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As climate change drives demand for wind energy, can technology protect birds?

By Jane Braxton Little

From the peaks of the Tehachapi Mountains the terrain free-falls a heart-stopping 5,000 feet to the flat of the Mojave Desert 80 miles north of Los Angeles. In early March the desert is mint green as it stretches southeast 100 miles to San Gorgonio Mountain, its peak still capped with snow. Spring is warming the sage-scented air, sending it aloft to collide with the currents moving down through the Tehachapi canyons. The gusts swirling against the ridgeline bluster out across the desert, making the Mojave one of the windiest places in the West.

For millennia these ridges have served as a platform for California condors to catch the thermals on nine-and-a-half-foot wings. Golden eagles, too, have been drawn by the currents to hunt and mate in elaborate aerial displays, and to nest in the canyons that spill into the Mojave.

Today this wind-swept region is also home to 4,581 wind turbines. They are part of a surge in wind-energy development that has nearly quadrupled in the last decade.

For wildlife advocates, this escalation can't come soon enough. With climate change already delivering more extreme weather and impacting a diverse array of species, a shift from fossil fuels to renewable energy is urgent, says Joy Page, Defenders of Wildlife's director of renewable energy and wildlife. "The only hope for avoiding the worst of this damage requires transforming the world economy at a speed and scale that has no documented historical precedent. We can get there, but it's going to take stakeholders working together."

The Tehachapi turbines represent the paradox of the burgeoning wind industry. Occupying space long the domain of condors and golden eagles, turbines present dangers to raptors. But with climate change one of the greatest overall threats facing wildlife, they are also the hope for the future of these species and more. As wind energy replaces carbon-emitting fossil fuels, careful turbine siting and innovative technology promise to protect these and other birds and the ecosystems on which they depend.

Wind industry leaders have embraced the challenge of developing renewable energy in a landscape where wildlife and wind energy coexist. They are well aware of the hazards spinning blades present to certain birds, and of the industry's early record of avian fatalities at several poorly sited projects. To address this, industry leaders such as Avangrid Renewables and Duke Energy are employing a variety of innovations designed to detect and minimize conflict with wildlife at wind farms.
Representatives of conservation organizations and the wind industry alike believe these scientific solutions—some under development, some on the market—are already providing wildlife protections that allow expansion of wind energy at the pace needed to curb further climate change. "This is a time of hope and promise—a time to think creatively," Page says.

On a sunny March morning gleaming after days of rain, I drive across the northwestern corner of the Mojave. Wind turbines line the gentle hills to the north, silhouetted against the sky like soldiers guarding a pass. As I head toward the Tejon escarpment the turbines march downhill into the sage, a cadre of three-armed giants amid Joshua trees sporting creamy white flowers the size of pineapples. Sam Somerville is waiting for me at the Manzana Wind Power Project operations and maintenance building, an unadorned structure on a low rise at the base of the ridge. Owned by Manzana Wind, LLC, a subsidiary of Avangrid, Manzana boasts 126 turbines generating up to 189 megawatts of clean energy.

Somerville, Avangrid's wildlife compliance specialist, drives us through a network of dirt roads leading uphill into a maze of turbines. A lean man with blue eyes, stubble beard and dimples, he heads toward the Tehachapi Mountains and the long sweeping ridgeline to the west, where golden eagles nest and condors congregate in small groups.
We cross a section of the Pacific Crest Trail and pass turbines where workers have ascended some 200 feet into the Winnebago-sized units that house the gears and generators behind the rotor blades. Along with conducting routine maintenance and repairs, these technicians are trained to report the birds and other animals they see onsite or nearby: eagles, of course, but also mountain lions, Mojave-green rattlesnakes and a bobcat with two cubs sighted in the crouch of a Joshua tree. Somerville is here to provide periodic wildlife training to the technicians.

The turbines throb with power. The blades—about half the length of a football field—do not beat the air as much as rotate with a casualness that belies the speed of their spin, as much as 200 miles an hour at the tip. Each turbine is self-regulating, turning on and off and adjusting the direction of the blades as winds shift.

