

PRE- AND POST CONSTRUCTION MONITORING OF BAT ACTIVITY AND FATALITY:

What We've Learned and Where to Next

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Bat Conservation International



Recent and Future Publications:

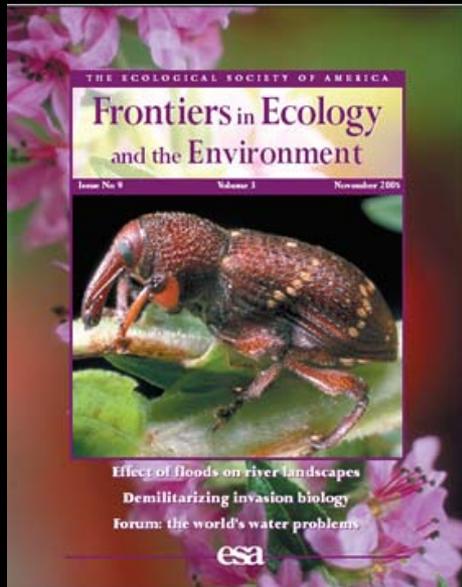


Johnson, G.D. 2005. A review of bat mortality at wind-energy developments in the US. *Bat Research News* 46: 45-49

Arnett, E. B., et al. In prep. Patterns of fatality of bats at wind energy facilities in North America. *Journal of Wildlife Management*.

Future Publications:

Kunz et al. 2006. Ecological Impacts of Wind Energy Development on Bats: Questions, Hypotheses, and Research Needs



Larkin et al. 2006. Ecological Impacts of the Wind Energy Development on Bats: Methods and Research Protocols

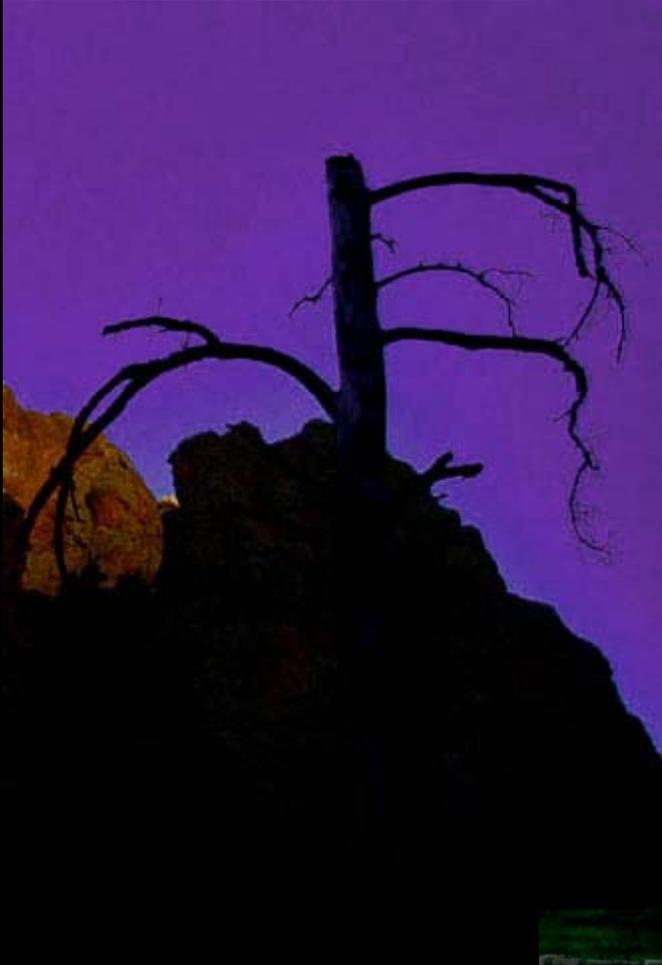
Possible Explanations Why Bats Are Being Killed by Wind Turbines?



- Use of Linear Corridors?
- Sensory Failure?
- Visual Attraction?
- Acoustic Attraction?
- Insect Concentration
and/or Entrapment?
- Habitat/Roost
Attraction?

**Meyersdale, PA
August 2005**



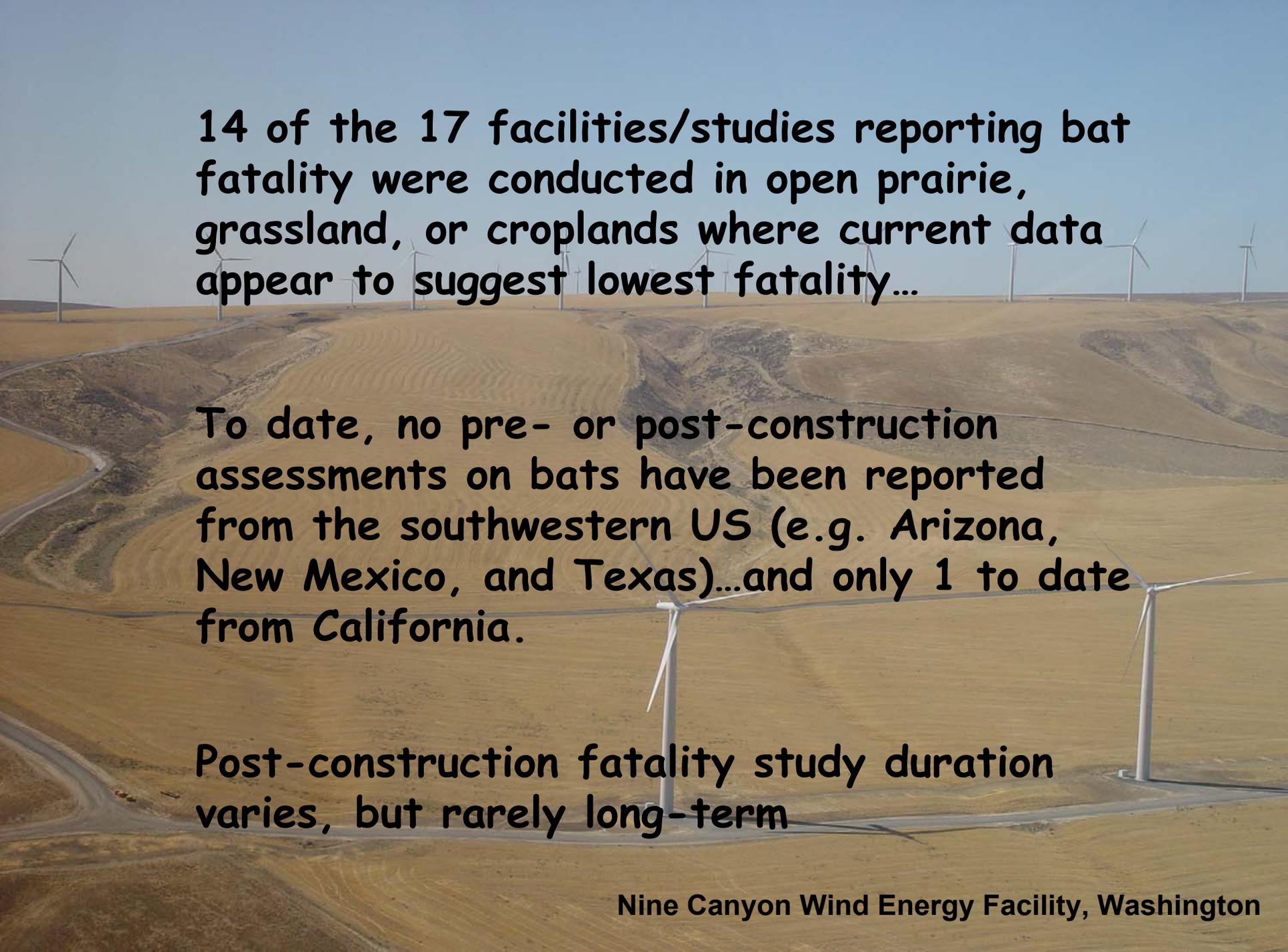


**Meyersdale, PA
August 2005**



Bats Have Not Been Well Studied





14 of the 17 facilities/studies reporting bat fatality were conducted in open prairie, grassland, or croplands where current data appear to suggest lowest fatality...

To date, no pre- or post-construction assessments on bats have been reported from the southwestern US (e.g. Arizona, New Mexico, and Texas)...and only 1 to date from California.

Post-construction fatality study duration varies, but rarely long-term

Post-Construction Fatality: What We Know



Bat fatalities have been documented at wind facilities worldwide

Fatalities have been reported at all wind facilities investigated in the North America across a wide range of habitats

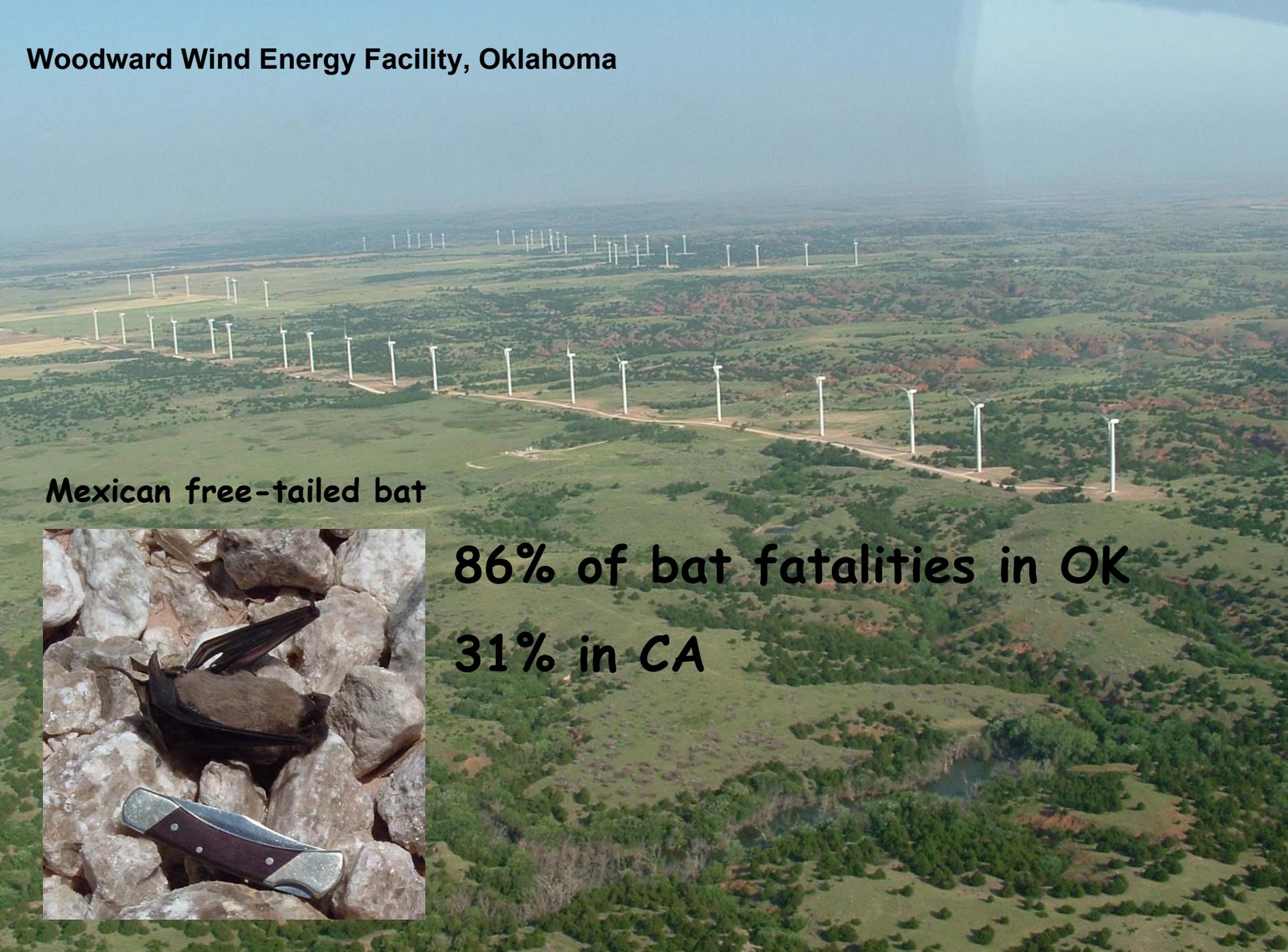
Eleven of the 45 species north of Mexico have been found killed by turbines



