Environment and Natural Resources Trust Fund

M.L. 2020 Approved Work Plan

General Information

ID Number: 2020-027

Staff Lead: Corrie Layfield

Date this document submitted to LCCMR: August 13, 2021

Project Title: Freshwater Sponges And AIS: Engaging Citizen Scientists

Project Budget: $400,000

Project Manager Information

Name: Venugopal Mukku

Organization: U of MN - Crookston

Office Telephone: (218) 281-8097

Email: mukku002@umn.edu

Web Address: https://www.crk.umn.edu/

Project Reporting

Date Work Plan Approved by LCCMR: August 13, 2021

Reporting Schedule: April 1 / October 1 of each year.

Project Completion: June 30, 2024

Final Report Due Date: August 14, 2024

Legal Information

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 03k

Appropriation Language: $400,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota, Crookston, to use citizen scientists to study the geographic distribution, taxonomic diversity, and antifouling potential of freshwater sponges against aquatic invasive species.

Appropriation End Date: June 30, 2024

Narrative

Project Summary: Freshwater sponges from Minnesota will be collected using citizen scientists thereby stimulating STEM education. Compounds produced by sponges will be tested against invasive species such as zebra mussels.

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

Sponges are among the most ancient living basal Metazoa and grow both in marine and freshwater environments. They are sessile animals and play a significant role in aquatic communities as filter feeders. Because freshwater sponges are sessile animals, they are also known to produce interesting chemical compounds that provide the sponge a chemical defense against other organisms. Despite the abundance of lakes and rivers in Minnesota, very few studies have been conducted examining the biogeographic distribution nor the chemistry of freshwater sponges in Minnesota. Sponges described in literature upto the 1970s and earlier relied heavily on morphological analysis in determining the taxonomy. Our limited exploration of MN lakes and rivers with funding from LCCMR (2017-2020) resulted in the discovery of two undocumented species in MN. Further, given the advances in taxonomic analysis and characterization, all new and known sponge species will be described by both morphological and molecular analysis. This will enable us to describe the phylogenetic relationships between various species.
Aquatic invasive species are a continued concern in the state of MN. Our preliminary research also showed that a few sponges contain antifouling chemicals that may be able to stop the spread of aquatic invasive species.

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.

One unanticipated and welcome outcome of the previous funding was the keen interest the project generated among high school students and ordinary citizens. We aim to capitalize on this interest in expanding our research statewide with the help of our undergraduate students, Master Naturalists and the University of Minnesota Center for Citizen Science. Involving citizens will enable us to sample multiple locations in all ten watersheds of the state in a short term (2021-2024). Sampling for sponges will occur in a narrow season (June to October).
We hope to collect 300- 500 sponge specimens. Many of those specimens may be identical species but that would enable us to determine the distribution and to compare the chemical composition of the same species from different lakes and rivers. We would prepare organic extracts of the collected specimens and test those extracts (where possible) on the growth of invasive species such as zebra mussels.

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 focuses on generating foundational data regarding the diversity and distribution of freshwater sponges in the state. The project involves citizen scientists and high school students and will be disseminated widely. Therefore, the public will become aware of the key role freshwater sponges play in the aquatic ecosystem. Public will also become aware of the interactions and competition using natural compounds between organisms. All data generated will be freely shared with MN DNR for dissemination to the public.

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

Activities and Milestones

Activity 1: Incorporate Minnesota's citizen involvement in the collection and identification of freshwater sponges.

Activity Budget: $208,500

Activity Description:
Numerous rivers and lakes in Minnesota remain to be explored for freshwater sponges. Collections will continue with the additional focus of citizen scientist involvement. Town hall meetings will be held at strategic locations across the state to explain the freshwater sponge project, and encourage citizen scientist participation. Using developed specimen collection packets, citizens will be able to collect sponge samples and mail them to UMC for taxonomic (research addendum section 4.1.3) and chemical (research addendum sections 4.2.2 and 4.2.3) analyses. . Dr. Robert Blair, Professor & Extension Specialist, University of Minnesota Twin Cities will assist the team by arranging town hall meetings and coordinating with the University of Minnesota's Extension Master Naturalist program.
Faculty/researchers will also travel to schools in Northwest Minnesota to engage students and teachers in STEM activities related to freshwater sponges. Freshwater sponge-focused activities will be designed to get students interested in scientific inquiry and stimulate participation in local and regional science fairs.

Activity Milestones:

Description	Completion Date
Develop information/collection packets to send to the public for collection of sponges	March 31, 2022
Collection of sponges from lakes/rivers within each major basin/watershed in MN.	October 31, 2023
Perform outreach activities using town halls, schools, etc. to stimulate sponge collection and STEM education	June 30, 2024

Activity 2: Identify compounds produced by freshwater sponges that could be used to combat the spread of aquatic invasive species

Activity Budget: $136,000

Activity Description:
Freshwater sponges, as well as water and sediment samples, will be collected. Sponges will be freeze-dried prior to chemical extractions. Organic components of these samples will be analyzed using chromatographic techniques (e.g., GC-MS with NIST library, LC-MS). Inorganic components will be analyzed using chromatographic (e.g., IC) and spectroscopic (e.g., ICP-MS) techniques.
All sponge extracts will be tested for their potential antifouling activity using zebra mussel attachment and in vitro assays. Compounds of interest will be identified using GC-MS and LC-MS and where possible, isolated in order to fully test their efficacy. The efficacy of readily available long chain amides such as oleamide against zebra mussels will be tested using compounds obtained from chemical suppliers.

