

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

Project Title:

ENRTF ID: 232-F

Bison as Keystone Species in Minnesota Savannas

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

Sub-Category:

Total Project Budget: \$ 344,000

Proposed Project Time Period for the Funding Requested: June 30, 2022 (2 yrs)

Summary:

Recently, bison have been reintroduced to Minnesota. Their reintroduction will likely have cascading effects on these ecosystem. We propose to study how bison reintroduction affects deer, pollinators, and other animals.

Name: Chad Zirbel

Sponsoring Organization: U of MN

Job Title: Dr.

Department:

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Location:

Region: Statewide, Metro

County Name: Anoka, Isanti

City / Township:

Alternate Text for Visual:

Figure 1 shows visitors watching and learning about bison. Figure 2 shows bison grazing the savanna at Cedar Creek. Figure 3 shows the cascading effects of bison on savanna species.

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



Environment and Natural Resources Trust Fund (ENRTF)
2020 Main Proposal Template

PROJECT TITLE: Bison as keystone species in Minnesota savannas

I. PROJECT STATEMENT

Historically, bison roamed Minnesota's prairies and oak savannas. However, the last wild bison went extinct in Minnesota over 100 years ago and we no longer have these iconic large grazers that had major impacts on ecosystems. Bison heavily altered ecosystems through grazing and were an important source of food for large carnivores, birds, and insects. Because of this, the loss of bison may have long-term consequences on the future of these ecosystems, such as the loss of other species or services these ecosystem provide.

Recently, bison have been reintroduced to several natural areas in Minnesota. While bison were historically a part of these ecosystems, without understanding the potential cascading effects of their reintroduction will have, there could be unintended consequences, such as changes in deer and pollinator populations. As more land managers across Minnesota consider reintroducing bison, we need to understand the effects of their reintroduction if we hope to avoid negative impacts on rest of the ecosystem.

Here we will focus on how bison affect other aspects of the ecosystems they are reintroduced to, including the abundance and behavior of deer and small mammals, which share a food source with bison. Likewise, bison may affect important pollinators or ticks, which can carry Lyme disease, by changing the proportion of wildflowers or vegetation cover where insects may live. We will monitor these impacts by establishing study areas both inside and outside the bison enclosure at Cedar Creek Ecosystem Science Reserve. Cedar Creek has a long history of research on Minnesota's ecosystems and is well positioned to answer these questions. This research on the cascading effects of bison reintroduction is essential as the role of bison in many ecosystems remains unknown. **The outcomes we plan to achieve are to: (1) Determine how bison grazing affects deer and small mammals through changing vegetation, (2) Evaluate how bison reintroduction impacts pollinators and ticks, and (3) Educate Minnesotans about bison reintroduction and oak savanna ecosystems.**

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Determine whether bison reduce the local abundance of deer and small mammals

Description: To study the effects of bison reintroduction on savanna plant communities, we will establish 14 sampling areas both inside and outside the bison enclosure at Cedar Creek. In each area we will establish a 50 meter transect with 10 plots. In each plot we will identify all plant species and estimate their abundance. We will also sample soil nitrogen, carbon, and bulk density which may be influenced by bison and affect plants and wildlife. We will also directly study deer and small mammals by setting up live traps along the same transect to capture small mammals. In addition, we will place a trail camera at each transect to photograph all wildlife in order to estimate their local abundance and study their behavior.

We will also study the direct effects of the changing deer and small mammal community on vegetation. Near each transect we will set up plots that allow grazing by all species, exclude large species (e.g. deer and bison), and exclude both large and small mammalian grazers. This will be done both inside and outside the bison enclosure. To better study bison movement and habitat use across the savanna we will attach GPS collars to 25 bison. Collars will store GPS location data every 10 minutes for the entire summer. We will use these data to understand how frequently bison visit each of our plots and how long they spend there, as well as how the bison use the savanna.

ENRTF BUDGET: \$195,430

Outcome	Completion Date
1. Sampling transects, camera traps, and fenced plots established	July 2020
2. Collar 25 bison	May 2021
3. Plant, soil, and small mammal data collected	August 2021
4. Data analyzed and publications submitted	May 2022

Activity 2: Determine whether bison increase pollinators by increasing wildflowers and how they affect ticks

Description: To study the impact of bison reintroduction on other savanna species we will use the same sampling



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areas mentioned in the previous activity. We will study insects through sweep netting and pitfall traps along transects. Insects, such as pollinators, may be influenced by bison, as grazing reduces grasses and allows for more wildflowers to grow, increasing the abundance and diversity of pollinators. Likewise, bison grazing could affect the abundance of ticks, and thus the spread of Lyme disease, through changes in the plant community. We will sample three times each summer to capture seasonal changes in the local abundance of ticks and pollinators.