Fatalities are skewed to migratory tree roosting bats

To date, no threatened or endangered species has been found at wind facilities, but likely just a matter of time given projected expansion of wind

Woodward Wind Energy Facility, Oklahoma



Mexican free-tailed bat



**86% of bat fatalities in OK
31% in CA**

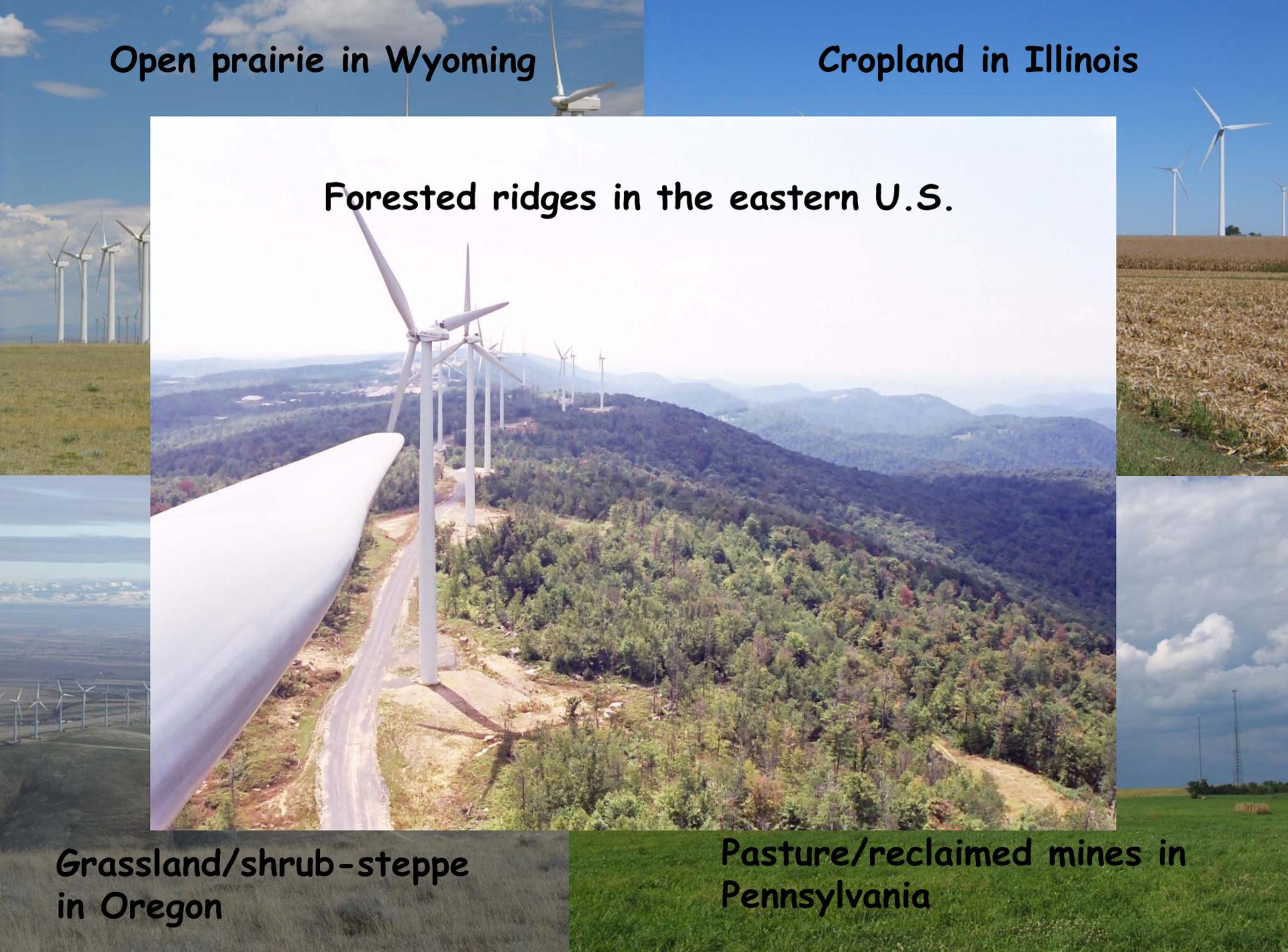
Open prairie in Wyoming

Cropland in Illinois

Forested ridges in the eastern U.S.

**Grassland/shrub-steppe
in Oregon**

**Pasture/reclaimed mines in
Pennsylvania**

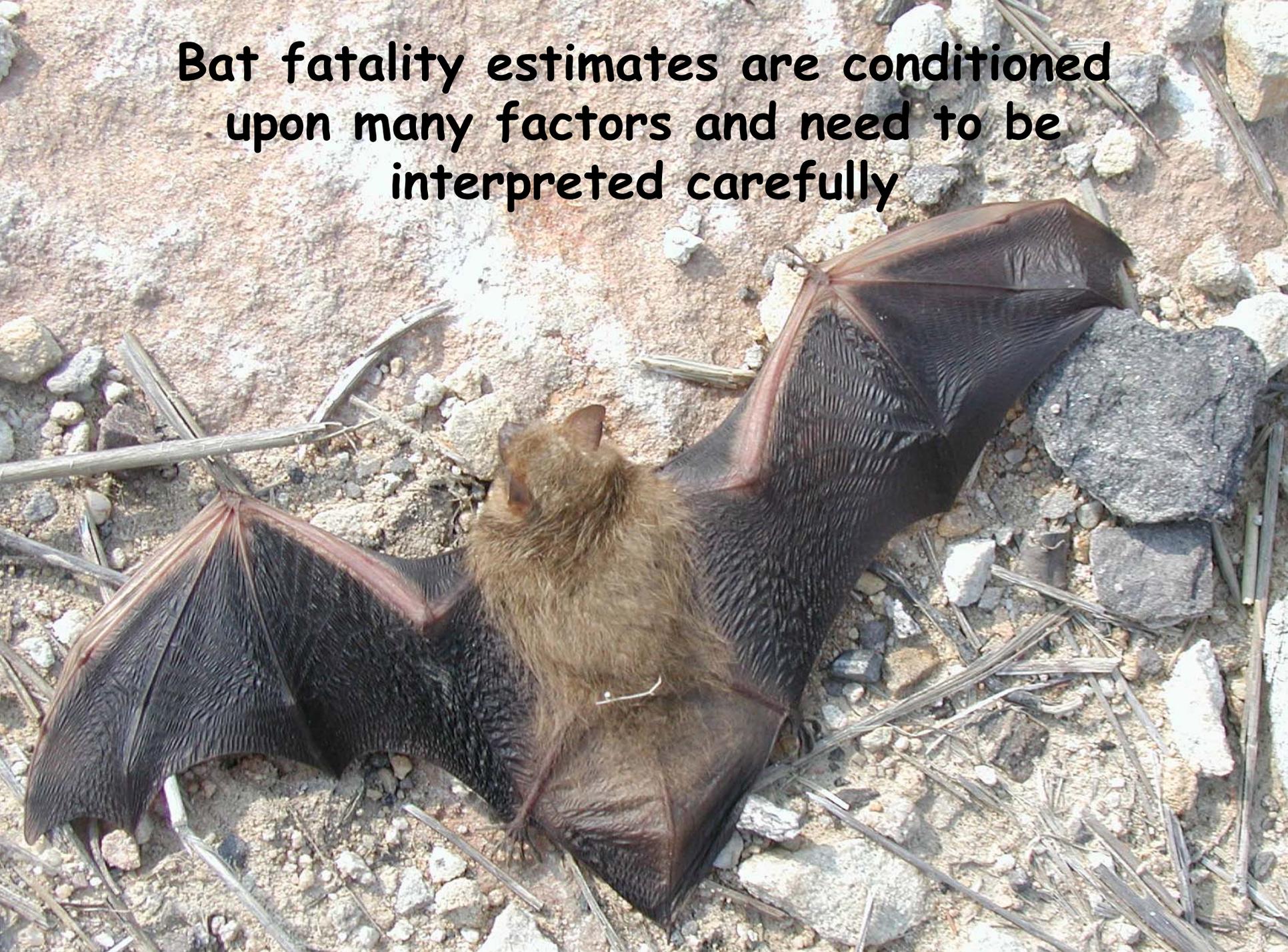


Regional bat fatality (Arnett et al. in prep)

<u>Region</u>	<u>Bats/MW/yr</u>
Castle River, AB	1.6 in 2003
McBride Lake, AB	0.9 in 2004
Summerview, AB	9.2 in 2005
Buffalo Ridge, MN	0.3 in Phase I and 2.7 in Phase II
Top of Iowa	7.1 in 2003 and 10.2 in 2004
Footc Ck. Rim, WY	2.0
Pacific Northwest	1.7
Buffalo Mt. TN	42.4 (0.66MW turbines) and 38.7 (1.8MW turbines)
Meyersdale	15.3 in 6 weeks
Mountaineer	32 in 2003; 25.3 in 6 weeks in 2004



Bat fatality estimates are conditioned upon many factors and need to be interpreted carefully

