

**Environment and Natural Resources Trust Fund**

# 2021 Request for Proposal

## **General Information**

**Proposal ID:** 2021-422

**Proposal Title:** Healthy Prairies III: Restoring Minnesota's Prairie Plant Diversity

## **Project Manager Information**

**Name:** Ruth Shaw

**Organization:** U of MN - College of Biological Sciences

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**Email:** shawx016@umn.edu

## **Project Basic Information**

**Project Summary:** We will collect native seed throughout Minnesota's prairie region, study microbial effects on plant survival, estimate the geographic scale and rate of adaptation, and communicate results aiding restoration and propagation.

**Funds Requested:** $531,000

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

**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): NW, SW, Metro, Central,

**What is the best scale to describe the area impacted by your work?** Region(s): NW, Central, SW,

**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.**

The widely supported goal of preserving and restoring the extraordinarily diverse plant and microbial life harbored in MN prairies presents serious, pressing challenges. This work is critically important in the face of habitat loss and rapid environmental change, which threaten the persistence of the once vast prairie and its stunning biotic diversity, which nurtures wildlife, purifies water and retains topsoil. Loss of prairie and prairie plant diversity touches Minnesotans across the state, because it impairs hunting and fishing, water quality of rural areas, and the ability to cultivate beautiful and sustainable landscapes on private and public lands. Our proposed and ongoing work will address critical problems that hinder cost-effective and sustainable restoration of the iconic Minnesota prairie biome for diverse uses. Land managers working to restore and preserve prairie need greater availability of seed and improvements in methods for propagating diverse plants appropriate to any one region, and well as the knowledge base to understand how diverse plants and beneficial microbes adapt to the varied landscape of MN prairies.

**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 request a third funding allocation to the Healthy Prairies Project to further realize the tremendous investment in preservation of MN prairie plant diversity, and to provide essential resources and information for prairie restoration. By evaluating the geographic scale and rate of adaptation by diverse prairie plants, and the beneficial roles of microbes, our project will guide seed deployment and improve the success of new plantings across the greatly varied environments of MN prairies. Motivated by these goals, we will build on the extensive accomplishments of two previous phases of funding and further the acquisition and propagation of materials and knowledge necessary for prairie restoration that is resilient to environmental challenges. Our team at UM-TC and UM-Morris and more than 50 volunteers have devoted over 2500 arduous hours at 66 prairie remnants across the state, collecting seeds of 90 native prairie species, retaining extensive genetic variation while tracking locality. We have shared early findings with land managers and provided seeds to producers who bring source-identified seeds to market. Because most prairie species are long-lived, our work has just now reached the crucial point of realizing the full benefits of the LCCMR's considerable investment.

**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?**

• Preserve diverse seed from 10 of the rarer prairie species, and develop methods for propagating them.
• Develop protocols for the use of beneficial microbes to improve plants' survival in conversion of marginal agricultural land to resilient prairie.
• Evaluate the distance over which prairie plants or seeds can be translocated into restorations without severely compromising survival and reproduction.

## **Activities and Milestones**

### **Activity 1: Preserving prairie plant diversity for conservation and restoration**

**Activity Budget:** $57,484

**Activity Description:**Working with our partners across MN, we will increase the availability of source-identified seed for use in MN prairie restorations. New collections will target 10 rarer yet important prairie species. Efforts will be evaluated via the amount and diversity of seed collected, by the number of species for which propagation methods are developed, and by the degree of partner involvement. Having consulted with land managers and seed producers over the past three years, we have learned which species groups are most needed. Through these consultations, we have also developed a careful approach to transferring seeds to producers, several of whom have now received numerous collections of seeds that we are authorized to distribute. We will extend our collecting efforts to gather additional seeds, focusing on groups of species that are most desired, but least available, for restorations.

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Continue to establish material transfer agreements with producers and to transfer seeds to them. | 2023-06-30 |
| Develop propagation methods for species that are currently difficult to propagate. | 2023-06-30 |
| Expand availability of source-identified seed by collecting 10 additional species from geographically widespread locations. | 2023-06-30 |

### **Activity 2: Characterizing beneficial microbes: the hidden partners in prairie restoration.**

**Activity Budget:** $234,073

**Activity Description:**We will use experimental plantings in the field and greenhouse to determine the beneficial impact of naturally occurring microbes for two types of plants essential to healthy prairies - legumes and grasses. Results will inform land managers about the role of beneficial microbes for successfully establishing new prairie restorations, and provide these mangagers with locally-sourced microbes.
\*We request an addition semester of support for the graduate student who will be carrying out this work, above our previously approved request. The additional support will allow the student to test a broader range of conditions for microbial enhancement of little bluestem's tolerance of drought and inundation , and thus generate results that have broader application across MN.