ENRTF BUDGET: \$138,570

Outcome	Completion Date
<i>1. Sample pollinators and ticks</i>	<i>August 2021</i>
<i>2. Pollinator and tick data analyzed and submitted for publication</i>	<i>May 2022</i>

Activity 3: Educate Minnesotans about bison reintroduction

Description: We will educate Minnesotans about the role that bison play in savannas and other Minnesota ecosystems by providing programming for K-12 students and other visitors who come to Cedar Creek each year. We will develop education programs to correspond with state and national academic standards and will incorporate inquiry-based activities. All programs will also highlight the historical impact of bison in Minnesota as well as the importance of bison to indigenous people and to land managers working to restore oak savanna. While the bison are on site, we will hold public outreach programs where visitors can observe them. These will include organized tours and activities focused on the role of bison in oak savanna systems and their historical importance in Minnesota. We will share results from ongoing research at these events.

We will also host a stakeholders meeting at Cedar Creek focused on land managers currently using or considering bison as a management strategy in Minnesota. This meeting will bring together land managers from across the state to discuss how bison reintroduction may aid the restoration of Minnesota's grasslands and savannas. At this meeting we will also work together to create best practices for bison reintroduction to meet restoration goals.

ENRTF BUDGET: \$10,000

Outcome	Completion Date
<i>1. Hold stakeholders meeting at Cedar Creek discussing bison reintroduction</i>	<i>June 2022</i>
<i>2. At least 6000 K-12 students and visitors benefit from educational programs</i>	<i>June 2022</i>

III. PROJECT PARTNERS AND COLLABORATORS:

Partners receiving ENRF funds

Dr. Chad Zirbel, Postdoctoral research associate, Cedar Creek Ecosystem Science Reserve, University of Minnesota, Project Manager, will oversee the project and supervise work on-site at Cedar Creek.

Partners not receiving ENRF funds

Dr. Forest Isbell, Associate Director, Cedar Creek Ecosystem Science Reserve and Assistant Professor, University of Minnesota, Co-Investigator, co-lead all activities.

Dr. Caitlin Barale Potter, Education and Outreach Coordinator, Cedar Creek Ecosystem Science Reserve, University of Minnesota, Collaborator, co-lead Activity 3.

IV. LONG-TERM IMPLEMENTATION AND FUNDING:

Our results will guide efforts by state and federal agencies and conservation organizations using bison to restore ecosystems across Minnesota. To maximize what is learned from reintroducing bison to Cedar Creek, we aim to maintain bison grazing as long as possible. The partnership with Northstar Bison makes this financially feasible as they provide and care for the bison each year at no cost to Cedar Creek, thus allowing the project to continue for the foreseeable future. Moreover, we have successfully attracted major federal research funding to Cedar Creek for more than three decades and will continue to seek such funding beyond the two years proposed.

Attachment A: Project Budget Spreadsheet
Environment and Natural Resources Trust Fund
M.L. 2020 Budget Spreadsheet

Legal Citation:

Project Manager: Chad Zirbel

Project Title: Bison as keystone species in Minnesota savannas

Organization: Cedar Creek Ecosystem Science Reserve, University of Minnesota

Project Budget: \$344,000

Project Length and Completion Date: 2 years (June 30, 2022)

