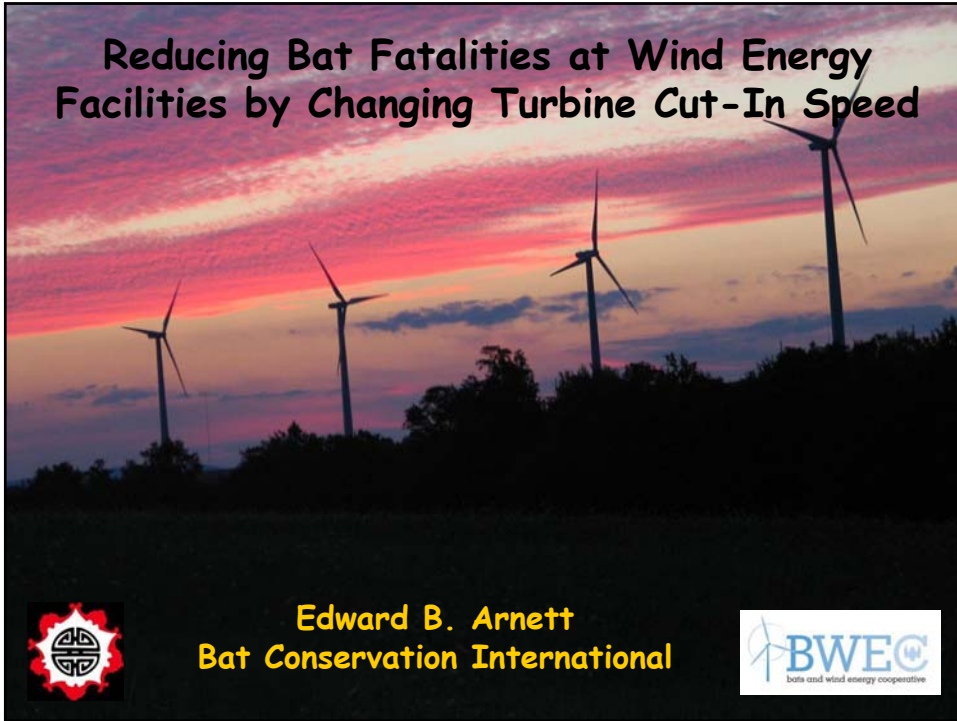


Reducing Bat Fatalities at Wind Energy Facilities by Changing Turbine Cut-In Speed



Edward B. Arnett
Bat Conservation International



What's the Evidence...

Why curtail if bats hit non-moving turbines?

Do bats strike stationary objects?

YES...BUT...

Frequency and magnitude of events are very different from birds...



Collisions with Towers

Bats are NOT birds!!!

<u>Site</u>	<u>Birds</u>	<u>Bats</u>
Topeka, KS	> 1000	5
Nashville, TN	336	2
Colombia, MO	658	1
North Dakota	561	5

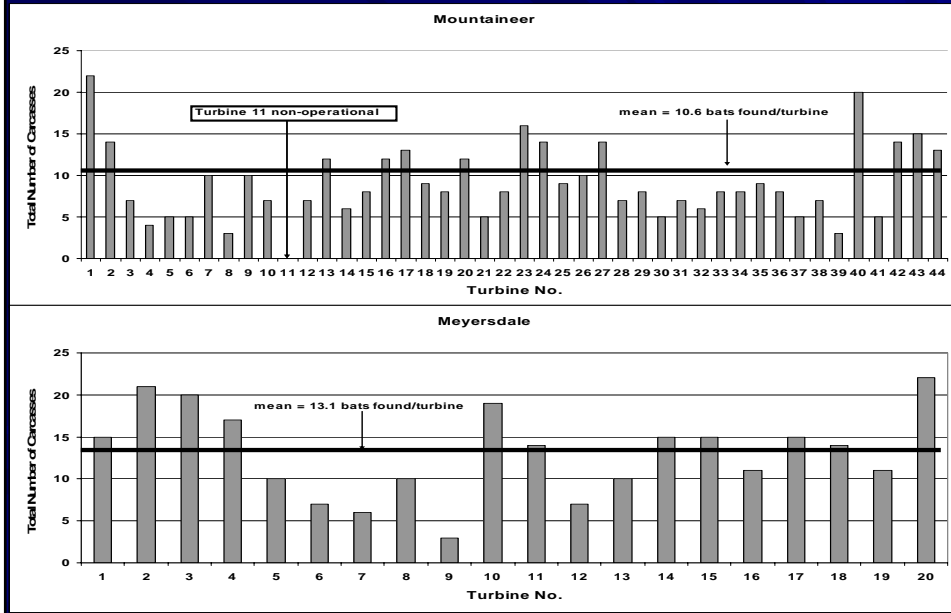
·About 6 other incidents in the literature; all eastern red bats; all during autumn

