



Environment and Natural Resources Trust Fund

2021 Request for Proposal

General Information

Proposal ID: 2021-309

Proposal Title: Bee Minnesota – Protect Our Native Bumblebees

Project Manager Information

Name: Declan Schroeder

Organization: U of MN - College of Veterinary Medicine

Office Telephone: (612) 696-1916

Email: dcschroe@umn.edu

Project Basic Information

Project Summary: Our goal is to protect native pollinators by screening and neutralizing bee pathogens, and promoting best honey bee management practices to prevent pathogen spillover into native bees.

Funds Requested: \$663,000

Proposed Project Completion: 2024-06-30

LCCMR Funding 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.

Native bumblebees, *Bombus* spp., are important pollinators of wild flowering plants and crops such as tomatoes and berries, and are appreciated for their beauty. Unfortunately, five of Minnesota's twenty-three species of native bumblebees are considered vulnerable, endangered, or critically endangered by the International Union for Conservation of Nature. The global decline in bee populations has been attributed to habitat loss, pesticides, parasites, and pathogens. For some bumblebee species, a leading problem may be infectious diseases. For example, the spread of the bumblebee pathogen, *Nosema bombi*, exacerbated through commercial rearing and distribution of *Bombus impatiens* across the U.S., was associated with declining bumblebee species. Another emerging threat is viral pathogen transmission among pollinator species as they forage on common flowers. For example, there is evidence that Deformed wing virus (DWV), may be transmitted from honey bees to bumblebees if diseased honey bees deposit viruses on flower parts (spillover) and other bees subsequently pick them up when visiting the same flowers. Very little is known about pathogen prevalence in bumblebees in Minnesota.

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

The prevalence of DWV and *Nosema ceranae* and *Nosema bombi* in bumblebees in Minnesota has not been previously examined. While it is suspected that honey bees may play a role in increasing the prevalence of pathogens in bumblebees, we currently have no information on existing pathogen level in Minnesota bumblebees. Minnesota is an important place to examine the relationship between honey bee and bumblebee pathogen levels because as a top honey producing state, there are areas of Minnesota with high densities of honey bee colonies and Minnesota is one of the last states still housing the endangered rusty-patched bumblebee. To first understand and then mitigate further declines in these important pollinators, it is critical to collect baseline data on archetypal pathogens in our local populations of honey bees and bumblebees. Finding a solution or even a cure to bee pathogens is a high priority for our assembled team; therefore, we propose to run an innovative pilot study in an attempt to neutralize DWV. Finally, we will protect our native pollinators by educating beekeepers about the critical "public health" need to keep managed bees as healthy as possible.

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 450 species and includes both native and non-native, managed and wild species. While we recognize the important role of managed bees in Minnesota, it is critical to provide outreach regarding the importance of our native bee pollinators and how unmindful honey bee management might negatively impact native bee health. We propose an educational campaign that increases understanding of the roles of native and managed bees in Minnesota. Additionally, we will engage backyard beekeepers in the cities of Minneapolis and Rochester to participate as beekeeper citizen scientists via local pathogen and pest sampling campaigns.

Activities and Milestones

Activity 1: Screen for Deformed Wing Virus and Nosema in bumblebees and quantify potential for virus transmission between honey bees and bumblebees.

Activity Budget: \$488,000

Activity Description:

There is potential for pathogens to be transmitted from honey bees to bumblebees while foraging on flowers, but the extent of this transmission in nature has not been explored. In three locations where we manage honey bee colonies (8 colonies per location: Minneapolis, the MSP airport, and in Rochester), we will use a new sequencing assay, first developed in the Schroeder Lab, to quantify the prevalence and abundance of DWV and Nosema in three species of bumblebees collected while foraging. We also will monitor pathogen load in honey bees foraging on the same species of flowers during early, mid, and late summer and throughout the year in our managed honey bee colonies. Furthermore, we will also set out pathogen-free *Bombus impatiens* colonies (reared from wild-caught queens) in the same locations to monitor possible infection over the season, and how the infection affects their health and reproduction.

Activity Milestones:

Description	Completion Date
Screen for DWV and Nosema in three common bumblebee species and surrounding honey bee colonies	2023-10-31
Monitor potential for virus transmission into <i>B. impatiens</i> colonies and quantify effects on bumblebee health	2023-12-31

Activity 2: Explore potential to neutralize DWV in bees.