Today's Date: 4/15/2019



ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	\$ 217,000	\$ -	\$ 217,000
Postdoctoral Scholar, Dr. Chad Zirbel, \$133,000 (80% salary, 20% benefits) 100% FTE each year for two years			
Graduate Student Field Assistants: two graduate student at 50% FTE for two years during the summer; \$35,000 (86% salary, 14% benefits). One graduate student will sample insects and the other will sample small mammals.			
5 Undergraduate student summer field and lab assistants for two years each at 25% FTE; \$49,000 (100% salary)			
Professional/Technical/Service Contracts			
	\$ -	\$ -	\$ -
Equipment/Tools/Supplies			
Field Supplies:	\$ 109,000	\$ -	\$ 109,000
30 GPS Logger collars (\$2900 each); \$87,000			
14 Reconyx PC900 Trail Cameras (\$550 each), batteries, memory cards, security devices, attachment; \$11,530			
140 small mammal Sherman traps (\$25.50 each): \$3,570			
Fencing supplies (panels, mesh, flashing, posts); \$3,300			
Experimental supplies (field sampling supplies, sweep nets, pit traps): \$3,600			
Educational/outreach supplies (activity supplies)	\$ 2,000	\$ -	\$ 2,000
Outreach supplies (signage, interactive materials, handouts)	\$ 5,000	\$ -	\$ 5,000
Capital Expenditures Over \$5,000			
	\$ -	\$ -	\$ -
Fee Title Acquisition			
	\$ -	\$ -	\$ -
Easement Acquisition			
	\$ -	\$ -	\$ -
Professional Services for Acquisition			
	\$ -	\$ -	\$ -
Printing			
	\$ -	\$ -	\$ -
Travel expenses in Minnesota			
		\$ -	\$ -
Other			
Soil sample lab analyses for Total N and C, Nitrate and Amonium	\$ 8,000	\$ -	\$ 8,000
Bison reintroduction stakeholders meeting (room rental and refreshments for participants)	\$ 1,000	\$ -	\$ 1,000
Education/outreach (field trip subsidies)	\$ 2,000	\$ -	\$ 2,000
COLUMN TOTAL	\$ 344,000	\$ -	\$ 344,000

SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		\$ -	\$ -	\$ -
State:		\$ -	\$ -	\$ -
In kind: Indirect costs associated with this proposal @ 54% MTDC	secured	\$ 185,000	\$ -	\$ 185,000

Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget	Spent	Balance
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M.L. 2017, Chp. 96, Sec. 2, Subd. 08c Evaluating the Use of Bison to Restore and P	\$ 200,725	\$ 388,000	\$ 187,275	\$ 200,725
M.L. 2017, Chp. 96, Sec. 2, Subd. 03k Cedar Creek Natural Area Wolf Recolonizatio	\$ 232,716	\$ 398,000	\$ 165,284	\$ 232,716

Bison as keystone species



Figure 1. Visitors to Cedar Creek watch the bison from the viewing gazebo and interact with educational materials to learn about bison.



Figure 2. Bison graze the oak savannas at Cedar Creek Ecosystem Science Reserve.