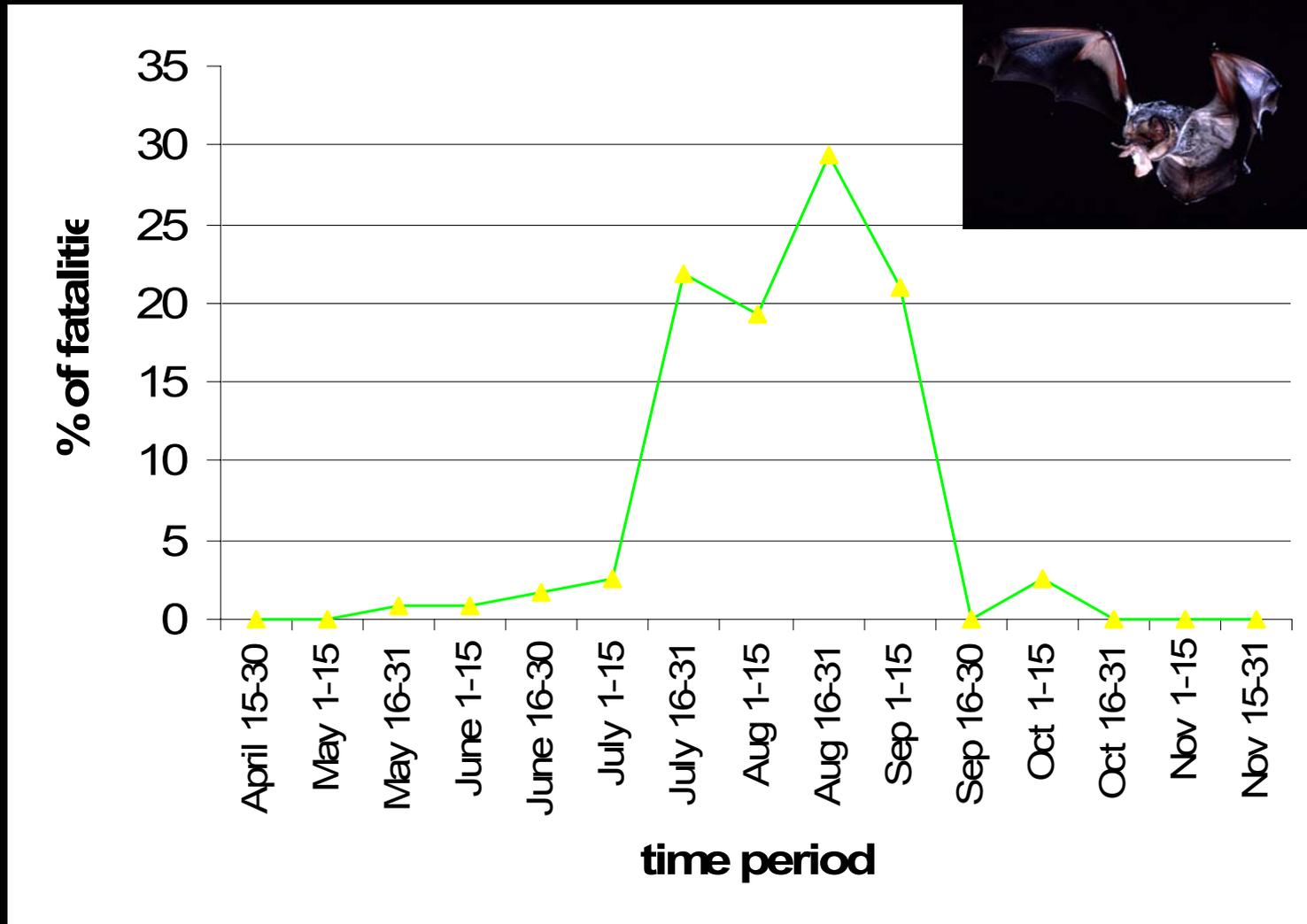




More bats found at larger turbines, but adjusted estimates of fatality/MW or rotor-swept area are similar or less for large turbines...

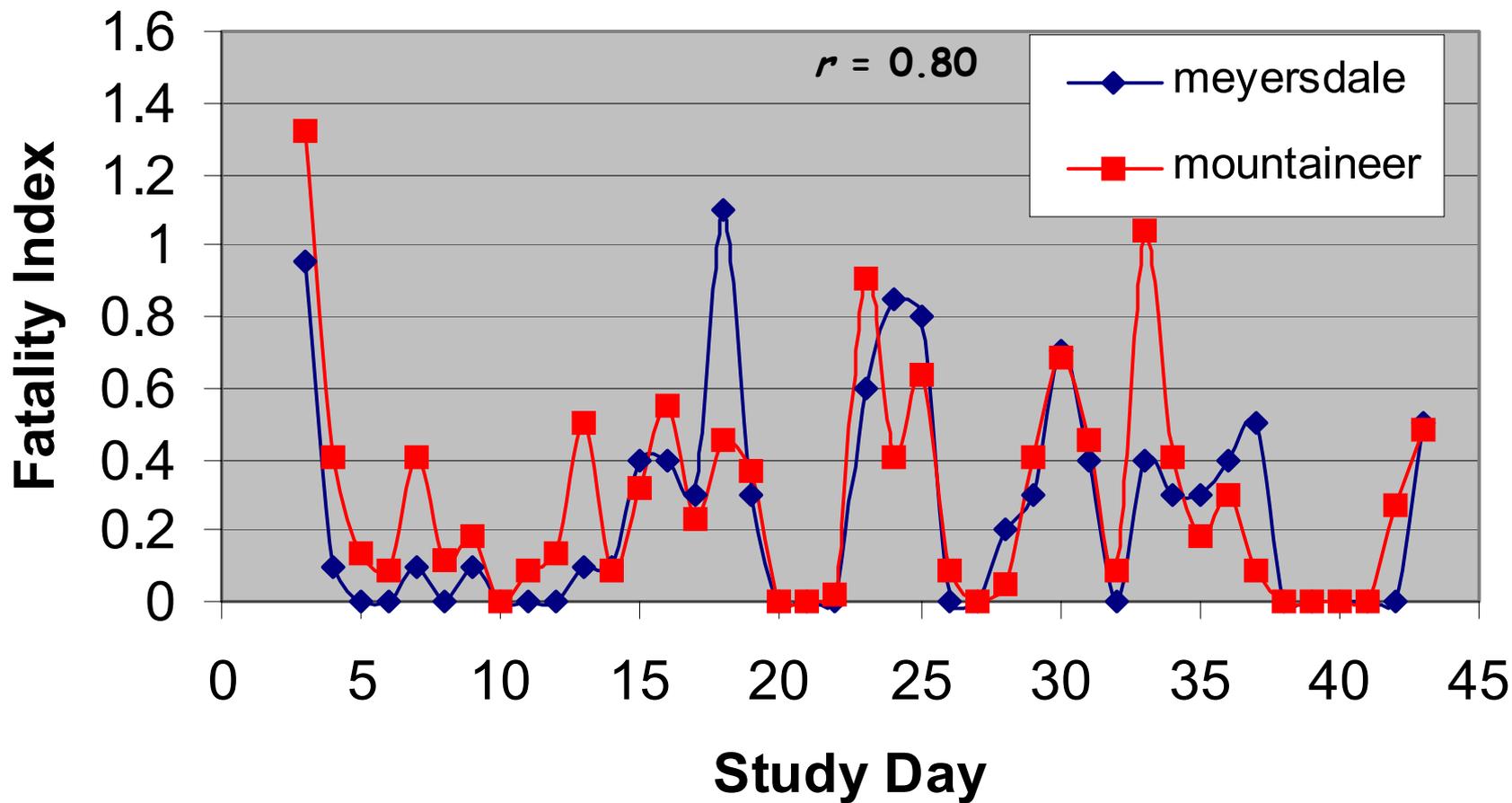
Bat mortality appears to occur primarily in late summer and early fall

(from Johnson 2005)



Bat fatality highly variable and periodic, but similar timing of fatalities between sites