from: P. Cryan, USGS

What's the Evidence: Turbine Data

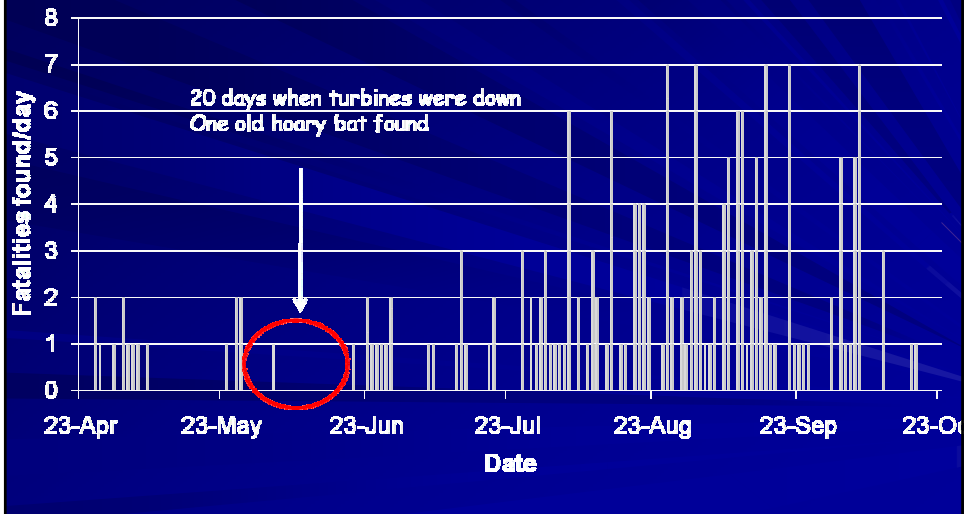


What's the Evidence: Turbine Data

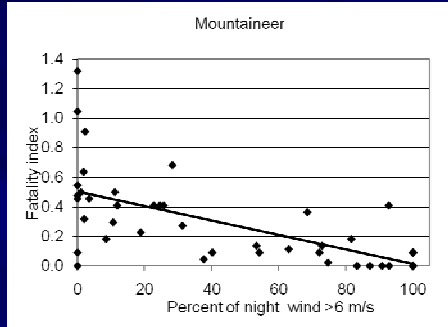


What's the Evidence: Turbine Data

Casselman, PA 23 April - 23 October 2008



What's the Evidence: Bats and Wind



Majority of bats killed in PA, TN, WV were on low wind nights (Arnett et al. 2008)

