Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-564

Proposal Title: On Edge: Investigating Tipping Points of Woody-Encroached Prairies

Project Manager Information

Name: Megan Wilcots

Organization: The Nature Conservancy

Office Telephone: (612) 331-0730

Email: megan.wilcots@tnc.org

Project Basic Information

Project Summary: The integrity of Minnesota grasslands statewide is threatened by encroachment of woody plant species. We seek to identify when and how to remove woody species to preserve grassland function.

ENRTF Funds Requested: $655,000

Proposed Project Completion: June 30, 2030

LCCMR Funding Category: Land (F)

Project Location

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

Statewide

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

Statewide

When will the work impact occur?

In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Grasslands depend on disturbance to maintain their diversity and function. In Minnesota, grasslands co-evolved with indigenous peoples and grew to depend on regular fire and grazing disturbance to maintain the prairies we see today. However, land management changes, including suppression of fire, over the last century have put Minnesota's remaining grasslands at risk of invasion by woody species. Without disturbances like fire or large mammal grazing, grasslands will often pass a "tipping point" beyond which woody species are extremely difficult to remove. This loss of grassland habitat can have major impacts on prairie plant species and charismatic animal species like pollinators and birds which depend on grasslands for breeding. However, the mechanisms through which woody species gain a competitive foothold and outcompete native grassland species are still unknown. Without clear indicators of how close grasslands are to passing the tipping point, land managers can struggle to perform the right management actions (like prescribed fire) in the right areas at the right time. Understanding the mechanisms that lead to these tipping points is thus key for land managers to be able to conserve our native grasslands.

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.

Here, we propose a study to investigate how woody species assert competitive advantage over grassland species to push grasslands past tipping points. We will investigate the differences between high-quality (un-encroached) grasslands, woody-encroached grasslands, and grasslands with an active woody encroachment front (henceforth Unencroached, Encroached, and Active Front, respectively). We hypothesize that woody species are able to alter their microenvironment to establish a competitive advantage over grassland species. We will investigate the differences in soil condition, aboveground microclimate, and plant physiology between the three grassland types. We will also investigate how these metrics differ between different woody species, particularly those of different provenance (native versus invasive) and different reproductive strategies (clonal versus non-clonal). By comparing Active Front areas with Encroached and Unencroached areas, we will be able to identify where and when tipping points occur. Along the Active Front, we will identify key points beyond which the area has passed over a tipping point and will be difficult to apply management to return it to prairie. With this information, we will create an easy-to-use decision tool for land managers to assess the best management strategy for an area.

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?

Our project will identify mechanisms of woody encroachment in grasslands, a key threat to Minnesota's native prairies. Our results will help land agencies and land managers understand when grasslands are at risk of passing a tipping point into a woody state where management is more costly and difficult. We aim to identify key, easy to collect metrics that will help land managers diagnose the state of encroachment in a grassland. This will help land management conservation strategies be more proactive rather than reactive, saving money and resources, and preventing prairies from falling past a tipping point into an encroached state.

Activities and Milestones

Activity 1: Site selection and preliminary data analysis

Activity Budget: $108,985

Activity Description:
Using local land manager knowledge, we will identify 12 study sites in each landscape (Driftless Area, Ordway-Glacial Lakes , Prairie Coteau, Agassiz Beach Ridges/Tallgrass Aspen Parkland; see attachment for map). Our study sites will include three main landscapes: Unencroached prairie (i.e. herbaceous plant-dominated), Encroached prairie (i.e. woody-dominated), and Active Front sites (consisting of a gradient from un-encroached prairie to encroached prairies). We will then conduct preliminary analyses using GIS to assess similarities and differences in site factors like mean annual temperature, mean annual precipitation, slope, aspect, and soil type. We will also assess plant community assemblies by measuring native and invasive species abundance and woody species presence across all 48 sites. Work will be completed by TNC leads (Dr. Megan Wilcots and Ellen Titus), with assistance from TNC land managers. All on-the-ground field work (e.g. plant sampling, and see Activities 2 and 3) will be divided across the summer of 2028 and 2029, with half of all sites visited each summer.

