Environment and Natural Resources Trust Fund
2018 Request for Proposals (RFP)

Project Title: **ENRTF ID:**   177-F

Identifying Pollinator Conservation Areas in Minnesota Prairie Parklands

Category: F. Methods to Protect or Restore Land, Water, and Habitat

Total Project Budget: $ 552,100

Proposed Project Time Period for the Funding Requested: 3 years, July 2018 to June 2021

Summary:

This research will produce an on-line, interactive map illustrating current or potential future quality of pollinator conservation areas in Minnesota by considering habitat quality, surrounding land cover, and pesticide risk.

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Sponsoring Organization: U of MN

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Location

Region: Central, Northwest, Southwest, Southeast

County Name: Big Stone, Blue Earth, Brown, Chippewa, Clay, Cottonwood, Dakota, Dodge, Douglas, Faribault, Fillmore, Freeborn, Goodhue, Grant, Jackson, Kandiyohi, Kittson, Lac qui Parle, Le Sueur, Lincoln, Lyon, Mahnomen, Marshall, Martin, McLeod, Meeker, Mower, Murray

City / Township:

Alternate Text for Visual:

Extent of study area and description of research activities

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

PROJECT TITLE: Identifying Pollinator Conservation Areas in Minnesota Prairie Parklands

I. PROJECT STATEMENT

Wild bees are the primary pollinators of native flowering plants and provide important pollination services for many crops. Declines in native bees has prompted state, federal and non-profit organizations to encourage the creation of pollinator habitat throughout Minnesota. While habitat is undoubtedly important to conserving pollinators, key knowledge gaps remain. First, most studies on native bees only consider abundance and bee diversity within new habitats. However, direct population measures such as survivorship and reproductive output are lacking. Quantifying the effect of pollinator habitat on survivorship and reproductive output is essential as these measures govern changes population size. Second, while habitat is critical for pollinators, high pesticide exposure can have dramatic effects on pollinator abundance and diversity and may limit the positive effects of increasing forage quality. Finally, while there is a need to evaluate the benefits and risks of new habitat, a critical step is creating user-friendly tools to enable land managers to comprehensively identify locations for new habitat.

To overcome these knowledge gaps, we will perform three linked activities:
1. Assess the quality of pollinator habitat by quantifying survivorship and reproductive output of bees at trap nests and bumble bee colonies at multiple locations
2. Analyze pesticides collected by bees at trap nests and at bumble bee colonies
3. Develop an on-line, user-friendly map of Pollinator Conservation Areas (PCAs) for the Minnesota Prairie Parklands. This map will consider habitat quality, surrounding land cover, and pesticide risk.

We will leverage ongoing work by co-PI Cariveau who is sampling wild bees on conservation easements in Minnesota's Prairie Parklands. At these sites, Cariveau is quantifying wild bee diversity and abundance. These conservation sites lie along a gradient of land use from low to high amounts of agriculture surrounding each site. Using funding from this proposal, we will evaluate survivorship and reproductive output of cavity nesting bees and bumble bees. Traps nests will be placed at each of the sites. To assess bumble bee colonies, we will collect mated queens of common species in the preceding summer. We will raise colonies at the UMN Bee Lab and place them at conservation sites. We will monitor survivorship, colony growth and reproductive output. In addition, we will sample pollen from the nests and hives and identify the types and amount of pesticides in the pollen collected by these bees.

Using the results of field work, we will leverage existing pollinator habitat mapping procedures developed by PI-Lonsdorf that translate land cover to indicators of pollinator forage and nesting quality for Minnesota (see visual). Prior to this proposed study, these mapping tools do not account for potential pesticide impacts and have depended upon expert opinion-derived parameters. Using our work, we will develop a pesticide exposure index combining county-level data on pesticides used per crop and finer-scale county land cover data on crops and toxicity. These pesticide use data are currently available from the USDA and EPA. We will use our field data on pesticides to fine-tune the pesticide exposure projections. Ultimately, the analysis will allow us to evaluate current and proposed pollinator habitat for their expected potential exposure to pesticides and their overall habitat quality.

We will engage in outreach by placing our maps online so that land managers can evaluate potential habitat creation in terms of potential benefits and risks. We will create a user-friendly web-based decision tool based on the predictive models in Activities 1 and 2 and data from other Minnesota pollinator studies. Users will be able to input multiple potential location for a pollinator habitat planting.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: *Assess pollinator habitat quality by quantifying colony growth and survivorship*   **Budget: $204,100**
We will deploy trap nests for cavity nesting bees (e.g. *Osmia sp.*) and distribute wild bumble bee colonies and monitor colony growth and reproductive success. We will perform our field work on existing MN-DNR and conservation easement sites used by PI, Cariveau, to sample wild bee diversity.

