County, Washington*. Prepared for the National Renewable Energy Laboratory: 1-75.

(activity tended to decrease with increasing cutblock size, although not significantly). Bat activity was increased after road construction. However, data were pooled for different cutblock sizes because of the small sample size (no N located in this study). Small-scale habitat disturbance may provide commuting and foraging areas for bats, but larger scale disturbances on bat ecology are still unclear. **Journal; reviewed by three referees (C.I. Stephan, P. Bradshaw, M.A. Setterington).**

33. Herzog, F., S. Dreier, et al. (2005). "Effect of ecological compensations areas on floristic and breeding bird diversity in Swiss agricultural landscapes." *Agriculture, Ecosystems and Environment* **108**: 189-204.

Vegetative and avian surveys were conducted in 56 study regions between 1998 and 2001 to assess whether ecological compensation areas (ECAs) in Switzerland enhance biodiversity, as stated in policy goals. ECAs make up approximately 13% of the utilized Swiss agricultural area (UAA). ECA grasslands occurred more frequently up to 50 m from the forest edge; they were much more often located in steeper areas. There were very few Red List plant species found within ECAs, suggesting that the ECA program is hardly contributing to the preservation of endangered species, as the policy states. The quality of vegetation of 51%-87% of the ECA meadows did not correspond to traditional hay meadows, and they generally did not enhance populations of meadow birds. Most ECA litter meadows achieved target vegetation compositions; breeding birds used them more frequently than they did other ECA types. Approximately 50% of the hedgerows in the ECA program had good ecological quality and were advantageous for birds, and traditional orchards reflected prior intensive utilization with little contribution to floral diversity. The study recommended that meadow programs be eliminated, litter meadow and hedgerow programs be expanded, and extension activities be concentrated on traditional orchards. Results are limited to the Swiss plateau and cannot be extrapolated to the whole of Switzerland. **Journal; reviewed by seven referees (S. Aviron, S. Birrer, P. Jeanneret, L. Kohli, D. Bailey, M. Kuusaari, G. Le Lay).**

34. Larsen, J.K., and J. Madsen. (2000). "Effects of wind turbines and other physical elements on field utilization by pink-footed geese (*Anser brachyrhynchus*): A landscape perspective." *Landscape Ecology* **15**: 755-764.

This study was carried out in spring 1998 to examine the effects of wind turbines and other physical landscape elements on field utilization by wintering pink-footed geese in farmlands in Denmark. Habitat loss per turbine was found to be higher in wind farms with turbines arranged in a large cluster than for those with turbines in small clusters or lines, with avoidance distances at 200 m and 100 m, respectively. This is believed to result from placing wind farms in small clusters or linear layouts generally close to roads or other 'avoidance zones,' whereas large clusters were placed in open farmland areas. The study notes, however, that the configuration with the fewest impacts in a given situation may be the result of factors other than habitat loss. A significant difference was determined between field utilization and the location of avoidance zones; geese were unlikely to use fields in which avoidance zones covered the centers (2 of 11 used) and more likely to use fields in which zones did not cover the centers (13 of 15 used). The synergistic avoidance effects of reducing field use was not taken into account and needs to be researched in the future. Overall, this study indicated that wind farm disturbance is relatively minor (<200 m) in relation to foraging pink-footed geese. **Journal; reviewed by numerous referees (incl. T. Fox).**

35. Leddy, K. L., K. F. Higgins, et al. (1999). "Effects of wind turbines on upland nesting birds in Conservation Reserve Program grasslands." *Wilson Bulletin* **111**(1): 100-104.

Conservation Reserve Program grasslands without turbines and areas located 180 m from turbines supported grassland birds at mean densities that were 4x higher than those found in grasslands closer to turbines. Although wind turbines may not cause mortality directly, the presence of turbines may affect local grassland bird populations indirectly by decreasing the area of grassland habitat available to area-sensitive breeding birds. In addition to human disturbance and noise, the physical movements of the turbines when they are operating may have disturbed nesting birds. Maintenance trails between turbines that are driven daily may have further decreased the availability of grassland habitat adjacent to turbines. The study recommended that wind turbines be placed within cropland habitats that support lower densities of grassland passerines than those found in CRP grasslands. The study was conducted for one only breeding season (May-July 1995), and data indicate a larger number of birds identified in the turbine area than in the nonturbine area (379 vs. 150, respectively). Species composition, however, varied between the two sites. **Journal; reviewed by numerous referees (incl. L.D. Flake, D.H. Johnson).**

Artificial Nests

36. Belthoff, J.R., and R.A. King. (2002). "Nest-site characteristics of burrowing owls (*Athene cunicularia*) in the Snake River Birds of Prey National Conservation Area, Idaho, and applications to artificial burrow installation." *Western North American Naturalist* **62**(1): 112-119.

This study observed 32 burrowing owl nests and 31 unused burrows to (1) measure physical, vegetative, and topographic characteristics of burrowing owl nest sites; (2) determine potentially important features for nest-site selection by burrowing owls; and (3) use this information to help guide future construction and placements of artificial burrows. A significant difference was found between nest and comparison burrows in relation to tunnel angle—a 17% reduction in odds of use with each 1-degree increase in the slope of the tunnel angle. This feature and productivity, however, were not found to be significantly related. A weak significant relationship was found between productivity and distance to the perch, and a stronger negative relationship was found between productivity and distance to irrigated agriculture. The most common vegetation surrounding burrowing owl nests included cheatgrass, tumble mustard, and annual wheatgrass; there was no significant difference in cover classes between nest and comparison burrows. Results suggest placing nest burrows near agriculture and open areas, in low shrub cover and short vegetation; however, there are concerns about the effects of pesticides and intensive agriculture on birds. The study also suggested that tunnel entrance angles be limited to gradual slopes (average of 27 degrees), although this suggestion has not been field-tested. **Journal; reviewed by five referees (L. Bond, A. Dufty, J. Munger, B. Smith, N. Woffinden).**

37. Smith, G.C., and G. Agnew. (2002). "The value of 'bat boxes' for attracting hollow-dependent fauna to farm forestry plantations in southeast Queensland." *Ecological Management & Restoration* **3**(1): 37-46.

This study was conducted to assess vertebrates' use of artificial nest or roost boxes, and their contribution toward enhancing biodiversity in plantation forests through the provision of habitat. Two sites were located in a relatively 'intact' forest landscape and two in a more 'fragmented' landscape, and each site was checked 5-9 times from April 1996 to November 2000. Fewer animals were recorded in boxes at the intact sites; the highest numbers of animals were recorded in boxes in forest plantations with variegated landscapes (five native mammal species). No vertebrates were found in boxes at the State Forest (the most intact) site. The maximum occupancy rate recorded was 40%. Data suggested no preference toward box aspect. No significant relationships were determined; the sample size was 50. Additionally, there are approximately 21 species of potentially hollow-roosting microbats in the area, but only 1 species was found to occupy the boxes (max. 25% at one site). **Journal; no mention of review process.**

38. Smith, M.D., C.J. Conway, et al. (2005). “Burrowing owl nesting productivity: a comparison between artificial and natural burrows on and off golf courses.” *Wildlife Society Bulletin* **33**(2): 454-462.

This study was conducted on 8 golf courses in south-central Washington to examine whether burrowing owls would locate and occupy artificial burrows placed on golf courses, and if so, which course features influenced the probability that owls used an artificial burrow. The study also examined whether occupied artificial burrows were as successful as other types (natural on golf course, natural off-course, artificial off-course). About 175 natural burrows off golf courses, 14 natural burrows on courses, 86 artificial burrows off golf courses, and 130 artificial burrows on courses were monitored from February 1-August 21 during 2001 to 2004. Burrowing owls used a smaller proportion of artificial nests on golf courses (7% average) than off golf courses (18% average); golf course usage occurred primarily in nonmaintained areas (12.5% of burrows established were used) and only 1 burrow was used in maintained areas. Owls were additionally found to occupy 35% of the 23 burrows installed within 200 m of natural nest burrows. Analysis suggests that proximity to rough, fairway, sprinkler, and maintained areas (areas receiving turf maintenance) influenced the use of artificial burrows, as does proximity to natural burrows. Management suggestions include that burrowing owls preexist for artificial burrows to be successful, as well as the importance of maintaining burrows outside the owl's breeding season. No significant relationships were detected in the analysis; however, the information may prove useful in mitigation at wind turbine sites with burrowing owls in terms of maintenance requirements for burrows and sites. **Journal; reviewed by three referees (incl. D. Cristol, A. Rodewald).**

39. Trulio, L.A. (1995). “Passive relocation: A method to preserve burrowing owls on disturbed sites.” *Journal of Field Ornithology* **66**(1): 99-106.

This study examined the belief that passive relocation is more likely to occur if artificial nest boxes are placed within 100 m of destroyed burrows, based on the observation that burrowing owls spend most daylight hours 50-100 m from their nests. Passive relocations using artificial burrows were conducted on six sites in northern California between 1988 and 1993. Burrowing owls moved into the artificial burrows in less than 1 month in all sites where boxes were placed within 75 m of the destroyed burrow; however, birds were not banded at 4 of the 5 sites, so it is unclear as to whether birds living in the boxes were the same ones that were evicted. The only site where birds did not occupy the artificial nest was the one in which the box was placed 165 m from the destroyed burrows. Passive relocation is believed to be a better alternative than active relocation of the owls, because birds generally disappear from a new, unfamiliar site within a season (Schulz 1993), and predation may increase for owls moved long distances in contrast to those living in familiar surroundings (Dyer 1987). While passive relocation is deemed a successful way to relocate birds, the study notes that it is not an adequate mitigation strategy if sufficient adjoining foraging habitat is not preserved. The sample size is unclear; Table 1 provides the number of birds evicted, but this doesn't match the number of artificial burrows or the occupation of burrows. Also, distances to new burrows tested was not consistent (75 m compared with 165 m; a question remains as to distances between those two). **Journal; reviewed by five referees (J. Barclay, P. Delevoryas, T. Schulz, L. Feeney, K. Bildstein).**

Relocation

40. Matthews, K.R. (2003). “Response of mountain yellow-legged frogs, *Rana muscosa*, to short distance translocation.” *Journal of Herpetology* **37**(3): 621-626.

