Environment and Natural Resources Trust Fund

2023 Request for Proposal

General Information

Proposal ID: 2023-164

Proposal Title: Restoring Wildlife Habitat with Perennial Grain Agriculture

Project Manager Information

Name: John Berini

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

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Project Basic Information

Project Summary: Compare the wildlife benefits of Kernza® perennial grain to traditional annual crops and natural perennial cover, and create new modules for outreach and education focused on agriculture-wildlife dynamics.

Funds Requested: $575,000

Proposed Project Completion: June 30, 2026

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): SW

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

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.

In Minnesota, 346 wildlife species are listed as being "in greatest conservation need," and the decline of nearly 80% of these species is related to habitat loss. Agriculture constitutes more than half of Minnesota's land area, and the conversion of more than 98% of native prairies to annual crops is a leading cause of biodiversity loss statewide. A perennial grain crop called Kernza® could restore many of the habitat-related benefits lost during conversion to agriculture, while providing farmers with new economic opportunities. Perennial overwintering cover provided by Kernza can be critical habitat for birds, mammals, and insects, all of which support a healthy ecosystem. While it is widely thought that Kernza leads to habitat improvements over traditional annual crops, there are no studies quantifying this relationship. This project will compare the wildlife benefits of Kernza to those of annual crops and natural perennial cover.

While Kernza is known to have a range of environmental benefits, this opportunity is critical because the benefits to wildlife are unknown. Moreover, Kernza is the world's first perennial grain crop, and Minnesota is the global leader in Kernza production. Understanding the biodiversity benefits of Kernza will add commercial appeal via improved knowledge of ecosystem services.

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.

Previous LCCMR-funded studies have shown that Kernza leads to a range of environmental benefits, many of which are expected to help local wildlife. Kernza requires less fertilizer and pesticides than traditional crops, which will directly influence invertebrates as well those organisms that depend on them as food. Additionally, consistent vegetative cover throughout the year provides habitat for both game and nongame wildlife. While the scientific literature and popular media allude to the suspected wildlife benefits of Kernza, no study has documented this relationship. As the global leader in Kernza production, Minnesota is ideally positioned to provide unequivocal evidence regarding the benefits of Kernza to both game and nongame wildlife.

This unique partnership of researchers, growers, local land-management organizations, and educators will collaborate to quantify and disseminate how the wildlife benefits of Kernza compare to traditional annual crops of corn and soybean and natural perennial cover. We will hire a graduate student research assistant to help measure habitat quality, along with the abundance and diversity of invertebrates, mammals, and birds at three different times throughout the year. Results will be disseminated to a wide range of stakeholders and audience groups via extensive outreach events, popular media outlets, and educational modules.

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?

We will quantify the habitat potential of Kernza and evaluate how it compares to natural perennial cover and traditional annual agriculture. We will provide multiple reports detailing how invertebrates, birds, and mammals use Kernza during late spring, mid-summer, and late fall, allowing us to detail how different landscape management strategies influence biodiversity and seasonal habitat use. In addition to traditional scientific reporting, we will disseminate our findings via a diversity of outlets building on an experienced team of regional experts, using short films, popular and social media, field-day presentations, and educational modules.

Activities and Milestones

Activity 1: Measure and compare metrics of habitat quality for Kernza fields, traditional monoculture, and natural perennial cover

Activity Budget: $97,277

Activity Description:

We will identify three study areas within three different landscape settings - natural perennial cover, traditional annual crops of corn and soybean, and Kernza fields. Within each landscape, we will measure a range of habitat-quality metrics relevant to invertebrates, birds, and mammals. Specifically, field-based measurements will include but not be limited to plant height, plant density, total above ground biomass, temperature (air, vegetation, and soil), soil composition, and soil water content. Using satellite imagery and geographic information systems (GIS), we will also estimate numerous landscape metrics known to influence biological diversity (e.g., field size, field perimeter, availability of other habitat types within a fixed distance). Because agricultural landscapes can exhibit significant change both seasonally and annually, all field-based metrics will be measured during late spring, mid summer, and late fall, for two consecutive years. During analysis, we will assume that natural perennial cover is the optimum among our three landscape settings and as a result, will serve as our "control" landscape. With this in mind, we will evaluate how field-based and GIS-based metrics in both Kernza fields and traditional annual crops deviate from this "control".

