



Environment and Natural Resources Trust Fund

2024 Request for Proposal

General Information

Proposal ID: 2024-242

Proposal Title: Restoring the Planet While Feeding the World

Project Manager Information

Name: Clarence Lehman

Organization: U of MN - Cedar Creek Ecosystem Science Reserve

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Project Basic Information

Project Summary: This project will evaluate ways of restoring natural habitats to maintain Minnesota wildlife populations while simultaneously providing material to produce clean, healthy foods for human populations.

Funds Requested: \$346,000

Proposed Project Completion: July 31, 2027

LCCMR Funding Category: Methods to Protect, Restore, and Enhance Land, Water, and Habitat (F)

Project Location

What is the best scale for describing where your work will take place?

Region(s): Central

What is the best scale to describe the area impacted by your work?

Region(s): Central

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 problem is that about two-thirds of the land surface of Minnesota, and two-fifths of the land surface of the entire earth, has been converted from natural ecosystems to agricultural systems. The efficiency of modern agriculture has helped feed the world, but has also produced a great "extinction debt," where a vast number of natural species -- spanning mammals, birds, reptiles, amphibians, insects, and native plants -- are documented to be on the road to extinction. A native prairie, or a well-restored prairie, supports hundreds of these species, whereas a well-managed corn field or other agricultural field supports only a few. Fields with a huge reduction in the number of species are not able to function as completely stable ecosystems and instead exhibit consequences that we have not been able to fully control - leaking fertilizers into waterways, releasing gases into the air, reducing natural soil fertility, reducing pollinators, and more. The opportunity, emerging from technological possibilities of this century, is to restore native ecosystems for wildlife and still use them to produce food for people.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

The proposed solution involves novel research, development, and restoration efforts that this project would define and refine. Using large prairie grasslands at the University's Cedar Creek area, it would examine three different methods of improving, maintaining, and utilizing prairie: (1) Periodic burning to remove plant litter, control weeds, and increase pollinators. (2) Grazing with bison, for similar purposes, in part using the native grasslands to produce food directly in the form of bison meat. (3) Periodic harvesting for similar purposes, but also to analyze the biochemical composition and concentration of essential nutrients in the harvested plant material, which ultimately could be reconstructed into pure healthy foods, including cultured vegetables and the kinds of cultivated meats that have now been developed in industry and approved for sale. This harvesting method creates a wholly new possibility arising in this century that can change the world's approach to natural habitat and healthy food. This project would outline possibilities for future chemical engineering projects to develop and Minnesota corporations to pursue. The project would build upon previous LCCMR projects that determined methods of harvesting from Minnesota restored prairies while not harming wildlife, and also for grazing by bison, as enabled by another LCCMR project.

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?

One specific outcome will be new restored prairies for Minnesota. A second outcome will be further information on methods of restoring natural habitats in the form of native prairies. A third outcome will be education within and beyond the university on the outcomes, and interaction with Minnesota corporations on possibilities for development. Finally, a fourth outcome, presently completely novel, will be information on converting low-diversity working agricultural lands into high-diversity working natural lands that can support wildlife while still producing food for people. This fourth outcome is to make progress on the theme, "Restoring the planet while feeding the world."

Activities and Milestones

Activity 1: Evaluate prairie management approaches to support habitat and biodiversity

Activity Budget: \$121,100

Activity Description:

Few facilities in the world are set up to manage grasslands and simultaneously examine the effects that bison grazing, prescribed burning, and plant harvesting have on biodiversity and habitat. Cedar Creek is one of those facilities, and this project would leverage that facility to address two global grand challenges: (a) restoring native habitat and biodiversity while (b) producing healthy food to feed a growing human population. Native prairies in Minnesota developed under prescribed fire and bison, and these management approaches are expected to increase the diversity of plants, based on studies at Cedar Creek and beyond. Harvesting vegetation is another way maintain and improve diversity while also obtaining nutrients to create human foods. In Activity 1, we will measure plant diversity and habitat quality in research fields that are grazed by bison, managed with prescribed burning, as they have been for decades, and also managed by harvesting prairie vegetation. A substantial dataset exists for the diverse plant species in these fields, which supports thorough analyses to determine the effects. We will also characterize the grasslands in terms of habitat structure, soil carbon and nutrient contents, and plant resources for pollinators, small mammals, and birds.

Activity Milestones:

Description	Approximate Completion Date
Impact of burning, grazing, and mowing on biodiversity	July 31, 2027
Habitat quality assessment of grasslands following burning, grazing, and mowing	July 31, 2027

Activity 2: Evaluate prairie management methods that can provide diverse foods for people.

Activity Budget: \$173,000

Activity Description:

Burning helps prairie areas by recycling nutrients and opening the plant canopy to encourage a large and diverse collection of species. Burning generally promotes the cycling of carbon from the air into plants and back to the air, and similar cycling into the soil. Agriculture is all about capturing and converting those materials to feed people and power society. Bison grazing interrupts that cycling in a way that sends some material to bison meat and some into the air as methane. That can power society by providing meat, but can also result in a great loss of carbon to the air. In Activity 2, we will examine emerging technologies in food creation that can allow most of that carbon to be captured for human use. After harvesting, we will collect the plant material to examine carbon, nutrients, and minerals that could be synthesized into food using advanced biotechnology that is just now emerging. We will measure the movement of carbon under all three approaches by sampling plants, measuring the carbon content of their tissues, and estimating human food possibilities of the methods of grazing and harvesting by analyzing the biomass for nutritional components.