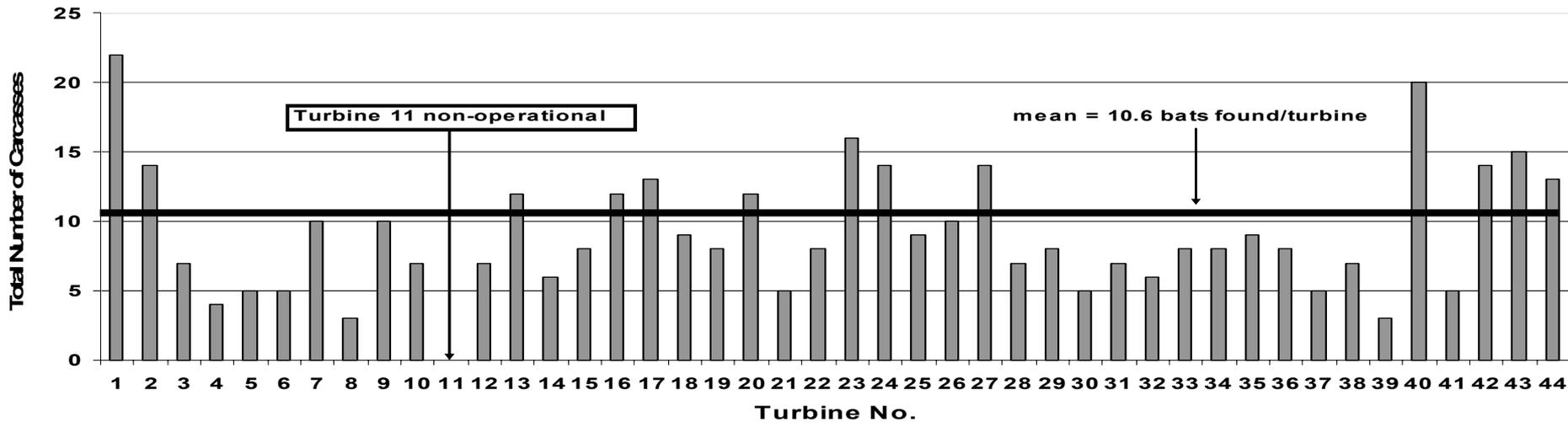
Timing of Bat Mortality



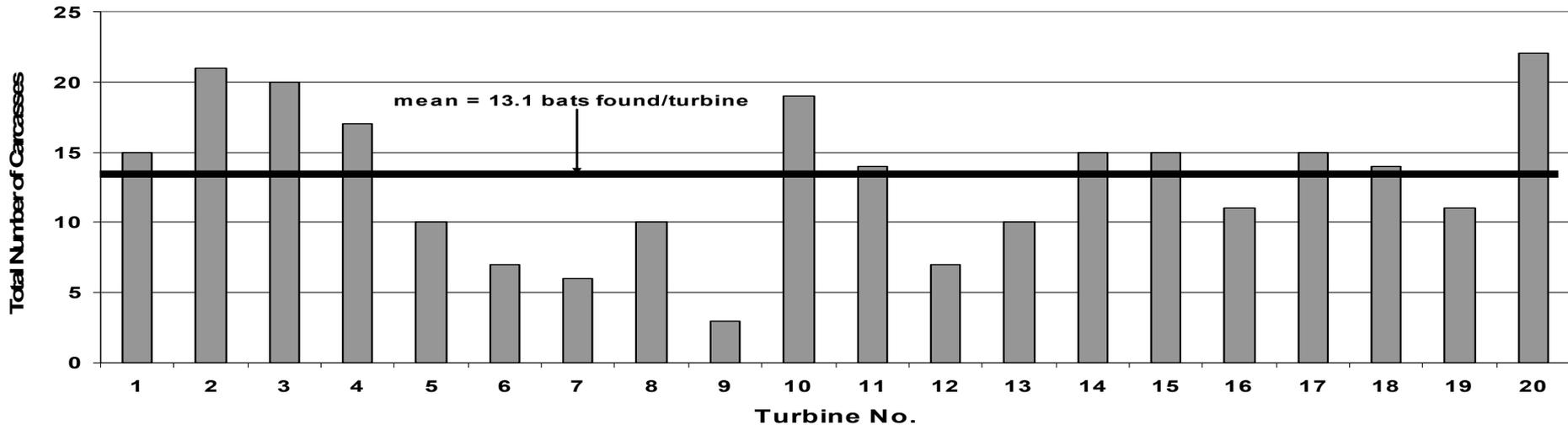


Spatial Patterns of Fatalities

Mountaineer



Meyersdale



Bat Fatalities at Lit and Unlit Turbines

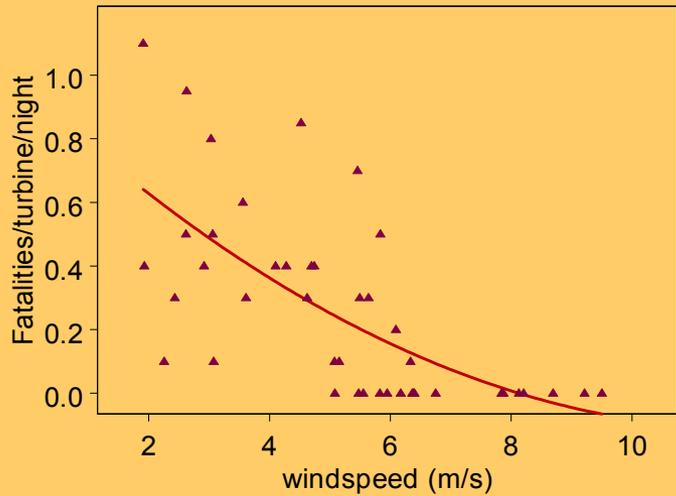
	Mountaineer		Meyersdale	
	Lit	Unlit	Lit	Unlit
# Turbines	12	32	6	14
Mean Dead	9.3	9.7	11.9	13.2
SE	0.5	0.3	1.7	1.2



L-864
20-40 Flashes
Per minute

No difference in fatalities at lit
and unlit turbines

Bat Fatality and Weather:



Majority of bats killed in PA and WV in 2004 were on low wind nights; kills negatively related to wind speed

Bat kills also associated with lower relative humidity and higher barometric pressure; conditions typical after weather fronts passed through the area.



In TN, wind speed (-), wind speed difference between the first and second portions of the night (-), ave. nightly wind direction (+), and maximum temperature (-) best predicted bat fatality

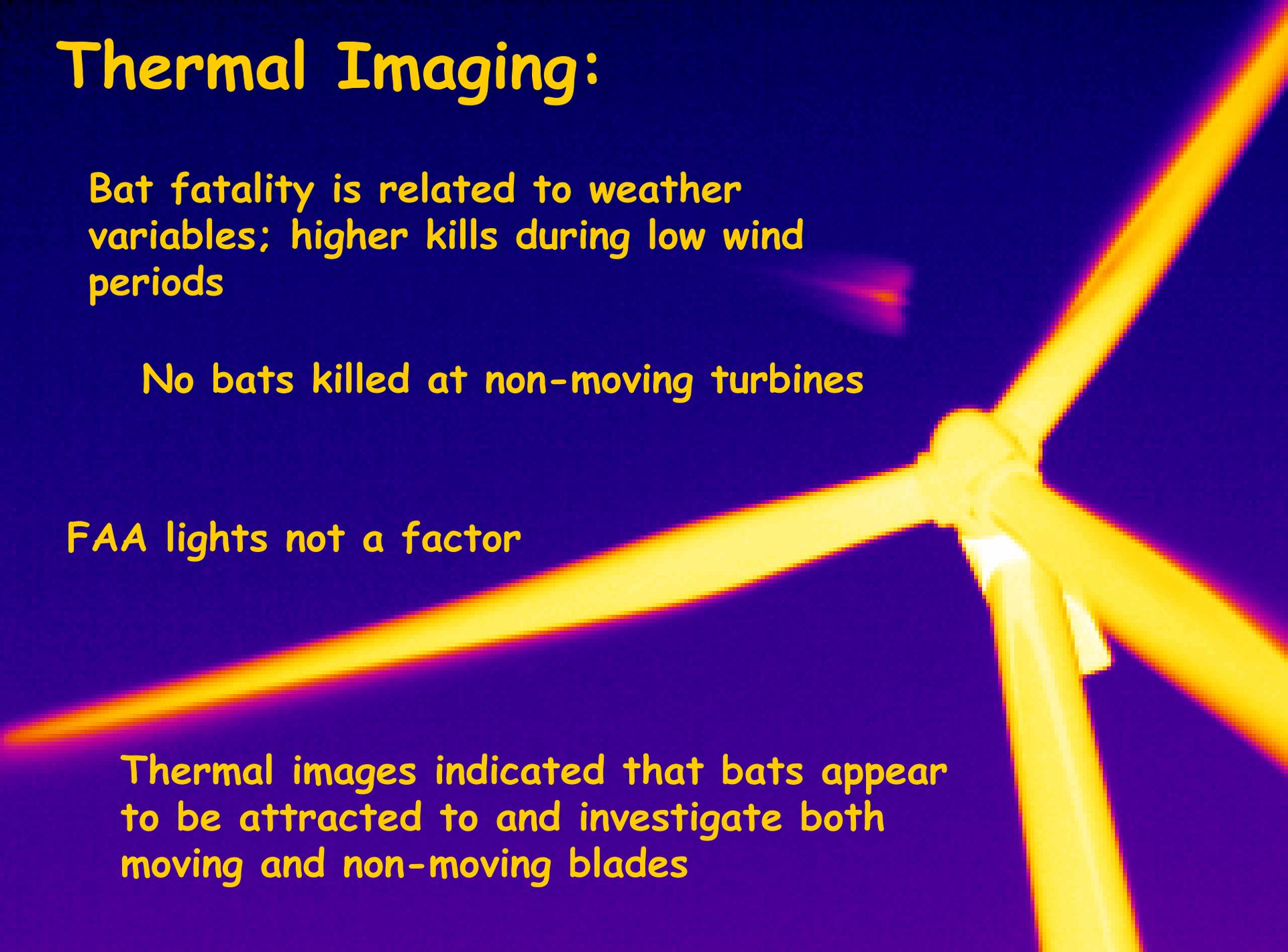
Thermal Imaging:

Bat fatality is related to weather variables; higher kills during low wind periods

No bats killed at non-moving turbines

FAA lights not a factor

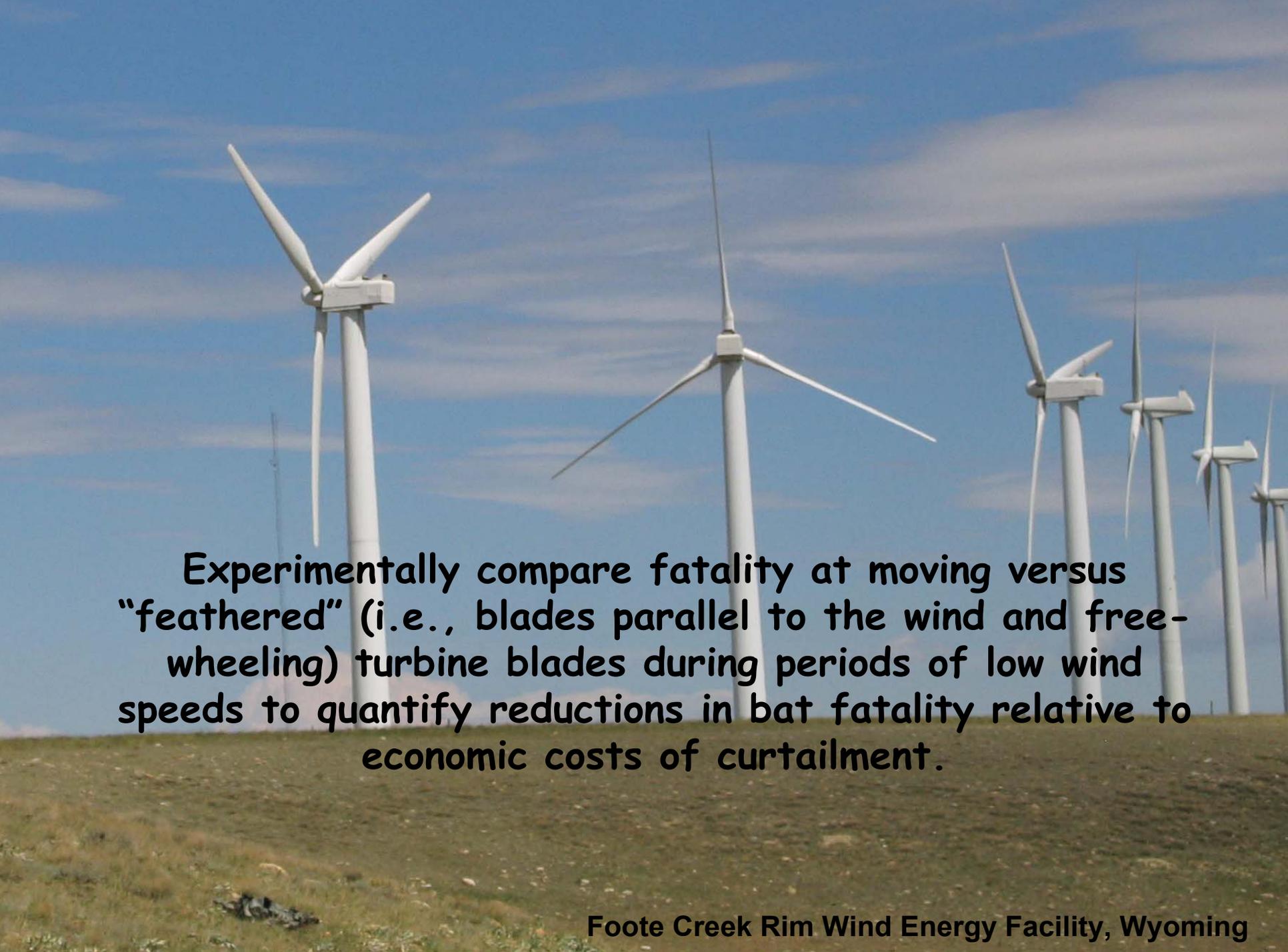
Thermal images indicated that bats appear to be attracted to and investigate both moving and non-moving blades



Post-construction: where too next?

Conduct extensive post-construction fatality searches:

- At wind facilities encompassing a broad range of habitat types and topographic features
 - “Full season” of bat movement and activity (April-October) to fully elucidate temporal patterns of fatality and relationships with climatic variables.



Experimentally compare fatality at moving versus “feathered” (i.e., blades parallel to the wind and free-wheeling) turbine blades during periods of low wind speeds to quantify reductions in bat fatality relative to economic costs of curtailment.

