

Texturizing Wind Turbine Towers to Reduce Bat Mortality

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Why are bats coming into contact with wind turbines??

Cryan & Barclay 2009

- Collisions are random events
- Wind facility and surrounding area provide resources for bats
- Bats are attracted to wind turbines
 1. Wind turbines provide a resource
 2. Bats misperceive turbines to be a resource
 3. Bats just find wind turbines intriguing

Not mutually exclusive

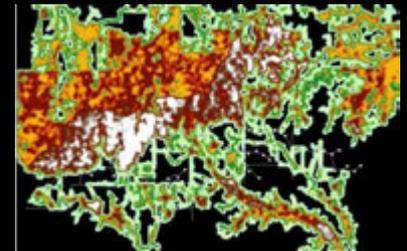
Species-specific



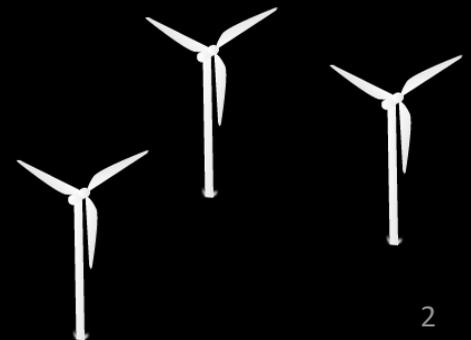
Potential spring movements by hoary bats

Paul Cryan

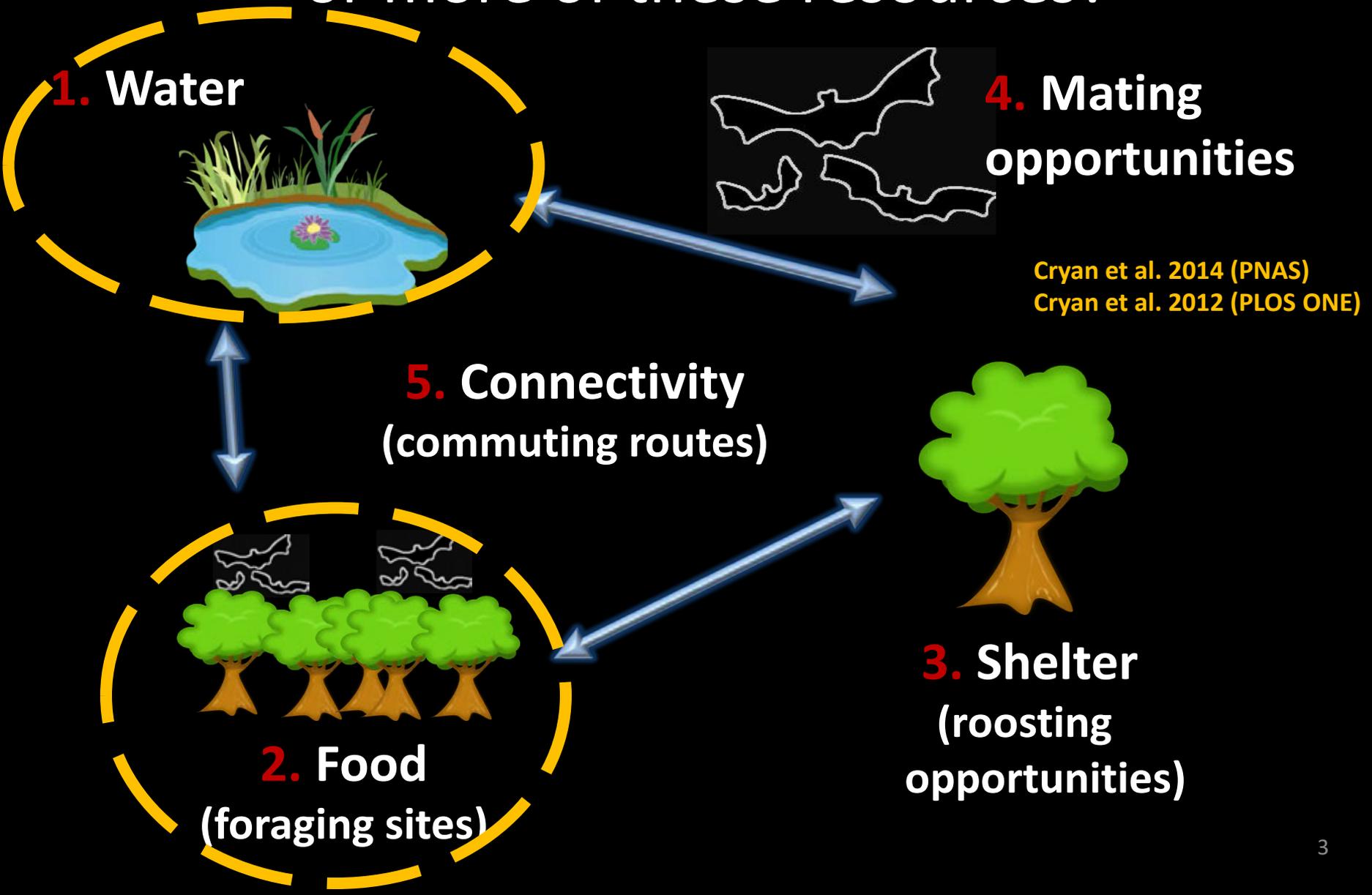
U.S. Geological Survey based on stable isotopes



