Environment and Natural Resources Trust Fund
2016 Request for Proposals (RFP)

Project Title: **ENRTF ID: 003-A**

Data Driven Pollinator Conservation

Category: A. Foundational Natural Resource Data and Information

Total Project Budget: $ 558,611

Proposed Project Time Period for the Funding Requested: 3 years, July 2016 to June 2019

Summary:

Rigorous guidelines are lacking for designing and planning pollinator habitat. We will determine optimal placement of pollinator habitat, ideal plants for native bees, and assess bee pollination of rare plants.

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Sponsoring Organization: U of MN

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Falcon Heights MN 55108

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Location

Region: Central, NW, SW

County Name: Becker, Big Stone, Brown, Chippewa, Clay, Cottonwood, Dodge, Grant, Jackson, Kandiyohi, Kittson, Lac qui Parle, Lincoln, Lyon, Mahnomen, Marshall, Martin, Murray, Nobles, Norman, Otter Tail, Pennington, Pipestone, Polk, Pope, Red Lake, Redwood, Rock, Roseau, Stearns, Stevens, Swift, Traverse, Wadena, Watonman, Wilkin, Yellow Medicine

City / Township:

Alternate Text for Visual:

The following visual shows the region of the Minnesota Prairie Conservation Plan that is focused in the western part of the state. The proposed research will take place in this region. We include a photo of a pollinator habitat planting In addition, a graphical representation of the four activities is provided.

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

PROJECT TITLE: Data Driven Pollinator Conservation

I. PROJECT STATEMENT

1. Why? With billions of dollars to be spent on Minnesota prairie restoration in coming years, there is an urgent need for more information about the habitat requirements of declining pollinators. The primary objective of this project is to provide foundational data and information to guide land managers in Minnesota so they can effectively plan and design habitat for native bees. These insects are among the most important pollinators of native plants and crops. The dramatic decline of some native bees species has motivated government agencies, non-profit organizations, and private landowners to create thousands of acres of pollinator habitat throughout Minnesota. However, it is expensive to install and little information exists on how maximize investments to best support native bees. As public awareness of pollinators increases and creation of pollinator habitat grows, there is an urgent need to develop effective strategies for creating pollinator habitat. A second objective is to determine the pollination effectiveness of native bees within habitat restorations. A goal of restorations is to create functioning, self-sustaining ecosystems and this relies on seed production of native plants. Many plants need bees for seed production however bee species vary in pollination effectiveness. Understanding this variation is important, as it will enable land managers to optimize habitat for bees that are the most effective pollinators and maximize overall success of habitat restorations.

2. Goals and outcomes. Currently, there are no rigorous guidelines to help land managers best implement pollinator habitat. Given this lack of information, the project we propose has ***four main goals***. The ***first goal*** is to determine the best placement of pollinator habitat to maximize value for native bees. Correct location of pollinator habitat is critical. If a habitat is too far from a source population, native bees will not be able to colonize the new habitat. The outcomes of this goal will be guidelines on how distance from remnant prairie sites affects success of pollinator habitat. The ***second goal*** is to determine which plant species are most preferred by native bees. One outcome of this goal is to create a list of plant species that most benefit native bees. A second outcome is to determine whether certain plants benefit rare or declining bee species. A third outcome is to create a list of plant species that are most effective in the early spring when some species must establish their nests. These early blooming plants are critical for a number of bee species, including the economically and ecologically important bumble bees. Spring plants are among the most difficult and costly to establish. The ***third goal*** is to determine which bee species provide the greatest benefit to plants within plantings. The outcome of this goal will be a list of native bees species that quantifies pollination effectiveness for various rare or declining plants. The ***fourth goal*** is to disseminate findings to land managers. The outcomes of this goal will be talks and printed outreach documents.

3. How? In collaboration with TNC, DNR and BWSR, we will select sites near the Minnesota Prairie Conservation Plan. To determine how placement affects success of pollinator habitat, we will collect bees within pollinator habitats at varying distances from remnant prairies. To determine flower use, we will collect bees from flowers using hand nets and record the flower species each bee was visiting. A botanist will conduct flower surveys and identify plants. To determine pollination effectiveness of bee species, we will measure pollen deposition of bee species to a sample of several prairie plants, focusing on 2-3 rare or declining plant species.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Determine most effective placement of pollinator plantings **Budget: $ 206,188**

Native bees will be collected from remnant prairies and at pollinator habitats at varying distances. We will compare native bee communities will be compared across various distances. We will assess impact of surrounding land cover using GIS.

Outcome	Completion Date
1. Compare native bee abundance and diversity in remnant prairies and pollinator habitat	2019
2. Determine how distance from remnant prairies affects success of pollinator habitat	2019

Activity 2: Quantify plant use by bees in remnant prairies and pollinator habitat. **Budget: $ 209,188**
Native bees will be collected from flowers using a hand net. Flower and bee species will be identified. The plants most preferred by native bees will be identified.

