

U.S. DEPARTMENT OF
ENERGY

Office of
**ENERGY EFFICIENCY &
RENEWABLE ENERGY**

Wind Operational Issue Mitigation (WREN/Tethys & Avian Remote Sensing)

Project ID # M2

Andrea Copping

Pacific Northwest National Laboratory



FY17-FY18 Wind Office Project Organization

“Enabling Wind Energy Options Nationwide”

Technology Development

Atmosphere to Electrons

Offshore Wind

Distributed Wind

Testing Infrastructure

Standards Support and International
Engagement

Advanced Components, Reliability, and
Manufacturing

Market Acceleration & Deployment

Stakeholder Engagement, Workforce
Development, and Human Use Considerations

Environmental Research

Grid Integration

Regulatory and Siting

Analysis and Modeling (cross-cutting)

Project Overview

M2: Wind Operational Issue Mitigation (WREN/Tethys & Avian Remote Sensing)

Project Summary

- This project works with an international collaborative to share and develop new information on wind energy and wildlife issues (WREN)
- The project also collects, collates, analyzes, and disseminates scientific information to inform and accelerate siting and permitting processes (Tethys).
- This project develops and tests technologies to observe birds and bats around wind farms, to decrease uncertainty of wind energy effects on these animals (Avian Remote Sensing)

Project Objective & Impact

- Potential effects of wind farms on wildlife and habitats continue to concern regulators and stakeholders which complicate and slow permitting. This project brings technology solutions to monitoring wildlife, engages the international community to share solutions to wind and wildlife interactions, and shares existing scientific information broadly to address these concerns.

Project Attributes

Project Principal Investigator(s)

Andrea Copping
Shari Matzner

DOE Lead

Jocelyn Brown-Saracino

Project Partners/Subs

WREN/Tethys:

- 11 WREN nations, IEA Wind.
- NOAA, BOEM

Project Duration

October 2011 – September 2020

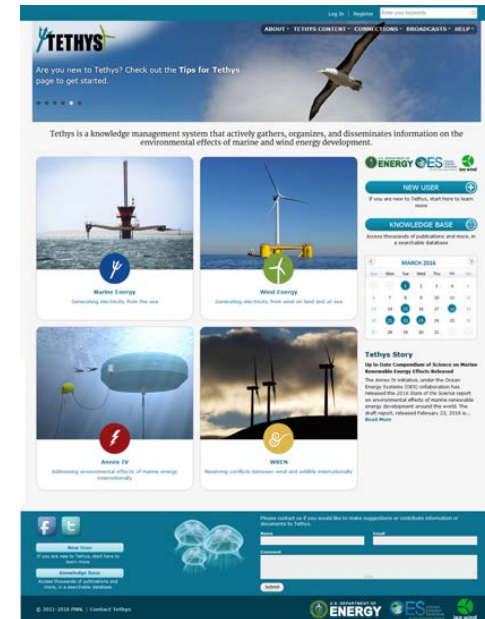
Technical Merit and Relevance

WREN

- Regulators and stakeholders are concerned about **potential effects of wind energy development on wildlife and habitats** for land-based and offshore wind, which may impede permitting and may foster opposition to wind projects. WREN investigates and analyzes information to address these concerns.

Tethys

- Regulators and other stakeholders may not have access to the **best science to support efficient permitting**. Using Tethys, scientific papers, reports, and other media are collected, curated, and disseminated to allow a common base of knowledge across the wind community.



Technical Merit and Relevance

Avian Remote Sensing

- Goal: **Advance the science** of risk assessment for offshore wind to birds and bats by providing:
 - **Continuous observations** of activity, night and day, all weather
 - **Timely, accurate information** through automated processing
 - **Site-specific, species-specific data**



Approach and Methodology

WREN

- In cooperation with NREL and WETO, coordinate among 11 nations under IEA Wind
- Understand interactions of wind energy & wildlife to support siting and permitting
- Create and transfer knowledge by developing white papers, webinars, other outreach and engagement materials and processes

