



Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-509

Proposal Title: Enhancing Agrilus Biomonitoring to Increase Minnesota Forest Resilience

Project Manager Information

Name: Cristian Beza Beza

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

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Project Basic Information

Project Summary: A previous project used biosurveillance to canvass jewel beetles across Minnesota, some of which are important pests. This proposal targets beetles related to emerald ash borer, which remain largely unexplored.

ENRTF Funds Requested: \$296,000

Proposed Project Completion: June 30, 2030

LCCMR Funding Category: Small Projects (G)

Secondary Category: Resiliency (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.

Minnesota's 17.4 million acres of forest (22% of state land) face escalating threats from flat-headed wood-borer beetles of the genus *Agrilus*. This genus includes devastating pests like the invasive emerald ash borer and outbreak-prone native species such as the two-lined chestnut borer and bronze birch borer. Because these beetles develop hidden under bark, they are easily transported and difficult to detect before causing extensive damage. *Agrilus* species are numerous and difficult to identify; for example, *Agrilus ribesi*, a pest of gooseberries and currants, went undetected in Minnesota for 75 years. While a 2014-2017 biosurveillance project (M.L. 2014, Chp. 226, Sec. 2, Subd. 04d) identified 40 species, including 14 new state records, new species continue to emerge.

Because traditional visual identification is slow and often impossible for larvae, our proposal seeks to bridge this gap using targeted surveys to document diversity and develop a robust genetic library for Minnesota's *Agrilus* species. This "DNA barcode" database will provide a critical tool for rapid biomonitoring of future outbreaks and non-native introductions. Furthermore, these genetic techniques will allow us to identify host-plant shifts, providing forest managers with the foresight to protect natural resources and timber industries amid a changing climate.

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.

The aim of this project is to build Minnesota's resilience against *Agrilus* outbreaks or invasions by developing genetic tools and data that will assist with detection and monitoring. There are three steps to this work: First, we will conduct a comprehensive review of museum specimens to verify identities, update records, and identify geographic and taxonomic gaps in the state. Informed by museum data, we will execute targeted field collections across Minnesota. By rearing specimens in the lab, we will uncover new state records and improve the representation of rarely observed species that may pose future threats. Second, we will generate molecular data from *Agrilus* specimens to create a "DNA barcode" library. This serves as a foundational resource for modern monitoring methods, such as environmental DNA (eDNA) and metabarcoding. Finally, we will develop genetic protocols to accurately identify host-plant species from adult beetles, allowing us to track host-plant shifts and provide forest managers with the foresight to protect Minnesota's natural resources in a changing climate.

We are seeking funding to:

Activity 1: Develop an updated species checklist of *Agrilus* in Minnesota

Activity 2: Generate *Agrilus* molecular data for emerging and future biomonitoring

Activity 3: Expand knowledge of Minnesota *Agrilus* diets

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 enhances the protection and preservation of Minnesota's 17.4 million forest acres by providing the scientific foundation to distinguish native biodiversity from invasive threats. By building a comprehensive *Agrilus* database and genetic library, we enable the conservation of vulnerable tree species through early detection of outbreaks. These outcomes directly support the enhancement of state natural resources by providing forest managers with rapid-response tools to mitigate climate-induced pest damage. Ultimately, this work secures the health of Minnesota's natural forest resources, ensuring our ecosystems remain resilient against current and emerging wood-boring pests.

Activities and Milestones

Activity 1: Develop an updated species checklist of Agrilus in Minnesota

Activity Budget: \$108,628

Activity Description:

With close to 3,000 species, Agrilus is considered one of the most diverse genera in the world. A previous study led by collaborator Dr. Brian Aukema found at least 40 species of Agrilus in Minnesota using a broad biosurveillance technique. That number is almost certainly an underestimate of true abundance and diversity: the project did not perform specifically-targeted collections. The University of Minnesota Insect Collection holds at least 2,000 specimens of Agrilus that are not fully catalogued, for example.

In this activity, we will develop a comprehensive and accurate species checklist as a critical first step for effective conservation and pest management. For building this checklist we will: 1) morphologically examine all the individual Agrilus specimens held at the UMN insect collection and other state collections, to review their taxonomic identity, and extract relevant ecological data from specimen labels; 2) with the distribution data obtained from the museum specimens, we will identify undersurvey areas and rarely collected species; Finally 3) we will travel around the state each summer to collect infested material before rearing specimens for identification in the laboratory. Collection areas will be prioritized based on museum representation and earlier results from Project 2014-04d.

