



# Environment and Natural Resources Trust Fund

## 2021 Request for Proposal

### General Information

**Proposal ID:** 2021-278

**Proposal Title:** Preserving Minnesota's Wetlands: Our Resource for Future Medicine

### Project Manager Information

**Name:** Brian Dingmann

**Organization:** U of MN - Crookston

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### Project Basic Information

**Project Summary:** Our Minnesota bogs are an essential resource. As we use microbes to biomonitor the health of these critical habitats, we could find the next antibacterial, antifungal, or antiviral medicinal product.

**Funds Requested:** \$247,000

**Proposed Project Completion:** 2024-06-30

**LCCMR Funding 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.**

Our Minnesota bogs are unique and vital wetland resources because they are the most carbon-dense ecosystems on the planet. Bogs are an essential carbon sink since carbon is bound and sequestered in the peat layer. Microorganisms play an indispensable role in bog habitat geochemical cycling. Microbial biomonitoring would enhance wetland assessment/management since the microbial community responds quickly to any disturbances. Since knowledge of the microbial communities in Minnesota bogs is lacking, cataloging this diversity would be an efficient and economical method to establish a baseline for future bog health assessment and management. This project provides enriched educational opportunities for underrepresented students in Minnesota.

This study contributes to the overall understanding of Minnesota's peatlands and their conservation. Additionally, the University of Minnesota Crookston (UMC) and White Earth Tribal and Community College (WETCC) students participate in Tiny Earth. This antibiotic discovery initiative utilizes techniques to investigate various soils for potential antibiotic-producing microorganisms. Due to increased antibiotic resistance, there is a great need to discover and develop new antimicrobials. To our knowledge, the microbial communities of Minnesota's bogs have not been mined for potential antibiotic-producers. Such findings would support Minnesota wetland conservation and Minn. Stat. § 103A.201, subd.

### **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.**

Bogs are defined by the vegetation and hydrological parameters found in a given area. Since microorganisms quickly adjust to various fluctuations in these bogs, it is crucial to understand better the microbial functional diversity and community structure. We would establish a baseline for efficient assessment and economical management practices by monitoring the microbial communities in all ten ecoregions within the state.

The need for new antimicrobials is self-evident in this time of growing antibiotic resistance. The Tiny Earth Studentsourcing Antibiotic Discovery project has standardized the methodology to isolate and characterize soil bacteria. By training undergraduates from two institutions, we would have a small army of investigators searching for antibiotic-producing bacteria in bogs. We hypothesize our Minnesota bogs contain a potentially unexploited reservoir of these bacteria. Specifically, the bogs are inhabited by the Actinomycetes bacterial group that has shown to provide antibacterial, antifungal, and antiviral medicinal natural products. Faculty and undergraduate students working on this project will develop sustainable protocols which characterize the microbial community functionality and diversity within bogs. Additionally, bacteria capable of producing novel antimicrobials will be targeted.

### **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?**

The project would catalog the bog microbial functional diversity and community structure in Minnesota's ten ecoregions. The database/protocols will be widely disseminated to stakeholders for best management practices.

Enhancement sampling for the Actinomycetes bacterial group would lead to potential new sources for antimicrobials. These types of efforts are crucial for the health and wellbeing of not only Minnesotans but society in general.

The University of Minnesota Crookston and White Earth Tribal and Community College undergraduates will be trained in molecular and microbiological techniques for future careers in health and conservation (e.g., DNR, USDA, MPCA, and graduate schools).