Outcome	Completion Date
1. Identify and list which plant species provide the greatest benefit to pollinators in remnant prairies as well as newly created pollinator habitat	2019
2. Identify and list plant species most effective for supporting native bees in spring.	2019

Activity 3: Determine most effective native bee species for pollinating prairie plants. **Budget: $ 137,236**
Pollination effectiveness will be measured for multiple bee species. After a bee species visits a flower, we will record the bee species and count pollen grains on the flower using a compound microscope.

Outcome	Completion Date
1. Quantify pollination effectiveness of bee species to 2-3 rare or declining prairie plants	2019

Activity 4: Disseminate results to land managers. **Budget: $ 6,000**
We will travel throughout the state to meet and present our findings to land managers.

Outcome	Completion Date
1. Give presentations to land managers at meetings	2019
2. Develop and print outreach materials such plant and bee list based on Activities 1-3	2019

III. PROJECT STRATEGY

A. Project Team/Partners

Daniel Cariveau (U MN) will lead the project. Dr. Cariveau is a newly hired Assistant Professor, funded for first three years by ENRTF through proposal "Enhancing Pollinator Landscapes" submitted by Marla Spivak in 2014. He will supervise a PhD student, crew leader and field technicians. Marissa Ahlering (TNC), Dan Shaw (MN BWRS), and Greg Hoch (MN DNR) will act as project advisors and assist in selecting sites, acquiring permits, and provide technical guidance. M. Spivak (U MN) will provide scientific and administrative advice.

B. Project Impact and Long-Term Strategy

This project will provide valuable information to help maximize success of prairie habitat restoration projects. This project will focus on the tallgrass prairie region of Minnesota, as this is the primary area of new pollinator habitat. It will inform efforts such as the Minnesota Prairie Conservation Plan, a $3.5 billion effort with a major focus on restoration. This project will also provide other foundational natural resource data resulting in the most comprehensive assessment of bee-flower relationships in the tallgrass prairie.

This project complements a number of current and proposed LCCMR projects. "Wild Bee Pollinator Surveys in Prairie-Grassland Habitats" led by the DNR is measuring pollinator use of prairie restorations and remnant prairie sites. Our proposal differs from this project in two ways. First, we will be assessing the effectiveness of habitat plantings as they vary by distance from remnant prairies and surrounding landscape. Second, we will collect bees directly from flowers with hand nets instead of using passive bowl traps as is in the DNR surveys. This will allow us to acquire data on flower use by bees in these habitats. These findings will inform the implementation of habitat projects such as "Pollinator & Habitat Enhancement Program" proposed by the Pheasants Forever and BWSR. Finally, "Measuring prairie fragment connectivity" proposed by Lauren Sullivan (U MN), David Moeller (U MN) and Allison Shaw (U MN) seeks to understand how placement of habitat restorations influences gene flow of prairie plants through pollen and seed movement. Our project will complement their work by identifying which species of bees are visiting the flowers in their study.

C. Timeline Requirements

We will conduct this study over 3 complete growing seasons (May-Sep). We will begin site selection in the winter of 2016 and start sampling in May 2016. As LCCMR funds would not be available until July, D. Cariveau will supplement project using already secured start-up funds from the University of Minnesota.

2016 Detailed Project Budget

Project Title: Determining placement, plant use and pollination in wild bee habitat plantings.