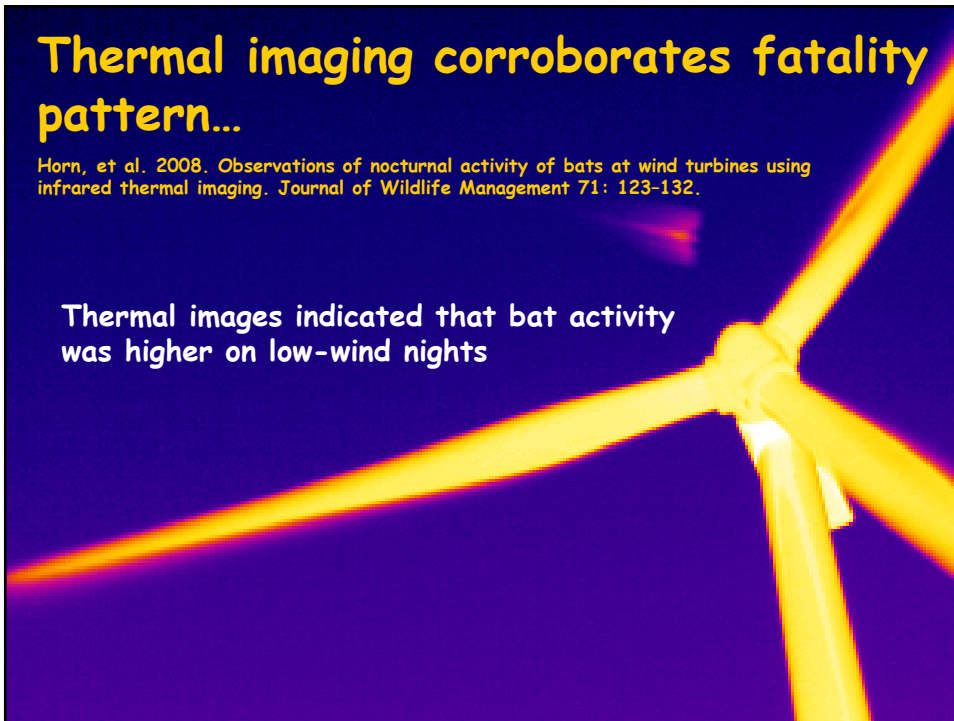
Proportion of the night when winds were >6 m/s negatively associated with bat fatalities



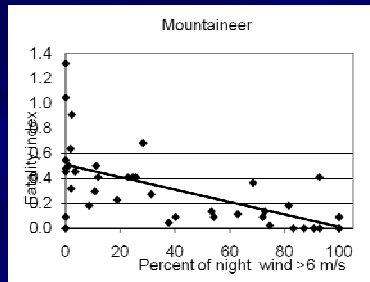
Thermal imaging corroborates fatality pattern...

Horn, et al. 2008. Observations of nocturnal activity of bats at wind turbines using infrared thermal imaging. *Journal of Wildlife Management* 71: 123-132.

Thermal images indicated that bat activity was higher on low-wind nights



Hypothetical Curtailment at Mountaineer and Meyersdale



Assuming that:

- all turbines were non-operational on nights when median wind speed was < 6 m/s (sunset to sunrise)

85% fatalities at Mountaineer occurred on those nights (24 of 43 nights)

82% fatalities at Meyersdale (19 of 42 nights)

Will changing cut-in speed reduce fatality of bats?



Curtailment Studies:



Study conducted in Germany found ~50% reduction of bat kills when turbine "cut-in" speed was changed to 5.5 m/s

Study conducted in Alberta Canada showed ~60% reduction in kills with 5.5 m/s cut-in

