



Environment and Natural Resources Trust Fund

M.L. 2021 Approved Work Plan

General Information

ID Number: 2021-294

Staff Lead: Rory Anderson

Date this document submitted to LCCMR: July 21, 2021

Project Title: Behavioral Response of Bald Eagles to Acoustic Stimuli

Project Budget: \$261,000

Project Manager Information

Name: Christopher Feist

Organization: U of MN - St. Anthony Falls Laboratory

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Project Reporting

Date Work Plan Approved by LCCMR: July 20, 2021

Reporting Schedule: December 1 / June 1 of each year.

Project Completion: July 31, 2023

Final Report Due Date: September 14, 2023

Legal Information

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 07d

Appropriation Language: \$261,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota, St. Anthony Falls Laboratory, to protect wildlife by designing and implementing an acoustic deterrence protocol to discourage bald eagles from entering hazardous air space near wind energy installations.

Appropriation End Date: June 30, 2024

Narrative

Project Summary: The goal of the work is to design and implement an acoustic deterrence protocol that will discourage bald eagles from entering hazardous air space near wind energy installations.

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Wind energy is a cost competitive, clean energy source that offers benefits for Minnesota. However, there are some undesirable environmental impacts of wind energy installations; one of primary interest here is federally protected bald eagle collisions with wind turbines resulting in fatalities. A promising method designed to reduce eagle collisions is the installation of acoustic deterrent devices at wind energy installations. In recent years, several studies have attempted to estimate the efficacy of acoustic deterrent systems, but these studies have been conducted in uncontrolled environments with limited data, resulting in a wide range of effectiveness estimates; i.e. estimates of effectiveness on altering flight paths of raptors away from wind turbines range from 7% to 88%. Further, the acoustic stimuli used were developed in the absence of knowledge relating to the hearing attributes of bald eagles. For these devices to be useful as a reliable raptor collision mitigation method, acoustic deterrence developers must have confidence in their effectiveness. This project aims to answer this question under controlled experimental conditions.

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

In experiments designed to develop the most effective acoustic deterrent, behavioral responses of bald eagles to a battery of natural and synthetic stimuli will be acquired and analyzed to establish a clear understanding of which stimulus types bald and golden eagles are most responsive to and habituate to the least. A set of prospective deterrence signals will be engineered using the most effective stimuli identified in the behavioral response tests referenced above. Those signals will be used to determine if tethered, but otherwise free-flying birds, respond to deterrence signals by altering customary flight paths. Additional experiments will be conducted by associating prospective sound-based deterrent signals with a visual object to determine if the eagles associate objects with acoustic cues and that those cues might enhance the avoidance behaviors that mitigate the taking of birds at wind energy facilities.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

This project will provide scientifically rigorous data addressing the effectiveness of acoustic deterrence signals to alter the flight path of eagles and therefore mitigate the fatality rate associated with wind turbine collisions. The project will identify and design acoustic deterrence signals that have been tested under controlled experimental conditions with bald eagles. Findings from this study will provide system designers and developers alike a solid foundation upon which to implement acoustic deterrence technologies.

Project Location

What is the best scale for describing where your work will take place?

Statewide

What is the best scale to describe the area impacted by your work?

Region(s): Central, NW, SW, NE,

When will the work impact occur?

In the Future

Activities and Milestones

Activity 1: Behavioral testing of perched bald eagles to potential acoustic deterrence signals

Activity Budget: \$120,000

Activity Description:

In this activity, the team will build on work recently concluded as part of a U.S. Department of Energy (DOE) funded project. In phase one of that study, the auditory attributes of bald and golden eagles were investigated. In a second study, a subset of calls from the vocal repertoire of bald and golden eagles were acoustically analyzed, and in a third preliminary data associated with behavioral responses of 3 bald eagles to a collection of natural and synthetic acoustic stimuli in a laboratory setting were acquired and analyzed.

In the first activity of the proposed study, our goal is to expand the small sample sizes used in the preliminary study to include 10 bald eagles in an effort to identify the most effective alerting acoustic stimuli and to which there is little, if any, habituation. Using this information, acoustic deterrence signals will be developed and used in tests specified in activities 2 and 3. Bald eagles will be tested at the University of Minnesota Raptor Center.

