Birds, bats, and habitat

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Wyoming's Wind Energy Future

October 2-3, 2017

In partnership with NextEra Energy Resources, we have been investigating wind-wildlife issues since 2008.

TCU · UNIVERSITY OF OXFORD · NEXTera ENERGY RESOURCES

WIND RESEARCH INITIATIVE

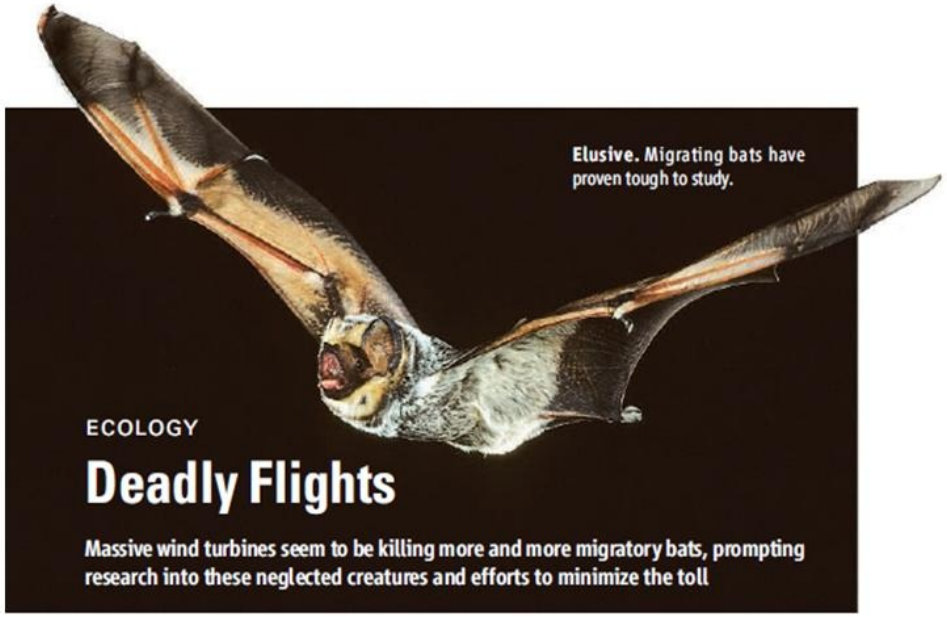
Wolf Ridge Wind, LLC in north-central Texas

- 75 1.5-MW turbines
- Field and lab studies underway since 2009

Impacts to wildlife

Direct

- Habitat loss
- Collision mortality



24 JULY 2009 VOL 325 **SCIENCE** www.sciencemag.org

Indirect

- Contribute to habitat loss and fragmentation
- Disrupt migratory paths
- Displace wildlife
- Alter nesting success

Impacts to habitat

- Habitat impacts vary from site to site
- Turbines are typically sited 5 to 20 rotor diameters apart, so the turbines and associated infrastructure occupy a small fraction of the total wind facility
  - Less than 3.5 acres per MW are disturbed during construction
  - Less than 1 acre per MW are disturbed permanently
- Remainder of the land can be used for a wide range of activities

Direct effects on birds

- Collisions have been documented globally
- ~170 studies conducted at nearly 100 wind project are publically available for the U.S. & Canada
  - Reported fatalities for about 250 bird species
- Studies are not a random sample of all wind facilities or even of wind turbines within a single facility
  - Are the publically available data representative of what is really occurring?

www.Audubon.org

- Fatality rates from most studies range from 3 to 5 birds per MW per year
  - For all species combined and adjusted for detection biases

Direct effects on birds

- Songbirds comprise more than 60% of turbine fatalities in the U.S. and Canada
  - Fatality peaks during spring and fall migration
- Diurnal raptors are also frequent fatalities
  - Flight patterns and hunting behavior
- Species with small populations, delayed maturity, long lifespans, and low reproductive rates are of most concern
- Cumulative effects are unknown

www.Audubon.org

www.Audubon.org

How many birds are killed?

