



Environment and Natural Resources Trust Fund

2025 Request for Proposal

General Information

Proposal ID: 2025-311

Proposal Title: Fighting Insect Decline: Minnesota Bumblebees to the Rescue

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: We propose to use Minnesota native bumblebees as model organisms to gauge the effects of human activity on the states' ecosystems and understand the drivers of the global insect decline.

ENRTF Funds Requested: \$249,000

Proposed Project Completion: December 31, 2027

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?

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.

Bumblebees play an important role in our ecosystems as pollinators, including crops that other bees cannot pollinate. Consequently, effective conservation strategies are essential to safeguard these species. The world is facing accelerated rates of biodiversity loss, leading to significant changes in our land, impacting human livelihoods. The recent focus on insect decline reveals alarming trends, marking this era as a global Insect Apocalypse. Although there are multiple reasons for the rapid loss of biodiversity, most can be attributed to human activity, like climate change and habitat loss. Currently Minnesota bumblebee species are in decline, most notably the federally endangered rusty-patched bumblebee, which has undergone range contractions and local extinctions. Models predict that as the climate warms, species will shift their distribution northward. Minnesota houses 25 different bumblebee species, many of which have their northern or southernmost distribution in the state. This creates a wonderful opportunity to use bumblebees as model organisms to study the effects of human activity on Minnesota's ecosystems. To ensure the future success in monitoring we need modern species identification tools, and reliable data repositories accessible to all stakeholders. Understanding the local responses of species to global trends is essential for the development of effective conservation strategies.

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.

Biodiversity conservation involves many aspects, from understanding current status of species, creating resources for effective monitoring, designing and implementing conservation plans, to public engagement. Here we propose to use historic collections, local collecting efforts, and Ecological Niche Models (ENMs) to measure if shifts in the distribution of Minnesotan bumblebee species have already occurred and predict future changes. We will improve taxonomic and identification resources for Minnesota bumblebees by creating a taxonomic revision of Minnesota bumblebees that will be published in a peer-reviewed scientific journal. In addition, we will generate traditional and non-traditional molecular barcodes for the Minnesota bumblebees; this resource can be used in the future to improve the accuracy of non-lethal monitoring strategies such as environmental DNA and metabarcoding. Furthermore, we will make the results of this project available to all Minnesotans through the development of online resources. We will generate and disseminate foundational data and information, directly addressing priority A listed in the request for proposals. We seek funding for: hiring a Master's student for ecological niche modeling and DNA barcode development, enhancing digitization and georeferencing of bumblebee specimens across various insect collections, and engaging a professional in bioinformatics for the creation of the online Minnesota Pollinator Hub.

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?

We will generate historical and current distribution maps of the Minnesota Bumblebees. These will be disseminated in a locally hosted website, digital biodiversity repositories, and peer-reviewed publications. We will develop a well curated identification tool using molecular barcoding of all bumblebee species in the state. Finally we will create an online information repository that can be used by different communities. With this website we will initiate the Minnesota Pollinator hub, which consists of an online resource containing species pages that will aggregate important information for environmental and conservation agencies, educators, and the general public.

Activities and Milestones

Activity 1: Using bumblebees as indicator species for assessing distribution shifts and insect decline in the state of Minnesota.

Activity Budget: \$104,186

Activity Description:

Specimens held in museums and scientific collections represent the data used to approximate a species distribution range, including metadata such as collecting locality, date, and collector information. This record allows for a historical reconstruction of where a species has been found in space and time. The UMSP holds approximately 4,300 bumblebees specimens from Minnesota, including collections since 1896. Additionally, we have identified collections at the Minnesota Department of Natural Resources (~3,100 specimens), and the Essig Museum of Entomology (Berkeley, California) as important repositories for bumblebees of Minnesota. Using Ecological Niche Models, we will formally compare the historical and current distribution records of bumblebees in MN to inform how species distribution range has changed through time. Ecological niche modeling combines occurrence and environmental data to create maps showing where that species is likely to thrive. To achieve this, efforts in the digitization and georeferencing of museum specimens are needed. Currently there is financial support for digitizing the bees held at the UMSP. The funds of the requested award will complement this existing effort. We will hire a Master's student to georeference historical records, visit other important museums, and develop Ecological Niche Models.

Activity Milestones:

Description	Approximate Completion Date
Hiring of Master student for data analyses	August 31, 2025
Obtaining loans from Essig Museum of Entomology	December 31, 2025
Georeferencing of historical and current records	August 31, 2026
Ecological niche modeling, and comparative analyses	December 31, 2026
Field visits for model validation	July 31, 2027

Activity 2: Building a modern and practical identification tool for the Minnesota bumblebee species

Activity Budget: \$97,734

Activity Description:

Accurate species identification is a crucial component of biological research, environmental monitoring, and effective conservation efforts. However, the reliable identification of organisms, particularly in hyperdiverse groups such as bees, is a difficult task. Since 2005, international efforts, like Barcode of Life (BOLD), pioneer DNA species identification using a region of the genome i.e. "Barcode" that is conserved within but variable between species. This technique has proven useful in assisting (but not replacing) species identification by group experts. Additionally, new sequencing technologies now allow the use of environmental DNA for the non-invasive detection of biodiversity. These new techniques promise to reduce costs, enhance capacity of detection, and minimize the lethal collection of specimens. Nonetheless their accuracy depends on having well curated and complete databases built from the DNA of previously identified specimens. The hired Master student will be in charge of creating well curated molecular barcodes for MN bumblebees. For this purpose, we will use 10 specimens of each Minnesota bumblebee species and test both traditional (COI) and non-traditional (CAD) molecular barcodes. This will increase the representation of data from MN bumblebee species populations in publicly available databases and develop a reliable online identification tool that can be used locally.

