Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)

Project Title: **ENRTF ID: 015-A**

Comparison of Burning and Haying for Prairie Restoration

Category: A. Foundational Natural Resource Data and Information

Sub-Category:

Total Project Budget: $ 345,599

Proposed Project Time Period for the Funding Requested: June 30, 2024 (4 yrs)

Summary:

This project will test how the frequency and timing of haying, used alone or combined with prescribed burning, can promote biodiversity and pollinator habitat in prairie.

Name: Daniel Hernandez

Sponsoring Organization: Carleton College

Job Title: Associate Professor of Biology

Department:

Address: One North College Street

Northfield MN 55057

Telephone Number: (507) 222-5643

Email dhernand@carleton.edu

Web Address:

Location:

Region: Northwest

County Name: Becker, Mahnomen

City / Township: numerous

Alternate Text for Visual:

Prairie haying restoration project location (Lake Agassiz Beach Ridges Prairie Region) and a schematic showing the basic experimental design.

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

PROJECT TITLE: Comparison of Burning and Haying for Prairie Restoration

I. PROJECT STATEMENT

Virtually all of Minnesota's threatened bird and invertebrate species depend on endangered prairie ecosystems, yet prairie is the least protected ecosystem in the state. Prairie is essential habitat for pollinators and provides key nesting areas for species of waterfowl, pheasants, and greater prairie-chickens. The preservation and restoration of prairie is challenging because the now-fragmented prairies must be actively managed with regular disturbance to prevent encroachment by woody plants and invasive grasses, and maintain populations of sensitive, native species. Historically, this management has been performed with prescribed burning. However, prescribed burning is costly and logistically challenging, requiring trained burn crews and ideal weather conditions. To expand prairie restoration capacity across Minnesota, additional cost-effective strategies such as haying must be investigated to increase habitat quality for all prairie-dependent species.

Can haying increase prairie quality and reduce costs relative to burning? Many prairie species require frequent disturbance. Haying can provide this disturbance by removing plant biomass, increasing light availability, and removing nutrients from the system. While no management strategy universally benefits all native species, haying may increase plant diversity and floral resources for pollinators, while being economically and logistically favorable to prescribed burning. The 2011 Minnesota Prairie Conservation Plan states that restoration of prairie (using burning, haying, or grazing) is needed on over 500,000 acres for long-term conservation. Thus, our findings will inform management on hundreds of thousands of acres of prairie.

Our GOAL is to provide land managers with clear evidence of the impacts of haying and burning on prairie biodiversity and pollinator habitat. Prairie management has been the focus of past LCCMR-funded projects, but land managers at the DNR, The Nature Conservancy, and elsewhere must have rigorous evidence on the ecological tradeoffs between burning vs. haying before haying can be considered as a management tool. This will allow managers to make informed decisions about how to allocate limited resources. This project builds upon past LCCMR projects – one that reported best management practices of haying for bioenergy, and an observational study of the biotic condition of burned and grazed prairies in western MN. Our project differs from these because our goal is to investigate the use of haying as a tool for restoration enhancement.

The **OUTCOMES** we plan to achieve are to:

1) Quantify the effectiveness of haying to promote restoration success, including increased native plant diversity (particularly native forbs), decreased abundance of invasive species, increased floral abundance and diversity to enhance pollinator habitat, and decreased soil nutrient content;
2) Understand how the timing of haying and interactions with burning affect restoration success; and
3) Communicate our findings with both scientific and land management communities via site visits, peer-reviewed publications, and a restoration strategies report and brochure for land managers.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: ***Establish an experiment to test the impacts of haying on 10 prairies*** **Budget: $ 62,428**

Our experiment will target 10 privately-owned conservation properties in western MN. The 10 prairies selected will all be remnant prairies that range in habitat quality, with an emphasis on more degraded prairies dominated by non-native species. The experiment will include six treatments with all combinations of Burning (unburned or burned) and Haying (not hayed, annually hayed, or hayed every other year). Five of the 10 sites will be burned in 2020, the other half will be burned in 2021. Each treatment area will be large enough to determine effects on habitat quality, while minimizing the unmanaged footprint (since lack of any disturbance may have negative effects on prairie habitat).

In degraded prairies, disturbance alone may not be sufficient to restore biodiversity. Therefore, we will also include a seed addition experiment. Native seed will be added to sub-plots of each treatment in three mixtures (diverse prairie mix, CRP mix, and a mix designed to promote pollinators). Seed additions will allow us to test whether disturbance alone, or in combination with seeding is needed to maximize restoration success.