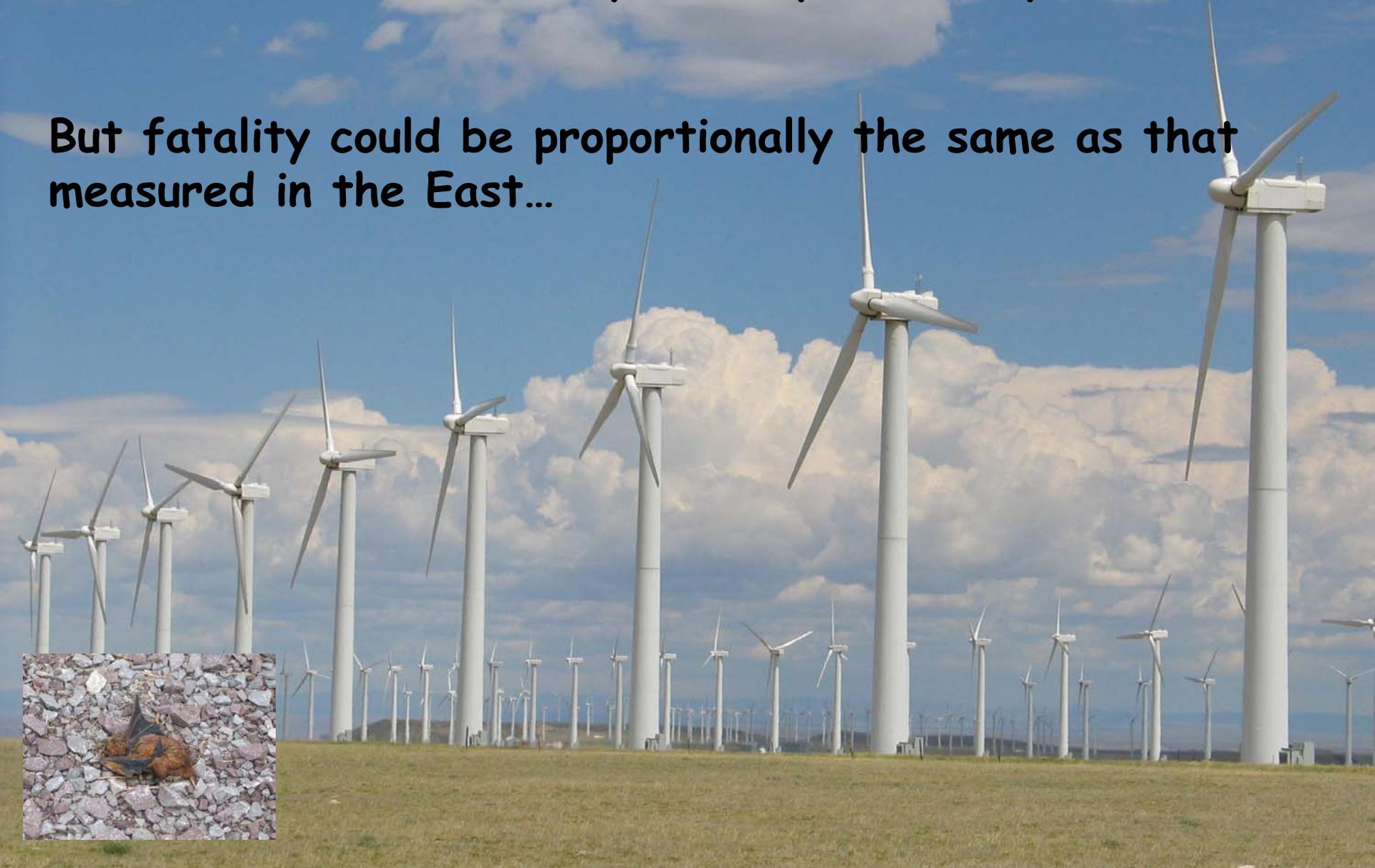
What's the Context?

How many critters are moving through the airspace in relation to fatality?



Bat mortality has been estimated to be relatively low (<2 bats/turbine) at many sites, particularly in the west

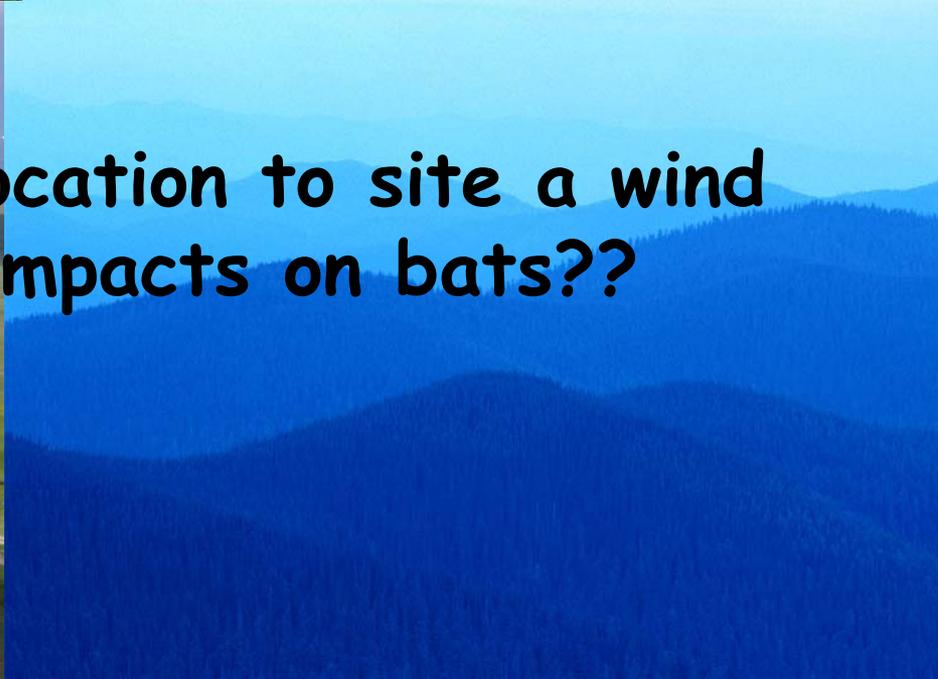
But fatality could be proportionally the same as that measured in the East...



Pre-Construction Monitoring



Where is the “best” location to site a wind facility to reduce impacts on bats??





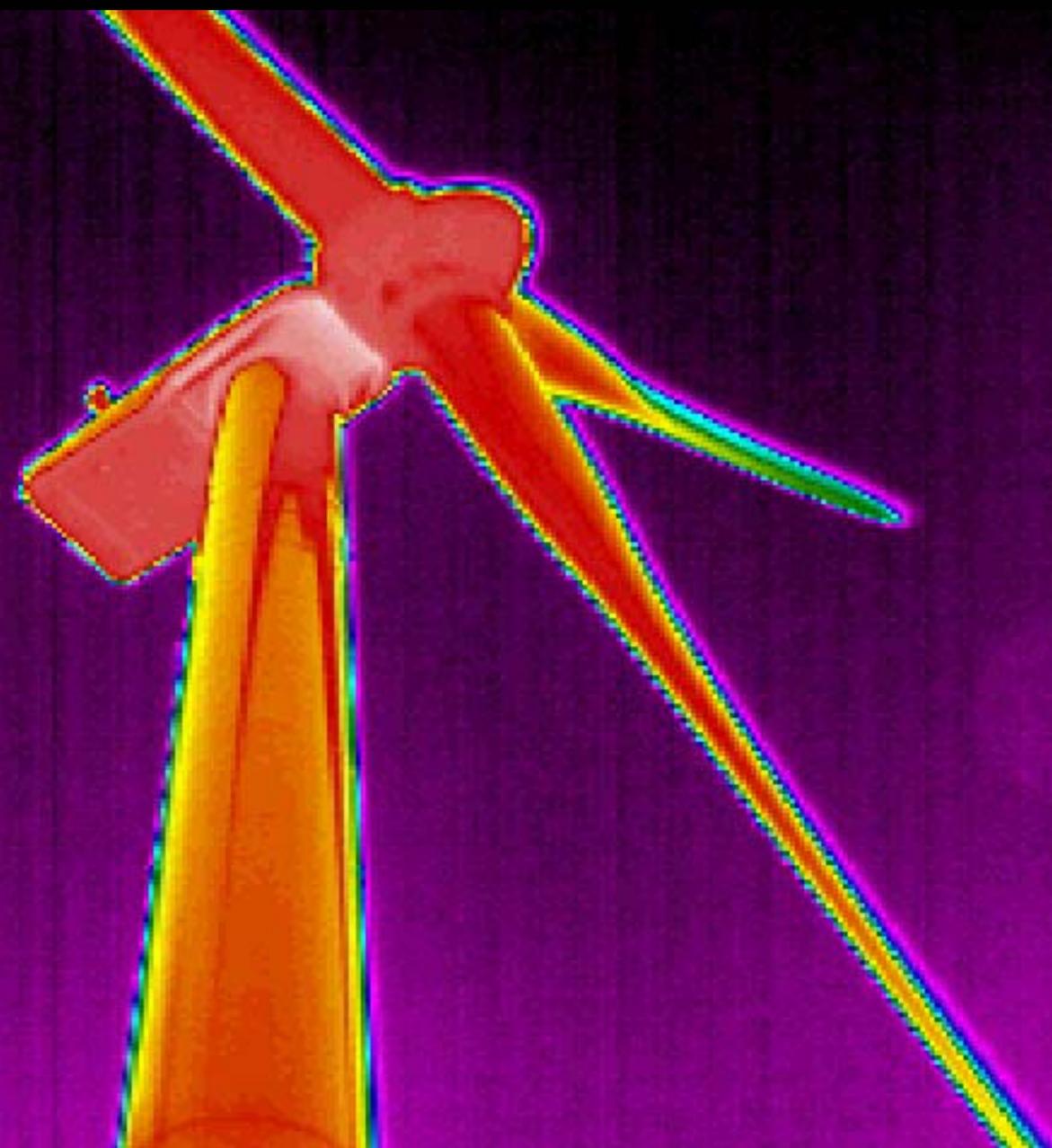
Factors Influencing Pre-Construction Monitoring and Confidence of Data