Activity Milestones:

Description	Approximate Completion Date
Meet with land managers and select preliminary list of sampling sites	December 31, 2027
Complete GIS analysis of sites factors and determine final list of sampling sites	February 28, 2028
Plant sampling at first half of sites completed	August 31, 2028
Plant sampling at second half of sites completed	August 31, 2029

Activity 2: Impact of invasion on micro-environments

Activity Budget: $302,166

Activity Description:
Here, we will investigate how woody species encroachment into prairies affects the physical abiotic environment. We hypothesize that successful woody encroachment is preceded by woody species altering the non-living environment, including moisture regime (soil moisture, relative humidity, water transport), air temperature, and soil conditions to provide a more conducive environment to woody species over herbaceous prairie species. To investigate this, we will sample soils and aboveground microclimate in all three prairie types (Encroached, Unencroached, and Active Front of encroachment). In the Active Front sites, we will sample along a transect stretching across the encroachment front to identify at what stage of encroachment these characteristics begin to change. The sampling will be led by the graduate student and Dr. Wright (microclimate) and the 5th year interns and Dr. Hernandez (soils), with support from the TNC research leads. Soil samples will be analyzed at Carleton College for soil moisture and texture, carbon and nitrogen content, and nitrogen mineralization rates.

Activity Milestones:

Description	Approximate Completion Date
First half of sites sampled	August 31, 2028
Preliminary analyses on first half of sites sampled	December 31, 2028
Second half of sites sampled	August 31, 2029
Preliminary analyses on second half of sites sampled	December 31, 2029
Final analyses completed	February 28, 2030

Activity 3: Impact of encroachment on plant growth and competition

Activity Budget: $135,974

Activity Description:

We will also investigate how woody species encroachment alters plant growth and germination. We hypothesize that woody species outcompete prairie grasses and forbs for light, water, and nutrients by continuing to alter the microclimate to favor trees and shrubs over grasses and forbs (Activity 2). To investigate this, we will measure differences in above- and belowground plant allocation and carbon uptake rates across all three prairie types. This fieldwork will be led and conducted by Dr. Mary Heskel and supported by two undergraduate researchers. Concurrently, we will collect soil samples from across the sites and use them to conduct a seedbank assay. We will identify, count, and remove seedlings grown from the soil samples in a greenhouse environment. This work will be led by two undergraduate researchers and Dr. Austin Yantes. Finally, we will determine if the soil microbial community differs in differently encroached sites, determining if woody invasives leverage soil microbes to dominate landscapes. Samples will be sent to the UMN Genomics center to analyze differences in soil microbial communities between sites. Altogether, we will be able to assess whether woody species' success in invaded areas is due to a competitive advantage over native prairie species, or if

Activity Milestones:

Description	Approximate Completion Date
First half of sites sampled	August 31, 2028
Preliminary analyses on first half of sites completed	December 31, 2028
Second half of sites sampled	August 31, 2029
Preliminary analyses on second half of sites completed	December 31, 2029
Final analyses completed	February 28, 2030

Activity 4: Dissemination of results

Activity Budget: $107,875

Activity Description:

We will share the results of this study in scientific conferences, meetings with land managers, and with publication of white papers and preprint scientific papers. Our project includes project collaborators from varied Minnesota institutions of higher learning, and the students supported by this project will present their findings from this study at local and regional scientific conferences in spring 2029 and 2030. Work from this project will also contribute to multiple undergraduate research projects and graduate student theses. We expect these students to present and disseminate their work as is expected within their degree programs, including at least one scientifically peer reviewed journal article preprint by June 2030. To reach a broader audience, TNC staff will organize outreach field days and online presentations of data in 2029 and 2030 for land managers from both public and private entities in the four focal areas of the study. At these events, we will distribute a data-driven decision tree tool for land managers to determine when sites are at or near encroachment tipping points. We will also prioritize archiving all of our data in public data repositories such that future land managers can access our results.

