Environment and Natural Resources Trust Fund

2021 Request for Proposal

General Information

Proposal ID: 2021-312

Proposal Title: Freshwater Sponges and AIS: Engaging Citizen Scientists

Project Manager Information

Name: Venugopal Mukku

Organization: U of MN - Crookston

Office Telephone: (218) 281-8097

Email: mukku002@umn.edu

Project Basic Information

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.

Funds Requested: $500,000

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.

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.

This proposal is a resubmission of the tentatively recommended project (40-A). The tenure of the postdoctoral associate increased from 2 to 3 years due to the high expected workload. The budget increased from $400,000 to $500,000. If the recommended project is funded, we will withdraw the resubmission.

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.

Activities and Milestones

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

Activity Budget: $260,000

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	2022-03-31
Collection of sponges from lakes/rivers within each major basin/watershed in MN.	2023-10-31
Perform outreach activities using town halls, schools, etc. to stimulate sponge collection and STEM education	2024-06-30

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

Activity Budget: $165,000

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	2021-12-31
Perform Zebra Mussel reattachment assay with commercially available long chain amides	2022-06-30
Isolate antifouling compounds and perform biological assays to assess the antifouling ability of sponge extracts	2024-06-30
Examine the chemical ecology of freshwater sponges	2024-06-30

Activity 3: Stimulate STEM education for students in Minnesota

Activity Budget: $75,000

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
Assess the impact of STEM-related opportunities at all levels of education	2024-06-30
Stimulate STEM-related experiences to high school students, partner with additional community colleges, and train undergraduates	2024-06-30

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Timothy Dudley	University of Minnesota Crookston	Co-Principal Investigator	Yes
Anthony Schroeder	University of Minnesota Crookston	Co-Principal Investigator	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 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

Project Manager and Organization Qualifications

Project Manager Name: Venugopal Mukku

Job Title: Associate Professor

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

Dr. Mukku received over $1.5 Million over the course of last ten years for research and research infrastructure development at the University of Minnesota Crookston. Working with faculty across various departments he was instrumental in developing the first center for collaborative research at Crookston and modernising teaching laboratories. During his doctoral work he worked on a number of marine organisms and published on the metabolites produced by marine sponges, soft corals, etc. As a tenured associate professor he has worked with a number of undergraduate students. Many of his students presented their research at the annual National Conference on Undergraduate Research.

Organization: U of MN - Crookston

Organization Description:

University of Minnesota Crookston is an Undergraduate degree granting institution and is one of the five campuses of the University of Minnesota system. It primarily serves students from Northwestern MN, ND and WI. More than 50% of the students are first generation students. The Crookston campus is a leader in online learning and the student population is divided between on campus and online students. Crookston campus continues to build its research portfolio by investing in infrastructure, faculty and students thereby fulfilling its Land-Grant Mission.

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		$45,524
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		$47,447
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		$40,560
Postdoctoral Associate		work with PIs on all activities			24.3%	3		$186,450
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		$36,000
Citizen Science/Extension Office Associate		Coordinate town hall meetings with Master Naturalists			36.5%	1.65		$16,380
							Sub Total	**$430,779**
Contracts and Services								
							Sub Total	**-**
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					$4,500

	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)					$9,000
	Tools and Supplies	General chromatography supplies such as GCMS vials, columns, reagents, solvents	For performing analytical chemistry work					$7,100
	Equipment	Maintenance contract for GCMS	with the constant use of GCMS on the project, we need a service contract.($6,600/year)					$13,200
	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					$4,500
	Tools and Supplies	Chemicals	For sponge morphology experiments and extracting the sponges with organic solvents (at $15/sample)					$4,500
	Equipment	Instrument use at University of Minnesota Twin Cities and/or at the University of north Dakota	For performing analysis of sponge extracts and water sample (LC-MS/MS, ICP-MS), ($20/sample)					$6,000
							Sub Total	**$53,300**
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					$7,951
	Miles/ Meals/ Lodging	Lodging	Overnight stays on multi-day field trips and town hall meetings					$3,200
							Sub Total	**$11,151**
Travel Outside Minnesota								
							Sub Total	**-**

Printing and Publication								
	Printing	Infographics and documents	For distribution to citizen scientists and high school students					$2,270
							Sub Total	**$2,270**
Other Expenses								
		Shipping costs	For sending prepaid collection kits to citizens and for sending samples for chemical and DNA analysis					$2,500
							Sub Total	**$2,500**
							Grand Total	**$500,000**

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				
In-Kind	Indirect costs (waived)	These are F&A Indirect costs which are waived	Secured	$280,000
			State Sub Total	**$280,000**
Non-State				
			Non State Sub Total	**-**
			Funds Total	**$280,000**

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 sponge in one of the lakes.

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?

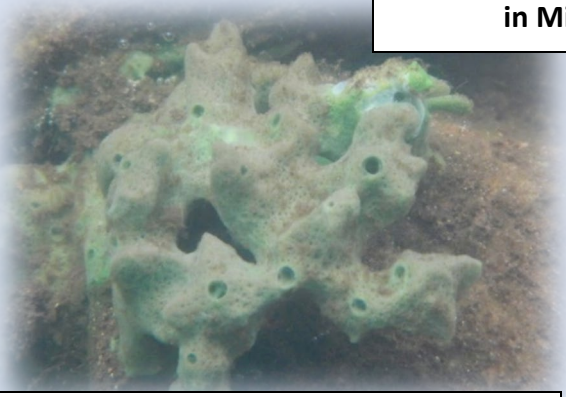
Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

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