

## **Environment and Natural Resources Trust Fund**

## 2026 Request for Proposal

## **General Information**

Proposal ID: 2026-513

Proposal Title: Species-Specific Assessment of Hibernation Phenology for Minnesota Bats

## **Project Manager Information**

Name: Elena West Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences Office Telephone: (612) 743-1530 Email: elwest@umn.edu

## **Project Basic Information**

**Project Summary:** Acoustic monitoring of bat hibernation timing and environmental factors in Minnesota to improve conservation of endangered populations affected by white-nose syndrome.

ENRTF Funds Requested: \$479,000

Proposed Project Completion: December 31, 2029

LCCMR Funding Category: Fish and Wildlife (D)

## **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.

White-nose syndrome (WNS), caused by the fungus Pseudogymnoascus destructans (Pd), has devastated hibernating bat populations in Minnesota since 2016, with some populations declining by over 90%. Three of Minnesota's four hibernating species are now endangered or threatened: the northern long-eared bat (endangered), little brown bat and tri-colored bat (threatened, likely to be listed as endangered soon).

While previous bioacoustics statewide research has focused on summer bat ecology, little is known about speciesspecific timing and environmental factors that may influence pre- and post-hibernation periods. This information is crucial for effective conservation, as it allows for precise timing of monitoring activities and treatment applications. Without this knowledge, conservation efforts may miss critical windows for intervention, further endangering already decimated populations. Our project will fill critical knowledge gaps to:

1. Identify pre- and post hibernation activity patterns for Minnesota bat species

2. Determine key environmental variables that may influence hibernation timing

3. Provide essential data for conservation as promising WNS treatments (vaccines, UV-C therapy, biocontrol) advance toward implementation

4. Validate passive acoustic sampling methods for count-based measures of bat species using emerging technologies to quantify potential recovery or decline

5. Monitor P. destructans reservoirs seasonally in hibernacula

# What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

We will deploy acoustic recording units (ARUs), environmental data loggers, break beam devices, and thermal cameras at cave entrances across Minnesota to monitor bat activity and hibernation patterns without disturbing sensitive populations. Site selection will involve consultation with DNR personnel to identify active hibernacula.

Monitoring will occur during critical transition periods: late July to early November (swarming and entrance) and March to May (emergence) across two years. Environmental data loggers will continuously record temperature, barometric pressure, and relative humidity. We will also monitor environmental reservoirs of the WNS pathogen P. destructans in hibernacula. Acoustic data will be analyzed to identify bat species presence and activity timing, determining speciesspecific hibernation patterns and examining relationships with environmental variables. Data from beam break devices and thermal cameras will quantify bat numbers and movement direction, correlating with acoustic data to validate whether ARUs alone can determine population counts for future monitoring.

This non-invasive approach provides comprehensive orthogonal data while minimizing human impact on vulnerable populations. Results will directly inform conservation planning, particularly for implementing emerging WNS treatments and developing effective non-invasive monitoring protocols.

# 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 create the first comprehensive dataset on hibernation timing and environmental triggers for Minnesota's threatened bat species. Our work will develop effective non-invasive monitoring protocols for at-risk hibernacula during critical pre- and post-hibernation periods while testing the accuracy of count-based estimates using passive methods (ARUs).

The research will provide essential information for targeted implementation of emerging WNS treatments and inform evidence-based management decisions. Wildlife managers and conservation partners will gain precise hibernation

phenology data to improve the timing and effectiveness of conservation interventions for these endangered populations.

## Activities and Milestones

## Activity 1: Acoustic Field Sampling and Environmental Data Collection

#### Activity Budget: \$252,346

#### **Activity Description:**

Sampling will be conducted at cave and mine entrances across Minnesota with active hibernacula and through consultation with personnel from the MN DNR. We will deploy ultrasonic acoustic recording devices to monitor bat activity, data loggers to measure environmental variables, and Apodemus beam break detectors and thermal cameras to count the number of bats that enter and exit hibernacula.