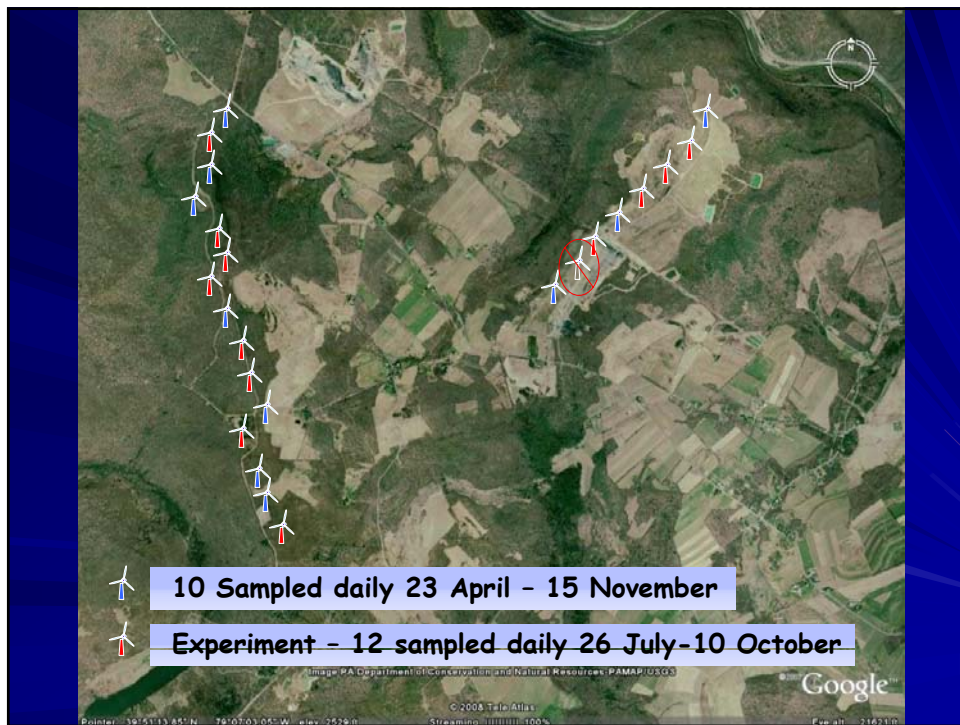
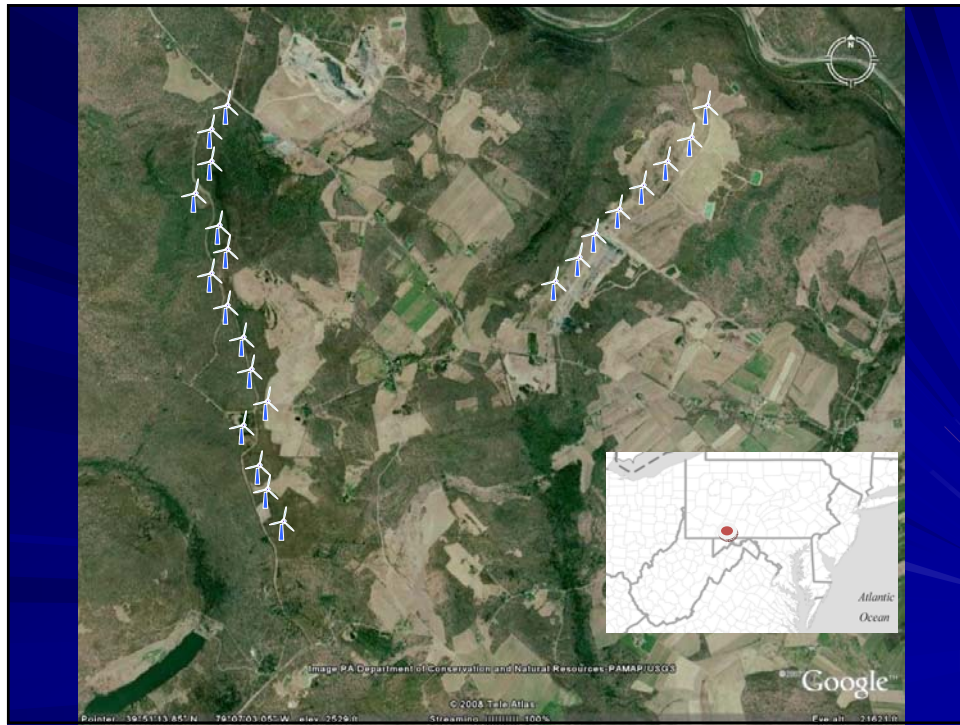


