U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Evaluating the Effectiveness of Ultrasonic Acoustic Deterrents in Reducing Bat Fatalities at Wind Energy Facilities

Project ID: M20

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Bat Conservation International

FY17-FY18 Wind Office Project Organization

"Enabling Wind Energy Options Nationwide"

Technology Development	Market Acceleration & Deployment
Atmosphere to Electrons	Stakeholder Engagement, Workforce Development, and Human Use Considerations
Offshore Wind	Environmental Research
Distributed Wind	Grid Integration
Testing Infrastructure	Regulatory and Siting
Standards Support and International Engagement	
Advanced Components, Reliability, and Manufacturing	

Analysis and Modeling (cross-cutting)

Project Overview

M20: Evaluating the Effectiveness of Ultrasonic Acoustic Deterrents (UADs) in Reducing Bat Fatalities at Wind Energy Facilities

Technology Summary:

- UADs produce ultrasound overlapping with bat echolocation frequencies
- Preliminary lab and ground-based field testing show bats avoiding areas exposed to ultrasound
- Distance ultrasound travels varies by frequency and is influenced by weather (e.g., humidity)
- Reduce fatalities by creating an uncomfortable or disorienting airspace near wind turbines

Period of Performance: 1 September 2015–31 May 2019

Technology Impact:

- Cumulative estimated bat fatality at wind turbines in U.S. and Canada (840,486–1,690,695) between 2000 and 2011.
- Curtailment is the only accepted impact reduction method, but loss of energy is cost-prohibitive
- UADs present a promising technology to reduce bat fatalities and allow normal turbine operations

Project Goals: To assess the effectiveness of an ultrasonic acoustic deterrent device to reduce bat activity and fatality at wind turbines

Partners:

batcon.org BAT CONSERVATION INTERNATIONAL

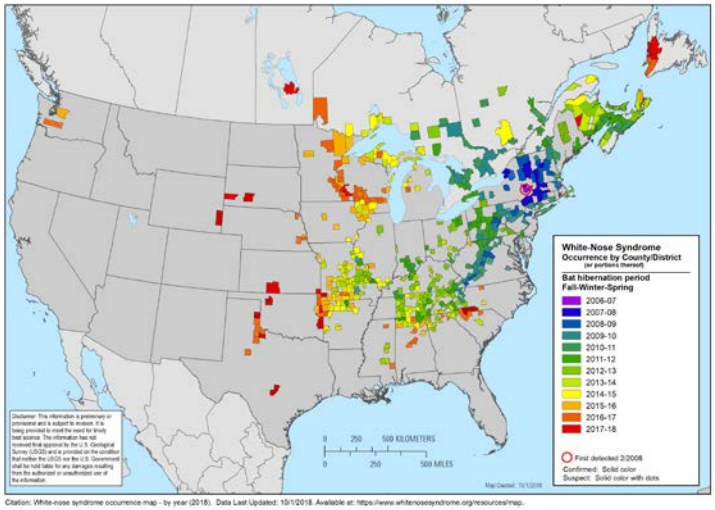
AVANGRID RENEWABLES

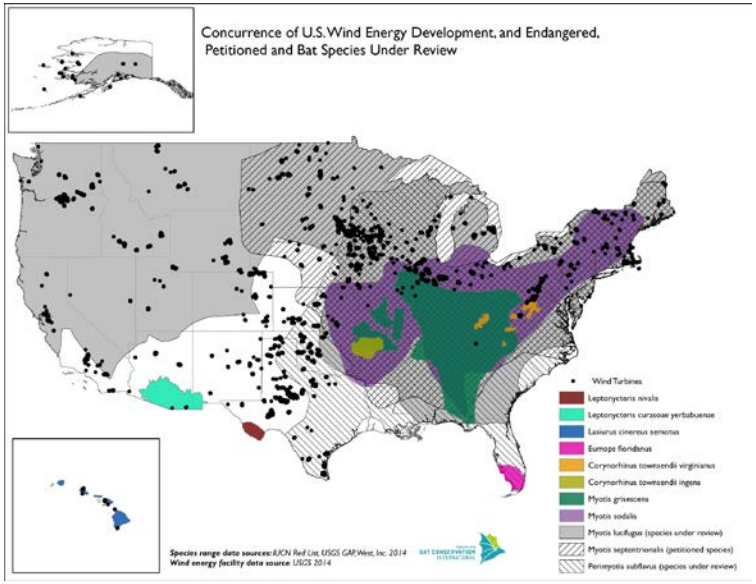
NRG Systems

USGS science for a changing world

Technical Merit and Relevance

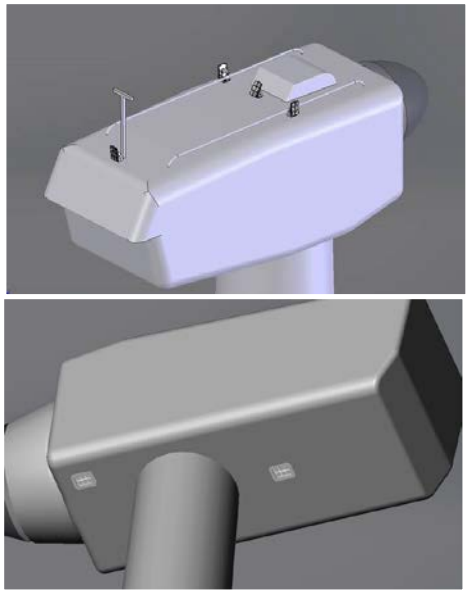
- Concerns about cumulative impact of wind turbines on migratory tree-roosting bats
- Existing and potential federal listings present siting and operational challenges
- Developing and testing strategies that minimize risk to wildlife and maximize wind energy production are beneficial to wind-wildlife community
- If successful, UADs represent a mutually beneficial strategy by reducing bat fatalities and allowing wind turbines to operate normally

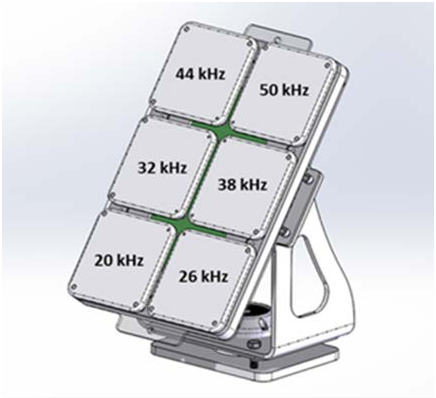




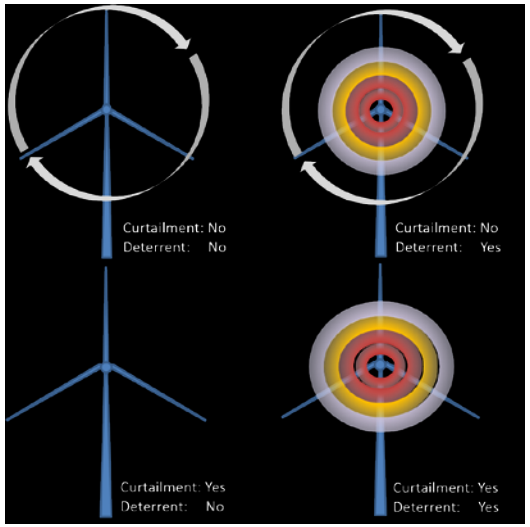
Approach and Methodology

- **Functional Test**
  - 2 turbines
  - 6 UAD/turbine
  - UAD: Reliability and Performance
  - Bats: Thermal video





- **Comparative Study**
  - 16 turbines (4 treatments)
  - UAD: Reliability
  - Bats: Reduction in activity and fatality
    - Daily fatality monitoring
    - 3-D thermal video monitoring