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Compare early seedling survivorship and establishment in Dalea spp. with and without beneficial microbe inoculation. | 2022-10-31 |
| Compare drought and inundation tolerance of little bluestem grass with and without beneficial fungal inoculation. | 2023-06-30 |

### **Activity 3: Evaluating adaptive genetic diversity of prairie plants**

**Activity Budget:** $239,443

**Activity Description:**Continue field experiments to characterize the spatial scale of local adaptation for six prairie perennials. This work focuses on four field sites. In all sites, each of the six species is represented by twelve populations originally sampled from throughout the prairie region late in 2014. We assess survival and reproduction of all individuals planted. In a second major study, we are focusing on little bluestem grass evaluating, for two populations, genetic variation for survival and reproduction, and assessing effects of interbreeding between them. We have shared interim results with land managers in response to their requests for advice about restoration practices. Our further results will better inform methods of prairie conservation and restoration that maintain genetic diversity and optimize use of genetic resources.

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Evaluate pedigreed little bluestem populations in field experiments to assess their genetic capacity to adapt. | 2023-06-30 |
| Monitor survival, growth, and reproduction in established experiments with 6 species and over 6000 plants. | 2023-06-30 |

## **Project Partners and Collaborators**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Organization** | **Role** | **Receiving Funds** |
| Dr. Margaret Kuchenreuther | Division of Science and Mathematics, University of Minnesota-Morris | Dr. Kuchenreuther leads efforts to gather seeds of prairie species. Through her classroom teaching, she trains the undergraduates who carry out this work. She supervises them through the collection process. | Yes |
| Dr. Georgiana May | Department of Ecology, Evolution and Behavior, CBS, University of Minnesota-TC | Dr. May leads research investigating the diversity of microbial symbionts of prairie plants, as well as their effects on the plants. | 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?**Given the long lifespans of prairie plants and complexity of microbial plant communities, continuing the established project through further field seasons (2021 – 2023) is required to accomplish its goals.

This proposal is comparable to our submssion for funding beginning July 2020. The current budget includes an additional semester of funding to support a graduate student for this work, as well as UMN required increases in salary and fringe. If both proposals are funded, the research could continue during 2020-2021, without pause, and then proceed through June 2023, yielding considerably more evidence for interpretations than if one or neither is funded.

## **Other ENRTF Appropriations Awarded in the Last Six Years**

|  |  |  |
| --- | --- | --- |
| **Name** | **Appropriation** | **Amount Awarded** |
| Preserving Minnesota Prairie Plant Diversity – Phase II | M.L. 2017, Chp. 96, Sec. 2, Subd. 03c | $900,000 |
| Prairie Sustainability through Seed Storage, Beneficial Microbes, and Adaptation | M.L. 2014, Chp. 226, Sec. 2, Subd. 06c | $600,000 |

## **Project Manager and Organization Qualifications**

**Project Manager Name:** Ruth Shaw

**Job Title:** Professor, Department of Ecology, Evolution and Behavior, University of Minnesota

**Provide description of the project manager’s qualifications to manage the proposed project.**B.A. Biology 1976 Oberlin College, Oberlin, Ohio;
Ph.D. Botany and Genetics 1983 Duke University, N. Carolina
Post-doctoral in Genetics 1984-1986 University of Washington, NIH Fellow

Throughout my career, my research has addressed fundamental questions regarding adaptation in native plant populations and has also yielded guidance for managing impacts of human disturbance, including climate change, introduction of invasive plants, and the fragmentation of populations into small remnants. In my 27 yr at UM, I have mentored graduate students’ experimental studies of adaptation in prairie plant populations, and for 20 yr I have led UM’s participation in an NSF-funded long-term experimental study investigating the evolutionary consequences of severe fragmentation of prairie populations of purple coneflower, Echinacea angustifolia (collaboration with Dr. Stuart Wagenius of the Chicago Botanic Garden: http://echinacea.umn.edu). Among the key results of these studies are demonstration of: degree of local adaptation to present-day habitats and limits to rates of adaptation to climate change in partridge pea, Chamaecrista fasciculata, dramatic reduction in seed production of progeny from crosses between prairie plant populations, large differences in survival and fecundity among remnant populations, and exceptionally severe inbreeding depression affecting growth and fitness in purple coneflower (all reported in leading scientific journals). Moreover, with colleagues, I have developed an approach for analyzing data on individual survival and fecundity, the central measures of adaptation. Because this approach provides far more precise inferences about adaptation than previously possible, it is crucially important to the success of our ongoing research.
I have led the Healthy Prairies Project since it began in 2014. A dedicated, hard-working team has advanced the ambitious goals of this project, and key collaborators Drs. May, Kuchenreuther, and Flint remain committed to accomplishing these aims.

**Organization:** U of MN - College of Biological Sciences

**Organization Description:**The mission of the Department of Ecology, Evolution and Behavior within the College of Biological Sciences is to advance and disseminate knowledge spanning the fields of ecology, evolution and behavior through excellence in theoretical, experimental, and field research; undergraduate and graduate education; scholarly activities; and outreach. The integration of this knowledge across levels of biological complexity is a prerequisite to addressing many of the biological and environmental challenges facing society.

