



# Environment and Natural Resources Trust Fund

## 2021 Request for Proposal

### General Information

**Proposal ID:** 2021-396

**Proposal Title:** Bioacoustics for broad-scale species monitoring and conservation

### Project Manager Information

**Name:** Elena West

**Organization:** U of MN - College of Food, Agricultural and Natural Resource Sciences

**Office Telephone:** ( ) -

**Email:** elwest@umn.edu

### Project Basic Information

**Project Summary:** This study will use autonomous recording devices to determine the statewide distribution and reproduction of red-headed woodpeckers and develop a protocol to monitor population trends and responses to habitat management.

**Funds Requested:** \$359,000

**Proposed Project Completion:** 2024-12-31

**LCCMR Funding Category:** Foundational Natural Resource Data and Information (A)

### 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?**

Statewide

**When will the work impact occur?**

During the Project and In the Future

## Narrative

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

Severe declines in red-headed woodpeckers over the last 50 years have resulted in a cumulative loss of nearly 95% of the population in Minnesota. Although there are a number of known breeding locations in the state, there is a lack of information on the species' statewide distribution, reproduction, and the habitat characteristics associated with breeding success. The coarseness of the Breeding Bird Survey and the incomplete nature of more intensive surveys (e.g., the County Biological Survey) do not provide the necessary information about the species' distribution and reproduction that are critical components of habitat management and restoration efforts. To address these information gaps we will focus on the following objectives:

1. Identify the current breeding distribution of red-headed woodpeckers in Minnesota and collect information on occupancy, reproduction, and breeding habitats.
2. Develop a monitoring protocol to rigorously detect red-headed woodpecker population trends and responses to habitat management.

We propose a broad-scale, fine-resolution survey for red-headed woodpeckers across their potential breeding distribution in Minnesota using cutting-edge technology (autonomous recording units [ARUs]) and an evaluation of how ARUs can best be used to establish a monitoring program for this species, and possibly other species of management concern.

### **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.**

We propose to make use of technological advances by utilizing ARUs, which passively record sound for long periods. ARUs may reduce the need for trained observers and per-survey costs, allowing for more frequent, widespread surveys than traditional observer-based approaches. This study is a logical extension of our study of a single population of red-headed woodpeckers at Cedar Creek Ecosystem Science Reserve (supported by the ENTRF). We will work with existing partners from Cedar Creek and the Audubon Chapter of Minneapolis, in addition to U.S. Fish and Wildlife Service to analyze acoustic results and determine red-headed woodpecker presence and behavior at the landscape scale.

As this is a new technology, a key consideration is determining the level of sampling effort needed to detect changes in site occupancy. ARU placement periods will vary from 3-14 days to evaluate the effect of visit frequency on occupancy and breeding activity estimations. ARUs will be moved among potential breeding habitats throughout the species' range to increase sample size, allowing us to assess the factors that influence power to detect trends (e.g., sample size, number of visits, and magnitude of change) and develop a rigorous monitoring protocol that can detect response to management activities.

### **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?**

It is critically important in efforts to restore red-headed woodpecker populations to not only identify presence but also breeding locations. Habitat restoration initiatives are successful only when wildlife both use and reproduce at rates that sustain populations. A standardized protocol for monitoring these parameters in the species statewide is needed to determine their responses to habitat restoration and improve conservation efforts more broadly. ARU versatility is continually improving and device costs have fallen dramatically. Therefore we will also test the capabilities of both a higher- and low-cost ARU to determine a rigorous approach that is also cost-effective and scalable.

## Activities and Milestones

### Activity 1: Conduct passive acoustic monitoring of red-headed woodpecker occupancy and reproduction

**Activity Budget:** \$236,940

#### Activity Description:

We will compile red-headed woodpecker vocalization libraries, determine the effective range of ARUs, and test a subsample of units to validate field methods in summer 2021. Pilot work will be conducted at Cedar Creek, where red-headed woodpeckers occur in relatively stable numbers (>100 breeding adults annually) and the location of our current study. We will then identify potential study locations by processing land cover maps to identify suitable sites and deploy 2 ARUs at each site (low and higher cost). Within each site, we will space plots  $\geq 250$  m apart to avoid overlap in the sampled acoustic environment. We will evaluate auditory data to identify potential target vocalizations (i.e., vocalizations indicative of presence and breeding), and also record the presence of other forest bird species' vocalizations in the audio data for potential future evaluation. Based on results from 2021, we will deploy ARUs more broadly beginning in March 2022 to assess red-headed woodpecker occupancy and reproduction at sites throughout their potential breeding distribution in Minnesota. To assess breeding habitat selection at confirmed nesting locations we will measure nest tree (species, height, cavity size and direction), forest stand (vegetation structure, and age or size class), and landscape characteristics.