Among the turbines at the western edge of the Manzana project is a diminutive 23-foot pole mounted with a ring of fish-eye cameras and topped by a rectangular box. This is IdentiFlight, a monitoring system designed to detect bald and golden eagles within a kilometer of the turbines.

“I call it WALL-E,” says Somerville almost affectionately. And indeed, IdentiFlight has the square-headed charm of Pixar’s beloved robotic trash compactor. As we discuss its looks and operation, the box suddenly swivels, its black-rimmed “eyes” riveting into focus on something barely visible on the eastern horizon. After several seconds of palpable tension, the “robot” loses interest and just as suddenly relaxes. “Helicopter,” Somerville says.

IdentiFlight uses high-precision optical technology to determine the distance to the birds it spots, then measures the wingspan and records other attributes such as color. Using artificial intelligence software, it decides if this is a species of interest, says Tom Hiester, president of IdentiFlight International. Each photo it takes of a golden eagle adds to a database of images, making identification of future images increasingly accurate. If it’s a protected bird that’s on track to collide with a wind turbine, IdentiFlight can shut the turbine down either automatically or by sending a signal to a human operator.

Moments after locking onto the helicopter, IdentiFlight again snaps to attention, swiveling this time to focus due west on the Tehachapi ridgeline. Condors, North America’s largest land birds, have been spotted there for several years as they reclaim this sector of their historical territory. In the 1980s, when the species was reduced to just 23 birds, federal officials captured all of them and launched a captive-breeding program to stave off extinction. Since they began releasing captive-bred condors in 1992, the birds have gradually expanded and now are using the entire range scientists documented in the 1980s, says Jesse Grantham, retired coordinator of the federal condor recovery program. They work the ridges above the Mojave Desert in groups of five to 10, using the thermals to soar on outstretched wings in one of nature’s most inspiring sights.

Wind energy boomed while condors were reproducing in captivity. Today it represents over 6.5 percent of the nation’s power supply, up from levels too insignificant to measure a mere 16 years ago. In 2018, wind reached the capacity to power the equivalent of over 30 million American homes, according to the American Wind Energy Association. California is poised for a “massive amount of electrification” to meet its goal of zero-carbon electricity by 2045. Industry officials know for this boom to continue, they must work diligently to minimize the effects on wildlife. That has led to new-found collaboration with conservation groups focused on technological innovations.

At Avangrid’s Manzana project, the Portland-based company is midway through a one-year test of IdentiFlight’s accuracy in detecting eagles, says Amy Parsons, operations wildlife compliance manager. The unit could eventually recognize condors, says Hiester. In the meantime, the Manzana site monitors for condors using the radio transmitters and GPS units mounted on a majority of the roughly 80 birds that make up the Southern California population. Avangrid also uses “geofence,” a virtual protection around the wind farm perimeter that alerts operators when a condor crosses over it.

The immediate target for IdentiFlight at Manzana is golden eagles. These birds were not doing well before the wind-farm boom, the victims of starvation and poisoning. They are also suffering from shootings, electrocutions and collisions, some with wind turbines, says Page. Endangered in

California, golden eagles are projected to lose 41 percent of their breeding range and 16 percent of their nonbreeding range by 2080, according to a 2015 Audubon report.

While these other threats to eagles are believed to be much greater than wind-energy development, the industry is committed to reducing their impact. IdentiFlight units have been mounted at 51 sites around the world. The effectiveness of this technology was reviewed in a month-long field test of four units conducted by American Wind Wildlife Institute (AWWI), a nonprofit organization founded by a coalition of conservation, science and wind industry groups. IdentiFlight detected nearly all the birds human observers saw, and it saw 5,958 birds that the humans missed—a whopping 562 percent more.

Bird advocates welcomed this proof-of-performance test as validation despite the small sample size and very brief test period. While testing has only been completed in Wyoming to date, IdentiFlight is promising technology that is needed right now, says Garry George, Audubon's director of clean energy. "Considering the dire threat birds face from climate change, we need to move quickly on this technology so responsible wind energy can accelerate at the scale and pace needed with the least impact on our eagles," he says.