Biological Conservation 168 (2013) 201–209

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

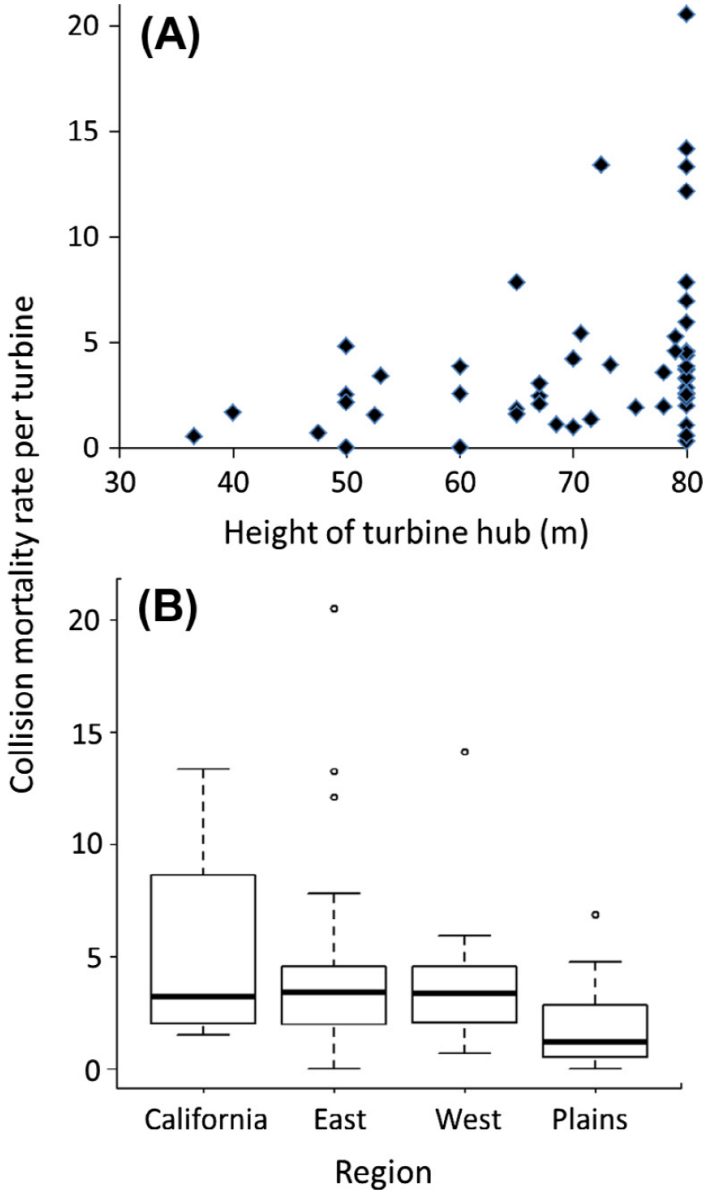
Review

Estimates of bird collision mortality at wind facilities in the contiguous United States

Scott R. Loss [a,*], Tom Will [b], Peter P. Marra [a]

[a] Migratory Bird Center, Smithsonian Conservation Biology Institute, National Zoological Park, P.O. Box 37012 MRC 5503, Washington, DC 20013, USA
[b] U.S. Fish and Wildlife Service, Division of Migratory Birds, Midwest Regional Office, 5600 American Blvd. West, Suite 990, Bloomington, MN 55437-1458, USA

- 68 studies, monopole turbines
- 140,438 – 327,586 annual bird collisions with turbines in U.S.



How many songbirds are killed?

www.Audubon.org

OPEN ACCESS Freely available online

PLOS | ONE

A Comprehensive Analysis of Small-Passerine Fatalities from Collision with Turbines at Wind Energy Facilities

Wallace P. Erickson[1]*, Melissa M. Wolfe[1], Kimberly J. Bay[1], Douglas H. Johnson[2], Joelle L. Gehring[3]

1 Western EcoSystems Technology, Inc., Cheyenne, WY, United States of America, **2** U. S. Geological Survey, Northern Prairie Wildlife Research Center, Saint Paul, MN, United States of America, **3** Federal Communications Commission, Washington, DC, United States of America

