BEST MANAGEMENT PRACTICES FOR BATS AND WIND ENERGY

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1.0 BACKGROUND

For more than a decade, wind energy has been the fastest growing energy technology worldwide, achieving an annual growth rate of over 30%. In the United States, the current total installed capacity is over 60,000 megawatts of wind projects.

1.2 Impact of Wind Energy on Bats

Fatalities associated with wind energy development are a threat to bat populations in North America. In the U.S. and Canada, nearly 3 million bat fatalities are estimated to have occurred between 2000 and 2014.[4] [4,5] The hoary bat (*Lasiurus cinereus*) and the silver-haired bat (*Lasionycteris noctivagans*), two of the three species that together account for approximately 70 percent of all fatalities across the U.S. are tree-roosting migratory bats, though cave-roosting bats have also been impacted in both the west and east.[4,5]

Bats average about one pup per year and require high adult survivorship to maintain their populations. This slow reproductive rate means they are unable to recover quickly from intensive, large-scale impacts to their populations, such as those that occur at wind energy facilities. Moreover, recent research indicates some species of bats may be attracted to wind turbines.[6] Therefore, placing wind turbines in high-quality bat habitats could exacerbate fatalities.

Wind energy development affects bats indirectly by disturbing or eliminating foraging or roosting habitat and directly through collisions with turbine blades or mortality from sudden changes in internal barometric pressure when in direct proximity to turbine blades.[7] The majority of bat fatalities seem to occur during certain times of the year and under specific conditions, although this is likely related to latitude or species-specific activity patterns. For example, in the Northeast and Midwest U.S., the greatest number of bat fatalities typically occur from July through September, a time when many species are migrating and mating.[4, 8]

However, fatalities also occur during other seasons when bats are active and can be high in spring and summer for some species, such as the Brazilian free-tailed bat (*Tadarida brasiliensis*) or year-round in warmer climates, such as the federally-endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*). For example, at a site in Oklahoma, pregnant Brazilian free-tailed bats made up the majority of fatalities, likely related to the siting of the facility in close proximity to a maternity roost.[8] Bats also tend to be at higher risk during warmer temperatures and lower wind speed, as these conditions increase the activity levels of their insect prey, with a corresponding increase in bat activity. The inverse occurs at higher wind speeds and cooler temperatures.[4,6] However, little information is available for western states.

Moreover, relationships of fatality risk to weather and wind speed are still limited for some species, like the Brazilian free-tailed bats.[8,9] Acquiring data on the potential risk at a proposed site and the actual impact once the site is operational is necessary for understanding the patterns of fatality and determining whether efforts to reduce bat fatalities are warranted. Current methods for estimating bat population sizes are considered inadequate, and their migratory movements and pathways are poorly understood.

Since bats prevent more than 3 billion dollars of crop damage annually by eating insect pests and pollinate and disperse the seeds of important plants in the desert southwest, the loss of these ecological services could have a significant impact on human economies and ecosystems.[10] With wind energy development in the U.S. expected to triple by 2030, the negative impact on bat populations and the ecosystem services they provide could be severe unless adaptive management solutions are implemented to reduce these impacts.

2.0 BEST MANAGEMENT PRACTICES FOR ASSESSING AND MINIMIZING THE IMPACTS OF WIND ENERGY DEVELOPMENT ON BATS

Many federal and state land management agencies have established policies and BMPs[3] for wind energy projects on the lands they administer. The policies often identify required mitigation measures for incorporation into project-specific wind development plans of development and right-of-way authorization stipulations as appropriate to address site-specific and species-specific issues[3]. In addition, the project-level environmental assessments should also include a site-specific Bird and Bat Conservation Strategy (BBCS) or Avian and Bat Protection Plan[11,12] (ABPP) to provide project-specific guidelines, as well as details for conducting pre- and post-construction bat surveys, mortality monitoring, and conservation measures to reduce the project's impacts to bats.

