Strategies to Reduce Bat Fatalities at Wind Energy Facilities

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Bat Conservation International

U.S. Fish & Wildlife Service
5th Wind Energy Broadcast

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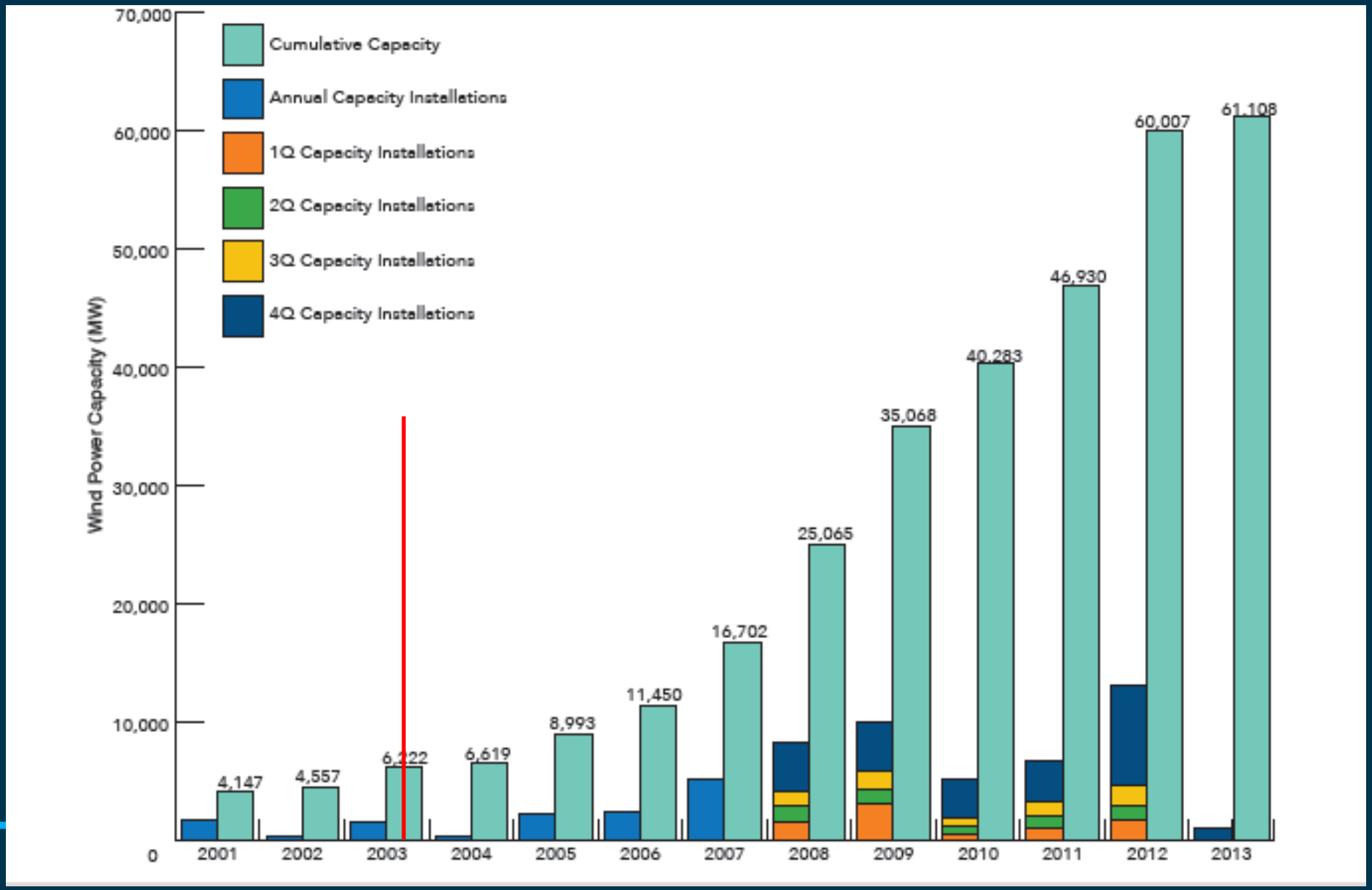
BWEC
bats and wind energy cooperative

Wind Energy in the U.S.