Activity Milestones:

Description	Approximate Completion Date
Mining of public repositories and data curation	December 31, 2025
Selection of target species for collections	December 31, 2025
DNA extraction, marker amplification and sequencing	July 31, 2026
Data analyses, database construction, and tool validation	December 31, 2026
Making identification tool publicly available	July 31, 2027

Activity 3: Creating and Launching The Minnesota Pollinator Hub

Activity Budget: \$47,080

Activity Description:

Biodiversity and conservation sciences increasingly rely on digital data aggregated in Information Portals, like the Global Information Facility (GBIF) or the National Center for Biotechnology Information (NCBI). Each of these portals hold specialized data. For example, GBIF is a repository of species occurrences whereas NCBI is for molecular and genomic data. Accessing the available information of each portal requires specific know-how. To facilitate and integrate the use of existing and newly generated data we aim to launch the Minnesota Pollinator Hub, housing an online resource comprising species pages that will consolidate crucial information for environmental and conservation agencies, educators, and the broader public. In phase 1 of this resource we propose to create species pages for all 25 MN bumblebee species. These pages will include species diagnosis, high quality photographs, global and state distribution maps, floral associations, and links to the data house on relevant biodiversity information portals. In the creation process we plan to involve key users of the platform in focus groups to improve design and content. The future plan is to expand this web resource to include information for all Minnesota pollinators

Activity Milestones:

Description	Approximate Completion Date
Hiring of Web developer	January 31, 2026
Building web page backbone	June 30, 2026
Feedback with key stakeholders (Conservation agencies, educators)	August 31, 2026
Final design and making web resource publicly available	July 31, 2027

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Daniel Cariveau	University of Minnesota	Associate professor, who will assist in advising the Master student in the project	No
Zachary Portman	University of Minnesota	Hymenoptera expert, who will serve as the bumblebee taxonomic expert in the project	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?

The online products of this project will be hosted in the University of Minnesota servers, and maintained using university resources, Scientific Publications in open source journals, and all data will be publicly available and shared in data repositories such as University of Minnesota DRUM. The future plan is to expand the Minnesota Pollinator Hub to include information for all Minnesota pollinators. Additionally, newly collected specimens and its information will be hosted by the University of Minnesota Insect Collection using their existing infrastructure.

Project Manager and Organization Qualifications

Project Manager Name: Cristian Beza Beza

Job Title: President's Postdoctoral Fellow

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

Dr. Cristian Beza-Beza is the current President's Postdoctoral Fellow at the Department of Entomology at the University of Minnesota. His research focuses on understanding the role of biogeography and trophic specialization in insect diversification. Specifically, the geographical patterns of biodiversity resulting from processes such as restricted distributions and isolation. Additionally, he has also studied the altitudinal shift in communities of passalid beetles in Guatemala. The outcomes of his research demonstrated that increasing temperatures and consistent rainfall could partly explain changes in the community structure of beetles along an altitudinal gradient. Furthermore, by combining the phylogenetic and distribution data, he characterized the spatial distribution of phylogenetic diversity, compared it with the distribution patterns of taxonomic diversity and discussed how these patterns correlate with existing conservation efforts in his home country Guatemala.

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

Organization Description:

The project will be done within the Department of Entomology at the Regents of the University of Minnesota where the department is part of the College of Food Agriculture and Natural Sciences. Housing the University of Minnesota Insect Collection (UMSP), 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								
Non-academic Civil service Staff		Bee taxonomist / Serve as the taxonomic expert of the project for bee identification.			33.5%	0.75		\$88,319
Graduate research Associate		Master's Student / Person in charge of data gathering analyses and publication.			25.1%	2		\$100,579
Undergraduate Research Associate		Field assistant / part time undergraduate research associate, to assist in the field collections necessary for the study			0%	0.1		\$2,374
							Sub Total	\$191,272
Contracts and Services								
TBD	Professional or Technical Service Contract	services for the web development of the online identification tool and the Minnesota Pollinator Hub				-		\$25,000
TBD	Professional or Technical Service Contract	DNA sequencing for the Barcoding of at least 250 bumblebee specimens.				-		\$5,000
							Sub Total	\$30,000
Equipment, Tools, and Supplies								
	Tools and Supplies	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 for materials to process samples for barcoding					\$18,000
							Sub Total	\$18,000
Capital Expenditures								
							Sub Total	-

Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Funds are required for covering expenses associated with transportation, lodging and per diem for travel within Minnesota to collect bumblebees	This trip will serve in the gathering of new data and validation of Ecological Niche Models.					\$5,000
							Sub Total	\$5,000
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Publication	Funds are requested to cover the cost associated with publication in open-source peer-reviewed journals. 2 publications	Publication on peer- reviewed journals					\$4,728
							Sub Total	\$4,728
Other Expenses								
							Sub Total	-
							Grand Total	\$249,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
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Non ENRTF Funds

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

Total Project Cost: \$249,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [a4fafe38-8f6.pdf](#)

Alternate Text for Visual Component

Work flow for the use of ecological niche modeling to predict distribution shifts, validation of the model and identifying areas of interest for conservation...

Supplemental Attachments

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

Title	File
U of M SPA letter	909ebf3c-f73.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?

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:

Andrea Little (University of Minnesota)