Wind turbines and local wildlife: A collision course

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Introduction and background

Located in the Diablo Range of west-central California, Altamont Pass Wind Resource Area (APWRA) is one of the earliest-established wind farms in the United States and has the highest concentration of wind turbines in the world. The wind resource area includes 5,400 wind turbines across 165 km^2 and a total capacity of up to 480 MW, the yearly annual benefit of which can power over a hundred thousand households. It is known less for the clean energy that it provides, however, and more for its drastic effect on local bird populations: "[A]nnual wind turbine–caused bird fatalities [...numbered] 67 golden eagles (*Aquila chrysaetos*), 188 red-tailed hawks (*Buteo jamaicensis*), 348 American kestrels (*Falco sparverius*), 440 burrowing owls (*Athene cunicularia hypugaea*), 1,127 raptors, and 2,710 birds" (United States of America, National Renewable Energy Laboratory). These statistics do not include hypothesized impact on bats or the effect of shadow-flicker and low frequency noise on ground animals.

In 2004, Carleton College dedicated its first 1.65 MW wind turbine, which, while not directly connected to the Carleton electrical grid due to lagging infrastructure, provides electricity to the Northfield electrical grid capable of powering between 500 and 600 homes. Later, in 2011, the college added a second 1.6 MW turbine as a gift from alumni that provides power directly to campus and serves more than twenty-five percent of the electrical load. Together, these wind turbines decrease Carleton's carbon footprint by a minimum of ten percent, allowing the college to make significant progress on its Climate Action Plan (Carleton Climate Action Plan Steering Committee). Since installation, there have been no major concerns with the wind turbines, environmental or otherwise, according to Carleton's Manager of Campus Energy and Sustainability, Martha Larson. The only regular monitoring that occurs relates to functionality, rather than ecological impact, and has only ever indicated the need for basic

maintenance. Never has there been a survey or study done to analyze the impact of these wind turbines the near the wildlife area provided by the Cowling Arboretum.

From a highly anthropocentric perspective, the wind turbines have also been significantly more advantageous than they have been disadvantageous. Each wind turbine requires only one third of an acre, located in the midst of an agricultural field, and the owner leasing the land financially benefits far more than she would otherwise (Martha Larson). Moreover, there have been no complaints of "Wind Turbine Syndrome", the affliction that is said to result from living in close proximity to wind turbines, which is notable given that a residence is found only a short distance away from Carleton's wind turbines on the same property. Supposedly caused by shadow flicker and low frequency vibrations, common complaints of Wind Turbine Syndrome include tinnitus, headaches, nervousness, and nausea. Currently, the syndrome is unproven and widely regarded as a nocebo, meaning the syndrome does not truly occur.

In sum, the wind turbines have thus far been significantly advantageous to the college with few proven defects, yet we have little idea of the impact that this infrastructure might have on natural spaces nearby. Given the role of these wind turbines in multiple areas of environmental concern, how do we weigh the impact on wildlife populations against the environmental benefits of renewable energy? How might we reconsider the usage of wind turbines to power Carleton?

Results of student survey

Regardless of the factual advantages of wind turbines at Carleton College, it would not be uncommon to face differing opinions from the general public -- in this case, those of the students, faculty, staff, and community members of the college. David Bidwell is a professor at the University of Rhode Island in the College of Environment and Life Science, and has examined public knowledge and its influence on green energy projects. In Bidwell's discussion of "The Effects of Information on Public Attitudes Toward Renewable Energy", he highlights the role of adequate information on attitude

formation and change; specifically, that "public attitudes or behaviors can be explained by a deficiency in knowledge". Given scenarios where this deficiency of knowledge is relevant, opposition to wind turbines is generally characterised by vocal minorities concerned by the impact on their interests, desire to protect highly valued places, and conditional support for wind energy as a whole (Bidwell). To evaluate public opinion surrounding Carleton College's use of wind energy, a survey was designed to assess the perspectives of students. The following question was asked of survey participants:

> *Carleton's two wind turbines may have an impact on local bird and bat populations. In this context, which of the following is more important to you: use of renewable energy or local wildlife conservation?*

The results were overwhelmingly in favor of renewable energy. Of the 117 respondents to this survey question, 110 would prioritize the use of renewable energy over local wildlife conservation. Extrapolating, we can estimate that 94 percent of Carleton students would support the use of wind turbines, even if they impact local wildlife. Of the students who replied that they would prioritize the use of renewable energy over local wildlife conservation, a majority also ranked "protecting the environment" and "working to preserve the environment" as their first or second priority on previous survey questions. We can then draw the intriguing conclusion that perhaps Carleton students who identify strongly as environmentalists see ecosystem stability rather than the rights of individual animals as more important for the environment, as we do. It is possible then to assume that the recommendation made from our ethical framework aligns with public opinion -- at least that of students -- at the college, and therefore would receive support from the community as a whole.

Ethical framework

The ethical framework that we use to consider this dilemma is one that values the lives of individuals within the ecosystem, but places a higher value on the overall stability and well-being of the

biotic community. This allows us to maintain an ethical relationship with the animals that live in the vicinity of Carleton and to place the health of the ecosystem above all else.

There is a significant amount of ethical literature that supports this view, including Holmes Rolston's "Duties to Ecosystems", which advocates valuing ecosystems as biotic communities that ultimately force individuals to depend on one another. "Duties to Ecosystems" proposes that when each individual self-aggrandizes, the community's value as a whole will rise. Although cooperation in an ecosystem is unlike cooperation in a human community, as nonhumans have a tendency not to place the needs of one another in high regard, the struggle of community members for survival ultimately affects both the entire ecosystem and their fellow community members. Although the ecosystem has no subjective life, individuals are dependent on the ecosystem to live. Another environmental ethicist Eric Katz advocates for the protection of ecosystems first, with a secondary nod to individual organisms (Katz). Similarly, utilitarian Peter Singer says that it is imperative that we acknowledge the suffering of sentient creatures: "If a being suffers, the fact that it is not a member of our own species cannot be a moral reason for failing to take its suffering into account" (Singer). We cannot, however, prioritize individual nonhumans to a degree that results in damage to ecosystems, as this would only serve to do further harm unto those that live in that environment; specifically, nonhumans.

There are, naturally, a few questionable points in this argument: Though it may be complex to define an individual ecosystem, as each biotic community is in essence a cog in a global ecosystem, we may easily bypass this concept by recognizing how the stability of a single part may affect that of the whole. As a cog fails in a machine, it does not rotate, which thereby causes the entire machine to fail. Likewise, were an area of a smaller ecosystem polluted with oil, the original ecosystem would affect the ecosystems around it, polluting ecosystems downstream, and the ecosystems that interact with it, such as birds that may fly between ecosystems. As the smaller ecosystems interact with one another, they

ultimately form a single ecosystem that depends on the cooperation of each other. Furthermore, ecosystems are always adapting, and it's hard to decide whether a change is good or bad. The word stability is similarly inscrutable. Here we will define stability as a measure of the integrity and diversity of an ecosystem, as well as that system's ability to self-regulate. Integrity, by our definition, is the ability of a system to maintain life at equilibrium; in other words, a certain ecosystemic homeostasis. To borrow a phrase from Aldo Leopold, "A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise" (Leopold).

Application of ethical framework

Wind turbines at Carleton are permissible and even encouraged because of their benefits to the environment and minimal impact on individual nonhumans. The renewable energy benefits of wind turbines far outweigh any cost to animal life. Wind energy is the nation's fastest growing energy source due to tax credits and renewable energy mandates in some states. Wind energy is the future of clean energy and a major step in moving away from energy sources like coal that pollute the environment. By 2011, wind power was already generating about 2% of the nation's electricity, but the Department of Energy estimates that with improved technology and large-scale investment, wind power could be generating up to 20% of power worldwide by 2030 (David Hosansky). The expansion of the wind industry is a major part of the future of clean energy in the United States, and will be critical in reducing carbon emissions.