Activity Milestones:

Description	Completion Date
Identify sampling locations	May 31, 2023
Field work measuring habitat quality metrics (year 1)	October 31, 2023
Processing and analysis of data collected during Activity 1 (year 1)	April 30, 2024
Perform GIS-based analysis on three landscape types	April 30, 2024
Field work measuring habitat quality metrics (year 2)	October 31, 2024
Processing and analysis of data collected during Activity 1 (year 2)	April 30, 2025
Generate final report on habitat quality of Kernza.	May 31, 2026

Activity 2: Measure and compare invertebrate diversity and use of Kernza fields, traditional monoculture, and natural perennial cover

Activity Budget: $100,163

Activity Description:

Invertebrates are the most diverse group of animals on the planet and provide critical ecosystem services (i.e., crop pollination, nutrient cycling, pest control). We will employ a variety of sampling techniques to characterize the diversity of invertebrates across these different landscapes, as well as how they use these landscapes. We will use pitfall traps to sample for spiders, springtails, beetles, grasshoppers, and ants. When sampling for butterflies, bees, and other flying invertebrates we will use sweep nets. Because pollinators play an integral role in healthy ecosystems, we will also use pollinator-specific methods such as bee bowls and light traps, which also help identify nocturnal invertebrates. Additionally, the larvae of many invertebrates can be difficult to sample using the techniques noted above. Thus, we will also use suction sampling in conjunction with line transects. Finally, we will identify signs of nesting and feeding by way of field surveys (i.e., direct observation). Because the abundance and diversity of invertebrates changes throughout the year, we will sample each landscape during late spring, mid summer, and late fall for two consecutive years. Identification of invertebrates to the species-level is time consuming and difficult. Thus, all organisms will be categorized by functional group.

Activity Milestones:

Description	Completion Date
Acquire sampling equipment and identify sampling locations	April 30, 2023
Field work measuring insect abundance and diversity (year 1)	October 31, 2023
Processing and analysis of data collected during Activity 2 (year 1)	April 30, 2024
Field work measuring insect abundance and diversity (year 2)	October 31, 2024
Processing and analysis of data collected during Activity 2 (year 2)	April 30, 2025
Final report on insect abundance and use of Kernza and other landscape cover	May 31, 2026

Activity 3: Measure and compare mammalian diversity and habitat use in Kernza fields, traditional monoculture, and natural perennial cover

Activity Budget: $121,071

Activity Description:

Mammals are critical to healthy ecosystems and, like invertebrates, provide a range of important services (e.g., seed dispersal, pest control, food web stability). Additionally, mammals are extremely diverse and thus, we will employ a range of sampling techniques to characterize their diversity across different landscape types. For small mammals, we will use Sherman live traps set in 7 x 7 trapping grids, evenly distributed across 0.49 ha for 10 nights per sampling period. All captured individuals will be temporarily marked using humane methods to estimate population size across species. To sample large and medium-sized mammals, we will deploy camera traps using t-post camera trap mounts. Camera traps will be deployed within the small mammal grid at 30 m intervals for a total of 9 camera traps per grid. Finally, to estimate bat diversity, we will deploy a single autonomous recording unit (ARU) at the center of each small mammal trapping grid to passively record audio, which we can use to ID calling individuals to species. All mammal sampling procedures will occur for 10 days, across three locations per landscape type, during late spring, mid summer, and late fall, for two consecutive years.

Activity Milestones:

Description	Completion Date
Acquire sampling equipment and identify sampling locations	April 30, 2023
Field work, including ARU and camera trap deployment (year 1)	October 31, 2023
Processing and analysis of data collected during Activity 3 (year 1)	April 30, 2024
Field work, including ARU and camera trap deployment (year 2)	October 31, 2024
Processing and analysis of data collected during Activity 3 (year 2)	April 30, 2025
Final report on small mammal abundance and use of Kernza and other landscape cover	May 31, 2026

Activity 4: Activity 4: Estimate and compare avian diversity and habitat use of Kernza fields, traditional monoculture, and natural perennial cover

Activity Budget: $123,508

Activity Description:

Agricultural fields are important habitat for game and nongame birds, with spring nesting activity varying significantly as a function of tillage frequency. Thus, we will survey different landscape types for seasonal variation in bird diversity and spring nesting activity.