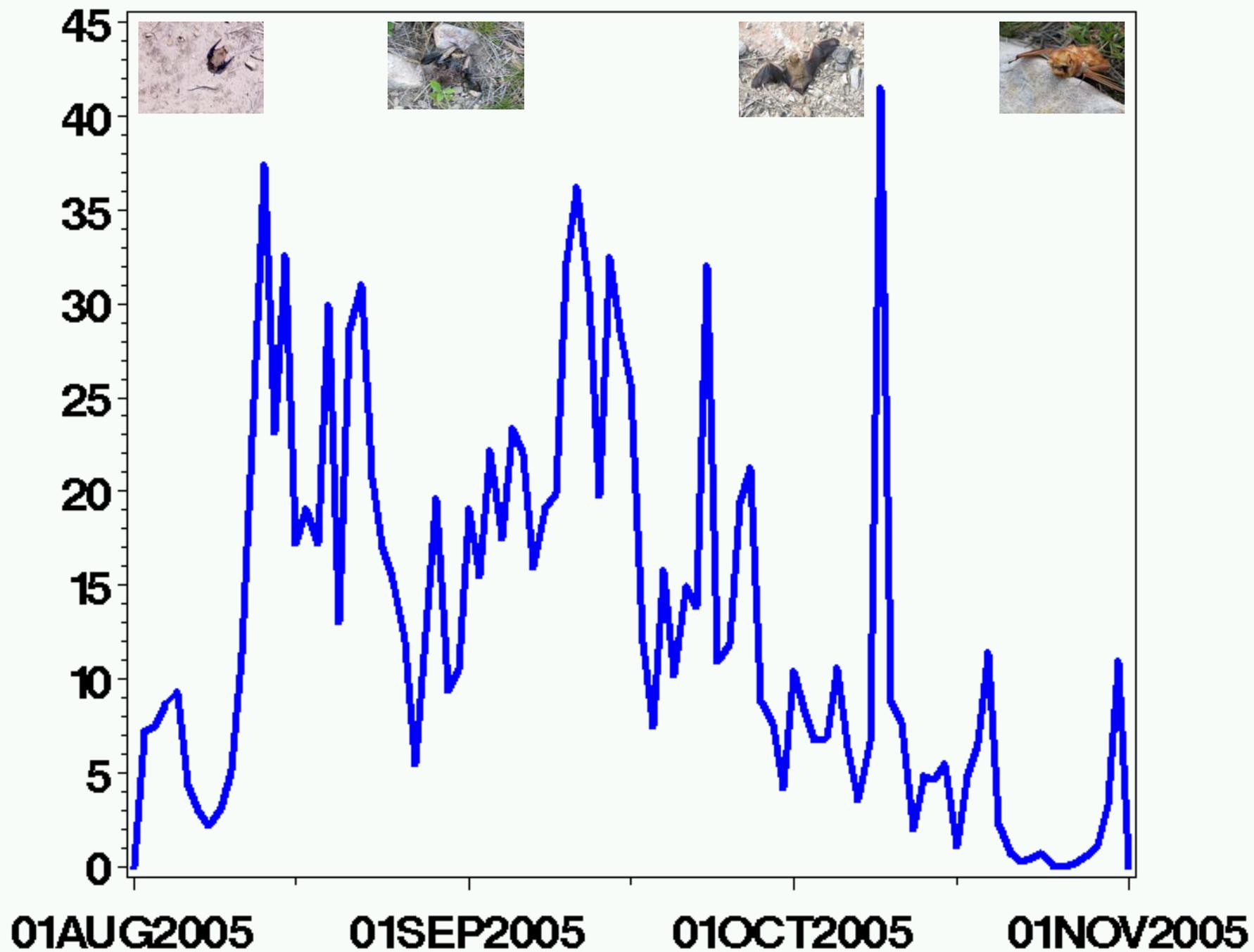
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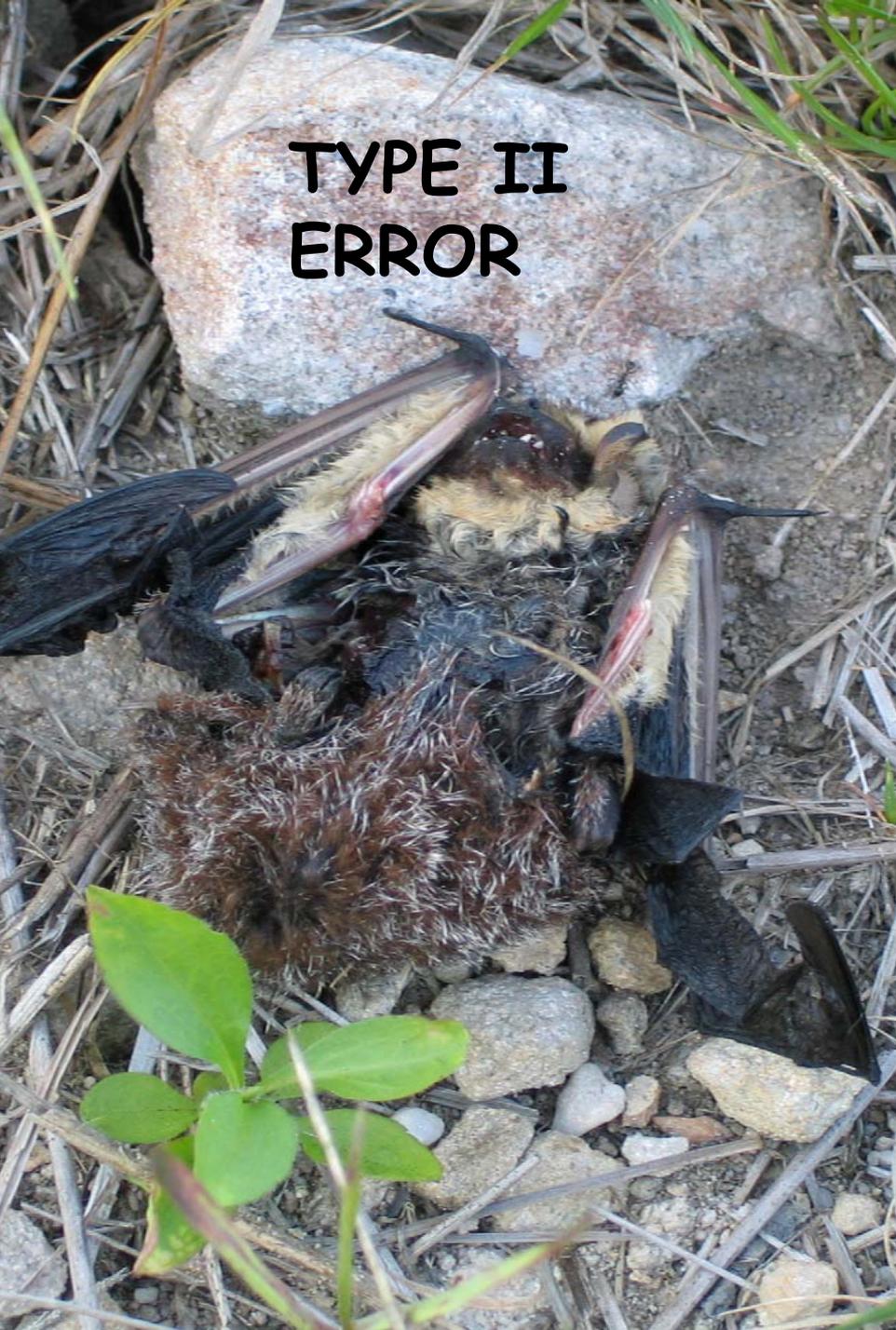
No linkage between pre-construction assessments and post-construction fatality...



© 2005 J. W. Horn



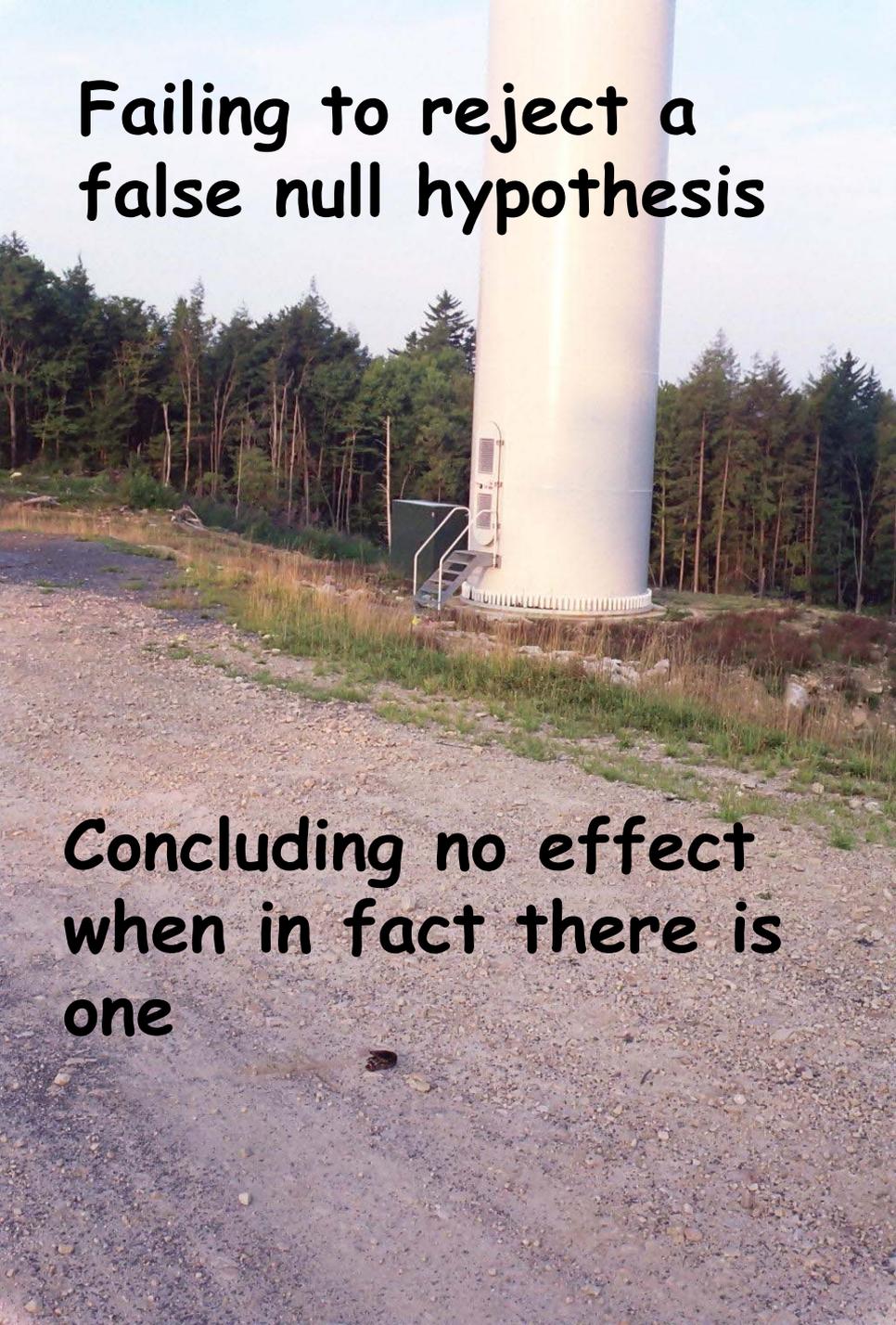


A close-up photograph of a dead bee on its nest. The nest is constructed from a mix of dry twigs, sticks, and some green leaves. The bee is positioned in the center, with its wings spread out. The background is a light-colored, textured surface, possibly a rock or a piece of wood. The text "TYPE II ERROR" is overlaid in the upper left corner.

**TYPE II
ERROR**

A photograph of a large, white wind turbine standing in a field. The turbine is the central focus, with its base and lower section visible. The field is a mix of green grass and brown, dry vegetation. In the background, there is a dense forest of tall, thin trees. The sky is a pale, clear blue. The text "Failing to reject a false null hypothesis" is overlaid in the upper right corner.

