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Battered by Harsh Winds
Must bats pay the price for wind energy?
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Through the psychedelic lens of a thermal-imaging camera, the 115-foot (35-meter) blades of giant wind turbines are blends of reds, yellows, blues and purples. Then a bat arrives as a surreal triangle with an orange core that shifts through yellows, reds and shades of blue out to its wing tips. The images show the colorful little bat meeting the spinning blade and spiraling down and out of the picture. If the camera could have tracked the bat, it would have seen orange warmth fade to cold blue.

The $60,000 thermal imaging cameras set up at the Mountaineer Wind Energy Center in West Virginia showed bats approaching the electricity-producing turbines almost like curious kittens enchanted by a tumbling ball of yarn. When the blades were spinning at their standard 17 revolutions per minute (rpm), the results could be and often were fatal. Yet bats sometimes chased harmlessly after the tips of slow-moving blades as though investigating the inexplicable devices that proved neither prey nor bat. Some bats actually landed on stationary blades, suggesting curiosity about potential roosts or sources of insects.

Boston University researcher Jason Horn set up three thermal-imaging cameras night after night at the Mountaineer Wind Energy Center in Thomas, West Virginia, to record, for the first time, bats' interactions with the 220-foot-tall (67-meter) wind turbines. He collected and stored hundreds of hours of video footage – more than 8,000 gigabytes of data – that has since been meticulously studied to finally let biologists see how the rapidly spreading wind turbines are killing bats and, we hope, learn how to avoid those deaths.

Horn joined forces during the summer of 2004 with BCI Conservation Scientist Ed Arnett (wind energy research coordinator), statistician Wally Erickson of Western Ecosystems Technology and biologist Jessica Kerns from the University of Maryland in the most intensive investigation of bat fatalities at wind farms ever conducted. The six-week field study, from July 31 through September 13, 2004, was under the direction of the Bats and Wind Energy Cooperative (a BCI-led alliance of key federal agencies, wind-industry groups and international experts).

The study was funded by BCI, the American Wind Energy Association, the U.S. Department of Energy's National Renewable Energy Laboratory and alternative energy initiatives from several states. Florida Power and Light Energy, a key industry partner in last year's progress, offered its wind facilities at Mountaineer, West Virginia (44 turbines), and Meyersdale, Pennsylvania (20 turbines), for the study. Both are located along the Appalachian Plateau.

The scientists' report summarizing the first year's research into potential causes and solutions to the bat kills was released last June (see *www.batcon.org/ wind/research/*). The study documented alarming kill rates at both facilities. We calculated that between 1,364 and 1,980 bats were killed at Mountaineer and 400 to 660 died at Meyersdale during just this six-week period. These estimates support the observation that wind farms built on

forested ridges, as these were, pose especially high risks for bats.

Our work pointed us toward a promising and apparently low-cost possibility for sharply reducing bat kills at turbines. At both locations, the majority of bat kills occurred on nights of low wind, when electricity production was insubstantial but blades were kept spinning at or near full speed. Of the 64 turbines studied, only one produced no bat fatalities – it was also the only turbine that was out of service, with its blades "feathered" (turned parallel to the wind and left to rotate slowly, so they posed little or no threat to bats) throughout the study.

The Bats and Wind Energy Cooperative scientists propose that most bat kills can be avoided by simply not attempting to power up blade rotation until wind speeds reach profitable levels. Based on these findings, our scientific team recommends experiments that would compare fatalities when turbine blades are feathered versus when they are set to spin at near-normal speeds during low-wind periods. The goal is to measure precisely how much mortality can be prevented and at what impact on power production.

Unfortunately, the cooperative has not yet found a single wind-farm operator willing to permit such experiments, despite earlier promises of participation.

The 2004 research identified bat fatalities of six species at both sites: hoary bats (*Lasiurus cinereus*), eastern red bats (*Lasiurus borealis*), eastern pipistrelles (*Pipistrellus subflavus*), little brown myotis (*Myotis lucifugus*), silver-haired bats (*Lasionycteris noctivagans*) and big brown bats (*Eptesicus fuscus*). Northern myotis (*Myotis septentrionalis*) were killed only at Meyersdale.

Rain or shine, for six weeks in that August and early September, field technicians searched each day along transect lines under turbines looking for dead birds and bats. Half of the turbines were searched once each day while the others were searched once a week so the fatality counts of the two sampling intervals could be compared.

The searchers' ability to find dead bats was, not surprisingly, highest on bare ground and declined precipitously as the height and density of vegetation increased. Overall search efficiency was estimated at just 25 percent at Meyersdale and 44 percent at Mountaineer.

We also confirmed that the removal of dead bats by scavengers such as ravens and coyotes seriously reduced overall mortality estimates, demonstrating the necessity of daily searches. At Mountaineer, scavengers removed 70 percent of confirmed bat kills within 24 hours. At Meyersdale, where scavenging rates were low, the estimates for daily and weekly searches were similar. The Mountaineer facility began operation one year earlier than Meyersdale and it is possible that scavengers had more time to learn of a new food source beneath turbines at Mountaineer.

At both localities, bat kills were in full swing prior to beginning our six-week study and they continued unabated through its end. Peak kills showed similar timing at both sites, suggesting that broader, perhaps regional, conditions – landscape, weather patterns or prey availability – contribute to the patterns of fatalities we observed. As noted, most bat kills occurred when average wind speed and power production were low but turbine blades were kept spinning at relatively high speeds. More male than female bat fatalities were recorded, but the timing of the kills was similar. Bat kills occurred at turbines located throughout both facilities, but higher-than-average numbers were found at turbines near the ends and

centers of both wind farms. The presence of aircraft warning lights on turbines had no detectable impact on bat kills.

The thermal images indicated that bats were attracted to both moving and non-moving blades. Images of bats chasing turbine blades rotating at slow speeds suggest the possibility of attraction to movement that may be confused with prey or perhaps other bats.

This study covered only six weeks of a single year and was not intended to measure a full season of bat activity, behavior or fatalities. Unusually cool summer temperatures and the passage of four major hurricanes in August may have greatly reduced ridge-top bat activity, as high winds and low temperatures are known to suppress bat and insect activity, particularly at higher elevations.

Full-season searches, extending from April through October, are needed to fully understand the patterns of bat fatalities at wind turbines. Nonetheless, our results reveal an emerging pattern of alarming kill rates at wind-energy facilities on forested ridges. Similar fatality rates are likely at other sites with comparable forests and topography. There are also reports of widely distributed but poorly documented kills under varied conditions in the western United States.

This vital, state-of-the-art research could not have been accomplished without the Bats and Wind Energy Cooperative and the support of all parties involved. By working together, we now have a much better understanding of the causes and potential solutions to this rapidly escalating problem. We still face many challenges, however, and much more research is required. Bat Conservation International cannot condone further turbine construction, especially along wooded ridgelines, until solutions are found, tested and applied to minimize bat kills at wind-energy facilities.

But we are, as always, committed to gathering solid, scientific data and working with diverse partners to develop solutions that can benefit all of us without endangering the ecosystems upon which we must build the future.

Merlin D. Tuttle is Founder and Chief Executive Officer of Bat Conservation International.