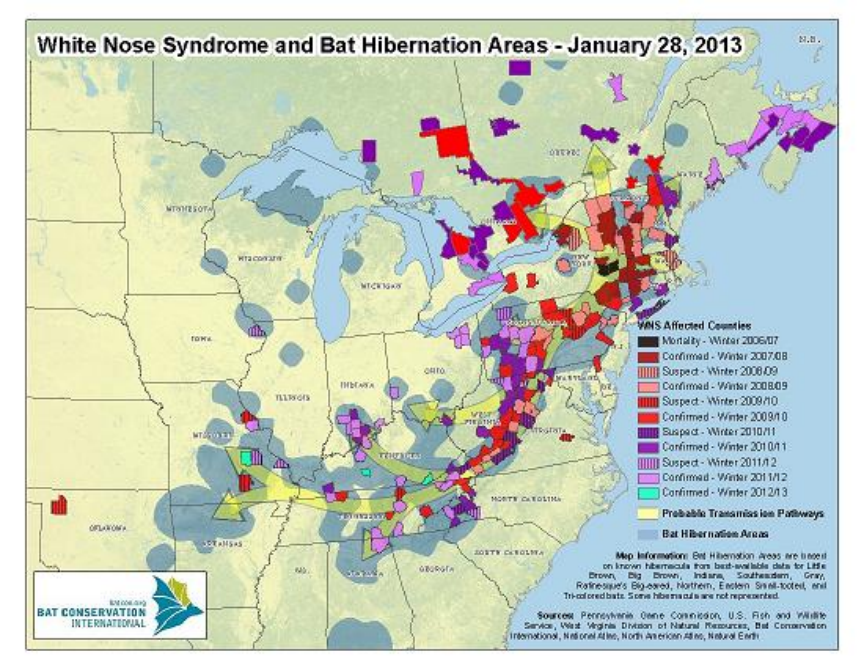
Impact of Wind Energy Development on Bats in the U.S. & Canada (Arnett & Baerwald 2013)

- **840,486–1,690,696 bats** between 2000–2011
- **196,190–395,886 bats** in 2012
- **78%** of fatalities are migratory tree-roosting bats
  - hoary (38%), eastern red (22%), silver-haired (19%)
- **21 species** in U.S.

Impacts Compounded by WNS

(Arnett & Baerwald 2013)

- Several species impacted by WNS also can make up high % of fatalities
  - Little brown bat (6.0% overall, as high as 60%)
  - Tri-colored bat (5.6% overall, as high as 25%)



Bat Populations

- Little to no data on bat populations
- Remains difficult to put fatalities & effectiveness of minimization measures in context
- Bats are long-lived with low reproductive rates
  - Populations are not able to recover quickly
- Despite lacking population data, response is needed

Operational Minimization

Synthesis of Studies

- Fatalities highest under low wind conditions ~mid-July–mid-October
- Several completed & ongoing studies investigating the effect of raising turbine cut-in (&/or feathering blades) speed on bat fatalities
- Studies consistently demonstrate substantial reductions in bat fatality can be achieved with relatively little loss in operating time…but variation can be expected