To capture pre- and post-hibernation activity patterns, devices will be deployed at the same locations in late summer, spring and winter during the following periods:

Fall sampling period: July 20th - November 15th Spring sampling period: March 1st - May 31st Winter sampling period: January 1st - Feb 28th (a small number will be deployed at the largest hibernacula during hibernation to detect abnormal bat activity due to WNS)

ARUs will be programmed to begin recording 30 minutes before sunset until 30 minutes following sunrise. Data loggers will record environmental conditions hourly. Count devices (break beam and infrared) will record constantly. Equipment and data will be collected at the end of each recording period and uploaded to a secure drive for storage and analysis. Devices will be redeployed at the beginning of each sampling period to reduce damage and loss.

#### **Activity Milestones:**

Description	Approximate
	Completion Date
Identify sampling locations based on accessibility and bat presence	August 31, 2026
Deploy ARUs, data loggers, thermal cameras, and beam break devices (Year 1)	September 30, 2026
Deploy ARUs, data loggers, thermal cameras, and beam break devices (Year 1)	May 31, 2027
Deploy ARUs, data loggers, thermal cameras, and beam break devices (Year 2)	September 30, 2027
Deploy ARUs, data loggers, thermal cameras, and beam break devices (Year 2)	May 31, 2028

#### Activity 2: Monitor WNS pathogen (P. destructans) abundance in hibernacula and laboratory analyses

#### Activity Budget: \$96,658

#### **Activity Description:**

We will obtain substrate samples from sediment collections and swabs of hibernacula surfaces at cave/mine entrances and roost areas (~10 per entrance site/biannually, non-hibernation periods). P. destructans DNA from samples will be quantified using a standard qPCR assay, which we have used successfully to measure the abundance and persistence of environmental reservoirs of potentially infectious pathogens. These data will be correlated with environmental parameters and bat population information obtained through break beam detectors, thermal cameras, and data loggers.

#### **Activity Milestones:**

Description	Approximate Completion Date
Collect sediment samples and swabs of hibernacula surfaces (Year 1)	June 30, 2027
Laboratory work to extract substrate samples from sediment collections (Year 1)	August 31, 2027
Quantification of P. destructans DNA from samples using qPCR assays (Year 1)	August 31, 2027

Collect sediment samples and swabs of hibernacula surfaces (Year 2)	June 30, 2028
Laboratory work to extract substrate samples from sediment collections (Year 2)	August 31, 2028
Quantification of P. destructans DNA from samples using qPCR assays (Year 2)	August 31, 2028
Data analysis to assess relationship between environmental parameters and bat population	June 30, 2029
information	

# Activity 3: Assess bat species activity patterns using audio data and relationship to environmental variables

#### Activity Budget: \$129,996

#### **Activity Description:**

Acoustic recordings will be analyzed to identify species-specific activity patterns using machine learning software, employing both automated classifiers and manual validation to ensure accurate species identification. For each monitoring site, we will determine:

- 1. Species composition and temporal activity patterns (daily and seasonal)
- 2. First and last detection dates for each species
- 3. Peak activity periods during pre- and post-hibernation phases

Environmental data will be synchronized with acoustic data to examine correlations between bat activity and variables such as temperature, barometric pressure, humidity, and precipitation. We will identify environmental predictors of hibernation entry and emergence for each species using generalized linear mixed models.

We will determine count-based estimates using data from break breams and thermal cameras. Count data will also be used in conjunction with audio data to validate whether acoustic devices alone can be used to determine counts for future monitoring efforts.

Together these analyses will yield critical insights into species-specific responses to environmental conditions, and provide precise timing windows for each species' hibernation cycle and the emerging methodology for future passive monitoring analyses.

We will map spatial patterns and hibernation phenology data to create a comprehensive baseline for future monitoring and conservation efforts targeting these endangered populations.