Tethys

- *Tethys* knowledge base used to collect, curate, and disseminate documents for land-based and offshore wind.
- *Tethys* platform used to promote engagement among users

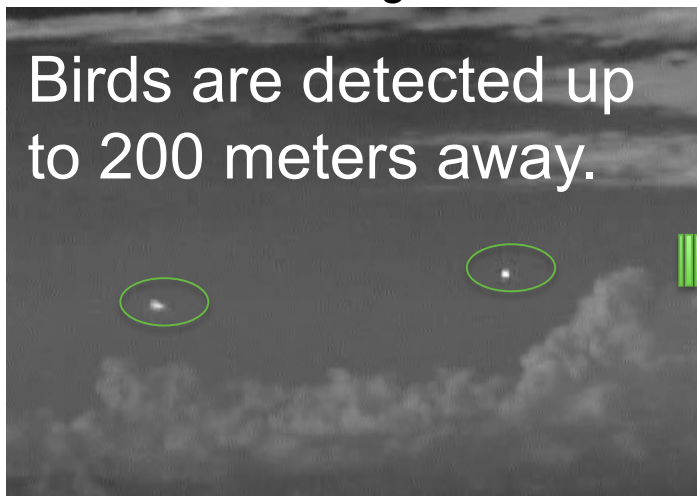


Approach and Methodology

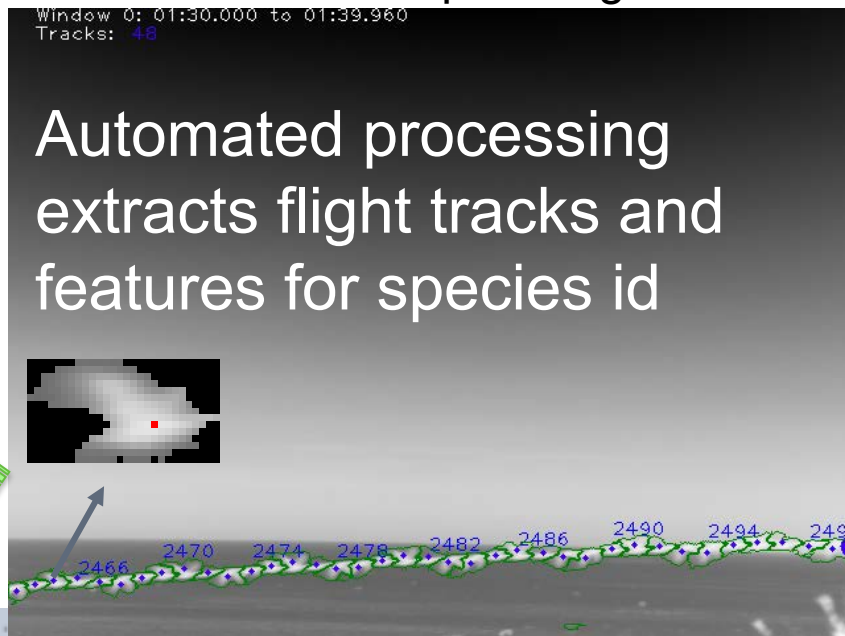
Avian Remote Sensing

Raw thermal image.

Birds are detected up to 200 meters away.