Despite concerns raised by various environmental groups, wind turbines do not actually have a large impact on the surrounding ecosystems. Earlier designs of turbines with lattice structures for the tower and shorter blades posed a much greater threat to birds and bats than the more sleek design with longer, slower-moving blades that is now commonly used. Additionally, wind farms not directly located in migration routes do not contribute to bird or bat deaths. . Each year, several million more bird and bat

deaths are caused by pesticides, attacks by other animals, and collisions with windows than by wind turbines (David Hosansky). Wind energy is also a safe and inexhaustible resource, and turbines are less expensive to install than coal or nuclear plants. The United States also has very good resources in terms of wind.

Before installing the turbines, Carleton conducted studies on shadow flicker and noise to ensure that any nearby buildings would not be disturbed, and looked at migratory patterns to confirm that neither turbine would interfere with bird migrations. Additionally, Nancy Braker, Puzak Family Director of the Cowling Arboretum, and other local ecologists discussed the potential impacts of a wind turbine on wildlife, and concluded that the ways in which the wind turbine could harm birds were insignificant and not a primary concern. This hypothesis has been further strengthened by a study at St. Olaf College led by Gene Bakko found only one bird death in three years of regular monitoring. While no similar study has been conducted at Carleton, both of Carleton's wind turbines are situated in the middle of farmed fields and not in the way of any migration patterns, so bird deaths are unlikely.

There are, however, concerns about turbines and their effect on wildlife that need to be recognized. Gene Bakko, a now-retired professor of biology at St. Olaf College, was first in the Northfield area to inquire into the potential impacts of wind turbines on local ecosystems, specifically in regards to the adverse effect they may have on birds. St. Olaf's wind turbine is surrounded on three sides by 150 acres of land that is in a permanent easement, meaning that the land will be protected as it is forever, even through any changes in ownership, and cannot be developed. Shortly after the installment of the wind turbine, the U.S. Fish and Wildlife Service expressed concern about its effects on the wildlife inhabiting the permanent easement areas. To investigate, Bakko began a study with students of his natural history course to determine the effects, if any, that St. Olaf's wind turbine had on surrounding wildlife. Conducted primarily during spring migrations, the survey spanned the last three years of Gene's teaching,

and concluded that there was very little cause for worry. Students were taught to observe the interactions birds had with the turbine and report their findings. They found that the flight patterns of the birds would often change in order for them to fly around the turbines' spinning blades (Bakko). When searching for evidence of wildlife killed by the turbines, the students would regularly and systematically walk the area defined by the radii of the blades, assuming any animal that had come into contact with the blades would fall somewhere within the circle. After not finding anything, they enlisted the help of trained hunting dogs to find any animals they may have missed. The even planted fake kills to ensure the dogs were effective. In three years, the most they ever found were a few crow feathers The researchers concluded that while it is possible that predators found and ate the wildlife before they could search the area, only one bird died from collision with the wind turbine over the course of the study (Bakko).

Another study observed 23 prairie chicken leks near a wind turbine in Kansas. Conducted over a four year period, this study noted that leks within 1 kilometer of the turbine had a 50 percent chance of remaining active, compared to leks that were at least 6 kilometers away from the wind turbine, which had a 95 percent chance of remaining active (Winder). The study concluded that nearby wind turbines likely caused the prairie chickens to move their leks.

Recommendations

Many environmental groups desire a moratorium on wind energy development, and wish to do more research into bird and bat deaths before continuing to establish wind farms. This is not necessary as long as wind developers take certain precautions. Adaptive planning is the best alternative to a moratorium, because it allows for a continued mitigation of climate change through using wind energy, while still allowing room for reducing any potential bird and bat deaths. There will always be uncertainty, so adaptive planning will be more effective if it focuses on "the development of renewable energy as part of efforts to meet climate policy goals" (Johann Köppel, et al.), instead of halting development of this

budding industry completely. However, there must be a set plan. Adaptive planning cannot be “trial and error”; it needs a clear and defined outcome and an investigative approach that takes into consideration other possible pathways and the management plans corresponding to those pathways. Since it is not practical or efficient to modify a turbine once it has been installed, adaptive planning is essential toward preventing unnecessary bird and bat deaths.