Accomplishments and Progress

Functional Test

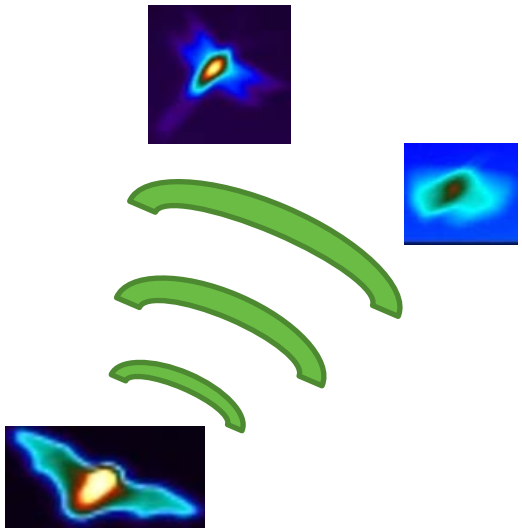
Organization	FY2015	FY2016	FY2017
Quarter One			
Quarter Two		Initial manufacturing of UAD	Analysis and reporting of preliminary functionality test of UAD
Quarter Three		Initial installation and monitoring of UAD	Final manufacturing and installation of UAD
Quarter Four	Initial installation plan of UAD		Comparative study

Comparative Study

Organization	FY2017	FY2018
Quarter One	Go/No-Go Decision: Submit biological study plan and award continuation report	M6.1: Complete Comparative Study
Quarter Two	M5.1: Complete study design for thermal video study, and operational performance for UADs M5.2: Complete report summarizing results of thermal video analysis	M7.1Complete analyses, including performance of UADs, effectiveness in reducing fatality, and economic comparison
Quarter Three	M5.3: Complete manufacturing and installation of UADs for Comparative Study	
Quarter Four		M8.1: Submit final report for overall project (final deliverable extended to Q3 FY19)

Accomplishments and Progress

- **Functional Test**
  - Reliability
    - Some issues with UADs and thermal video cameras which resulted in reduced sample size
  - Thermal video results, non-significant but
    - 72% reduction in bat activity at UAD at one turbine
    - 59% of activity at control turbines
    - 8/11 observed collisions at control turbines
  - Changes to Comparative Study
    - All technical issues with UADs resolved
    - Initiated development of new 3D analysis