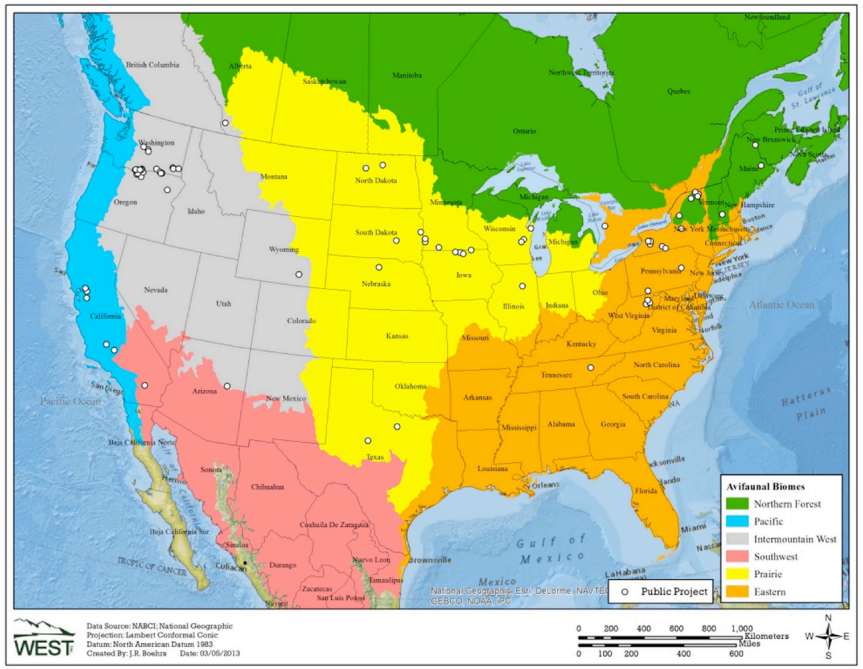


Figure 1. Locations of studies included for analysis of small-bird fatalities at wind energy facilities. The locations of wind energy facilities associated with 116 studies that were appropriate for inclusion in an analysis of fatalities of small passerines due to collisions with wind turbines. See details of studies in Appendix S1. Biomes adapted from Rich et al. [19] [58] [59] [60].
doi:10.1371/journal.pone.0107491.g001

- 116 studies in the U.S. and Canada; lattice and monopole turbines
- 133,993 – 229,765 annual songbird fatalities
- Fatality rates varied by biome
- Compared fatality rates to estimated population sizes
  - Black-throated Blue-warbler (*Dendroica caerulescens*) had the greatest estimated population effect (0.029-0.043% annual loss)

Wind turbine-bird mortality in context

Collisions with buildings

365 – 988 million birds killed annually in the U.S. (Loss et al. 2014)

Free-ranging cats

1.4 – 3.7 billion birds killed annually in the U.S. (Loss et al. 2013)

Collisions with communication towers

6.8 million birds killed annually in the U.S. and Canada (Longcore et al. 2012)

Indirect effects on birds

- In the U.S., the focus has been on prairie-chickens, grouse, and grassland birds
- Most studies investigated displacement from wind turbines
- Increasingly more data are available on breeding performance, nesting success, and adult survival
- Responses appear to be species-specific and site-specific
- Mechanisms are poorly understood
- High-site fidelity and the potential for habituation are a challenge
- Cumulative effects remain unknown

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www.acoustics.org

Greater Prairie-chickens and Greater Sage-grouse

- These species are sensitive to disturbance from roads, utility poles or lines, trees, oil and gas infrastructure, etc.
- Wind facility studies to date have shown neutral, negative, and positive responses

Greater Prairie-chicken (*Tympanuchus cupido*)

(Winder et al. 2013, 2014, 2015; Smith et al. 2017)

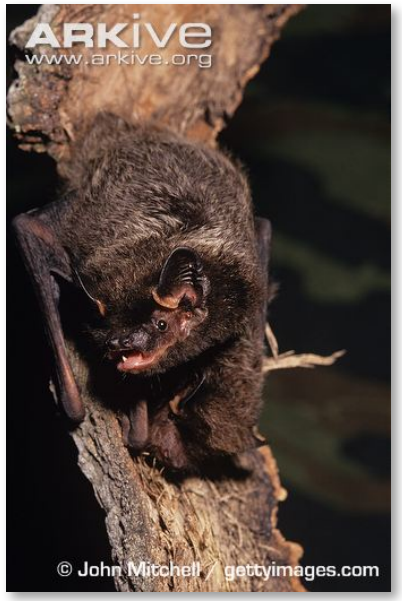
Greater Sage-grouse (*Centrocercus urophasianus*)

(LeBeau et al. 2014, LeBeau et al. 2017)