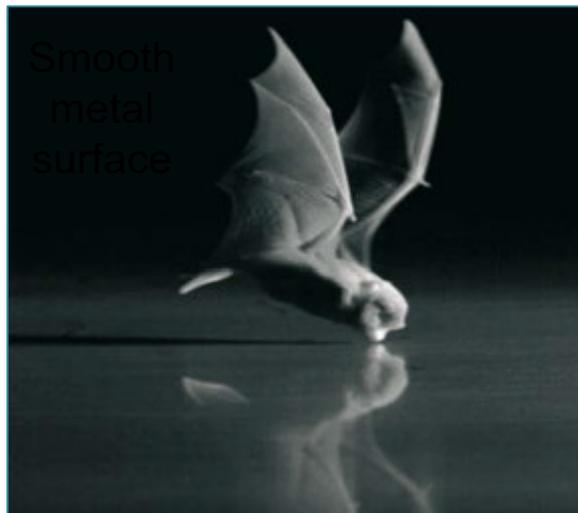
Resource map



Do wind turbines provide or appear to be one or more of these resources?

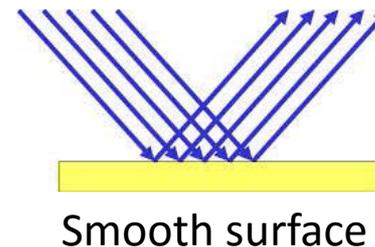


Why would bats misperceive turbine tower surfaces to be water?



Greif & Siemers (2010) showed that:

- 1) Bats exhibit repetitive drinking behavior at smooth surfaces
- 2) Bats cannot effectively distinguish water from other smooth surfaces



Does the acoustic mirror effect enhance turbine towers as a foraging resource?



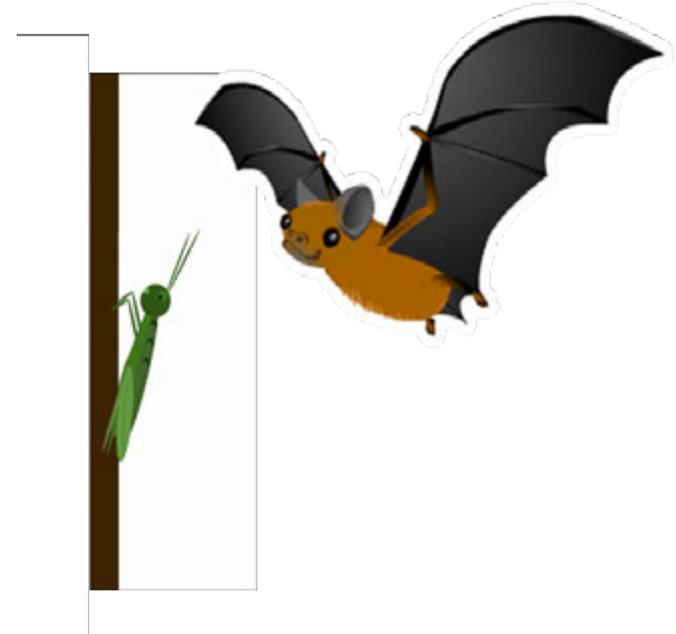
- Detection of surface-based prey using echolocation is facilitated by smooth backgrounds such as water surfaces and smooth leaves