The purpose of this study was to determine the response of *R. muscosa* (a species being considered for federal listing) to short-distance (144-630 m) translocations in the upper Dusy Basin, Kings Canyon National Park, California. Twenty frogs were captured and outfitted with radio transmitters and passive integrated transponder (PIT) tags, and body masses were collected. The frogs were then moved distances ranging from 144-630 m from one water body to another. Patterns of movement for the translocated frogs were monitored from August 5-September 4, 1999 (the period is short because the transmitters work for only 30 days). Eighteen of the frogs were relocated at the end of the study, the radio transmitters were removed and body mass collected (the other 2 were found in summer 2000). Of the 20 translocated frogs, 7 returned to their original capture site, 4 moved in the direction of their capture site but had not returned by the end of the study, and 9 did not return and were found at the translocation site. All frog relocations were found closer to the capture site than to the release site. Translocated frogs exhibited a loss in body mass when weighed at the beginning and end of the study (n = 18, mean loss = –1.2 g). A control study that outfitted 14 frogs with radio transmitters but did not translocate them found the frogs exhibited a mean gain in body mass of 2.5 g (n=18). This study illustrates that translocation may not be an effective tool for some species because of increased stress levels and site fidelity. Further research is suggested to determine the effectiveness of relocating eggs or tadpoles. **Journal; no mention of review process**.

41. Roby, D., K. Collins, et al. (2002). "Effects of colony relocation on diet and productivity of Caspian terns." *Journal of Wildlife Management* **66**(3): 662-673.

This study investigated the efficacy of management agencies to reduce the impact of Caspian tern predation on the survival of juvenile salmonids in the Columbia River estuary by relocating approximately 9,000 pairs of terns from Rice Island to East Sand Island, 26k m away. Efforts to attract terns to nest on East Sand Island included the creation of nesting habitat, use of social attraction techniques (decoys and audio playback systems), and predator control (gulls), with concurrent efforts to discourage nesting on Rice Island (fencing, streamers, undesirable vegetation). All nesting Caspian terns shifted from Rice Island to East Sand Island during the 3-year period 1999-2001. Nesting success overall was found to be higher at East Sand Island than at Rice Island; 1.4 young were raised per breeding pair at East Sand Island after gull control attempts had terminated in 2001 (the highest Rice Island productivity was from 1998-2000—0.55 young per pair). Considerable information is provided concerning dietary alterations, but this does not appear to be relevant to current research. **Journal; reviewed by two referees (D. Duffy, C. Thompson).**

Cave Gating

42. Martin, K.W., D.M. Leslie, Jr., et al. (2003). "Internal cave gating for protection of colonies of the endangered gray bat (*Myotis grisescens*)." *Acta Chiropterologica* **5**(1): 1-8.

This study examined the effects of constructing gates inside cave passages on resident populations of the endangered gray bat in eastern Oklahoma, specifically (1) population trends before and after cave passages were gated and (2) initiation of emergence from protected and nonprotected caves. Six gated caves were examined to determine population trends before and after gating, and three gated and three nongated caves were examined to determine cave emergence. The total numbers of gray bats in all six caves was 60,130 in 1981 and 71,640 in 2001 (after gating); two caves harbored more bats after gating and three caves exhibited no change in population (cave 1 is not included because there was no pregate data to compare results with). Internal cave gate effects on bat flight were examined from mid-June to mid-July in 1999 and 2000. Cave gating was not found to impede or delay exit flights of colonies ($\leq$ 25,000) of gray bats. Additional research is suggested to determine the applicability of these findings to other species of bats, as well as to determine the effect of internal gates on larger colonies of gray bats. While these findings are positive, there was no mention of statistical significance. **Journal; reviewed by three referees (D.M. Engle, E.C. Hellgren, J.H. Shaw)**

Livestock Fencing/Grazing

43. Dobkin, D.S., A.C. Rich, et al. (1998). "Habitat and avifaunal recovery from livestock grazing in a riparian meadow system of the northwestern Great Basin." *Conservation Biology* **12**(1): 209-221.

This research was conducted to examine vegetation dynamics in riparian meadow systems in the absence of livestock and to relate these dynamics to avian species composition and relative abundance. The study was conducted from 1991-1994 in the Hart Mountain National Antelope Refuge in southeastern Oregon, commencing one year after livestock grazing was entirely eliminated from the refuge. Data were compared between areas that had been fenced off from livestock for many years and areas that had been subjected to regionally typical cattle grazing until the study began. Results indicated that the recovery of vegetation in riparian meadow systems does not follow a simple successional direction. Sedges and forbs were found to constitute significantly greater percentages of cover on exclosure plots than on open plots, while bare ground and litter were found to be significantly more extensive on open plots than on exclosure plots. Grass cover increased and litter and bare ground decreased on all plots during years of increased moisture. Forbs, rush, and cryptogamic cover increased on open plots, but not on enclosed ones. Avian species composition was markedly different on the two plots; wetland and riparian birds dominated exclosure plots, and upland grassland species dominated open plots. While avian species richness and relative abundance were greater on exclosure plots, it is not known how closely the restoration of the avian community composition will track vegetation recovery. Although this study indicates that habitat structure and avian populations change in response to livestock grazing (or lack thereof), it was conducted for only four years and many of its findings were not deemed significant. **Journal; reviewed by one referee (D. Pyke).**

44. Earnst, S.L., J.A. Ballard, et al. (2004). *Riparian Songbird Abundance a Decade after Cattle Removal on Hart Mountain and Sheldon National Wildlife Refuges*. U.S. Department of Agriculture Forest Service Gen. Tech. Rep. PSW-GTR-191: 9 pp.

This study compared songbird abundance in 2000-2001 to that in 1991-1993 on 69 permanent plots to determine the effects of cattle removal. It took place in the high desert riparian habitats of Hart Mountain and Sheldon National Wildlife Refuges located in south-central Oregon and northwestern Nevada, respectively. The plots featured 6 different cover types (meadow, riparian aspen, snow pocket aspen, willow, nonriparian shrub, and mixed deciduous), and each was surveyed three times from May 8-June 24, 2000, and from May 17-June 25, 2001. Survey data from 1991-1993 had been collected 3 times annually from May 7-July 11. Comparisons within this study were limited to passerines, doves, woodpeckers, and shorebirds that either primarily nest or forage in riparian habitat within the Hart-Sheldon landscape. Of 51 species for which detections were sufficient to calculate changes in abundance, 71% (36/51) exhibited a positive trend and 76% (16/21) that exhibited a significant change (either positive or negative) increased. Species associated with aspen and willow habitats exhibited a significant increase in detections/km^2, but species associated with meadows did not exhibit this change. Ground/low cup nesting species were found to increase more than either high cup or cavity nesting species; ground/understory foraging species increased significantly more than overstory or bark foraging species. Only meadow associates, cavity nesters, and bark gleaners did not increase significantly. Of the 26 riparian species of concern within the area, 7 exhibited significant increases on original plots after the removal of cattle (yellow warbler, white-crowned sparrow, dusky flycatcher, warbling vireo, MacGillivray's warbler, orange-crowned warbler, and mourning dove) and 3 exhibited significant declines (Bullock's oriole, ruby-crowned kinglet, and Wilson's warbler). For the 16 significantly increasing species identified in this study, patterns of change on breeding bird survey routes from 1980-1999 suggested that the changes were not merely a reflection of regional patterns. Another year of data collection was mentioned, but there is no evidence that this project continued past 2001. **Report; unknown review process**.

45. Manier, D.J., and N.T. Hobbs. (2006). "Large herbivores influence the composition and diversity of shrub-steppe communities in the Rocky Mountains, USA." *Oecologia* **146**: 641-651.

This study examined changes in plant cover and diversity at 17 sites in western Colorado where livestock and wild ungulate grazing had been excluded for 41-51 years from semi-arid shrub-steppe communities. Differences in species richness and evenness between protected treatments and surrounding grazed communities were small and not significant. Although mean species richness and diversity were similar between treatments, protected areas featured much higher dominance by fewer species, primarily sagebrush. Shrub cover was 2x times greater inside exclosures relative to adjacent areas outside exclosures (significant in protected Great Basin communities and sagebrush steppe sites), with no significant effects of grazing exclusion on cover or frequency of grasses, biotic crusts, or bare ground. Species evenness was positively correlated with richness in protected plots, while evenness and richness were inversely related in grazed plots. The exclusion of grazing appears to cause minor changes in cover and diversity of herbaceous plants, an increase in shrub cover, and an alteration in the relationship between evenness and richness. **Journal; no mention of review process.**

46. Maron, M., and A. Lill. (2005). "The influence of livestock grazing and weed invasion on habitat use by birds in grassy woodland remnants." *Biological Conservation* **124**: 439-450.