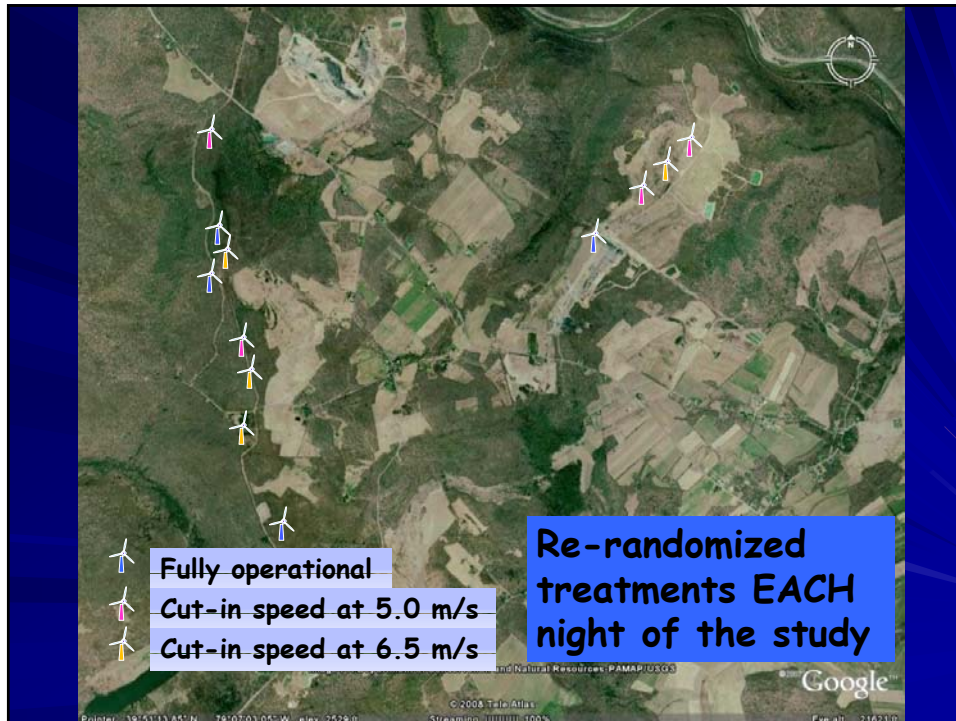
Implemented experimental test of fully operational turbines and those with two different cut-in speeds (5 m/s, 6.5 m/s)

Sampled from 26 July to 10 October 2008 at Iberdrola's Casselman Wind Project in south-central Pennsylvania

Objective: Quantify reductions in bat fatality relative to economic costs of curtailment







Measures of curtailment effect

1. Comparison of fresh killed bats among treatments
2. Comparison of all bat fatalities found from 12 "experimental" turbines and 10 turbines ("PGC study" surveyed during same time period



Relationships between bat fatalities and operational hours, wind speed, etc.



Results

- 76 days of sampling
- Total of 52 bats found (no corrections) and 32 fresh carcasses

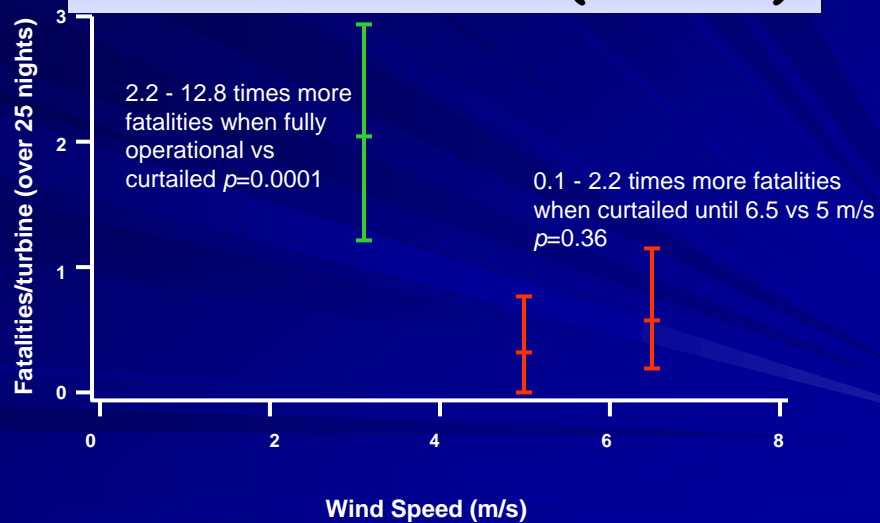


Fresh Fatalities/Treatment

Full Operation	5.0 m/s	6.5 m/s
21	5	6

Casselman, PA - Arnett et al. 2009

73% mean reduction (53-87%)



Results

Estimated bat fatalities per turbine were 1.23 to 4.68 times greater (mean = 2.34) at PGC turbines relative to curtailed turbines...

Further support for the contention that reducing operational hours during low wind periods reduces bat fatalities...