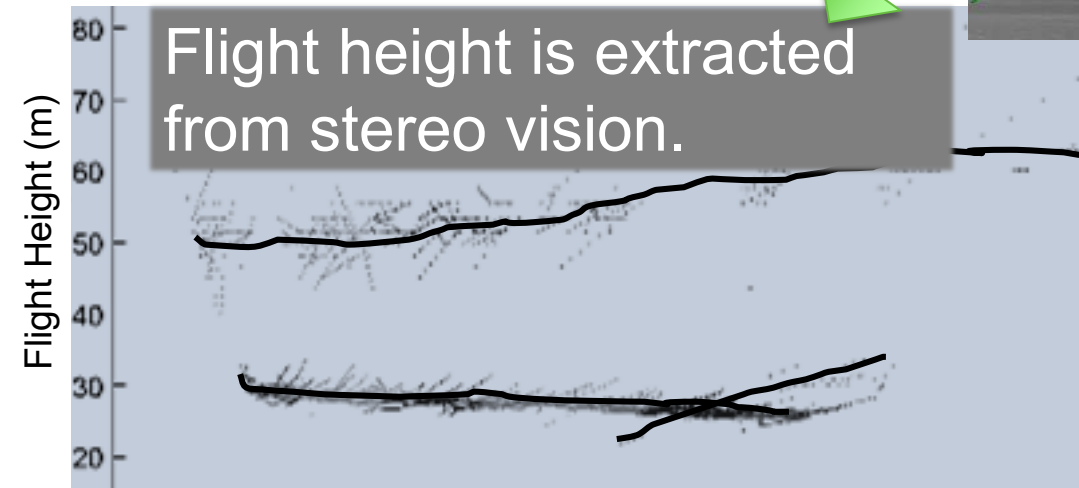


ThermalTracker output image.



Automated processing extracts flight tracks and features for species id

Flight height is extracted from stereo vision.



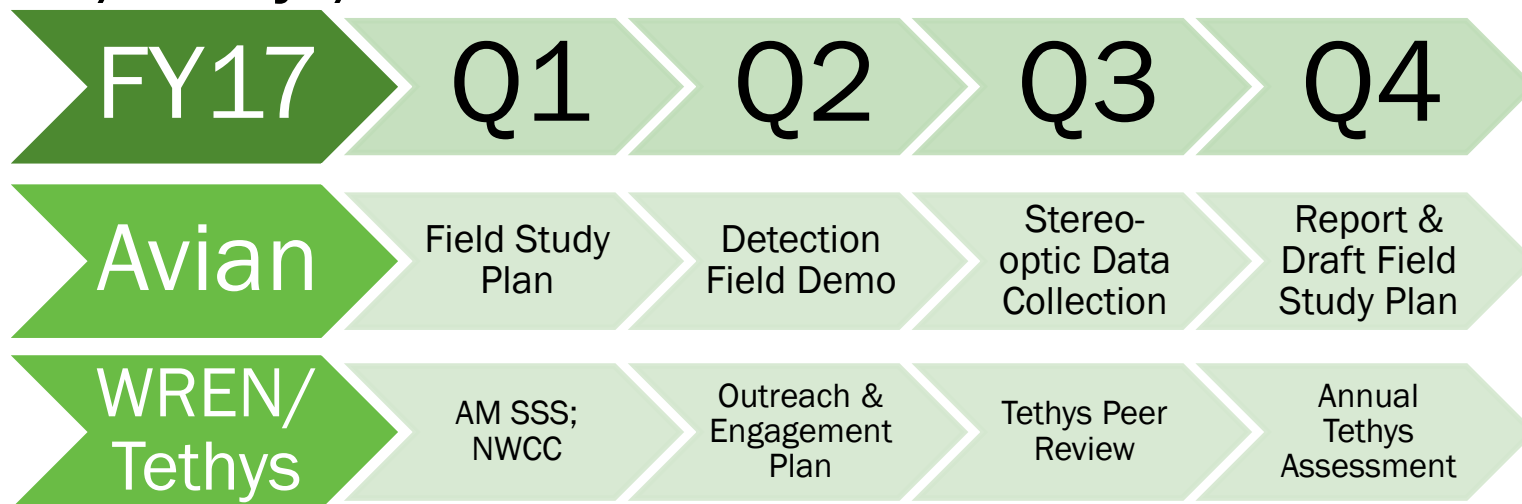
Commercial-off-the-shelf hardware is reliable and cost-effective.