This study compared the intraspecific variation in bird foraging behavior and microhabitat selection of seven ground-foraging bird species among three site types of remnant woodland in southeastern Australia: heavily grazed with little to no ground vegetation (9 sites); weedy, ungrazed sites with a ground layer dominated by tall introduced grasses (9 sites); and a relatively intact ground layer dominated by native plant species (5 sites). Data were collected eight times from January 3 to November 6, 2003 (2 per season). Most bird species were present in similar proportions in each site type, but there was evidence of a negative impact of habitat degradation on all but two of the bird species studied. Observations suggest that weed invasion contributes to a reduction in habitat suitability by reducing the availability of foraging substrates, thereby forcing birds to forage in a subset of available microhabitats when foraging on the ground or inducing them to use more energy-costly foraging maneuvers. Cattle grazing decreases weed invasion, but can injure the development of the cryptogamic crust and result in low tree densities. The ideal management regime, therefore, is believed to be a combination of careful grazing to control weeds alternating with periods of no livestock grazing, during which regeneration can occur. Areas within remnants where the ground layer is in good condition (limited weeds and intact cryptogamic crust) could be fenced permanently, while other areas with heavy weed invasions could be managed through grazing or chemicals. **Journal; reviewed by three referees (incl. S. Attwood, R. Major).**

Wetland Creation

47. Balcombe, C.K., J.T. Anderson, et al. (2005). "Wildlife use of mitigation and reference wetlands in West Virginia." *Ecological Engineering* **25**: 85-99.

This study was conducted to evaluate the success of mitigation wetlands in West Virginia in supporting healthy wildlife communities by comparing 11 constructed and partially restored mitigation wetlands (4-21 years old) with four reference wetlands. All reference wetlands were classified as palustrine emergent or palustrine scrub-shrub and mitigation wetlands as palustrine emergent or palustrine unconsolidated bottom wetlands. All reference wetlands were located near mitigation sites within each area, usually within the same watershed. Avian communities were evaluated between May 5 and June 27 in 2001 and 2002. Mitigation wetlands were significantly different from reference sites in vegetation community structure, containing more open water (40.6% vs. 11.6%) and less emergent aquatic vegetation.

Despite differences in vegetation and invertebrate abundance, mean species richness, diversity, and abundance were similar between mitigation and reference wetlands. High avian numbers in mitigation wetlands appear to be the result of wetland size, landscape position, vegetative structure, and diversity and invertebrate community structure. The study notes that a diverse wetland community within mitigation wetlands does not mean that birds are successfully reproducing, and that future studies should correlate changes in vegetation and invertebrate communities to avian community structure and evaluate breeding success. Effects on anuran communities were also evaluated. Authors caution that it is premature to assess the outcome of mitigation efforts in West Virginia because this was only a 2-year study, that created wetlands often take more than a decade before functioning in a manner comparable to reference wetlands (5 sites were over 10), and that the data should not be extrapolated to other states. **Journal; reviewed by four referees (incl. W.J. Mitsch, J.S. Rentch, W.N. Grafton).**

48. Darnell, T.M., and E.H. Smith. (2004). "Avian use of natural and created salt marsh in Texas, USA." *Waterbirds* **27**(3): 355-361.

This study examined the "accuracy" of habitat creation as a means of mitigation by comparing avian use of three man-made sites of various ages with three natural marsh reference sites on the central Texas coast. Geomorphology of created sites differed substantially from the natural sites, affecting habitat development and avian use. In both natural and created sites, unvegetated, irregularly flooded habitat was used more consistently by a larger number of birds than any other habitat type (shorebirds, wading birds, and gulls or terns were associated significantly with unvegetated shallow water and exposed substrate). This zone of habitat, however, was compressed into a narrow band along the elevation gradient in created wetlands; more frequent inundation and decreased salinity occurred as a result of their smaller sizes. Results indicated that each of the created wetlands, especially the oldest one (4 years old vs. 2 years), became overgrown with vegetation in intertidal elevations over time, indicating that a habitat component was being lost. The oldest created wetland, which was the most overgrown, had significantly more perching birds than other sites and was rarely used by shorebirds. Management recommendations include a need for created marshes to provide unvegetated habitats, which may be accomplished through management (e.g., removal) of vegetation or through geomorphic design that attempts to mimic natural conditions producing unvegetated habitats. The length of this study was unclear. **Journal; reviewed by numerous referees**.

49. Federal Highway Administration. (1992). *Evaluation of Wetland Mitigation Measures*, Volume 1: Final Report: 1-353.

This study determined the level of success of 23 highway-related wetland mitigation projects (divided into enhancement, creation, restoration) in terms of goal attainment and replacement of wetland functions. Success or failure determinations were based on both informal goals, expectations of biologists, and model assessments of wetland functions and values. This study was conducted during summer 1989, and projects were located around the country. Of the 23 mitigation projects, only 3 (1 enhancement site and 2 creation sites) appeared fully successful in replacing all functions lost to construction. Mitigation type was not apparently a factor in determining mitigation effectiveness; level of planning effort, inclusion of certain design elements in detailed mitigation plans, and precision with which plans were implemented appeared to be the most important aspects of effectiveness. As to planning, firm mitigation objectives and detailed plans were found to be necessary to ensure that good ideas were communicated clearly to construction crews and that the sequencing of construction was correct. Design elements of primary importance to successful enhancement, creation, or restoration of wetlands included location in relation to surface water systems and other wetlands, slope and elevation, topdressing of some type of topsoil, and configuration of vegetation and open water. In determining whether spreading topsoil was more effective than planting marsh plants to protect soils, this study found that although spreading topsoil is significantly more expensive ($14,600/acre vs. $1,100/acre); it was significantly more successful than plantings due to herbivory, harvesting, and moisture/substrate problems. As to set mitigation ratios, the study found that most were not based on scientific study or monitoring of success rates for functional replacement, but rather were set subjectively on the basis of a few previous examples of mitigation successes or failures. The study notes that, if appropriately located and implemented, certain wetland functions can be replaced through out-of-kind mitigation efforts. It also suggests that postconstruction monitoring occur for at least 3-5 years to determine if specific goals have been met. **Report; unkown review process**.

Wildlife Corridors

50. Aresco, M.J. (2005). "Mitigation measures to reduce highway mortality of turtles and other herpetofauna at a north Florida lake." *Journal of Wildlife Management* **69(2)**: 549-560.

The purpose of this study was to test the effectiveness of a drift fence and culvert system in reducing road mortality and facilitating the migration of turtles and other herpetofauna at Lake Jackson near Tallahassee, Florida. This study was conducted from 2000 to 2003 both during and following a severe 3-year drought (a 97.4 cm rainfall deficit in 1998-2000), and entailed a sampling period of 1,367 days and 5,664 total hours. Migration and death rates were attained before and after fence construction by monitoring a 700-m section of U.S. Highway 27N for live and dead animals and by observing the type and number of tracks along the roadside and culvert. A total of 10,229 reptiles and amphibians of 44 species were found either behind fences or on the highway. Road mortality rates for turtles were found to significantly decrease after the installation of fences (to 0.09 dead on road (DOR)/km/day from 11.9 DOR/km/day); less than 1% of turtles accessed the highway by climbing or penetrating the fences. Because all aquatic, semiaquatic, and terrestrial species are able to scale the temporary fences, only 74% of upland and semiaquatic species and 25% of aquatic species (excluding turtles) were prevented from reaching the highway. This study found vinyl erosion control fencing in combination with existing culverts to be an effective method of reducing road mortality. However, it states that attaining these results required frequent fence maintenance and daily monitoring to remove turtles from behind fences. A more effective long-term solution might be a permanent barrier with a smooth, vertical surface and an over-hanging, inward facing lip. Another potential issue of fencing is predation; 92/95 turtles were found dead behind fences as a result of mammalian predation after nightfall. **Journal; reviewed by six referees (incl. K. Dodd, F. James, M. Gunzburge, J. Travis, E. Walters).**

51. Cain, A.T., V.R. Tuovila, et al. (2003). "Effects of highway and mitigation projects on bobcats in southern Texas." *Biological Conservation* **114**: 189-197.

This study identified habitats selected by bobcats, assessed landscape characteristics correlated with vehicle-caused mortalities, evaluated bobcats' use of three types of highway crossing structures (bridges, modified culverts, and unmodified culverts), determined characteristics correlated with bobcats' use of these structures, and tested the utility of 100-m wing fences to increase bobcats' use of crossing structures. The study was conducted from July 9, 1997, to May 31, 1999, using radio collars to track 16 bobcats. Monthly crossing usage varied among structure types; bridges and modified culverts were used more often than unmodified culverts. Openness and cover were positively correlated with felid crossing use. Bobcats were photographed using the crossings at all times during diel periods; however, 41 of 54 complete crossings occurred in darkness. High-use crossing structure types were near dense thornscrub or drainages; regression analysis indicated cover was an important variable explaining bobcat crossing usage. Regression analysis also indicated that openness was significant in crossing usage, but the exact size of optimal culvert openings is not known. Erecting a fence to funnel wildlife toward culvert openings was found to have no significant effect on felid use of crossing structures; however, when culverts were little used were removed from the analysis, there was an indication that fences may increase bobcat use. During this study, 25 bobcats were hit while crossing the highway; mortality was more frequent on sections of the highway with large amounts of thornscrub (the preferred habitat type). Observations also indicate that catwalks may be important where standing water is likely to persist, and culverts that open into the median may reduce the tunnel effect and encourage usage. **Journal; reviewed by four referees (S.E. Henke, F. Hernandez, M.J. Chamberlain, T.J. Mallow).**

52. Dixon, J.D., M.K. Oli, et al. (2006). "Effectiveness of a regional corridor in connecting two Florida black bear populations." *Conservation Biology* **20**(1): 155-162.