Siemers et al. 2005, Clare & Holderied 2015



- Bats can switch foraging strategies when it is efficient for them to do so

Todd & Waters 2007



For this hypothesis to be feasible:

- Prey items must be on or very close to turbine towers, and
- Bats must be able to switch from an aerial hawking to a gleaning foraging strategy





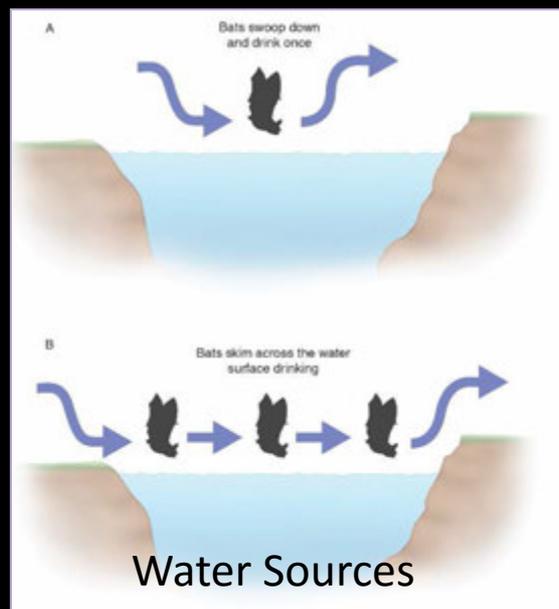
- Condensation occurs on turbine towers

- Insects are attracted to the white surfaces of turbine towers (Long et al. 2010)

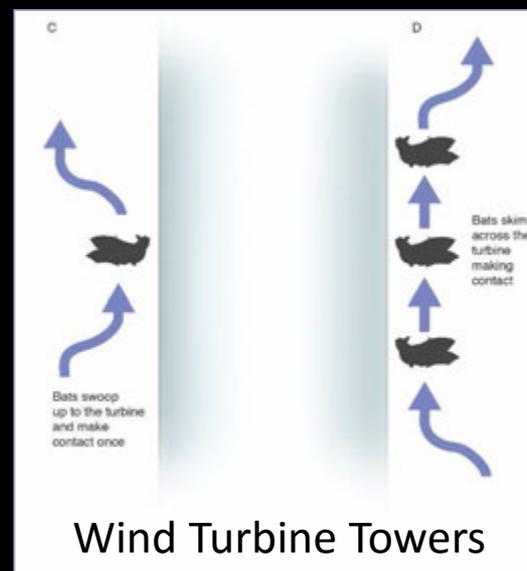


2012-2013 Night vision surveys (McAlexander 2013)

468 bats were observed at wind turbines over 80 survey nights

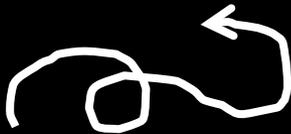


Distinct activities	# observed
Passing	176
Foraging	256
Potential drinking	14
Roosting	5
Gleaning	3
Collision	4
Reversal	10