Activity Milestones:

Description	Approximate Completion Date
Review Agrilus in UMN Insect Collection, UMN Duluth and Science Museum of Minnesota	January 31, 2028
Canvassing trips across the state	December 31, 2028
Publication of Agrilus species checklist	June 30, 2029

Activity 2: Generate molecular data for emerging and future monitoring methods

Activity Budget: \$67,147

Activity Description:

Recent advancements in DNA sequencing technologies have transformed the way biodiversity is monitored. These innovations, including non-invasive methods (e.g., eDNA, metabarcoding), improve detection capabilities while providing cost-efficient monitoring solutions (e.g., imagine being able to swab a piece of wood to identify what insect killed the tree, instead of needing to catch or rear the culprit out in the laboratory!). These methods are undoubtedly the direction for biomonitoring in the future but their precision relies on having meticulously curated and comprehensive databases derived from molecular data of previously identified samples. International efforts, like Barcode of Life (BOLD), pioneered DNA barcoding and served as international repositories of data. But with so many species in the world, the production of “barcodes” for different species is a community effort needing local scientists and their native fauna.

We will create a molecular database for native Agrilus species of Minnesota. In addition to the traditional (COI) barcode region, we will generate “Mitogenomes” for each species. These new molecular markers will increase the accuracy and capabilities of biodiversity monitoring using DNA. This initiative will enhance the inclusion of data from MN Agrilus species populations in public databases and increase the identification capabilities for local use.

Activity Milestones:

Description	Approximate Completion Date
Mining of public repositories and data curation	June 30, 2027
DNA extraction, marker amplification and sequencing	June 30, 2028
Data analyses, database construction	December 31, 2028
Publication of database	June 30, 2029

Activity 3: Advanced Molecular Host-Plant Identification and Diet Analysis

Activity Budget: \$120,225

Activity Description:

Identifying the host plants of wood-boring larvae is traditionally labor-intensive, requiring the collection and rearing of infested wood. Furthermore, as climate change stresses Minnesota's forests, native *Agrilus* species may shift to new host plants, creating new ecological threats. This activity will develop a molecular toolkit to identify host plants directly from beetle specimens. We will use gut-content metabarcoding to sequence plant DNA remains within *Agrilus* adults and larvae. By analyzing specimens at various time points post-emergence and post-mortem, we will establish the "detection window" in which host plant determination remains viable. This "insect-as-sensor" approach will allow us to document host-plant shifts in real-time and provide forest managers with precise data on which timber and urban resources are at immediate risk. This tool could potentially open the door to reconstruct long-term changes in beetle diets over the last century if the developed protocols can be successfully applied to historical museum specimens.

Activity Milestones:

Description	Approximate Completion Date
Gut-content extraction and DNA metabarcoding of field-collected specimens.	August 31, 2029
Comparative analysis of known vs. novel host-plant associations.	December 31, 2029
Publication of host-plant identification protocols for state biomonitoring	June 30, 2030

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Brian Aukeman	University of Minnesota Department of Entomology	Collaborator - Help mentor personnel on biodiversity of woodboring beetles. He was a university lead on an earlier project using biosurveillance of smokey-winged beetle bandit wasps to sample jewel beetles in Minnesota. The team successfully published a guide that provides a baseline for more focused work on one important family	No
Patrick Perish	University of Minnesota	Graduate Student - Will assist in data collection, and taxonomic review of Minnesota Agrilus.	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.

The results of this project will be shared with forest managers and natural resources professionals through relevant workshops and conferences (e.g., Cloquet Research Review, Northern Silviculture Workshop, etc). We will publish and make freely available an updated checklist of Minnesota Agrilus, DNA barcodes, and host-plant identification protocols. We will support University of MN Extension education efforts by offering updated information on pest species for their outreach materials. Specimens collected as part of this research will be housed in the UMSP insect collection which will give public access to the specimens.