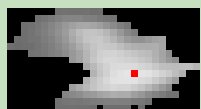
Flir A65 thermal cameras

Accomplishments and Progress

WREN/Tethys/Avian FY17 Milestones



FY 17 Go/No-Go Decisions



Avian Remote Sensing

- 9/30/2017: Real-time detection algorithm has been validated to meet benchmarks → GO

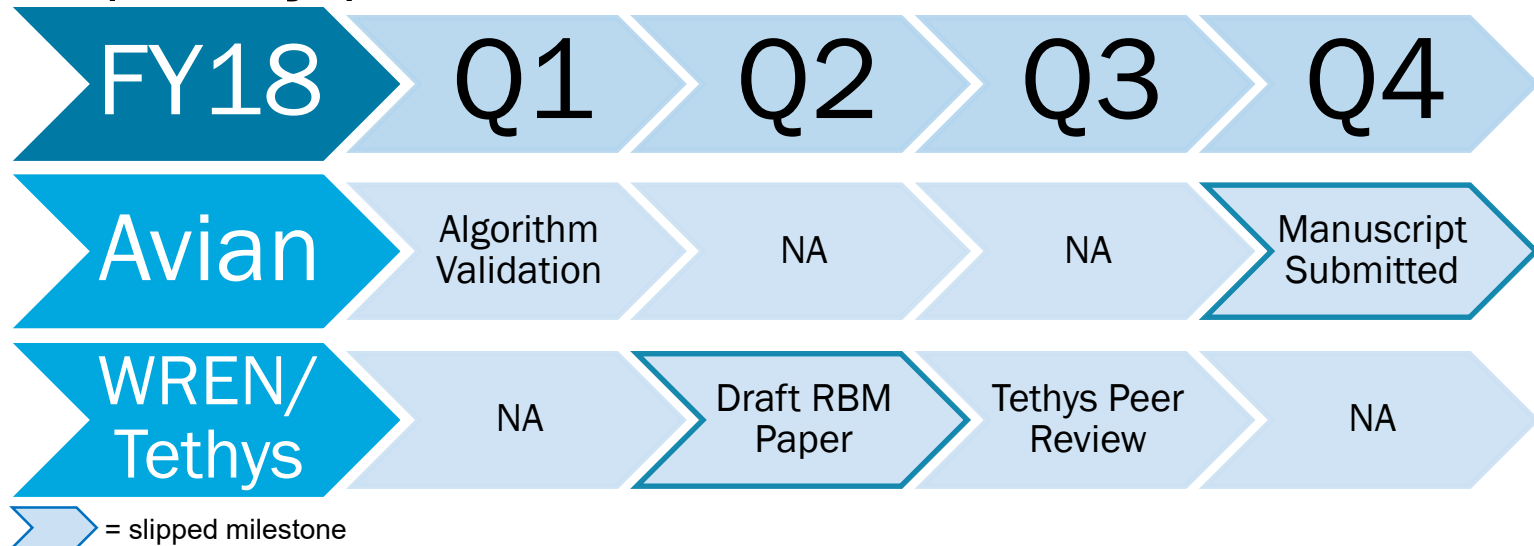


WREN/Tethys

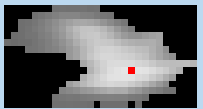
- 12/30/2016: IEA Wind Committee must agree to a 2nd phase of WREN in order for the initiative to continue → GO

Accomplishments and Progress

WREN/Tethys/Avian FY18 Milestones




FY 18 Go/No-Go Decisions



Avian Remote Sensing

- 9/30/2018: Classifiers can recognize a detected target as a bird & Land-Based Wind Demo successfully completed → GO



WREN/Tethys

- 6/30/2018: Evaluation of whether there has been a significant increase in Tethys wind users and collection as a result of focused outreach efforts during the first 3 quarters of FY18 → GO

Accomplishments and Progress

WREN/Tethys

December 2016
IEA Wind Task 34
Assessing Environmental Effects (WREN)
Adaptive Management White Paper

TETHYS
Collecting and Disseminating Environmental Effects Research to Support the Marine Renewable and Wind Energy Industries

WREN SHORT SCIENCE SUMMARY
WORKING TOGETHER TO RESOLVE ENVIRONMENTAL EFFECTS OF WIND ENERGY

Harbor Porpoises and Offshore Wind Energy
The science associated with understanding and managing the effects of offshore wind energy on Harbor porpoise populations is introduced below.