Activity Milestones:

Description	Completion Date
Engineer prospective acoustic deterrent stimuli for activities 2 and 3	October 31, 2021
Complete bald eagle behavioral response testing	November 30, 2021
Complete analysis of bald eagle behavioral responses to acoustic stimuli	December 31, 2021

Activity 2: Phase 1 behavioral testing of bald eagles to potential acoustic deterrent signals during tethered flight

Activity Budget: \$65,000

Activity Description:

The objective of activity 2 is to measure the effectiveness of acoustic deterrence signals developed in activity 1 to alter the flight path of eagles during tethered flight. Testing in this phase of the project will take place with wild bald eagles that are being rehabilitated at The University of Minnesota Raptor Center. To evaluate the effectiveness of acoustic deterrence signals to alter the flight path of eagles, 10 individuals will be evaluated during this phase of the investigation. Individual eagles will be evaluated multiple times on different days to assess habituation tendencies. By the end of the project, as many as 1200 flights, or more, will have been logged. Half of these flights will have included an acoustic deterrence element and half will not. Analyzing data collected during these flights using tracking sensors (GPS tags) attached to the birds will permit the objective assessment of the acoustic deterrence strategy.

Activity Milestones:

Description	Completion Date
Develop data acquisition system	October 31, 2021
Complete analysis of tethered flight trial data	May 31, 2022
Complete bald eagle tethered flight trials	May 31, 2022

Activity 3: Phase 2 behavioral testing of bald eagles to potential acoustic deterrent signals during tethered flight

Activity Budget: \$76,000

Activity Description:

Activity 3 will expand tethered flight testing into a second season. Tethered flight exercise associated with the Center's rehabilitation program typically occurs during the months of October through December in preparation for the bird's release into the wintering population of wild eagles. A second phase of testing will allow refinement of the testing procedure and concentration on acoustic stimuli shown in the earlier phases of this study to be most effective. We will also assess the combined influence of the presence of a structure and the broadcast of deterrence signals, as well as the influence of each element in isolation. Field testing of acoustic deterrence systems at wind farms have indicated some positive association between the noise deterrent and wind turbines.

Activity Milestones:

Description	Completion Date
Modify tethered flight procedure and acoustic stimuli	August 31, 2022
Complete tethered flight trials	December 31, 2022
Complete analysis of flight response data	March 31, 2023
Final project report	June 30, 2023

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Peggy Nelson	Speech-Language-Hearing Science, University of Minnesota	Peggy will serve as a co-investigator and assist in the design of behavioral response testing.	Yes
Jeffrey Marr	St. Anthony Falls Laboratory, University of Minnesota	Jeff Marr will serve as a co-investigator and assist with project management and research dissemination.	Yes
Christopher Milliren	St. Anthony Falls Laboratory, University of Minnesota	Chris Milliren will provide technical support and develop the sensor systems used in the behavioral response and tethered flight testing.	Yes
Edward Walsh	VA Loma Linda Healthcare System	Ed will serve as a lead research scientist on the project with responsibilities including developing acoustic stimuli, design of laboratory testing, and analysis of behavioral response test data.	Yes
JoAnn McGee	VA Loma Linda Healthcare System	JoAnn will serve as a lead research scientist on the project with responsibilities including developing acoustic stimuli, design of laboratory testing, and analysis of behavioral response test data.	Yes
Lori Arent	The Raptor Center, University of Minnesota	Lori Arent will assist in the design of laboratory testing, be responsible for access to test subjects, animal care protocols and permitting requirements, and lead tethered flights of bald eagles.	Yes
Julia Ponder	The Raptor Center, University of Minnesota	Julia Ponder will serve as a co-investigator and provide expertise on raptor behavior, design of laboratory testing, animal care protocols, and permitting requirements.	Yes

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.

Results of the project will be communicated with the wind industry and other stakeholders via conferences, journal articles, reports, and direct communication with wind industry partners. Acknowledgement of the Environment and Natural Resources Trust Fund will be done through the use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications as per the ENRTF acknowledgement guidelines. The impact of this project will influence strategic planning activities of primary wind energy stakeholders as they develop the next generation of environment friendly technologies.

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this be funded?

