Wind Power and its Impact on Wildlife: A Look at Current Efforts to Minimize Harm

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The energy transition is likely to result in continued growth of wind energy project development with a total wind capacity projected to be 224.07 GW across 47 states by the year 2030, according to the U.S. Department of Energy (https://www.energy.gov/maps/-map-projected-growth-wind-industry-now-until-2050). Along with the environmental benefits of replacing fossil-fuel power with wind power, there is an undeniable impact to songbirds, raptors, other birds and bats. This article looks at various systems and technologies for minimizing harm to our flying friends.

The first step is to locate the individual wind turbines properly: biological surveys are done, sometimes for several years prior to development, to provide data regarding sensitive habitat, nesting locations, and migration routes. A biologist will study the landscape and point out risks that may not be obvious to the engineers. Once operating, minor changes in operations can significantly reduce risk. For example, bats prefer to fly in low wind, so raising the wind cut-in speed has resulted in significant reduction in bat impacts without sacrificing a lot of electrical production.

But once you've sited properly and optimized your operations, what more can be done?

1. **Radar / GPS**

   The use of radar to detect approaching birds is tried and true. It has been used for over ten years now on wind farms and has been largely voluntary. Radar is good at detecting large flocks of migrating birds. The first systems required a human to respond to the information, meaning someone would need to turn off one or a group of turbines when birds are approaching within a certain distance. Current radar systems can be connected directly to the wind turbine controls to turn them off or on automatically.

   Although less accurate at detecting individual large birds, they are becoming more sophisticated, and newer systems have seen success with detecting large individuals or smaller flocks of approaching birds.

   Software is being developed to identify biological targets from large-scale, established Weather Surveillance Radar, and track movements across large areas. The data could be used to produce models to assist with finding new locations for wind farms or improve curtailment protocols at existing wind farms.

The California Condor has presented a challenge to wind farms in the Tehachapi region (north of LA). The California Condor was near extinction in the 1980s and at one point there were fewer than 30 left in the world. For conservation, the last few wild individuals were brought into captivity for a breeding program. Some condors were hand raised until ready for release into the wild. Their repopulation has been successful, and their range is expanding, so there is starting to be some overlap into the wind farm areas. Not only are California Condors very large, most were tagged over the years with a Very High Frequency (VHF) radar or GPS device, for tracking. This enabled wind farm biologists to be alerted to the approach of a California condor and monitor their movements, curtailing turbines as needed. As more condors are born in the wild, not all will have GPS. Wind farms in this location rely on biologists in surveillance towers to respond to condor and eagles, as well as employ new technology such as IdentiFlight, in place at the Manzana Project.

2. New Technology

A bird deterrent technology called DTBird was developed in Spain and is being used at about 50 sites worldwide. The device looks like a speaker strapped to the monopole towers, aimed toward the blade-swept area. Once the system detects birds, it can make a warning sound and/or curtail the turbine. If birds can be deterred from entering the area, curtailment can be avoided. The issue with the sound is disturbance of non-targeted wildlife, and people, if near a populated area. Other researchers are working on "directional sound," directing sound in a narrow beam, like light. This is called Audio Spotlight technology and a product called Audio Lighthouse is being studied for use at wind farms.

Another new technology called Identiflight uses cameras on top of their own towers combined with artificial intelligence software to identify species of birds and curtail turbines as needed. For example, if you are interested in detecting golden eagles, this system uses a database of millions of images of golden eagles to match the characteristics of an observed bird to the images – along with adding images in real time to further refine its intelligence. The technology can see one kilometer away and respond by curtailing turbines in the same way that radar can. The main advantage of Identiflight is its ability to identify individual protected species. This technology is in operation at the Manzana Wind Power Project as part of a Condor Risk Minimization Program. The Program is discussed in a December 2020 Environmental Assessment to support an application for an Incidental Take Permit for California Condors, which will be the first such permit for this species.

3. Bat Deterrent Technology

Bats require a different approach for study and protection. Regarding siting, it's been found through experience that biological surveys prior to development may not identify risks: locations that did not show a lot of bat activity prior to construction have been found to have increased activity once the turbines are in place. It appears that bats are attracted to the turbines. It's been speculated that bats mistake the mono poles for trees and come looking for food. It's also possible that the monopoles do actually attract insects which then attract bats. Bats use sound waves for identifying objects and navigation, called echolocation, and it has been hypothesized that their sense of echolocation may not detect the moving blades. Once they are in close proximity to the spinning blades, the sudden and extreme change in air pressure could burst air pockets in the body - this is called barotrauma. A study in 2008 found that more than 50% of the dead bats had internal barotrauma without any signs of impact, but a later study by NREL was not as conclusive and indicated that bats are, in fact, being struck by the blades. In either case, the challenge is keeping bats away from the turbines.

The company that developed DTBird also developed DTBat. The system identifies the presence of bats by recognizing their ultrasound and then can curtail the turbines to prevent impacts.

Researchers at various organizations and private companies have developed technology to deter bats from approaching wind turbines using what we know about echolocation. The systems emit an ultrasonic acoustic field in the same range as bats natural frequencies, but louder. This effectively "jams" the air waves and the bats ability to hear its echoes. The goal is to discourage bats from entering the airspaces being treated with the unnatural sound waves. If bats can be deterred, curtailment can be avoided.

There are also studies regarding basic design:

- Engineers have been experimenting with new designs: one that is teardrop shape, for example, and spins on a vertical axis.
- Researchers are studying different paint colors, since light colors attract insects. Yellow, white and gray were the most attractive, and darker colors less so. But darker colors may have other issues, such as heat.
- What effect do turbine tower height and blade length have on wildlife? Some studies have shown that higher hub height and smaller blade lengths have reduced impacts on birds, although other studies have not found this to be the case.

CONCLUSION

If you're interested to learn more, check out the Department of Energy's Wind Energy Technologies Office website. They summarize the many studies being done to develop innovative technologies and lower costs to accelerate the deployment of wind energy throughout the country. Looking through the current projects these days, you will notice that the focus has really shifted to offshore wind development. I'm sure we will see some of the technologies discussed here applied to offshore wind farms.

To learn more about E3's services or to discuss your situation, contact **Carol Ho** at **720-833-6345** or email to **carol.ho@e3co.com.**