Strategies to Reduce Bat Fatalities at Wind Energy Facilities

Working Together to Resolve Environmental Effects of Wind Energy

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International Energy Agency's Wind Task 34 Webinar

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batcon.org
BAT CONSERVATION INTERNATIONAL

Impact of Wind Energy Development on Bats in the U.S. & Canada (Arnett & Baerwald 2013)

- **840,486–1,690,696 bats** between 2000–2011
- **196,190–395,886 bats** in 2012
- **79%** of fatalities are migratory tree-roosting bats
  - hoary (38%), eastern red (22%), silver-haired (19%)
  - Free-tailed species also a concern
- **½ of species (n = 23)** in U.S.

Operational Minimization

Definitions

- Cut-in speed
  - 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 3.0 and 4.0 m/s. For some turbines, their blades will spin at full or partial RPMs below cut-in speed when no electricity is being produced.
- Feathering
  - 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

Operational Minimization

- Consistent patterns of bat fatalities across studies
  - Bats only active at night (1/2 the day)
  - Peak fatalities occur in late summer–fall (limited time of year)
  - Higher fatalities on low wind nights (under specific conditions)
- No bats killed at non-moving turbines
- Altering turbine operations to reduce bat fatalities
  - Raise cut-in speed & feather blades below cut-in when bats are at greatest risk

Arnett et al. 2011, Mid-Atlantic, USA

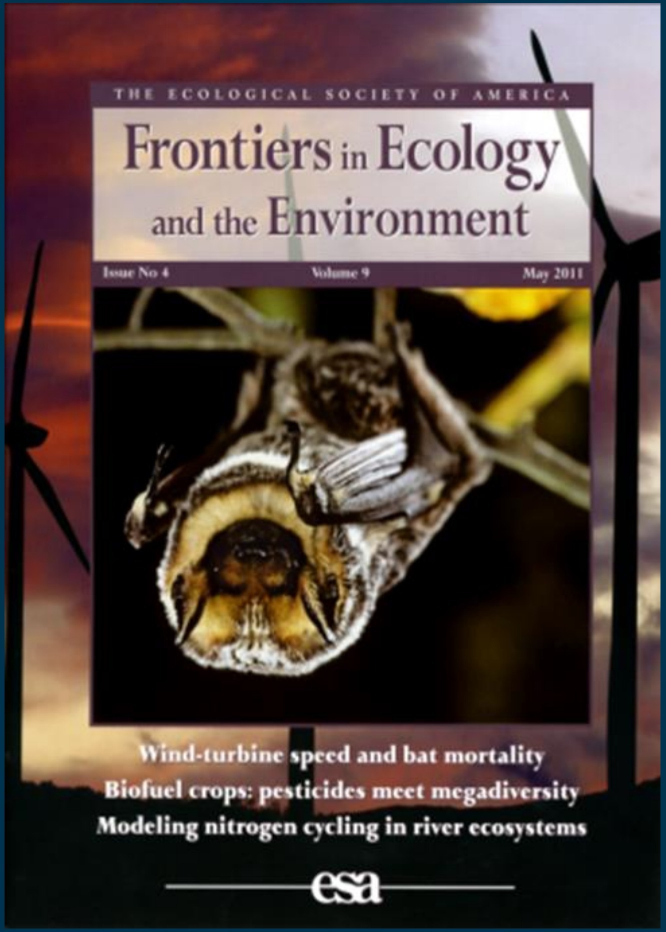
Randomly assigned 3 cut-in speeds (3.5, 5.0, & 6.5 m/s)

12 turbines rotated nightly, daily searches

44–93% fewer bats killed

No difference between treatments

0.3–1% annual power



Good et al. 2011, Midwest, USA

Similar treatments as Casselman – changed cut-in speeds 5.0, 6.5 m/s & control (9 turbines/treatment)

Treatments rotated on a weekly basis

50% fewer bats killed at 5.0 m/s &
78% fewer bats killed at 6.5 m/s

1st to demonstrate differences in between 5.0 & 6.5 m/s

Good et al. 2012, Midwest, USA

Changed cut in speeds and feathered below 3.5, 4.5, 5.5 m/s and controls (42 turbines/treatment)

Treatments rotated nightly

36% fewer bats killed at 3.5 m/s
56% fewer bats at 4.5 m/s
73% fewer bats killed at 5.5 m/s *

*Anonymous study in the Midwest USA found similar results with <1% annual production loss