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Outcome	Completion Date
1. Collect bumble bee queens to establish colonies	*2018, 2019*
2. Place bumble bee colonies and empty nest boxes at each site	*2019, 2020*
3. Measure colony reproduction and nest colonization at each site	*2019, 2020*

Activity 2: *Determine pesticide exposure to bees in pollinator habitat*   **Budget: $294,000**

We will determine pesticide exposure from the surrounding landscape. We will collect pollen stored in the colonized nest boxes and pollen loads from bumble bees colonies. We will analyze the pollen for pesticides at each site. We will use information from the EPA's Ecotox database to determine overall risk index to wild bees.

Outcome	Completion Date
1. We will determine pesticides found in the pollen at each study site for each bee group	*2019, 2020*
2. We will develop a pesticide risk index for each site using EPA data on toxicology.	

Activity 3: *Develop bee habitat quality and pesticide risk maps for Minnesota Prairie*   **Budget: $54,000**
Parklands

We will integrate the field data collected here as well as those of other Minnesota pollinator projects to create a map of bee habitat quality and pesticide risk throughout the prairie parklands.

Outcome	Completion Date
1. Use field studies and land cover data to build pollinator habitat quality map	*2021*
2. Use field studies and land cover data to build pesticide exposure map for bees	*2021*
3. Determine pesticide exposure risks of existing easements and protected areas and identify important pollinator protection areas (IPAs)	*2021*
4. Provide on-line tool habitat quality and pesticide exposure maps for outreach	*2021*

III. PROJECT STRATEGY

A. Project Team/Partners

Personnel	Role (activity)	Financial support
Eric Lonsdorf	Project leader (1-3); co-advise postdoctoral researcher	Salary + fringe
Dan Cariveau	Lead field teams for activities 1&2; co-advise postdoctoral researcher	None
Rich Baker (MN-DNR)	Provide project advice and guidance	None
Postdoctoral Researcher	Coordinate field manipulations (3); writing (1-3)	Salary + fringe
Lab Technician	Coordinate nutrient measures (1)	Salary + fringe
GIS Technician	Develop maps for activity 3	Salary + fringe

B. Project Impact and Long-Term Strategy

The final outcome of this project will be identification of "Important Pollinator Areas", core areas of pollinator habitat of Minnesota's Prairie Parklands of high habitat quality and low pesticide exposure. We will develop an online interface of these projections to support future pollinator habitat establishment decisions. This map and approach can then be extended throughout Minnesota as data from other regions become available. Datasets will be made publically available on the digital repository "DRYAD"; publications will be open access. Final recommendations will be made in collaboration with our MN-DNR collaborator and communicated to all relevant stakeholders.

C. Timeline Requirements

The project will take three years (July '18 to June '21).

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Project Title: Developing cost-effective guidance on pollinator habitat improvements

IV. TOTAL ENRTF REQUEST BUDGET *3* **years**

Budget Item:	AMOUNT
Personnel: Eric Lonsdorf – (PI) will oversee all activities and is requesting 2 months of salary each year. (75% salary, 25% benefits)	$63,000
Personnel: Dan Cariveau – (co-PI) will oversee field activities 1 and 2 - no salary requested	$0
Personnel: One postdoctoral associate will direct activities 1 & 2. (100% FTE for 3 years; 82% salary, 18% benefits)	$193,000
Personnel: A lab technician will help coordinate surveys and sample processing for two years during the project (activities 1 & 2). (100% FTE for 2 years; 79% salary, 21% benefits)	$120,000
Personnel: A GIS technician will help gather spatial data and develop habitat and pesticide exposure maps for activity 3. (50% FTE in year 3; 79% salary, 21% benefits)	$31,000
Travel and lodging: Travel to sites for sampling pollinators (approx 8000 miles per year for 16 weeks of travel and 500 miles per week). Lodging for 64 nights and food for 80 days for two people - activities 1 & 2.	$42,100
Equipment/Tools/Supplies: Cavity nests and bumble bee colony boxes for activities 1 & 2	$5,000
Additional Budget Items: Pesticide analysis for ~5 nests and colonies at ~30 sites each year ($300 per sample) to be analyzed externally.	$90,000
Additional Budget Items: Costs of *open-access* research publications.	$8,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$552,100

V. OTHER FUNDS

| SOURCE OF FUNDS	AMOUNT	STATUS
Other Non-State $ To Be Applied To Project During Project Period:	N/A	N/A
Other State $ To Be Applied To Project During Project Period:	N/A	N/A
In-kind Services To Be Applied To Project During Project Period:	N/A	N/A
Past and Current ENRTF Appropriation:		
Cariveau (PI): Data Driven Pollinator Conservation In Tallgrass Prairies	$520,000	Secured
Cariveau (Co-PI) - Minnesota Bee and Beneficial Species Habitat Restoration	$202,037	Pending
Other Funding History:		
Lonsdorf (co-PI): Developing Sustainable Pollination Strategies for U.S. Specialty Crops. USDA-Specialty Crop Research Initiative.	$115,000	Expires 7/31/17
Lonsdorf (PI): CRP Land Management and Pollinator Health. USDA – Economic Research Service	$92,000	Expired 12/31/16
Lonsdorf (co-PI): Reassembling pollinator communities to promote pollination function at the landscape scale. National Science Foundation	$206,601	Expired 8/31/13