Activity Milestones:

Description	Approximate Completion Date
Determine carbon capture and cycling in grasslands following burning grazing, and harvesting.	July 31, 2027
Determine nutritional profile of foods produced in bison grazing and processing of harvested prairie.	July 31, 2027

Activity 3: Education about developments and communication of possibilities.

Activity Budget: \$51,900

Activity Description:

The ideas for restoring the planet while feeding the world have recently been taught in one ecology class (EEB-3407), and will be expanded to other classes at the University as the results from this project develop. In particular, we would work to expand into sustainability classes and agricultural classes, so that students and faculty there could help adapt to the new possibilities for restoring, developing, and using natural systems. In addition, we would develop public gatherings to expose these ideas quite generally. Also in Activity 3, and perhaps most importantly, we would work with Minnesota industries on the technological developments to collect, process, and convert this new kind of harvested product into pure and healthy foods. In this last step, the University's divisions for technological development and the University's Institute on the Environment (Ione) will be called into play.

Activity Milestones:

Description	Approximate Completion Date
Incorporate ideas and results into University classes and public interactions.	July 31, 2027
Interact with local industries able to develop associated technologies.	July 31, 2027

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Jessica Hellman	University of Minnesota Institute on the Environment	Role: Dr. Hellmann is Distinguished McKnight University Professor and Director of the University's Institute on the Environment (IonE). Role on this project includes overall design as well as facilitating public, government, and business interactions.	Yes
Jacob Jungers	University of Minnesota Department of Agronomy and Plant Genetics	Dr. Jungers is McKnight Land-Grant Professor and Assistant Professor of Agronomy. Role on this project includes overall design and supervision of operations. Among other tasks, Jungers will help organize and conduct the nutrient analysis of harvested biomass.	Yes
Maowei Liang	University of Minnesota Cedar Creek Ecosystem Science Reserve	Dr Liang is staff scientist at Cedar Creek. Role on this project includes overall design, incorporation of sound scientific principles, supervision of operations, and helping document and publish results.	Yes
Forest Isbell	University of Minnesota College of Biological Sciences	Dr. Isbell is Associate Professor of Ecology who, among other topics, considers the influence and dependence of humans on natural systems. Dr. Isbell proposed and managed the LCCMR project introducing bison at Cedar Creek. Role on this project includes integration of bison grazing as well as general general scientific leadership.	No

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 work be funded?

The main goals of this project can be completed within three years. However, as we have done successfully in past LCCMR projects, matching funds will be sought to extend the scope. The largest amount of new work needed is learning to deconstruct harvested prairie biomass into its constituent nutrients, so partnerships with chemical engineering groups will be developed using new funding aimed at that purpose. We hope and expect that the present project can ultimately become broad enough to expand beyond Minnesota and beyond this nation to help form a new paradigm for preserving and managing our planet.

Project Manager and Organization Qualifications

Project Manager Name: Clarence Lehman

Job Title: Adjunct Faculty

Provide description of the project manager's qualifications to manage the proposed project.

Dr. Lehman has served as Associate Director for the University's Cedar Creek field station for six years (1999–2005), as Associate Dean for Research and Graduate Education in the University's College of Biological Sciences for six years (2010-2016), and as General Advisor to the Dean in the College of Biological Sciences for six years (2016-2022). Lehman has managed a number of LCCMR projects as principal investigator, including two projects examining groundwater leaching from various plant communities, jointly with the USGS (2007-2011), two projects about how Minnesota restored prairies can be harvested without harming the wildlife living there (2008-2013), and a number of others as co-principal-investigator. Associated with these projects were matching federal grants that extended their scope into related areas. He has taught the ecological principles of restoring the planet to over a thousand students and developed new approaches to ecology jointly with them, and has published a textbook on ecological principles. Lehman also has

background in the design of computer software and hardware, to handle the computational and data-management aspects of projects.

Organization: U of MN - Cedar Creek Ecosystem Science Reserve

Organization Description:

The University of Minnesota is a public land-grant teaching and research university with campuses around the state. It was established in 1851 and presently focuses on teaching, research, and public interaction. Cedar Creek Ecosystem Science Reserve is a nine-square-mile natural area owned by the University of Minnesota and dedicated to ecosystem preservation and research. Cedar Creek has started and contributed to a number of fundamental developments in the 20th and 21st centuries, including the science of ecosystem ecology, radio tracking, and biodiversity. Located as it is at the triple meeting point of the three great ecosystems of North America -- the broad-leaf forests stretching eastward to the Atlantic, the needle-leaf forests reaching northward to the Arctic, and the prairies flowing westward to the Rockies -- it forms an ideal place to understand ecology.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Academic field supervisor		Oversee field data collection, sample processing, and data analysis			13%	1.5		\$167,780
Student field technician		Data collection and project maintenance			10%	1.5		\$61,776
Civil service research coordinator and fire boss		Plan and oversee prescribed burning and harvesting			30%	0.12		\$9,600
Faculty summer salary		Oversee student field work and define data analysis			36.83%	0.12		\$20,498
							Sub Total	\$259,654
Contracts and Services								
TBD	Professional or Technical Service Contract	Mowing and baling biomass from selected blocks of restorations subject to harvesting.				0.15		\$7,200
Minnesota Conservation Corps	Professional or Technical Service Contract	Preparing fields for restoration, harvesting, and burning, including removing obstacles, preparing entryways, constructing fire breaks, and so forth.				0.1		\$30,000
							Sub Total	\$37,200
Equipment, Tools, and Supplies								
	Tools and Supplies	Culverts and road materials, sampling and storage materials.	Items to provide access to the new fields, replacement tools for soil sampling, supplies for sample storage and archiving.					\$10,696
							Sub Total	\$10,696

Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
							Sub Total	-
Travel Outside Minnesota								
	Conference Registration Miles/ Meals/ Lodging	One trip within the United States, one person, estimate 2000 miles	Presentation at conference to expose results to a large audience, so the results of this grant can understood more generally.					\$2,000
							Sub Total	\$2,000
Printing and Publication								
							Sub Total	-
Other Expenses								
		Analysis of biomass samples for nutrient content, forage value, and renewable energy potential. 81 samples per year for three years, and four analyses per sample.	To compare grazing versus harvesting potential for food and fuel production.					\$36,450
							Sub Total	\$36,450
							Grand Total	\$346,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
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Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	-
Non-State				
			Non State Sub Total	-
			Funds Total	-

Acquisition and Restoration

Parcel List

Name	County	Site Significance	Activity	Acres	Miles	Estimated Cost	Type of Landowner	Easement or Title Holder	Status of Work
				-	-	-			
Totals				0	0	-			

Restoration

1. Provide a statement confirming that all restoration activities completed with these funds will occur on land permanently protected by a conservation easement or public ownership.

All restoration activities completed with these funds will occur on the lands of Cedar Creek Ecosystem Science Reserve, which is permanently protected by public ownership through the University of Minnesota.

2. Summarize the components and expected outcomes of restoration and management plans for the parcels to be restored by your organization, how these plans are kept on file by your organization, and overall strategies for long-term plan implementation.

The parcels to be restored will be managed as part of the ongoing protection plans at Cedar Creek. These plans will be recorded in the field site's standard experimental database and managed as part of the field site's overall management plans, which have been in operation since the 1960's.

3. Describe how restoration efforts will utilize and follow the Board of Soil and Water Resources "Native Vegetation Establishment and Enhancement Guidelines" in order to ensure ecological integrity and pollinator enhancement.

Restoration efforts will observe the MN-BSWR guidelines for native vegetation. In particular, any supplemental seeding will use only Minnesota native plants. Sites under restoration will be surveyed periodically for plant species present. Any invasive species will be monitored and tracked, and where feasible removed. Soils will be sampled periodically and analyzed for organic and chemical content. Results from all the restored and managed areas at Cedar Creek will carry over to the areas restored under this proposal as part of adaptive management plans. Management will be aimed at diversity of the native plants, pollinators, and wildlife using and benefiting the area.

4. Describe how the long-term maintenance and management needs of the parcel being restored with these funds will be met and financed into the future.

Cedar Creek has long-term budget allocations from the University for maintenance of the site. Such allocations will also apply to the areas to be restored in this proposal.

5. Describe how consideration will be given to contracting with Conservation Corps of Minnesota for any restoration activities.

Cedar Creek has been working with the Conservation Corps, including them in preparing and conducting habitat restorations. In this proposal we plan to continue and extend that interaction.

6. Provide a statement indicating that evaluations will be completed on parcels where activities were implemented both 1) initially after activity completion and 2) three years later as a follow-up. Evaluations should analyze improvements to the parcel and whether goals have been met, identify any problems with the implementation, and identify any findings that can be used to improve implementation of future restoration efforts at the site or elsewhere.

The areas addressed by this proposal will be analyzed before any activities begin, annually during the activities, and three years and more later as follow-up operations. As recommended, evaluations will examine improvements and how well the goals have been met, will identify any problems with the implementation, and will document anything useful to improving future restorations at Cedar Creek and elsewhere.

Attachments

Required Attachments

Map

File: [7b14b813-714.pdf](#)

Alternate Text for Map

The map shows the location of the Cedar Creek Ecosystem Science Reserve within Minnesota (45 25'30" N, 93 12'6" W). Within the nine-square-mile area, three locations are marked on the map that are suitable for the proposed burning--grazing--mowing project....

Optional Attachments

Support Letter, Photos, Media, Other

Title	File
Approval letter	68298aa9-9b5.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

Yes: Restoration,

Does your project have potential for royalties, copyrights, patents, or sale of products and assets?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

No

Does your project include the design, construction, or renovation of a building, trail, campground, or other capital asset costing \$10,000 or more?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services, as defined in Minnesota Statutes section 299C.61 Subd.7?

No