Anonymous 2012, Southwest, USA

Control, ½ night for 4, 5, 6 m/s & 5 m/s all night (8 turbines/treatment)

Nightly treatments and daily searches

20.1% fewer bats at 4 m/s ½ night

34.5% fewer bats at 5 m/s ½ night*

32.6% fewer at 5 m/s all night*

38% fewer bats at 6 m/s ½ night*

*No difference between control & treatment groups

Almost 75% of fatalities were Brazilian free-tailed bats

Martin et al. 2013, Northeast, USA

Control & 6.0 m/s cut-in speed (+ 9.5 °C)

Nightly treatments and daily searches

Treatment: 1.0 (95% CI: 0.6–1.8) bats/turbine

Control: 2.7 (95% CI: 1.9–3.9) bats/turbine

60% (95% CI: 29–79) reduction in fatalities

Operational Minimization-Next Steps

- At minimum, feather up to manufacturer's cut-in speed
- Incorporate additional weather variables
- Test in different regions & species compositions
- Ultimately "bat friendly" turbine automation that self regulates based on several variables
  - Date (July 15 to September 30)
  - Time of day (sunset to sunrise)
  - Wind speed (<6.0 m/s)
  - Temperature (>50°F)

Limitations of Operational Minimization

- Industry Perspective
  - Economic costs variable & relatively unknown
  - Impact to turbines relatively unknown
- Conservation Perspective
  - Not applicable in low wind regions
  - May not meet conservation goals for all species
- Mutually beneficial to have an alternative minimization strategy

Ultrasonic Acoustic Deterrents

Ultrasonic Acoustic Deterrents

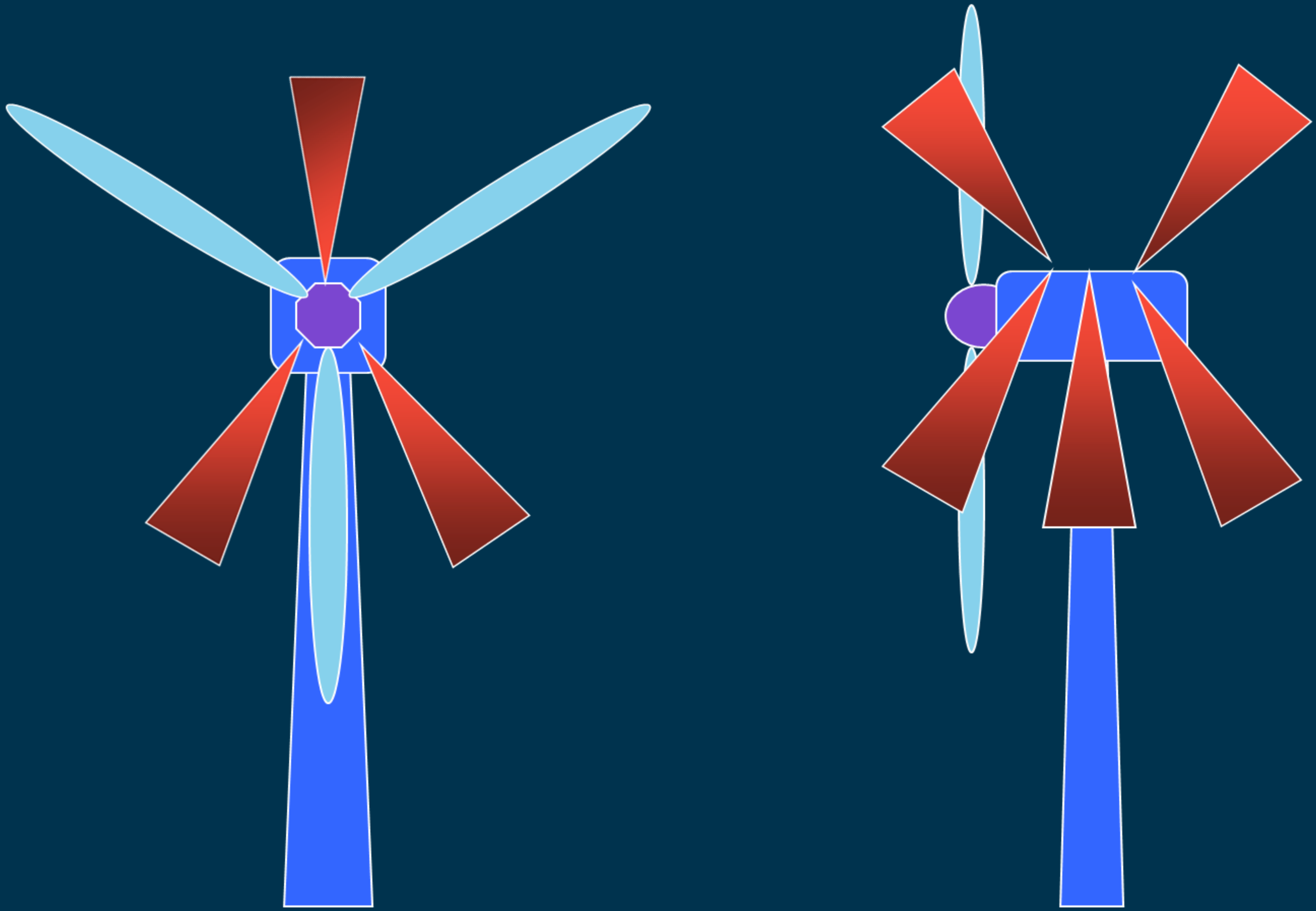
- Uncomfortable airspace that limits bats ability to orient & forage
- Predictable costs (+ maintenance)
- Unproven technology (only 1 study)
- Attenuation of high frequency sound