## Activities and Milestones

### Activity 1: Characterize the microbial community functionality and diversity in bogs

**Activity Budget:** \$132,112

#### Activity Description:

Bogs are found in all ten ecoregions of the state and are an essential carbon sink for global carbon cycling. Conservation and preservation of our Minnesota peatlands are critical as carbon dioxide levels continue to rise worldwide. The importance of wetlands in geochemical cycling and specifically the microbial community in these processes is well established. The proposed research investigates the microbial functional diversity and community structure within our Minnesota bogs. Using commercially available kits, faculty and undergraduates will analyze the diversity of the microbial community between bogs (inter-bog diversity) and within bogs (intra-bog diversity). To facilitate more efficient and effective biomonitoring, we propose to establish a microbial diversity database and protocols for assessment and best management practices. The databases and associated protocols would be widely disseminated to the various stakeholders (e.g., DNR, MPCA, etc.). Aspects of this activity will be incorporated into suitable courses at UMC and WETCC. Students engaged in this work will be well prepared for required internships and future employment.

#### Activity Milestones:

Description	Completion Date
Faculty and 4-6 undergraduates will collect samples from bogs in each of the ten ecoregions.	2021-10-31
Faculty and 4-6 undergraduates will complete microbial functional and biodiversity analyses.	2023-08-31

### Activity 2: Characterize the microbial community's ability to produce potential antimicrobials

**Activity Budget:** \$114,888

#### Activity Description:

The crisis of antibiotic resistance provides an immediate and critical need for new and novel antimicrobials. Natural products, such as secondary metabolites produced from microorganisms, constitute the majority of our antibiotics. The Tiny Earth, Studentsourcing Antibiotic Discovery project has standardized the methodology to isolate and characterize potential producers of antimicrobial bacteria. After isolation and purification of soil bacteria, we will conduct competition experiments against the so-called safe pathogens to identify likely antibiotic-producing cultures. Subsequently, chemical extraction/fractionation would lead to the identification of antimicrobial compounds. Faculty and undergraduate students at UMC and WETCC will employ both molecular techniques and microbiological methods to identify and selectively enhance the culture of Actinobacteria. This group of bacteria is known to exist in bogs and has demonstrated the ability to produce antibacterial, antifungal, and antiviral products. Molecular techniques will identify Actinobacteria genes that are responsible for the production of potential antibiotics. Additionally, we will establish empirically-derived methods to enhance the cultures of these antibiotic-producing bacteria since most soil bacteria cannot usually be cultured. Aspects of this activity will be incorporated into suitable courses at UMC and WETCC. Faculty and undergraduates will compile results and disseminate information to stakeholders.

#### Activity Milestones:

Description	Completion Date
4-6 undergraduates will be trained in gene analysis and initial analyses of antibiotic-producing bacteria.	2023-08-31
Faculty and 4-6 undergraduates will conduct chemical extraction, fractionation, and identification of potential antimicrobial.	2024-01-31

Faculty and 4-6 undergraduates will compile/disseminate findings to stakeholders (MPCA, DNR, etc.) and conferences.
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2024-04-30
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## Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Lorna Lague	White Earth Tribal and Community College	President of White Earth Tribal and Community College	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 be funded?**

We have used most of the techniques for several years in our teaching laboratories at the University of Minnesota Crookston and have the existing infrastructure to train the undergraduates as mentioned in this proposal. The proposed database and baseline data sets will be widely disseminated to the appropriate entities (e.g., DNR, MPCA, etc.). Once sampling and data analysis protocols are established the biomonitoring can be incorporated into existing citizen scientist resource management programs. If we find some promising or at least interesting leads for antibacterial, antifungal, or antiviral medicinal natural products we will aggressively seek additional funding opportunities.

## Project Manager and Organization Qualifications

**Project Manager Name:** Brian Dingmann

**Job Title:** Associate Professor, University of Minnesota Crookston

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

The Tiny Earth, Studentsourcing Antibiotic Discovery project, has standardized the methodology to isolate and characterize potential antibiotic-producing bacteria. Their mission is to create a worldwide crowdsourcing initiative to search for new and novel antibiotics. These microbiological techniques have been used extensively in the teaching laboratories at the University of Minnesota Crookston. We have already trained many students in these techniques in the teaching laboratories with this project would act as a large-scale field sampling effort.

The project manager, along with the co-PIs, have either published articles or presented at national conferences regarding the proposed techniques. At the University of Minnesota Crookston campus, the science faculty seek to empower the next generation of scientists and health science professionals. Research is not necessarily about the accolades and personal achievement as much as the critical process of training students to think, and problem solve critically.