Activity Milestones:

Description	Approximate Completion Date
Field tours for TNC land managers	September 30, 2029
Presentation of results to land managers	April 30, 2030
Conferences attended by undergraduate and graduate students	May 31, 2030
Additional field tours for TNC, state, and other land managers	May 31, 2030

White papers circulated and preprints of scientific papers available online	June 30, 2030

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Austin Yantes	Winona State University	Dr. Yantes will mentor and supervise two undergraduate technicians each year to conduct the seed bank assay portion of this project. Dr. Yantes will help students with greenhouse setup, seedling identification and data entry, and analysis of data and results dissemination as a part of student senior capstone projects.	Yes
Dr. Daniel Hernandez	Carleton College	Dr. Hernandez will recruit, mentor, and supervise two 5th-year interns from Carleton College, one each year, to collect soil samples, prepare in the lab and analyze, and report data as a part of the dissemination. Dr. Hernandez will supervise all soil analysis at his lab at Carleton College.	Yes
Dr. Mary Heskel	Macalester College	Dr. Heskel will recruit, mentor, and supervise two summer undergraduate researchers from Macalester College to collect plant samples and carbon allocation data, conduct lab work, analyze results, and report data as a part of the dissemination. Dr. Heskel will supervise all analyses at the lab at Macalester College.	Yes
Dr. Alexandra Wright	University of Minnesota	Dr. Wright will recruit and supervise one graduate student who will collect field samples and data for this project and work with TNC staff to analyze data and write peer-reviewed research articles on findings. Dr. Wright will also supervise work at her lab in St. Paul, MN.	Yes

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.
We will share the results of this study in scientific conferences, meetings with land managers, and with publication of white papers and preprint scientific papers. Work from this project will also contribute to multiple undergraduate research projects and graduate student theses. We expect these students to present and disseminate their work as is expected within their degree programs, including at least one scientifically peer reviewed journal article preprint by June 2030. To reach a broader audience, TNC staff will organize outreach field days and online presentations of data in 2029 and 2030 for land managers from both public and private entities in the four focal areas of the study. At these events, we will distribute a data-driven decision tree tool for land managers to determine when sites are at or near encroachment tipping points. We will also prioritize archiving all of our data in public data repositories such that future land managers can access our results.

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?
Our findings will be incorporated into a decision-making tool for land managers such that management decisions can be made in situ without needing input from science staff or university partners. We will attempt to correlate our belowground findings that are difficult to assess visually, (e.g. soil moisture, soil texture) to aboveground metrics that are easy to evaluate in the field, such as woody stem count or density. We do not anticipate further work needed after this project.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded

Community Response Monitoring for Adaptive Management	M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 03r	$483,000
A Riparian Area Adaptation Strategy for Southeast Minnesota	M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 08o	$243,000

Project Manager and Organization Qualifications

Project Manager Name: Megan Wilcots

Job Title: Applied Grassland Climate Scientist

Provide description of the project manager's qualifications to manage the proposed project.
Dr. Megan Wilcots has held the position of Applied Grassland Climate Scientist at The Nature Conservancy (TNC) since February 2024. Prior to TNC, she held the position of Global Change Postdoctoral Fellow at the Arnold Arboretum of Harvard University in Boston, MA. She received her PhD from the University of Minnesota – Twin Cities in 2023, where her dissertation work focused on the impact of nitrogen pollution on grassland plant communities, productivity, and carbon and nitrogen cycling. She has published seven peer-reviewed papers, five of which are first-author publications.

Within her role at TNC, Dr. Wilcots leads the Grassland Monitoring Team project, which is a decades-long, coordinated project that includes TNC, the US Fish and Wildlife Service, and the Minnesota DNR. This requires data management, organization, and people skills that are also necessary for executing this project. She is also the supervisor for Ellen Titus, who will be leading the field work component of this project. As such, Dr. Wilcots has the necessary organizational and management skills needed to manage a large grant and project with many moving parts.

Scientifically, Dr. Wilcots has over a decade of experience conducting field work and ecological research. She has led projects using the majority of the techniques outlined in the proposal, including soil sampling, plant monitoring, measuring microclimate variables, and doing laboratory-based soil analyses.