This study evaluated the effectiveness of the Osceola-Ocala corridor for the Florida black bear using genetic material (hair and tissue samples) and geographic information system (GIS) maps to characterize the dispersal of bears from the source populations. Data were collected from 1998-2003 within the Osceola-Ocala corridor, a patchwork of public and private lands within a matrix of roads and development. Bears were present in multiple locations in the corridor, indicating that some individuals may be corridor residents. Most bears sampled in the corridor were assigned to Ocala (28 of 31), indicating a predominantly unidirectional pattern of movement from Ocala into the corridor. The ratio of bears sampled in the corridor was 3 females to 31 males, suggesting that the corridor is used primarily for gender-based dispersal. All bears sampled in Ocala (N = 40) were of the same origin, while 5 of 41 bears in Osceola were genetically related to the Ocala population. The results indicate that the corridor is functional and provides genetic and demographic connectivity; however, increasing pressure for development may affect the functional connectivity of these populations if the corridor habitat is not protected. There is some question as to whether the genetic restructuring within the Osceola population is due to corridor migration or the relocation of nuisance bears from Ocala into Osceola (6 of 7 fates are known; 1 is unclear). **Journal; reviewed by one referee (M. Sunquist).**

53. Ng, S.J., J.W. Dole, et al. (2004). "Use of highway undercrossings by wildlife in southern California." *Biological Conservation* **115**: 499-507.

This study sought quantitative data on the extent to which passages beneath highways (underpasses, livestock tunnels, and drainage culverts) in a fragmented landscape are used by wildlife and assessed characteristics of the passages most often frequented by species of concern. Fifteen potential wildlife passages were monitored, and each was observed for four consecutive days each month from July 1, 1999, to June 30, 2000. During the year of study, 2,723 detections were recorded as tracks and photos, of which 531 were native medium to large mammals, 1,640 were humans, 155 were domestic animals, and 397 were small mammals. Length was found to have a significant negative correlation with cross-sectional area. Coyote use showed a significant positive correlation with human activity and a significant negative correlation with development. Bobcat use showed a significant positive correlation between passage use and percentage of natural habitat; all three carnivores—bobcat, mountain lion, and coyote—showed a positive but not significant relationship between passage use and extent of natural habitat. Raccoon use correlated negatively with the extent of natural habitat and positively with the extent of developed habitat and passage length. No statistically significant relationships were found between passage attributes and activity of opossums or either of two skunk species, but passage length and use were positively correlated. Passage dimensions were found to significantly influence deer passage; mule deers' use of passages correlated negatively with passage length and positively with cross-sectional area. No significant relationships were found between the use of passages by mule deer and habitat type; however, all sites used by deer were characterized by significant amounts of nearby natural habitat. Domestic animals' use correlated negatively with passage length and positively with both cross-sectional area and the amount of human activity. This study offers some useful information pertaining to mammalian use of passageways under highways, but significant correlations were confusing and wind turbines are not likely to be close to highways. **Journal; reviewed by three referees (incl. M. Schwartz).**

Baseline Data

54. Erickson, W. P., G. D. Johnson, et al. (2002). *Synthesis and Comparison of Baseline Avian and Bat Use, Raptor Nesting and Mortality Information from Proposed and Existing Wind Developments*. Prepared for Bonneville Power Administration**:** 1-129.

To assist stakeholders in evaluating new projects, this report evaluates the ability to predict direct impacts on avian resources (primarily raptors and waterfowl and waterbirds) using less than a year of baseline avian use data. Data were collected for more than 30 study areas from 15 WRAs, including Foote Creek Rim (Wyo.), Stateline (Ore./Wash. State), Klondike (Ore.), and Buffalo Mountain (Tenn.). The amount and extent of baseline data should be determined on a case-by-case basis using information from this report; recent projects; existing project site data from agencies, groups, and individuals; public scoping; and results of vegetation and habitat mapping. Other factors that should be considered include the likelihood of sensitive species and expected impacts to those species, project size, and project layout. Baseline data on raptors collected during one season (spring, summer, or fall) appear to be adequate for making overall wind plant direct impact predictions (e.g., low, moderate, or high relative mortality), especially in agricultural settings. In areas where baseline data indicates a site has high levels of raptor use, the study recommends that data be collected for more than one season to refine predictions and micrositing decisions. Correlations are very low between fatalities and overall raptor nest density, but data on nests very close to turbines (within one-half mile) are currently inadequate to determine the level of impact. Wind plants with year-round waterfowl use have shown the highest waterfowl mortality; native landscape sites show very little waterfowl use except where significant water sources are available. Resident and migrant passerines constituted a large proportion of the fatalities at wind plants, but nocturnal migrant mortality appears very low compared with utilization rates. Bat collision mortality is virtually nonexistent during the breeding season; most mortalities involve migrant or dispersing bats in late summer and fall. Conclusions are based solely on a literature review; recommendations need to be field-tested. **Report; reviewed by nine referees (D. Malin, K. Kronner, A. Linehan, T. Meehan, G. McEwen, D. Mudd, J. Bernowitz, L. Sharp, Two Ravens Inc).**

55. Percival, S.M. (2003). *Birds and Wind Farms in Ireland: A Review of Potential Issues and Impact Assessment:* 1-25.

This document reviews current knowledge on the effects of wind farms on birds and provides a methodology for assessing those effects. In assessing wind turbine placement, it is not possible to have a fixed baseline survey requirement, so a phased approach (the level of detail required depends on the avian sensitivity of the site) is more useful. Phase 1 should include a collation of all existing information on the proposed site, as well as a bird survey of an area 500 m around the proposed site (or 300 m for breeding birds in less sensitive habitats such as farmland). These areas are based on the results of studies looking at the disturbance effects of wind farms on bird distribution (see Table 2). Phase 2 is completed if important bird species and populations may be affected (defined as those listed in Annex 1 of the European Union's Birds Directive, BirdWatch Ireland's red list, rare or vulnerable migratory species, or species occurring in regionally or nationally important numbers); this phase requires a more detailed assessment of the importance of the site to these species within an area of at least 1 km. An evaluation of potential collision risk and direct or indirect disturbance should also be conducted during this phase. Phase 3 is required where a significant potentially adverse effect (e.g., direct habitat loss, collision risk, or behavioral disturbance) is predicted, and includes a population analysis and options for reducing the risk. To determine the significance of a potential impact, a matrix combining impact magnitude and species sensitivity was established. To account for the inevitable degree of uncertainty in the predictions of wind farm impacts on birds, enhancement measures should be enacted that provide a benefit over and above the predicted adverse effect. This study also provides some useful tables listing bird mortality and habitat disturbance studies throughout Europe. **Report; no review process noted**.

56. Young, D.P., Jr., W. P. Erickson, et al. (2003). *Avian and Bat Mortality Associated with the Initial Phase of the Foote Creek Rim Windpower Project, Carbon County, Wyoming.* Prepared for Pacificorp, Inc., Bureau of Land Management and SeaWest Windpower, Inc.: 1-50.

This report presents results of more than 3 years of carcass search studies for Foote Creek Rim I, consisting of 69 towers and associated met towers. The large majority of wind-plant-related casualties (92%, N = 122) were passerines; slightly more than half of these, based on species and date found, were probably nocturnal migrants. The number of raptor casualties was very low during the study period despite high raptor use estimates for the site and a rotor swept area 5x larger than the average rotor swept area of turbines at Altamont. Although some studies have suggested that birds may be more at risk of collisions with wind turbines during inclement weather, this study found no strong correlations between avian or bat casualties and weather. Correlating fatalities to weather was difficult because the time of death was not known. More frequent casualty searches would be required to better determine time of death; however, in environments with low scavenging and high searcher efficiency, daily or weekly searches would not be necessary to estimate mortality accurately. **Report; no mention of review.**

Postconstruction Data

57. Arnett, E. B., W. P. Erickson, et al. (2005). *Relationships between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines*. Prepared for the Bats and Wind Energy Cooperative: 1-187.

This study investigated the relationships between bats and wind turbines at the Mountaineer Wind Energy Center in Tucker County, West Virginia, and the Meyerdale Wind Energy Center in Somerset County, Pennsylvania. Primary objectives were to compare results of daily versus weekly carcass searches, quantify bias corrections needed to more accurately estimate fatality, and recommend improved search protocols for bats. Bat fatalities were also correlated to previous nights' weather and turbine conditions, and their behavior was quantified when encountering moving and nonmoving blades at turbines with and without Federal Aviation Administration (FAA) approved lights. Estimates at the two locations were among the highest ever reported, supporting the contention that forested ridges pose especially high fatality risks to bats at wind facilities. Weekly searches at Mountaineer produced mortality estimates 3x lower than daily estimates because of high scavenging rates and the periodicity of fatalities. Weekly searches at Meyerdale, however, yielded similar but slightly higher (1.2x) results compared with daily searches because of low scavenging rates. A better design might be to search a portion of turbines each day for 4 days, rather than all turbines on 1 day. Considerably more adult male bat carcasses were found than those of adult females or juveniles of either sex. This may result from differential distribution among males and females within landscapes, especially during summer. Fatalities were distributed across all turbines at both sites, although higher than average numbers of bats were found at turbines near the end or center of a string (but no significant correlation supported a relationship). The only turbine with no fatalities was in a feathered (blades parallel to wind), "free-wheeling" (blades allowed to move freely) mode in which the blade essentially did not move unless winds were quite high (>15 m/s); this suggests that bats are not running into stationary blades or turbine masts. Lighting or ultrasounds do not appear to be significant attractions; however, other sources of ultrasonic emissions from turbines should be investigated further. The timing of all bat fatalities was highly correlated, suggesting broader landscape patterns dictated by weather and availability of prey. Thermal images indicated that bats are attracted to and investigate both moving and nonmoving blades; most bat activity occurs in the first 2 hours after sunset. The majority were killed on low-wind nights when power production appeared insubstantial but turbine blades were still moving, often at or close to full operational speed (17 rpm). Fatalities increased just before and after the passage of storm fronts. Turbines within forest openings and near edges may be misconstrued by bats as favorable roosting sites, as shown in observations of bats landing on turbine masts and stationary turbine blades. Modifications to wind farm landscapes (e.g., open spaces around turbines and access roads) may create favorable foraging habitats for both local and migratory bats. **Report; reviewed by numerous referees (incl. E. Gates, M. Huso, P. Jodice).**

No Effect

58. Lucas, M. D., G. F. E. Janss, et al. (2005). "Bird and small mammal BACI and IG design studies in a wind farm in Malpica (Spain)." *Biodiversity and Conservation* **14**: 3289-3303.

