

### **Environment and Natural Resources Trust Fund**

### 2022 Request for Proposal

### **General Information**

Proposal ID: 2022-091

Proposal Title: How do prescribed fires affect native prairie bees?

### **Project Manager Information**

Name: Stuart Wagenius

**Organization:** Negaunee Institute for Plant Conservation Science and Action at the Chicago Botanic Garden - Echinacea Project

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### **Project Basic Information**

**Project Summary:** Pollinators are declining in Minnesota's tallgrass prairies. We will investigate how prescribed fire affects the nesting habitat, food resources, and diversity of ground-nesting bees to make recommendations for prairie management.

Funds Requested: \$421,000

Proposed Project Completion: June 30 2025

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? Region(s): Central

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.

Prescribed fire is widely used to maintain tallgrass prairie in Minnesota. Burning promotes native plant diversity, and a 21-year investigation from Dr. Wagenius' research group in Douglas County, MN (Echinacea Project) shows that fire also improves pollination. However, we know very little about how fires affect solitary bees – the most diverse and important pollinators in tallgrass prairie. Fire harms some insects and but benefits others. Natural resource managers currently lack clear guidance about prescribed fire and pollinator conservation. We do not know if fire directly threatens solitary bees, most of which nest belowground. We also don't know how prescribed fires affect bee nesting habitat or the nutritional quality of their food resources (pollen and nectar from wildflowers). Better understanding how prescribed fires influences solitary bee nesting habitat, food resources, and diversity is critical for providing recommendations about how prescribed fire should be used to promote pollinator conservation and healthy prairie. With over 25 years of experience researching insects and plants in western Minnesota, as well as active research investigating fire effects on prairie plants and pollination, the Echinacea Project is uniquely well-positioned to investigate how prescribed fire affects native solitary bees, and to develop guidelines for promoting pollinator conservation.

## 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.

We propose to investigate how prescribed fires influence the nesting habitat, food resources, and diversity of groundnesting solitary bees in Minnesota tallgrass prairie. This research is distinct from and complements previous ENRTFfunded projects that investigated habitat requirements of cavity-nesting solitary bees and cataloged native bee diversity in Minnesota. We will conduct prescribed burns in a sample of 50 prairie remnants and restorations in Douglas and Grant Counties, where we have been researching prairie plants and insects since 1995. We will characterize bee nesting habitat and survey solitary bees before and after prescribed burns to determine how fire affects nesting habitat and solitary bee diversity. In addition, we will repeat the pan trap surveys our research team began in 2004. This will allow us to characterize the population trends and habitat requirements of numerous solitary bee species (Activity 1). We will then investigate how fire influences food resources and pollinator activity by surveying flowering plant density, measuring the quantity and nutritional quality of pollen and nectar, and monitoring how frequently bees visit different wildflower species (Activity 2).

# 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 provide guidelines and offer recommendations to conservation practitioners and policymakers about best management practices for maintaining healthy prairie plant and pollinator populations. The proposed research will directly inform conservation efforts in Minnesota tallgrass prairie by revealing how prescribed fire influences the nesting habitat, quantity and quality of food resources, and diversity of ground-nesting prairie bees. Additionally, our research will provide valuable information about nesting habitat requirements for different bee species, preferred wildflower species, and population trends.

### **Activities and Milestones**

# Activity 1: Investigating how prescribed fire influences the nesting habitat and diversity of solitary, ground-nesting bees in Minnesota tallgrass prairie

Activity Budget: \$212,000

### **Activity Description:**

We will survey solitary bee diversity and nesting habitat before and after prescribed fires in a subset of 30 prairie remnants and 20 prairie restorations to determine how prescribed fire affects solitary bee nesting habitat and abundance. We will use emergence traps and detailed measures of soil and litter to characterize how prescribed burning influences the nesting habitat and diversity of solitary bees. In addition to these detailed investigations, we will repeat the broader-scale pan trap surveys our research team began in 2004 to reveal population trends and habitat requirements of numerous bee species. We will provide natural resource managers and policymakers with guidelines and recommendations about how prescribed fire affects solitary bees and their nesting habitat. In addition to disseminating results at regional and national scientific meetings, we will share results locally to interested groups. Summer interns from local high schools (2 per year) will present results at their school, FFA, 4H, and other groups. Additionally, we established an experimental plot at West Central Area High School in 2018 with science teacher and research collaborator VanKempen. He will present results of fire effects on plants and pollinators within the school's restored prairie at a statewide teacher conference.

