

**Environment and Natural Resources Trust Fund  
2020 Request for Proposals (RFP)**

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**Project Title:**

**ENRTF ID: 018-A**

Bee Minnesota - Protect our Native Bumblebees

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**Category:** A. Foundational Natural Resource Data and Information

**Sub-Category:**

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**Total Project Budget: \$** 693,000

**Proposed Project Time Period for the Funding Requested:** June 30, 2023 (3 yrs)

**Summary:**

By screening and neutralizing bee pathogens we wish to promote best management practices to maintain honey bee health and prevent pathogen spill-over into native bee populations.

**Name:** Declan Schroeder

**Sponsoring Organization:** U of MN

**Job Title:** Dr

**Department:** Veterinary Population Medicine

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**Location:**

**Region:** Statewide

**County Name:** Statewide

**City / Township:**

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**Alternate Text for Visual:**

Screening (I) and disease prevention (II) of bee pathogen infections for public bee health (III) to protect our native bumblebees

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____ %



PROJECT TITLE: Bee Minnesota - Protect our Native Bumblebees

I. PROJECT STATEMENT

Our goal is to protect native pollinators from risk of disease transmission and population declines. By screening and neutralizing bee pathogens we wish to promote best management practices to maintain honey bee health and prevent pathogen spill-over into native bee populations. 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 our twenty-three species of native bumblebees in Minnesota are considered vulnerable, endangered, or critically endangered by the International Union for Conservation of Nature. The rusty patched bumblebee, Bombus affinis Cresson, was the first bumblebee to be listed as federally endangered in the U.S. Rusty patched bumble bee populations in Minnesota are crucial to recovery as over 35% of all observed individuals in 2018 were in Minnesota.

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 the U.S. and in Minnesota. 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.

We propose to use cutting edge technology to rapidly screen for DWV and Nosema presence in three common bumblebees: Bombus impatiens, B. bimaculatus, and B. griseocollis (accounting for ~80% of bumblebee individuals in this region of Minnesota) in three locations near honey bee colonies. 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. Beekeepers within 2 miles of the three sampling locations will be engaged in monitoring their colonies for DWV, Varroa mite parasites that vector DWV, and other health concerns.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1 Title: Screen for DWV and Nosema in bumblebees and quantify potential for virus transmission between honey bees and bumblebees.

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 B. 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. ENRTF BUDGET: \$505,000

Table with 2 columns: Outcome, Completion Date. Row 1: 1. Screen for presence of DWV and Nosema in three common bumblebee species and surrounding honey bee colonies, October 2022



**Environment and Natural Resources Trust Fund (ENRTF)  
2020 Main Proposal Template**

2. Monitor potential for virus transmission into <i>B. impatiens</i> colonies placed near honey bee colonies, and if pathogen is found, quantify effects on bumblebee colony health	<i>December 2022</i>
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**Activity 2 Title: Explore potential to neutralize DWV in bees.**

**Description:** 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). **ENRTF BUDGET: \$101,500**

<b>Outcome</b>	<b>Completion Date</b>
1. Preparation, synthesis, formulation, and testing of DWV specific antibodies in honey bee and bumblebee tissues	<i>July 2021</i>
2. Application of DWV antibodies in caged honey bees and bumblebees	<i>May 2022</i>

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

**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 importance 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. **ENRTF BUDGET: \$86,500**

<b>Outcome</b>	<b>Completion Date</b>
1. Provide education via a bee public health campaign to promote practices and policies that support wild, native bees	<i>April 2023</i>
2. Establish and disseminate updated beekeeping best management practices to protect wild, native bees in Minnesota	<i>June 2023</i>

**III. PROJECT PARTNERS AND COLLABORATORS:** Dr Declan Schroeder (Pathogen detection & surveillance Associate Professor, U of M) is the project leader. Project partners are with Dr Marla Spivak (Distinguished McKnight Professor Apiculture / Social Insects, U of M), Dr Rebecca Masterman (Assistant Extension Professor and Bee Squad Program Director, U of M), and Dr Elaine Evans (Assistant Extension Professor, Bee Researcher, U of M). Project Collaborator is Dr Ben Hause (Tallgrass Biologics LLC).

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:** The Bee Lab at the University of Minnesota has an active Extension and Outreach program run by Dr. Rebecca Masterman (honey bees) and 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.

