Environment and Natural Resources Trust Fund

2022 Request for Proposal

General Information

Proposal ID: 2022-138

Proposal Title: Moss and lichens of Minnesota prairies and meadows

Project Manager Information

Name: Daniel Stanton

Organization: U of MN - College of Biological Sciences

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Project Basic Information

Project Summary: Mosses, lichens and cyanobacteria are an overlooked part of our prairies and meadows as "biocrusts". This project will document this forgotten diversity and its important functions.

Funds Requested: $160,000

Proposed Project Completion: June 30 2025

LCCMR Funding Category: Small Projects (H)

Secondary Category: Foundational Natural Resource Data and Information (A)

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?

During the Project and In the Future

Narrative

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

It is easy to be impatient about "mud season", the often frustrating wait between when snow melts and the ground dries out enough for crops to be sown and plants to start growing. But for a whole host of organisms, this is their time in the sunlight. An impressive diversity of plants and plant-like organisms (lichens, cyanobacteria) take advantage of this brief period before they are overshadowed by taller flowering plants, and while small, their impacts may be key to understanding our seasonal cycles. Cyanobacteria spread as a slimy film across open spaces, moving nitrogen from the air into the soil. Mosses and lichens fill up with water, slowing the runoff and potentially the loss of nutrients. Not only is much of this abundance and diversity hidden, we know far too little about it. Some of the moss species documented in the Bell Herbarium haven't been seen in over 100 years. This may be that they've disappeared from our territory, but could also be that they've been missed, since some species only appear for a few weeks a year. This project will uncover previously missing information on the identity and importance of our mud season plants.

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

We propose to fill the large gaps in our knowledge of Minnesota's mosses and lichens with an array of field surveys across the state, supplemented by laboratory measurements of important properties (effects on hydrology and nutrients). These surveys are divided into three complementary goals, aimed at understanding state-wide patterns (Activity 1), relocating rare or possibly extinct species (Activity 2) and revealing the impacts of fire management on ground mosses and lichens (Activity 3).

Wide-ranging surveys of ground communities of moss and lichens will adapt a methodology successfully used in forests in a currently funded ENRTF project, applying it to prairies, meadows and other open habitats. While these are found state-wide, they are most common in the southern, western and northwestern parts of Minnesota. Material from these surveys will be used in laboratory evaluations of ecologically valuable properties (hydrology, nutrients and pollutants). The wide surveys will be accompanied by intensive efforts in areas with century-old historical records of rare species such as the Winona bluffs and Yellow Medicine county (Activity 2), as well as places with a range of fire-management practices such as Cedar Creek Ecosystem Reserve in Anoka-Isanti counties (Activity 3).

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?

This project will provide valuable and previously lacking information on mosses and lichens in Minnesota, including their potential ecological value in prairies and meadows, the ranges and distributions of species and the impacts of fire management. Furthermore, targeted searches will determine whether some seemingly rare species, some of which haven't been reported in over a century, truly are rare or simply overlooked. This will provide key information on the ecosystem services provided by lichens and mosses, and facilitate the inclusion of lichens and mosses in management strategies, including restoration and remediation efforts.

Activities and Milestones

Activity 1: Assessing the diversity and importance of Minnesota's ground-dwelling mosses, lichens and allies

Activity Budget: $77,500

Activity Description:
We will apply the sampling methodology used in previous surveys to estimate moss, lichen and cyanobacterial ground cover. Because only the ground is considered, the surveys are efficient, completed in a day at each site by a taxonomic expert and a student field assistant. This makes it possible to evaluate widely to cover a range of climates and conditions. We have identified at least potential 20 sites across southern, central and western Minnesota (see Visual). The biggest challenge is one of timing. the surveys are easiest in Spring before the surface is hidden under the taller flowering plants. On-site estimates of abundance are combined with collections of voucher specimens of all species present. Based on our work with forest moss and lichens, we expect to find many new county and state records.
The surveys of abundance will also be used to estimate the contributions of mosses and lichens to "ecosystem services" provided by open plant communities. The biggest of these is expected to be water-retention, but other roles such as producing nitrogen and filtering rainwater. These properties will be measured in the field during the spring (nitrogen fixation) and in the lab during winter (water retention, nutrient/pollutant content).

Activity Milestones:

Description	Completion Date
Field surveys of biocrusts across Minnesota	October 31 2024
Identification of specimens from surveys	January 31 2025
Measurements of water and nutrient properties of biocrusts	May 31 2025

Activity 2: Finding Minnesota's "lost" mosses

Activity Budget: $44,500

Activity Description:
Many of the moss and moss allies (liverworts, hornworts) species reported for Minnesota are only known from a handful of records from the early 20th century. Because these tend to be very small and short-lived, it is not clear whether they truly are rare (or maybe even extinct) or just overlooked. While some of these might be round in the surveys listed in Activity 2, they are most likely to require more targeted searches of specific locations in southeastern and western Minnesota. Trained moss experts will visit sites with historical records (primarily the Bluffs around Winona and the river shores near Odessa, which were collected in the early 1900s), as well as promising new sites in key habitats (SE MN bluffs, dry western prairies and muddy riverbanks) in Spring and Fall to search for these "lost" mosses. Specimens will be brought back to the University of Minnesota for identification, and added to the Bell Atlas records, and all records of rare and uncommon species contributed to the DNR efforts for species listing.