### **Activity Milestones:**

Description	Completion Date
Repeat general bee survey using pan traps	September 30 2022
Complete pre-fire surveys of solitary nesting habitat and diversity across sites	September 30 2023
Experimentally burn subset of remnant and restored prairies	May 31 2024
Complete post-fire survey of bee nesting habitat and diversity across sites	September 30 2024
Analyze data and write papers for publication in peer-reviewed scientific journals	June 30 2025
Develop and disseminate management guidelines and recommendations	June 30 2025

# Activity 2: Characterizing fire effects on food resources for bees and plant-pollinator interactions in Minnesota tallgrass prairie

### Activity Budget: \$209,000

### **Activity Description:**

Healthy bee populations require sufficient quantity and quality of food (pollen and nectar). Fire could benefit bees by increasing the quantity or nutritional quality of these food resources. We will investigate how prescribed burns affect the density of flowering plants, the quantity and nutritional quality of both pollen and nectar, and the activity of pollinators within remnant and restored prairies where Dr. Wagenius and his team have been working since 1995. Most sites are owned by private landowners and many have not burned in >30 years. Assessment of fire effects on flower density and pollinator visitation will be particularly valuable because they can be compared to long-term datasets of annual variation of flowering in the absence of fire. We will measure quantity and quality of pollen and nectar from wildflowers before and after prescribed burns. Nutritional contents of pollen includes fat, protein, and micronutrients and nectar provides sugar, protein, and micronutrients. Results of these activities will reveal how fires affect food resources for bees and also pollination for plants. We will provide recommendations to managers and policymakers about which plant species are most nutritionally valuable for pollinators and how much fire affects the quantity and nutritional content of their diets.

### **Activity Milestones:**

Description	Completion Date
Assess flowering plant density in remnant and restored prairies (before fire)	September 30 2022
Collect pollen and nectar samples from prairie wildflowers & investigate pollinator visitation (before	September 30 2023
fire)	
Complete nutritional analysis of pollen and nectar (pre-burn)	February 28 2024
Collect pollen and nectar samples, assess flower density, & investigate pollinator visition (after fire)	September 30 2024
Complete nutritional analysis of pollen and nectar (after fire)	February 28 2025
Analyze data and write papers for publication in peer-reviewed scientific journals	June 30 2025
Develop and disseminate management guidelines and recommendations	June 30 2025

### **Project Partners and Collaborators**

Name	Organization	Role	Receiving Funds
Dr. Rahul Roy	St. Catherine University	Dr. Roy is a molecular biologist specializing in pollen and nectar biology at St. Catherine University in St. Paul, MN. He will conduct biochemical assays to quantify the nutritional content of pollen and nectar.	Yes
Dr. Zach Portman	University of Minnesota Bee Lab	Dr. Portman is a bee taxonomist at the University of Minnesota in the Cariveau Native Bee Lab. His research focuses on the identification and taxonomy of Minnesota bees. We will contract Dr. Portman to identify our field-collected bee specimens.	Yes
John VanKempen	West Central Area High School	VanKempen is a high school science teacher at West Central High School (Barrett, MN) who has collaborated with the Echinacea Project on pollinator projects since 2018. VanKempen will lead the pan trapping investigation, assist with all other fieldwork, and serve as liaision to local communities.	Yes
Stacy Salvevold	Fergus Falls Wetland Management District, US Fish & Wildlife Service	Salvevold and members of the fire staff at Fergus Falls will coordinate the timing and location of prescribed burns of Waterfowl Production Areas in the study site so that they can be included in the proposed investigations of fire effects on native bees and pollination.	No

### 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?

Our research group, the Echinacea Project, investigates the biology, conservation, and restoration of plants and insects in tallgrass prairie. The research we propose here advances our 25-year efforts to conserve the diverse native bees and plants of Minnesota tallgrass prairie. We will publish findings from Activities 1 & 2 in peer-reviewed scientific journals, present results at local and regional conferences, and produce research briefs for conservation practitioners, policymakers, and the general public that summarize our findings and provide recommendations about burning.