Activity Milestones:

Description	Completion Date
Obtain permissions from MN DNR and collect Zebra Mussels for performing reattachment assay	December 31, 2021
Perform Zebra Mussel reattachment assay with commercially available long chain amides	June 30, 2022
Examine the chemical ecology of freshwater sponges	June 30, 2024
Isolate antifouling compounds and perform biological assays to assess the antifouling ability of sponge extracts	June 30, 2024

Activity 3: Stimulate STEM education for students in Minnesota

Activity Budget: $55,500

Activity Description:

During phase 1 of the freshwater sponge project, two community colleges and a few high schools reached out to us and we have been training their students in the study of sponges. UMC annually conducts the Western Regional Science Fair and school children from the ten surrounding counties compete in the Fair. We will collaborate with interested school districts and high school science teachers to stimulate STEM education. This is in addition to training our own undergraduate students.

Activity Milestones:

Description	Completion Date
Stimulate STEM-related experiences to high school students, partner with additional community colleges, and train undergraduates	June 30, 2024
Assess the impact of STEM-related opportunities at all levels of education	June 30, 2024

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Anthony Schroeder	University of Minnesota Crookston	Co-Principal Investigator	Yes
Timothy Dudley	University of Minnesota Crookston	Co-Principal Investigator	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.
The results of this project will be inherently disseminated to citizens in Minnesota who chose to participate in the project. The results of the project will also be presented at the town hall meetings to provide attendees with information about how their involvement in the project will continue to provide information about organism diversity in Minnesota. The incorporation of this project into the Zooniverse platform will also allow citizens to be involved in the project and be updated with the results of the project. Citizens will be able to utilize the Zooniverse platform at https://www.zooniverse.org. A listserv will be set up via the University of Minnesota Crookston communications office at https://www.crk.umn.edu/units/university-relations. Additional information can be obtained by visiting the freshwater sponges' website at https://freshwatersponges.crk.umn.edu.

Undergraduate students will still be heavily involved in this research, despite the importance of including Minnesota's citizens, the students will be presenting their results via poster and oral presentations at any number of local, regional, and national conferences and symposia. UMC hosts an undergraduate research day each year in which students discuss the research projects they work on with their peers and other faculty. Recently, UMC students have presented their research findings at both regional and national meetings (e.g., American Chemical Society, National Council of Undergraduate Research). Similarly, UMC faculty have been presenting at many of these and other conferences (e.g., Society of Environmental Toxicology and Chemistry). We plan to continue our attendance at these conferences in order to disseminate our findings for this project.

We have also been in contact with various state agencies as a result of the initial sponge project. We will continue to work closely with the Minnesota Department of Natural Resources (DNR) and Pollution Control Agency. The DNR will be especially interested in any anti-fouling compounds that we identified from the freshwater sponges. We have also contacted Nicholas Phelps at the University of Minnesota Aquatic Invasive Species Center about the project. He mentioned that this research could be a potential partner project and we are interested in working with the center to help disseminate the results of this project.

Lastly, we have tried to publicize the project through various media outlets. We will continue to try to do this as well as this is another way to let the people of Minnesota know about the project and how it is contributing to Minnesota's natural resources because of funding through the ENRTF.

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 diversity and distribution data will be shared with MN DNR annually through the project completion. The findings and results will be published in scientific journals. The project may generate new scientific questions. Further research if warranted will be funded by seeking grants from multiple resources including but not limited to the University of Minnesota and federal agencies.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Mapping Taxonomy and Environmental Toxicology of Minnesota Freshwater Sponges	M.L. 2017, Chp. 96, Sec. 2, Subd. 03m	$258,000

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Venugopal Mukku		Project Manager 11% FTE in years 1 and 2, 22% in year 3. 1 month salary in year 1 and 2 and 2 months salary in year 3. Supervise students, coordinate the project, compile and file reports, disseminate results.			36.5%	0.33		$43,032
Timothy Dudley		Investigator, 11% FTE in years 1 and 2, 22% in year 3. 1 month of salary for first two years and 2 months for third year. Supervise students, develop curricula, compile and file reports, and organize the dissemination of results.			36.5%	0.33		$46,300
Anthony Schroeder		Co-Principal Investigator, 22% FTE in year 1 and 11% in years 2 and 3. 2 months salary in year 1 and 1 month salary in years 2 and 3. Responsible for activity 3.			36.5%	0.33		$38,973
Postdoctoral Associate		work with PIs on all activities			24.3%	3		$124,300
3 Undergraduate students		Summer research and field work			0%	3		$58,418
3 undergraduate students		Lab/field work on activities 1, 2 and 3 during academic year			0%	3		$24,000
							Sub Total	**$335,023**
Contracts and Services								
Shimadzu	Internal services or fees (uncommon)	with the constant use of GCMS on the project, we need a service contract. ($6,600/year). Shimadzu technicians will perform annual preventive maintenance and will be on call for any service-related issues.				2		$13,200
TBD	Internal services or fees (uncommon)	For performing analysis of sponge extracts and water sample (LC-MS/MS, ICP-MS), ($20/sample). These analyses will be performed either at the				3		$6,000

