Wind turbine bird mortality

Castle Lloyd windfarm, Wales. Source: Geograph United Kingdom

Wind turbine bird mortality is a by-product of large scale wind farms, which are increasingly promoted as an alternative to fossil fuel derived energy production. To adequately assess the extent of impact to avian populations, deeper factors than gross mortality by turbine action must be assessed. In particular, one must examine: (a) impacts to threatened bird species, (b) total impacts due to avian habitat loss as well as direct mechanical kill, (c) ecological impacts due to apex predator bird loss and (d) future siting decisions for windfarms, since much of the prior bird mortality is due to poor siting decisions.

Bird mortality from wind turbines is a significant adverse ecological impact, and threatens to expand in scope dramatically with the rush to develop new energy sources. This impact is measured as high due to the loss of threatened species and due to disproportionate mortality of top level predators, whose decline can unravel the integrity of entire regional ecosystems. The rapid development of numerous large scale wind farms may be a repeat of the ecological disasters of the 1970s, as the world rushed to produce hydropower from every possible river; decades later, we now realize the folly of that hydroelectric excess.
Over four million direct kill bird deaths per annum by 2030 are projected in some scenarios of wind turbine installation. The sheer volume of bird kill does not begin to depict the magnitude of ecological damage, since the most susceptible species tend to be those which are keystone species or species already threatened by other human pressures. Additionally, bird mortality due to large wind farms is exacerbated by inherent linkages between bird behavior and windfarm siting decisions. Proponents of large scale wind farms (including some federal agencies), for example, tend to favor sparsely vegetated saddles or other funnel like landforms, which are highly correlated with high density bird migration routes or raptor soaring locations.

Impacts to Threatened Species

The disproportionate numbers of threatened species killed by large wind turbines, is explained in part by the fact that many large raptors are vulnerable or endangered species. The following is a partial list of threatened avian taxa that are present in disproportionately high numbers (relative to the entire species population) in turbine kill counts:

- Whooping crane (*Grus americana*) [Rare and Endangered]
- Greater prairie chicken (*Tympanuchus cupido*) [Vulnerable, with one subspecies Endangered]

- Greater sage grouse (*Centrocercus urophasianus*) [Near threatened, IUCN]

  A 2003 compilation of bird deaths by wind turbines indicated that the non-California mortality included an astonishing 78 percent of all bird deaths as protected passerines pursuant to the U.S.Migratory Bird Treaty Reform Act; moreover, this percentage is viewed as a possible underestimate of this group of threatened species, due to the relative difficulty of detected small passerine carcasses and a suspected lack of adequate sampling during passerine migrations.

Apex Predator Bird Loss

Male American Kestrel. Source: U.S. Bureau of Land Management

Raptors as well as predator seabirds represent an important class of apex (or high level) predators in ecosystems around the world, and are disproportionally present in bird kill numbers, because of their flight habits requiring extensive distances travelled in soaring during predation. Example species counted in high numbers from turbine mortality are:

- Griffin falcon (*Gyps fulvus*)
- Golden eagle (*Aquila chrysaetos*)
- Bald Eagle (*Haliaeetus leucocephalus*)
- Old world kestrel (*Falco tinnuculus*)
- American Kestrel (*Falco sparvenius*)
- Brown pelican (*Pelecanus occidentalis*)
- Northern gannet (*Morus bassanus*)

Some windfarms have been sited in known areas of high raptor use, such as the West Ridge unit in the Tehachapi Pass of California. This location also correlates with relatively high abundance of rodents and other raptor prey. Correspondingly this facility has accumulated high occurrences of raptor mortality.

Understanding effects of offshore windfarms is becoming more significant as terrestrial platforms are coming under greater scrutiny. From observations at the Nysted windfarm in Denmark, before and after construction, there is some evidence to suggest seabird avoidance behavior may be greater than for terrestrially anchored turbines.

Biogeography

There are important instances of windfarm siting decisions which reveal a great lack of biological insight. Chief among these are two large windfarms near the Strait of Gibraltar and the California installation ofAltamont Pass. Research summaries have stressed the need to view avian mortality as a regional issue, in order to assess thoroughly the true impact upon bird migration patterns and the total ecological impact. The use of national statistics can mask ecological effects by yielding gross counts that may have little meaning of regional ecological consequence.

Geometric Data

Older style wind turbine towers using latticing at Altamont Pass, California.

It is useful to examine some statistics relevant to major windfarm installations. Rotor diameters are typically in the range of 42 to 72 meters, the latter being achieved in the Mountaineer, West Virginia array; consequently the vertical area swept by a single turbine is generally in the range of 1500 to 4000 square meters. As maximum heights of these farms have crept upward over the years to capture higher winds and more area, there is a greater likelihood of intercepting nocturnal passerine migration paths, which are typically in excess of about 130 meters above ground surface.

The number of individual wind turbines in a windfarm typically ranges from 16 to 143, the latter number being evinced in the Buffalo Ridge, Minnesota Phase One Array. However, some very large windfarms have been constructed such as the gigantic array at Altamont Pass in California, which has over 4900 individual wind turbines. This poorly sited array has turbines, and is noted as the largest bird killing field in North America. One reason for the high mortality at Altamont is the early development of this facility, prior to the availabiltiy of present data on siting criteria; unfortunately the state and federal regulations have not added a great deal to reduction in mortality, although they have produced many bureaucratic hurdles to the process.

In terms of the mechanics of mortality, it has been generally assumed that bird collisions with the rotor blade cause most mortality; however, compilations of data from the U.S. National Research Council do not fully support this premise in the case of passerines. Other mechanisms clearly contribute, such as collisions with support structures or guy wires. Statistics clearly show that passerine mortality increases with the use of guy wiring. Another aspect of tower design which influences bird deaths is adherence to Federal Aviation Administration guidelines requiring night illumination for taller towers. Bird deaths are greater at illuminated towers.

Outlook

Knowledge of how deaths occur will help alleviate problems in the future An obvious geometric consideration, for example, is to array turbines such that the rotor planes are parallel to any known bird migration corridors. Another ecological mitigation is to avoid placing wind turbine arrays between bird foraging and resting areas.

Small scale wind power systems offer a much more viable solution to bird conservation since wind hardware is of smaller scale and typically situated in more urbanized areas where migration routes and raptor hunting are not as intense as the open high wind velocity landscapes typically chosen for large commercial windfarms.

Any future windfarms should be preceded by much more detailed ecological studies than were characteristic of installations over the last three decades. Firstly siting decisions must reflect knowledge of bird migrations as well as occurrences of threatened species. On a more detailed level, it is desirable to survey for patterns of raptor use of thermals and other local patterns of predation. There are even more subtle factors, such as aerial courtship of certain species known to utilize turbine height airspace for their courtship rituals; USA examples of such species are the Horned lark (*Eremophila alpestris*), Vesper sparrow (*Pooecetes gramineus*) and Bobolink (*Dolichonyx oryzivorus*).

Design of individual turbines should reflect the best state of the art features in reducing bird mortality. For example, lattice support structures have been shown to attract more birds by offering perching opportunities, compared to the superior design of tubular mounts.

Planners and ecologists should be attentive to other mortality caused by windfarms, particularly to bats; moreover, the ecological implications to a broad palette of species is present, due to habitat alteration during windfarm construction and due to selective removal of apex and threatened species.

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