### Project Manager and Organization Qualifications

### Project Manager Name: Stuart Wagenius

### Job Title: Conservation Scientist

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

Dr. Stuart Wagenius is a conservation scientist at the Negaunee Institute for Plant Conservation Science and Action at the Chicago Botanic Garden. Every summer since 1994, Wagenius has lived in Douglas County Minnesota to conduct research on the biology, conservation, and restoration of plants and insects in tallgrass prairie. Wagenius earned his PhD at the University of Minnesota in 2000 investigating the ecology and pollination of prairie plants. For 25 years, Wagenius has conducted research on prairie remnants and restorations near Kensington, MN owned by the State, the U.S. Fish and Wildlife Service, local governmental units, but mostly private landowners. He has strong relationships with local landowners and substantial experience conducting experiments and investigations like those proposed. Wagenius's research, the 'Echinacea Project' has continuous funding from the National Science Foundation from 2000 through 2026. His research has also been funded by National Geographic Society, the University of Minnesota, the Minnesota Department of Natural Resources and the USFWS. Wagenius has extensive experience managing grants and producing outcomes, including new scientific knowledge, recommendations about conservation and restoration practices, as well as educational outcomes, including training, mentoring, and developing educational resources. Before graduate school,

Wagenius taught secondary school science; he is now an adjunct professor of biology at Northwestern University. Wagenius is committed to engaging and providing experience for conservationists, scientists, educators, and students interested in prairies. Teachers and students from four local high schools have participated in research: Alexandria, Minnewaska, Morris, and West Central Area (Barrett). As manager of this project, Wagenius will supervise the team of scientists, coordinate with landowners, and work with collaborators to deliver all proposed outcomes: craft educational resources, conduct high quality original research, develop and disseminate strategies for effectively managing native bees, plants, and prairie habitat. Wagenius requests no salary for his work on this project.

**Organization:** Negaunee Institute for Plant Conservation Science and Action at the Chicago Botanic Garden - Echinacea Project

### **Organization Description:**

The Chicago Botanic Garden is a global leader in the fields of plants and education guided by its mission: We cultivate the power of plants to sustain and enrich life. Plant research and conservation efforts are led by the Negaunee Institute for Plant Conservation Science and Action, comprising 19 Ph.D. scientists and 25 additional staff. The Institute and its scientists are actively engaged in research projects and conservation initiatives ranging from local collaborations in the Chicago area to regional partnerships to national and international conservation initiatives. The Echinacea Project, founded by Dr. Stuart Wagenius in 1995, conducts research to understand the biology, conservation, and restoration of insects and plants in Minnesota tallgrass prairie. Our research focuses on remnant and restored prairies in Douglas and Grant Counties. We conduct cutting edge research while training students and engaging the public. We also advise natural resource managers and policymakers about how to improve conservation and management efforts in fragmented prairies. The Minnesota-based infrastructure, including data collectors, computing resources, and support staff, required for the proposed activities to occur will be funded by a current award from the National Science Foundation (2021 – 2026) during the proposed grant period.

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineli	% Bene	# FTE	Class ified	\$ Amount
Personnel				gible	TITS		Staff?	
Postdoctoral		The Postdoctoral Researcher will supervise fieldwork			28%	3		\$212,000
Researcher		and coordinate day-to-day research activities. This			2070	5		\$212,000
hesedioner		individual will design and implement data collection						
		workflows manage data sets conduct statistical						
		analyses serve as lead author for most peer-						
		reviewed nublications, and assist with the						
		dissemination of research materials to natural						
		resource managers policymakers scientists and the						
		general public						
Field		We will hire one field technician in summer 2022 (3			11%	2.25		\$72,000
assistants		months) and 2 field technicians in summer 2023 &			/-			<i>\(\_\)</i>
		summer 2024 (6 months). These individuals will help						
		conduct pan trapping surveys, bee nesting habitat						
		and emergence trapping surveys, pollen and nectar						
		collection, and pollinator visitation surveys.						
High School		Two local high school students will participate during		Х	0%	0.8		\$20,000
Research		summer 2023 and another two during summer 2024						
Interns		for 10 weeks each summer. These interns from						
(Participants)		Alexandria, Minnewaska, Morris, or West Central						
		Area will assist with all research activities and gain						
		appreciation about Minnesota's rich natural						
		resources. As part of the internship, students will						
		develop a poster, pamphlet, or exhibit about prairie						
		and native pollinators to share with school and civic						
		groups.						
High School		John VanKempen, high school science teacher from		Х	0%	0.39		\$20,000
Teacher		West Central Area High School, will participate in all						
Researcher		summer research activities, supervise pan trapping						
(Participant)		surveys, coordinate with local landowners and						
		present research findings to educational						
		organizations.						
							Sub	\$324,000
							Total	
Contracts and Services								