Activity Milestones:

Description	Completion Date
Field searches for "lost" and rare mosses	June 30 2024
Report on "lost" and rare mosses of prairies and meadows	November 30 2024

Activity 3: Disturbance, fire and soil communities

Activity Budget: $38,000

Activity Description:

Land management practices have large impacts on the plants present at a site. This is true of mosses and lichens as well, perhaps even more so as they don't have deep roots that might withstand fires and surface disturbances. However, we don't know how the fire frequencies used in managing our native prairies impact the rare mosses and lichens that share those spaces with the grasses and wildflowers. In addition to the broad surveys in Activity 1, we will look at the effects of fire and other disturbance on biocrusts in a few select prairie communities at a few sites. The Cedar Creek Ecosystem Reserve in Anoka and Isanti counties has a patchwork of prairie and savanna plots with different fire frequencies, as well as fields at various ages of abandonment. This is an ideal location for examining the impact of fire frequency and field age on moss and lichen. We also want to ensure that other parts of the state are well represented as well. We will select similar sites in southern and western MN with varying time between burns to look at effects on biocrusts and their properties.

Activity Milestones:

Description	Completion Date
Field surveys of mosses and lichens at different fire frequency at Cedar Creek Ecosystem Reserve	November 30 2023
Field surveys of mosses and lichens at different fire frequency in western Minnesota prairies	November 30 2024
Report and research article on effects of fire frequency on biocrusts	May 31 2025

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 be funded?

The results will be used to prepare reports, peer-reviewed scientific articles and presentations (to general public, stake-holders and academics) on the mosses and lichens of Minnesota prairies and meadows. These include maps of distributions and environmental impacts of mosses and lichens, reports on the occurrence and abundance of "lost" and rare Minnesota mosses for the DNR and reports on the effects of fire frequency and other management strategies on moss and lichen communities. Additional work, if required, will be funded through internal funds at the University of Minnesota and external grants.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Assessing Natural Resource Benefits Provided by Lichens and Mosses	M.L. 2018, Chp. 214, Art. 4, Sec. 2, Subd. 03e	$213,000

Project Manager and Organization Qualifications

Project Manager Name: Daniel Stanton

Job Title: Assistant Professor

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

My research focuses on how some plants cope with difficult environments, and what consequences those coping strategies have on their surroundings. In particular I have worked on lichens and mosses at sites across Minnesota and around the world, from their effects on trees in South American deserts to understanding how the shape of mosses adapts them to Antarctica. I am currently running experiments on Minnesota lichens near Grand Rapids, and managing the Lichen and Moss collections at the University of Minnesota Bell Herbarium, some of the largest in North America (>250,000 specimens). As an instructor and educator I have taught courses on Minnesota Flora and Flowering Plant Diversity, as well as participated in outreach to the general public at the Minnesota State Fair, Bell Museum, Minnesota Naturalists Association, Minnesota Mycological Society and various Nature Centers and training workshops with park rangers.

Organization: U of MN - College of Biological Sciences

Organization Description:

The Department of Ecology, Evolution and Behavior and the University of Minnesota are dedicated to supporting biological research that integrates knowledge across levels of biological complexity. This includes field research, the development of collections, and the management of ecosystems. The institution is dedicated to teaching and research, especially as it pertains to biological issues that affect society.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Postdoctoral Associate		Field and identification work (Activity 2), support on Activities 1 & 3			20%	0.9		$60,000
Graduate student		Lead field and lab work for Activities 1 and 3			51%	1.2		$60,000
Ungraduate student assistant (summer)		Assisting graduate student with fieldwork and sample processing during summer.			0%	0.25		$5,000
Undergraduate student assistant (semester)		Assisting research scientist with labwork during school semesters			0%	0.6		$9,000
							Sub Total	**$134,000**
Contracts and Services								
University of Minnesota	Internal services or fees (uncommon)	Analyses of samples for measurements of nitrogen fixation (gas chromatography of ethylene), nutrients (carbon and nitrogen analysis) and nutrients/metals (elemental analysis of common and trace elements)				-		$4,000
							Sub Total	**$4,000**
Equipment, Tools, and Supplies								
	Tools and Supplies	Collection bags, tools etc. Includes specialized jars, acetylene gas and syringes	For collection of material in the fiedl and measurement of nitrogen fixation					$4,000
							Sub Total	**$4,000**
Capital Expenditures								
							Sub Total	**-**

Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging							$15,000
	Miles/ Meals/ Lodging							$3,000
							Sub Total	**$18,000**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$160,000**