Avangrid is still testing its two IdentiFlight units, but the AWWI trial was enough for Duke, the nation's largest energy company. It has installed 47 IdentiFlight units covering all 110 turbines in the undulating sage-steppe grasslands at its 1,700-acre Top of the World wind project in Wyoming. A big incentive was its dramatic out-performance of human monitors, says Tim Hayes, Duke's environmental director.

Duke was also motivated by federal law after the company was prosecuted in 2013 for killing golden eagles at a project in Wyoming. As part of a $1 million settlement agreement with the U.S. Fish and Wildlife Service, Duke agreed to invest in new technology to address impacts at existing projects located in areas at high risk for golden eagle fatalities. "The company has since become a leader in addressing wind energy impacts on eagles," says Page.

Hayes is optimistic about the combined efforts of industry, scientific research and conservationists: "We're in that early stage of developing these technologies to address environmental issues, but wind is growing so rapidly I have no doubt we'll figure it out."

As the urgency of climate change increases the pressure to generate more wind energy, wind farms are experimenting with several technologies and techniques to detect birds entering their air space. In addition to IdentiFlight, operators are testing DT Bird, a device that uses a variety of audio alarms to deter raptors from approaching wind turbines; ThermalTracker, which uses heat-sensing cameras to record seabirds approaching offshore sites; and devices to detect vibrations in blades signaling a bird strike. AWWI offers independent scientific reviews that contribute to company decisions on whether to invest in a particular technology.

Behind each innovation is the science that makes it useful. Esteban Fernandez-Juricic and Jeff Lucas, both Purdue University professors of biological sciences, are studying the visual and auditory physiology of bald and golden eagles. They are trying to understand just what sounds and light properties birds might pay attention to and avoid. Funded by the Department of Energy and Avangrid, the Purdue researchers believe the synergy of combining auditory and visual stimuli could lead to better deterrence techniques.

Ecologist Shawn Smallwood has spent decades studying the flight patterns of eagles, kestrels and other birds at Altamont, California, site of one of the nation's earliest wind farms. He has established that golden eagles fly around the perimeter of ground squirrel colonies, using ridge saddles and

breaks in the slope to surprise their prey. Kestrels hover at the tops of hills, drifting with the wind. At turbine farms “they forget there’s something behind them that’s really dangerous and they get pushed back in the turbine engine and clobbered,” Smallwood says, adding that nothing protects birds better than proper siting of wind turbines. Smallwood has used his scientific studies to relocate turbines to reduce bird fatalities at Altamont, where hundreds of bird fatalities in the 1990s launched industry efforts to reduce collisions.

Not all attempted innovations have panned out and, along with widespread enthusiasm, the collaboration among scientists, industry officials and conservation organizations on technological innovations has generated some skepticism. Smallwood, for example, is still waiting for data demonstrating that IdentiFlight and other technologies will protect eagles. “Like everyone else, I hope for a mitigation solution,” he says. “But I’ve learned the hard way that there are no shortcuts to adequate experimental design.”

For Page, this is a time of great expectations—when wind industry and conservation leaders are working together to develop carbon-free electricity on a landscape where wildlife is protected. “We have proved the power of collaboration and the will of the industry to keep investing in technology,” she says. “The solutions are out there.”

As turbines hum across the hillside where Somerville and I are standing, IdentiFlight again snaps into action. A barely detectable bird dives on the horizon near the Tehachapi ridgeline. We freeze for several seconds, straining to see if the cameras have sighted one more eagle to add to IdentiFlight’s database. Just as suddenly the unit drops into sleep mode. Another raven. Each identification, golden eagle or not, adds to IdentiFlight’s IQ, says Somerville. “It’s getting smarter every day.”

California-based freelance journalist Jane Braxton Little writes for Scientific American, High Country News, Yale E360 and other publications.

Watch condors in the wild at www.defenders.org/condorvideo.

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