



MIGRATORY BATS AND WIND ENERGY

Wind turbines © Ed Arnett/Bat Conservation International

Millions of Bats Have Been Killed by Wind Energy Turbines

Globally, millions of bats are killed by wind energy turbines each year, and bat fatality rates increase as wind energy expands with demand for cheap energy and to meet global decarbonization targets. Wind energy is an important part of a renewable energy strategy to reduce the use of fossil fuels, but sustainable use of wind energy depends on avoiding biodiversity loss. Monitoring the number of bats killed at turbines is a first step to estimate the impact. Bat fatality data that are available indicate that wind energy is one of the leading causes of direct mortality of migrating bats around the world.¹ Yet we do not know how many bats are killed at wind turbines in many places, specifically in emerging markets; partly because this information is not released. Scientists are currently researching the scope of this threat and exploring solutions that protect bats at wind turbines.

Scope

Estimates of how many bats are killed at turbines are based on post-construction-fatality monitoring (PCFM) conducted at operational wind energy facilities.² Bat fatality rates are calculated as the number of bats killed per MW of energy production per year, and these rates vary with location, turbine height, blade length, and operational policies.² Regional reported bat fatality rates and the annual wind energy production capacity from those regions in 2023 are shown at above right.

Fatalities at wind energy facilities impact a diversity of bat species, and migratory bats face heightened risk from this threat. At least 47 genera of bats are represented in the bat fatalities documented at wind turbines globally. A list of genera with documented species fatalities is shown to the right. This list will grow as more facilities conduct PCFM, and as wind energy facilities expand into new regions.

BAT FATALITY RATES AT WIND FACILITIES AND 2023 ENERGY PRODUCTION BY REGION^{1,3}

- North America: 6-7 bats/MW; 167 GW
- Europe: 6-7 bats/MW; 225 GW
- Africa, Middle East: 3 bats/MW (in South Africa); 10 GW
- Central and South America: 2-57 bats/MW; 37 GW
- Asia, Australia, Oceania: Rate unknown (Australia: 7-20 bats/turbine); 403 GW

BAT GENERA KILLED AT WIND TURBINES^{3,4}

Artibeus, Austronomus, Barbastella, Brachyphylla, Chaerephon, Chalinolobus, Eidolon, Eonycteris, Epomophorus, Eptesicus, Erophylla, Eumops, Falsistrellus, Glischropus, Hesperoptenus, Hypsugo, Kerivoula, Lasiurus, Megaerops, Miniopterus, Molossus, Monophyllus, Mops, Mormoops, Mormopterus, Myotis, Neoromicia, Noctilio, Nyctalus, Nycticeius, Nyctinomops, Nyctophilus, Otomops, Parastrellus, Perimyotis, Pipistrellus, Plecotus, Pteropus, Rhinolophus, Rousettus, Scotophilus, Stenoderma, Tadarida, Taphozous, Tylonycteris, Vespertilio, Vespertilio

Rousettus amplexicaudatus and *Lasiurus cinereus* are two of many species found dead below wind turbines.



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1. Voigt, C. C., Bernard, E., Huang, J. C. C., Frick, W. F., Kerbiriou, C., MacEwan, K., ... & Whitby, M. (2024). [Toward solving the global green-green dilemma between wind energy production and bat conservation](#). *BioScience*, 74(4), 240-252.

2. IFC, EBRD, and KfW. (2023). [Good Practice Handbook and Decision Support Tool, Post-Construction Bird and Bat Fatality Monitoring for Onshore Wind Energy Facilities in Emerging Market Countries](#).

3. Energy Task Force (ETF) Bat Mitigation Working Group (2025) Regional Highlights for Virtual ETF Workshop on Bats & Wind. [PowerPoint slides]

4. American Wind Wildlife Institute (2020) [AWWIC Technical Report: 2nd Edition](#): Summary of Bat Fatality Monitoring Data Contained in AWWIC. Washington, DC

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Projections for the Future

In 2024, an additional 117 GW of wind power was installed globally, and a goal from the 2023 Conference of the Parties to the United Nations Framework Convention on Climate Change is to install an additional 320 GW of wind power capacity each year by 2030. It is likely that the number of bats killed at turbines will drastically increase due to this expansion of wind energy production. Major growth is expected in Asia, where bat fatality monitoring and reporting are in early stages. The impact of future buildout will threaten bats globally, unless protective measures are taken. In population modeling for hoary bats (*Lasiurus cinereus*), the species with highest fatality at wind facilities in North America, fatality rates were sufficient in 2014 to cause rapid population declines, risking extinction within 40 years. As energy production grows, a solution is needed to avoid rapid and irrevocable population loss of bat species.

Solutions

Several actions can reduce bat fatalities at wind turbines. In planning stages, strategic environmental assessment can guide responsible development, and environmental impact assessment can inform facility siting. Often, these measures are legally required. Constructing wind facilities away from key bat habitat, such as hibernacula, maternity roosts, foraging habitat, and commuting or migratory pathways, can lower the number of bats that encounter turbines. EUROBATS and some national guidelines recommend buffer distances around key habitats (such as forests). Adjusting turbine blade angle to reduce spinning at wind speeds below those at which energy is being produced can reduce fatalities by 30%. Maintaining this angle until a wind speed of 5–6 m/s (at nacelle height) can further reduce fatalities—in North America, by an average of 62%.

Regional Context

As wind energy expands globally, regions vary in their stages of wind energy development and conservation response, and local challenges depend on the ecological and political contexts. In most cases, information documenting bat species assemblages, activity patterns, migratory pathways, and population status is urgently needed. Regions with experience in managing bats and wind energy have guidance and policies available as models for emerging markets, and can provide training to build capacity in other regions. Emerging markets can leverage existing guidance, identify novel problems, and build regional networks of experts. With a concerted global effort, renewable energy can grow with effective strategies to reduce bat fatalities, leading to a sustainable future that meets society's energy needs and maintains biodiversity.

RECOMMENDED PRACTICES FOR WIND ENERGY FACILITIES

- Site wind energy facilities away from key bat habitats (hibernacula, maternity roosts, foraging grounds, migratory pathways)
- Monitor annual patterns of bat activity at potential sites and at operational sites
- Reduce turbine blade spinning at wind speeds below those at which energy is produced
- Reduce blade spinning until a minimum wind speed of at least 5 or 6 m/s at nacelle height
- Conduct post-construction-fatality-monitoring
- Set fatality thresholds to inform mitigation requirements when possible
- Transparent communication of fatality data

THREATENED OR DATA DEFICIENT / TOTAL BAT SPECIES BY REGION (IUCN RED LIST)

- North America: 15/150 species (10%)
- Central and South America: 100/366 species (27%)
- Europe: 13/54 species (24%)
- Africa, Middle East: 104/308 species (34%)
- Asia: 203/582 species (35%)
- Australia and Oceania: 64/192 species (33%)

About CMS

The Convention on the Conservation of Migratory Species of Wild Animals (CMS), also known as the Bonn Convention, works for the conservation of a wide array of migratory animals worldwide through negotiation and implementation of agreements and species action plans. It has 133 Parties (as of 1 January 2023).

CMS engages all relevant stakeholders in addressing threats to migratory species in concert with all other aspects of wildlife conservation and management.

CMS Instruments

Animals receive protection under CMS through listing on its two Appendices, global or regional agreements (e.g., [EUROBATS](#)), and action plans.

For more Fact Sheets please visit: <http://www.cms.int/en/publications/factsheets>



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