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				
In-Kind	University of Minnesota	The University of Minnesota does not charge the State of Minnesota its typical overhead rate of 55% of the total modified direct costs.	Secured	$74,000
			Non State Sub Total	**$74,000**
			Funds Total	**$74,000**

Attachments

Required Attachments

Visual Component

File: ad8f6696-6b4.pdf

Alternate Text for Visual Component

Three Panel Graphic with:
A-Outline map of Minnesota with points showing potential sampling sites for each activity. Activity 1 (Green): Two Rivers SNA (Roseau County), Malmberg Prairie SNA (Polk), Prairie Smoke Dunes (Norman), Iron Springs Bog (Clearwater), Bluestem Prairie SNA (Clay), Otter Tail Prairie (Otter Tail), Roscoe Prairie (Stearns), Uncas Dunes (Sherburne), Big Stone Lake SP (Big Stone), Sibley SP (Kandiyohi), St Croix Savanna SNA (Washington), Hastings SNA (Dakota), Kasota SNA ...

Optional Attachments

Support Letter or Other

Title	File
Sponsored Projects submission authorization	ebabf717-da7.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?

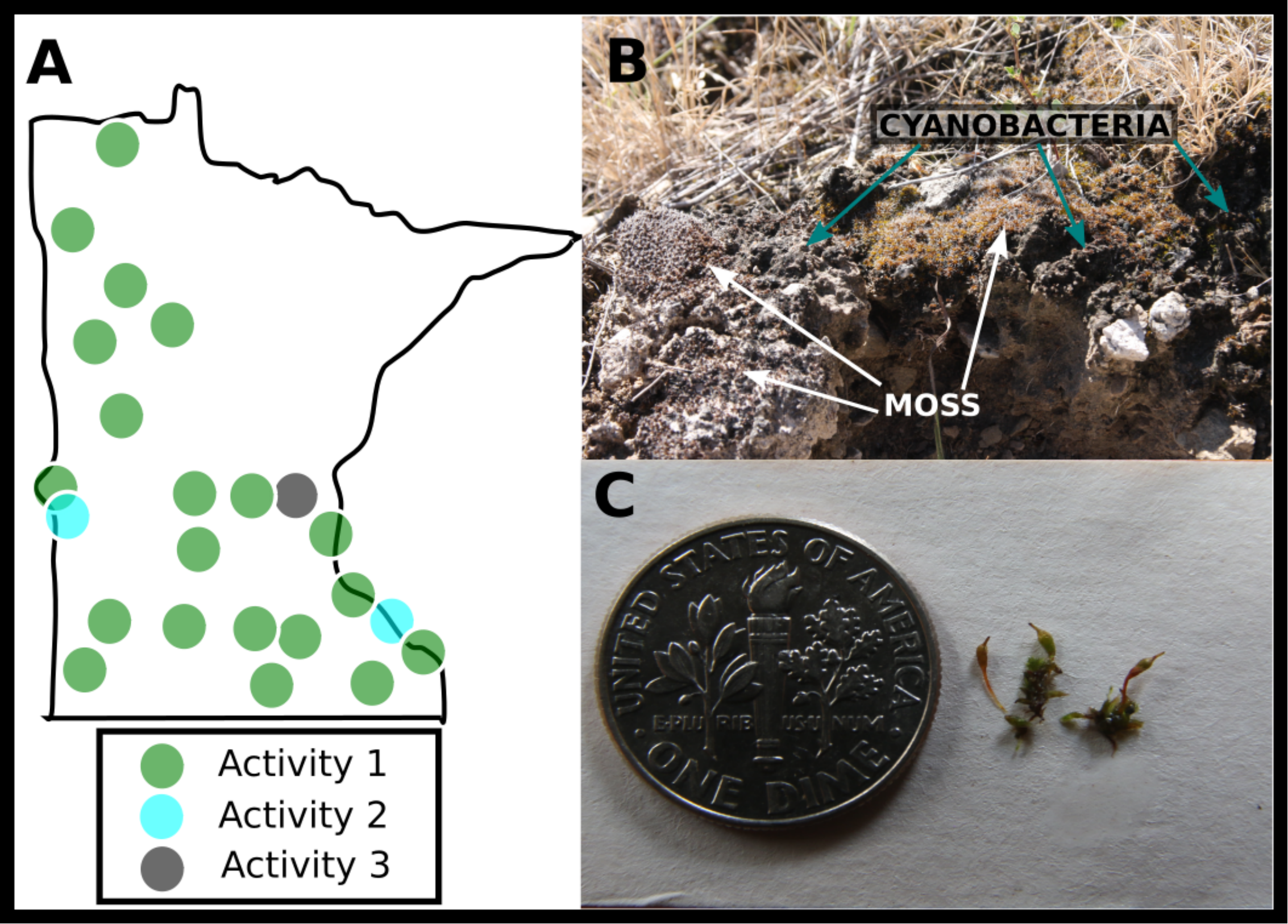
N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration


A
Activity 1
Activity 2
Activity 3
B
CYANOBACTERIA
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UNITED STATES OF AMERICA
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