Large numbers of bat are killed at wind energy facilities world-wide

- In the U.S. and Canada most observed fatalities are migratory tree bats

Lasiurus cinerus



Lasionycteris noctivagans

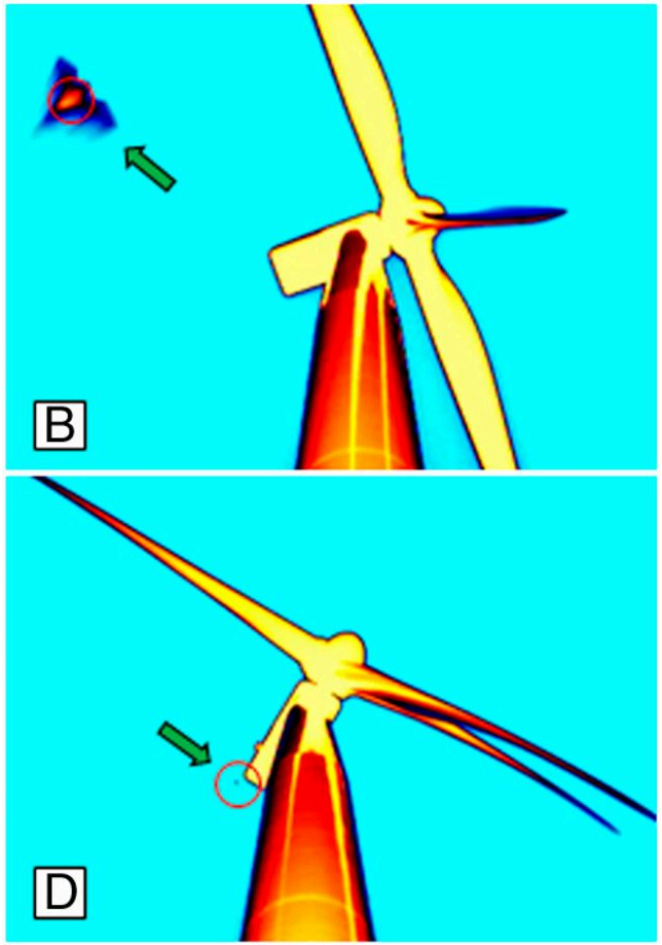
Lasiurus borealis

- 650,104 – 1,308,378 cumulative bat fatalities from 2000 to 2011 (Arnett & Baerwald 2013)
- >600,000 bat fatalities in the U.S. in 2012 (Hayes 2013)

Increasing evidence that bats are attracted to wind turbines

Attraction hypotheses:

1. Wind turbines provide one or more resources
2. Bats misperceive turbines to be a resource
3. Bats just find wind turbines intriguing



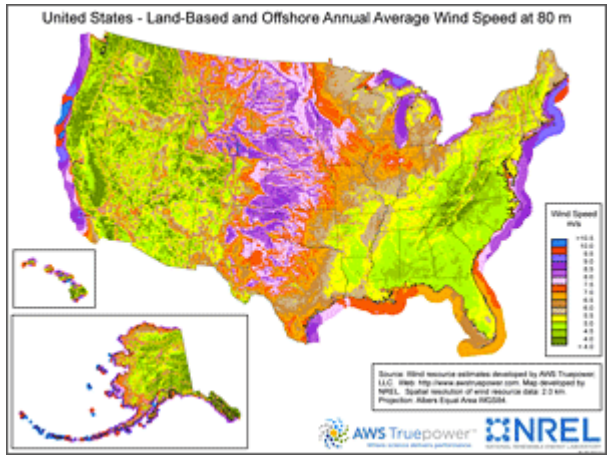
Cryan et al. 2014

- Videos show bats exploring and contacting monopoles, nacelles, and wind turbine blades
- Flight patterns are suggestive of foraging, roost investigation, mating behavior, and drinking behavior

Management techniques to reduce impacts to wildlife

1. Pre-construction

- Risk assessment
- Siting



2. Post-construction

- Evaluation of the impacts
- Effective mitigation

3. New and improved regulations

Environmental Compliance

Does The U.S. Fish And Wildlife Service Selectively Enforce Bird Laws?

Despite the fact that the wind industry kills far fewer birds than other industries, the government agency seems to overly scrutinize it.