This study was carried out in northwestern Spain for 3 years during various periods of wind farm construction: preconstruction (June 1995), construction (June 1996), and postconstruction (June 1997). The turbines are in a mixed coastal shrub steppe and maritime woods habitat. The study analyzed (1) the possible impacts of the wind farm on nesting and nonnesting bird communities, (2) flight behaviors of both nesting and nonnesting birds affected by the presence of the wind farm, (3) possible impacts of wind farms on rodents. Wind farms were not found to clearly affect bird and small mammal populations, as there was no significant difference in avian abundance or density between study years or areas (wind farm vs. reference). Significant differences were detected in flight heights between study areas; soaring birds were observed to detect the turbines and change flight directions. Small mammals did not appear to be affected by the wind farm at all. Mortality studies were not conducted because the postconstruction period of study was only a few months. **International journal; not sure of review process.**

Offshore

59. Pettersson, J. (2005). *The Impact of Offshore Wind Farms on Bird Life in Southern Kalmar Sound, Sweden.* Prepared at the request of the Swedish Energy Agency**:** 1**-**128.

This study was conducted over four spring and four autumn seasons from 1999 to 2003 in the Kulmar Sound in Sweden. Migration patterns of waterfowl and flock reactions to wind turbines (7 in all) were studied and documented. Researchers found that spring migratory paths have shifted up to 2 km eastward, and that during both spring and fall migration, flocks avoid flying closer than 1 km to turbines. The proportion of flocks that made a change in flight path was about 30% in good visibility in spring and 15% in fall. Radar monitoring showed waterfowl migration in fog and mist to be limited, and indicated that nocturnal migrants reacted similarly to the turbines as daytime migrants did. Visits to turbines by wind farm service boat were found to disturb the long-tailed duck and common scooter, so that they abandoned their feeding areas in the vicinity of the turbines in the daytime. This study site included only 7 turbines, and only 1 death was recorded (Eider). **Report; reference group indicated.**

Literature Reviews

60. Drewitt, A.L., and R.H.W. Langston. (2006). "Assessing the impacts of wind farms on birds." *Ibis* 148: 29-42.

61. Erickson, W. P., G. D. Johnson, et al. (2001). *Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States*. National Wind Coordinating Committee**:** 1-67.

> This paper provides a detailed summary of mortality data collected at wind plants and puts avian collision mortality associated with wind power development into perspective in regard to other significant sources of avian collision mortality across the United States. A summary is provided of data collected at many U.S. wind plants and annual bird fatality estimates and projections for all U.S. wind turbines.

62. Gerson, J., and D. Klute. (2006, January). *Wind Power and Wildlife in Colorado: An Informational Resource Guide*. Prepared for the Colorado Division of Wildlife.

63. Herbert, E., E. Reese, and R. Anderson. (1995, October). *Avian Collision and Electrocution: An Annotated Bibliography.* Prepared by the California Energy Commission: 1-114.

64. Johnson, G.D. & E. Arnett. (2004, July 16). *A Bibliography of Bat Interactions with Wind Turbines.*

65. Kerlinger, P. (2000). *Avian Mortality at Communication Towers: A Review of Recent Literature, Research, and Methodology*. Prepared for the U.S. Fish and Wildlife Service Office of Migratory Bird Management.

66. Mabey, S. (2006, November). *Impact of Wind Energy and Related Human Activities on Grassland and Shrub Steppe Birds*. Prepared for the National Wind Coordinating Committee by the Ornithological Council: 1-128.

67. Manville, A. M. (2005). *Bird Strikes and Electrocutions at Power Lines, Communication Towers, and Wind Turbines: State of the Art and State of the Science—Next Steps Toward Mitigation*. U.S. Department of Agriculture Forest Service**:** 1051-1064.

68. Rowland, M.M., M.J. Wisdom, et al. (2005). "Effects of roads on elk: Implications for management in forested ecosystems." In M.J. Wisdom (technical editor), *The Starkey Project: A Synthesis of Long-term Studies of Elk and Mule Deer*. Reprinted from the 2004 *Transactions of the North American Wildlife and Natural Resources Conference*, Alliance Communications Group, Lawrence, Kansas: p.45-52.

> This paper (1) describes current knowledge about the effects of roads on elk, emphasizing results of research conducted at Starkey; (2) describes an example in which a distance-band approach, rather than the traditional road density method, was used to evaluate habitat effectiveness (HE) for elk in relation to roads; and (3) discusses the broader implications of road-related policies and land management with regard to elk. Illustrated direct impacts of increased road density on elk include avoidance of areas near open roads (response varies with traffic rates, extent of forest canopy, topography, type of road, gender, and temporal and spatial scales); increased vulnerability to mortality from hunting; and increased stress and movement rates. The study suggests that road closures may have the following benefits: decreased energy expenditures and improved diet quality for elk, increased total amount of effective habitat, increased hunting opportunities on public lands, decreased damage to crop and haystacks by elk on private lands, and decreased vulnerability of elk during hunting

seasons. However, road closures alone may not be effective in eliminating the effects of roads and traffic on elk because of inadequate enforcement. Careful assessment of how roads are being used, rather than their official status, is suggested as necessary to credibly evaluate effects of roads on elk and other wildlife. Additional research is suggested to enhance our understanding of the effectiveness of road closures, as well as on the precise levels of disturbance from motorized traffic that elicits a response and the duration of that response. Much of what has been learned about elk and roads is from field studies that lacked experimental components; thus, there was no sound basis from which to infer cause-effect relationships. **Report in book; reviewed by three referees (J.G. Kie, G.J. Roloff, B.C. Wales)**.

69. Spellerberg, I.F. (1998). "Ecological effects of roads and traffic: A literature review." *Global Ecology and Biogeographical Letters* **7**(5): 317-333.

70. Trombulak, S.C., and C.A. Frissell. (2000). "Review of ecological effects of roads on terrestrial and aquatic communities." *Conservation Biology* **14**(1): 18-30.

This study involves a literature review of the ecological effects of roads. Road construction has been shown to cause soil compaction, sedimentation, and direct mortality of individual species. Wildlife collisions with vehicles have increased with traffic volume (Rosen and Lowe 1994, Fahrig et al. 1995); however, high-speed and medium-speed roads have both attracted various species of wildlife. Environmental characteristics that are altered by roads include soil density, temperature, soil water content, light, dust, surface-water flow, pattern of runoff, and sedimentation. In addition, the maintenance and use of roads contribute at least 5 different types of chemicals to the environment: heavy metals, salt, organic molecules, ozone, and nutrients. Heavy metal contamination has been shown to increase with vehicular traffic (Leharne et al. 1992, Dale and Freedman 1982). Accumulations of salts from chemicals used to control dust or deice roads can disrupt natural stratification patterns and thus potentially upset the ecological dynamics of meromictic lakes (Hoffman et al. 1981, Kjensmo 1997). Roads tend to disperse exotic species by stressing or removing native species and allowing easier movement by wild or human vectors. Overall, the specific mechanisms by which flora and fauna are affected by roads are often complicated and uncertain; thus, mitigation or treatment of specific effects can be costly and uncertain. In addition, the multiplicity of effects resulting from the construction of roads suggests it is unlikely that consequences will ever be completely mitigated or remediated. It is thus critical to retain remaining roadless or near-roadless areas in their natural state. **Journal; reviewed by two referees (incl. R. Noss).**

Current Studies

71. Lehn, K., and F. Bairlein. (2006). "Is mulching a suitable method for improving the nesting habitat of the northern lapwing?" *Journal of Ornithology* **147**(5).

This study was conducted from 2002 to 2004 in the Diepholzer Moorniederung in northwest Germany to determine if winter mulching could be used to improve pastures for northern lapwing nesting. Mulching is defined as cutting and leaving the shredded vegetation in situ. Five nature reserves comprising 100.6 ha were mulched during the winter; then, the distribution and breeding of northern lapwings were mapped during the breeding seasons. Vegetation in mulched areas was significantly shorter and less dense during the breeding season (April/May) than in control areas, but no significant difference was found in the density of lapwings between the two areas. Lapwings showed a preference for mulched areas over control areas, however, and more nests were found in mulched areas than within control areas. Mulched areas appear to provide suitable nest sites, presumably because litter is present and vegetative regeneration is delayed. Therefore, they offer a suitable management tool for improving lapwing nesting habitat.

72. Gregory, A., S.M. Wisely, and B.K. Sandercock. (In progress) The Genetic Consequences of Wind-power Development on Greater Prairie Chicken (Tympnuchus cupido) Leks in Eastern Kansas.

This study is using a BACI design to assess the possible genetic consequences of habitat loss and fragmentation due to wind-power development on greater prairie chickens in the Flint Hills region of eastern Kansas.

73. McNew, L.B., B.K. Sandercock, and S.M. Wisely. (In progress) Effects of Wind Power Development on the Demography of the Greater Prairie Chicken.