Organization: The Nature Conservancy

Organization Description:
Founded in 1951, The Nature Conservancy is a global conservation organization dedicated to conserving the lands and waters on which all life depends. Guided by science, we create innovative, on-the-ground solutions to our world's toughest challenges so that nature and people can thrive together. We use a collaborative approach that engages local communities, governments, the private sector, and other partners.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Project Manager and PI		Responsible for managing project, TNC staff, and subaward partners. Tracks and ensures progress towards deliverables, reports, and activities. Supervises TNC staff and all analysis and reports.			32%	0.3		$45,824
Fieldwork and Collaborator Coordination Supervisor		Interacts with project partners in day-to-day manner, supervises technicians in the field and sets fieldwork schedule and objectives, analyzes data from all partners and gathers into final reports and deliverables.			32%	2.4		$289,134
							Sub Total	**$334,958**
Contracts and Services								
Carleton College	Subaward	The work will be conducted in the lab of Dr. Dan Hernandez. It will include pay and fringe for two fifth year technicians (6 month term, each) plus mentorship salary. Includes budget for sample collection in field and machine and consumables for analysis in Dr. Hernandez's lab at Carleton.				1.2		$104,317
Macalester College	Subaward	The work will take place in Dr. Mary Heskel's lab. The cost will cover pay and fringe for two undergraduate technicians for summer internships collecting samples and lab analyses, consumables, and mentorship salary.				0.66		$36,410
Winona State University	Subaward	The work will be conducted in the lab of Dr. Austin Yantes. It will cover pay for four school year interns (2 per year) to grow and identify seeds from seedbank assay, supplies budget, and mentorship salary.				0.84		$19,715
University of Minnesota	Subaward	The work will be conducted in the lab of Dr. Alexandra Wright. It will cover salary and fringe pay for one graduate student in Dr. Wright's lab, along with necessary lab supplies.				2		$125,000
							Sub Total	**$285,442**

Equipment, Tools, and Supplies								
	Tools and Supplies	Soil moisture and temperature probes (2)	Soil moisture and temperature probes to measure in situ moisture and temperature at our sites.					$2,000
	Tools and Supplies	Sample cost for genetic sequencing	Cost of genetic sequencing for soil microbial community analysis					$4,000
	Equipment	Consumable field equipment	Field equipment for sampling soil and plant collection.					$1,000
							Sub Total	**$7,000**
Capital Equipment								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Conference Registration Miles/ Meals/ Lodging	Registration for the project team to attend local meetings	Conference registration for meetings with local stakeholders					$1,000
	Miles/ Meals/ Lodging	Miles, meals, and lodging to for travel to the 48 sampling sites	Mileage, meals, and lodging for team members to travel to the 48 sampling sites across the state to collect data					$26,100
							Sub Total	**$27,100**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Printing	Handouts and final report printing	Printing handouts, visual aids, and our final report for field tours and stakeholder meetings					$500

							Sub Total	**$500**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$655,000**

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	**-**

Total Project Cost: $655,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: b9da5971-c92.pdf

Alternate Text for Visual Component

Top panel: A map of Minnesota showing the four focal areas where sampling occur. Bottom panel: A diagram showing the three types of sampling sites: Unencroached (high-quality prairie), Encroached (dominated by woody species), and Active Front (active encroachment into high-quality prairie areas)....

Financial Capacity

Title	File
Form 990	399b9d71-2c8.pdf
Secretary of State	780cc1df-95b.pdf
Recent Audit	0d748350-3d3.pdf

Board Resolution or Letter

Title	File
Board Resolution	ad04422c-6a1.pdf

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
University of Minnesota LOS	532afcd2-ae5.pdf
Winona State LOS	75a6f806-b88.pdf
Carleton LOS	c32e28e7-f4e.pdf
Macalester LOS	912fc935-625.docx

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Do you understand that travel expenses are only approved if they follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I understand the Commissioner's Plan applies.

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

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 pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing $10,000 or more or large-scale stream or wetland restoration?

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 as "the provision of care, treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this proposal:

Dr. Megan Wilcots, The Nature Conservancy
Ellen Titus, The Nature Conservancy
Marya McIntosh-Johnston, The Nature Conservancy
April Yoder, The Nature Conservancy
Jeff Streier, The Nature Conservancy
Dr. Dan Hernandez, Carleton College
Dr. Mary Heskel, Macalester College
Dr. Austin Yantes, Winona State University
Dr. Alexandra Wright, University of Minnesota

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

N/A