Activity 1: *Assess pollinator habitat quality by quantifying colony growth and survivorship*
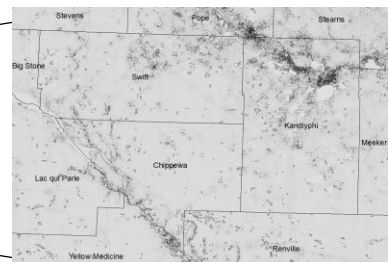

Activity 2: *Determine pesticide exposure to bees in pollinator habitat*

Activity 3: Develop bee habitat quality and pesticide risk maps for Minnesota Prairie Parklands
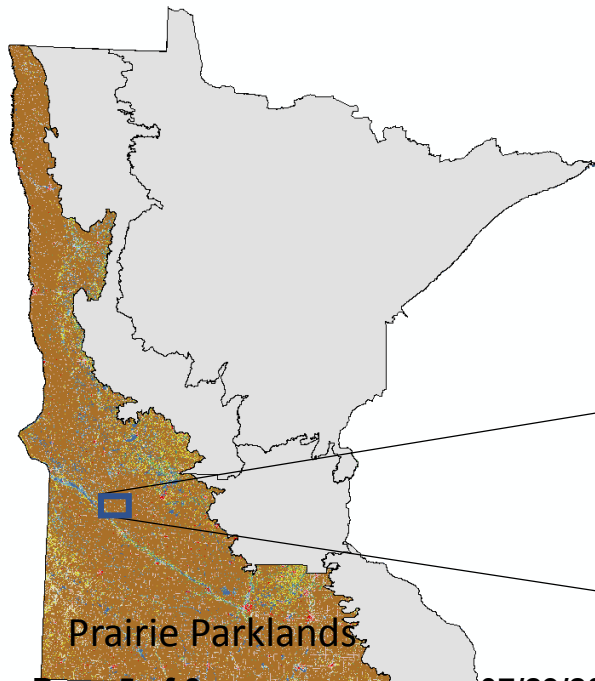
Close-up example of pollinator conservation area map. Darker areas represent higher quality locations for pollinator habitat.

Prairie Parklands

VI. Project Manager Qualifications and Organization

Eric V. Lonsdorf, Project Manager
Lead Scientist, Institute on the Environment, University of Minnesota
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Organization

The mission of the Institute on the Environment is to discover solutions to Earth's most pressing environmental problems by conducting transformative research, developing the next generation of global leaders and building world-changing partnerships. The Institute supports programs addressing global food and agricultural systems, ecosystem services, water resources, sustainable enterprise, and environmental leadership. At the University of Minnesota, the Institute on the Environment coordinates and accelerates translational research through discovery programs like the Natural Capital Project, and through a network of faculty and research scholars across numerous departments and colleges.

Recent Awards and Grants

- USDA-Economic Research Service - CRP Land Management and Pollinator Health. $92,000 (7/1/15 – 12/31/16)
- National Science Foundation Collaborative Research (Co-PI with Dan Larkin) - Testing the effects of phylogenetic diversity on restoration outcomes in tallgrass prairie. $318,738 (9/1/14 – 8/31/19).
- USDA-Specialty Crop Research Initiative (Co-PI with several others) - Developing Sustainable Pollination Strategies for U.S. Specialty Crops, $115,000 - total grant budget: $9,800,000 (9/1/12 – 8/31/17)

Relevant Publications

- Williams, N. M. and **E. Lonsdorf**. Selecting cost-effective plant mixes to support pollinators. In review, *Biological Conservation*.
- Koh, I., **E. V. Lonsdorf**, N. Williams, C. Brittain, R. Isaacs, J. Gibbs and T. H. Ricketts. 2016. Modeling the status, trends, and impacts of wild bee abundance in the United States. *Proceedings of the National Academy of Sciences* 113: 140-145.
- Olsson, O. A. Bolin, H. Smith, and **E. Lonsdorf**. 2015. Modeling pollinating bee visitation rates in heterogeneous landscapes from foraging theory. *Ecological Modelling* 316: 133-143.
- Kennedy, C.K., **E. V. Lonsdorf**, et al (38 more authors). 2013. A global quantitative synthesis of local and landscape effects on native bee pollinators in agroecosystems. *Ecology Letters* 16: 584-599.
- **Lonsdorf, E.**, C. Kremen, T. Ricketts, R. Winfree, N. Williams, and S. Greenleaf. 2009. Modelling pollination services across agricultural landscapes. *Annals of Botany* 103: 1589–1600.

Selected relevant publications by research team members

- **Cariveau**, D. P. and R. Winfree. 2015. Causes of variation in wild bee responses to anthropogenic drivers. *Current Opinion in Insect Science* 10: 104-109
- **Cariveau**, D. P., N. M. Williams, F. E. Benjamin, R. Winfree. 2013. Response diversity to land use occurs but does not consistently stabilize ecosystem services provided by native pollinators. *Ecology Letters* 16: 903-911.