IV. TOTAL ENRTF REQUEST BUDGET FOR 3 YEARS

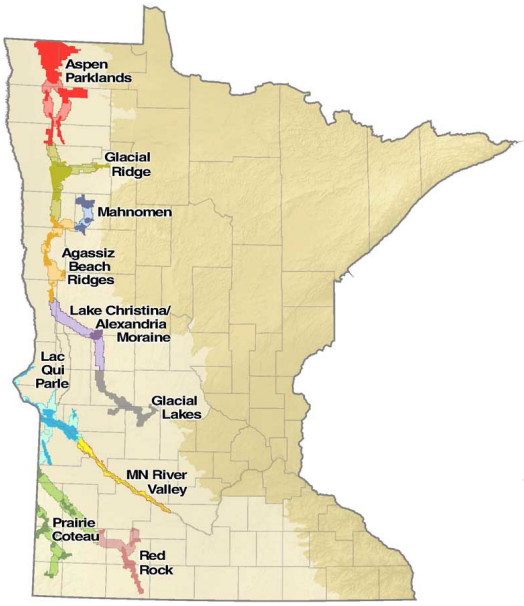
BUDGET ITEM	AMOUNT
Personel: D. Cariveau 6 weeks of summer salary + fringe + 3% COLA fo 3 years ENRTF covering Cariveau 9 mo academic year salary suport 2016-2018 on proposal funded to M. Spivak in 2014)	$ 57,209
Personel: PhD level student advised by Cariveau in Entomology support for 3 years	$ 128,060
Personel: Crew Leader 40,000 year plus 26.3% fringe + 3% COLA for 3 years	$ 156,152
Personel: 3 field technicians for 16 weeks at $15/hr + 26.3% fringe + 3% COLA for 3 years	$ 112,430
Personel: 2 student workers over academic year for 3 years+ 3% COLA for 3 years	$ 21,760
Professional/Technical/Service Contracts: TBD Bee identification at ~$2 per bee for 8000 bees	$ 16,000
Equipment/Tools/Supplies: Insect collection supplies (nets, collecting jars, gps devices to find sites)	$ 2,000
Equipment/Tools/Supplies: Insect curation equipment (drawers, cabinets, insect pins, label paper, barcode software)	$ 5,000
Equipment/Tools/Supplies: Plant collection and curation for type specimens (herbarium, plant presses, herbarium supplies)	$ 3,000
Equipment/Tools/Supplies: Pollination quantification tools (pollen dye, microscope slides, flourscent UV cube)	$ 2,000
Acquisition (Fee Title or Permanent Easements): NA	$ -
Travel: Travel to and from field sites, renting fleet vehicles, hotel/camping, travel to share information with agencies and land ownsers	$ 50,000
Additional Budget Items: Printing of outreach documents and publication costs associated with scientific publication	$ 5,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 558,611

V. OTHER FUNDS

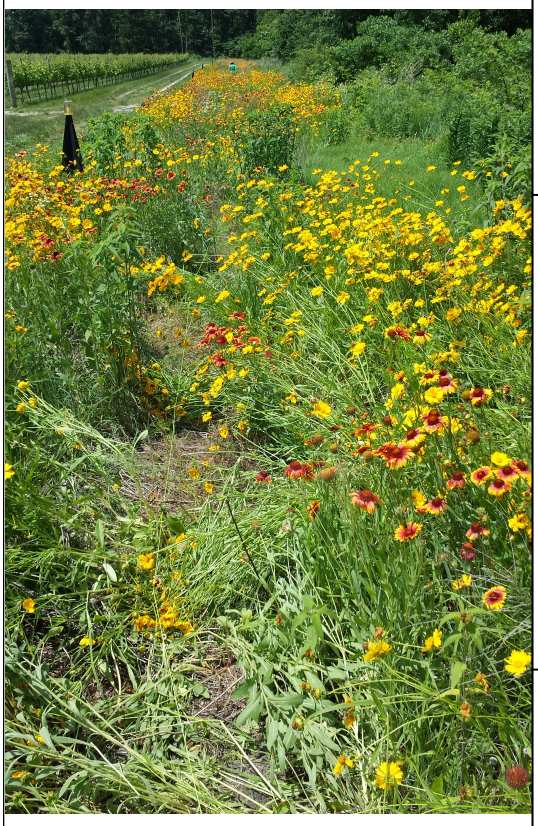
SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period:	NA	*NA*
Other State $ To Be Applied To Project During Project Period:	NA	*NA*
I In-kind Services To Be Applied To Project During Project Period: So that field work can start in spring of 2016, D Cariveau will use start-up funds provided from the University of Minnesota Department of Entomology to begin project. This funding is secured. It will include salary and fringe for field techs ($20,461), crew leader ($8,744), travel ($3500) and equipment ($500).	$ 33,205	*secured*
Funding History: D. Cariveau's 9-month academic year salary is covered by ENRTF award to M. Spivak in 2014, "Enhancing Pollinator Landscapes"	$864,000 to M. Spivak	*secured*
Remaining $ From Current ENRTF Appropriation Salary funds to be spent on D. Cariveau's salary beginning Aug 3, 2015: $329, 144.	$ 329,144	*secured*

Data Driven Pollinator Conservation

Daniel Cariveau, UMN

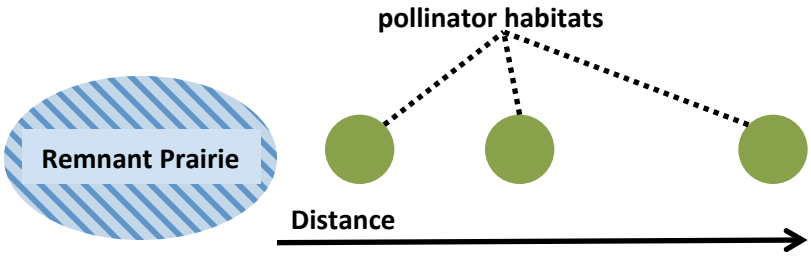


Map showing areas of MN Prairie Conservation Plan. Sites for this project will occur in this region.