The following bat-specific BMPs were compiled from several sources including: the BLM's June 2005 Final Programmatic Environmental Impact Statement (FEIS) on Wind Energy Development on BLM-Administered Lands in the Western United States[2] (as clarified in BLM IM 2009-043, Wind Energy Development Policy3, Attachment 1); the Unites States Fish and Wildlife Service's (USFWS) Land Based Wind Energy Guidelines[11]; BCI's Wind Energy Program[12]; as well as guidelines from state wildlife agencies and expert opinion. BMPs from these sources were included if they addressed bats directly, or indirectly by addressing important components of bat habitat such as water and riparian foraging habitats, potential roosting habitat such as caves and abandoned mines, or vegetation communities which support bat's insect prey. Implementing these BMPs will help BLM natural resource managers and wind energy developers and operators reduce the impact of wind turbines on bats at all phases of wind energy development; from siting to decommissioning.

2.1 GENERAL AND POD/ROW BEST MANAGEMENT PRACTICES

The following BMPs are applicable to all phases of wind farm development; siting, pre-construction, construction, operations, retrofitting or repowering, and decommissioning.

2.1.1. Designate a point of contact (authorized officer) for environmental and public inquiries. Start this and other management processes, i.e. monitoring, formation of Technical Advisory Committee (TAC), etc., as early as possible.[3,11]

2.1.2. Proactively communicate with other state and federal wildlife agencies during all phases of planning and development.[3,11]

2.1.3. Comply with all applicable federal, state, and local laws.[3,11]

2.1.4. Consult with the USFWS if Threatened or Endangered species are known or potentially occur in the project area, as required by Section 7 of the Endangered Species Act of 1973 (ESA). The specific consultation requirements will be determined on a project-by-project basis.[3] Communicate early and often with the USFWS counterparts.

2.1.5. Incorporate management goals and objectives specific to habitat conservation for species of concern (e.g. BLM Sensitive species, state Species of Greatest Conservation Need, etc.), as appropriate, into the POD for proposed wind energy projects.[3]

2.1.6 Adhere to all state and other federal measures for handling toxic substance to minimize danger to water and wildlife resources from spills. Facility operators should maintain Hazardous Materials Spill Kits on site and train personnel in the use of these.[2,3]

2.1.7. Avoid impacts to wetlands, hydrology, and stream morphology by using appropriate erosion control measures to limit runoff to nearby water sources. Follow all applicable provisions of the Clean Water Act (33 USC 1311-1313, 1317) and the Rivers and Harbors Act (33 USC 301 et seq.).[2]

2.1.8. Establish and implement a monitoring program at the POD/project level to ensure that environmental conditions are monitored during the construction, operation, and decommissioning phases, including an adaptive management component to minimize or mitigate potential adverse impacts of wind energy development.[3,11,12]

2.1.9. Identify monitoring variables for each environmental resource present at the site, establish metrics against which monitoring observations can be measured.[11, 12,13]

2.1.10. Include protocols for incorporating monitoring observations into PODs, standard operating procedures, BMPs, and the adaptive management process.[3]

2.1.11. Conduct scientifically-credible monitoring studies during all phases of development. Form a Technical Advisory Committee (TAC) to review all proposals and reports.[11,12]

2.1.12. Provide the results of all monitoring program efforts, including post-construction mortality information, to the appropriate state and federal wildlife offices[3,11,12]. Consider contributing the data (confidentially) to the American Wind and Wildlife Institute's (AWWI) Wind/Wildlife database.[12]

2.1.13 Develop a habitat restoration plan to avoid, minimize, or mitigate negative impacts on bats and bat habitat while maintaining or enhancing habitat values for other species. The plan should identify reclamation measures to implement to ensure that all temporary use areas are restored. Restoration should occur as soon as possible after completion of activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.[3]

2.2 SITING AND PRE-CONSTRUCTION BMPS (USFWS LAND-BASED WIND ENERGY GUIDELINES TIER'S I–III[10])

Siting and pre-construction includes 1) the initial broad geographic or landscape-scale evaluation that a developer would pursue when looking for a suitable site for a wind energy development, 2) the subsequent site characterization and more detailed analysis at an individual site or sites selected for potential development, including more rigorous and quantitative field studies and impact prediction. This also includes the erection of meteorological ("Met") towers, which often requires little in the way of site modification, however exceptions occur. Met towers can also serve as a platform for the installation of acoustic monitoring equipment.