We will use point counts along randomly located transects to estimate bird diversity. Sampling will occur between dawn and 0930, with observers remaining at each point for 10 minutes. All observations occurring within the sampled landscape will be recorded. Each landscape type will be sampled at three random locations during late spring, mid summer, and late fall for two consecutive years. Because visual sampling is known to favor different species than audible sampling, we will use audio recorded by ARUs during mammal sampling to help estimate avian diversity.

Finally, recent evidence suggests that unmanned aerial vehicles (drones) equipped with thermal imaging cameras can identify bird nests on agricultural landscapes with high accuracy. However, accuracy can vary by landscape type. Thus, we will sample each landscape type using drones, immediately followed by traditional rope dragging surveys and compare these results. Nest surveys will take place for two years in early spring, during morning and evening, across three locations within each landscape type.

Activity Milestones:

Description	Completion Date
Acquire sampling equipment and identify sampling locations	April 30, 2023
Field work, including bird surveys, ARU, and drone sampling (year 1)	October 31, 2023
Processing and analysis of data collected during Activity 4 (year 1)	April 30, 2024
Field work, including bird surveys, ARU, and drone sampling (year 2)	October 31, 2024
Processing and analysis of data collected during Activity 4 (year 2)	April 30, 2025
Final report of bird abundance and use of Kernza and other landscape cover	May 31, 2026

Activity 5: Create new modules and opportunities for outreach and education

Activity Budget: $132,981

Activity Description:
Kernza is rapidly growing as the world's first perennial grain crop, and Minnesota is the global leader in Kernza production. Excitement around the prospect of a new sustainable crop, and the environmental benefits it can provide, offer opportunities to engage youth in science and agriculture.

For outreach, we will partner with the YWCAs Eureka! program, a STEM-based program aimed at giving 8-12 grade girls hands-on STEM education. Participants will help with sampling and gain exposure to data analysis and scientific presentation skills. Additionally, we will create high-quality videos documenting our work with real-time updates. Videos will be shared with popular media and posted on social media. We will also create pamphlets detailing the measurable benefits that wildlife gain from Kernza. Pamphlets will be distributed during field day events and events local to Eureka! participants.

For education, we will develop numerous academic modules designed for high-school to graduate-school students. Using Kernza as a case study, initial modules will focus on: socioeconomic relevance of agricultural awareness, environment-agriculture connections, wildlife-agriculture connections, and regenerative agriculture. Modules will include topical relevance, the current state of knowledge, current gaps in knowledge, how to move forward, and why it is important to do so.

Activity Milestones:

Description	Completion Date
Establish a working relationship with Eureka! program	April 30, 2023
Create and release videos highlighting project and results (on going)	May 31, 2026
Create and distribute pamphlets highlighting project and results (on going)	May 31, 2026
Develop academic modules (on going)	May 31, 2026
Analyze data from Activities 1-4, and submit for publication	May 31, 2026

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Jacob Jungers	University of Minnesota	CO-PI, Oversee the experiments including field sampling, data analysis, GIS, development of outreach and education materials	Yes
Constance Carlson	University of Minnesota	Oversee outreach and education	Yes
Luke Peterson	A-Frame Farm	Manages A-Frame farm, which will be sampled	Yes
Quintin Peterson	Lac Qui Parle Soil Water and Conservation District	Manages the CRP grasslands that will be sampled	No
Rhyan Schicker	Lac Qui Parle Soil Water and Conservation District	Manages the CRP grasslands that will be sampled	No
Benjamin Richason	St. Cloud State University	Oversee drone operations	Yes
Brad Gordon	Great River Greening	Oversee pollinator surveys and aid with invertebrate sampling and outreach and education	Yes
unspecified individuals	ywca Eureka!	Participate in various phases of data collection, analysis, and presentation	Yes
unspecified individual	University of Minnesota	graduate student research assistant that will participate and help lead field sampling as well as help execute data analysis, GIS, development of outreach and education materials	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 work be funded?