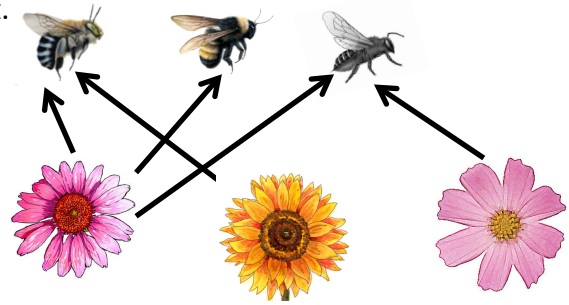


Example of pollinator habitat planting

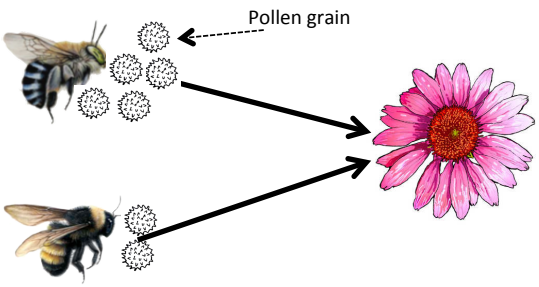
Activity 1. We will determine how distance of pollinator habitat from remnant prairie affects successful colonization of pollinator habitats by native bees.



Activity 2. We will identify which plants are preferred by native bees. We will also determine whether certain plants are preferred by rare or declining bee species. Finally, we will focus on early spring species as these are important but often lacking in new pollinator habitat.



Activity 3. Native bee species vary in the amount of pollen they deposit on flowers. We will record the the number of pollen grains deposited by various bee species to rare and declining plants.



Activity 4: We will disseminate our results to land managers throughout the state with printed materials and presentations.

Project Manager Qualifications/Organization

Daniel P Cariveau, Project Manager
Assistant Professor (Starting August 31, 2015)
Funded for first three years by ENRTF through proposal "Enhancing Pollinator Landscapes" submitted by Marla Spivak in 2014
Department of Entomology; University of Minnesota
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I (D. Cariveau) will supervise research and outreach. I will coordinate with government agencies, non-profit organizations, and private landowners. I will be responsible for report writing and the administering of funds. My main research focus is to understand how landscape and habitat influences native bee abundance and diversity. In addition, I seek to understand how native bees influence the pollination of crops as well as wild plants. I have extensive experience in native bee ecology and am leading a large-scale pollinator habitat project in my current position at Rutgers University in New Jersey. In addition, I am continually involved in outreach that is aimed at land managers, growers and the general public. I will use these skills and my current relationships with conservation professionals in Minnesota to disseminate the results of this project. Finally, my teaching appointment at the University of Minnesota is focused on the native pollinator ecology and will increase to reach of this project.

Representative Publications

Cariveau DP, R Winfree (*In Press*). Causes of variation in wild bee responses to anthropogenic drivers. *Current Opinion in Insect Science*.

Winfree R, J Fox, NM Williams, JR Reilly, **DP Cariveau**. (*In Press*) Abundance of common species, not species richness, drives delivery of a real-world ecosystem service. *Ecology Letters.*

Winfree R, M MacLeod, T Harrison**, DP Cariveau** (*In Press*) The conservation and restoration of mutualisms. In: *Mutualisms*, ed Bronstein, J Oxford University Press, Oxford, UK

Cariveau DP, JE Jenkins, H Koch, R Winfree, NA Moran (2014) Variation in gut microbial communities and its association with pathogen infection in wild bumble bees (*Bombus*) *ISME Journal* 8: 2369-2379

Cariveau DP, N Williams, F Benjamin, R Winfree (2013) Response diversity to land use occurs but does not consistently stabilise ecosystem services provided by native pollinators. *Ecology Letters* 16: 903-911

Kennedy CM, E Lonsdorf, MC Neel, N Williams, TH Ricketts, R Winfree, R Bommarco, C Brittain, A Burley, **DP Cariveau**, and 31 others (2013) A global quantitative synthesis of local and landscape effects on wild bee pollinators in agroecosystems. *Ecology Letters* 16:584-599

Winfree R, N Bartomeus, and **DP Cariveau** (2011) Native pollinators in anthropogenic systems. *Annual Review of Ecology, Evolution, and Systematics* 42:1-22

Organization:

D. Cariveau will supervise new PhD student, crew leader, field techs and student workers. The crew leader will supervise daily activities of field techs and student workers. D. Cariveau will select sites and coordinate with BWSR, DNR and TNC. Outreach will be carried out primarily by D. Cariveau but will also include crew leader and graduate student.