#### **Activity Milestones:**

Description	Approximate
	Completion Date
Process and validate audio data using machine learning software (Year 1)	August 31, 2027
Estimate bat species presence, call frequency, activity patterns, and count-based estimates (Year 1)	August 31, 2027
Analysis of environmental data and bat activity patterns (Year 1)	August 31, 2027
Process and validate audio data using machine learning software (Year 2)	August 31, 2028
Estimate bat species presence, call frequency, activity patterns, and count-based estimates (Year 2)	August 31, 2028
Analysis of environmental data and bat activity patterns (Year 2)	August 31, 2028
Produce maps showing individual bat species hibernation phenology across Minnesota	May 31, 2029

## **Project Partners and Collaborators**

Name	Organization	Role	Receiving Funds
Dr. Robert Blanchette	University of Minnesota, Department of Plant Pathology	Dr. Blanchette will assist with pathogen quantification work.	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 work be funded?

Information gathered on bat hibernation phenology, activity, hibernacula occupancy, and pathogen reservoirs will inform future management strategies, particularly for WNS treatments. Knowing species locations and hibernation timing will improve efficiency of treatment deployment.

This project will provide land managers with detailed information about bat species presence and hibernation patterns. Correlation of audio data with beam breaks and cameras will advance acoustic methodology for estimating species composition and abundance, supporting site-specific management plans and future monitoring.

ENRTF support will enable pilot bioacoustic monitoring of hibernacula and aid collaborative efforts with ongoing University of Minnesota research on potential biocontrol options for WNS.

## Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Bioacoustics for Broad-Scale Species Monitoring and Conservation	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 03n	\$305,000
Bioacoustics for Species Monitoring and Conservation - Phase 2	M.L. 2024, , Chp. 83, Art. , Sec. 2, Subd. 08j	\$568,000

## Project Manager and Organization Qualifications

#### Project Manager Name: Elena West

#### Job Title: Teaching Assistant Professor

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

Dr. Elena West is an ecologist and conservation biologist with extensive expertise in wildlife behavioral ecology, population monitoring, and conservation of threatened species. Her research integrates cutting-edge monitoring technologies with conservation biology to address pressing wildlife management challenges, making her uniquely qualified to lead the proposed bat hibernation phenology project.

Currently a faculty member in the Department of Fisheries, Wildlife, and Conservation Biology at the University of Minnesota, Dr. West has successfully implemented passive acoustic monitoring projects for multiple species at the statewide scale, including red-headed woodpeckers, green heron, and avian biodiversity more broadly. Her work to develop statewide acoustic monitoring networks provides the methodological foundation for this bat hibernation study. Her expertise in bioacoustic data collection, processing, and analysis is directly transferable to monitoring bat

echolocation calls and activity patterns.

Dr. West has established protocols for non-invasive wildlife monitoring that minimize disturbance—crucial when studying endangered bat species already stressed by white-nose syndrome. Since 2017, she has successfully managed complex field projects requiring coordination with multiple stakeholders, including state and federal agencies and land managers.

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

#### **Organization Description:**

The Department of Fisheries, Wildlife, and Conservation Biology at the University of Minnesota Twin Cities provides world-class training and expertise to contribute to the management, conservation, and sustainable use of fisheries and wildlife resources. Our goal is to use innovative teaching, research, and outreach to respond to societal needs for information and education pertaining to natural resources.

