

U.S. DEPARTMENT OF
ENERGY

Office of
**ENERGY EFFICIENCY &
RENEWABLE ENERGY**

Evaluating the Effectiveness of a Camera-Based Detection System to Support Informed Curtailment and Minimize Eagle Fatalities at Wind Energy Facilities

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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

Evaluating the Effectiveness of a Camera-Based Detection System to Support Informed Curtailment and Minimize Eagle Fatalities at Wind Energy Facilities

Technology Summary: IdentiFlight is a camera-based, autonomous eagle detection, classification, and tracking system intended to facilitate turbine shutdown (aka 'informed curtailment') to reduce collision risk of golden eagles and other protected species. IdentiFlight uses two camera types (fixed wide-field-of-view cameras and stereoscopic HD cameras) and a classification algorithm based on machine vision learning.

Period of Performance: May 1, 2017 – January 31, 2022

Technology Impact: IdentiFlight has the potential to be a faster, more accurate, and more cost-effective option for eagle detection and triggering of turbine curtailment than the current status quo of human observers.

Project Goals:

- Evaluate how IdentiFlight compares to human observers in detecting and identifying eagles under a suite of environmental conditions; and
- Use the observation data to model how IdentiFlight and human observers reduce the eagle fatality prediction through informed curtailment.

Partners:

- American Wind Wildlife Institute (**AWWI**), Western EcoSystems Technology, Inc. (**WEST**), Boulder Imaging, IdentiFlight, Duke Energy Renewables, EDP Renewables

Technical Merit and Relevance

- Evaluate and improve a detection system that discriminates among bird species and informs focused risk-reduction curtailment
- Multi-year, multi-site evaluation of IdentiFlight's capabilities provide robust quantification of collision risk reduction for eagles
- 3rd party, peer-reviewed findings better inform the application of IdentiFlight (as appropriate) in regulatory settings



Approach and Methodology

- Merit-reviewed study design
- Full-scale evaluations at two wind facilities (WY, OR) with two-year field study, informed by AWWI pilot test
- Direct comparison of IdentiFlight vs human detection and classification abilities, comparing IdentiFlight with accepted eagle risk reduction practices.
- GPS-telemetered eagles at WY site provide estimate of “absolute detection rate” and means to analyze the accuracy of the IdentiFlight flight tracks
- Evaluation of quarterly machine learning improvements
- Evaluation of IdentiFlight vs human curtailment decisions
- Comparative systems cost analysis



Accomplishments and Progress

MILESTONES

- Merit-reviewed study design approved Aug '18
- Updates to IdentiFlight system implemented
- Field and data protocols established
- Added new component to project during peer-review: GPS-telemetered eagle data at WY site to provide estimate of absolute detection rate
- IdentiFlight installation in OR scheduled for Spring '19



Image of Golden Eagle detected and classified by IdentiFlight

Accomplishments and Progress

Project Schedule		BP1																																															
Assumed Start Quarters Months	Description	2017												2018												2019												2020											
		Q1			Q2			Q3			Q4			Q5			Q6			Q7			Q8			Q9			Q10			Q11			Q12			Q13											
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40								
Budget Period 1																																																	
Task 1	Project Launch																																																
Subtask 1.1	Improve IF																																																
Subtask 1.2	Study Design																																																
Subtask 1.3	Prepare for Study																																																
Task 2	Install IF Units in OR																																																
Task 3	Compare IF and Human Observers																																																
Subtask 3.1	Wypming Surveys																																																
Subtask 3.2	Oregon Surveys																																																
Subtask 3.3	Compile Data from IF and Humans																																																
Subtask 3.4	Sufficient Data Collected?																																																
Subtask 3.5	Evaluate Algorithm																																																
Subtask 3.5	Evaluate Detection with GPS data																																																
Task 4	Collect Eagle Data																																																
Subtask 4.1 (Bridge)	Collect Eagle Data																																																

- Slipped milestones and schedule**

- Peer-review of study design extended**

- In Original SOPO, study design scheduled for completion July 2017.
- Draft study design was submitted January 2018.
- In-person Merit Review took place on April 2018.
- The final study design was submitted in July 2018, approved August 2018.
- Delays due to extended Award Negotiations, and delays in coordination between merit reviewers

- Installation of IdentiFlight at Oregon site**

- Extended process for construction permitting, landowner negotiations, and finalization of the agreement between the wind facility and IdentiFlight/Boulder Imaging
- Original target installation date was Fall 2018, updated to Spring 2019.
- Updated target start date for field work in Oregon: June 15, 2019