Dr. Zach	Professional	Identify field-collected bee specimens at rate of \$2		Х		0.2		\$6,000
Portman	or Technical	per bee. Single-source provider selected due to the						
(UMN Bee	Service	unique and expert skills required for accurate and						
Laboratory)	Contract	efficient bee identification. This contract will be						
		executed as part of Activity 1.						
St. Catherine	Sub award	Summer salary to support Dr. Rahul Roy for 1 month				0.2		\$13,000
University		each summer (2023 & 2024) while he conducts						
		pollen and nectar nutritional assays. Dr. Roy's						
		expertise in molecular biology as well as pollen and						
		nectar biology uniquely positions him to collaborate						
		on this project and perform the biochemical assays.						
St. Catherine	Sub award	Dr. Roy will hire undergraduate students at St.				0.28		\$9,000
University		Catherine University to assist with labwork needed to						
		conduct nutritional assays of pollen and nectar.						
		Students will work 20 hours/week over two 14-week						
		periods. Dr. Roy is uniquely positioned to collaborate						
		on this project and perform biochemical assays.						
							Sub	\$28,000
							Total	
Equipment,								
Tools, and								
Supplies								
	Tools and	Field supplies: 50 emergence traps (\$200/trap) as	These supplies are necessary to					\$12,000
	Supplies	well as pan traps, bee pinning supplies, pin flags,	conduct proposed fieldwork outlined in					
		meter sticks, and other field supplies as well as	Activities 1 & 2.					
		replacement tools for burning.						
	Tools and	Lab supplies for conducting chemical assays to	These lab supplies are needed to					\$14,000
	Supplies	quantify pollen & nectar nutrition. We plan to collect	quantify the nutritional content of					
		and analyze 400 pollen and 300 nectar samples. For	field-collected pollen and nectar					
		each pollen sample, we will analyze carbohydrates	samples (Activity 2).					
		(\$6/sample), lipids (\$6/sample), and total						
		protein/amino acids (\$5/sample) content. For all						
		nectar samples we will analyze carbohydrate						
		(\$6/sample) and total protein/amino acid						
		(\$5/sample) concentrations. We also request funds						
		to analyze 100 nectar samples for micronutrients						
		(\$6/sample) content. In addition to the chemical						
		analyses, we request \$3300 to purchase lab supplies						
		needed to conduct biochemical analyses (chemical						
		I reagants multichannel pipetters 6 well plates tubes		1	1			
		reagents, multichannel pipettors, o wen plates, tubes,						

						Sub Total	\$26,000
Capital Expenditures							
						Sub Total	-
Acquisitions and Stewardship							
						Sub Total	-
Travel In Minnesota							
	Miles/ Meals/ Lodging	Travel from research base in Douglas County to field sites in Douglas, Grant, Pope, and Stevens Counties. Estimated 120 miles per week per person at federal mileage reimbursement rate of \$0.56/mile (2 individuals for 8 weeks during summer 2022 and 4 individuals for 16 weeks during summer 2023 & summer 2024).	Local travel to research sites within Douglas, Grant, Pope, and Stevens Counties.				\$9,500
	Miles/ Meals/ Lodging	Housing near field sites for summer research crew (\$1500/month): July - September 2022 (3 months), April - September 2023 (6 months), and April - September 2024 (6 months).	Renting a house near our study sites in rural western Minnesota minimizes travel and allows us to conduct research efficiently.				\$22,500
						Sub Total	\$32,000
Travel Outside Minnesota							
	Conference Registration Miles/ Meals/ Lodging	Requested funds include travel, meals, and incidentals for one individual.	We request funds for the post-doctoral researcher to travel to an Ecological Society of America or Conservation Biology meeting to present project findings. Attendance at one of these meetings will enhance our ability to conduct the research, disseminate our results, and promote conservation of natural resources in Minnesota & beyond.	X			\$1,500
						Sub Total	\$1,500