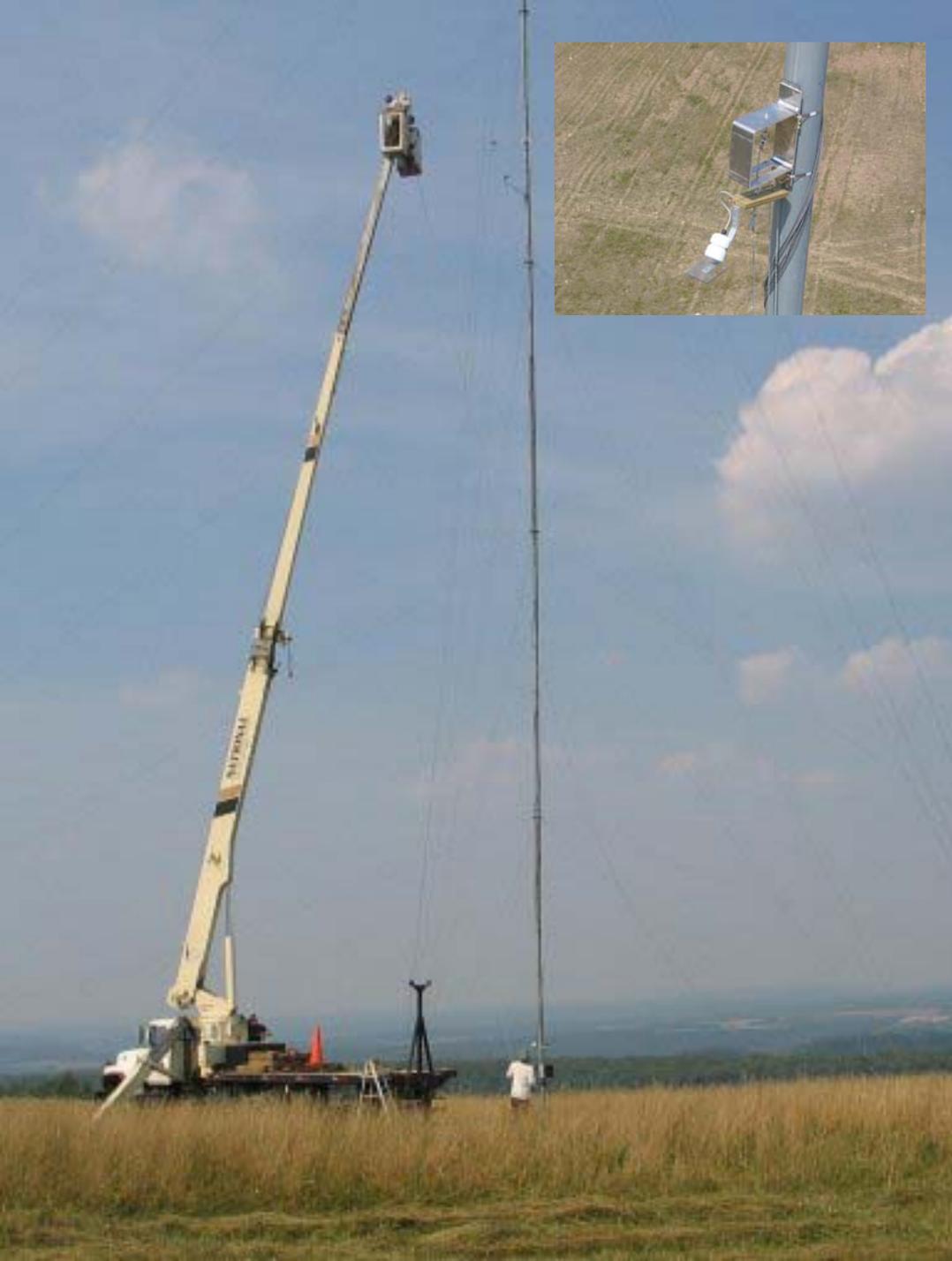
**Failing to reject a
false null hypothesis**

A photograph of a gravel path leading towards a wind turbine. The path is made of small, light-colored stones and is the central focus of the image. The path leads from the foreground towards the background, where a large, white wind turbine is visible. The turbine is partially obscured by the path. The background shows a field of grass and a forest of trees. The text "Concluding no effect when in fact there is one" is overlaid in the lower right corner.

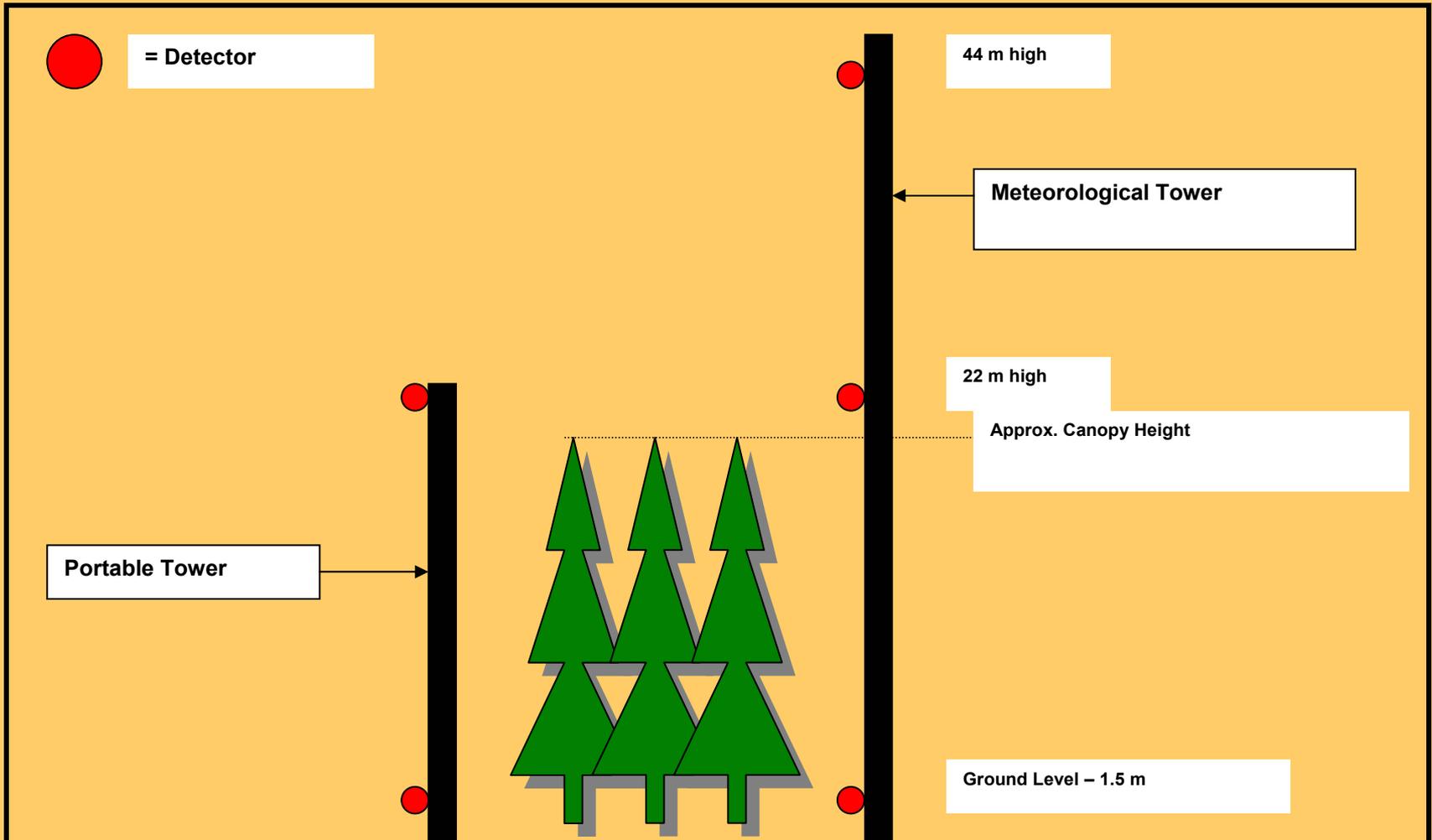
**Concluding no effect
when in fact there is
one**

Can indices of activity gathered pre-construction with acoustic detectors predict bat fatality post-construction?

A large flock of bats is seen flying in a sky during sunset or sunrise. The sky is a mix of blue, orange, and yellow, with some clouds. The bats are silhouetted against the bright light, creating a dense pattern of dark shapes. The foreground is dark, suggesting a silhouette of trees or a building.



Detector Placement on Towers



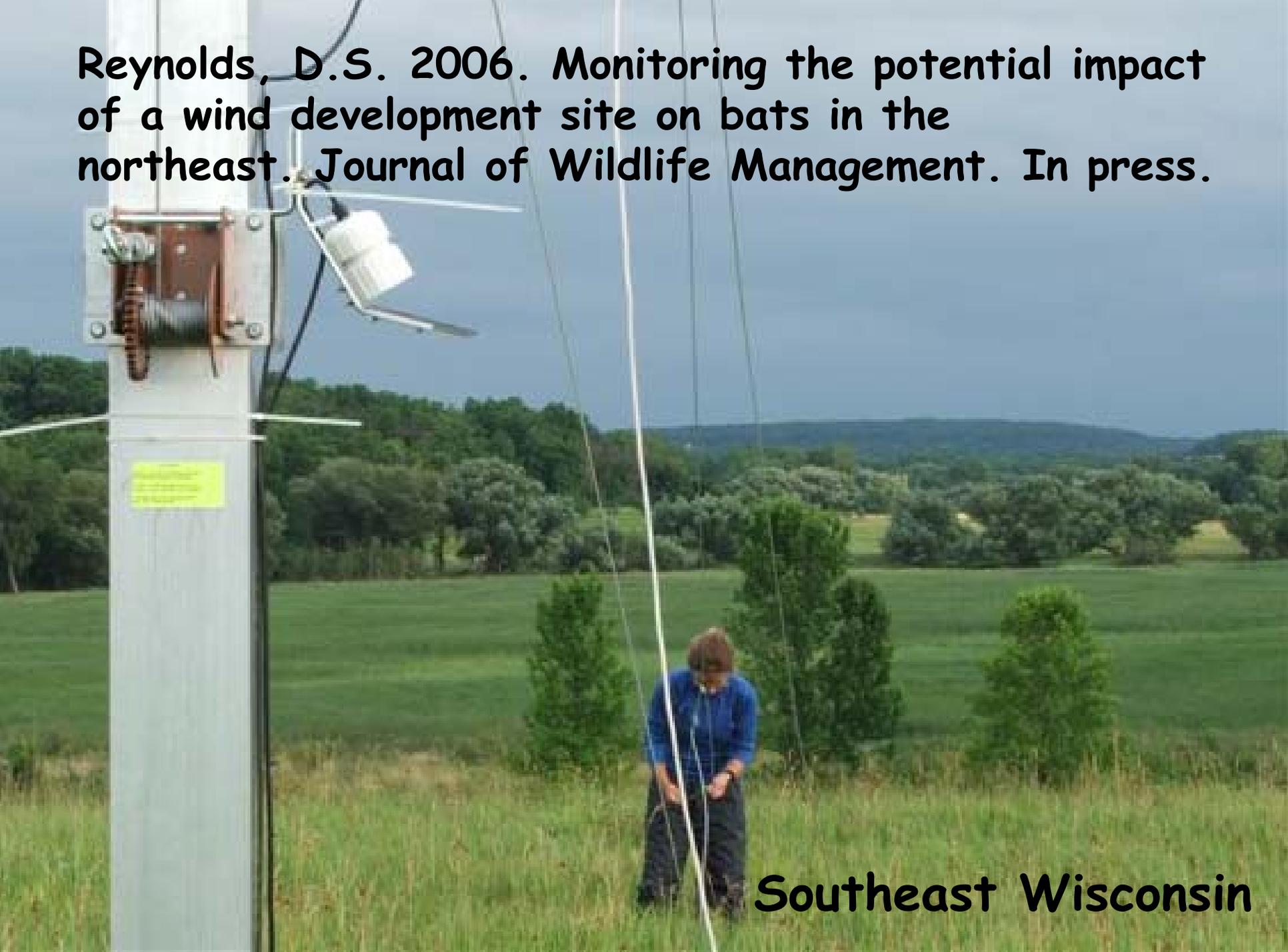
Pre-Construction Findings:

Bat activity is highly variable, both temporally and spatially...implications for timing and design of studies

High frequency bats (i.e., *Myotis* species) generally were more active at lower (1.5 m) altitudes than high (22 and 44-60 m) and the reverse was true for low frequency bats (e.g. hoary bat)

Activity for both high and low frequency bats negatively related to wind speed and positively related to temperature

Reynolds, D.S. 2006. Monitoring the potential impact of a wind development site on bats in the northeast. *Journal of Wildlife Management*. In press.