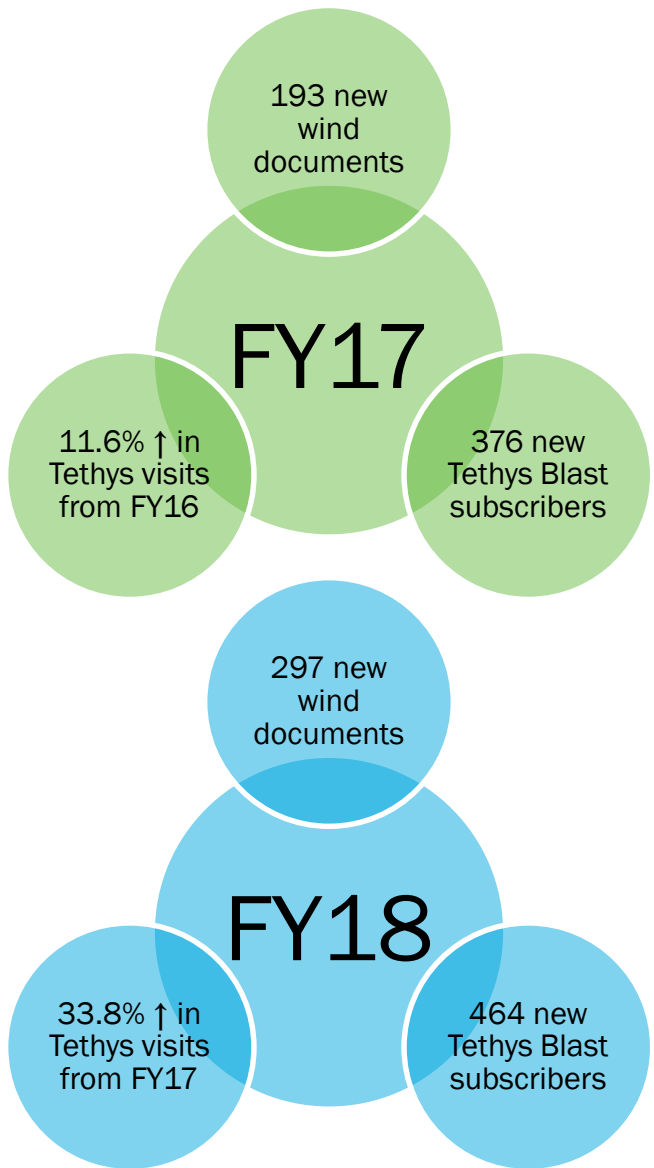
THE SPECIES
Harbor porpoises (*Phocoena phocoena*) are a small and abundant cetacean species. Found throughout the temperate and subtropical waters of the northern hemisphere, they prefer shallow, coastal waters, and feed near the bottom on small fish, squid, and crustaceans. The population status worldwide is not of concern. Repeat surveys during the last two decades of the relatively coastal North Sea population of the United States suggest that this local population is healthy. The status of populations on the east and west coasts of Canada and the United States

THE MECHANISM OF SPECIES RISK FROM WIND ENERGY
Most concerns about offshore wind energy and harbor porpoises are associated with construction activities, particularly if pile driving is required to install turbine foundations. These loud impulsive sounds may affect an individual's survival and reproduction with the significance of the effect likely to vary according to the importance of the area (for example, animals may respond differently in important feeding areas than in other areas). These effects on individuals could lead to impacts at the population level. Studies have demonstrated that species abundance typically remains at previous levels

WREN WHITE PAPER ON WIND ENERGY DEVELOPMENT
Adaptive Management for Wind and Wildlife Interactions
ADAPTIVE MANAGEMENT
Adaptive management (AM) is a learning-based management approach that is used to reduce scientific uncertainty, and has been applied to many types of management including filling of wetlands and various forms of renewable energy. AM has been identified as a tool to advance the wind energy industry, although its application in practice has been limited. AM has primarily been actively implemented in the United States, while other nations have applied some of the principles of AM. Many wind energy projects use the iterative hierarchy of the precautionary principle to guide development, both of which focus on mitigating or avoiding project-related risks or impacts. Overall, AM allows wind energy projects to adapt monitoring and mitigation over time, leading to improved decision-making. The WREN authors have developed a white paper on AM that explains how AM principles are used by the wind energy industry in several nations, and identifies ways the process and its implementation may be improved. See <https://tethys.conf.gov/about-wren> and <https://www.energytask34.html> for more information.

