Environment and Natural Resources Trust Fund

2025 Request for Proposal

General Information

Proposal ID: 2025-063

Proposal Title: Evaluating Anticoagulant Rodenticide Exposure in Minnesota's Carnivores

Project Manager Information

Name: Michael Joyce

Organization: U of MN - Duluth - NRRI

Office Telephone: (218) 788-2656

Email: joyc0073@d.umn.edu

Project Basic Information

Project Summary: We will determine anticoagulant rodenticide exposure rates and concentrations in bobcats and fishers, evaluate factors influencing exposure risk, and evaluate negative effects of rodenticide exposure on carnivore health.

ENRTF Funds Requested: $247,000

Proposed Project Completion: June 30, 2028

LCCMR Funding Category: Small Projects (H)

Secondary Category: Foundational Natural Resource Data and Information (A)

Project Location

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

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

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.

Rodenticides are used to control rodent populations to protect crops, reduce disease and property risks in human dwellings, and prevent ecological damage. Anticoagulant rodenticides (hereafter, ARs) are a class of rodenticides that interfere with blood clotting factors. Importantly, the negative effects of rodenticides are the same whether ingested directly by rodents or indirectly by predators eating rodents that were poisoned.

Recent studies have found AR exposure and poisoning to be surprisingly widespread among wild carnivore populations:

1. Predators in Europe, New Zealand, and North American have high rates of AR exposure.
2. Over 78% of fishers and ~50% of bobcats sampled in the northeastern US were exposed to ARs.
3. AR exposure is highest near urban and agricultural areas but also present in remote areas.
4. Fishers have received lethal doses of ARs in the wild.
5. AR consumption can cause negative effects on carnivore health and behavior.

Exposure of predators to ARs is an emerging issue that is receiving a lot of global attention, but data from Minnesota is lacking. Research is needed to fill key knowledge gaps including identifying exposure pathways, evaluating negative effects of exposure on wildlife populations, and determining effective strategies for reducing AR exposure.

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 evaluate anticoagulant rodenticide (AR) exposure rates in bobcats and fishers to determine whether Minnesota's carnivores are being exposed to ARs and to fill key knowledge gaps related to exposure risk factors and effects of AR exposure. Given the widespread exposure of fishers and bobcats elsewhere in North America, we anticipate finding high exposure rates in Minnesota.

We will work with MN DNR researchers and managers to sample road-killed and trapper-harvested bobcats and fishers for exposure to 11 first- and second-generation ARs. We will combine AR exposure data with sample location, age, sex, and reproductive status of females to evaluate negative effects of AR exposure. We will use the data we collect to:

1. Determine current prevalence of AR exposure in Minnesota bobcats and fishers.
2. Evaluate factors influencing AR exposure risk.
3. Map AR exposure risk for bobcats and fishers in Minnesota.
4. Evaluate negative consequences of AR exposure to carnivore health and reproduction.

The results of this project will have high management value. Additionally, we expect our results to be of high interest and value to the public. We will conduct public outreach and disseminate project results to help raise awareness of AR exposure in Minnesota's carnivores.

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?

No studies have previously evaluated anticoagulant rodenticide (AR) exposure in Minnesota's carnivores, so prevalence, routes of exposure, and potential effects to populations are currently unknown. The results of this study will help fill those critical knowledge gaps and provide foundational data on AR exposure in bobcats and fishers. Specifically, understanding the factors that influence AR exposure can help identify and map sources of exposure, which can be used to direct efforts to reduce AR exposure risk. High AR exposure rates for bobcats and fishers may also indicate risk to other predators.

Activities and Milestones

Activity 1: Evaluate anticoagulant rodenticide exposure rates, exposure risk factors, and negative effects on bobcats and fishers.

Activity Budget: $247,000

Activity Description:
We will use samples collected from road-killed and harvested bobcats and fishers to evaluate anticoagulant rodenticide (AR) exposure rates for both species. We will analyze 200-300 samples of each species distributed from across their range to evaluate spatial patterns in AR exposure. We will also evaluate intrinsic (species, sex, age, diet) and extrinsic (proximity to human dwellings, land cover) factors influencing rodenticide exposure risk and map exposure risk across Minnesota. AR exposure risk will be determined by analyzing tissues for exposure to 11 different first- and second-generation ARs. For adult females, we will evaluate past reproductive status and litter sizes to determine whether AR exposure has an adverse effect on reproductive output. Reproductive data will come from analyzing placental scars on the uterus of each sample. Animal age will be determined for each sample using cementum annuli from teeth. We will conduct public outreach to share results of the project with the public.

Activity Milestones:

Description	Approximate Completion Date
Summarize all data collected during the first year of sampling	June 30, 2026
Summarize all data collected during the second year of sampling	June 30, 2027
Determine AR exposure rates from 200-300 bobcat and fisher samples	September 30, 2027
Complete all analysis of factors influencing exposure risk and negative effects on carnivores	June 30, 2028

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Michael Joyce	UMD-NRRI	Project manager, overseeing all aspects of this project including coordinating sample collection, data management and analysis, and reporting.	Yes

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?