2.2.1. Develop a study design strategy for any environmental studies initiated or baseline data collected during the site testing and monitoring period. The operator shall submit the study design strategy to the project point of contact for review (and if possible, the TAC).[3,11]

2.2.2. Review existing information on species and habitats near the project area using agency, conservation organization, academic, and other database searches, reports from nearby projects, local experts and other sources to identify existing or potential sensitive species or habitat presence or concerns.[3,11,12]

2.2.3. Avoid locating wind energy facilities in areas identified as having a demonstrated and un-mitigatable high risk to bats such as near one or more significant roosts.[3,11,12]

2.2.4. Avoid sites with topographical features that could concentrate migratory bat movements, for example, ridges, escarpments, forest edge, the shorelines of large water bodies, rivers, or other landforms that might funnel bat movement.[11,12]

2.2.5. Minimize the area (i.e. footprint) disturbed by installation of meteorological towers.[3]

2.2.6. Avoid locating meteorological towers within or near sensitive habitats or areas where ecological resources known to be sensitive to human activities are present.[3,11,12]

2.2.7. Develop procedures to minimize or mitigate potential impacts to special status species and other priority wildlife species. Such measures may include avoidance or relocation of project facilities or lay-down areas (areas where turbine components are staged before erecting).[3,11]

2.2.8. Coordinate with state, federal, and or other qualified entities to facilitate or conduct surveys for Federal and/or State-protected species (permits may be required for handling or disturbing bats) and other species of concern, including priority wildlife and special status species, as well as important, sensitive, or unique habitats near the project. Design the project to avoid and minimize impacts to these resources (e.g., locate the wind turbines, roads, and ancillary facilities in the least environmentally sensitive areas, i.e., away from riparian habitats, wetlands, critical wildlife habitats, etc.).[3,11] If unavoidable residual impacts are anticipated, then integrate a compensatory mitigation strategy into the project's design and implementation program.[11]

2.2.9. Evaluate bat use of the project area and design the project to avoid or minimize the potential for bat strikes (e.g., development shall not occur in riparian habitats and wetlands).[3,11,13] Bat use surveys consistent with current methodologies and standards shall be conducted; the amount and extent of ecological baseline data required shall be determined on a project basis.[12,13] As it is not possible however to quantify effects on bats based primarily on pre-project surveys, post-construction monitoring should be implemented. When possible, implementing paired pre- and post-construction surveys may increase the understanding of risk in the future.[9,13] When under operation and monitoring reveals unexpected bat strikes are occurring, develop a post-construction management plan to address unexpected bat strikes or prepare compensatory mitigation strategy to offset unanticipated post-construction impacts.

2.2.10. Report Observations of potential wildlife impacts, including wildlife mortality to the authorized point of contact as soon as possible.[3]

2.2.11. Determine the presence of bat colonies and avoid placing wind energy facilities or wind turbines near known bat hibernation, breeding, and maternity/nursery colonies, in known migration corridors, or in known flight paths between colonies and feeding areas.[11,12]

2.2.12. Use available data from state and federal wildlife agencies and non-governmental organizations (e.g., NatureServe, Databasin, etc.), which could include maps or databases that show the location of sensitive resources and the results of more in-depth site characterization and pre-construction surveys to avoid high risk areas for bats. For example, Arizona, Nevada, and New Mexico have areas with high concentrations of agriculturally important Brazilian free-tailed bats that are known to be extremely susceptible to wind turbine development.[11,12]

a. Features that may attract high bat concentrations include but are not limited to: forests or woodlands, wetlands, riparian zones, playa lakes and other water bodies, exposed cliffs, caves, karst formations, abandoned mines, abandoned buildings and connectivity between habitats.