This study is examining the impacts of wind development on lek attendance, mating behavior, habitat use, dispersal, and demographic performance of greater prairie chickens. A BACI design with three replicates of paired study sites will be used to assess potential impacts of wind development on prairie-chicken demography. Focal population studies will occur at the Elk River II site in Butler County, Kansas, in Year 1, and expand to three sites in Years 2-4. Birds will be captured and radio-marked at leks during the 2006-2009 breeding seasons for this study. Treatment and reference sites will be monitored simultaneously during three phases of wind power development: predevelopment, construction, and operation.

74. PIER Energy-Related Environmental Research. (In progress) Range Management Practices to Reduce Wind Turbine Impacts on Burrowing Owls and Other Raptors in the East Bay Regional Parks. For information, see www.energy.ca.gov/pier/environmental/project_summaries/PS_500-01-032_DIDONATO.PDF.

This study is investigating land management practices in relation to raptor behavior and prey distributions, as well as raptor flight behavior and spatial distribution over land with and without wind turbines at the Altamont Pass WRA. The study seeks to understand how vegetation management practices (e.g., sheep grazing) in the APWRA can modify raptor foraging patterns by changing the distribution of prey. Three-dimensional GIS models will be used to characterize the influence of range management practices on raptor flight patterns, small mammal burrow distributions, burrowing owl nesting patterns, and turbine-induced avian mortality. A progress report detailing preliminary results is expected in January 2007.

75. Schroeder, M.A., C.E. Braun, and J.W. Connelly. (In progress) Effects of Wind Power Development on Sage Grouse.

This study is looking at the effect of sagebrush-steppe site developments on local sage grouse populations. The hypothesis is that the footprint of wind power generation in the sagebrush steppe is far larger than that presented by proponents because of the spread of noxious weeds, habitat loss and fragmentation, and mortality risk due to predation and collisions with turbines, power lines, fences, and vehicles. Researchers believe that site developments within this habitat-type will present major impediments to the retention of local sage-grouse populations.

76. Sherwell, J. (In progress) Developing a Mitigation Strategy for Bat Impacts from Windpower Development in Maryland.

This study presents a model that has been established to aid in the development of mitigation strategies for wind turbine developments in Maryland along the Appalachian Mountains. Two mitigation scenarios were investigated: one in which suboptimum tip speed ratios are explored, the other in which the rotation rate is managed from a low value up to a threshold value, above which the optimum tip speed ratio is established. Results indicate that both mitigation strategies significantly reduce cumulative risk of collisions relative to operation at maximum tip speed ratios.

77. Szewczak, J., and E.B. Arnett. (In progress) Evaluation of Acoustic Deterrents to Reduce Bat Fatality at Wind Facilities.

> This study seeks to determine if high-intensity ultrasounds will deter bats from wind developments. The hypothesis is that above some threshold, bats will exhibit avoidance because they cannot hear anything but the sound being emitted from the deterrence device.

78. Young, D.P. (In progress) Impacts of Wind Power Development on Mountain Plovers at Foote Creek Rim.

> This study showed mountain plover nesting success to be lowest during construction years, increasing in subsequent years. The sample size was small (n = 41), and it is difficult to separate potential disturbance or displacement effects from a broader decline in the mountain plover population. The results of this study indicate that mountain plovers appear to be compatible with wind projects over the long term.

Case Study 1

Arnett, E.B., technical editor. (2005*). Relationships between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Bat Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines*. Final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Introduction

This study was conducted in 2004 to investigate the relationship between bats and wind turbines at the Mountaineer Wind Energy Center in West Virginia and the Meyersdale Wind Energy Center in Pennsylvania, because an abnormally high number of bat fatalities were discovered at Mountaineer in 2003. Numerous hypotheses were proposed about the mechanisms of bats' attraction to wind turbines or failure to detect them. However, there was little research on the relationships between bats and wind turbines.

In response to concerns about potential bat fatality issues and potentially inaccurate postconstruction monitoring protocols (an avian fatality protocol was used to study bats in Mountaineer), representatives from the American Wind Energy Association (AWEA), Bat Conservation International (BCI), the U.S. Department of Energy's National Renewable Energy Laboratory (NREL), and the U.S. Fish and Wildlife Service (USFWS) joined together to form the Bats and Wind Energy Cooperative (BWEC). The purpose of this collaborative was to conduct research needed to address issues and develop solutions surrounding wind energy development and bat fatalities.

This study describes the first field research undertaken by the BWEC. The primary objectives were to compare results of daily versus weekly carcass searches, quantify bias corrections needed to more accurately estimate fatalities, and recommend improved search protocols for bats. In addition, bat fatalities were correlated to previous nights' weather and turbine conditions, and their behavior was analyzed when bats encountered both moving and unmoving blades on turbines both with and without Federal Aviation Administration (FAA)-approved lights.

This case study summarizes the techniques used, data collection, and results described in each of three chapters in the report: "Bat and Bird Fatality at Wind Energy Facilities," "Timing of Nightly Bat Activity and Interaction with Turbine Blades," and "Use of Dogs to Recover Bat/Bird Fatalities**."**

Techniques Used

Bat and Bird Fatality at Wind Energy Facilities. Statistical techniques were used to develop estimators of fatality and compare these estimates from weekly and daily searches. The researchers also investigated the use of the program DISTANCE for developing estimates of bat fatalities. Associations between turbine and weather characteristics and recent bat fatalities were investigated using graphical methods, univariate association analyses, multiple regression, and logistic regression. For more, see the detailed description of statistical methods used in this study.

Timing of Nightly Bat Activity and Interaction with Turbine Blades. Thermal infrared imaging was used to observe the basic types of flight behavior around the rotor-swept zone of the turbines. This allowed researchers to observe bat and turbine blade interactions and establish the timing of nightly flight activity around operating turbines.

Use of Dogs to Recover Bat/Bird Fatalities. Using hand signals and whistle commands, researchers trained two Labrador retrievers to quarter within a 10-m wide area and to locate bat carcasses of different species and in different stages of decay. Dogs were trained using the fundamental principles employed to teach basic obedience, upland game bird hunting techniques, and blind-retrieve handling skills.

Data Collection

Bat and Bird Fatality at Wind Energy Facilities. Carcass searches were conducted for 6 weeks, from the beginning of August to mid-September. Half the turbines at each site were sampled daily for three weeks; the other half were sampled once a week (on the same day) for three weeks. The sampling protocols switched in the final three weeks to ensure that all turbines were sampled at both daily and weekly intervals.

Fatality studies were conducted by centering a rectangular plot measuring 130 m x 120 m on each turbine sampled. This distance was based on previous studies that indicated most bat fatalities are found within half the maximum distance from the tip height to the ground (the tip height for Mountaineer is 104.5 m and for Meyersdale, 115 m). Search plots at Mountaineer, however, were often irregularly shaped because of the proximity of the forest edge, and the distance from each turbine to its search plot boundary varied in all directions. Transect lines were established 10 m apart within each plot, and searchers walked each transect line and searched the area 5 m away on each side of the line.

Searcher efficiency and carcass removal trials were conducted using fresh and frozen or thawed bat carcasses found at each study site, by discreetly marking each specimen for later identification purposes. Fresh bat carcasses found each day were uniquely marked and either left in the field where found or redistributed to a predetermined randomly selected location. Carcasses were checked daily until removed or until the end of the 21-day trial period.

Information was also collected on whether bat fatalities occurred at lit or unlit turbines, and whether or not ultrasonic sounds were being emitted by digital anemometers at the turbine (anemometers were disabled at half the even-numbered turbines at each site). Finally, weather data were collected every 10 minutes from each meteorological tower and turbine by using a digital anemometer.

Timing of Nightly Bat Activity and Interaction with Turbine Blades. Data were collected between 2030 and 0530 hours from August 2 to 27, 2004, at the Mountaineer Wind Energy Center. Images were collected by using three FLIR Systems S60 uncooled microbolometer video cameras mounted on tripods and grouped together at a single observation station beneath a turbine. Data were captured at 30 frames per second, and the cameras were placed at randomly chosen lit and unlit turbines for five nonconsecutive nights. Terrain permitting, camera stations were located 30 m from the base of the turbine, directly upwind and perpendicular to the plane of rotation; each camera focused on a different part of the rotor-swept area. Each object observed was classified according to a set of qualitative criteria, a time stamp was recorded, and flight elevation and direction were estimated.

Use of Dogs to Recover Bat/Bird Fatalities. Dogs and their handlers and human searchers alone were tested regularly during searcher efficiency trials at both sites. Dog/handler searches were conducted both before and after humans conducted searches alone. The two Labradors alternated between each plot in order to reduce observer bias, evaluate differences in search efficiency between dogs, and allow rest to reduce fatigue and increase performance. Humans alone were restricted to the transect lines; dogs were allowed to quarter the entire 10-m-wide search area for each transect.

Results

Bat and Bird Fatality at Wind Energy Facilities. Searchers found 398 bat carcasses from six bat species at Mountaineer and 262 bat carcasses from seven species at Meyersdale; the most common species killed was the hoary bat. Bat fatalities were highly variable and periodic throughout the study. Fatalities were distributed across all turbines, although generally higher than average numbers of bats were found at turbines near an end or the center of the string at both sites. Of the 64 turbines studied, one (turbine 11 at Mountaineer) was not operational throughout the study period, and no fatalities were found near it.

The timing of all bat fatalities at Mountaineer and Meyersdale was highly correlated. Although more male than female bat fatalities were found, the timing by sex was similar at both sites. Additionally, timing of fatalities of hoary and eastern red bats was positively correlated at both sites. These temporal patterns suggest broader landscape, perhaps regional, patterns dictated by weather and prey abundance or availability or other factors. Ninety-three percent (Mountaineer) and 84% (Meyersdale) of fatalities were found $\leq$40 m from the turbine; there were more adults than juveniles and more male than female carcasses at both sites.