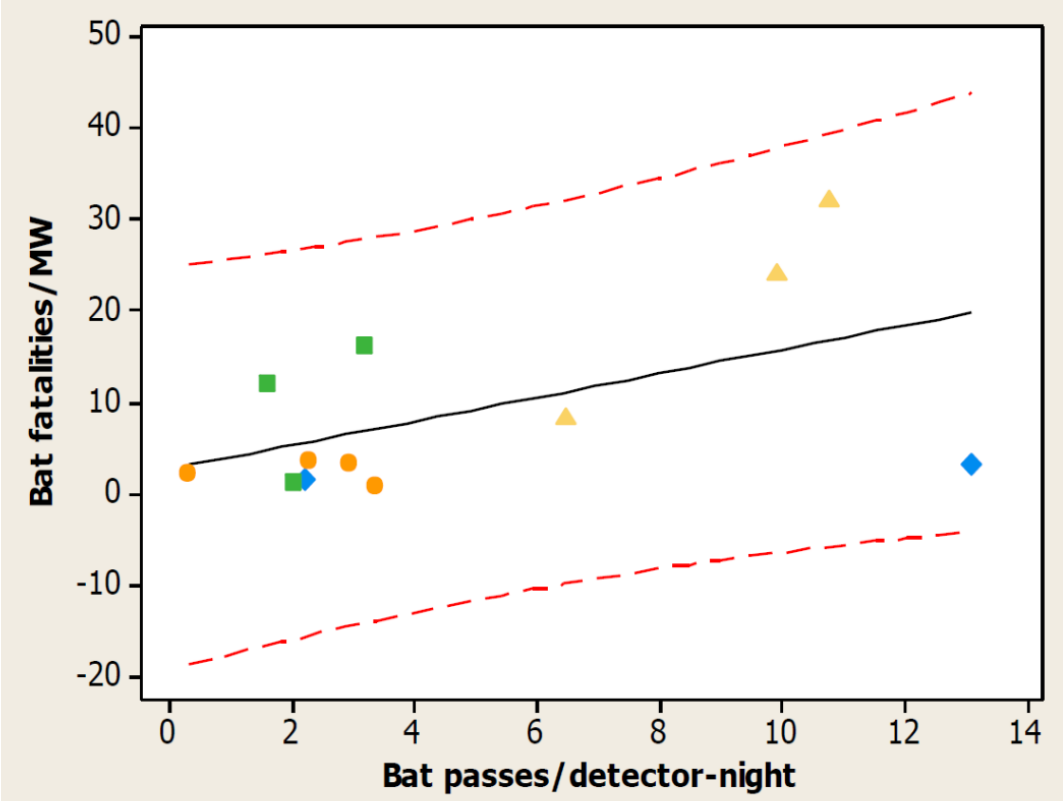
By Paul Kerlinger

Risk assessment and siting

- Macro-siting
  - Avoid high-risk sites for species or habitats of conservation concern
  - Avoid core areas for species at risk
  - Develop wind energy in disturbed landscapes
- Micro-siting
  - Avoid placing individual turbines near particular landscape features (along ridges or near wetlands) or known resources for target species (e.g., golden eagle nest)
  - Effectiveness is not well understood
  - Largely untested

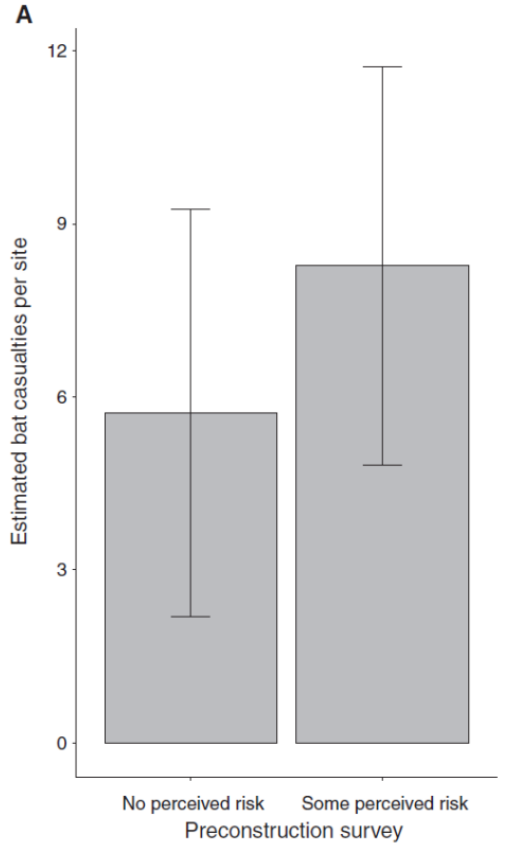
Attraction may help explain why predicting risk to bats has been unsuccessful to date

