Environment and Natural Resources Trust Fund

2024 Request for Proposal

General Information

Proposal ID: 2024-198

Proposal Title: Early Detection of Invasive Viruses in Native Pollinators

Project Manager Information

Name: Declan Schroeder

Organization: U of MN - College of Veterinary Medicine

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Project Basic Information

Project Summary: Forewarned is Forearmed: Our goal is to protect the newly described MN DNR native bees from invasive virus-derived diseases and population declines.

Funds Requested: $200,000

Proposed Project Completion: June 30, 2026

LCCMR Funding Category: Small Projects (H)

Secondary Category: Aquatic and Terrestrial Invasive Species (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

Narrative

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

There are thousands of insect pollinator species in Minnesota, including over 500 species of native bees. Bees are the most efficient pollinators because their bodies are designed to collect and store pollen to feed to their young. Pollinators are integral parts of functioning environments. The plants they pollinate provide food and habitat for animals, buffer waterways, and store carbon. Without pollinators, we would not have many nutritious fruits, vegetables, and nuts like blueberries, squash, and almonds. Pollinator conservation provides economic benefits through improved crop pollination, and intrinsic value in beautiful, flowering landscapes. Numerous pollinators are in decline with disease being a potential leading cause. However, we have little to no information on the viruses present in our native bees. Through an ongoing ENRTF 2021-309 grant entitled Bee Minnesota – Protect our Native Bumblebees, we were the first to uncover at least two new invasive viruses not previously known to infect bumblebees, mainly Bombus impatiens. How many other invasive bee viruses are we missing? Without knowing the viral landscape, we cannot be prepared to mitigate their impact on our bees and thus pollination services.

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 prevalence of invasive viruses in sentinel native bee species, other than Bombus impatiens, in Minnesota has not been previously examined. Our recent discovery of two new invasive viruses in B. impatiens has led us to hypothesize that this is only the tip of a sizable iceberg. We currently have no information on existing virus diversity and levels in Minnesota native bees. Minnesota is an important place to examine the relationship between different bee populations and communities because we are home to wide variety of bee species. To first understand and then mitigate further declines in these important pollinators, it is critical to collect baseline data on archetypal viral pathogens in our local native populations. Forewarned is forearmed- finding a solution to the invasive virus bee pathogens might already exist, but we lack the important hindsight to identify the resources needed to combat the invasive viruses in our native bees.

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?

Minnesota's bee diversity boasts over 500 species. While we recognize the important role of managed bees in Minnesota, we must not underestimate the important role of native bees. We will continue to utilize the resources established in our ENRTF Bee Minnesota grant, for example the website that increases the awareness to the general public of the viral pathogens and how they impact native bees in Minnesota. This project complements the ongoing research funded by ENRTF. The importance of identifying and profiling the true viral landscape in our bee pollinators cannot be overstated. It is essential that we collect baseline data.

Activities and Milestones

Activity 1: Sampling, cataloging and extraction of viruses from sentinel native MN bees

Activity Budget: $71,700

Activity Description:
Dr Cariveau has secured funding from USDA and US Fish and Wildlife Service, to collect native bees across Minnesota from new study sites. We will target five main families, namely Andrenidae, Apidae, Colletidae, Halictidae and Megachilidae. These were selected because 1) these bees are on the MN DNR native species list, 2) they are relatively common and we are confident that we can collect the 20-25 species within these families from the funded study locations, 3) spans five of the six bee families in Minnesota (the sixth family is too rare, there are only a total of seven bee families globally and one is relegated to Australia), 4) includes a mix of important life-history traits such as social vs. solitary and ground nesting vs. stem nesting and 5) we can reliably identify them quickly. Funding from ENRTF will be used to transfer samples into the correct containers and to transfer them to the Schroeder Virology Lab, where we will use a new virus extraction workflow, first developed in the ENRTF 2021-309 Bee Minnesota grant, to extract any resident virus from the bees.

Activity Milestones:

Description	Approximate Completion Date
Collection of native bees	April 30, 2025
Taxonomic identification of native bees collected	May 31, 2025
Extraction of viruses from the native bee samples	September 30, 2025

Activity 2: Screening for viruses in native bees by applying genomic sequencing technologies

Activity Budget: $128,300

Activity Description:
High through-put DNA/RNA extraction on bee pools per location will be achieved using a commercially available Viral DNA/RNA Isolation Kit. Quantity and quality of nucleic acids extracted will be assessed using a fluorometer. We will apply a custom designed sequencing pipeline to describe the viral metagenomic diversity. Briefly, gDNA/cDNA will be sequenced on the GridION device (Oxford Nanopore Technologies), which allows multiple library preparations to be run simultaneously. The sequence reads will be assembled into contigs using a Minimap2 de novo assembler, which was designed to assemble highly heterogeneous virus populations and is well suited to the computational challenge that the virus quasispecies present. The virus genomes will be visualized in Anvi'o. Outputs include read count tables by sample, virus load and diversity per sample, whole-recombinant and partial viral genomes, and identification of quasispecies. A threat analysis will be undertaken to assess which invasive viruses to target for mitigation or eradication.