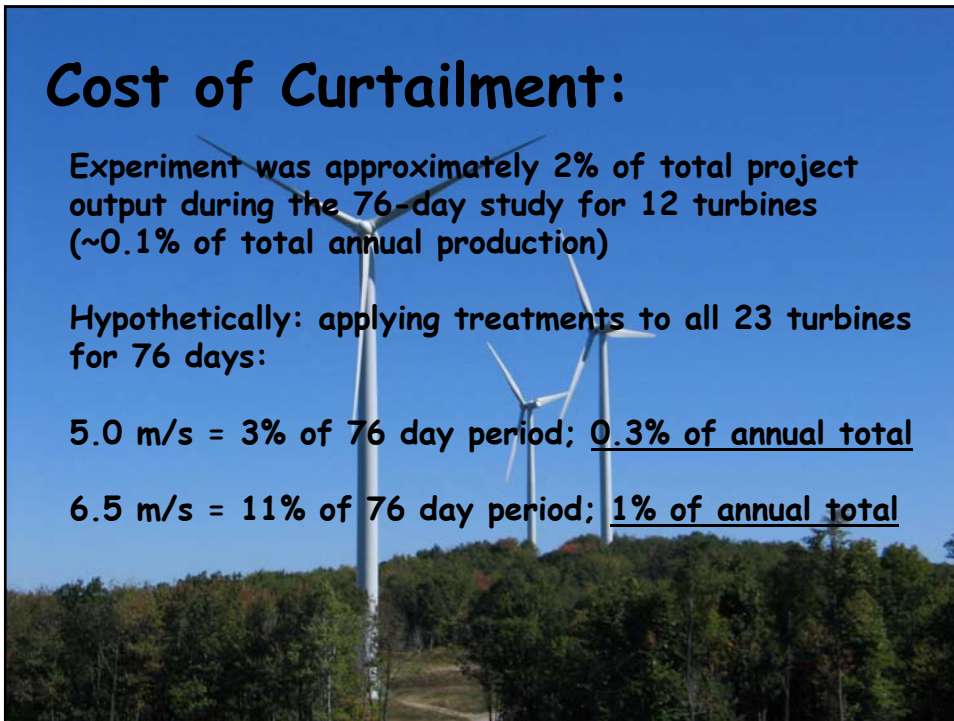
Cost of Curtailment:

Experiment was approximately 2% of total project output during the 76-day study for 12 turbines (~0.1% of total annual production)

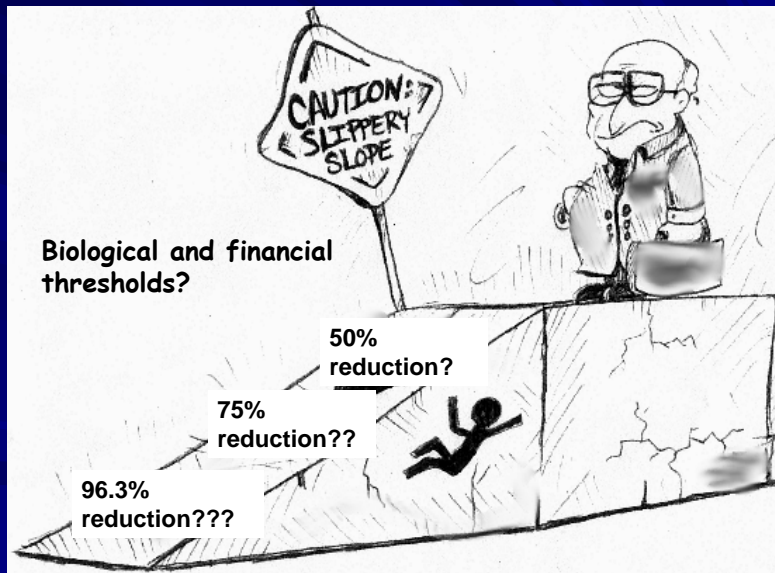
Hypothetically: applying treatments to all 23 turbines for 76 days:

5.0 m/s = 3% of 76 day period; 0.3% of annual total

6.5 m/s = 11% of 76 day period; 1% of annual total



How Much is Enough?



Conclusions and Next Steps:

Significant reductions in bat fatality;
pattern similar to other studies

Conduct a second year at Casselman in
2009 AND need to duplicate study at
other sites...currently seeking new sites

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Chris Long, many others...)

Field crews!!!

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