**PROJECT TITLE: Measuring mussel habitat suitability in the Cannon River**

**I. PROJECT STATEMENT**

Freshwater mussels are the most imperiled group of species in North America, but the direct causes of their decline have been difficult to identify. Human land-use has been implicated in the loss of mussels, but many competing hypotheses exist: loss of habitat, amplified streamflows, increased sediment supply, and increased nutrient loading, among others. The Cannon River in southern Minnesota is home to 17 species of mussel (5 threatened, 4 of special concern) and has experienced many of the environmental problems that negatively impact mussel populations. Additionally, the Cannon has long-term mussel data collected by Minnesota DNR (dating to 1987), so it is an ideal location to study the relation of mussel populations, habitat, and environmental conditions through field data collection and statistical and hydrodynamic modeling.

We have two primary goals in this study:

1. *Measure the hydrodynamic and environmental characteristics of known mussel habitat*

We will conduct field work at known mussel sites to measure a large number of channel and environmental attributes, including sediment transport, channel geometry, and water quality. All these characteristics are known to impact mussel populations. In addition, we will develop hydrodynamic models at known mussel sites. These models predict velocity and bed stability at a variety of flows and have been successfully coupled with mussel data in other rivers.

2. *Identify suitable mussel habitat and identify areas for habitat restoration*

We will identify suitable mussel habitat by pairing existing DNR mussel data with our hydrodynamic models and environmental data. We will develop statistical models that quantify links between physical characteristics and mussel populations. Based on these models, we will create maps of habitat suitability throughout the Cannon River watershed. This will allow us to identify existing sites that can support mussel re-introduction and to prioritize areas that can be actively managed to protect and improve mussel habitat.

**II. PROJECT ACTIVITIES AND OUTCOMES**

**Activity 1 Title: *Characterize physical attributes of successful mussel sites***

The Minnesota Department of Natural Resources has collected mussel data in the Cannon River watershed periodically since the 1980s and has several long-term monitoring sites with successful mussel populations. We will re-visit sites on the Cannon River, Straight River, Little Cannon River, Heath Creek, and Chub Creek. These sites span the geographic range of the watershed and have distinct species assemblages, based on DNR reports. At each site we will:

* Measure physical characteristics, including topography, grain size, channel geometry, water quality, and bedload and suspended-sediment transport
* Deploy instruments to continuously monitor discharge and suspended sediment
* Develop statistical relations between discharge and sediment transport to extrapolate beyond the period of record

Using the topographic data, we will develop hydrodynamic models of each site. Hydrodynamic models produce predictions of velocity and sediment transport for a variety of flows. This approach will allow us to identify stable areas of the river bed, which are required by mussels. Previous studies have successfully identified links between hydraulic attributes and mussel habitat.

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| **ENRTF BUDGET: $ 92, 067** |  |
| **Outcome** | **Completion Date** |
| 1. Measure grain size, channel geometry, and sediment transport | 11/01/2020 |
| 2. Develop hydrodynamic models of known mussel sites | 06/01/2021 |

**Activity 2 Title: *Model habitat suitability and identify restoration sites***

We will use the findings of Activity 1 to create habitat suitability relationships based on statistical relations between mussel populations and physical characteristics. We anticipate that a combination of sediment characteristics, channel geometry, and hydraulic attributes will predict suitable habitat. From these relationships, we will map available and optimal mussel habitat in the Cannon River watershed. Sites with good mussel habitat will be listed as high priority for protection, while sites with some attributes of good habitat provide targets for restoration. We will provide the DNR and Cannon River Watershed Partnership with recommendations to promote additional high-quality habitat.

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| **ENRTF BUDGET: $ 62, 344** |  |
| **Outcome** | **Completion Date** |
| **1.** Create habitat suitability curves and maps for the Cannon River watershed | 04/30/2022 |
| **2.** Produce recommendations for restoration sites and actions to improve mussel habitat  | 06/30/2023 |
| **3.** Present habitat suitability and restoration recommendations to stakeholders | 06/30/2023 |

**III. PROJECT PARTNERS AND COLLABORATORS:**

**Partners receiving ENRTF funding:**

Jabari Jones, PhD student, UMN Earth Sciences – Project manager, environmental data collection, hydrodynamic modeling, habitat suitability

Andy Wickert, Assistant Professor, UMN Earth Sciences – Instrument development and deployment, data collection, hydrodynamic modeling, advising Jones and undergraduate technicians

**Partners not receiving ENRTF funding:**

Kelly Macgregor, Associate professor, Macalaster College Geology

Dan Hornbach, Professor, Macalaster College Biology

Jess Kozarek, Research Associate, Saint Anthony Falls Laboratory

Bernard Seitman, Malacologist, Minnesota DNR

Mark Hove, Research Associate, UMN Fisheries, Wildlife, and Conservation Biology

Kristi Pursell, Executive Director, Cannon River Watershed Partnership

**IV. LONG-TERM IMPLEMENTATION AND FUNDING:**

Products of this research will be freely available to resource managers and scientists to design management and restoration strategies. This work builds on work by previous research groups, including the DNR and research groups working in the St. Croix and Minnesota River watersheds. The DNR has collected extensive population data but does not have the capacity to collect detailed environmental and hydraulic data. And the Cannon is distinct from the St. Croix and Minnesota watersheds due to its geographic setting (e.g. mixed bedrock/alluvial sections) and species assemblages. Together, these datasets build a more comprehensive picture on the state of native mussels in Minnesota. Discharge and sediment transport gages will remain in place after completion of the project to continue data collection and environmental monitoring in the watershed. For further scientific research, we will seek grants from the National Science Foundation, while management options based on our recommendations will be pursued by partners from the Cannon River Watershed Partnership and the MN DNR.

**V. SEE ADDITIONAL PROPOSAL COMPONENTS:**

**A. Proposal Budget Spreadsheet**, **B. Visual Component or Map**, **F. Project Manager Qualifications and Organization Description**