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineli	% Bene	# FTE	Class ified	\$ Amount
Personnel				gible	iits		Stall	
Dr. Elena West		Responsible for overall project management and			36.6%	0.45		\$66.663
(Co-PI)		supervision of graduate research assistant, project			00.070	01.0		<i>+•••</i> ,••••
,		associate, and undergraduate students working on						
		acoustic sampling and environmental data collection.						
Dr. Christine		Responsible for Pd monitoring and beam break			36.6%	0.36		\$56,208
Salomon (Co-		population analysis.						
PI)								
Graduate		Responsible for field work, data and euipment			23.2%	1.25		\$152,773
Student		management, and analyses required to achieve						
Researcher		project activities. One 50% GRA for 2.5 years.						
		Graduate student fringe is 23.2% + tuition for 5						
		semesters, totaling \$ 50,248.						
Project		Assist in the development and testing of acoustic			32.3%	1		\$61,577
Associate		recorder hardware, and co-leads field work safely						
		and efficiently, e.g. most field activities require at						
		least two individuals.						
Research		Assist with bat counter data processing, Pd			32.3%	0.3		\$30,410
Associate (Ben		quantification, data analysis.						
Held)								
Undergraduate		Assist with field work (ARU deployment and			0%	0.3		\$11,856
Technicians		management), sound file and environmental data						
		processing.						
Undergraduate		Assist with bat counter data processing, Pd			0%	0.42		\$17,472
Technicians		quantification.						4
							Sub	\$396,959
							Total	
Contracts and Services								
							Sub	-
							Total	
Equipment, Tools. and								
Supplies								
	Tools and	15 autonomous recording unit (ARU) sets (ARUs @	ARUs used for data collection of bat					\$21,135
	Supplies	\$1,099 each + shipping, microphone, conduit, lock and cable @ \$310).	activity patterns.					

<b></b>	Tools and	15 ovtornal nowar kits @ \$100 aach	Power kits used to support longer		¢2 005
	Turneline	15 external power kits @ \$199 each.	Power kits used to support longer-		ş2,965
	Supplies		term ARO deployments and data		
			collection.		44.005
	Tools and	Kestrel DROP D3 data loggers (15 @ \$129 each).	Devices used to collect		\$1,935
	Supplies		environmental data at each sampling		
			location.		
	Tools and	3 Thermal cameras + setup (mount, NVR, battery,	Cameras used to collect bat count		\$5,850
	Supplies	and cables ) @ \$1,950 each.	data at each sampling location.		
	Tools and	20 mast poles (2' PVC pipe, couplings, t-post and	Used to mount ARUs high enough off		\$988
	Supplies	post planter).	the ground and away from any from		
			features that will inhibit recording of		
			ultrasonic calls.		
	Tools and	SD Cards (78 @ \$35 for ARUs and cameras).	SD cards store acoustic and		\$2,730
	Supplies		video/image data on ARUs and		
			thermal cameras.		
	Tools and	Apodemus bat beam break counter (3 @ 2849 each	Beam break counter is used to count		\$8,772
	Supplies	+ shipping (\$225).	bats as they emerge and enter		
			hibernacula.		
	Tools and	D alkaline batteries (15 ARUs * 4 deployments * 4	Batteries are needed to power ARUs.		\$542
	Supplies	batteries @ \$2.26 each).			
	Tools and	12 external hard drives: 8TB drives that are portable	External hard drives are needed to		\$1.800
	Supplies	@ \$150 each.	store data for analyses.		, ,
	Tools and	Deep cycle marine battery (6 @ $$106$ ) + 1 charger	Marine batteries are used to power		\$706
	Supplies	(\$70).	beam break devices.		<b>*</b> • • • •
	Tools and	Subscription for machine learning software (\$399/yr	Machine learning software will be		\$798
	Supplies	for 2vrs).	used to analyze audio data.		<i><b></b></i>
	Tools and	Pd sampling supplies (swabs gloves tubes)	Sampling supplies needed to safely		\$500
	Supplies		collect sediment samples and Pd		çsöö
	Supplies		swahs		
	Tools and	Pd quantification supplies (Swah and DNA extraction	Supplies needed for Jaboratory		\$12,000
	Supplies	kits a DCR reagents tubes ninette tins gloves	analyses to quantify Pd		<i><b>JIZ,000</b></i>
	Supplies	nlactic consumables: ~10 samples per site v 10 sites			
		2 times per year)			
	Tools and	Equipment repair, part replacement, breakage	Funds to support repair and		\$2.500
	Supplies	replacement	replacement costs associated with		\$2,500
	Supplies		long torm field compling		
			long-term neid sampling.	Cub	662 241
				Sub	<b>\$03,241</b>
Conital				TOLAI	
Capital					
Expenditures				Cub	
				Sub	-
				Total	

