



# Environment and Natural Resources Trust Fund

## 2021 Request for Proposal

### General Information

**Proposal ID:** 2021-308

**Proposal Title:** Creating Cost-Effective Forage And Management Actions For Pollinators

### Project Manager Information

**Name:** Daniel Cariveau

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

**Office Telephone:** (612) 624-1254

**Email:** dcarivea@umn.edu

### Project Basic Information

**Project Summary:** We will collect long-term, species-specific plant data on pollinator forage quality and quantity. These data will be used to design an open-access web-based tool for land managers in Minnesota.

**Funds Requested:** \$198,000

**Proposed Project Completion:** 2023-06-30

**LCCMR Funding Category:** Small Projects (H)

**Secondary Category:** Methods to Protect, Restore, and Enhance Land, Water, and Habitat (F)

### Project Location

**What is the best scale for describing where your work will take place?**

Region(s): SE

**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.**

Planting flowers is the most effective method to conserve pollinators. For example, the first goal in the 2019 Minnesota State Agency Pollinator Report is that “lands throughout Minnesota support healthy, diverse, and abundant pollinator populations”. The key output of this goal is to provide “More food sources for pollinators”. However, pollinator habitat is incredibly expensive with seed mixes alone often costing over \$1,000 per acre. Further, to ensure that habitats provide forage for multiple years, land managers often carry out costly management actions. The high cost of seeds and management limits the ability of public and private landowners to increase and maintain healthy pollinator landscapes.

A critical next step in creating habitat is to determine how to maximize benefits for pollinators while minimizing costs. There are three main knowledge gaps. First, there is a lack of information on the forage (nectar and pollen) quality and quantity of different plants used in pollinator seed mixes. Second, we lack detailed information on how forage resources change across years. Third, we do not understand how different management regimes influence forage quality and quantity. Finally, it is critical that this information is easily accessible to land managers.

### **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.**

To fill these knowledge gaps, we will measure the forage (nectar and pollen) quantity and quality of 30 different flowering plant species. We will also collect data on the amount of flowers blooming and the number and species of bees visiting these plants. Second, we will use this information to help design and disseminate a web-based seed mix optimization tool. Third, we will conduct a study in which we randomly assign burning, mowing, or no treatment (control) to the experimental plots.

To accomplish this, we will leverage an ongoing study. We established a large-scale seed mix experiment in 2018. In total, we installed 288 - 9x9' plots that vary in the types and number of flowering plant species. In 2019 and (hopefully) 2020 we collected flower abundance and bee data on these plots. In addition, the seed mix tool is currently in development. Both the field study and the seed mix tool are funded by the Foundation for Food and Agriculture Research.

### **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 species-specific plant data that will enable land managers to create seed mixes that maximize the benefit to pollinators while minimizing the costs. Habitat is critical for native pollinators - including the over 400 species of bees native to Minnesota. This proposal will directly benefit the state's natural resources by increasing the quantity of pollinator habitat by reducing the cost per acre while also increasing habitat quality. For example, results from the project will help meet the output of the first goal of the Minnesota State Agency Pollinator Report: to provide "more food resources for pollinators".

## Activities and Milestones

### Activity 1: Measure the quantity and quality of pollinator forage (nectar and pollen) over time.

**Activity Budget:** \$121,795

#### Activity Description:

In the late fall of 2018, we planted a large-scale experimental study to determine how to maximize benefits to pollinators while minimizing costs. In particular, we planted 288 - 9x9' plots. Each plot contains a plant community in which we varied the number and type of plant species as well as the density of seeds. Prior to this current ENRTF proposal, we will have collected 2 full years of data on floral abundance and bee use. We will use ENRTF funds to complete 2 additional field seasons. This is critical as prairie plants take 3-4 years to establish. In particular, we will measure how floral abundance changes through time. Further, we will collect data on the nectar and pollen produced by the plants in this experiment. This will include sugar content of nectar, amount of nectar and pollen produced, and protein content of pollen. This information is critical as it will allow us to quantify the value of different plant species in regards to forage resources for pollinators. We can then link this forage value with the seed costs (see Activity 2) and will disseminate this information to land managers in Minnesota (see Activity 4).

#### Activity Milestones:

Description	Completion Date
First field season data collection	2021-10-31
Collect data on bee diversity and abundance	2022-09-30
Summarize results in outreach materials for land managers in Minnesota	2023-04-30

### Activity 2: Design and implement online, publicly accessible seed mix tool

**Activity Budget:** \$35,154

#### Activity Description:

We are collaborating with researchers at the UMN Institute on the Environment (IonE) to create an online seed mix tool. This tool will allow a user to input their site characteristics (e.g. soil moisture, sun/shade), county, and pollinator conservation program generate a seed mix that is optimized to support the greatest number of pollinators for a given budget. Currently, the model underlying the web-based interface uses basic data on a limited suite of plant species. We will use the results from Activity 1 to provide more detailed data and include more plant species. Further, we will incorporate seed costs data into the model. Our experimental results will enable land managers to create highly effective seed mixes at minimal costs. We will deliver our data to the primary model developer, Peter Hawthorne (IonE), and assist with model trouble-shooting and stakeholder engagement. We will organize stakeholder meetings to test and refine the tool with land managers in government agencies and conservation groups. We had already held a preliminary stakeholder meeting to get initial feedback on this tool that included participants from BWSR, DNR, and Minnesota offices of The Nature Conservancy, Xerces Society, and United States Fish and Wildlife Service.