- Pre-construction bat activity does not predict bat fatalities



n = 12 wind farms (Hein et al. 2013)

- Ecological impact assessments fail to reduce risk of bat fatalities



n = 29 wind farms (Lintott et al. 2016)

Strategies to minimize fatalities for birds

Repowering:

- Replace several small turbines with fewer, larger turbines

- Repowering the Altamont Pass Wind Resource Area in California could reduce mean fatality rates for raptors by 54% and for all birds by 65% (Smallwood and Karas 2013)

Strategies to minimize fatalities for birds

Selective shutdown or curtailment:

- High raptor fatality rates have been observed in southern Spain near the Strait of Gibraltar (important migratory route)

Juvenile Griffon Vulture (*Gyps vulvus*)
(andaulucianguides.blogspot.com)

- Selective shutdown of high-fatality turbines reduced Griffon Vulture mortality by 50% (de Lucas et al. 2012)

Strategies to minimize fatalities for birds

Golden Eagle (*Aquila chrysaetos*) fatalities at the Top of the World Windpower Project:

Several measures to reduce impacts:

- Carrion removal
- Tested radar technology to detect eagles
- Tested visual and sound deterrent devices to deter eagles from turbines

Duke Energy Renewables - Top of the World Windpower Project, WY

Current approach:

- Selective shutdown when eagles are in the area
  - Human observers
  - Camera system with machine vision (IdentiFlight detection technology)

Current mitigation strategies for bats

- Siting restrictions
  - Limit where wind facilities can be built
  - Setbacks from important bat habitats
- Operational minimization
  - Limit wind turbine blade rotation on low wind speed nights

    (e.g., Baerwald et al. 2009, Arnett et al. 2011)
  - Reduce bat fatality rates 50-93%

    (reviewed in Arnett et al. 2013)

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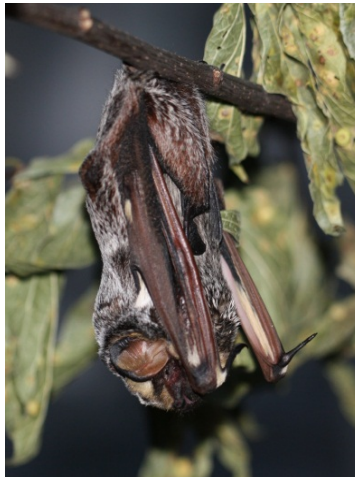


Photo credit: Tory Bennett

Downside: Limit wind energy production

Efforts to improve mitigation strategies for bats

1) Refine operational minimization

- Target when bats are active in the area
  - Not just wind speed, look at other variables such as temperature, wind direction, etc.

    (e.g., Martin et al. 2017)
  - Real-time acoustic monitoring to know when bats are near turbines
  - Regional weather patterns

Goal: Improve fatality reductions while limiting financial costs

Efforts to improve mitigation strategies for bats

2) Technological solutions that are being tested

- Acoustic deterrents

  Broadcast ultrasonic sound from wind turbines to deter echolocating bats from entering the rotor swept zone

  (Arnett et al. 2013)

- Dim UV light illumination

  Affect how bats see turbines (Gorresen et al. 2015)

- Texture coating for wind turbine towers

  Alter how echolocating bats perceive the surfaces

  (McAlexander 2013, Bienz 2015)