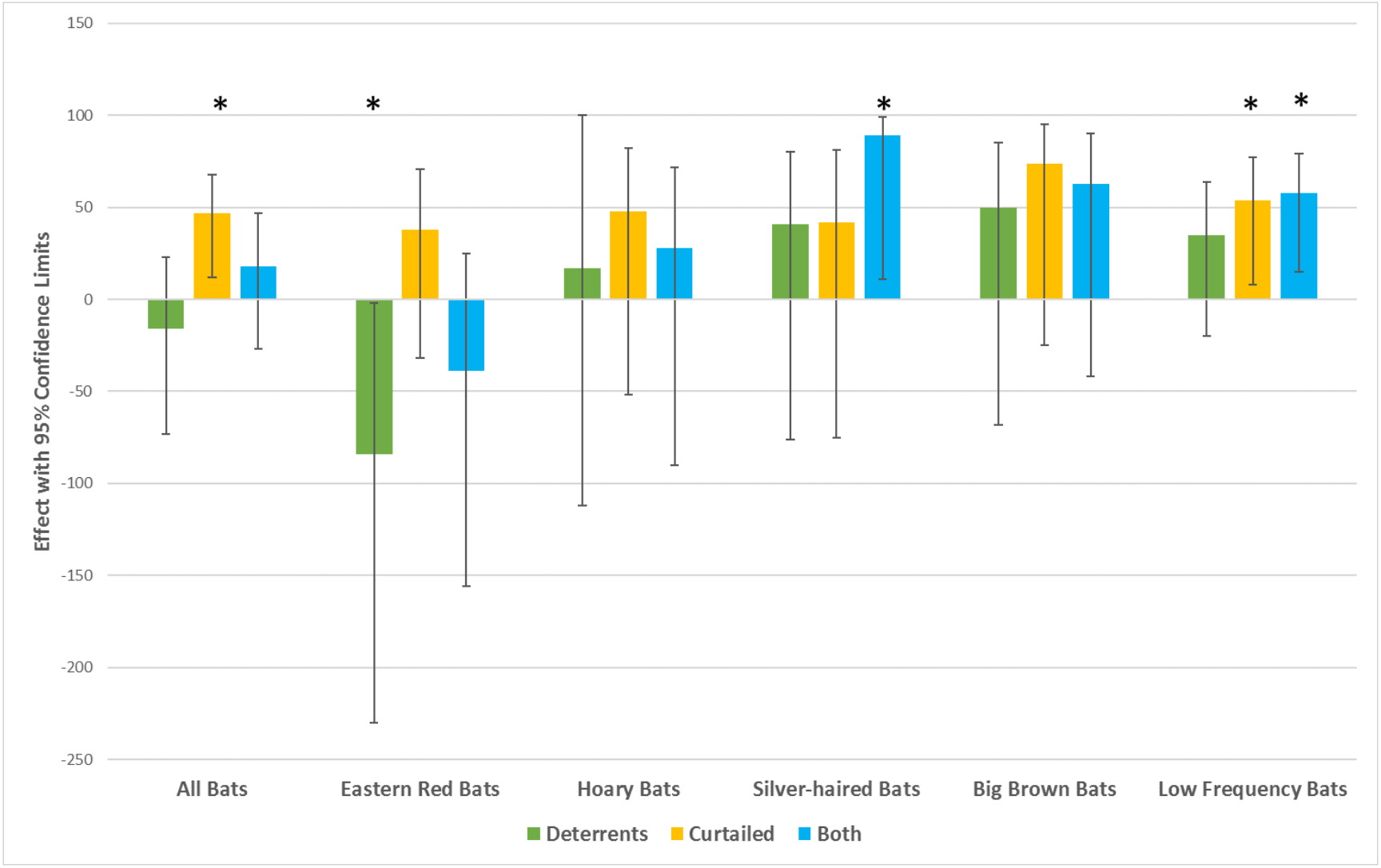


Accomplishments and Progress

- **Comparative Study**
  - UAD worked 99% of the time during the study
  - Recorded 83% and 87% of camera nights at 2 wind turbines
- **3-D thermal video**
  - <1 RPM
    - Significantly less bat activity and rotor-swept zone crossings
  - >10 RPM
    - No difference in duration or rotor-swept zone crossings
    - Increase in proportion of time within 5 m blades at UAD turbines
  - Increasing # of deterrents and/or modifying placement and orientation may improve effectiveness