Activity Milestones:

Description	Approximate Completion Date
Assembled virus genomes that includes a list of invasive native bee viruses	June 30, 2026
Quantification of virus load and diversity per sample and location.	June 30, 2026
Threat analysis of invasive viruses found	June 30, 2026

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 data generated in this project will create a new body of work that lists the potential viral pathogens damaging native bee pollinator communities in Minnesota. The College of Veterinary Medicine, University of Minnesota, has an active Extension and Outreach program that who will continue to disseminate results after project completion. Drs. Schroeder and Cariveau will publish research findings and present to scientific communities. Funds from this project will build on federal resources being used to pursue these goals, greatly expanding the scope of our efforts

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Bee Minnesota – Protect Our Native Bumblebees	M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 03h	$650,000

Project Manager and Organization Qualifications

Project Manager Name: Declan Schroeder

Job Title: Associate Professor

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

Dr Schroeder is an Associate Professor of Virology in the Veterinary Population Medicine Department in the College of Veterinary Medicine at the University of Minnesota. He also held an honorary Chair in Viral Metagenomics in the School of Biological Sciences at the University of Reading, United Kingdom, form 2016 to 2022. He has over 20 years of research experience as a molecular biologist in the areas of virology, biodiversity, pathology and genomics – in particular the use of genomic tools to study key biological processes. Moreover, his track record in winning and administered research projects (over $8 million equivalent from 10 different funders), collaborated with other researchers (within departments, nationally and internationally), and produced several high impact peer-reviewed publications (4 Nature & Science papers). He has also enjoy mentoring and teaching the next generation of scientists. To date he has mentored 10 postdoctoral assistants/fellows, 16 PhD students, 19 Masters students and 7 graduate students. In summary, he has a demonstrated record of accomplished research and teaching in an area of relevance for environmental and animal health sciences.

In keeping with the mission statement of our university, Dr. Schroeder's research program is focused on pathogen discovery; comparing and contrasting a diverse array of host-virus interactions. He is particularly interested in seeing his fundamental mechanistic based research translated into practical solutions. He continues to develop molecular tools to enhance detection and surveillance of pathogens to enhance insect, animal and human health (One Health paradigm). His role in this project is to oversee and implement the molecular screening protocol previously developed in his lab.

Organization: U of MN - College of Veterinary Medicine

Organization Description:

"The University of Minnesota (UMN) is the state's land-grant university and one of the most prestigious public research universities in the nation. It was founded in the belief that all people are enriched by understanding; is dedicated to the advancement of learning and the search for truth; to the sharing of this knowledge through education for a diverse

community; and to the application of this knowledge to benefit the people of the state, the nation, and the world." University of Minnesota mission statement.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Project Manager		Dr Schroeder will project manage and to oversee and implement the molecular screening protocol previously developed in his lab. In addition, he will be directly responsible for all communication for the team			36.8%	0.32		$71,000
Co-PI		Dr Cariveau will advise on the sampling design and collecting of native bees (Activity 1) and will assist with data analysis and publication, and with all dissemination of results and outreach.			0%	0.1		-
Postdoc or Research Assistant		Responsible for running the sequencing assays for cataloging invasive viruses in native bees			25.7%	1.5		$102,600
Postdoc or Research Assistant		Collect native bees and species identification			0%	0.1		-
							Sub Total	**$173,600**
Contracts and Services								
							Sub Total	**-**
Equipment, Tools, and Supplies								
	Tools and Supplies	Supplies to setup and collection of field samples	For the purchasing of nets, collection tubes and preservation material.					$1,500
	Tools and Supplies	Virus screening molecular consumables (Virus extraction, Nucleic acid extraction, molecular grade chemicals, NGS sequencing etc.) for bee samples	Surveying the viral pathogens in bee material collected					$14,900
							Sub Total	**$16,400**
Capital Expenditures								
							Sub Total	**-**

Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
							Sub Total	**-**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	Scientific publication in open access journal	Outreach and publication of results					$2,000
							Sub Total	**$2,000**
Other Expenses								
		Service contract	Contribution to the annual maintenance contract (for 2 years) on the ONT GridION sequencer					$8,000
							Sub Total	**$8,000**
							Grand Total	**$200,000**

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				
			Non State Sub Total	**-**
			Funds Total	**-**

Attachments

Required Attachments

Visual Component

File: 785ed1ff-6b1.pdf

Alternate Text for Visual Component

The five families of native bees targeted in our proposal is shown. We provide the results from our active project that found a new invasive virus in bumblebees. We the go on to outline the aim and outcome of the project....

Optional Attachments

Support Letter, Photos, Media, Other

Title	File
SPA Letter	cd1de974-a51.pdf
Audit	52bf597b-dbb.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

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

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 design, construction, or renovation of a building, trail, campground, or other capital asset costing $10,000 or more?

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?

No