**PROJECT TITLE:** **Healthy Prairies III: Resources for restoring MN prairie plant diversity**

**I. PROJECT STATEMENT**

We request a third funding allocation to the Healthy Prairies Project to further realize the tremendous investment in the preservation of MN prairie plant diversity, and to provide essential resources and information for prairie restoration. We will:

* Preserve diverse seed from 20 of the rarer prairie species, and develop methods for propagating them.
* Evaluate roles of beneficial microbes in successful conversion of marginal agricultural land to resilient prairie.
* Evaluate the decline of prairie plant survival and reproduction with distance from source.

We will build on the extensive accomplishments of two previous phases of funding (2014-2020) and garner the materials and knowledge necessary to 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 hours at 66 prairie remnants, collecting seeds of 90 native prairie species, retaining extensive genetic variation while tracking locality. We have also cultured over 5000 microbes from prairie plants. Among our experimental results are indications that a) Dalea (prairie clover) transplanted closer to their source site establish more beneficial microbial associations and b) prairie plant adaptation depends on environmental similarity as well as proximity. All our efforts address the critical need to maintain and restore Minnesota’s native prairies.

Project results will guide seed deployment and optimize the success of new plantings across the greatly varied environments of MN prairies, thereby addressing pressing challenges to the preservation and restoration of the extraordinarily diverse plant and microbial life harbored in MN prairies. This work is critically important as habitat loss and rapid environmental change threaten the persistence of the once vast prairie and its stunning biotic diversity that nurtures wildlife, purifying water and retaining topsoil*.* Moreover, limited understanding of this diversity and insufficient seed availability hinder cost-effective and sustainable restoration of the iconic Minnesota prairie biome. We actively communicate with stakeholders in prairie restoration to provide essential resources and information emerging from our work. Thus, project outcomes contribute to the economic and ecological well-being of Minnesota’s public by providing information and materials supporting prairie restoration.

**II. PROJECT ACTIVITIES AND OUTCOMES**

|  |  |
| --- | --- |
| **Activity 1:** **Preserving prairie plant diversity for conservation and restoration**  **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 20 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. | **ENRTF BUDGET: $185,187** |

|  |  |
| --- | --- |
| **Outcomes** | **Completion Date** |
| *1.* Establishmaterial transfer agreements with producers. | *2021* |
| *2.* Research propagation methods for species that are currently difficult to propagate. | *2022* |
| *3.* Increase availability of source-identified seed for use in MN prairie restorations through collection of 20 additional species from geographically widespread locations.Deposit voucher specimens at UM. | *2023* |

|  |  |
| --- | --- |
| **Activity 2:** **Beneficial microbes: hidden partners in prairie restoration.**  **Description:**We will use experimental plots to determine the diversity and effect of naturally occurring microbes for two types of plants essential to healthy prairies - legumes and grasses. Results will inform land managers about the use and role of beneficial microbes for successfully establishing new prairie restorations after conversion of marginal agricultural land. | **ENRTF BUDGET:**  **$503,303** |

|  |  |
| --- | --- |
| **Outcomes** | **Completion Date** |
| *1.* Determine changes in soil nutrients, organic matter, and microbial communities after conversion of marginal agricultural fields to prairie plantings. | *2022* |
| *2.* Assess the role of beneficial microbes in drought tolerance of little bluestem in greenhouse and field experiments. | *2022* |
| *3.* Evaluate the role of beneficial nitrogen-fixing microbes for prairie clover (Dalea spp.) establishment and growth in new restorations, compare local and more distant plant-microbe combinations. | *2023* |

|  |  |
| --- | --- |
| **Activity 3:** **Adaptive genetic diversity of prairie plants**  **Description:**Continue field experiments to characterize the spatial scale of local adaptation for 6 prairie perennials, evaluate genetic variation for survival and reproduction of little bluestem grass, and assess effects of interbreeding between its populations. Results will inform methods of prairie conservation and restoration that maintain genetic diversity. | **ENRTF BUDGET: $439,510** |

|  |  |
| --- | --- |
| **Outcomes** | **Completion Date** |
| *1.* Continue monitoring established experiments with over 6000 plants in 3 sites to evaluate the effect of seed source on survival, growth, and reproduction in prairie plants within restorations. | *2023* |
| *2.* Evaluate pedigreed little bluestem populations in field experiments to assess their genetic capacity to adapt to varied environmental conditions. | *2023* |

**III. PROJECT PARTNERS AND COLLABORATORS:**

**A. Project Team/Partners**

*Project Team*  - R. G. Shaw, UM-TC; G. May, UM-TC; L. Kinkel (UM-TC collaborator); M. Kuchenreuther UM-Morris (collaborator; coordinating efforts in Western MN), S. Flint and A. Pozzi (postdocs). *Partners –* MN DNR; Drs. D. Moeller and D. Wyse UM-TC; J. Shaub (collector, N. MN); MN Crop Improvement Association; The Nature Conservancy (TNC); MN Native Plant Society; MN Master Naturalists, US Fish and Wildlife Service Prairie Restoration Initiative.

**B. Project Impact and Long-Term Strategy**

With LCCMR funding 2014 and 2017, the Healthy Prairies team committed their efforts to build this project over at least 10 yr because the conservation of these long-lived perennials is necessarily a long-term effort. We are now poised to translate the information and materials developed through previous funding into contributions to successful prairie preservation and restoration – methods to improve propagation of source-identified seed collections for 90 prairie species and of microbial symbionts that promote prairie plant establishment, improved practices widely disseminated through our extensive outreach, and continued evaluation of plant survival and reproduction in experimental plantings. The HPP serves four major MN geographic regions across the native prairie through our active outreach to citizens, the TNC, the DNR, and seed suppliers. Increasing supply of source-identified seed and beneficial microbes, while addressing open questions, the project will help restore and conserve the diversity of MN prairies and of their associated wildlife and pollinators, and improve soil and water quality.

The HP project leverages funding and expertise from seed collection infrastructure developed with NSF funding (Shaw and colleagues), from NSF-funded microbial research (May and colleagues), and from cooperative agreements with TNC and MN DNR. Continuation of this work will greatly expand the knowledge base and improve the guidance to land managers and our outreach to the MN public**.** Future research to address basic questions may be funded through NSF, while the production of locally sourced and certified seed is facilitated through our material transfer agreements with local producers of native plant seed. The production of inoculum for beneficial microbes will be funded through the USDA or contracts with commercial providers.

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:**

Given the long lifespans of prairie plants and complexity of microbial plant communities, continuing the established projects through three more field seasons (2020 – 2023) is required to advance the stated goals.