Communication, Coordination, and Commercialization

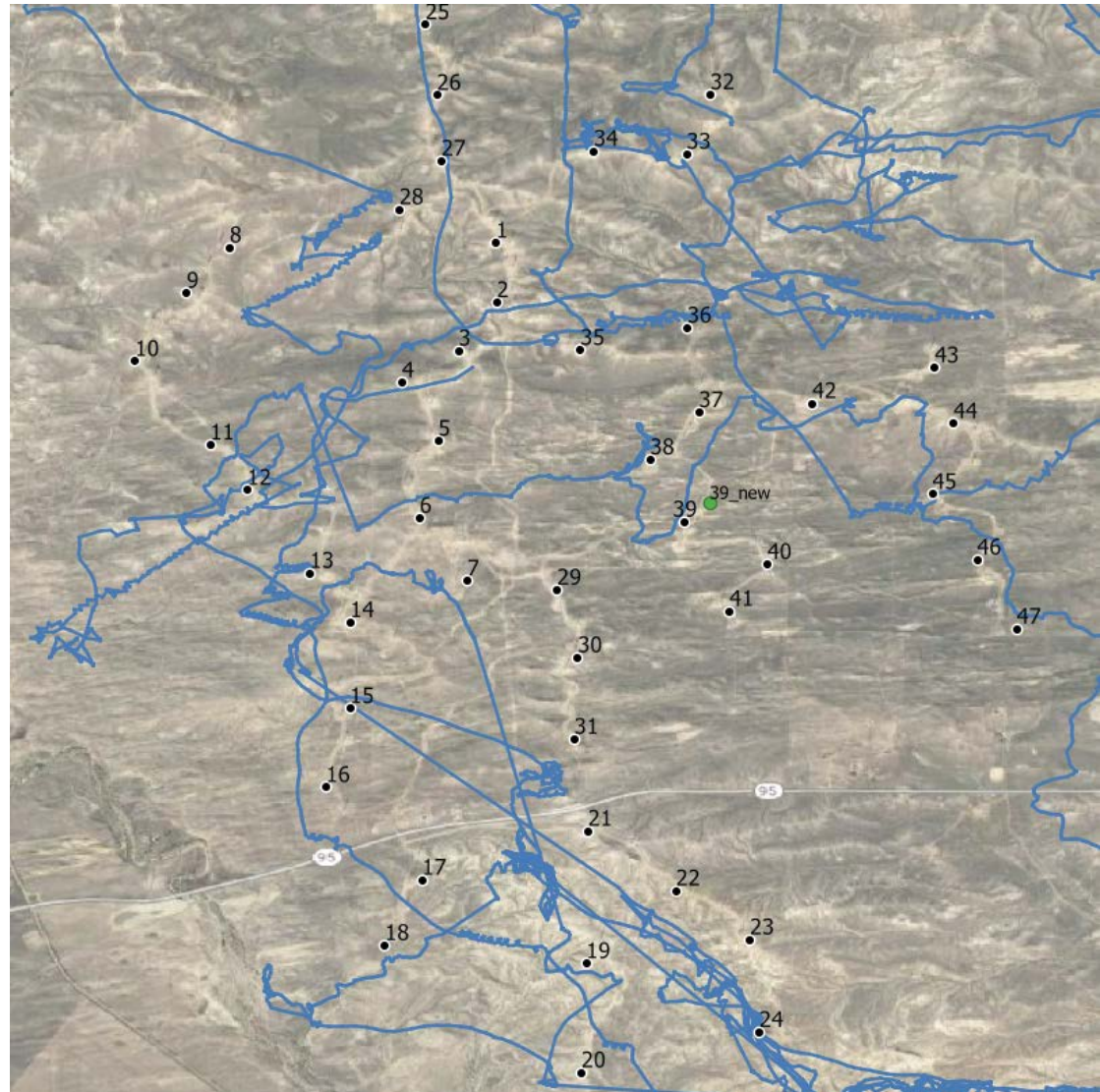
- AWWI/WEST will submit completed manuscripts for publication in peer-reviewed journals
- AWWI/WEST will present results of study at national conference(s) such as the Wind Wildlife Research Meeting
- As part of AWWI's Education & Outreach initiative, team will present peer-reviewed study results to relevant industry, conservation, and regulatory stakeholders through webinars, conference, and in-person presentations.
- IdentiFlight will use study results to demonstrate performance to potential customers and further improve IdentiFlight's performance
- Results will inform the appropriate use of IdentiFlight to satisfy requirements of Eagle Conservation Plans

Upcoming Project Activities

- Project is on track to accomplish study objectives
- Schedule:
 - Project and Go/No Go Decision schedule to be adjusted to accommodate delays in installation of IdentiFlight at Oregon site
 - Two primary paths forward, collaborating with DOE to decide on best option to enable collection of 2 full years of data at each site
- Budget is on target:
 - Added cost share to allow addition of GPS-telemetered eagle data
DOE provided additional budget in Budget Period 1 to account for out-of-scope work
- Project is relevant regardless of marketplace changes as an evaluation of the application of artificial intelligence and machine learning to eagle risk reduction strategies

Accomplishments and Progress

- Analysis of 1st quarter (Nov 2018-Jan 2019) of detection, classification, and GPS data is underway
- 1st Quarter GPS-eagle tracks from WY site



Upcoming Project Activities

- Budget Period 1:
 - Ongoing: Surveys at WY site to compare IdentiFlight vs human detection and classification abilities (Nov 2018 – Oct 2019)
 - Spring 2019: Installation of IdentiFlight at OR site
 - Spring 2019 – 2020: Surveys at OR site to compare IdentiFlight vs human detection and classification abilities
 - Ongoing collection and analysis of GPS eagle data in WY to evaluate true detection rate and eagle tracking capabilities

Upcoming Project Activities

- Budget Period 2:
 - Conduct surveys at WY and OR sites to compare IdentiFlight vs human curtailment orders
 - Evaluate IdentiFlight curtailment algorithm and effect on power generation of the facility
 - Quantify relationship between flight, landscape, weather variables and IdentiFlight performance
- Budget Period 3:
 - Estimate reduction in collision risk to eagles through implementation of IdentiFlight vs biomonitors, as applicable to Eagle Conservation Plans
 - Develop manuscript(s) for peer-reviewed journal(s)
- Remaining project activities are within the approved budget and schedule.