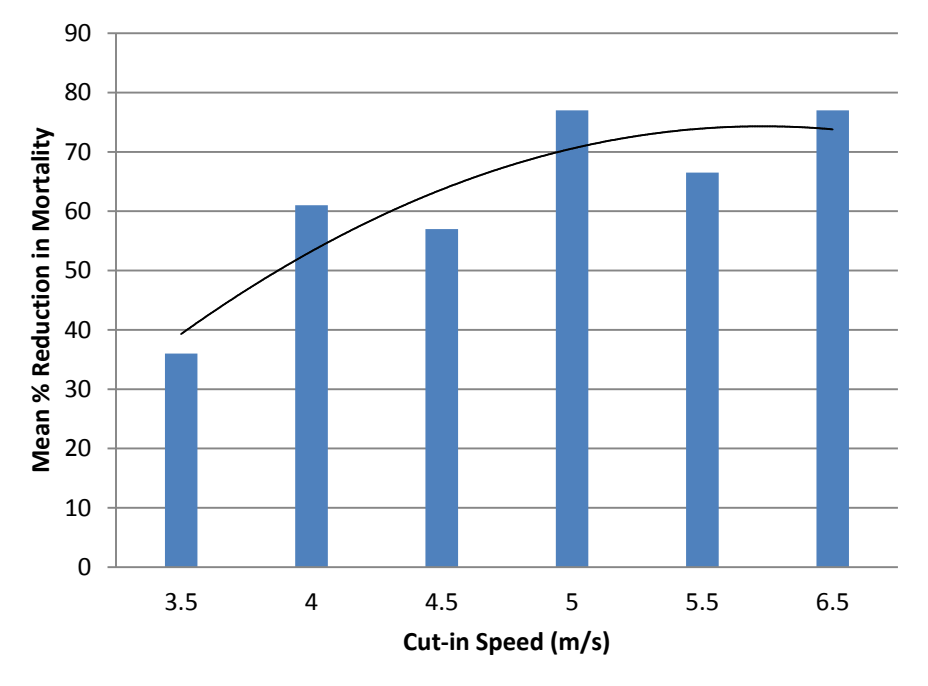
Operational Minimization

Results from publicly available operational adjustment studies.

Study Name	Cut-in Speed (m/s)	Mean Percent Reduction in Mortality	Mean Percent Reduction in Mortality Per Cut-in Speed
Fowler Ridge 2011	3.5	36	36
Mount Storm[a]	4	64	61
Summerview	4	58	
Fowler Ridge 2011	4.5	57	57
Casselman 2008	5	82	68
Casselman 2009	5	72	
Fowler Ridge 2010[b]	5	50	
Summerview	5.5	60	67
Fowler Ridge 2011	5.5	73	
Casselman 2008	6.5	82	78
Casselman 2009	6.5	72	
Fowler Ridge 2010[b]	6.5	79	

[a] Average reduction from first and second halves of the night

[b] Study did not include feathering below cut-in speed



Operational Minimization-Next Steps

- Feather blades below manufacturer's cut-in speed
- Incorporate additional weather variables
- 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
  - Long-term 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

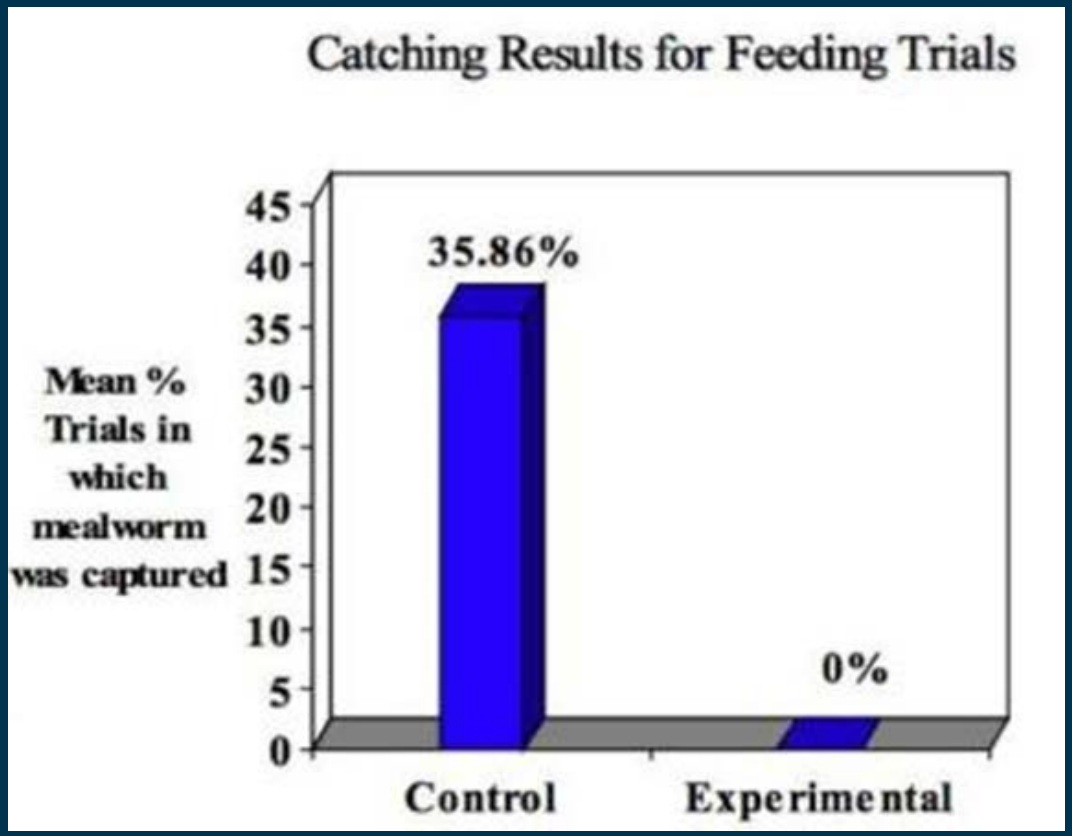
- Uncomfortable airspace limiting bats ability to orient & forage
- Predictable costs
- Unproven technology
- Attenuation of high frequency sound