**Organization:** U of MN - Crookston

**Organization Description:**

The marketable laboratory-trained undergraduates and the biomonitoring databases produced reflect the University of Minnesota Crookston and the White Earth Tribal and Community College land-grant missions to focus on practical teaching and dissemination to society. This project is a partnership of two teaching institutions in northwest Minnesota that are committed to the land-grant mission and the success of the region we serve.

Both institutions serve underrepresented populations of students pursuing science and professional degrees. Specifically, the University of Minnesota Crookston has the highest percentage of students that are Pell-eligible and first-generation college learners within the University of Minnesota system.

Likewise, the White Earth Tribal and Community College engages a rural community that is grounded in Anishinaabe

culture, values, and traditions. Over ninety percent of the students are Pell-eligible. Practical training of these students has the potential to retain and empower these students to seek jobs and careers that will not only transform their lives but their extended families. Students will develop skills that can be applied to situations that are high-wage and benefit paying in rural communities of the region, including the Minnesota Department of Natural Resources, the White Earth Nation, and the Minnesota Department of Agriculture.

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
Project Manager/PI		Brian Dingmann (project manager)			36.5%	0.39		\$29,187
co-PI		Karl Anderson (NDSU research collaborator)			36.5%	0.39		\$17,400
co-PI		Venugopal Mukku (UMC research collaborator)			36.5%	0.26		\$19,344
Undergraduate Researchers		Undergraduate research			8%	0.39		\$90,450
							<b>Sub Total</b>	<b>\$156,381</b>
<b>Contracts and Services</b>								
							<b>Sub Total</b>	-
<b>Equipment, Tools, and Supplies</b>								
	Tools and Supplies	BIOLOG Lab supplies	activity one: microbial diversity and functional analysis					\$5,500
	Tools and Supplies	General use Polymerase Chain Reaction (PCR) reagents	To analyze microbial structure and function we will investigate 200 samples across the state. General PCR will allow us to gauge structure and function to focus research.					\$18,000
	Tools and Supplies	QPCR on 200 samples	To analyze and quantify the microbial community structure and function we will investigate 200 samples across the state.					\$21,000
	Tools and Supplies	Microbiological lab supplies	Microbiological culturing and manipulating soil microbes.					\$12,000
	Tools and Supplies	DNA sequencing lab supplies	DNA sequencing is necessary to identify microbial strains in the bog environment.					\$10,000
	Tools and Supplies	Chemical extraction	Extraction, and fractionation is necessary to identify potential antimicrobial products from the bog microbes.					\$12,000

	Tools and Supplies	Chemical reagents	Various chemical reagents will be used that are considered general chemical consumables.					\$3,000
							<b>Sub Total</b>	<b>\$81,500</b>
<b>Capital Expenditures</b>								
							<b>Sub Total</b>	-
<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	-
<b>Travel In Minnesota</b>								
	Miles/ Meals/ Lodging	Travel to sample bogs	Travel (\$0.575 per mile of travel, 14,989 miles sampling around state)					\$8,619
							<b>Sub Total</b>	<b>\$8,619</b>
<b>Travel Outside Minnesota</b>								
							<b>Sub Total</b>	-
<b>Printing and Publication</b>								
	Printing	Printing of reports to stakeholders	Printing of reports to stakeholders					\$500
							<b>Sub Total</b>	<b>\$500</b>
<b>Other Expenses</b>								
							<b>Sub Total</b>	-
							<b>Grand Total</b>	<b>\$247,000</b>



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
<b>State</b>				
			<b>State Sub Total</b>	-
<b>Non-State</b>				
			<b>Non State Sub Total</b>	-
			<b>Funds Total</b>	-

## Attachments

### Required Attachments

#### *Visual Component*

File: [c032089e-535.pdf](#)

#### *Alternate Text for Visual Component*

The attached picture provides an overview of the proposed research. Preserving Minnesota's Wetlands: Our Resource for Future Medicine.