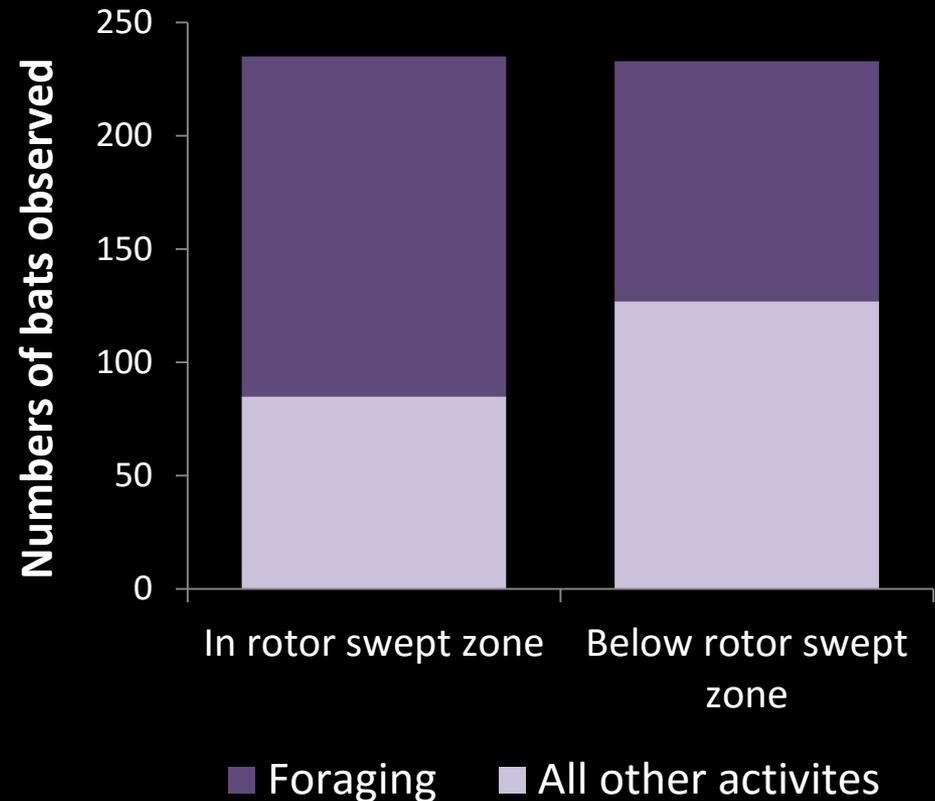


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Foraging:
Zigzagging flight with
multiple turning angles



Project Goals

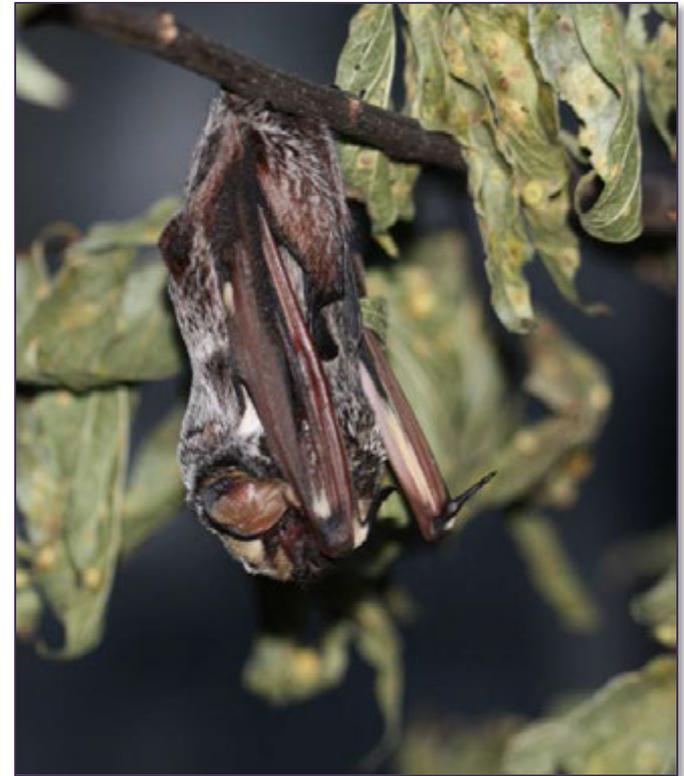


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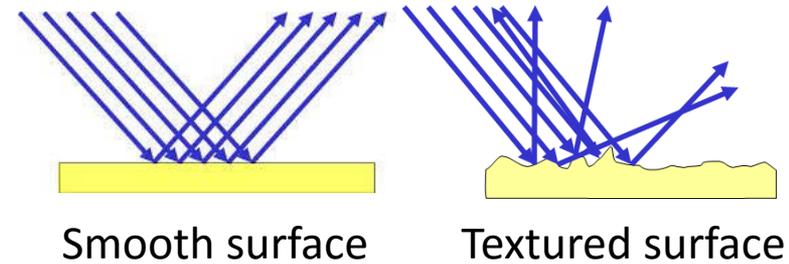
Develop a wind turbine tower coating that:

- 1) Bats show little or no interest in approaching
- 2) Can be applied to currently deployed wind turbine towers
- 3) Is economically feasible to produce and apply
- 4) Ultimately contributes to a reduction in bat mortality at utility-scale wind facilities



Considerations for developing the turbine tower coating

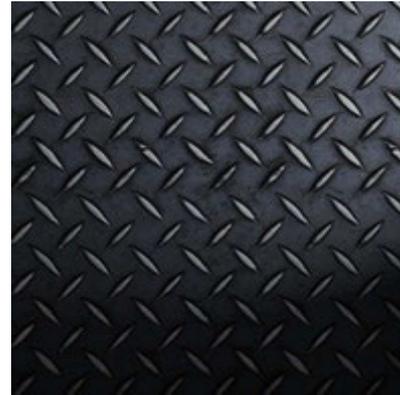
- Returning echoes from bat echolocation calls must no longer resemble echoes from smooth surfaces like water
- Must be accomplished using paint additives and/or appliques



Avoid textures that resemble resources



Grade of texture



Feasibility
(Is it practical and cost effective?)