BWEC History & Current Progress

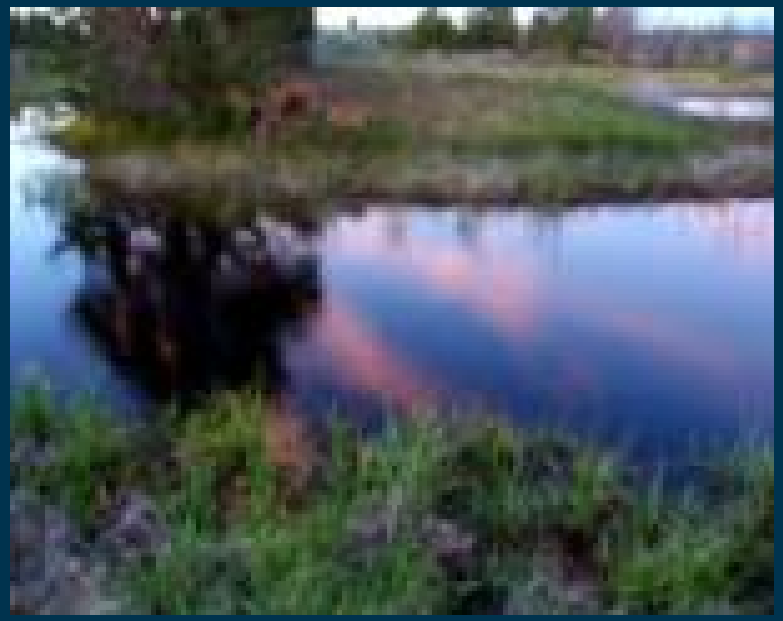
- Initiated in 2006 with lab & preliminary field tests
- Conducted 1st-ever study in 2009–2010
- Published report (*Arnett et al. 2012*)
- Webinar: Current state of knowledge (Apr 2013)
- Workshop: Next steps (Aug 2013)
- Tested a slightly modified device (Oct 2013)
- R&D phase, & testing next-gen device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