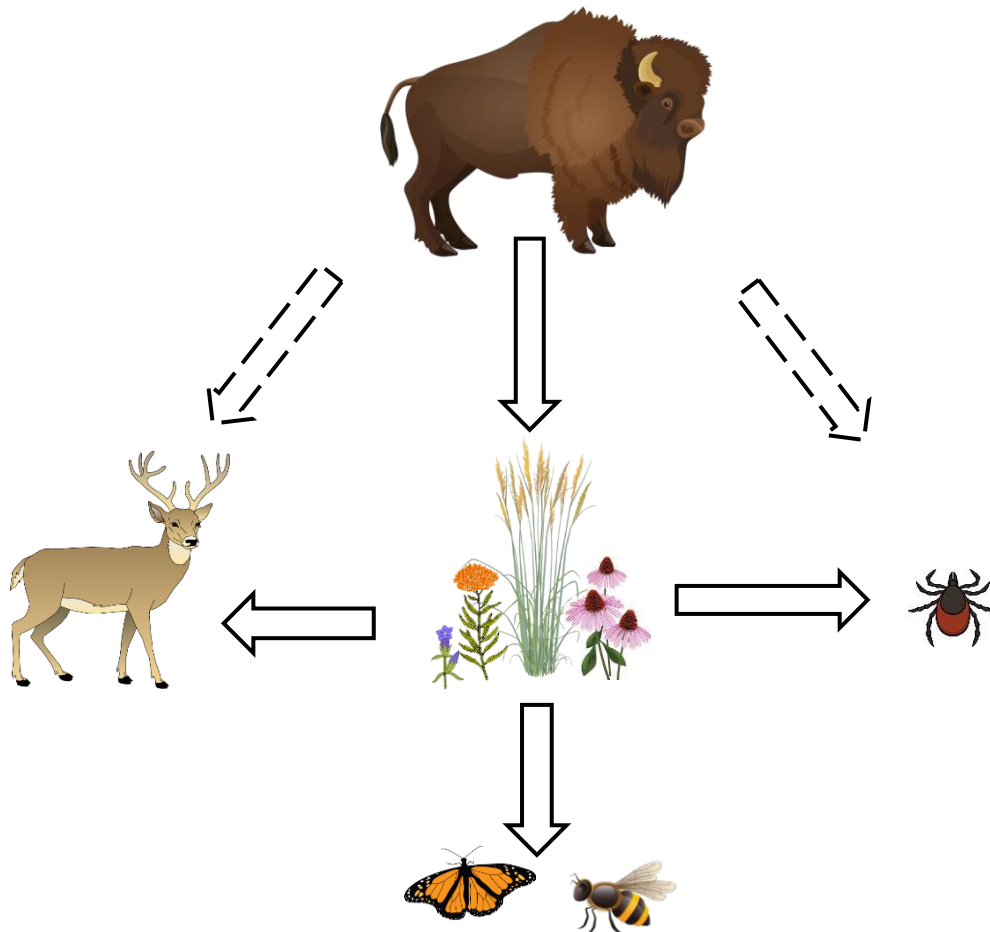


Figure 3. Bison are keystone species and can have cascading affects on ecosystems. Bison can directly compete for food sources with deer and other mammals and their grazing can reduce grass abundance and increase the abundance of wildflowers. This change to the plant community can also impact pollination or the spread of disease, such as Lyme disease through ticks.

Project Manager Qualifications & Organization Description

Dr. Chad Zirbel is a postdoctoral research associate at the University of Minnesota. Dr. Zirbel received his PhD from Michigan State University in Plant Biology and Ecology, Evolutionary Biology, and Behavior (2018) and his B.S. from the University of Wisconsin-Madison (2012). Dr. Zirbel is currently the postdoctoral research associate studying bison reintroduction at Cedar Creek. Dr. Zirbel has 9 years of experience working in and studying Midwestern oak savannas and grasslands.

Dr. Zirbel will serve as project coordinator, working with collaborators at the University of Minnesota and Cedar Creek Ecosystem Science Reserve. Dr. Zirbel will coordinate the field sampling, trail camera sampling, and GPS collaring efforts. Dr. Zirbel will also lead the stakeholder's meeting at Cedar Creek as a part of activity 3.

Dr. Forest Isbell will act as a co-Principal Investigator at the University of Minnesota and will work with Dr. Zirbel to coordinate work at Cedar Creek. As Associate Director of Cedar Creek Ecosystem Science Reserve, Dr. Isbell designs, conducts, and reports independent ecological research; manages Cedar Creek's land, staff, and budgets; and supervises Cedar Creek's Education and Outreach program. Isbell has conducted field research at Cedar Creek for eight years and is a co-Principal Investigator on the National Science Foundation's Long-Term Ecological Research project based at Cedar Creek. Isbell has also received an NSF CAREER award, was a Lead Author on global and regional reports for the United Nations Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services, and was recognized by the Web of Science as one of the most highly cited researchers in the field of Ecology and the Environment. Isbell has published more than 60 peer-reviewed journal articles, including 11 publications in the world's top journals (Nature, Science, PNAS).

Dr. Caitlin Barale Potter will co-lead Activity 3 at Cedar Creek coordinating educational programs and outreach events. Dr. Barale Potter organizes and leads outreach and educational events for thousands of students and members of the general public who visit Cedar Creek each year.

Cedar Creek Ecosystem Science Reserve - Cedar Creek Ecosystem Science Reserve is a University of Minnesota biological field station that is world-renowned for its long-term ecological research. Its 5,500 acres includes many ecosystems and species found throughout the forests, grasslands, and wetlands of Minnesota and North America. Faculty, staff, and students who work at Cedar Creek are dedicated to discovering sustainable solutions to environmental challenges. We do this by: (1) *investigating* the fundamental processes that govern the dynamics and functioning of ecological communities and ecosystems, and how human activities are changing ecosystems; (2) *sharing knowledge* gained at Cedar Creek with citizens of the state, the nation, and the world; and (3) *conserving natural ecosystems* as platforms for study and as examples of intact ecosystems. Cedar Creek has a long history of ecology research and active research has been conducted within Cedar Creek's oak savannas since the 1960s.

University of Minnesota – The University of Minnesota is a land-grant institution of higher education, and ENRTF funding granted for this project would be managed by the University of Minnesota.