Fatalities per turbine averaged 10.6 at Mountaineer and 13.1 at Meyersdale. The only turbine with no fatalities operated in a 'feathered' mode (blades parallel to the wind) and 'free-wheeling' (blades allowed to move freely). At Mountaineer, 6.1 times more fatalities were found during daily searches than during weekly ones; at Meyersdale, daily searches yielded only 2.1 times more fatalities than weekly searches. Searcher detection probability was found to be 43.6% overall for all trials at Mountaineer and 25% at Meyersdale; detection probability decreased with distance from the transect line (5x lower >2.5-3 m from the transect, unless it was open habitat), with distance from the turbine (decreasing beyond 10 m), and in lower visibility habitat areas.

Carcass removal rates were found to differ substantially between the two study sites; 24% of the fresh bat carcasses left in place were removed within the first day at Mountaineer, and only 3% were removed within the first 24 hours at Meyersdale. Carcasses placed in high visibility habitats at Mountaineer were removed at approximately twice the rate of those placed in low to extremely low visibility habitats (47.7% vs. 12.5% and 29% respectively) within the first 24 hours, and fresh carcasses were removed more rapidly than those that had been previously frozen. Based on estimates derived from habitat visibility strata, daily searches yielded an estimated 38 bats killed per turbine, and a total of 1,364–1,980 bats were killed for the 6-week study at Mountaineer. An estimated 25 bats were killed per turbine, and a total of 400–660 bats were killed at Meyersdale during the 6-week study.

Bat fatalities were similar between turbines equipped with FAA lights and those that were unlit, and fatalities at turbines with anemometers turned off were slightly lower than at turbines with operating anemometers, but the differences were not statistically significant. Factors relating to wind speed were found to be significantly related; higher wind speeds were associated with lower fatality rates.

Timing of Nightly Bat Activity and Interaction with Turbine Blades. Although 4,572 objects (birds, bats, insects, etc.) were observed within the datasets collected, time constraints required that datasets be selected that were collected by one camera (Camera A) from 10 sample nights for the final analysis. A total of 2,398 observations were made at turbines during this 10-day period from Camera A: 998 bats (41%), 503 insects (20%), 37 birds (1%), and 860 unknown (35%). Flight elevation was highly variable, but 3x more bats were observed to fly within the medium-altitude band (within the upper and lower bounds of the blade swept area), than at 'low' or 'high' altitudes. The number of bats observed nightly was highly variable, and a significant correlation was found between insect passes or insect abundance and bat passes. Bat activity was highest 2 hours after sunset and in the early morning hours; a lull in activity occurred close to midnight. Aviation lighting did not appear to affect foraging around turbines, although it was observed to result in higher insect activity.

Thermal images indicated that bats are attracted to and investigate both moving and unmoving blades. Thermal images of bats attempting to land or actually landing on stationary blades and turbine masts suggest possible curiosity about potential roosts or use for gleaning insects. Images of bats chasing turbine blades rotating at slow speeds suggest possible attraction to movement out of curiosity. However, most of the observed collisions (7 of 8) were between bats and fast-moving (17 rpm) turbine blades.

Use of Dogs to Recover Bat/Bird Fatalities. Results varied between the male and female dogs at Mountaineer (80% and 60% efficiency, respectively), but were similar between dogs at Meyersdale (80% and 82% for the male and female, respectively). Dog/handler and human searchers' efficiency varied considerably between the two sites; the dog team found 71% of the carcasses at Mountaineer and 81% at Meyersdale, compared with 42% and 14% for the human searchers, respectively. Dog and human searchers' efficiency also varied considerably with distance from the turbine and visibility. Both teams found a high proportion of bats within 10 m of the turbine and in high-visibility habitats, but humans' efficiency declined beyond 10 m with declining visibility while the dog/handler team remained relatively consistent.

Implications For Wind Development

Although this study has improved our understanding of why and how bat collisions and fatalities occur, it marks the first attempt to observe and interpret bat behavior in the rotor-swept zone of operating turbines; as such, it presents numerous questions requiring further investigation. While statistical inferences are limited to the forested ridges in the Appalachian Mountains where the study areas were located, similar findings could be expected at wind facilities with comparable forest composition and topography. The following areas appear to be most promising for improving research and mitigating the effects of wind development in the future:

- Daily searches must be conducted at a portion of turbines in a wind farm to establish relationships between fatalities, weather patterns, and turbine characteristics. These relationships are critical in furthering our understanding of the predictability of fatalities.

- A pilot study on carcass removal rates would be useful in determining intervals for fatality searches. Fresh carcasses should be used to more accurately reflect realistic rates of scavenging.

- In areas where carcass removal rates are relatively low, infrequent searches can yield relatively accurate fatality estimates. However, removal rates should be expected to change over time, thus changing fatality estimates, as scavengers learn about a new food source. In areas where carcass removal rates are high, however, more frequent fatality searches should be conducted to avoid underestimating the fatality rate. Daily searches are advised in areas with high scavenger rates; however, weekly searches interspersed among days of the week rather than on one day should result in similar estimates. It is important to note that searchers' efficiency and scavenger removal differ by habitat type because different vegetative cover conditions influence observer detectability and scavenging rates. Thus, these statistics should not be extrapolated from one habitat type to another.

- Dog/handler teams have strong potential for increasing the precision of fatality estimates for at least some questions of interest. However, the results of this study are preliminary, and further research is necessary to better understand the efficacy of the use of dogs and determine any bias associated with that.

- FAA lighting and ultrasonic sounds were found to have little to no effect on bat fatality rates.

Potential mitigation strategies include the following:

- High wind speeds appeared to result in low levels of bat fatalities associated with wind turbines; low wind speeds were associated with high levels of fatalities. “Feathering” turbines on nights of low winds and relatively low levels of power production may reduce fatalities, but further study is required to evaluate the reductions relative to economic costs.

- Bats’ attraction to turbines appears to be influenced by several interacting factors. Extreme variations in nightly insect and bat activity suggests that dynamic variables (e.g., weather conditions) are at play rather than some fixed property of the turbines themselves. However, bats also were observed attempting to land on stationary blades and masts, supporting the roost-attraction hypothesis. These factors, combined with the fact that bats are most active during the first two hours after sunset, suggest that windows of high risk for collisions may be clearly identifiable with additional long-term studies. Curtailing turbines during these periods may significantly reduce bat fatality rates.

Case Study 2a

Young, D. P., W. P. Erickson, et al. (2003). *Comparison of Avian Responses to UV-Light-Reflective Paint on Wind Turbines.* Prepared for the National Renewable Energy Laboratory: 1-67

Introduction

The study was conducted to test the hypothesis that painting turbine blades to increase their visibility will reduce avian fatalities. Birds can visually detect wavelengths outside the range of human vision, including the ultraviolet (UV) spectrum; some research suggests that birds may be more sensitive to UV light than to visible light (Kreithen and Eisner 1978, Burkhard and Maier 199, Chen et al. 1984). UV light is defined within this study as light between 0 and 400 nm in wavelength.

The objectives of this study were to (1) review and critique published and unpublished information relevant to the study, (2) estimate the spatial and temporal behavior of birds near turbines with blades coated with UV-reflective paint vs. the behavior of birds near turbines coated with non-UV-reflective paint, and (3) compare the number of carcasses found near turbines with blades coated with UV-reflective gel vs. those found at turbines without the coating. The overall study format is quasi-experimental because the study design was based on U.S. Fish and Wildlife Service (USFSW) recommendations without control over the spatial distribution of turbines with UV-reflective blades.

Techniques Used

UV gel was applied by the blade manufacturers at the factory, and conformed to Mitsubishi Heavy Industries standards for spectral reflectance of light wavelengths. UV reflectance was approximately 60% in comparison to that of standard paint, which reflects approximately 10% of UV light and absorbs the rest. UV-reflective blades were installed during Phases I and II of the Foote Creek Rim Wind project in response to USFWS recommendations, but Phase III was constructed using conventionally painted turbine blades. Mean use estimates were calculated (using detections within 400 m of each point) by species and grouped by bird size.

Data Collection

Six permanent stations were established within the Foote Creek Rim (FCR) wind site. Two stations were placed in the section of the plant with conventional paint (FCR III, 33 turbines) and 4 stations were placed in the section in which UV-reflective gel had been applied to turbine blades (FCR I, II, 72 turbines). Avian use was estimated by conducting point count surveys once per week for 76 weeks from July 1, 1999, to December 31, 2000. Each survey consisted of visiting six plots 2x each survey day, once in the morning (0600-1200 hours) and once in the afternoon (1200-1800 hours). A survey consisted of 40-minute point counts at each station.

Data from fatality studies conducted in 1998 were used to estimate the number of fatalities associated with the FCR I turbines, and the protocol was expanded to cover FCR II (UV) and FCR III (non-UV). Fatality searches were conducted within plots that extended 60 m in all directions from the turbine, centered on a turbine by walking parallel transects. Transects were set approximately 8-10 m apart, and searches of all turbine strings were conducted every 28 days. Carcasses found at other times and places were recorded as incidental carcass discoveries. Carcass removal and searcher efficiency trials were conducted for statistical purposes.

Results

Golden eagles (GOEA) were the most abundant raptor species observed (0.238/survey). Overall raptor use was significantly higher on the UV area (0.778) than on the non-UV area (0.215); mainly because of the high estimates for GOEAs and red-tailed hawks (RTHA). The lowest raptor use occurred during winter (November-March). Raptor use by distance from turbine was not significantly different between the UV and non-UV areas. Overall passerine use was not different between the two areas, primarily because of the offset of use in the non-UV area caused by a greater abundance of horned lark (HOLA) in that area.