#### Activity Milestones:

Description	Completion Date
Delivery of field season 1 data to IonE collaborator	2022-01-31
First virtual stakeholder meeting to test version of the tool with experimental data	2022-05-31
Delivery of field season 2 data to IonE collaborator	2023-01-31
Second virtual stakeholder meeting to test version of the tool with experimental data	2023-05-31
Seed mix tool place online with publicly available data collected from Activity 1	2023-06-30

### Activity 3: Evaluate the effects of burning and mowing on pollinator forage quality and quantity

**Activity Budget:** \$26,831

#### Activity Description:

Land management actions, specifically mowing and prescribed fire, are costly methods used to promote growth of native plant species and reduce growth of invasive plants. Despite the large effects that mowing and burning have on plant communities, we do not know how these management actions impact the quantity and quality of pollinator forage. With our existing experimental setup of 288 seed mix plots, we are in a perfect position to test this. We will mow one-third of our plots, burn one-third using an experienced tallgrass prairie restoration management company, and designate the remaining one-third as control (unmanaged) plots. We will then quantify floral abundance, bee use, and forage quantity and quality in these different treatments.

#### Activity Milestones:

Description	Completion Date
Mow one-third of the experimental plots	2021-09-30
Burn one-third of the experimental plots	2022-02-28
Incorporate results into outreach materials	2023-03-31

### Activity 4: Communicating experimental results and introducing the seed mix tool to land managers

**Activity Budget:** \$14,220

#### Activity Description:

In addition to the virtual stakeholder meetings with MN land managers described in Activity 2, we will hold an in-person outreach event to communicate our results with MN land managers and introduce a larger audience to our seed mix tool. We propose a 1-day workshop at the Rosemount Extension and Outreach Center consisting of the following activities: 1) Overview of the experimental design and main results, 2) Guided tour of our experimental plots, 3) Walk-through of the seed mix tool by the software developer, and 4) Working session for attendees to work with the software developer to create seed mixes for their own project needs. This workshop will be free to all attendees. In addition, we will create instructions that will enable new users to access the web-based tool.

#### Activity Milestones:

Description	Completion Date
Create outreach materials - online and in print	2023-02-28
Hold workshop to disseminate results to land managers	2023-04-30

## Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Peter Hawthorne	Institute on the Environment	Develop web-based tool	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 web-based tool will be available in the middle of the project and we will continue to update as results become available. The website will be run by the Institute on the Environment at the University of Minnesota. We will continue to seek funding to maintain and update this website into the future. We predict that once this seed mix tool is adopted by land managers, we will be able to generate funding for this tool into the future.

## Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Pollinator Research and Outreach	M.L. 2017, Chp. 96, Sec. 2, Subd. 03n	\$500,000
Data-Driven Pollinator Conservation Strategies	M.L. 2016, Chp. 186, Sec. 2, Subd. 03a	\$520,000

## Project Manager and Organization Qualifications

**Project Manager Name:** Daniel Cariveau

**Job Title:** Assistant Professor

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

Daniel P. Cariveau, PhD is an assistant professor in the Department of Entomology at the University of Minnesota Twin Cities campus. He is housed in the Bee Research Facility on the Saint Paul campus. His research is focused on the ecology and conservation of native bees in Minnesota. In particular, his research is focused on Dr. Cariveau is an author or co-author of 25 peer-reviewed manuscripts. This includes research in the high-profile journals Science, Nature Communications, and Ecology Letters. Recent research of his has been used in the recovery plan for the federally-endangered rusty-patched bumble bee. Outreach has long been central to Dr. Cariveau's work. He works with agricultural producers, non-profit organizations and the general public. Dr. Cariveau has a large, vibrant lab that consists of 4 graduate students, 2 postdoctoral researchers, 3 full-time staff and numerous undergraduate researchers. This lab is supported by the over \$3 million in external funds. Finally, Dr. Cariveau teaches courses on pollinator ecology, statistics, data management, and research ethics.

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

**Organization Description:**

The College of Food, Agriculture and Natural Resources Sciences (CFANS) is housed at the University of Minnesota's Twin Cities campus. The vision of CFANS is to "To advance Minnesota as a global leader in food, agriculture, and natural resources through extraordinary education, science-based solutions, and dynamic public engagement that nourishes people and enhances the environment in which we live." It is comprised of 13 academic departments and 10 research and outreach center. The Bell Museum and Minnesota Landscape Arboretum are also part of CFANS.



## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
Postdoctoral Research Associate		Project Management, Report Writing, Data Management, Hiring and Supervising Field Technicians			25.4%	1.4		\$87,694
PhD Student - Summer and two semesters at 1-credit status		Data Analysis, Field Work, Supervising Field Technicians			20%	0.1		\$26,550
Principle Investigator		Oversee Projects, Financial Management, and Supervise Postdocs and PhD Student			37%	0.08		\$13,187
Field Technician		Data collection, entry, and management			7%	0.26		\$10,753
Field Technician		Data collection, entry, and management			7%	0.52		\$21,507
Software Developer		Develop Seed Mix Tool			37%	0.16		\$19,766
							<b>Sub Total</b>	<b>\$179,457</b>
<b>Contracts and Services</b>								
TBD	Professional or Technical Service Contract	The contractor will burn half of the 3 x 3 yard treatment plots.				0.25		\$10,000
Rosemount Research and Outreach Center (UMN)	Professional or Technical Service Contract	This is for renting the plots at the Rosemount Research and Outreach Center (part of University of Minnesota).				-		\$1,500
							<b>Sub Total</b>	<b>\$11,500</b>

<b>Equipment, Tools, and Supplies</b>								
	Tools and Supplies	Collecting nets (4), plot markers (1000), collection vials (2000), pin flags	Collecting bees, marking plots before and after burn					\$1,500
							<b>Sub Total</b>	<b>\$1,500</b>
<b>Capital Expenditures</b>								
							<b>Sub Total</b>	-
<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	-
<b>Travel In Minnesota</b>								
	Miles/ Meals/ Lodging	Travel to and from field site	This will pay for rental car to visit field site. Field site is at UMN Rosemount Research and Outreach Center					\$1,543
							<b>Sub Total</b>	<b>\$1,543</b>
<b>Travel Outside Minnesota</b>								
							<b>Sub Total</b>	-
<b>Printing and Publication</b>								
	Publication	Publication Costs	Cost of publishing peer reviewed research					\$2,000
	Printing	Outreach materials for land managers.	Printing of outreach materials for land managers to highlight the seed mix tool.					\$500
							<b>Sub Total</b>	<b>\$2,500</b>
<b>Other Expenses</b>								

		Field Day for Land Managers to Discuss	This will be a field day for land managers. We will show them how to use the seed mix tool					\$1,500
							<b>Sub Total</b>	<b>\$1,500</b>
							<b>Grand Total</b>	<b>\$198,000</b>

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
<b>State</b>				
			<b>State Sub Total</b>	-
<b>Non-State</b>				
			<b>Non State Sub Total</b>	-
			<b>Funds Total</b>	-

## Attachments

### Required Attachments

#### *Visual Component*

File: [3d75fe13-aaa.pdf](#)

#### *Alternate Text for Visual Component*

Visual showing a schematic of the project.

### Optional Attachments

#### *Support Letter or Other*

Title	File
Hawthorne_SupportLetter	<a href="#">8c62cd93-359.pdf</a>
UMN Proposal Letter	<a href="#">c8d4e0f8-f4f.pdf</a>

## Administrative Use

**Does your project include restoration or acquisition of land rights?**

No

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

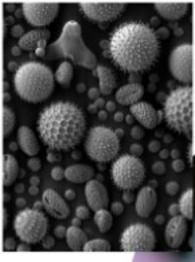
No

**Does your project include research?**

Yes

**Does the organization have a fiscal agent for this project?**

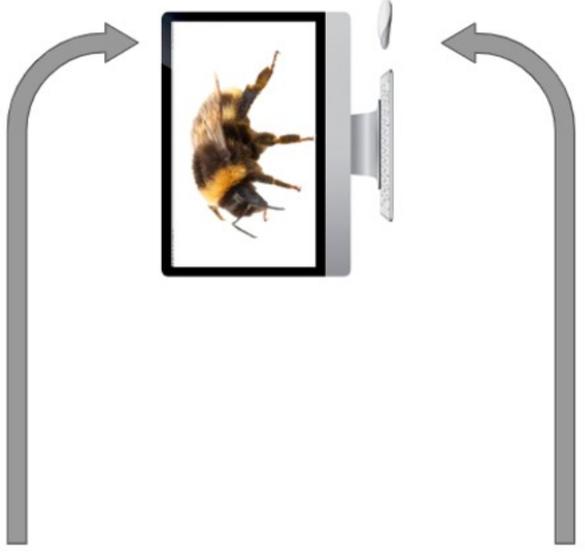
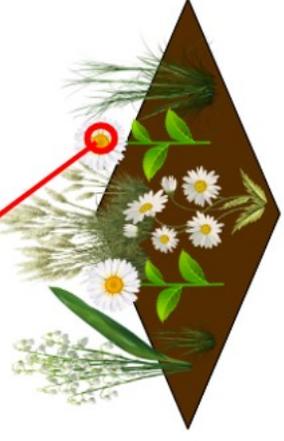
Yes, Sponsored Projects Administration



Variation in food for bees (pollen, nectar)



Variation in pollinator seed mixes



Web tool optimizes seed mixes to support the most pollinators for lowest cost