Preliminary Lab Tests

In the lab: captive bats unable to catch prey with device on

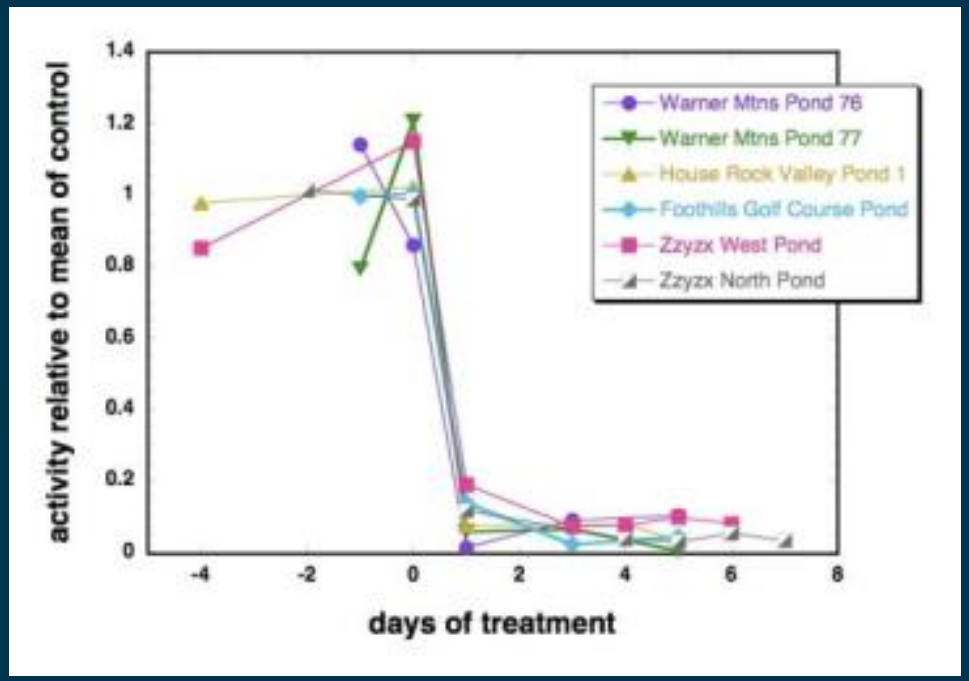


Preliminary Field Experiments



Preliminary field tests: ~90% reduction in bat activity at ponds

Sustained effect at ponds (no indication of habituation)



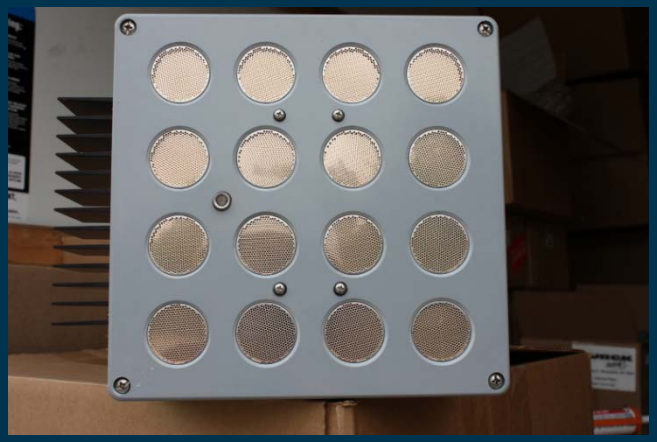
2007 Field Experiment

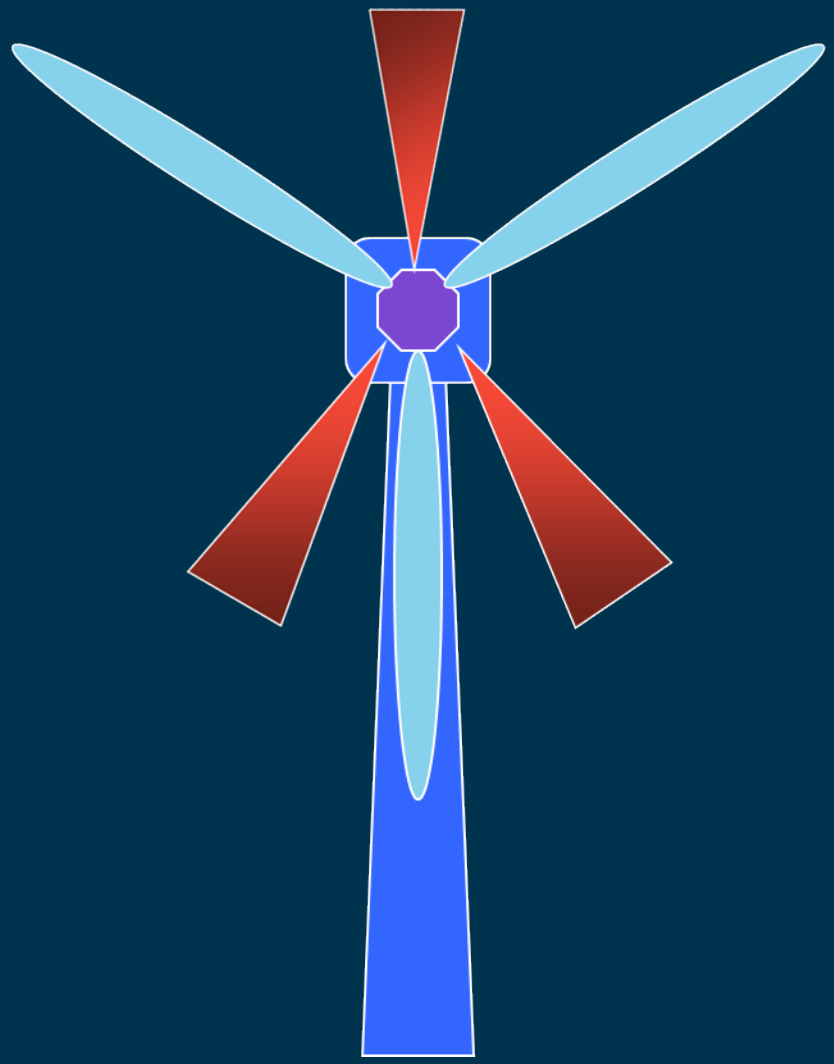
Thermal Infrared Imaging used to evaluate activity of bats and response to deterrents on turbines