Acquisitions							
and							
Stewardship							
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Travel In						. o tu	
Minnocoto							
winnesota		Vahiela menteli 4 vahiela fan 2 van de (annulin an aniad	The summer of this turned summer time				62.750
	whies/ weals/	venicie rental: 1 venicie for 2 weeks/sampling period	The purpose of this travel support is				\$2,750
	Lodging	* 2 sampling periods/year * 2.5 years	to provide the transportation				
		@\$1,100/vehicle/month.	support to complete field work/ARU				
			deployment and maintenance.				
	Miles/ Meals/	Vehicle mileage.	Vehicle mileage for fieldwork to				\$10,850
	Lodging		deploy, change batteries and SD				
	0.0		cards, and recover devices (775 miles				
			ner trin x 20 trins at $\frac{50}{7}$ (mile)				
	Conforanco	Formal procentation by graduate and undergraduate	Procenting at the Minnesota Chapter				\$500
	Desistration	student et state chenter Wildlife Cociety mosting	of The Wildlife Conjecture ill highlight				3300
	Registration	student at state chapter wildlife Society meeting	of the wildlife Society will nighlight				
	Miles/ Meals/	(\$255 registration x 2 + \$245 mileage (350mi x	the research in the state and serve				
	Lodging	\$0.70/mi).	an outreach function.				
						Sub	\$14,100
						Total	
Travel Outside							
Minnesota							
	Conference	Formal presentation by MS student at professional	Graduate student participation at	X			\$2,200
	Registration	society meeting (\$264 conference registration \$330	professional meeting will highlight				<i>\$2,200</i>
	Miles / Meale /	lodging (\$16E /ng v 2ngs) \$170 mod nor diam (\$51	the recearch and serve an outreach				
			the research and serve an outreach				
	Lodging	first day, \$68 full day, \$51 last day). \$336 miles	function				
		(480mi x \$0.70/mi)).					
						Sub	\$2,200
						Total	
Printing and							
Publication							
	Publication	We plan to publish 2 papers based on research from	Publishing peer reviewed papers.				\$2,500
		this project (December 2028 and August 2029 upon					+_,
		completion of field work and data analysis)					
						Cult	ć2 500
						Sub	\$2,500
						Total	
Other							
Expenses							
						Sub	-
						Total	

			Grand	\$479,000
			Total	

## Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Travel Outside	Conference	Formal presentation by MS student	Needed for attendance to participate in formal presentation of project methods, results,
Minnesota	Registration	at professional society meeting	and implications at relevant professional meetings. For example, the Society for
	Miles/Meals/Lodging	(\$264 conference registration. \$330	Conservation Biology North America (NACCB) annual meeting.
		lodging (\$165/ng x 2ngs). \$170 meal	
		per diem (\$51 first day, \$68 full day,	
		\$51 last day). \$336 miles (480mi x	
		\$0.70/mi)).	

## Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub	-
			Total	
Non-State				
			Non State	-
			Sub Total	
			Funds	-
			Total	

Total Project Cost: \$479,000

This amount accurately reflects total project cost?

Yes

## Attachments

### **Required Attachments**

*Visual Component* File: <u>3aa76f15-d0b.pdf</u>

#### Alternate Text for Visual Component

Hibernating bat populations in Minnesota have been devastated by white-nose syndrome. Three of our four hibernating species are now endangered or threatened. Information on species-specific activity patterns during critical periods around hibernation, and how environmental factors influence these patterns is needed for conservation of vulnerable populations and emerging treatment methods....

#### Supplemental Attachments

#### Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
University of Minnesota Sponsored Projects Administration	41b622d0-66c.pdf
Approval Letter	

### **Administrative Use**

Does your project include restoration or acquisition of land rights?

No

Do you understand that travel expenses are only approved if they 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 understand the UMN Policy on travel applies.

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

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

Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing \$10,000 or more or large-scale stream or wetland restoration?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care,

treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this proposal:

Dr. Christine Salomon

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

N/A