Farmers can use our results to inform which crops they choose to plant and consumers, which products they choose to support. Additionally, empirical evidence of the wildlife benefits of Kernza will add commercial appeal via improved knowledge of ecosystem services. Outreach through Eureka! will help establish long-term connections between Minneapolis youth outreach organizations, our project, and associated programs. Education and outreach materials will serve as long-term resources for numerous stakeholder groups, providing opportunities to cross the urban-rural divide through educational programming. Funding to support work on additional taxonomic groups and species-specific projects will be raised through outside sources.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Community Stewardship to Restore Urban Natural Resources - Phase Ten	M.L. 2017, Chp. 96, Sec. 2, Subd. 08i	$524,000
Using Perennial Grain Crops in Wellhead Protection Areas to Protect Groundwater	M.L. 2018, Chp. 214, Art. 4, Sec. 2, Subd. 04j	$250,000
Accelerating Perennial Crop Production to Prevent Nitrate Leaching	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 04k	$440,000
Promoting and Restoring Oak Savanna Using Silvopasture	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 08b	$750,000
Long-Term Nitrate Mitigation By Maintaining Profitable Kernza Production	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 04i	$485,000

Pollinator Central II: Habitat Improvement With Community Monitoring	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 08c	$631,000

Project Manager and Organization Qualifications

Project Manager Name: John Berini

Job Title: Adjunct Assistant Professor

Provide description of the project manager's qualifications to manage the proposed project.
John L. Berini's expertise is in studying animal habitat, behavioral and demographic responses to changes in this habitat, feeding behavior, stable isotopes, and geostatistical modeling. Dr. Berini's work is focused on understanding how habitat change, both through time and across space, influences movement, foraging behavior, demographics of the animals that depend on this habitat, and diversity within the communities of which these animals are a part.

Currently, Dr. Berini is a visiting assistant professor in both the Department of Biology and the Environmental Studies Program at Carleton College, as well as an adjunct assistant professor in the Department of Fisheries, Wildlife, and Conservation Biology at the University of Minnesota. In addition to teaching Landscape Ecology, Global Change Biology, and Population Ecology, he also has vast experience using and teaching a wide range of animal and vegetation sampling techniques, many of which are relevant to this project. His dual appointments at the University of Minnesota and Carleton College make him ideally suited to recruit high-quality graduate and undergraduate students to participate in this project.

Dr. Berini has worked on a prior LCCMR-funded project (unrelated to this project) and made significant contributions to project reports. The previous project served as a springboard for additional, ongoing work, throughout which Dr. Berini has managed multiple collaborations with members of the MN DNR, Grand Portage Band of Lake Superior Chippewa, the Fond du Lac Band of Lake Superior Chippewa, the 1854 Treaty Authority, the U.S. Forest Service, and various academic institutions. Finally, during his six years as a linguist in the United States Air Force, Dr. Berini ran a highly successful, multi-year operation including up to 24 team members from all four military branches and the National Security Agency.

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

Organization Description:
The College of Food, Agricultural and Natural Resource Sciences (CFANS) is one of seventeen colleges and professional schools at the University of Minnesota. CFANS comprises six divisions, twelve academic units, and 10 research and outreach centers, including the Minnesota Landscape Arboretum and the Bell Museum. CFANS offers students 13 majors, more than 25 minors, and 13 graduate programs, with applied goals that include developing novel crops, investigating synergies between animal systems and human health and nutrition, and gaining insight into how data can drive decisions in agriculture, forestry, and natural resource science. The stated vision of CFANS is "to advance Minnesota as a global leader in food, agriculture, and natural resources through extraordinary education, science-based solutions, and dynamic public engagement that nourishes people and enhances the environment in which we live," all of which are emphasized in this project.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineli gible	% Bene fits	# FTE	Class ified Staff?	$ Amount
Personnel								
John Berini		Project Manager, Primary Investigator			25%	1.5		$142,997
Jacob Jungers		Co-Primary Investigator			25%	0.24		$37,118
Constance Carlson		Oversee outreach and education			25%	0.3		$39,336
Graduate Research Assistant		Graduate students research assistant will participate and help lead field sampling as well as help execute data analysis, GIS, development of outreach and education materials.			47%	1.5		$148,678
Field Technicians		Participate in various phases of data collection, analysis, and presentation			0%	0.9		$33,970
Agronomy Technician		Help with farm operations including tractor operation, grain harvest and handling, and trailering ATVs, etc.			22.3%	0.45		$39,387
Brad Gordon		Oversee pollinator surveys and aid with invertebrate sampling and outreach and education			25%	0.39		$35,900
							Sub Total	**$477,386**
Contracts and Services								
Benjamin Richason, St. Cloud State University	Sub award	Will oversee drone operations associated with identifying game and non-game bird nests in fields of traditional annual crops, Kernza perennial grain, and natural perennial cover.				0.14		$26,714
							Sub Total	**$26,714**
Equipment, Tools, and Supplies								
	Tools and Supplies	small mammal traps, camera traps, t-posts, autonomous recording units (ARUs), sweep nets, light traps, sorting trays, binoculars, GPS units. Also includes consumable supplies such as bags, flagging, flags, and gloves.	Equipment and materials necessary for conducting field work, including habitat quality surveys, invertebrate surveys, mammal surveys, and bird surveys.					$52,088
							Sub Total	**$52,088**

Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	15 trips at 325 miles per round trip for two people. Includes lodging ($96/day) and per-diem ($59/day) for 12 days/nights. Mileage costs total $2851.88. Per-diem costs total $708. Lodging costs total $1152.	Travel to and from A-Frame farm for field sampling.					$4,712
							Sub Total	$4,712
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Printing	Printing materials for out reach and education through University of Minnesota and Great River Green. Events will occur both at the Twin Cities Campuses but also at A-Frame Farm Field Days.	printing of pamphlets, posters, and signage					$5,100
							Sub Total	$5,100
Other Expenses								
		Lease Agreement - Luke Peterson, A-Frame Farm	Three, one-time payments to Luke Peterson, who manages A-Frame Farms, for use of his land and any time he might invest in helping with sampling.					$9,000
							Sub Total	$9,000
							Grand Total	$575,000

Classified Staff or Generally Ineligible Expenses

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

Non ENRTF Funds

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

Attachments

Required Attachments
Visual Component
File: c28fcc13-0f0.pdf

Alternate Text for Visual Component
PDF provides a visual summary of the various partners, activities, locations, and outcomes that are integral to the success of this project....

Optional Attachments
Support Letter or Other

Title	File
Letter of Committment from SCSU Geography Department	cc5912e2-a74.pdf
Letter of Committment from Great River Greening	c67b5f5b-2ac.pdf
UMN SPA Letter of Endorsement	49175291-c9d.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?
> No

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?
> Yes, Sponsored Projects Administration

Restoring wildlife habitat with perennial grain agriculture

partners

A-Frame Farm

Eureka! YWCA Minneapolis

GREAT RIVER GREENING

Lac Qui Parle SWCD

ST. CLOUD STATE UNIVERSITY

UNIVERSITY OF MINNESOTA
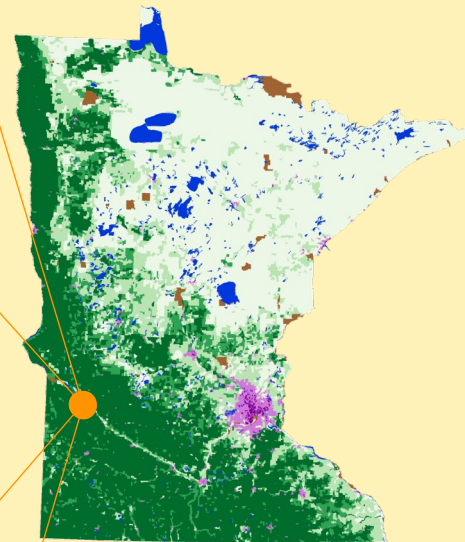
natural perennial cover

perennial grain Kernza®

traditional annual crops

measure and compare

habitat quality

insect use & diversity

mammal use & diversity

bird use & diversity

A unique partnership of researchers, growers, local land-management organizations, and educators coming together to quantify and disseminate the wildlife benefits of Kernza.

outreach

education

Land Use Strata

- >75% Cultivated
- 50-75% Cultivated
- 15-50% Cultivated
- Agri-Urban:>100 homes/sq.mi.
- Commercial:>100 homes/sq.mi.
- <15% Cultivated
- Non-Agricultural
- Water

Kernza is rapidly growing as the world's first perennial grain crop, and Minnesota is the global leader in Kernza production. Excitement around the prospect of a new sustainable crop, and the environmental benefits it can provide, offer opportunities to engage local communities, including youth, in science and agriculture.