Application
(additive or applique)

Flight facility experiments with wild-caught bats

1) *Bat foraging behavior trials*

- Record bat activity at a range of surfaces
 - Do we see gleaning?
 - Does prey removal vary with surface type?

2) *Bat drinking behavior trials*

- Record bat activity at a range of surfaces
 - Do we see drinking attempts?
 - Does behavior vary with surface type?



Treatment surfaces:

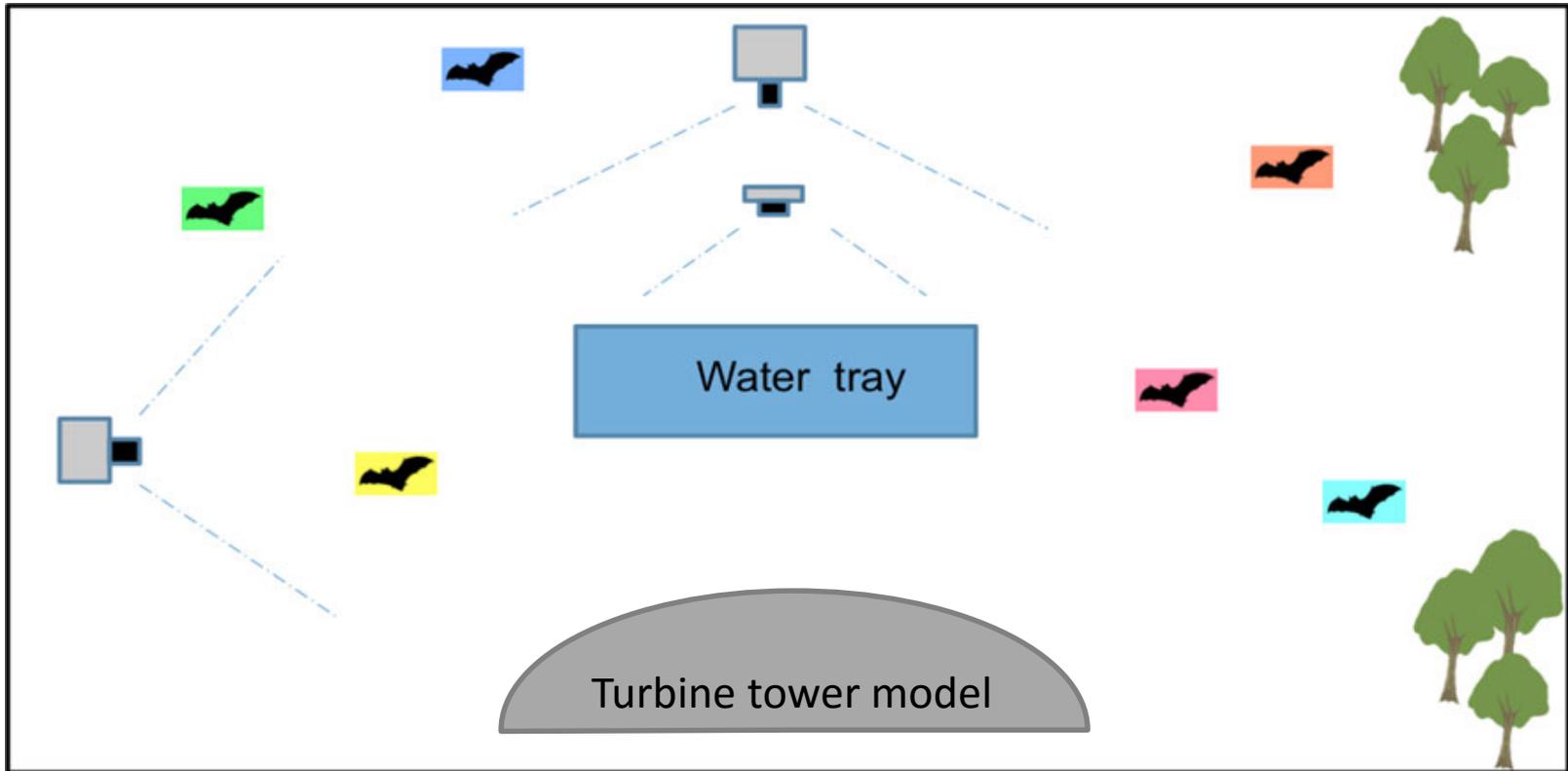
- 1) Smooth painted surface similar to a wind turbine tower surface
- 2) Tower section with the curvature of an 80-m tower at mid-tower height
- 3) Textured surfaces (three) created with a paint additive that varied with grade
- 4) Applique