Printing and Publication						
	Publication	Publication fees for peer-reviewed scientific papers	These publications will help disseminate our findings to practitioners, policymakers, and scientists across the state of Minnesota and more broadly.			\$9,000
	Printing	Participant costs: print posters, pamphlets, or exhibits developed by high school interns to share information about prairies and native pollinators with their high schools and civic groups.	These presentations will help disseminate our findings to local landowners and groups interested in protecting and enhancing natural prairie resources.			\$500
					Sub Total	\$9,500
Other Expenses						
					Sub Total	-
					Grand Total	\$421,000

#### Category/Name Subcategory or Type Description Justification Ineligible Expense or Classified Staff Request Personnel - High Two local high school students will Our summer research team includes 1-2 interns from local high schools funded by the School Research participate during summer 2023 and National Science Foundation. They are classified as participants instead of employees. Interns another two during summer 2024 We would do the same for ENRTF-funded interns. (Participants) for 10 weeks each summer. These interns from Alexandria, Minnewaska, Morris, or West Central Area will assist with all research activities and gain appreciation about Minnesota's rich natural resources. As part of the internship, students will develop a poster, pamphlet, or exhibit about prairie and native pollinators to share with school and civic groups. Personnel - High John VanKempen, high school Our summer research team includes 1-2 secondary school science teachers funded by School Teacher science teacher from West Central the National Science Foundation. They are classified as participants instead of Researcher Area High School, will participate in employees. We would do the same for ENRTF-funded teacher researchers. (Participant) all summer research activities, supervise pan trapping surveys, coordinate with local landowners and present research findings to educational organizations. Single-source provider selected due to the unique and expert skills required for accurate **Contracts and** Professional or Identify field-collected bee Services - Dr. Zach Technical Service specimens at rate of \$2 per bee. and efficient identification of Minnesota bees. Portman (UMN Contract Single-source provider selected due This is a single source contract. Bee Laboratory) to the unique and expert skills required for accurate and efficient bee identification. This contract will be executed as part of Activity 1. **Travel Outside** Conference Travel to a conference outside the state of Minnesota for postdoctoral researcher to Requested funds include travel, Minnesota meals, and incidentals for one participate in formal presentation of project findings. Registration Miles/Meals/Lodging individual.

### Classified Staff or Generally Ineligible Expenses

### Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub	-
			Total	
Non-State				
In-Kind	The Chicago Botanic Garden's Federally-negotiated indirect cost rate is 55%. This rate is applied to MTDC, which excludes participant support costs (\$421K - 41K).	Unrecovered indirect costs associated with this proposal.	Secured	\$209,000
			Non State	\$209,000
			Sub Total	
			Funds	\$209,000
			Total	

### Attachments

### **Required Attachments**

*Visual Component* File: <u>252ff170-742.pdf</u>

### Alternate Text for Visual Component

Three panels, each with an illustration and a question: 1) Native bees before and after a prairie fire, "Does burning affect bees?"; 2) Bees seeking locations to nest with inset photo of bee, "Do more bees nest in burned areas?"; and 3) Bees and seeking food with inset USDA nutrition label, "Does fire affect the nutritional value of pollen and nectar?"...

### *Financial Capacity* File: <u>b80071bf-1c0.pdf</u>

### Board Resolution or Letter

Title	File
Board Letter	<u>96e60ee9-1ec.pdf</u>

### 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?

No



## **Nesting habitat**

Bees nesting belowground may be protected from fire

Do more bees nest in burned areas?





## Food quantity & quality

More plants flower after fire

Does fire affect the nutritional value of pollen and nectar?

Nutriti Serving Size 3 oz. Serving Per Conta	on Facts
Amount Per Serving	
Calories 200	Calories from Fat 120
	% Daily Value*
Total Fat 15g	20 %
Saturated Fat 5g	28 %
Trans Fat 3g	
Cholesterol 30m	ng <b>10 %</b>
Sodium 650mg	28 %
Total Carbohyd	rate 30g 10 %
Dietary Fiber 0g	0 %
Sugars 5g	
Protein 5g	
Vitamin A E9/	Vitomin C 29/
Calcium 15%	<ul> <li>Iron 5%</li> </ul>
*Percent Daily Values an Your Daily Values may be your calorie needs.	e based on a 2,000 calorie diet. e higher or lower depending on