**V. SEE ADDITIONAL PROPOSAL COMPONENTS: A. Proposal Budget Spreadsheet; B. Visual Component or Map & F. Project Manager Qualifications and Organization Description**

Attachment A: Project Budget Spreadsheet  
 Environment and Natural Resources Trust Fund  
 M.L. 2020 Budget Spreadsheet



Legal Citation:  
 Project Manager: Dr Declan Schroeder  
 Project Title: Protect our Native Bumblebees  
 Organization: University of Minnesota  
 Project Budget:  
 Project Length and Completion Date: 3 years, 06/30/2023  
 Today's Date: 03/15/2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET		Budget	Amount Spent	Balance
<b>BUDGET ITEM</b>				
<b>Personnel (Wages and Benefits)</b>				
Project manager (Pathogen specialist): Dr Declan Schroeder, 0.17 FTE yr 1, 0.1 FTE yrs 2 and 3, 36.0% fringe = \$71,500		\$ 470,545	\$ -	
Project partner (Bee specialist): Dr Marla Spivak, 0.01 FTE, 3 years, 36.0% fringe = \$3,957				
Project partner (Bumblebee specialist): Dr Elaine Evans, 0.2 FTE, 3 years, 36.0% fringe = \$51,531				
Project partner(Beekeeper & Community Education officer): Dr Rebecca Masterman, 0.2 FTE, 3 years, 36.0% fringe = \$56,294				
Molecular biologist - Post Doc: 1.0 FTE, 3 years, 24.3% fringe = \$187,901				
Molecular lab research technician : 0.5 FTE, 2 years, 29.5% fringe = \$44,470				
Bee field technicians & Public campaign - 5 members of the Bee Squad: 4 @ 0.10 FTE yrs 1-2 and 0.03 FTE yr3; 1@ 0.01 FTE for 3 years; 29.5% fringe = \$54,892				
<b>Professional/Technical/Service Contracts</b>				
Contract with Tallgrass Biologics for the synthesis, formulation & preparation of antibodies to cure bees. Tallgrass Biologics has a pending patent on the technology to be used in this study.		\$ 15,000		
Website to be designed by Bee Minnesota staff in collaboration with a third party (TBD) aimed specifically for LCCMR, beekeepers & general public in mind. Objective is to keep everyone updated and informed as to progress and conclusions reached throughout the duration of the project.		\$ 2,500		
<b>Equipment/Tools/Supplies</b>				
Field supplies (traps, nets, tubes, specimen preservation etc.)		\$ 8,800		\$ -
Pathogen screening molecular consumables ( Nucleic acid extraction, molecular grade chemicals, RT-PCR, NGS sequencing etc.) for 2,250 bee samples		\$ 149,300		
Pathogen neutralization molecular consumables ( cell lines, cages, RT-PCR assays & Sequencing)		\$ 39,800		
<b>Capital Expenditures Over \$5,000</b>				
		\$ -	\$ -	\$ -
<b>Fee Title Acquisition</b>				
		\$ -	\$ -	\$ -
<b>Easement Acquisition</b>				
		\$ -	\$ -	\$ -
<b>Professional Services for Acquisition</b>				
		\$ -	\$ -	\$ -
<b>Printing</b>				
Leaflets		\$ 1,375		
Scientific publications		\$ 2,000		
<b>Travel expenses in Minnesota</b>				
Approximately 4350 miles @ mileage rate of 0.58/mile - official UMN reimbursement rate, for field sample collection		\$ 2,530		
Approximately 2000 miles @ mileage rate of 0.58/mile - official UMN reimbursement rate, for beekeeper recruitment, outreach and communication		\$ 1,150		
<b>Other</b>				
			\$ -	\$ -
<b>COLUMN TOTAL</b>		\$ 693,000	\$ -	\$ -
<b>SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT</b>				
	Status (secured or pending)	Budget	Spent	Balance
<b>Non-State: General Mills</b>		secured	\$ 100,000	\$ -
<b>State:</b>			\$ -	\$ -
<b>Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS</b>				
	Amount legally obligated but not yet spent	Budget	Spent	Balance
		\$ -	\$ -	\$ -



# 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

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## Project Manager Qualifications and Organization Description

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### Dr. Declan Schroeder, PhD in Cell & Molecular Biology

He was appointed in February 2018, through the Agricultural Research, Education, Extension and Technology Transfer (AGREETT) 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. Previously, he held the positions of Director of the MBA Culture Collection (2014-2018) and Senior Research Fellow in Viral and Molecular Ecology (2001-2018) at the Marine Biological Association of the UK. 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 9 postdoctoral assistants/fellows, 15 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.

### Duties of the UMN Bee Minnesota Team pertaining to the proposal

*“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.

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 to effectively deliver on Activity 2 of the proposal. **Dr. Marla Spivak** will be assisting with the project. She is a professor in the Department of Entomology in the College of Food, Agriculture and Natural Resource Sciences. Her office and lab are in the Bee Research lab on St Paul campus, along with Drs. Masterman and Evans. She 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. **Dr. Elaine Evans** is a 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. **Dr. Rebecca Masterman** runs 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.

As a team we will collectively apply our experience, leadership and motivational skills to educate decisionmakers about the roles of managed and native bees in Minnesota and as result, protect pollinators. Members of the public, municipalities and beekeepers often promote beekeeping, the management of a non-native bee, as an effort that hobbyists can pursue to support the environment. This educational campaign combined with data collected in Activities 1 and 3 will influence how these user groups view bees in Minnesota. Using these data, we will be able to promote best management practices to maintain honey bee colony health and prevent spill-over of viruses (Activity 2) and other pathogens into native bee population.