2.2.13. Avoid siting near bat hibernacula, breeding colonies and maternity roosts, migration corridors, commuting and foraging areas. Until more definitive information is available, avoidance distances for siting should be determined on a case by case basis, in cooperation with state wildlife agency and local or regional experts.[11,12]

2.2.14. Site wind turbines to avoid separating bat species of concern from their daily roosting, commuting and foraging areas. For example, avoid placing wind turbines between roosting areas and major water sources.[3,11,12]

a. Wildlife habitat enhancements or improvements such as ponds, guzzlers, bat houses, etc. should not be created or added to wind energy facilities. These wildlife habitat enhancements are often desirable but when added to a wind energy facility result in increased wildlife use of the facility which may result in increased levels of injury or mortality to them.[12]

2.2.15. Assess species presence, activity levels, and patterns of activity prior to construction. Methods for pre-construction monitoring may include acoustic detectors, radar, mist-netting, and colony counts at known roost sites.[9,11,13]

2.2.16. Conduct a minimum of 1 year of pre-construction monitoring.[11,12]

a. The timing of surveys should coincide when bats are active in the area or year- round if there are limited data for an area.

2.2.17. Deploy monitoring stations among different habitats across the proposed project area to assess differences in habitat selection among species and time of year. Multiple stations per habitat type is necessary to increase replication of sample sites.[13,14]

2.2.18. Position acoustic detectors microphones at ground level (at least. 1 to 2 meters above ground level) and within the rotor-swept zone. Microphones should be mounted on existing structures, such as meteorological towers within the proposed project area. If number of detectors is a limiting factor, concentrate on rotor-swept zone.[12,13]

2.2.19. Relate bat activity (i.e., and if possible, species specific bat activity) to weather conditions (e.g., temperature, wind speed, barometric pressure, etc.).[12,13]

2.3 CONSTRUCTION BMPS

Construction BMPs include the actual site development including; establishing site access and roads, clearing of vegetation and grading for roads and lay-down areas, installing tower foundations, erecting wind turbines and permanent meteorological towers, and the construction of control and other outbuildings and electrical substations.

2.3.1. Limit the amount of disturbed areas during construction, including roads, power lines, infrastructure, and wind turbines[3,11,12]

2.3.2. Reclaim all areas of disturbed soil using weed-free native grasses, forbs, and shrubs. Reclamation activities shall be undertaken as early as possible on disturbed areas.[3,20]

2.3.3. Minimize lighting at both operation and maintenance facilities and substations within half a mile of the wind turbines to the minimum required.[3,11,12]

2.3.4. Avoid and minimize impacts to important bat habitat components (i.e. riparian habitat, caves, mines, and other cavern-like habitats, late seral stage forests, pooled water sources).[3,11,12]

2.4 POST-CONSTRUCTION (OPERATION) BMPS (USFWS TIER'S IV, V)

Post construction BMPs apply when the wind farm is operational.

2.4.1. Keep lighting at both operation and maintenance facilities and substations located within half a mile of wind turbines to the minimum required.[11,12]

2.4.2. Use lights with motion or heat sensors to keep lights off when not required. This includes adding safety measures to prevent internal turbine lights from being accidently left on.[12]

2.4.3. Hood lighting for operating and maintenance buildings downward and direct to minimize horizontal and skyward illumination.[12]

2.4.4. Minimize use of high intensity lighting or steady burning lights, such as sodium vapor, quartz, halogen or other bright spotlights.[12]

2.4.5 Establish non-disturbance buffer zones to protect sensitive habitats or areas of high risk for species of concern identified in pre-construction studies. Determine the extent of the buffer zone in consultation with the USFWS and state, local and tribal wildlife biologists, or other credible experts as appropriate[3,11]

2.4.6. Examine the impact of wind turbines on bats. Methods for post-construction monitoring may include fatality searches, acoustic detectors, radar, and thermal imaging.[9,11,12,13,14,15]

2.4.7. Conduct a minimum of 2 years of post-construction monitoring.[12,19]

a. The timing of surveys should coincide when bats are active in the area or if data are limited, surveys should occur year-round.[12]
b. For fatality monitoring, select wind turbines at random or via a systematic random approach.[9,13]
c. Fatality monitoring should be conducted at a minimum of 30% of wind turbines at the facility. If the facility contains less than 30 wind turbines, monitor at least 10 of the wind turbines.[12,13]
d. Establish a search plot at least ½ the height of the wind turbine with a minimum plot width of at least 120 meters from the turbine.[11]