Goal: Fatality reductions without power loss

Acoustic deterrents

batcon.org
BAT CONSERVATION INTERNATIONAL

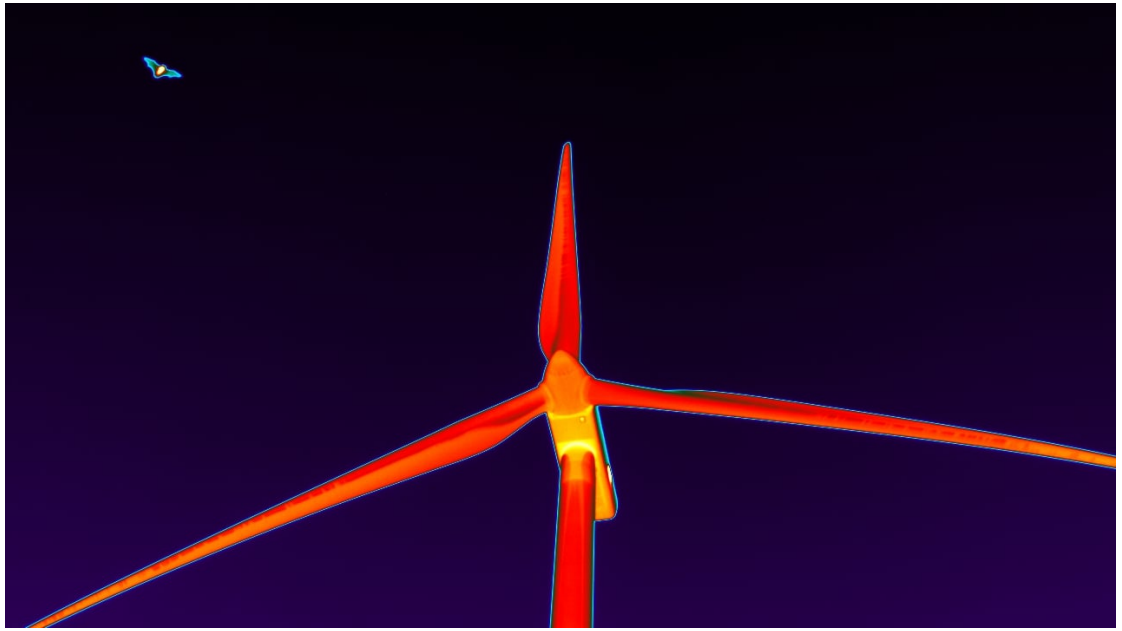
- Bat Conservation International is testing a new ultrasonic bat deterrent device with NRG Systems and three wind energy partners
- 2017: Tests are underway at 3 wind facilities in North America
- Devices are mounted on turbine nacelles

U.S. DEPARTMENT OF ENERGY

Acoustic deterrents

batcon.org
BAT CONSERVATION INTERNATIONAL

- Using thermal cameras to observe bats at turbines with nacelle-mounted devices



- Monitoring fatality with and without the devices operating
- Predict a significant reduction in bat fatalities when the devices are operating

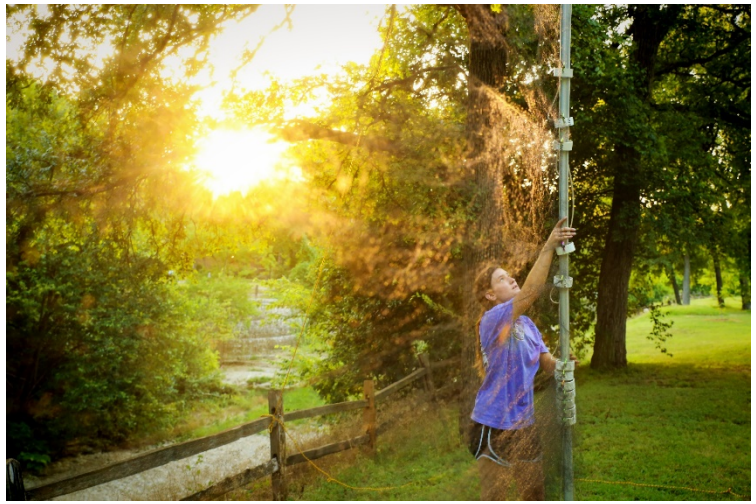
Texture coating for turbine towers

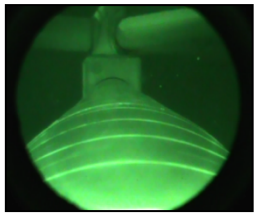
U.S. DEPARTMENT OF ENERGY

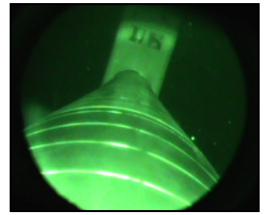
"DE-EE0007033 Texturizing Wind Turbine Towers to Reduce Bat Mortality"