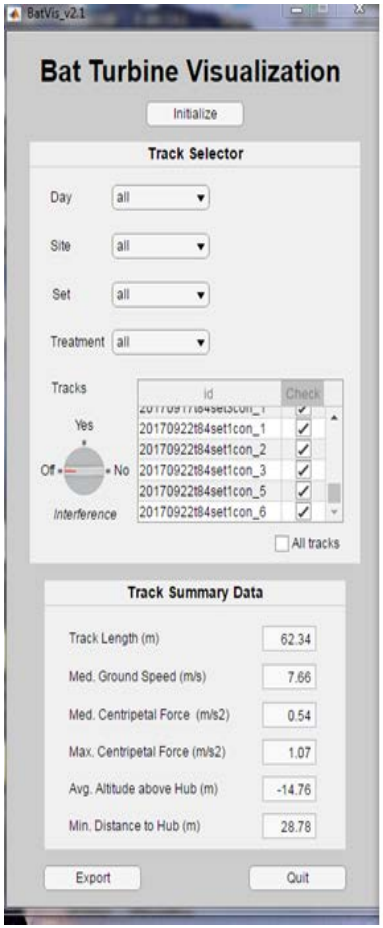
Accomplishments and Progress

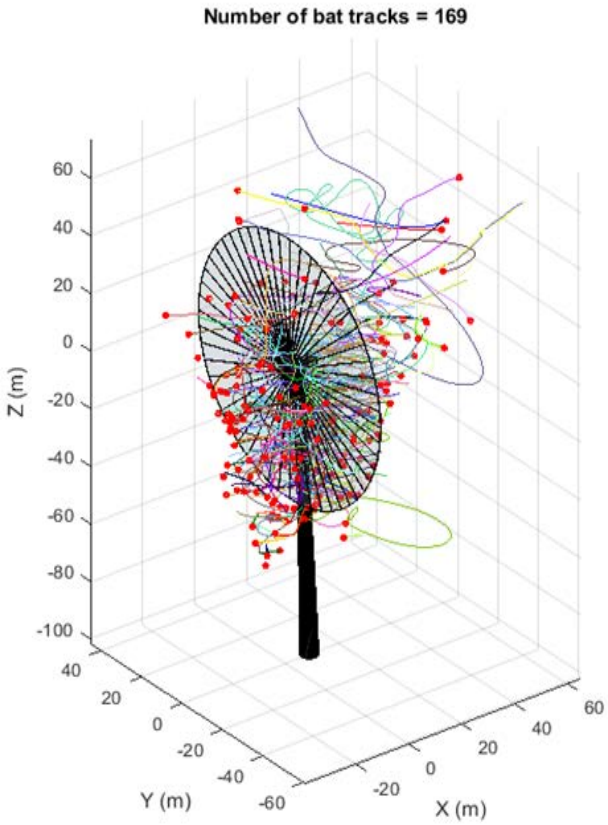
- Comparative Results



Accomplishments and Progress

- **Overall**
  - Working out issues during Functionality Test benefited Comparative Study
  - Effectiveness of UAD appears to be species-specific
    - Reaffirmed by results in other studies
  - Advanced thermal video monitoring methods and analysis tools, particularly for 3D processing



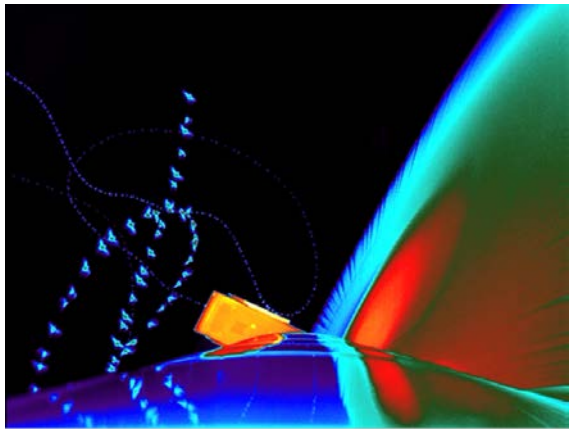


Accomplishments and Progress

Project Schedule & Milestones						DE-EE0007036
SOPO Task Number	Title / Task Description	Task Completion Date				Progress Notes
		Original Planned	Revised Planned	Actual	Percent Complete	
1	Initial Installation Plan	Nov-15		Nov-15	100%	Completed as scheduled
2	Initial Manufacturing of Ultrasonic Acoustic Deterrents	Jun-16		Jun-16	100%	Completed as scheduled
3	Initial Installation and Monitoring of Ultrasonic Acoustic Deterrents	Sep-16		Sep-16	100%	Completed as Scheduled
4	Analysis and Reporting of Preliminary Functionality Test of Ultrasonic Acoustic Deterrents	Jan-17	Apr-17	Apr-17	100%	Delayed, but completed
5	Final Manufacturing and Installation of Ultrasonic Acoustic Deterrents	Jun-17		Jun-17	100%	Completed as scheduled
6	Comparative Study	Sep-17	Oct-17	Oct-17	100%	Completed as scheduled
7	Final Analysis of Comparative Study	Mar-18	Mar-19		75%	Ongoing
8	Final Report, Review, and Dissemination	Jun-18	May-19		50%	Extended 6 months to complete video analysis

Communication, Coordination, and Commercialization

- **Communication**
  - Results have been presented via webinars and at professional conferences
  - Anticipating 2 peer-reviewed publications
    - Comparative study
    - Thermal video monitoring
  - Public release of 3D software



- **Coordination**
  - DOE funding spurred 8 additional studies
- **Commercialization**
  - This deterrent is commercially available in select areas where Brazilian free-tailed bats occur. However, the system requires additional refinement to improve effectiveness for certain species (e.g., eastern red bats)