AM IS DEFINED FOR THIS ANALYSIS AS:
"Adaptive Management is a decision process that involves flexible decision making that can be adjusted in the face of uncertainty as outcomes from management actions and their results become better understood. Careful monitoring of these outcomes, both advances scientific understanding and may adjust actions or operations as part of an iterative learning process." —MRE 2008
Waters et al., 2009
Wind energy is a clean, renewable energy source that provides numerous benefits to society, including reduced greenhouse gas emissions, improved air quality, and increased energy security. However, the implementation of wind energy projects can also have potential impacts on wildlife, particularly on birds and bats. Adaptive management (AM) is a flexible and iterative process that allows project developers to learn from previous developments and improve implementation. By doing so, lessons learned can be applied to future wind energy developments. Implementing AM for wind energy has the potential to fully address the industry-wide reducing environmental effects.

WREN WHITE PAPER ON WIND ENERGY DEVELOPMENT
Upscaling Individual Effects of Wind Energy to Population Impacts on Wildlife
POPULATION IMPACTS OF WIND ENERGY DEVELOPMENT
Wind energy (both land-based and offshore) provides significant benefits such as climate change mitigation, associated benefits to human health, and energy diversification. However, adverse interactions with wildlife have been documented at many facilities worldwide, especially for birds, bats, and marine mammals. Depending on the magnitude of effect on the fitness of an individual, coupled with the number of affected individuals, these interactions may or may not ultimately lead to reduced survival, reduced reproduction, and increased mortality at the population level. Learning frameworks generally focus on assessing the effects on individuals within a rather restricted temporal and spatial range. Yet from a conservation point of view, there is a need to upscale these effects to the level of the broader population that these individuals are part of. Such a shift in decision-making processes is an essential step to balance the costs of wind energy on wildlife with socio-economic benefits in a sustainable and socially acceptable way. The WREN authors prepared a white paper, based on the literature, to provide an overview of how population impacts are measured and predicted, and how impact thresholds can be established for decision-making.
ASSESSING POPULATION IMPACTS
For wind energy projects, one of the greatest challenges pertains to the definition, prediction, and detection of a population impact. Depending on the species, different demographic parameters can be targeted, such as population size or density, population growth rate, mortality, breeding success or fecundity, and survival rate. Quantifying an impact on any of these parameters requires a baseline for comparison. This comparison could be either of a temporal (before-after design) or a



