

**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. Ineli gible** | **% Bene fits** | **# FTE** | **Class ified 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](https://lccmrprojectmgmt.leg.mn/media/map/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