Results of the project will be communicated with the wind industry and other stakeholders via conferences, journal

articles, reports, and direct communication with wind industry partners. The impact of this project will influence strategic planning activities of primary wind energy stakeholders as they develop the next generation of environment friendly technologies. The US Department of Energy and the American Wind Wildlife Institute are committed to reducing the environmental impacts of wind energy and fund research aimed at this goal. Proposals for funding additional work can be submitted to these sources, as well as by establishing partnerships with private energy companies.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Technician		Veterinarian Technician - Animal Care			24%	0.18		\$8,042
Lori Arent		Scientist - Bird Handling			27%	0.24		\$21,257
Julia Ponder		Co PI			27%	0.06		\$11,438
Peggy Nelson		Co PI			27%	0.04		\$6,784
Benjamin Erickson		Scientist			24%	0.16		\$11,062
Christopher Milliren		Engineer			24%	0.48		\$29,447
Jeffrey Marr		Co PI			27%	0.02		\$3,165
Christopher Feist		PI			27%	0.4		\$30,649
							Sub Total	\$121,844
Contracts and Services								
Ed Walsh and JoAnn McGee	Professional or Technical Service Contract	Ed and JoAnn will serve as lead researchers on the project. They bring expertise in experimental design, data analysis, and animal bio-acoustics.		X		1		\$128,000
							Sub Total	\$128,000
Equipment, Tools, and Supplies								
	Equipment	Audio Equipment	Amplifiers and signal generators for use in the tethered flight testing					\$2,000
	Equipment	Speakers	Speakers used in tethered flight testing to emit acoustic stimuli					\$4,000
	Equipment	Tethered flight materials	Equipment used in tethered flights of bald eagles such as harness, gauntlets, creance line, etc.					\$1,675
	Equipment	RTK GPS tracking	Tracking device system to measure the flight path of bald eagles during tethered flights					\$3,000

							Sub Total	\$10,675
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel rate set at \$0.54 per mile for personal vehicles. Total miles of 297 for three individuals.	Reimbursement for travel to the eagle tethered flight location and the raptor center.					\$481
							Sub Total	\$481
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
							Sub Total	-
							Grand Total	\$261,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
<p>Contracts and Services - Ed Walsh and JoAnn McGee</p>	<p>Professional or Technical Service Contract</p>	<p>Ed and JoAnn will serve as lead researchers on the project. They bring expertise in experimental design, data analysis, and animal bio-acoustics.</p>	<p>Ed and JoAnn are critical partners to the success of this project. They served as lead researchers on the previous work completed by this team that is directly leading to the project proposed here. Ed and JoAnn were responsible for much of the experimental design, acoustic signal design, and data processing from our previous project where bald and golden eagle hearing were mapped as well as a pilot behavioral response experiment. Ed and JoAnn will be largely responsible for acoustic signal development, experimental design, and data processing in the project proposed here. Without Ed and JoAnn on the team this proposal would not have been submitted. There are no other researchers with their experience working with bald eagle hearing. Because of this, the single source contract is needed.</p> <p>Ed Walsh and JoAnn McGee are researchers with the VA Loma Linda Healthcare System. They have previously held affiliated research positions at the University of Minnesota in the Speech, Language, and Hearing Sciences department. They are being included on this proposal as a professional service contract as this was deemed the easiest way of including them on the proposal.</p> <p>Ed Walsh and JoAnn McGee each have a rate of \$100/hour. It was estimated their involvement on the project would total 640 hours.</p> <p>This is a single source contract.</p>

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	-
Non-State				
In-Kind	Unrecovered F&A	Support of SAFL facilities where research will be conducted.	Secured	\$143,550
			Non State Sub Total	\$143,550
			Funds Total	\$143,550

Attachments

Required Attachments

Visual Component

File: [4f8fffc1-b7b.pdf](#)

Alternate Text for Visual Component

The visual shows two of the experimental setups planned for the project. One figure shows a bald eagle in an indoor pen at the Raptor Center where behavioral testing to acoustic stimuli is occurring, image is from a previous DOE funded study. Speakers are located on either side of the eagle and researchers are monitoring/controlling the test from a remote location using video. The second figure shows an experimental setup with a bald eagle flying down a corridor with speakers on either side. ...

Optional Attachments

Support Letter or Other

Title	File
Proposal endorsement - UMN	bfa95df9-195.pdf
Peer Review Research Addendum	a6971368-350.docx
Background Check Form	31e142ec-15d.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

To reduce the project budget to the recommended funding amount, some of the project scope was removed. Specifically, our plan to travel to Cyril, OK to test golden eagle behavioral response as part of Activity 1 was removed. As MN has a low population of golden eagles, this part of the scope had the least significant impact to MN natural resources. Additionally, results from bald eagle behavioral response testing will have relevance to an acoustic deterrence system that would also work for golden eagles. The project title was changed to reflect the removal of behavioral response testing of golden eagles.