Eighty-four fatalities were found within the boundaries of the search plots, 57 of which occurred at the 72 UV turbines (68%), 13 at the 33 non-UV turbines (15%), and 14 at the 7 meteorological (met) towers (17%). The majority of casualties were passerines (78/84), most of which were HOLAs (26). No significant differences were noted between fatality rates for the UV and non-UV turbines, although overall passerine fatality rates at the UV turbines were 2x higher than at the non-UV turbines (primarily because of the higher number of HOLA casualties per turbine).

Overall mortality was estimated to be 1.49/turbine; raptor mortality was estimated to be 0.042. The risk index was found to be 3 times higher at the non-UV area compared with that of the UV area for raptors, but this was not statistically significant. Because there were only 6 raptor fatalities, the magnitude of the differences was probably not correctly estimated.

Implications for Wind Development

This study found no evidence to support the claim that turbine blades coated with a UV-light-reflective paint result in lower bird usage, mortality, or risk compared with those associated with blades coated with conventional paint. The low level of avian mortality observed and the uncontrolled experimental design, however, limit researchers' ability to make statistical inferences. The high level of use and fatalities observed for HOLAs suggest a correlation between avian use and mortality; however, relationships between raptor species use and mortality were not apparent. The high rate of passerine deaths at guyed met towers (4-5 times higher than those for either turbine type), support arguments that unguyed permanent met towers should be constructed to minimize avian mortality.

Case Study 2b

Hodos, W. (2003). *Minimization of Motion Smear: Reducing Avian Collisions with Wind Turbines.* Prepared for the National Renewable Energy Laboratory**:** 1-43.

Introduction

This study analyzed the causes of bird collisions with wind turbine blades and evaluated visual deterrents based on the results of the analysis. Although birds have excellent visual acuity (especially raptors), they still collide with turbines. The researcher's hypothesis was that a phenomenon known as "motion smear," "motion blur," or "motion transparency," in which an object becomes progressively blurred as it moves across the retina with increasing speed, may be part of the problem. The purpose of this study was to determine the ability of birds to see turbine blades at varying velocities, with varying patterns and colors and with and without lateral blade tip devices. The data collected were used to model the distances at which patterns maintain their visibility for different turbine diameters and rotation rates.

Techniques Used

A variable-speed motor was fitted with 32-cm-long rotor blades made from 5-mm white foamboard and placed against a background of white posterboard. Three tungsten halogen lamps were used for illumination, and positioned in a manner that minimized shadows. A pattern electroretinogram (PERG) was used to measure the visibility of the blades to birds using a variety of anti-motion-smear patterns and other patterns at various retinal-image velocities and against several types of stimulus backgrounds. The ENFANT visual electrophysiology system apparatus was used to present visual stimuli on a video display monitor and record, amplify, display and analyze electrical potentials. The rotation rate of the blades in rpm was measured by allowing the blades to interrupt a photocell light beam.

Data Collection

Fifteen American kestrels (AMKE) were used throughout this study, and a different number of individual subjects were used for each aspect of it. Individual birds were lightly anesthetized for testing purposes, and their heads were placed in a rigid metal head holder to eliminate movement. Vecuronium bromide was administered to the cornea over 20 to 30 minutes to paralyze accommodation. Platinum electrodes were inserted in each upper eyelid, and a third electrode was inserted in the skin of the scalp to serve as a ground. One eye was covered with a black patch (this electrode served as the reference).

Eight blade velocities, ranging from 36-144 rpm, were tested to determine the threshold visibility of a simulated turbine blade display. Blade visibility was measured by collecting data from seven recording sessions (three measurements were made per session at each velocity) from three AMKE using the following stimuli: (1) blank blades, (2) blades with thin stripes in a staggered, anti-motion-smear pattern, (3) blades with thick stripes in an anti-motion-smear staggered pattern, and (4) no stimulus (both eyes covered).

To evaluate a variety of blade patterns with anti-motion-smear properties, 6 pattern types were tested, as well as blank blades and a physiological noise condition (both eyes covered) on 6 AMKE. Presentation and recording methods were the same as in the velocity experiment, except that the blades were presented at 130 degrees of visual angle per second (dva/s) of retinal-image velocity, which is the retinal velocity at which the patterns are maximally visible. Three measurements were made of each pattern type during each recording session.

To determine the effectiveness of color on blade visibility, chromatic stimuli specified by the R-G-B color system were tested on seven AMKE. Stimuli were printed (solid and striped) using a Hewlett-Packard 2000, photo-quality, professional ink-jet printer. The rotation rate for the blades was 130 dva/s, at which achromatic patterns are maximally visible. Visibility of colored blades was tested against blank and colored backgrounds depicting wind-resource areas (three to five AMKE were used). A single-blade pattern composed of thin, silver, reflective stripes was also tested against the variegated naturalistic background.

The visibility of lateral blade stimuli against a neutral white background was also tested on four AMKE by attaching blade tip devices at right angles to the long axis of the blade. The devices attached were black squares that subtended 6.5 x 6.5 dva.

Results

The visibility of the thin stripes, as measured by the amplitude of the PERG in microvolts (μV), at 130 dva/s (4.2 μV) was significantly more visible than the noise, blank blades, and thick stripes; however, by 170 dva/s the visibility of the thin stripes dropped to 0.9 μV, and by about 240 dva/s it was close to zero. Although neither the thick stripes nor the blank blades were significantly different from the noise at 130 dva/s, at 170 dva/s the visibility of thick stripes was 1.0 μV and for blank blades it was 1.6 μV. By 200 dva/s and at all subsequent velocities, no differences between blades were significant, nor were any of the visibilities significantly different from noise (they were virtually invisible to the AMKE).

Of the 8 scenarios tested, the only blade patterns found to significantly differ from the blank blades at 130 dva/s were noise (both eyes covered), 1 blade painted with solid black and 2 left blank, and thin, staggered black stripes on all blades. Red, black, and green blade patterns were found to be significantly more visible than blank blades; however, when the blank background was changed to a colored scene, no statistically significant differences were found among the stimuli. Color and spatial patterning of the background played a major role in the visibility of a particular stimulus; the visibility of the blank blades increased considerably against this type of background.

The approach angle of a raptor toward the blades will vary the background considerably and could potentially have a major effect on blade visibility; the only color with a relatively consistent level of visibility was black. Results indicated that thin, black stripes on a single blade are the most visible against a variegated naturalistic background, but the small number of subjects tested (2) and recording sessions (4) were not significantly different than for blank blades.

No difference was found between laterally oriented blades with a single, black rectangle and those with no stimulus affixed to the tip with a neutral white background; however, 2-rectangle tip attachments significantly increased visibility when compared with results for blank blades. Three lateral tip devices offered no greater visibility benefit than did the single lateral tip device. When a variegated, naturalistic background was used, the difference between the two-tip device and the no-tip device diminished slightly, indicating that the devices may be less effective.

Implications for Wind Development

Data from this study suggest that a single, solid-black blade paired with two blank blades—or possibly a single, thin-striped blade paired with two blank blades—would be the most visible visual deterrent to birds in the field. Colored blades are not recommended because of their cost and possible problems with background contrast. The results from this study apply only to laboratory conditions that mimic some aspects of optimum viewing in the field, such as bright illumination and good viewing conditions; therefore, field tests need to be conducted. Suggestions for field testing design and implementation are included.

Case Study 3

Barrios, L., and A. Rodriguez (2004). "Behavioral and environmental correlates of soaring-bird mortality at on-shore wind turbines." *Journal of Applied Ecology* **41**: 72-81.

Introduction

This study analyzed the effect on birds of two wind energy farms, PESUR and E3, in the Campo de Gibraltar region, Cadiz province, Spain. The E3 farm consists of one row of 34 turbines and one of 32 turbines along a ridge of the Sierra de Enmedio (420-550 m above sea level). The PESUR farm has seven rows containing 190 turbines in all in the Dehesa de los Zorrillos hills (80-300 m above sea level). The Straits of Gibraltar are the main point of migratory passage for hundreds of thousands of soaring birds on their journeys between Europe and Africa, and this is also one of the four areas in Spain with the greatest potential for producing energy from the wind. Relief and wind are the two principal factors affecting both the behavior of soaring birds and the selection of wind sites. The specific aims of this study were to determine (1) the bird mortality rate associated with wind energy facilities; (2) the effect of these facilities on bird behavior and habitat use; (3) the factors that lead birds to approach turbines; and (4) mitigation measures that may reduce avian mortality.

Techniques Used

Bird corpses were surveyed along turbine lines and an associated power line to estimate mortality rates. The effects of location, weather, and flight behavior on risk situations (passes within 5 m of turbines) were analyzed using generalized linear modeling.

Data Collection

Mortality surveys were conducted between December 1993 and December 1994 at 15 randomly selected sampling sites, defined as groups of eight lattice towers or four tubular towers. Data were collected at a total of 87 wind turbines and seven lattice meteorological towers and lightning conductors. Searches were conducted twice a week within the turbine sampling areas and once a week at the power lines. A 100-m wide band along the entire length of both wind farms was also surveyed weekly for griffon vultures. Carcass removal and searcher efficiency trials were conducted for statistical purposes and to determine search frequency.

Behavioral observations were made from the edge of the ridges where the turbines were placed or from sampling areas of any soaring bird within 250 m of a turbine. Distance was estimated by using binoculars within 200 m of the turbines and using known distances between structures as a reference.

Data were also collected on type of flight, flight height, and wind speed for birds considered to be in a risk situation (passing within 5 m of the blades of an operating wind turbine). The frequency of risk situations was then used to create a risk index, the ratio between the number of birds observed within 5 m of the blades and the total number of passes or observations within 250 m of the turbine lines.