Haying and burning treatments will consider impacts on pollinators and other grassland species.
Haying and burning will be applied according to best management practices to minimize impacts on pollinators and nesting birds. Burning will occur in spring. Haying will occur in late summer. Haying will only target a portion of the total site area (less than 80 acres, as recommended by best management practices) to maintain cover and floral resources for pollinators throughout the season.

Outcome	Completion Date
1. Establish experimental plots and sampling locations	*Summer 2021*
2. Complete initial prescribed burning treatments	*Spring 2021*
3. Sow seeds for seed addition project	*Fall 2021, 2022*
4. Perform haying treatments	*Fall 2021 through 2024*

Activity 2: *Quantify the impacts of haying and burning on prairies in western MN* **Budget: $239,904**

Over 4 years our project team and trained botanists will measure the effects of haying and burning treatments on plant diversity and soil health. We will measure changes in plant diversity, floral abundance, and light levels, as well as soil nutrient availability. We will publish our results in the scientific literature.

Outcome	Completion Date
1. Annual sampling of plant diversity, floral abundance, and light levels	*August 2021 through 2024*
2. Annual soil sampling for nutrient availability	*August 2021 through 2024*
3. Data set produced and results published	*June 2025*

Activity 3: *Communicate results to land managers and the scientific community* **Budget $43,267**

We will maximize the Haying Project's educational impact from implementation to publishing results.
The findings will add significantly to scientific understanding of the effects of restoration strategies (via peer-reviewed publications) and directly inform on-the-ground management (via a manager-oriented report and brochure we will produce and help distribute through colleagues in the conservation community). The report and brochure will describe the relative effectiveness of haying and burning and the estimated costs associated with implementation of each management tool. We will also organize site visits for private land owners and land managers from US Fish and Wildlife, MN DNR, and The Nature Conservancy to discuss project outcomes.

Outcome	Completion Date
1. Management report and tri-fold brochure produced and shared	*Spring 2025*
2. Site visits hosted for public and private land managers	*August 2024 through June 2025*

III. PROJECT STRATEGY

A. Project Team/Partners

- Daniel Hernández (Associate Professor, Carleton College) will oversee the project. Receiving funds.
- Forest Isbell (Associate Director of Cedar Creek ESR, U of Minnesota): Not receiving funds.
- Clare Kazanski and Marissa Alhering (The Nature Conservancy): Not receiving funds.

B. Project Impact and Long-Term Strategy

Our results will guide efforts by land managers to restore prairie ecosystems and promote pollinator habitat. Land managers frequently tell us that good experimental research on the impacts of haying is needed to determine its utility in prairie management. Thus, our results will be directly relevant to prairie restoration on hundreds of thousands of acres of both public and private lands throughout the state.

C. Timeline Requirements

The proposed project will require 4 years to test the effects of haying on prairie plant diversity, floral abundance, and soil health; and to produce a brochure to highlight our research findings to state agencies, NGOs, and local private landowners. Four years is necessary for us to monitor each prairie for at least two years post-burn and to complete two haying treatments in the areas hayed every other year.