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

N/A

Do you agree travel expenses must follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I agree to the UMN Policy.

Does your project have potential for royalties, copyrights, patents, or sale of products and assets?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

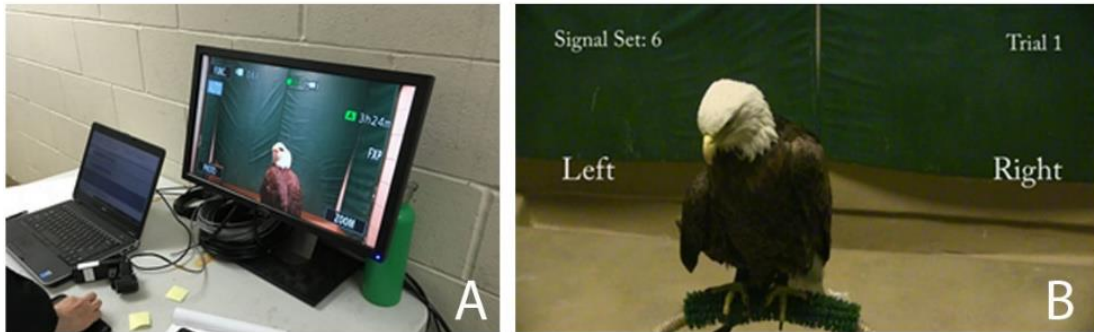
Yes, Sponsored Projects Administration

BEHAVIORAL RESPONSE OF BALD AND GOLDEN EAGLES TO ACOUSTIC STIMULI

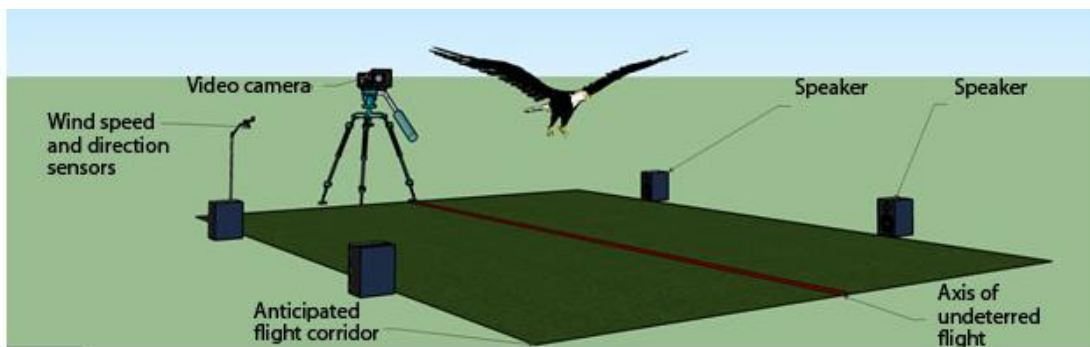
PRINCIPAL INVESTIGATOR: CHRISTOPHER FEIST, ST. ANTHONY FALLS LAB - UMN



Reducing the risk of eagle fatalities from wind energy by developing and testing an acoustic deterrence protocol



- Bald and golden eagles are protected by federal law under the *Bald and Golden Eagle Protection Act*
- Wind Energy is a cost competitive and clean energy source that offers clear benefits to Minnesota, but poses a risk to bald and golden eagles
- Acoustic stimuli has been suggested as a way to alert eagles to the presence of wind turbines and alter their flight paths away from hazardous airspace
- Currently available acoustic deterrent technologies have been shown to be between 7% and 88% effective, but were developed in the absence of knowledge related to the hearing attributes of bald and golden eagles – **We believe that we can improve effectiveness through a scientifically rigorous series of behavioral tests**



- We propose to leverage our previous work on the hearing characteristics of bald and golden eagles to develop and test an acoustic deterrence protocol in controlled environments
- To accomplish this we have assembled a highly specialized, interdisciplinary research team consisting of wind energy experts, veterinarians from the world-renowned University of Minnesota Raptor Center, and scientists specializing in auditory neuroscience and bioacoustics