## **Budget Summary**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Category / Name** | **Subcategory or Type** | **Description** | **Purpose** | **Gen. Ineli gible** | **% Bene fits** | **# FTE** | **Class ified Staff?** | **$ Amount** |
| **Personnel** |  |  |  |  |  |  |  |  |
| Dr. Ruth Shaw |  | PI |  |  | 26.7% | 0.08 |  | $19,337 |
| Dr. Georgiana May |  | Co-PI |  |  | 26.7% | 0.08 |  | $17,633 |
| Dr. Margaret Kuchenreuther |  | Collaborator |  |  | 26.7% | 0.12 |  | $19,795 |
| Postdoc Associate |  | Postdoc will work on Activity 3 for 2 years. |  |  | 20.25% | 2 |  | $133,398 |
| 2 Graduate Students |  | 50% FTE graduate students - Support is requested for two semesters in year 1 plus one semester plus the summer in year 2 under Activity 2. Also, support is requested for one semester in year 1 plus one semester plus summer in year 2 under Activity 3. Tuition included in academic year support. |  |  | 44.1% | 1.18 |  | $124,398 |
| 5 Undergraduate Students |  | Undergraduate students to work on activities 1-3. |  |  | 0% | 0.46 |  | $54,415 |
| Lab Tech |  | 100% FTE Lab Tech |  |  | 24% | 2 |  | $98,657 |
|  |  |  |  |  |  |  | **Sub Total** | **$467,633** |
| **Contracts and Services** |  |  |  |  |  |  |  |  |
| Consultant | Professional or Technical Service Contract | Northern MN seed collections |  |  |  | - |  | $6,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$6,000** |
| **Equipment, Tools, and Supplies** |  |  |  |  |  |  |  |  |
|  | Tools and Supplies | field and lab supplies | seed collection, censuses, microbial culturing |  |  |  |  | $11,866 |
|  |  |  |  |  |  |  | **Sub Total** | **$11,866** |
| **Capital Expenditures** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Acquisitions and Stewardship** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Travel In Minnesota** |  |  |  |  |  |  |  |  |
|  | Miles/ Meals/ Lodging | Travel to field sites for seed collection (Activity 1) and microbial sampling (Activity 2), establishing and monitoring experimental plots (Activities 2, 3), and seed increase plots in Rosemount. Total travel estimated: 30K mi in MN, w/ 180-hotel person overnights, over 2 yrs. All travel to be conducted per UMN Policy as required in Guidelines On Allowable Expenses. | Travel to field sites for seed collection and microbial sampling and establishing and monitoring experimental plots. |  |  |  |  | $28,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$28,000** |
| **Travel Outside Minnesota** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Printing and Publication** |  |  |  |  |  |  |  |  |
|  | Publication | $3,000 per year requested for publication of research results (page charges). | Dissemination of research results. |  |  |  |  | $6,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$6,000** |
| **Other Expenses** |  |  |  |  |  |  |  |  |
|  |  | Lab Services - Analsysis | UM Genomics Center - sequencing, 4 analyses (of 200 samples) @ $2,000 each |  |  |  |  | $8,000 |
|  |  | Greenhouse Fees | UM GH - 800 sq. ft for 12 months over 2 years, at $0.8 per sq. ft. per month, per current UMN greenhouse rental rates |  |  |  |  | $3,301 |
|  |  | Mailing or Courier Fees | Send seeds collected by collaborators at outstate sites to UMN. | X |  |  |  | $200 |
|  |  |  |  |  |  |  | **Sub Total** | **$11,501** |
|  |  |  |  |  |  |  | **Grand Total** | **$531,000** |

### **Classified Staff or Generally Ineligible Expenses**

|  |  |  |  |
| --- | --- | --- | --- |
| **Category/Name** | **Subcategory or Type** | **Description** | **Justification Ineligible Expense or Classified Staff Request** |
| **Other Expenses** |  | Mailing or Courier Fees | Mailing or courier fees to cover shipping of seeds collected by collaborators at sites outside MN to UMN. |

### **Non ENRTF Funds**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Category** | **Specific Source** | **Use** | **Status** | **Amount** |
| **State** |  |  |  |  |
| In-Kind | Indirect costs associated with this project. | Indirect costs | Potential | $269,000 |
|  |  |  | **State Sub Total** | **$269,000** |
| **Non-State** |  |  |  |  |
|  |  |  | **Non State Sub Total** | **-** |
|  |  |  | **Funds Total** | **$269,000** |

## **Attachments**

### **Required Attachments**

#### **Visual Component**

File: [f4e72bc7-a33.pdf](https://lccmrprojectmgmt.leg.mn/media/map/f4e72bc7-a33.pdf)

#### **Alternate Text for Visual Component**

Shaw\_2020\_Graphic. Counter-clockwise from the top left, we show Activity 1: Ordway prairie a seed collection site with an inset showing propagation methods; Activity 2: using beneficial microbial collections to enhance seedling establishment and growth; Activity 3; Assessing adaptive genetic diversity of prairie plants with three outstate evaluation sites (green rectangles) and collection sites for prairie species across MN (blue and red dots).

## **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