2.4.8. Define, using GPS, the searchable area and identify the different visibility classes within each plot.

2.4.9. Delineate transect lines, within the plot, in most situations, no further than 6 m apart, but this may vary from 3-10 meters depending on ground cover.[12,13]

2.4.10. Search wind turbines at least on a 3-day interval. More frequent searches may be required if the carcass removal rate is high, or if required by the proposed study objectives. Daily searches also may allow for the greater recovery of 'fresh' (i.e., determined to have died the previous night) carcasses, which can be related to weather patterns and operational conditions, thus providing data to help understand risk and refine minimization strategies. Consider more comprehensive surveys for areas with limited data (e.g. daily surveys year round) initially then adjust as more information becomes available. [13,14,15,16]

2.4.11. Conduct searcher efficiency and carcass removal bias trials throughout the study period and place trial carcasses in each visibility class. A minimum of 20 trials should be used per visibility class to quantify searcher efficiency and carcass removal. It is best to use carcasses that are recovered at the site for these trials, but surrogate carcasses (e.g., mice or sparrows) may be necessary to meet the minimum sample size requirement.[15]

2.4.12. Calculate the density-weighted proportion of carcasses[14] or report assumptions of carcass distribution[15]

2.4.13. Account for biases and density-weighted proportion in fatality estimation.[14]

2.4.14. Estimate fatalities using estimators that allow for flexibility in carcass removal distribution, rather than assuming a distribution (e.g. constant removal). See Bispo et al.[16] for implications of assuming carcass removal distribution.

2.4.15. Evaluate potential associations between turbine operation and weather patterns to fresh fatalities.

2.4.16. Based on the results of post-construction monitoring, scientifically-proven avoidance, mitigation, and minimization strategies such as operational minimization and curtailment should be used during periods of high risk to reduce bat fatalities and the potential take of sensitive species at wind turbines.[12,17,18]

2.4.17. Consult with BCI, the TAC, state and federal agencies, or other experts in bat-wind energy experts to determine the best minimization strategy for the species occurring in the area.[12]

2.4.18. Evaluate other technologies such as radar, cameras, visibility monitors, acoustic deterrents (for bats) or a combination of such technologies to determine their efficacy for the specific issue.[12,17,18]

2.4.19. Use data collected by the wind turbines or meteorological towers to relate bat fatality to weather and operational variables.[8,12]

2.4.20. Feather blades below the manufacturer's cut-in speed (i.e., the speed at which wind turbines begin generating electricity) during periods when bats are active.[12,17]

2.4.21. Disseminate all data and reports to the public to assist with large-scale regional analyses and/or to help refine future BMPs.[12]

2.4.22. Submit data to existing American Wind Wildlife Institute's databases and reports to the Bats and Wind Energy Cooperative.[12]

2.4.23. Participate in on-going and new research to better understand bat behaviors near wind turbines and effective strategies to minimize bat fatalities, such as ultrasonic acoustic deterrents, or operational minimization.[12,13,17]

2.5 DECOMMISSIONING BMP'S

Decommissioning is the cessation of wind energy operations and removal of all associated equipment, roads, and other infrastructure.

2.5.1. Restore the natural hydrology and plant community to the greatest extent practical.[3,11,12]

2.5.2. Refer to state and federal agencies guidance when seeding or planting native seeds during restoration.[11,12]

2.5.3. Restore habitat, in accordance with relevant habitat restoration plans, as soon as possible after completion of construction activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.[3]

2.5.4. Reclaim all areas of disturbed soil using weed-free native shrubs, grasses, and forbs.[3,20]

2.5.6. Restore the vegetation cover, composition, and diversity to values commensurate with the ecological setting.[3]

2.5.7. Use native species when seeding or planting during restoration. Consult with appropriate state and federal agencies regarding native species to use for restoration.[3,20]

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www.awea.org

American Wind Wildlife Institute
www.awwi.org

Bats and Wind Energy Cooperative
www.batsandwind.org

Department of Energy: Wind
http://energy.gov/science-innovation/energy-sources/renewable-energy/wind

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