Activity Budget: \$88,500

Activity Description:

Currently, there are no specific treatments for DWV infections in bees. The Schroeder Lab has previously reported on a phenomenon known as Superinfection Exclusion in which infection by one virus variant infers protection against other more virulent variants. Application of this phenomenon in honey bees is controversial and is still the subject of much debate. Another yet not commonly explored option to inhibit virus propagation in bees is the application of a foreign antibody. Here we will run laboratory-based cage and cell culture assays to determine if DWV can be neutralized in honey bees and bumblebees. It was recently reported that an effective treatment for a related virus of DWV, namely Sacbrood virus, was discovered. This treatment is based on a specific antibody raised from egg yolk against the virus which was used to immunize honey bee pupae. This work will be repeated here to determine whether DWV can be neutralized in both honey bees and bumblebees. Antibody synthesis, formulation, and production will be carried out in collaboration with Dr Ben Hause (vaccine production specialist).

Activity Milestones:

Description	Completion Date
Preparation, synthesis, formulation, and testing of DWV specific antibodies in bee tissues	2022-07-31
Application of DWV antibodies in caged honey bees and bumblebees	2023-05-31

Activity 3: Beekeeper and community “public health” education about native and non-native bees in Minnesota.

Activity Budget: \$86,500

Activity Description:

Minnesota’s bee diversity boasts over 450 species and includes both native and non-native, managed and wild species. While we recognize the important role of managed honey bees in Minnesota, it is critical to provide outreach regarding the value of our native bee pollinators and how unmindful bee management might negatively impact native bee health. We propose an educational campaign (Bee Minnesota) that increases understanding of the roles of native and managed bees in Minnesota. Additionally, we will engage backyard beekeepers in the cities of Minneapolis and Rochester to participate as beekeeper citizen scientists via pathogen and pest sampling in their honey bee colonies. Everyone will be kept updated as to progress made throughout the project by means of a well-managed and curated website.

Activity Milestones:

Description	Completion Date
Provide education via a bee public health campaign to promote practices to protect native bees	2024-04-30
Establish and disseminate updated beekeeping best management practices to protect wild, native bees in Minnesota	2024-06-30

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr Ben Hause	Tallgrass Biologics	Tallgrass Biologics created antibodies in eggs against DWV and has preliminary evidence supporting its specificity for DWV and therefore its potential application as an oral immunoglobulin's therapy against DWV (Patent filed). Here we will conduct controlled lab-based studies to determine the effectiveness of the antibodies against DWV	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 be funded?

The data generated through Bee Minnesota will create a new body of work that could predict how pathogens spillover into native pollinator communities. The Bee Lab at the University of Minnesota has an active Extension and Outreach program run by Dr. Elaine Evans (native bees, especially bumblebees) who will continue to disseminate results after project completion. Drs. Schroeder and Spivak 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

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 was appointed in February 2018, through the Agricultural Research, Education, Extension and Technology Transfer (AGRETT) program, as an Associate Professor of Virology in the Veterinary Population Medicine Department in the College of Veterinary Medicine at the University of Minnesota. He also holds an honorary Chair in Viral Metagenomics in the School of Biological Sciences at the University of Reading, United Kingdom. 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, 18 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. In addition, he will be directly responsible for all communication between the team and the Minnesotan company Tallgrass Biologics.

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 between the team and the Minnesotan company Tallgrass Biologics to effectively deliver on Activity 2 of the proposal.			36.5%	0.36		\$69,192
Co-investigator		Dr Spivak will advise on the experimental design for surveying and collecting honey bees and bumblebees (Activities 1 and 3) and will assist with data analysis and publication, and with all dissemination of results and outreach.			36.5%	0.03		\$4,046
Co-investigator		Dr Evans is an UMN Extension Educator and Bee Researcher working on pollinator education and research relating to bee conservation. She will be responsible for bumble bee surveys and rearing to support Activity 1 due to her expertise in native bees, particularly bumble bees. In addition, she will be responsible for developing and delivering content to increase awareness and protection of native pollinators in Activity 3.			36.5%	0.6		\$52,754
Co-investigator		Dr Masterman the Bee Squad for the University of Minnesota Bee Lab and is also a Minnesota Extension Educator. She will lead the Bee Squad in collecting the honey bee samples for analysis in Activity 1 as well as coordinating the beekeeper citizen science sampling effort in Activity 3. Additionally, Masterman will collaborate with Dr. Evans on the educational campaign and will lead the dissemination of information to beekeepers in Minnesota in Activity 3.			36.5%	0.6		\$56,501
Molecular postdoc		Responsible for running the sequencing assays for DWV & Nosema. And carrying out the antibody neutralization experiments.			25.4%	3		\$189,563

