Wind Turbines

What is the issue?

Renewable energy sources such as wind energy are increasingly being relied upon to help meet nationwide energy demands. The Department of Energy (DOE) has a stated goal of wind energy sources contributing 20 percent of the nation's total energy need by 2030. In 2015, some 49,000 wind turbines located in 39 states supplied about 5 percent of the nation's electricity demand. It is projected that with new technology, wind energy development will expand into areas not currently being explored, and that by 2030 nearly all 50 states will have wind energy facilities.

Estimates of bird/turbine collision range widely and all of the studies attempting to quantify this contain some level of bias and uncertainty. The most comprehensive and statistically sound estimates show that bird deaths from turbine collisions are between 140,000 and 500,000 birds per year. As wind energy capacity increases under the DOE's mandate (a six-fold increase from current levels), statistical models predict that mean bird deaths resulting in collisions with turbines could reach 1.4 million birds/year.

Why does this happen?

The risk of a bird collision with a wind turbine is influenced based on facility location (including turbine placement), turbine design, and how birds move across the landscape.

Turbine Location

Siting of wind energy facilities at both the landscape-level and project-level scales is deemed a critical element in reducing bird/turbine collision risk. Available data indicate that some regions are higher risk than others. Bird/turbine collisions in California are estimated to be an average 7.85 birds/turbine/year, higher than in the East (6.86 birds/turbines/year), the West (4.72 birds/turbine/year), and the Great Plains (2.92 birds/turbine/year).

At the landscape scale, mortality risk may increase near migratory routes, in areas with high concentrations of birds, along rivers and ridgelines, or near coastlines. How birds use the landscape also influences the level of exposure to turbine collision risk. For example:

- Birds in soaring flight are unable to maneuver well and may be unable to avoid the turbine if soaring within the rotor swept zone.
- Birds that move during the daytime fly at lower heights and may be at higher risk of flying into the rotor swept zone than birds flying at night.
- Birds have lower flight heights and can congregate near summits and steep slopes or open habitats (areas where turbine placement is common) while searching for food, increasing their risk of collision with turbines.

Over 200 species of bird have been documented as killed by collision with wind turbines. Passerines (i.e., songbirds) (https://en.wikipedia.org/wiki/Songbird) are most commonly reported, followed by raptors that hunt by day such as hawks (https://en.wikipedia.org/wiki/Hawk), eagles (https://en.wikipedia.org/wiki/Eagle)and falcons (https://en.wikipedia.org/wiki/Falcon). Although fatality rates for raptors may be lower compared to passerines, raptors are especially vulnerable to collisions due to their flight behaviors. Given the life history traits of raptors (i.e., long-lived and low reproductive rates) their populations are more at risk of decline from the number of different sources of impacts that affect these species on a daily basis.

Habitat impacts are also a major concern with wind energy facilities as they are often large developments that, if improperly placed, may cause a loss or fragmentation of habitat that species frequently use or depend on for survival. Knowing where certain birds are and when, and siting facilities to avoid high movement or occurrence areas can make a big difference in avoiding and reducing bird impacts.

Turbine Design

Collision risk is primarily influenced by turbine and blade tip height, but also tower type. Current turbine heights (i.e., the combination of the tower and the blades at maximum height) range from 475 to 639 feet. Bird collisions increase with turbine height because as turbines increase in size, the blades reach higher into the average "flight zone" of nocturnal migrating birds. Therefore, with the expected development of taller turbines, increased bird collisions are likely. Additionally, data suggest that bird collisions may increase with tall structures that are greater than 350 feet above ground level.

Additional studies have found that raptors that migrate by day and some landbirds fly at much lower altitudes than previously thought. Based on data from other structures, shorter structures (e.g., turbines compared to communication towers) pose a greater risk to birds moving around locally or migrating during the day compared to taller structures that take more bird species moving during the night. Older style turbines were made with lattice towers, which compared to monopole designs have an increased risk of causing bird/turbine collisions.

What are some solutions?

At present, once wind turbines are built, there are very few measures that can be implemented to avoid or minimize the collision risk. Turbine lighting may reduce attraction, however one study found no difference in bird impacts between lit and unlit turbines, suggesting that lighting may not be the driving factor behind bird/turbine collisions.

Reducing the quality of habitat and removing carrion may reduce the attraction of local individuals from the wind facility and lower exposure risk, but this may not reduce the risk to birds migrating during the day and night.

Ensuring proper siting of wind facilities is the first step in minimizing bird/turbine collision risk. The Service is exploring a standard, scientifically supported method for proper siting.

For more information about the impact of energy development on wildlife, the Service's role in reviewing energy development projects, and recommendations for avoiding and minimizing impacts to birds and bats from wind development, visit the Service's Ecological Service's Energy Development website (https://www.fws.gov/ecological-services/energy-development/energy.html) and the Service's Midwest Wind Energy Development (https://www.fws.gov/midwest/wind/wildlifeimpacts/index.html) website.

For more information about measures and guidance for avoiding and minimizing impacts to migratory birds, visit the Conservation Measures (https://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php) and Guidance Documents (https://www.fws.gov/birds/management/project-assessment-tools-and-guidance/guidance-documents.php) webpages.

Materials on this webpage sourced from
AWWI 2015, Diffendorfer et al. 2015, EIA 2015, Erickson et al. 2001, Erickson et al. 2014, Gehring pers com., Katzner et al. 2012, Kerlinger et al. 2010, Loss et al. 2013 (447.7KB) (../../../../migratorybirds/pdf/management/lossetal2013windfacilities.pdf), Manville 2009 (112.7KB) (../../../../migratorybirds/pdf/management/manville2009.pdf), May et al. 2015, Peterson et al. 2015, Schuster et al. 2015, Singh et al. 2015, Smallwood 2013, Smallwood and Thelander 2008, USDoE 2015, U.S. vs PacifiCorp 2014

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