### Optional Attachments

#### *Support Letter or Other*

Title	File
White Earth Tribal and Community Support Letter	<a href="#">675a24b5-44d.pdf</a>

## Administrative Use

**Does your project include restoration or acquisition of land rights?**

No

**Does your project have patent, royalties, or revenue potential?**

No

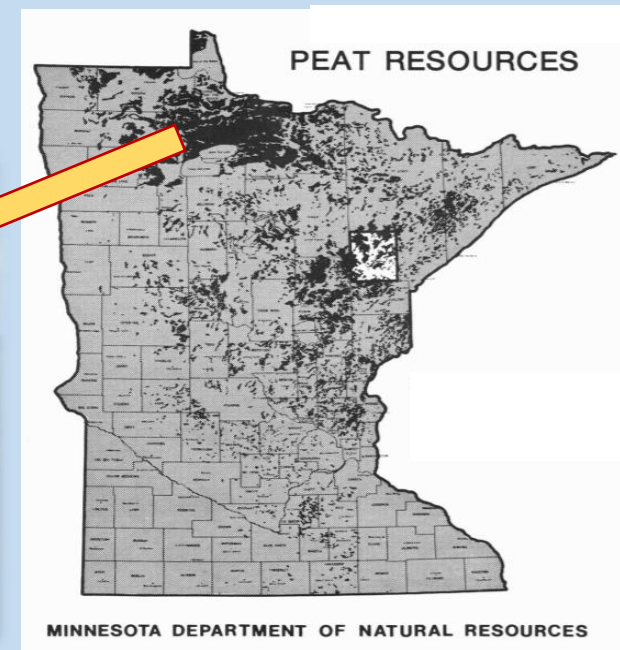
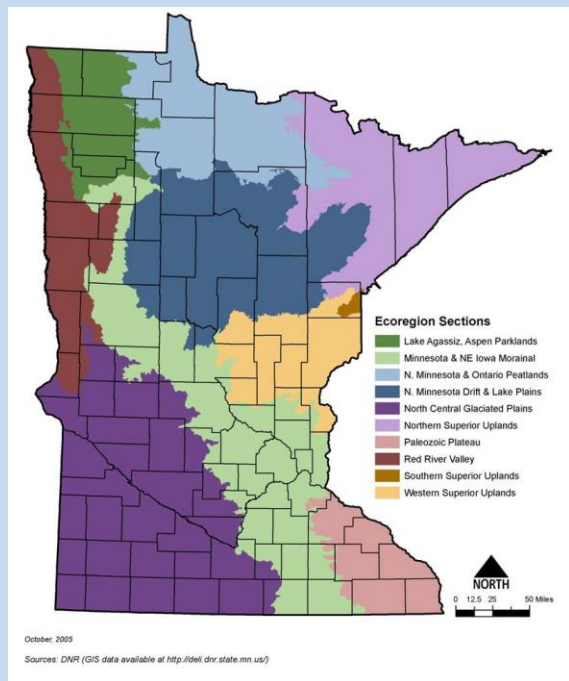
**Does your project include research?**

Yes

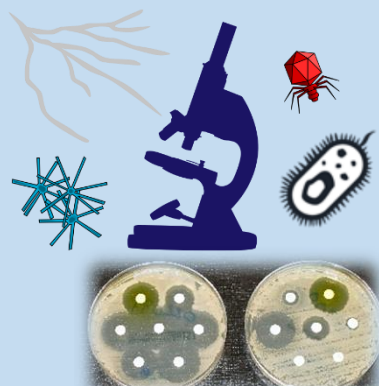
**Does the organization have a fiscal agent for this project?**

Yes, Sponsored Projects Administration

# Preserving Minnesota's Wetlands: Our Resource for Future Medicine



Undergraduate training in microbiology & molecular biology



Examining bog microbial biodiversity & antimicrobial properties



Efficient bog conservation & potential antimicrobials