Molecular tech		To support and assist the postdoc in running the molecular assays during the heavy data generation periods in Activity 1 & 3.			31.8%	1		\$45,260
Bee squad research tech 1		Responsible for co-ordinating the Bee Squad tech team, setting up the field experiments, managing the honey colonies and collecting the managed and wild bees. Also involved in communication to beekeepers and providing resources to community			31.8%	0.3		\$24,686
Bee squad research tech 2		As as of team assist in setting up the field experiments, managing the honey colonies and collecting the managed and wild bees. Also involved in communication to beekeepers and providing resources to community			31.8%	0.24		\$10,975
Bee squad research tech 3		As part of a team assist in setting up the field experiments, managing the honey colonies and collecting the managed and wild bees. Also involved in communication to beekeepers and providing resources to community			31.8%	0.24		\$11,496
Bee squad research tech 4		As part of a team assist in setting up the field experiments, managing the honey colonies and collecting the managed and wild bees. Also involved in communication to beekeepers and providing resources to community			31.8%	0.24		\$13,877
Bumblebee lab tech		To assist Dr Evans in setting up bumblebee lab and field experiments			31.8%	0.03		\$1,381
							Sub Total	\$479,731
Contracts and Services								
Tallgrass Biologics	Professional or Technical Service Contract	Tallgrass Biologics have a patented therapeutic method to use antibodies to DWV from chickens. Egg samples will be collected from egg laying hens at the time of first vaccination. Final antibody purification, formulation and production will be carried out by Tallgrass Biologics for use in this study.				0.5		\$10,000
							Sub Total	\$10,000
Equipment, Tools, and Supplies								

	Tools and Supplies	Supplies to setup and collection of field data	For the purchasing bee packages, nets, containers, hive equipment, tools, tubes, preservation material etc.					\$8,800
	Tools and Supplies	Pathogen screening molecular consumables (Nucleic acid extraction, molecular grade chemicals, RT-PCR, NGS sequencing etc.) for 2,250 bee samples	Surveying the pathogens in bee material collected.					\$119,614
	Tools and Supplies	Bee packages, cages, molecular grade chemistry & plastics - 300 assays	Neutralization assays for the removal of DWV					\$35,300
							Sub Total	\$163,714
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Setting up and maintenance of sentinel colonies, release and collecting of bees in the field.	Throughout the 3 years, travel to and from three field sites (Minneapolis, the MSP airport, and in Rochester). Surveying floral diversity and bumblebees colony health. Carry out community surveys and outreach activities. To reduce costs, many activities will be co-ordinated.					\$3,680
							Sub Total	\$3,680
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Printing	Leaflets	An universal and accessible communication tool especially for those communities that do not have					\$375

			easy access to computers and the internet.					
	Publication	Peer reviewed scientific journal papers	We aim to publish our findings in open access journals. These journals charge publication fees.					\$3,000
	Publication	Design of new website pages	Platform for rapid communication and active dialog with community					\$2,500
							Sub Total	\$5,875
Other Expenses								
							Sub Total	-
							Grand Total	\$663,000

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: [7d2b3e04-99a.pdf](#)

Alternate Text for Visual Component

Overview of the project

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have patent, royalties, or revenue potential?

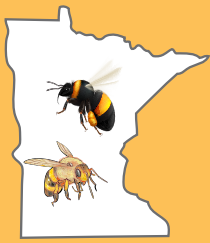
No

Does your project include research?

Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration



BEE MINNESOTA

Protect our Native Bumblebees

I. Screening honey bees and bumblebees for pathogens



1. Pathogens from honey bees onto flowers
2. Bumble bees visit same flowers
3. Pathogen spillover



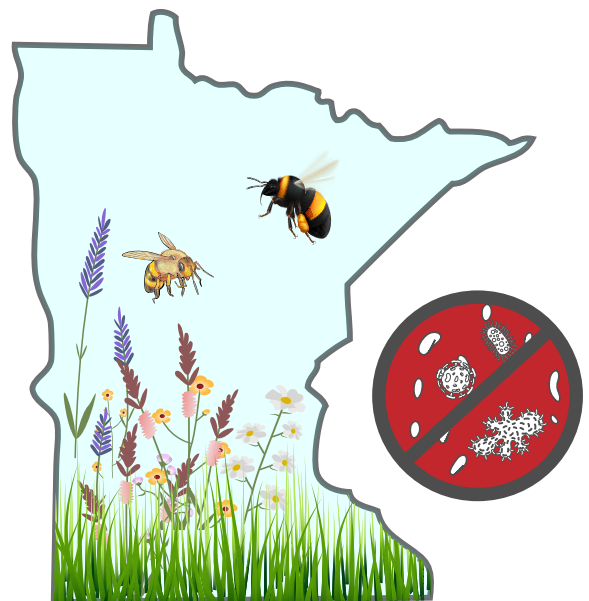
Pathogens pose a serious risk to declining bumblebees, such as the Rusty Patched Bumblebee.

II. Disease Prevention



Vaccination of bees against pathogens

III. Public Bee Health



Sharing information to increase health of honey bees and native bees