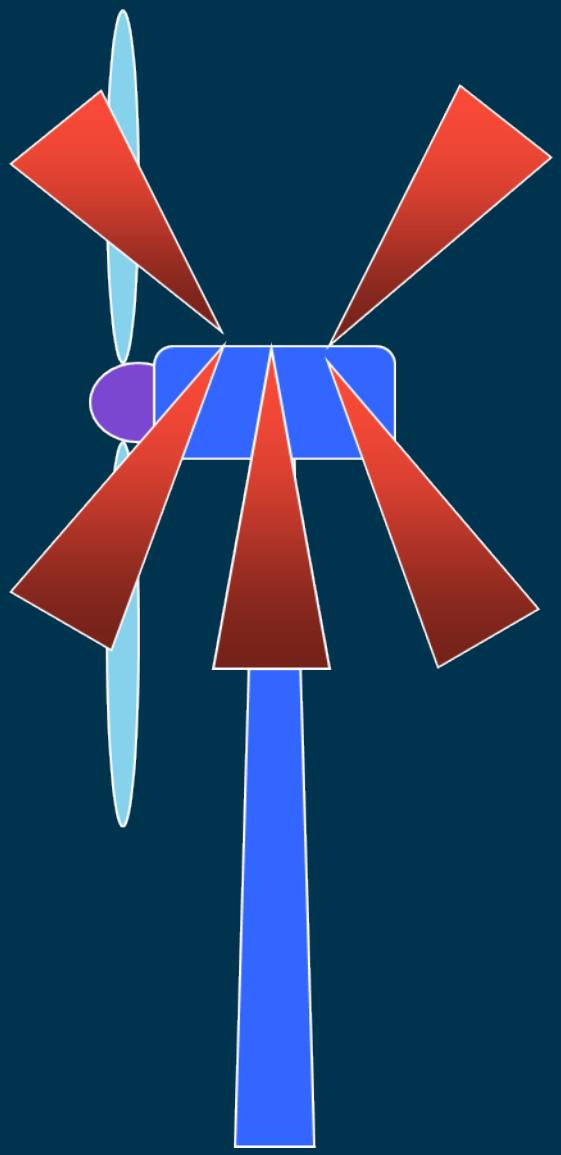
Mixed results: one experiment showed significant reduction in bat activity at treated turbine compared to control; second experiment showed no difference