This project will generate foundational data on anticoagulant rodenticide (AR) exposure risk and negative effects to bobcats and fishers, two charismatic game species in Minnesota. We have engaged with the MN DNR while developing this proposal to ensure results are of high management value. If results show high rates of AR exposure and the potential for negative effects to both populations, future work may be needed to evaluate exposure of other carnivores and develop effective strategies to reduce AR exposure while also effectively controlling rodent populations. Funding sources for future work would depend on the results of this project.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Den Boxes for Fishers and other Nesting Wildlife	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03i	$190,000
Bobcat And Fisher Habitat Use And Interactions	M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 03i	$400,000
Distribution and Movements of Fishers in Southern Minnesota	M.L. 2022, , Chp. 94, Art. , Sec. 2, Subd. 03f	$340,000
Changing Distribution of Flying Squirrel Species in Minnesota	M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 03e	$186,000

Project Manager and Organization Qualifications

Project Manager Name: Michael Joyce

Job Title: Wildlife Ecologist

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

Dr. Joyce is a Wildlife Ecologist at the Natural Resources Research Institute. He has over 13 years of wildlife research experience working on carnivore ecology, including past studies on bobcats and fishers. Michael is working on and managing three ENRTF-funded projects and is project manager for another project currently recommended for funding as part of the FY23 RFP. He has worked extensively on wildlife research projects in Minnesota over the last decade.

EDUCATION:
Ph.D., 2018. University of Minnesota, Integrated Biosciences.
M.S., 2013. University of Minnesota, Integrated Biosciences.
B.S., 2008. University of Wisconsin-Madison, Molecular Biology.

RECENT PUBLICATIONS:
Velander, T.B., M.J. Joyce, A.M. Kujawa, R.L. Sanders, P.W. Keenlance, and R. Moen. 2023. A dynamic thermal model for predicting internal temperature of tree cavities and nest boxes. Ecological Modelling 478:110302.

Alston, J.M., M.J. Joyce, J.A. Merkle, R.A. Moen. 2020. Temperature shapes movement and habitat selection by a heat-sensitive ungulate. Landscape Ecology 35(9):1961-1973.

Joyce, M., J. Erb, B. Sampson, R. Moen. 2019. Detection of coarse woody debris using airborne light detection and ranging (LiDAR). Forest Ecology and Management 433 (pp 678-689).

Joyce, M. 2018. Evaluating American marten habitat quality using airborne light detection and ranging (LiDAR) data. PhD Dissertation, University of Minnesota.

Joyce, M., A. Zalewski, J. Erb, R. Moen. (2017). Use of resting microsites by members of the Martes Complex: the role of thermal stress across species and regions. The Martes complex in the 21st Century: Ecology and Conservation.

Green, R., M. Joyce, S. Matthews, K. Purcell, J. Higley, A. Zalewski. (2017). Guidelines and techniques for studying the reproductive ecology of wild fishers, American martens, and other members of the Martes complex. The Martes complex in the 21st Century: Ecology and Conservation.

Organization: U of MN - Duluth - NRRI

Organization Description:
The Natural Resources Research Institute (NRRI) is an applied research and economic development engine for the University of Minnesota research enterprise. NRRI employs over 130 scientists, engineers and technicians to deliver on its mission to deliver integrated research solutions that value our resources, environment and economy for a sustainable and resilient future. NRRI collaborates broadly across the University system, the state and the region to address the challenges of a natural resource based economy.

NRRI researchers have extensive experience in managing large, interdisciplinary projects. NRRI's role is as an impartial, science-based resource that develops and translates knowledge. Projects include characterizing and defining resource opportunities, minimizing waste and environmental impact, maximizing value from natural resources and maintaining/restoring ecosystem function.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Michael Joyce, Researcher 6		Project Manager			27.1%	0.15		$17,414
TBD, Researcher		Planning and coordination of sample collection and data management			25.1%	1.05		$75,941
Masters Graduate Student		Completes MS thesis on project			20.1%	0.51		$27,836
Seasonal Technician		Conducts sample preparation and data entry/QAQC work			7.1%	0.6		$28,946
Undergraduate Research Assistant		Sample preparation and data entry			0%	0.27		$9,206
							Sub Total	**$159,343**
Contracts and Services								
Michigan State University Vet Diagnostic Lab	Professional or Technical Service Contract	Toxicological analysis of 200-300 carnivore samples per species to determine anticoagulant rodenticide exposure.				0		$75,000
							Sub Total	**$75,000**
Equipment, Tools, and Supplies								
	Tools and Supplies	Supplies for sample processing and collection (nitrile gloves, scalpel blades, measurement tools, sample bags and vials, shipping supplies)	Supplies needed to process carnivore carcasses and store samples prior to submission to toxicology lab for analysis					$4,557
							Sub Total	**$4,557**
Capital Expenditures								
							Sub Total	**-**

Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel to MN DNR wildlife management offices to pick up samples	Travel to obtain samples to test for toxicological analysis					$7,500
							Sub Total	**$7,500**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
		Shipping fees	Fees for shipping samples to the veterniary diagnostic lab for toxicological analysis					$600
							Sub Total	**$600**
							Grand Total	**$247,000**

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
State				
			State Sub Total	**-**
Non-State				
In-Kind	UMN unrecovered indirect costs are calculated at the UMN negotiated rate for research of 55% modified total direct costs.	Indirect costs are those costs incurred for common or joint objectives that cannot be readily identified with a specific sponsored program or institutional activity. Examples include utilities, building maintenance, clerical salaries, and general supplies. (https://research.umn.edu/units/oca/fa-costs/direct-indirect-costs)	Secured	$135,850
			Non State Sub Total	**$135,850**
			Funds Total	**$135,850**

Total Project Cost: $382,850

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: dd864e5c-7aa.pdf

Alternate Text for Visual Component

The graphic shows a diagram of rodenticide being eaten by rodents and then poisoned rodents being eaten by bobcats and fishers. Text describes past studies showing high rodenticide exposure rates in bobcats and fishers, project activities, research needs, and project impacts....

Supplemental Attachments

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

Title	File
UMD SPA Transmittal Letter	8730e01d-f5e.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

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?

No

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:

Taylor Velander (NRRI), Michael McMahon (NRRI), Anna Mangan (NRRI), Megan Gorder (NRRI), Julie Christopherson (NRRI), UMD Sponsored Project Administration