2020 Detailed Project Budget

Project Title: Comparison of Burning and Haying for Prairie Restoration

IV. TOTAL ENRTF REQUEST BUDGET: 4 years

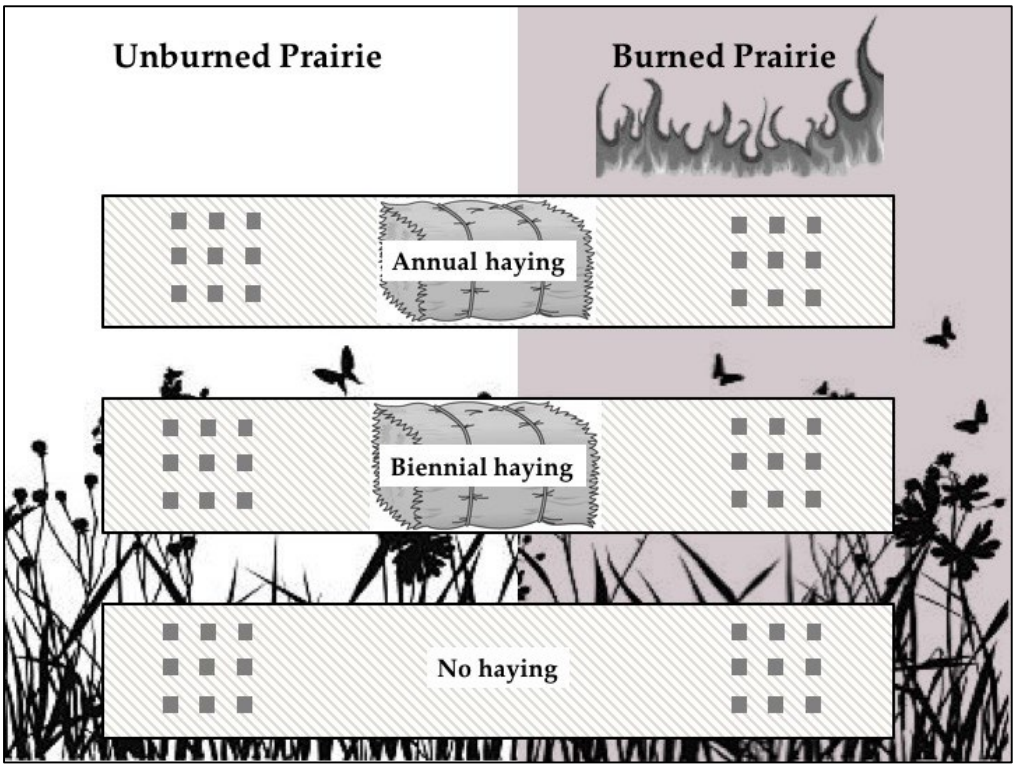
BUDGET ITEM *(See "Guidance on Allowable Expenses")*		**AMOUNT**
Personnel		**$ 275,087**
Project Director, Prof. Dan Hernández : Summer stipend for four years (4% of FTE, based on nine-month academic-year salary). $19,641 for salary + $1,503 for benefits at summer rate of 7.65%).	$	21,144
Postdoctoral Scholar (1): 100% FTE in Yr 4 only. Will help to analyze data, and publish results (Activity 2). Will also collaborate with project team to communicate findings to land managers and the scientific community (Activity 3); $56,275 for salary + $20,259 for academic year benefits at 36%.	$	76,535
Research Technician : 100% FTE for the first 3 years (Yr1- $32,302, Y2- $33,029, Y3- $33,772). Will help to establish experiment in year 1 (Activity 1), support field data collection efforts and manage team of undergrad researchers all 3 years (Activity 2). $99,103 for salary + $35,677 for academic year benefits at 36%.	$	134,780
Undergraduate Student Field and Lab Assistants (3) : two undergraduate student researchers funded by LCCMR and one by Carleton, in each summer of the project for four years ($4800 ea in Yr 1, annual incr $100). Will assist with field data collection and laboratory analyses of soil samples. $39,600 compensation + $3,029 benefits at 7.65%.	$	42,629
Professional/Technical/Service Contracts		**$ 25,600.00**
Trained botanists (2): to assist with vegetation and floral surveys for 4 weeks each summer for 4 years ($20 per hour for 160 hours each person each summer; consultant)	$	25,600
Equipment/Tools/Supplies (all one-time costs)		**$ 13,500**
Handheld GPS units (2) and a light meter to locate and relocate permanent plot locations	$	500.00
Light meter for measuring light availability (e.g., Li-Cor 191R and 250A data logger)	$	3,000.00
Native seeds for seed addition (approximate amount for 1 acre of seeding of each of the three seed types)	$	7,000.00
Field Supplies: plot markers, measuring tapes, soil corers, sieves	$	3,000.00
Travel		**$ 11,772.00**
6 trips per year for Project Director and Research Technicians from Northfield (Carleton College campus) to field sites near Detroit Lakes: each trip = 500 miles RT (including local travel) at rate determined by commissioner plan	$	6,540
6 trips per year for University of Minnesota partners (U of Minnesota campus) to field sites near Detroit Lakes: each trip = 400 miles RT (including local travel) at rate determined by commissioner plan	$	5,232
Additional Budget Items		**$ 19,640.00**
Dissemination (Activity 3): Printing costs for 500 educational brochures to private land owners and land managers	$	2,000
Dissemination (Activity 3): Site visits for private land owners and land managers (travel and hosting costs)	$	3,000
Soil Sample Lab Analyses preformed at Carleton College (soil CN; Western Ag Innovations PRS nutrient probes): $3,660 per year for four years: 10 prairies X 2 treatments X 6 samples per treatment = 120 samples per year. 1. CN Analysis: $5 per sample X 60 samples = $300. 2. Nutrient probes: $56 per sample X 60 composite samples = $3360	$	14,640
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	**$**	**345,599**