Adaptive planning can operate on several levels. Planning approaches can function on the operational level, and on the policy level. One possibility for planning is a temporary curtailment of turbine operations during times of the year associated with high mortality risks, such as migration seasons. In Pennsylvania, Shaffer Mountain Wind Farm instituted this kind of adaptive planning. Since the farm lies in a major migratory path for hawks, eagles, and the endangered Indiana bat,they drafted an Adaptive Management Plan (AMP) that curtailed their operation during certain migration-heavy times of the year so the mortality rate would not exceed 2%. This kind of adaptive planning and management is an appropriate alternative to a moratorium or the precautionary principle, since it does not limit the use or development of wind power, but rather continues to contribute toward climate change mitigation while also minimizing impacts on wildlife.

Given this information, Carleton should continue to maintain the turbines, but take adaptive planning measures if necessary. For example, if the college were to install a third turbine, siting would have to be taken into consideration. The developers would need to avoid wetlands and nesting grounds, as well as migration routes for birds and bats. Since the turbines have little to no effect on birds and bats, and generate a large percentage of the college’s energy on a daily basis, it would be less environmentally friendly to stop using them. To halt the wind turbines and thus their ecological benefits would be morally unjustifiable.

Annotated Bibliography

Bakko, Gene. Personal Interview. 24 October 2016.

Gene Bakko, a retired professor of biology at St. Olaf College, has done research on the effects of his college's wind turbine on local wildlife populations.

Bidwell, David. "The Effects of Information on Public Attitudes Toward Renewable Energy." *Environment and Behavior*, Volume 48, July 2016, 743-768.

Bidwell explains why public opposition is often due to a lack of public knowledge on a subject, and offers six different attitudes the public has toward wind energy and why they occur. He then explains a study done where one of two groups of people got information about wind energy, and the more informed group was more receptive of the idea of installing turbines.

Brahic, Catherine. "Wind Turbines Make Bat Lungs Explode." *New Scientist*. N.p., 25 Aug. 2008. Web. 21 Oct. 2016.

The area directly surrounding wind turbines give off an unwanted feature, in which there is dramatic air pressure differences caused by the moving blades. This air pressure difference puts a heavy strain on the bat's lungs, causing some of them to undergo barotrauma, an unpleasant experience that bursts the blood vessels.

Carleton Climate Action Plan Steering Committee. *Climate Action Plan May 2011.* Northfield, MN: Carleton College, May 2011. PDF.

Address the impact of Carleton College's wind turbines on plans for the college to cultivate environmental sustainability and achieve goals relating to renewable energy.

Fraser, David. "A "Practical" Ethic for Animals." *Journal of Agricultural and Environmental Ethics* 25.5 (2012): 721-46. Web.

Fraser's work provides insight on animal-human interactions based on knowledge of people affect animals and guidance on ethical concerns that arise. This framework acts as a counterpoint to Singer's philosophies, and is used in our analysis of what is, in fact, an ethical way to proceed in the issue of wind turbines.

Hosansky, David. "The Issues: Wind Power." *CQ Researcher* 21.13 (2011): 289-98. Web.

This article provides a detailed overview of the development and usage of wind turbines, as well as a discussion of the current issues facing wind turbines, including that of their impact on wildlife populations.

Köppel, Johann, et al. "Cautious but Committed: Moving Toward Adaptive Planning and Operation Strategies for Renewable Energy's Wildlife Implications." *Environmental management* 54.4 (2014): 744-55. *ProQuest.* Web. 21 Oct. 2016.