BWEC History & Current Progress

- Initiated in 2006 with lab & preliminary field tests
- Conducted 1st-ever study in 2009–2010
- Published report (*Arnett et al. 2012*)
- Technical Workshop: Next steps (Aug 2013)
- Tested a slightly modified device (Oct 2013)
- R&D phase, & testing next-gen device (2014–2015)

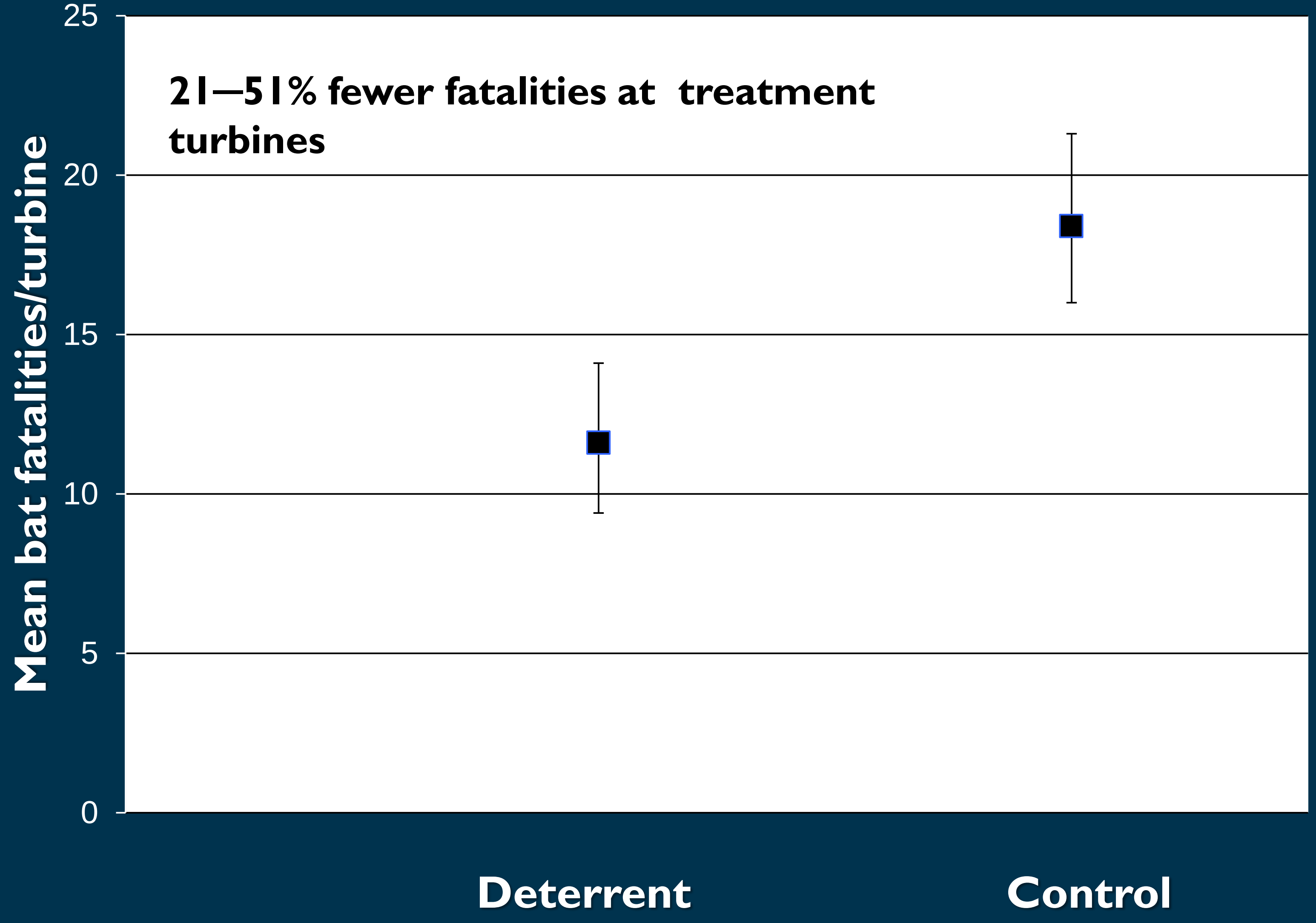
Device & Study Design

- Arnett et al. 2012 (Locust Ridge, PA):
  - SensComp 600 Environmental Grade Electrostatic Transducer
  - 122 db SPL @ 1 m; Frequency range 20–100 kHz
  - 8 devices/turbine, Randomly selected15 control & 10 deterrent turbines & conducted daily searches
  - In 2010, assessed inherent variation between control & treatment turbines. Though insignificant, applied 9% variation to results