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

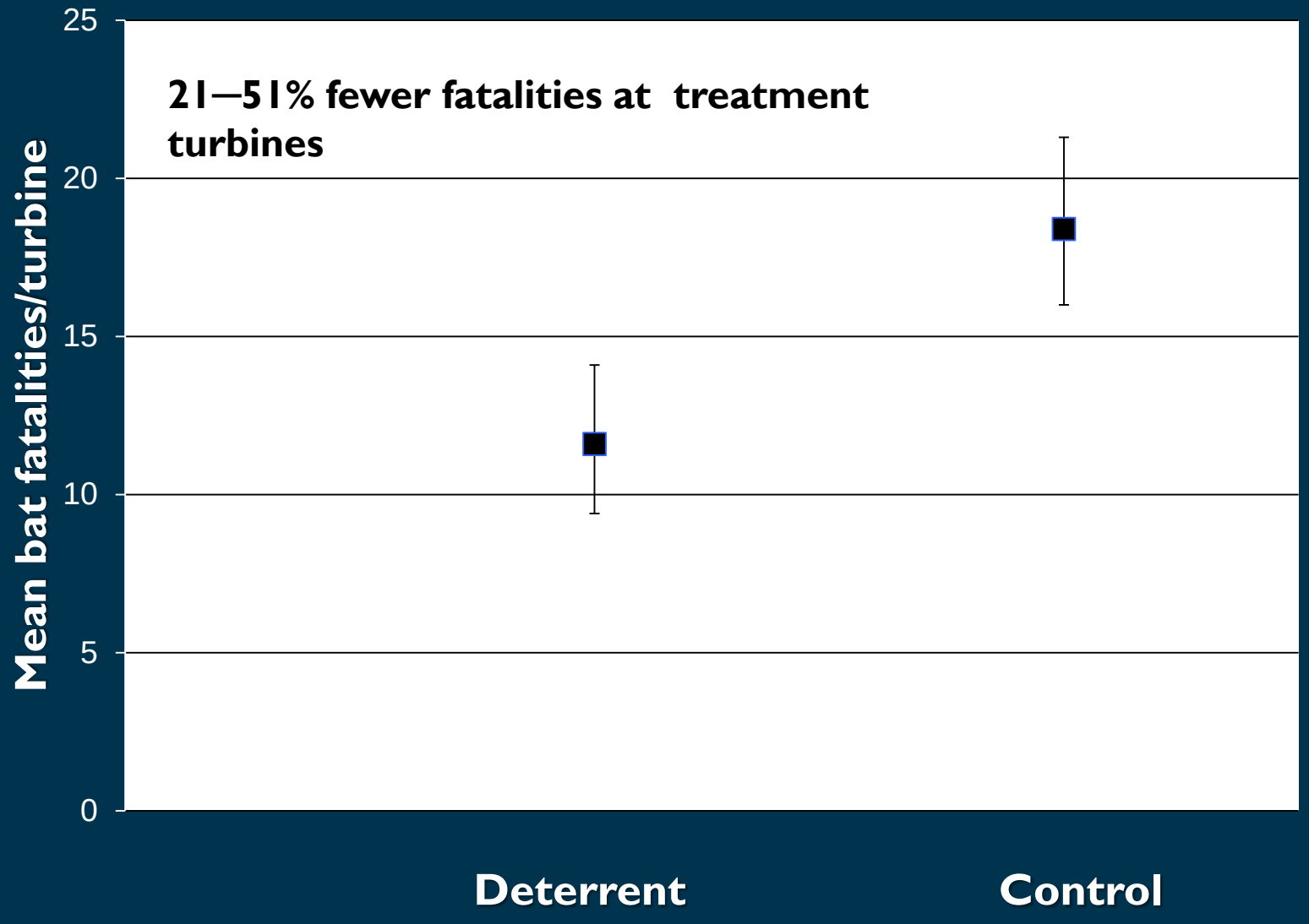






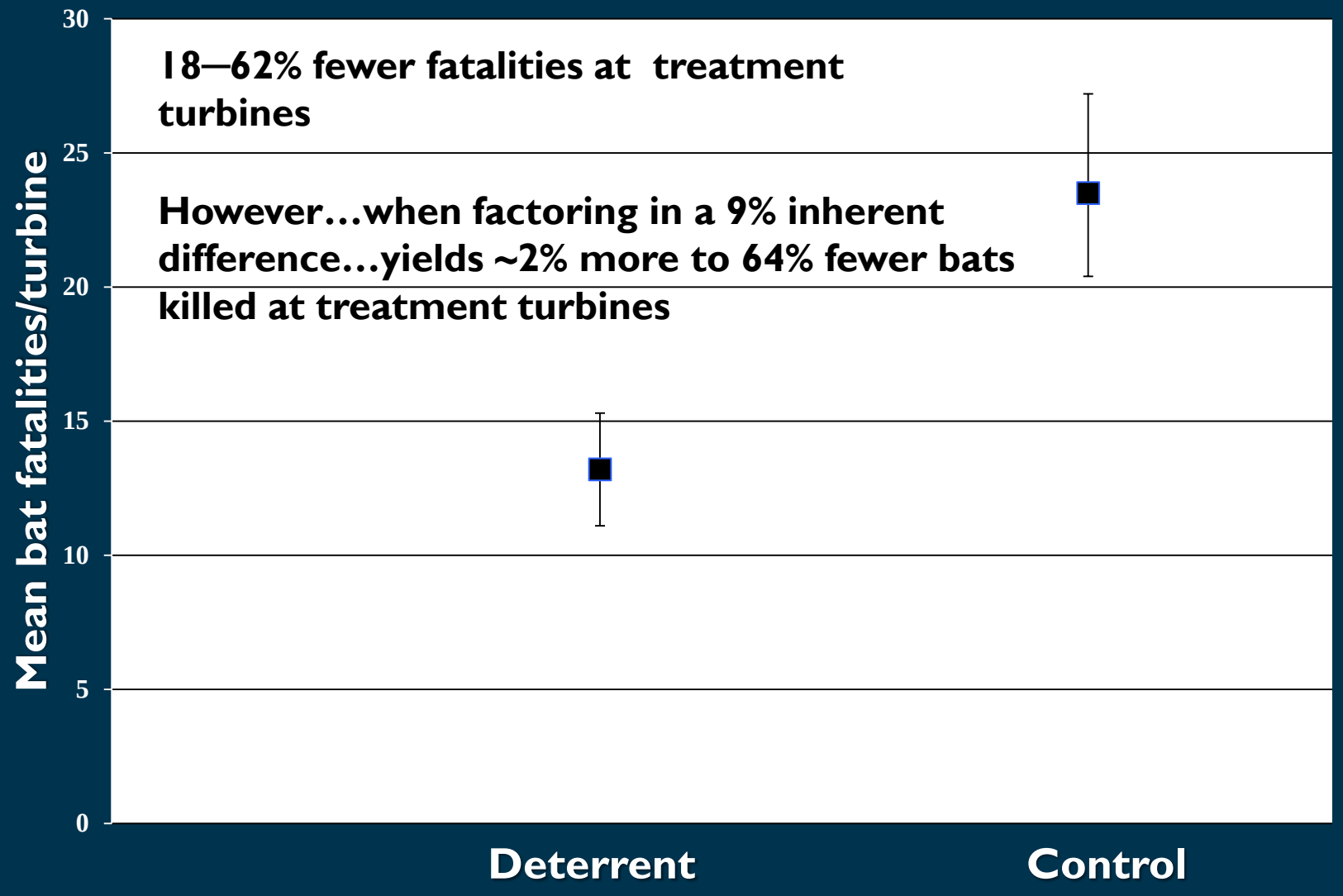
Estimated Bat Fatalities - 2009

Daily searches from 15 August—10 October 2009



Estimated Bat Fatalities - 2010

Daily searches from 31 July—9 October 2010

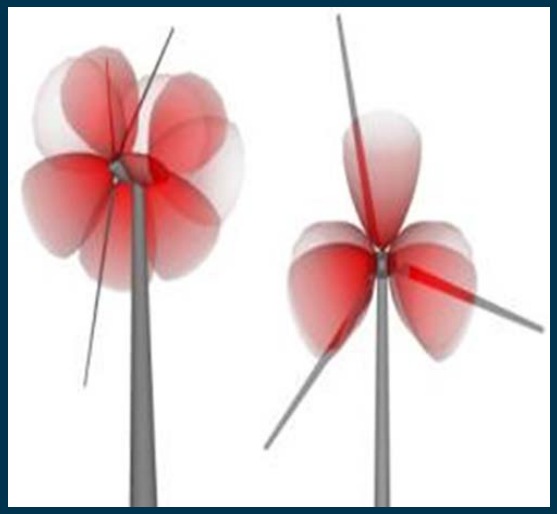


Species Specific Effects

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

Research & Development

- Optimize the design & placement of device(s)
- Investigate different transducer technology
- Improve weather-proofing of devices
- Test different frequencies, patterns of transmission



Conclusions

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

We Thank All Our Past, Current & Future Partners!

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