#### Activity Milestones:

Description	Completion Date
Acquire equipment, develop ARU deployment methods at Cedar Creek and identify deployment locations	2021-12-31
ARU deployment and field work (year 1)	2022-03-31
ARU site visits for data collection, battery and unit replacement, as necessary	2022-10-31
Processing and analysis of data collected during Activity 1 (year 1)	2023-02-28
ARU deployment and field work (year 2)	2023-03-31
Processing and analysis of data collected during Activity 1 (year 2)	2024-12-31

### Activity 2: Evaluate ARU effectiveness and develop a monitoring protocol to detect red-headed woodpecker population trends and responses to habitat management

**Activity Budget:** \$122,060

#### Activity Description:

We will use findings from activity 1 to evaluate ARU effectiveness and develop a broad-scale, fine-resolution monitoring protocol for red-headed woodpeckers. We will work with local, state, and federal partners to develop best practices and tools for land managers working on habitat restoration efforts to benefit red-headed woodpeckers and other species targeted with conservation and management initiatives. We will disseminate our best practices and recommendations for long-term monitoring of red-headed woodpeckers through our partner, the Audubon Chapter of Minneapolis, which has established working relationships with Audubon chapters and private landowners throughout the state and region.

#### Activity Milestones:

Description	Completion Date
Evaluate ARU effectiveness based on findings from Activity 1 and make recommendations for long-term monitoring of red-headed woodpeckers	2024-06-30
Submit final report and activity summary	2024-12-31

2. Develop a monitoring protocol to rigorously detect red-headed woodpecker population trends and responses to habitat management	2024-12-31
---	------------

## Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Mike Wells	U.S. Fish and Wildlife Service Midwest Regional Office	Dr. Wells will help coordinate field logistics and development of project protocols, and will assist with the writing and dissemination of the monitoring protocol. Dr. Wells will also assist with acoustic library development and analyses of audio data.	No
Dr. Caitlin Barale Potter	Cedar Creek Ecosystem Science Reserve	Dr. Potter will help coordinate field logistics and development of project protocols, and will assist with the writing and dissemination of the monitoring protocol.	No
Keith Olstad	Audubon Chapter of Minneapolis	Mr. Olstad will help coordinate field logistics and development of project protocols, and will assist with the writing and dissemination of the monitoring protocol. Audubon will provide \$7,500 per year of financial support to this initiative, in addition to in-kind volunteer engagement throughout the state.	No

## 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?**

There is currently a lack information necessary to restore red-headed woodpecker populations in Minnesota. Results from this study will reduce that information gap, and we will disseminate findings to state and federal land managers, and to organizations working on habitat restoration and conservation of red-headed woodpeckers. We will present our findings at state, regional, and national meetings and will publish study results in the peer-reviewed literature, and disseminate study results to the public via a project website and popular press articles. Funding to support a long-term monitoring program will be raised through outside grants and state Audubon chapters.

## Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Red-headed Woodpeckers as Indicators of Oak Savanna Health	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03j	\$171,000

## Project Manager and Organization Qualifications

**Project Manager Name:** Elena West

**Job Title:** Postdoctoral Researcher

**Provide description of the project manager's qualifications to manage the proposed project.**

Elena West is an avian ecologist and conservation biologist with expertise in animal foraging, movement behavior, and quantitative wildlife population ecology. Dr. West completed her M.S. in Natural Resource Ecology and Management at the University of Michigan where she also received a graduate certificate in GIS and Spatial Analysis. She completed her PhD in Zoology at the University of Wisconsin-Madison where she examined the influence of anthropogenic food subsidies on the behavior and ecology of Steller's jays in California state parks. Dr. West has 10 years of experience leading research projects, surveying, capturing, and marking birds and is currently working with Dr. David Andersen as a postdoctoral researcher at the Minnesota Cooperative Fish and Wildlife Research Unit and University of Minnesota,

examining the annual cycle demography, habitat associations, and migration ecology of red-headed woodpeckers at the Cedar Creek Ecosystem Science Reserve.