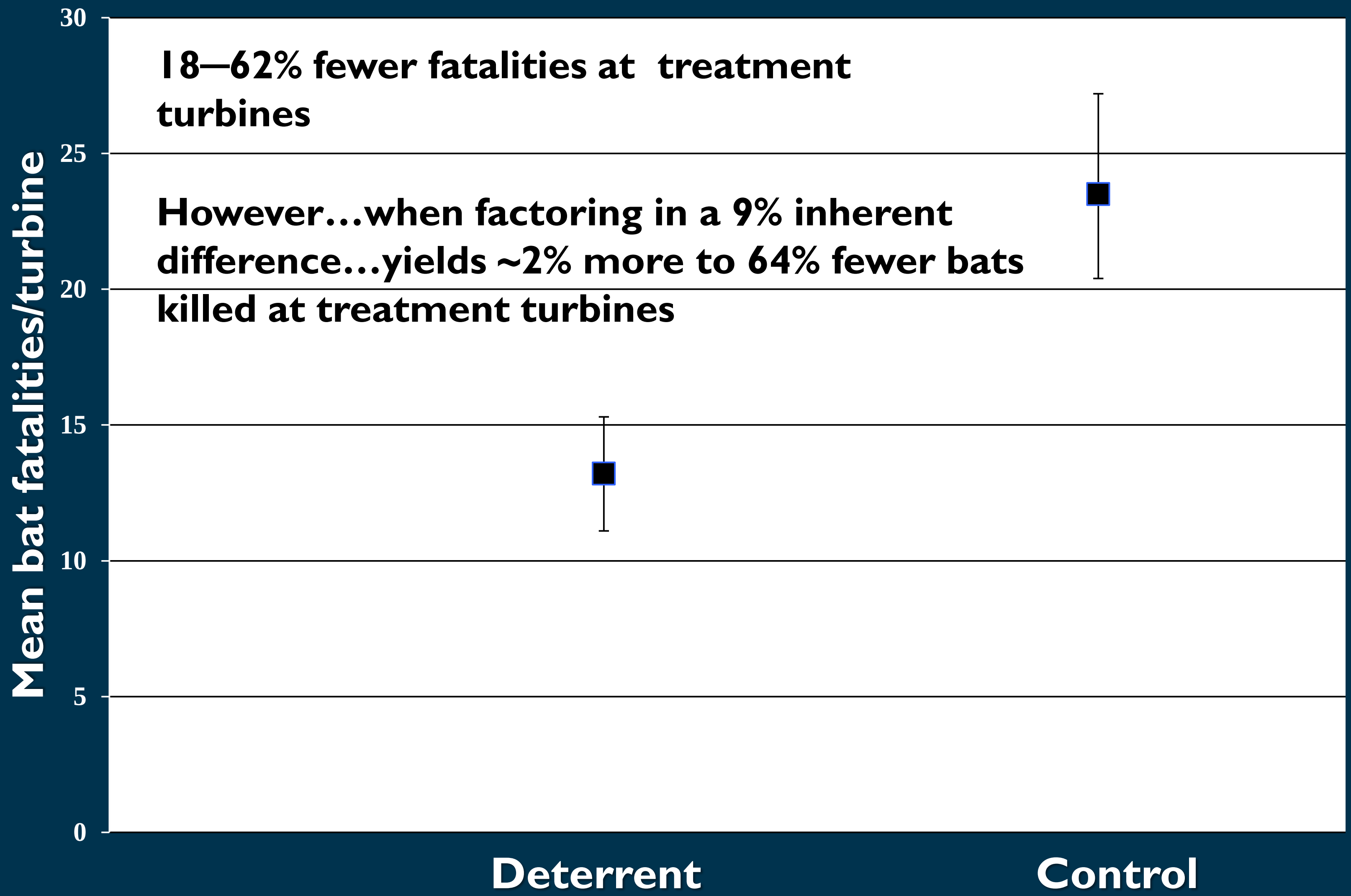
Estimated Bat Fatalities - 2009

Daily searches from 15 August—10 October 2009



Estimated Bat Fatalities - 2010

Daily searches from 31 July—9 October 2010

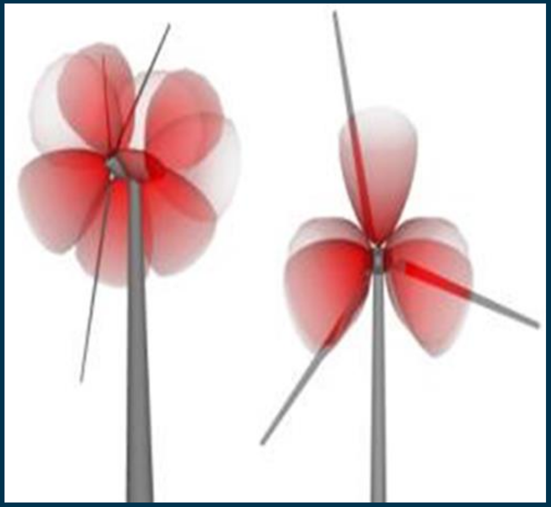


Species Specific Effects

Year	*Species*	Mean Ratio Control:Deterrent	Lower 95% CI	Upper 95% CI
2009				
	Big brown bat	1.74	0.41	6.13
	Eastern red bat	1.06	0.44	2.75
	*Hoary bat**	*2.09*	*1.18*	*4.04*
	Little brown bat	1.27	0.71	2.36
	Silver-haired bat	1.88	0.92	5.14
	Tri-colored bat	1.68	0.80	3.58
2010				
	Big brown bat	3.72	0.70	7.87
	Eastern red bat	1.59	0.93	2.78
	*Hoary bat**	*1.88*	*1.19*	*2.82*
	Little brown bat	1.72	0.43	5.22
	*Silver-haired bat**	*3.78*	*1.12*	*12.82*
	Tri-colored bat	1.59	0.84	2.96

Deterrent Research & Development

- Optimize the design of the device
- Improve weather-proofing of devices
- Test placement & orientation options
- Test different frequencies, patterns of transmission



Comparison of Strategies

- Operational Minimization
  - Multiple studies
  - Reduction 44–93%
  - Turbine impacts?
  - Power purchase agreement
  - Species-specific
    - *Myotis*
    - Brazilian free-tailed bats
  - Implementation needed
    - Feathering up to manufacturer cut-in speed!
    - Efforts to refine strategy
- Acoustic Deterrent
  - 1 study
  - Reduction 2% more–64% fewer
  - Maintenance costs?
  - Up front cost
  - Species-specific
    - *Myotis*
    - Hawaiian hoary bats
  - R&D needed
    - Transmission pattern & frequency
    - Placement & orientation

Next Steps-Minimization Strategies

- **Goal:** minimize bat fatalities & maximize wind power generation
- More research is needed to refine strategies
  - Relationships with weather conditions
  - Behavioral data
- How can we integrate these minimization strategies with existing & future turbine technologies?
  - Negotiate warranties with turbine manufacturers
  - Adaptable SCADA systems that can incorporate multiple variables for operational minimization
  - Dedicated space in/on turbines for cameras, detectors & deterrents

We Thank All Our Past, Current & Future Partners!

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