Behavior testing in the bat flight facility



- A stand-alone building approximately (8.5 m x 7.3 m)
- Environmental conditions were similar to those outside

Flight facility set-up

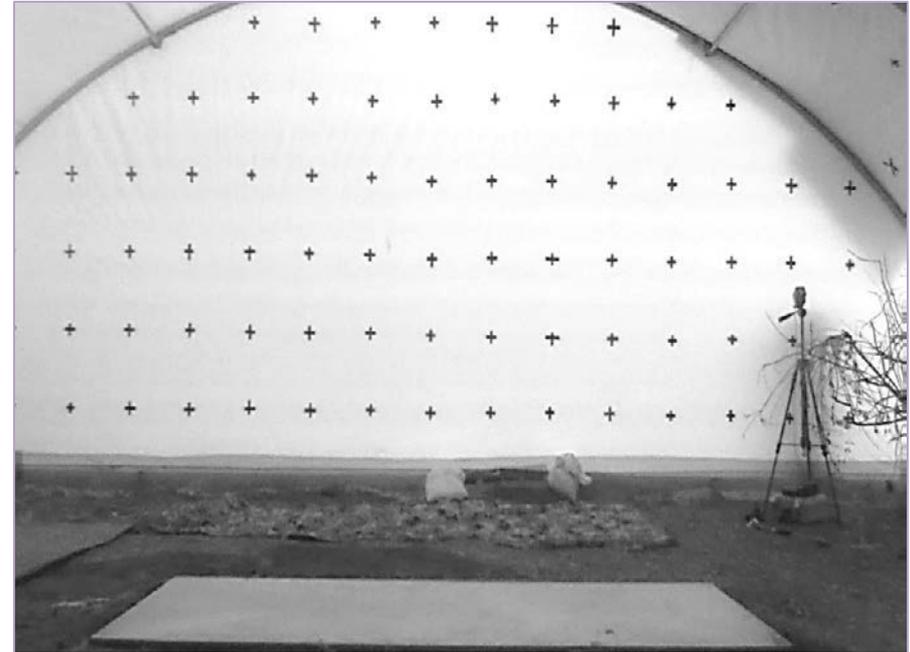


During 20 min trials, we presented bats with 1 of 6 treatment surfaces and recorded behavior at each surface with 2 Canon XA20 camcorders placed at right angles. A Fastec IL4 high speed mono imaging camera was also placed at ground level to record bat contact with the surfaces.

Camera set-up and footage analysis



Side view of flight facility



Front view of flight facility

Using Studiocode v. 5 software, we quantified the number of passes across the treatment surface, closest approach to surface (closest pass), time until approach to surface, number of drinking attempts (contact with surface), and drinks from the water tray (when water was available).