V. OTHER FUNDS	**AMOUNT**	**Status**
SOURCE OF FUNDS		
Other Non-State $ To Be Applied To Project During Project Period		
Carleton College : Undergraduate Student Field and Lab Assistants: one student per year; $4,800 Yr1, $4,900 Yr 2, $5,000 Yr 3, $5,100 Yr 4. Plus 7.65% benefits + 58% indirects each year	$ 32,798.70	
Carleton College indirect costs : 58% of all salary and wage figures for Project Director, Research Technician, Undergraduate Student Field and Lab Assistants, and Postdoctoral Scholar	$ 159,550.64	Pending
Other State $ To Be Applied To Project During Project Period	$ -	N/A
In-kind Services To Be Applied To Project During Project Period	$ -	N/A
Past and Current ENRTF Appropriation	$ -	N/A
Other Funding History	$ -	N/A

Comparison of Prairie Management with Burning and Haying to Promote Plant and Pollinator Biodiversity

Study includes **10 remnant prairies** in the Agassiz beach ridges region.

- Representative of prairie throughout western Minnesota.
- Sites will vary in habitat quality to study differences in responses to haying and burning.
- Privately owned and managed.



ABOVE: **Experimental design** at each of the 10 prairie sites. Size of haying treatments are not to scale and will vary in size depending on the site. In each plot (small squares), **we will measure plant biodiversity, soil quality, and floral resources for pollinators**.

PROJECT MANAGER QUALIFICATIONS: DANIEL HERNÁNDEZ

Professional Appointments

2015-present	Associate Professor of Biology, Carleton College
2009-2015	Assistant Professor of Biology, Carleton College
2008-2009	Visiting Professor, Hamline University
2007-2008	Postdoctoral Scholar, University of California, Santa Cruz

Professional Preparation

University of Minnesota	Ecology, Evolution, and Behavior	Ph.D., 2007
University of Kansas	Environmental Studies	B.S., 2001

Qualifications and Responsibilities

Daniel Hernández (Associate Professor, Carleton College) will oversee the project. His research focuses on the management and restoration of grassland ecosystems. He has studied grassland management in California serpentine grasslands, the restored prairies in the Carleton College Arboretum, and native prairies in western Minnesota. Hernández has published 15 articles, several of which have been co-authored with undergraduate students. He has received previous funding for his research from the National Science Foundation and the Kearney Foundation for Soil Science. Furthermore, Hernández is on the Advisory Board and serves as a Visiting Professor on the Doris Duke Conservation Scholars Program, a program designed to promote diversity in the field of Conservation Science.

Forest Isbell (Associate Director, Cedar Creek ESR, UMN) will co-supervise the postdoctoral researcher on the project and collaborate on all aspects of the research. Isbell's studies the causes and consequences of biodiversity loss in ecosystems. Much of his previous research has been conducted at the University of Minnesota's Cedar Creek Ecosystem Science Reserve. His work has been published in the world's top scientific journals (more than 40 publications, including 8 in *Nature*, *Science*, or *PNAS*). Isbell is currently a Lead Author on both regional (Americas) and global assessment reports for the United Nations Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services.

Isbell, F. (PI), D. Tilman, and C. Potter **Source:** Minnesota Environment and Natural Resources Trust Fund **Program:** Legislative-Citizen Commission on Minnesota Resources **Award Number:** M.L. 2017, Chp. 96, Sec. 2, Subd. 08c **Title:** *Restoring and Preserving Savanna Using Bison* **Amount:** $388,000 **Dates:** July 1, 2017 – June 30, 2020 **Location:** Cedar Creek Ecosystem Science Reserve
Isbell, F. (PI), C. Packer, D. Mech, and C. Potter **Source:** Minnesota Environment and Natural Resources Trust Fund **Program:** Legislative-Citizen Commission on Minnesota Resources **Award Number:** M.L. 2017, Chp. 96, Sec. 2, Subd. 03k **Title:** *Cedar Creek Natural Area Wolf Recolonization Assessment* **Amount:** $398,000 **Dates:** July 1, 2017 – June 30, 2020 **Location:** Cedar Creek Ecosystem Sci. Reserve

Organization Description

Carleton College, Northfield, MN, founded October 12, 1866, enrolls about 2000 diverse students. Carleton's official mission is "to provide an exceptional undergraduate liberal arts education." This educational mission is advanced most centrally by the colleges' faculty (who number approximately 200) and is supported by a full range of professional staff who successfully manage grant projects. This support includes grants staff in Corporate & Foundation Relations, accounting staff in the Business Office, grounds and trades staff in Facilities, and others who collectively provide the requisite financial and managerial structures and controls. In addition, Carleton has the research facilities and human resources necessary to perform the proposed work.

Carleton's most recent annual audit was completed by CliftonLarsonAllen and is available online at Audited Financial Statements for the year ending June 30, 2018.