This article reviews research that has already been done on bird and bat deaths and discusses difficulties in observing effects turbines have on wildlife. It explains Precautionary Principle but suggests that adaptive planning and management would be a better alternative that does not slow climate change mitigation efforts. It concludes with examples of locations that have used adaptive planning successfully.

Larson, Martha. Personal Interview. 19 October 2016.
Martha Larson is the Carleton College Manager of Campus Energy and Sustainability.

Loder, Reed. "Breath of Life: Ethical Wind Power and Wildlife." *Breath of Life: Ethical Wind Power and Wildlife*. Animal Law, Spring 2009. Web. 21 Oct. 2016.
The article examines the ethical issue of wind turbines disrupting the ecology of wild animals. The toll it places on wild animals such as bears, birds, and bats is irrefutable, and our culture must adapt to restrained aesthetic changes that bring wind turbines to dot selected mountain ranges.

Ruhl, J. B. "Harmonizing Commercial Wind Power and the Endangered Species Act through Administrative Reform." *Vanderbilt Law Review* 65.6 (2012): 1769-99.*ProQuest.* Web. 21 Oct. 2016.
This article discusses the potential risks the Endangered Species Act poses to wind developers, and argues that the ESA needs to be more flexible when it comes to developing wind energy, but also that the U.S. Fish and Wildlife Service needs to define actual regulations to streamline the process.

Singer, Peter. "Not for Humans Only: The Place of Nonhumans in Environmental Issues." *Environmental Ethics : An Anthology.* Malden, Mass.: Blackwell Pub., 2003. 55-63. Print. Blackwell Philosophy Anthologies.
The principal argument of this article -- that if a being suffers, we have a duty to consider its suffering -- is taken into consideration in our analysis of how we ought to account for the experiences of birds and bats affected by wind turbines.

Sprague, Terry, Harrington, M. Elizabeth, and Krogh, Carmen M. E. "Birds and Bird Habitat: What Are the Risks from Industrial Wind Turbine Exposure?" *Bulletin of Science, Technology & Society* 31.5 (2011): 377-88. Web.
Summarizes available literature on bird kill rate and disruption of habitat observed with the introduction of industrial wind turbines, but repeated invokes the clause “in proximity to migratory bird corridors, wetlands, and nesting grounds”, which gives rise to the premise that it might be possible to responsibly introduce industrial wind turbines with appropriate research and prior observation to avoid these areas.

United States of America. National Renewable Energy Laboratory. Office of Energy Efficiency and Renewable Energy. *Bird Mortality at the Altamont Pass Wind Resource Area.* By K. S. Smallwood and C. G. Thelander. Ojai, California: n.p., 2005. Print.
The Altamont Pass Wind Resource Area is the site at which concerns were first raised about industrial wind turbine usage, primarily due to the number of golden eagle fatalities.

Willis, C.K.R., et al. “Bats are not birds and other problems with Sovacool’s (2009) analysis of animal fatalities due to electricity generation.” *Energy Policy* (2009). Web.
The differences examined by Willis et al. are the basis for our consideration of the complexities of directly comparing the effect of wind turbines on birds with their vastly different effect on bats. ‘

Winder, V.L. et al. 2015. Responses of male Greater Prairie-Chickens to wind energy development. The Condor doi: 10.1650/CONDOR-14-98.1.

A four year study observing 23 leks in Kansas noted that prairie leks closer to wind turbines had a higher chance of abandoning their position. Prairie leks only had a 50% chance of remaining active within a mile of the wind turbine, compared to 95% chance if they were 6 or more miles away. Prairie chickens had a body mass loss of 2% after installation.

"Wind Turbine Interactions with Birds, Bats, and Their Habitats." National Wind Coordinating Collaborative, Spring 2010. Web. 21 Oct. 2016.

This article helps give a fact sheet in which it describes the impact that wind turbines have had on bats, birds, and raptors. It brings together data on the direct mortality of the animals, and the factors that have caused the most harm to wildlife. It then offers solutions that could greatly reduce the number of deaths and injuries.