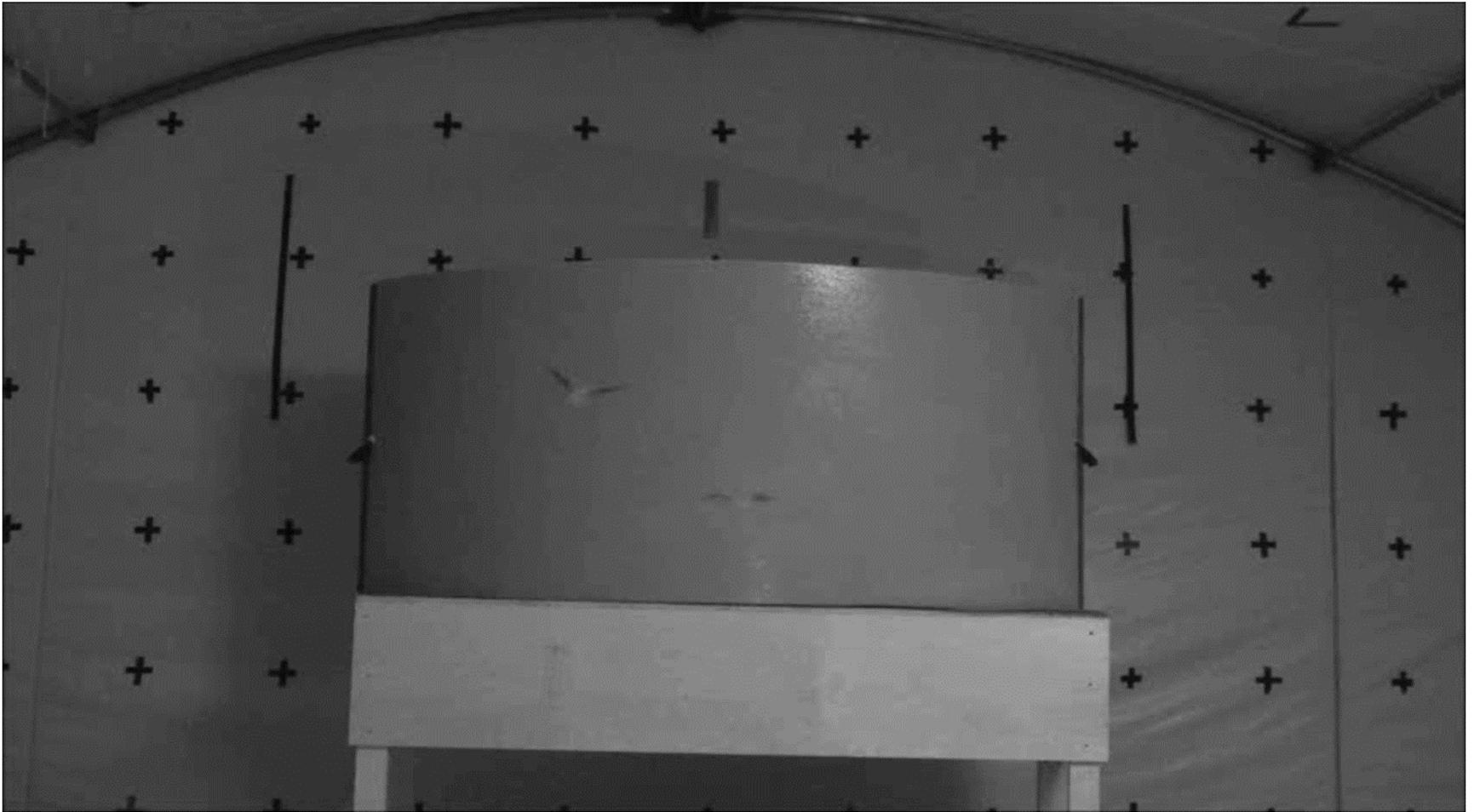
Bat foraging behavior trials:

- 537 foraging trials were completed from July 1 – September 29, 2015



Bat species	# of Females	# of Males	Total
Eastern Red (<i>Lasiurus borealis</i>)	2	7	9
Evening (<i>Nycticeius humeralis</i>)	25	26	51
Mexican free-tailed (<i>Tadarida brasiliensis</i>)	11	2	13