Southeast Wisconsin

Correlate pre-construction bat activity with post-construction fatality



Utilize patterns of activity to aid in predicting relative risk as well as potential fatality events

Pre-construction: where too next?

Continue intensive acoustic monitoring at numerous facilities and correlate activity with post-construction fatality

Numerous acoustic studies underway in:

Alberta, Canada

New England (MA, NY, VT)

Pennsylvania

West Virginia

Wisconsin

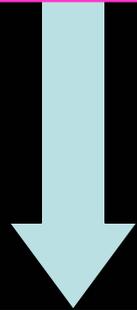
Pre-construction: where too next?

Conduct studies to evaluate other methods (radar, thermal imaging) for determining pre-construction activity/abundance and predicting post-construction fatality



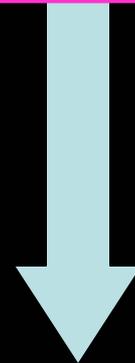
A Framework for Decision Making is Generally Lacking

Myotis sodalis
present



USFWS Consultation
HCP or Conservation
Agreement
Abandon Project

*82 bat calls/night;
157 captures of 5
species netted*



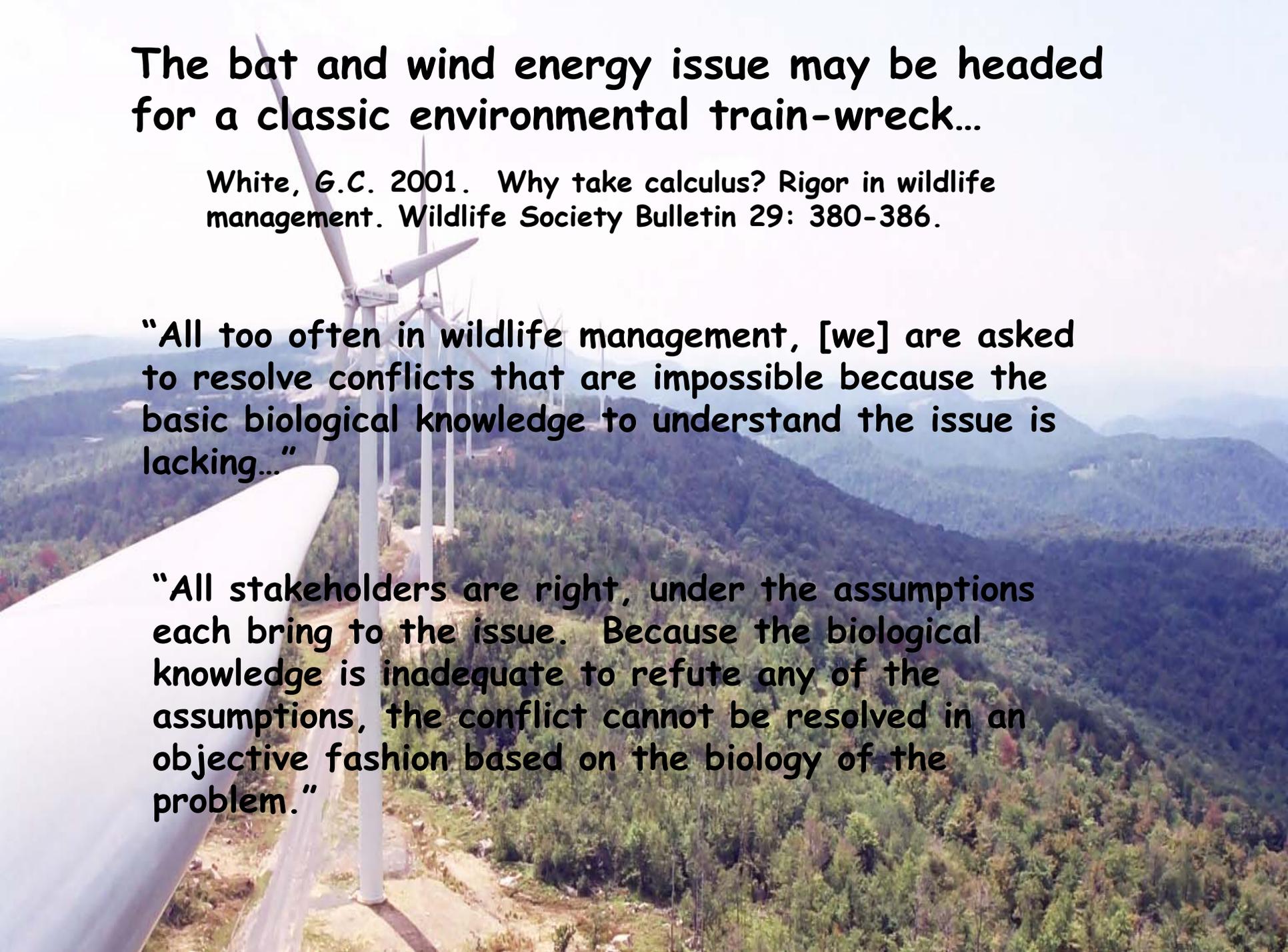
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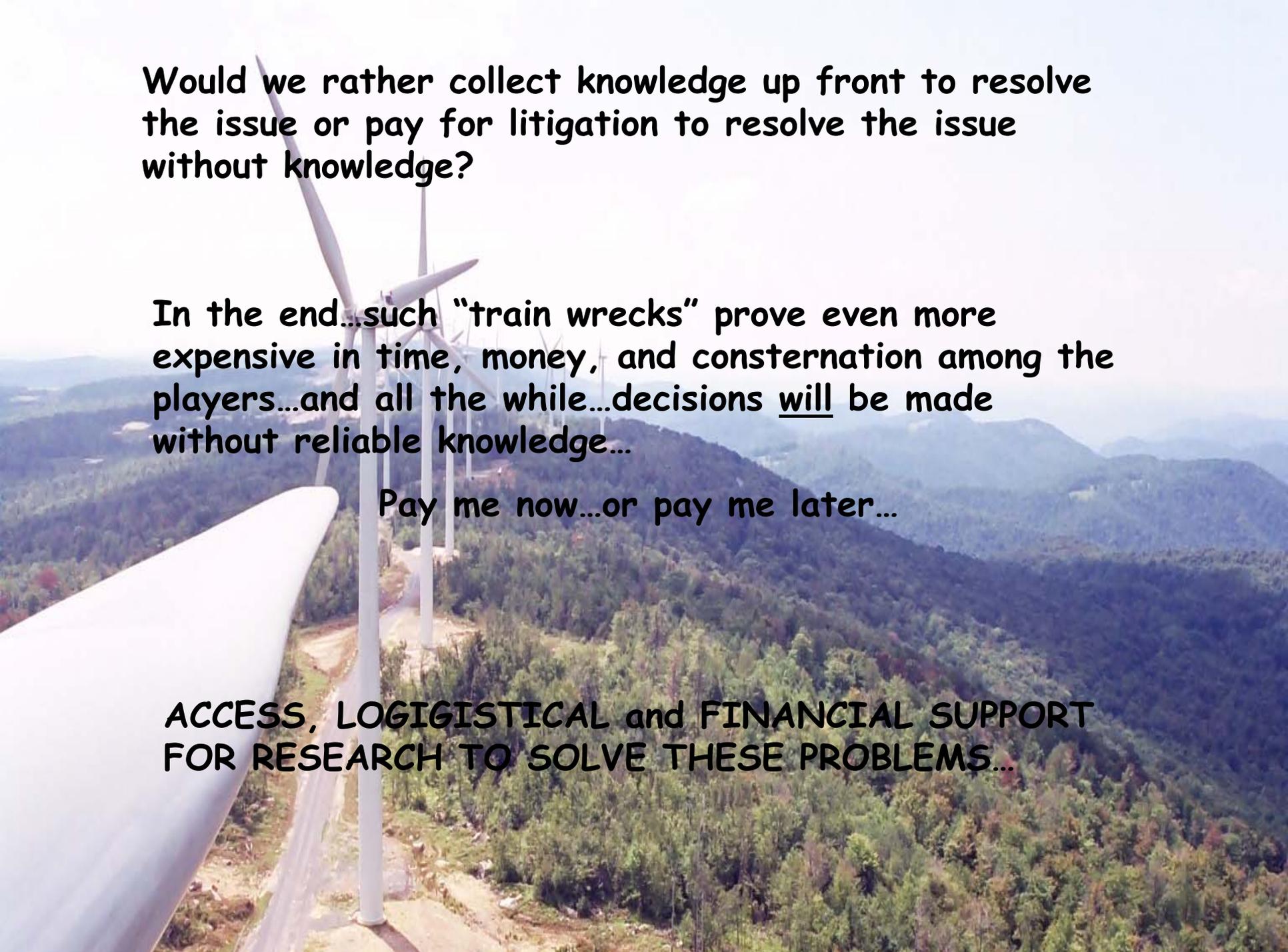
The bat and wind energy issue may be headed for a classic environmental train-wreck...

White, G.C. 2001. Why take calculus? Rigor in wildlife management. *Wildlife Society Bulletin* 29: 380-386.

“All too often in wildlife management, [we] are asked to resolve conflicts that are impossible because the basic biological knowledge to understand the issue is lacking...”

“All stakeholders are right, under the assumptions each bring to the issue. Because the biological knowledge is inadequate to refute any of the assumptions, the conflict cannot be resolved in an objective fashion based on the biology of the problem.”



An aerial photograph of a wind farm situated on a mountain ridge. The foreground shows the large white nacelle and part of a turbine tower. In the background, several other turbines are visible, spaced out along the ridge. The landscape is covered in dense green and brown trees, with rolling hills in the distance under a clear sky.

Would we rather collect knowledge up front to resolve the issue or pay for litigation to resolve the issue without knowledge?

In the end...such "train wrecks" prove even more expensive in time, money, and consternation among the players...and all the while...decisions will be made without reliable knowledge...

Pay me now...or pay me later...

ACCESS, LOGIGISTICAL and FINANCIAL SUPPORT FOR RESEARCH TO SOLVE THESE PROBLEMS...

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Rhode Island Renewable Energy Fund

TRF Sustainable Development Fund



<http://www.batcon.org>

under: Conservation
Programs and “Bats and
Wind Energy”