		University of Minnesota Twin Cities or the University of North Dakota.						
							Sub Total	**$19,200**
Equipment, Tools, and Supplies								
	Tools and Supplies	Tubes, bags, supplies (100 sponge samples and 100 water samples) by investigators	To store collected sponge specimens by investigators at $22.5/sample					$5,500
	Tools and Supplies	Tubes, mailing boxes, reagents for fixing sponges (200 samples)	To make kits for sending to citizen scientists for collecting samples (at $45/sample)					$8,100
	Tools and Supplies	General chromatography supplies such as GCMS vials, columns, reagents, solvents	For performing analytical chemistry work					$7,100
	Tools and Supplies	Culturing reagents and other consumables for approximately 300 assays	For performing Zebra Mussel assays (at $15/assay)					$4,500
	Tools and Supplies	Primers Big Dye Reagent, tubes, service costs	For DNA sequencing (approximately 300 samples) at $15/sample					$3,750
	Tools and Supplies	Chemicals	For sponge morphology experiments and extracting the sponges with organic solvents (at $15/sample)					$3,500
							Sub Total	**$32,450**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Miles plus meals	Covers costs for field trips for collecting sponges, renting University vehicles and meals					$6,600
	Miles/ Meals/ Lodging	Lodging	Overnight stays on multi-day field trips and town hall meetings					$2,000
							Sub Total	**$8,600**

Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Printing	Infographics and documents	For distribution to citizen scientists and high school students					$2,227
							Sub Total	**$2,227**
Other Expenses								
		Shipping costs	For sending prepaid collection kits to citizens and for sending samples for chemical and DNA analysis	X				$2,500
							Sub Total	**$2,500**
							Grand Total	**$400,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Other Expenses		Shipping costs	Since the project involves citizen scientists collecting sponge samples from around Minnesota, the PIs will need to send collection kits with instructions to various locations around Minnesota. DNA and chemical analyses must be performed at remote locations and the samples will be shipped to those locations.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
In-Kind	Indirect costs (waived)	These are F&A Indirect costs which are waived	Secured	$212,000
			State Sub Total	**$212,000**
Non-State				
			Non State Sub Total	**-**
			Funds Total	**$212,000**

Attachments

Required Attachments

Visual Component

File: 8497c88e-c4b.pdf

Alternate Text for Visual Component

The graphic has the title of the project (Freshwater Sponges and AIS: Engaging Citizen Scientists) at the top center. The page contains 4 pictures. Clockwise they are a lake in which perhaps citizen scientists notice a sponge and inform the researchers followed by a meeting hall where citizen scientists listen to the investigators and Master Naturalists at three o' clock. At six o' clock, there is a picture of a zebra mussel, an invasive species and at nine o' clock, a picture of greenish spo...

Optional Attachments

Support Letter or Other

Title	File
Background Check Certification	86b14c96-a56.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

The budget has been reduced to the recommended amount. Due dates for various activities were updated.

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

N/A

Do you agree travel expenses must 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 agree to the UMN Policy.

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?

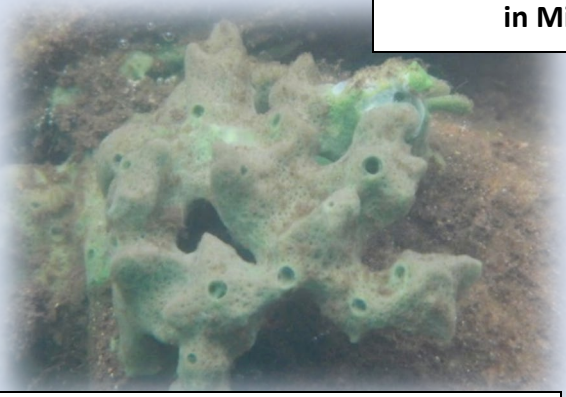
Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

Freshwater Sponges and AIS: Engaging Citizen Scientists

Citizen Scientists Provided Information to Assist in Identifying and Locating Freshwater Sponges in Minnesota's Lakes and Rivers



Collected Freshwater Sponges Identified and Analyzed in the Laboratory by UMC Students and Faculty

UMN Center for Citizen Science Assists in Sharing Project Findings with Citizen Scientists

Students and Faculty Analyze Samples for Natural Biofouling Compounds Capable of Mitigating AIS such as Zebra Mussels