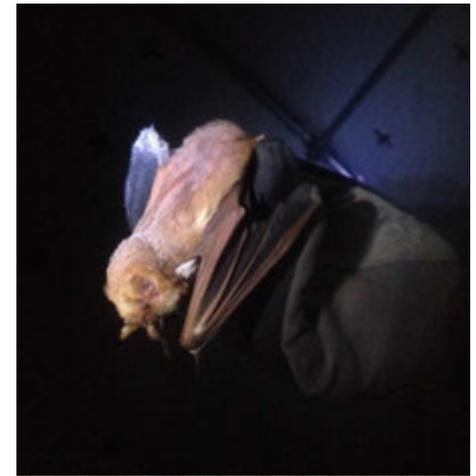
Video: Foraging trial



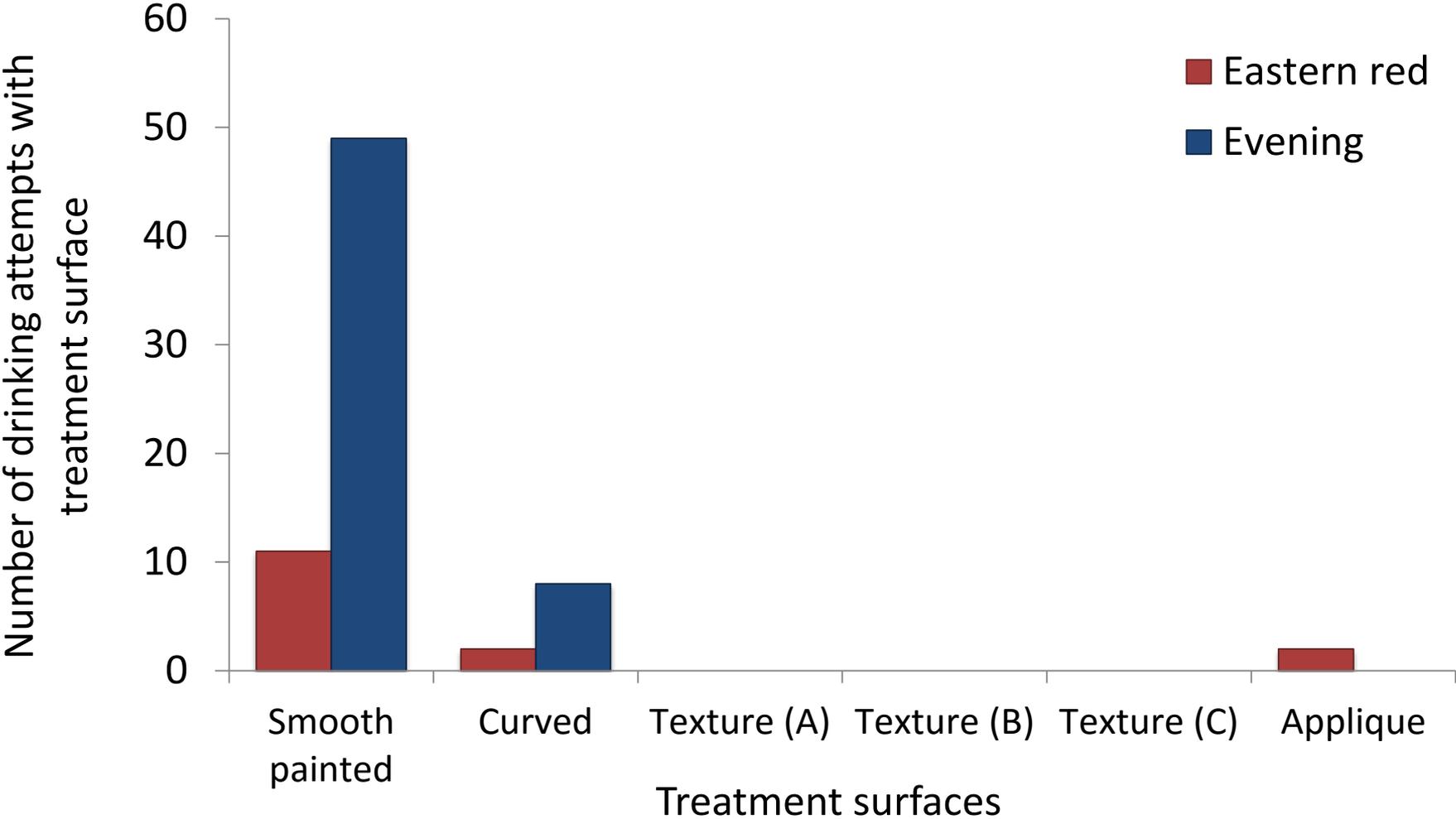
Bat drinking behavior trials:

Bat species	# of Females	# of Males	Total
Eastern Red (<i>Lasiurus borealis</i>)	3	4	7
Hoary (<i>Lasiurus cinereus</i>)	0	2	2
Evening (<i>Nycticeius humeralis</i>)	19	19	38
Mexican free-tailed (<i>Tadarida brasiliensis</i>)	12	1	13

- 77 drinking trials were conducted from July 16 - September 13, 2014 and June 10 - September 25, 2015



Number of drinking attempts at each surface



Video: Drinking trial at water



Video: Drinking trial at flat painted surface



Video: Drinking trial at curved painted surface