Dr. West will serve as project manager, supported by Dr. Andersen and in collaboration with partners from Cedar Creek, the U.S. Fish and Wildlife Service, and the Audubon Chapter of Minneapolis to conduct the proposed research. Drs. West and Andersen will co-lead the acoustic analyses, and writing and dissemination of the monitoring protocol for red-headed woodpecker distribution in Minnesota. Dr. Wells (U.S. Fish and Wildlife Service) will assist with acoustic library development and analyses of audio data. Dr. Potter (Cedar Creek), Dr. Wells (U.S. Fish and Wildlife Service), and Mr. Olstad (Audubon Chapter of Minneapolis) will help coordinate field logistics and development of project protocols, and will assist with the writing and dissemination of the monitoring protocol. Along with project collaborators, Dr. West will seek funding from other entities (e.g., MN DNR, FWS, Audubon Society); develop project protocols; aid in data collection, management, and analyses; and provide logistical support to field activities.

**Organization:** U of MN - College of Food, Agriculture and Natural Resource Sciences

**Organization Description:**

Minnesota Cooperative Fish and Wildlife Research Unit – The MN CFWRU was established in 1987 and staffed beginning in 1989. The MN CFWRU’s primary mission is to conduct research related to fish and wildlife addressing issues of regional, national, and international significance. Cooperators of the MN CFWRU include the USGS, FWS, MN DNR, University of Minnesota, and the Wildlife Management Institute. The MN CFWRU is currently staffed by 2 USGS scientists, who conduct research, train graduate students, teach graduate-level courses, and provide outreach. The MN CFWRU currently is involved in upwards of 15 projects involving over \$3 million in external research funding.

University of Minnesota – The University of Minnesota is a land-grant institution of higher education, and ENRTF funding granted for this project would be managed by the University of Minnesota.

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
University of Minnesota Postdoctoral Research Assistant		The postdoctoral researcher will co-lead data collection, analysis, writing and dissemination of management plan to local, state, and federal management agencies and the public.			25.4%	3.5		\$239,515
Field Technicians		Field technicians will carry out ARU deployments across the state.			8%	1.52		\$55,640
University of Minnesota Undergraduate Intern		Assist with extraction of acoustic target signals from raw audio data.			0%	0.76		\$7,680
							<b>Sub Total</b>	<b>\$302,835</b>
<b>Contracts and Services</b>								
							<b>Sub Total</b>	<b>-</b>
<b>Equipment, Tools, and Supplies</b>								
	Equipment	Autonomous Recording Units (low-cost category): 30 units	Needed for recording woodpecker vocalizations and assessment of different ARU models					\$2,100
	Equipment	Autonomous Recording Units (higher-cost category): 30 units	Needed for recording woodpecker vocalizations and assessment of different ARU models					\$7,500
	Equipment	Equipment for fieldwork including batteries, SD cards, protective cases for ARUs, and GPS units	ARUs each require an SD card, batteries and protective cases. Field work will also require the use of GPS units for deployment and maintenance of ARUs.					\$11,065
							<b>Sub Total</b>	<b>\$20,665</b>
<b>Capital Expenditures</b>								

							<b>Sub Total</b>	-
<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	-
<b>Travel In Minnesota</b>								
	Miles/ Meals/ Lodging	4-wheel drive vehicle mileage (100 miles/day x 40 days) x 2 vehicles = 8,000 miles @0.575 = \$4,600 per year x 2 years = \$9,200 plus mileage first year (50 miles/day x 40 days x 1 vehicle = 2,000 miles @0.575 = \$1,150) plus mileage for pilot work, attending meetings, etc. (2,000 miles @0.575 = \$1,150) = \$11,500	For ARU deployment and maintenance, delivering presentations, and meeting with collaborators in Minnesota					\$11,500
	Miles/ Meals/ Lodging	Lodging for field crews (4 people @ \$50/night/person x 60 nights x 2 field seasons) = \$24,000	Housing for field crews while deploying and maintaining ARUs					\$24,000
							<b>Sub Total</b>	<b>\$35,500</b>
<b>Travel Outside Minnesota</b>								
							<b>Sub Total</b>	-
<b>Printing and Publication</b>								
							<b>Sub Total</b>	-
<b>Other Expenses</b>								
							<b>Sub Total</b>	-
							<b>Grand Total</b>	<b>\$359,000</b>

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
---------------	---------------------	-------------	--