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 builds from an earlier investment focused primarily on emerald ash borer and biosurveillance (2014-04d). We learned that we are drastically underestimating native Agrilus diversity, and have found surprising instances since of unexpected tree mortality. This three-year project would complete our efforts in this area. Results will be shared with forest managers and resource professionals through relevant workshops (e.g., Cloquet Research Review, Northern Silviculture Workshop, etc), social media, and scientific publications.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Fighting Insect Decline: Minnesota Bumblebees to the Rescue	M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 03hh	\$249,000

Project Manager and Organization Qualifications

Project Manager Name: Cristian Beza Beza

Job Title: Assistant Professor

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

Dr. Cristian Beza-Beza is an assistant professor in the Department of Entomology at the University of Minnesota. His research focuses on how species isolated in space and time result in long term geographical patterns of biodiversity, with implications to conservation, recovery, and management. He has worked with a variety of insects in several regions

globally, and has shown how changes in temperatures, rainfall, and elevation alter insect assemblages. By combining phylogenetic and distribution data, his work informs ecological and species conservation efforts both in Minnesota and around the world.

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

Organization Description:

The University of Minnesota-Twin Cities, founded in 1851, is the largest campus within the University of Minnesota system with an enrolment of just over 50,000 students. As a historic land-grant university, the University of Minnesota's mission is to engage students and faculty to address Minnesota's most pressing issues. The project will be done within the Department of Entomology where the department is part of the College of Food Agriculture and Natural Sciences. UMN houses the University of Minnesota Insect Collection, one of the largest insect collections in North America.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Project Manager		overseeing the execution of the project			36.6%	9		\$11,959
Postdoctoral fellow		Development of gut metabarcoding objective			26.1%	100		\$84,065
PhD Student		Data collection and analyses			24.2%	150		\$118,391
							Sub Total	\$214,415
Contracts and Services								
TBD	Service Contract	DNA sequencing, metabarcoding of gut contents and barcoding of beetle specimens				0		\$15,000
							Sub Total	\$15,000
Equipment, Tools, and Supplies								
	Tools and Supplies	Lab & Medical supplies	Funds are requested for the following materials to process samples for barcoding; these materials include general lab consumables, Eppendorf tubes, DNA extraction kits, and PCR kits. Funds are budgeted for DNA extraction and template preparation. Funds are requested to purchase materials necessary to assist in field collection, and rearing equipment.					\$15,000
	Tools and Supplies	General operating supplies	Supplies for general operations, office supplies, collecting equipment.					\$1,541
							Sub Total	\$16,541
Capital Equipment								
							Sub Total	-

Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Domestic Collection trips	Funds are required for covering expenses associated with transportation, lodging and per diem for travel within Minnesota to collect buprestid beetles. We budgeted fleet vehicle rental for 4 months for the first two years and for 2 months for the last year					\$10,000
	Conference Registration Miles/ Meals/ Lodging	Domestic Conferences and Workshops	Funds are requested to cover the cost associated with travel to Minnesota-based conferences and workshops (e.g., North Central Forest Pest Workshop, Cloquet Research Review, Northern Silviculture Workshop).					\$1,250
							Sub Total	\$11,250
Travel Outside Minnesota								
	Conference Registration Miles/ Meals/ Lodging	National conference	Funds are requested to cover the cost associated with travel to the annual meeting of the Entomological Society of America to present findings to the national scientific audience.	X				\$1,250
							Sub Total	\$1,250
Printing and Publication								
	Publication	Peer-reviewed journal	Funds are requested to cover the cost associated with publication in open-source peer-reviewed scientific journals.					\$1,000
							Sub Total	\$1,000

Other Expenses								
		Tuition cost PhD - Student	Funds are requested to cover the tuition cost of PhD student while the person is enroll in the UMN entomology program					\$36,544
							Sub Total	\$36,544
							Grand Total	\$296,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	National conference	Creates capacity of the trainee, and helps in the dissemination of the results

Non ENRTF Funds

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

Total Project Cost: \$296,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [edcf634d-c81.pdf](#)

Alternate Text for Visual Component

Graphical abstract of "Enhancing Agrilus Biomonitoring to Increase Minnesota Forest Resilience" including a brief summary of the project, and graphical example of activities...

Supplemental Attachments

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

Title	File
Board Resolution letter_FP00015101	40b2e36e-0d5.pdf

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:

Brian Aukema, Patrick Perish

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

Yes, I understand