NASBR Statement on Wind Energy Impacts on Bat Populations

The bat conservation community and wind industry have worked together for almost two decades to measure the impact of wind energy generation on bats and research techniques to minimize those impacts. This research has identified actions that can be implemented to reduce the threat to bat populations. Ultimately, the state of scientific understanding is clear that migratory bat species are at risk and that this risk can be reduced if mitigation tools and protocols are implemented immediately.

Wind energy is a valuable part of reducing carbon emissions and limiting the negative impacts of global climate change. However, wind energy has measurable, negative impacts on bat populations[1]. As the world sets necessary carbon reduction goals, wind energy generation capacity is expected to grow exponentially by 2050. As wind energy growth accelerates, the threat to bat populations also increases, requiring immediate action to implement available solutions.

Wind turbines kill bats of multiple species[1], including at least 28 bat species in the United States and Canada combined. This is over half of the bat species found in these countries[2]. Bat fatalities are also documented at Mexican wind farms[3–5], although fewer reports exist from Mexico. It is possible that over 1 million bats were killed by wind turbines in North America in 2023 (Tables 1 & 2). Most bats killed at North American wind turbines are migratory, including hoary bats (*Lasiurus cinereus*), eastern red bats (*Lasiurus borealis*), and silver-haired bats (*Lasionycteris noctivagans*). In particular, fatality levels of hoary bats are expected to cause at least a 50% decline in populations by 2050 unless the wind industry immediately adopts fatality reduction measures that reduce fatality levels by at least 50%[6].

In accordance with the best available science, the North American Society for Bat Research (NASBR) encourages a rapid reduction in bat fatalities at wind energy facilities, at minimum, an immediate reduction of bat fatalities by 50%. This minimum reduction is a necessary stopgap measure to reduce the impact of wind turbines on bat populations, given the predicted expansion of the wind energy industry. This minimum target will need to be revisited and revised as we learn more about the cumulative impact that wind energy development continues to have on bat populations and as additional mitigation tools are developed and/or proven.

The following actions can be immediately implemented to reduce fatality levels:

1. Site wind energy away from hibernacula and areas with high abundance and/or diversity of bats.

Constructing wind energy facilities in areas of high bat activity can increase collision risk for bats[7,8]. Avoidance of high-risk sites is the first step of the mitigation hierarchy[9]. Wind project feasibility assessments should include surveys to identify key roosting sites, maternity colony sites, important foraging areas, travel corridors, and migration routes near proposed wind turbine locations. Defining buffer zones around these sensitive areas is an established approach to avoid negative consequences for bat populations[1]. There is no current unified guidance on appropriate buffer sizes for habitat features for bats, but some guidance exists, including in Europe[10], the United States[11], Canada[12], and South Africa[13]. Substantial setbacks from high-quality bat habitats and likely migration routes are needed given that bats may be attracted to wind turbines from a distance[1].

2. Feather turbine blades below the manufacturer's cut-in speed† from dusk to dawn during all times of the year that bats are active*

Feathering turbine blades below the manufacturer's cut-in speed to prevent free-wheeling (spinning when no energy is being produced) is thought to reduce bat fatalities by approximately 30% while causing negligible energy loss[14]. Feathering turbines is a best management practice recommended by industry groups[15].

3. Curtail turbines‡ below at least 5.0 m/s wind speeds at night during periods of high risk

Since 2008, the wind energy industry has collaborated on studies that have consistently demonstrated the efficacy of reducing bat fatalities by curtailing turbines during periods of highest risk (e.g., autumn migration in most of North America). While the reduction in fatalities from curtailment varies both temporally and spatially, curtailment is estimated to reduce cumulative fatality levels across facilities and years by 54–69% at 5.0 m/s and 68–80% at 6.0 m/s[14]. Higher fatality reductions can be achieved with higher cut-in speeds and will be necessary if bat populations are lower than experts predict, action is not immediately taken, or adoption of curtailment is not universal.

4. Standardize data collection and reporting across states and provinces, including open data accessibility.

Coordinated national and international efforts for data collection and aggregation of bat fatality monitoring at wind energy facilities are needed. The Bats and Wind Energy Cooperative and other multi-stakeholder groups have identified unified data collection protocols and aggregation as a high-priority research need in every science meeting since 2008[16]. Current efforts to aggregate data have been hindered by data inconsistency and poor data quality. Consistent collection of quality data under international standards and open data framework will facilitate broader-scale analysis that will inform the cumulative and species-specific impacts of wind energy to bat populations. International coordination aligns with cooperative efforts to conserve bats among the US, Canada, and Mexico[17]. The development of such data standards and data accessibility will only be possible through transparent and close coordination between states, provinces, industry, and other relevant stakeholders.

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*Adjusting the angle of the rotor blade parallel to the wind, or turning the whole unit out of the wind, to slow or stop blade rotation. The goal being to slow blade tip speed to less than bat flight speeds.

† The wind speed at which the generator is connected to the grid and producing electricity. The manufacturer's set cut-in speed for most contemporary turbines is between 2.0 and 4.0 m/s. On some turbines, blades will spin at full or partial RPMs below cut-in speed when no electricity is being produced.

‡ The act of limiting the supply of electricity to the grid during conditions when it would normally be supplied. This is usually accomplished by cutting-out the generator from the grid and/or feathering the turbine blades. The turbine's computer system is programmed to a cut-in speed higher than the manufacturer's set speed, and turbines are programmed to stay feathered at 90° until the increased cut-in speed is reached over some average number of minutes (usually 5–10 min), thus triggering the turbine blades to pitch back "into the wind" and begin to spin normally.

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Calculations of Total Bat Fatalities in the United States and Canada

Table 1. Estimated total bat mortality in the United States in 2023 based on the per megawatt (MW) bat mortality reported by the American Wind Wildlife Institute[18] and 2023 installed capacity in the US Wind Turbine Database[19]. Following the methods of Arnett and Baerwald[20]. See Hein and Schirmacher[21] for a review of methodology and biases associated with total fatality estimates.

Region	Mean Bat fatalities / MW[18]	MW Installed Capacity in 2023[19]	Total Mortality
Midwest	10.87	36,244	393,972
Mountain Prairie	3.66	29,256	107,077
Northeast	8.65	6,663	57,635
Pacific	1.11	8,393	9,316
Pacific southwest	1.99	6,006	11,952
Southwest	6.01	57,721	346,903
Total		**144,283**	**926,856**

Table 2. Estimated total bat mortality in Canada in 2020 based on the per turbine bat mortality reported in Zimmerling 2016[22] and number of turbines in the Canadian Wind Turbine Database[23]. Estimates follow the methodology of Zimmerling 2016[22]. See Hein and Schirmacher[21] for a review of methodology and biases associated with total fatality estimates.

Province/Territory	Mean bat fatalities / Turbine[29]	Number of Turbines in 2023[30]	Total Mortality
Yukon	1.5	2	3.0
Northwest Territories	1.5	4	6.0
British Columbia	4.2	292	1,226.4
Alberta	10.9	900	9,810.0
Saskatchewan	11.7	153	1,790.1
Manitoba	23.3	133	3,098.9
Ontario	24.5	2663	65,243.5
Quebec	2.1	1991	4,181.1
New Brunswick	0.6	119	71.4
Nova Scotia	0.5	310	155.0
Prince Edward Island	2.1	104	218.4
Newfoundland and Labrador	1.4	27	37.8
Total		**6,698**	**85,841.6**