Accomplishments and Progress

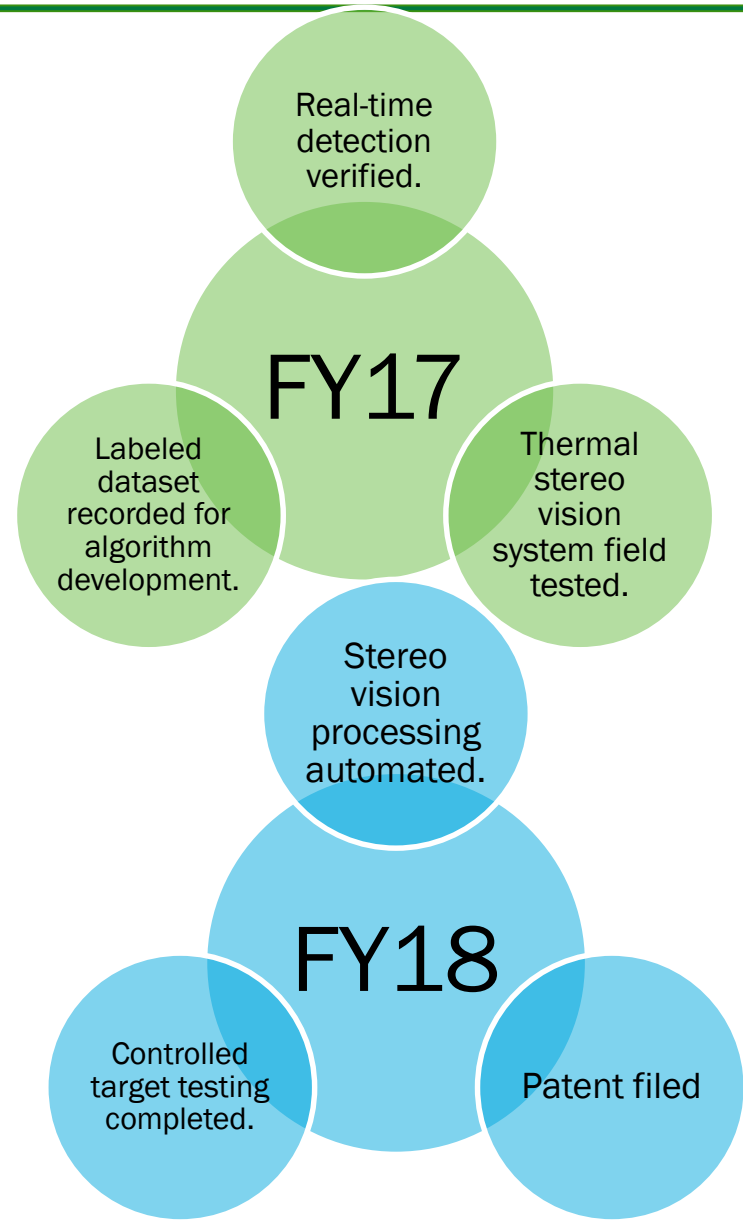
- **Avian Remote Sensing**

Prototype system field tested



Automated stereo processing accuracy verified

Controlled Target Test	Human-matched distance (m)	Algorithm-matched distance (m)	Difference (m)
1	28.43	28.55	0.12
2	31.96	32.15	0.19



Communication, Coordination, and Commercialization

News Center

Night vision for bird- & bat-friendly offshore wind power
 PNNL's ThermalTracker software can aid responsible wind farm siting and operations
 News Release
 August 11, 2017

Energy and Environment Directorate


Research Highlights
 Highlights Archive
ThermalTracker: The Secret Lives of Bats and Birds Revealed
 Open-source software can help accelerate widespread deployment of offshore wind
 May 2017

American offshore wind has the potential to produce over 2,000 gigawatts of power—that's well over double the amount of energy consumed by the U.S. each year. And, unlike land-based wind farms, offshore wind is more consistent, abundant, and reliable, making it much easier to integrate into the grid. There's just one small hiccup: bats and birds.





Increase the Visibility of Tethys



Enhance the Collection of Wind Documents in Tethys



Engage with Broad Range of Wind Stakeholders



Tethys Wind Outreach Goals

California Offshore Wind Symposium

Tsakopoulos Library Galleria
 Sacramento, CA
 March 13, 2018





Regina Bispo
 Joana Bernardino
 Helena Coelho
 José Lino Costa
 Editors

Wind Energy and Wildlife Impacts

Balancing Energy Sustainability with Wildlife Conservation

Springer

NWCC
WIND WILDLIFE
 RESEARCH MEETING



**Conference on
 Wind energy and
 Wildlife impacts**

Upcoming Project Activities

WREN

During FY19 we expect to:

- Publish WREN white paper on risk-based management
- Work on two other white papers on cumulative effects and “green versus green”
- Addition of Belgium as 12 WREN Member
- Second phase of WREN ends in 2020; expect to request a 3rd phase from IEA Wind

Tethys

- Tethys collection, curation, and dissemination of literature will continue
- Moving Tethys to a new platform (Drupal 8) for increased functionality
- Continue to support WREN, in collaboration with NREL



Upcoming Project Activities

Avian Remote Sensing

- Species classification from features using stereo vision
 - estimate wingspan, body length
 - flight speed, height



- Field testing at NREL's National Wind Technology Center
 - validate 3D tracking with drone
 - endurance test of system reliability