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
<b>State</b>				
			<b>State Sub Total</b>	-
<b>Non-State</b>				
Cash	Audubon Chapter of Minneapolis	Funding provided by the Audubon Chapter of Minneapolis RHWO Recovery Project for costs associated with dissemination of project results and the monitoring protocol to local Audubon chapters, members of the public, land managers, and state and federal agencies working on red-headed woodpecker habitat restoration and conservation (\$7500/year for 2 years)	Secured	\$15,000
In-Kind	U.S. Geological Survey	David E. Andersen salary and benefits (1 month/year x 3.5 years)	Secured	\$59,290
			<b>Non State Sub Total</b>	<b>\$74,290</b>
			<b>Funds Total</b>	<b>\$74,290</b>

## Attachments

### Required Attachments

#### *Visual Component*

File: [fdfa7f41-aa9.pdf](#)

#### *Alternate Text for Visual Component*

The visual component of our proposal states the problem we are seeking to address, which is: (1) Loss of nearly 95% of Minnesota's red-headed woodpecker population, and 2) Lack of information on the species' statewide distribution and reproduction needed for habitat management and restoration efforts), along with a photo of a red-headed woodpecker. We include our proposed approach in a box to the right of that, which is: 1) a broad-scale, fine-resolution survey for red-headed woodpeckers across their potential breeding distribution in Minnesota using Autonomous Recording Units (ARUs), a cutting-edge technology, and 2) an evaluation of how ARUs can best be used to establish a monitoring program for this species, and possibly other species of management concern.

We then show a diagram of this approach in three stages: 1) Data collection in potential breeding habitat across the state during which we will test different ARUs and survey designs (the graphic shows a picture of each of the different ARUs we will use, and a figure representing survey design/methods); 2) audio data output and processing (the graphic shows examples of what audio and data files look like); and 3) Analyze, review, and recommend (the graphic shows a computer outline, which represents this final stage of analysis, review of the data, and recommendations for our evaluation of ARUs and development of a statewide monitoring protocol for red-headed woodpeckers)

### Optional Attachments

#### *Support Letter or Other*

Title	File
Audubon Chapter of Minneapolis Letter of Support	<a href="#">30d7a9a2-388.pdf</a>

## Administrative Use

**Does your project include restoration or acquisition of land rights?**

No

**Does your project have patent, royalties, or revenue potential?**

No

**Does your project include research?**

Yes

**Does the organization have a fiscal agent for this project?**

Yes, Sponsored Projects Administration

# Bioacoustics for broad-scale species monitoring and conservation

## Problem

- Loss of nearly 95% of Minnesota's red-headed woodpecker population
- Critical information needed on the species' statewide distribution and reproduction for habitat management and restoration efforts



Photo by Siah St. Clair

## Approach

1. Broad-scale, fine-resolution survey for red-headed woodpeckers across their potential breeding distribution in Minnesota using **Autonomous Recording Units (ARUs)**, a cutting-edge technology
2. Evaluation of how ARUs can best be used to establish a monitoring protocol for this species, and possibly other species of management concern

## Data collection in potential breeding habitat across the state



Photo source: AudioMoth



Photo by Robert Weger



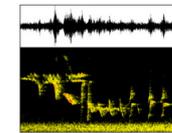
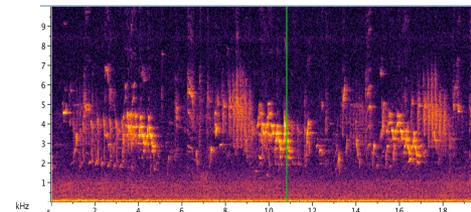
## Test different ARUs and survey designs

## Analyze, review & recommend



## Monitoring protocol

## Audio data output and processing



Index	Start	End	Duration	File	Time
1	0:00:00	0:00:01	0:00:01	01_000001.wav	01_000001
2	0:00:01	0:00:02	0:00:01	01_000002.wav	01_000002
3	0:00:02	0:00:03	0:00:01	01_000003.wav	01_000003
4	0:00:03	0:00:04	0:00:01	01_000004.wav	01_000004
5	0:00:04	0:00:05	0:00:01	01_000005.wav	01_000005
6	0:00:05	0:00:06	0:00:01	01_000006.wav	01_000006
7	0:00:06	0:00:07	0:00:01	01_000007.wav	01_000007
8	0:00:07	0:00:08	0:00:01	01_000008.wav	01_000008