Tasks

- Texture coating development
- Behavioral experiments with wild-caught bats in a flight facility
- Bat surveys at wind turbine towers







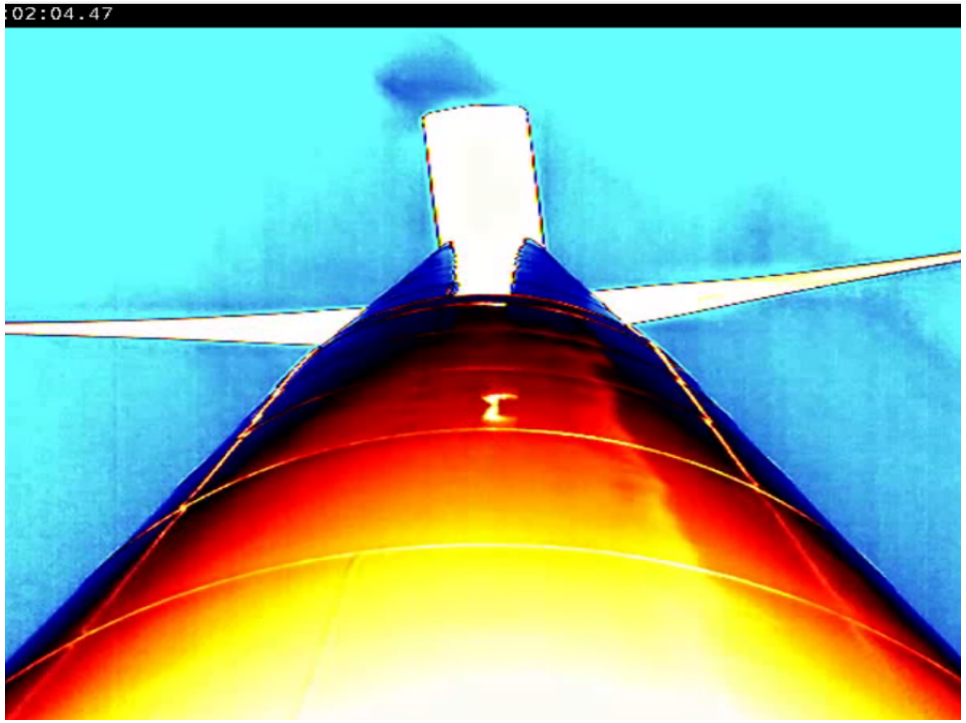
Texture coating for turbine towers

- Completed texture coating application to 2 turbine towers.

Texture coating for turbine towers

- Field test 2017…… stay tuned!

Predict: Bat activity will be higher at smooth compared to texture-treated towers



Research needs and recommendations

Research priorities:

1. Improved estimates of collision mortality

- We don’t understand the biological significance of these impacts
- Need standard criteria for monitoring, estimating, and reporting fatalities at wind energy facilities

2. Improved risk assessment

- Quantitative models linking risk factors to fatalities are generally lacking
- For those predictive risk models that have been developed, they need to be empirically tested

Research priorities:

3. Continued investment in developing effective mitigation strategies

- Invest in technologies and solutions to reduce collision fatalities

  Rigorous assessment of the effectiveness of these technologies

- Focus on species or populations of most concern
- Focus on elucidating the underlying mechanisms for adverse impacts

  What about their ecology or behavior that puts them at risk?

Research priorities:

4. Promote coordinated research efforts

- Encourage stakeholders to work together

5. Data must be publically available

- Peer-reviewed publications and sharing of results
- Central repository and database
- May require an “incentive-based” approach with new opportunities for industry and law enforcement agencies


TCU

Recommended FAA lighting

- FAA recommends strobe or strobe-like lights that produce momentary flashes interspersed with dark periods up to 3 sec in duration
- A proportion of turbines are lighted (e.g., 1 in 5), firing all synchronously
- Red lights are commonly used

An obstruction lighting unit atop the 144 MW Dokie Wind Farm, located near Chetwynd, British Columbia.

Current Approach:

- Songbird and bat fatalities at turbines with FAA-approved lighting are not greater than at unlit turbines (Gehring et al. 2009, Kerlinger et al. 2010, Bennett & Hale 2014)