



## Environment and Natural Resources Trust Fund

M.L. 2025 Approved Work Plan

### General Information

**ID Number:** 2025-178

**Staff Lead:** Noah Fribley

**Date this document submitted to LCCMR:** June 5, 2025

**Project Title:** Leveraging Statewide Datasets for Native Rough Fish

**Project Budget:** \$250,000

### Project Manager Information

**Name:** Grant Vagle

**Organization:** U of MN - College of Food, Agricultural and Natural Resource Sciences

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### Project Reporting

**Date Work Plan Approved by LCCMR:** June 24, 2025

**Reporting Schedule:** March 1 / September 1 of each year.

**Project Completion:** June 30, 2028

**Final Report Due Date:** August 14, 2028

### Legal Information

**Legal Citation:** M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 03q

**Appropriation Language:** \$250,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to construct species distribution models that predict presence and abundance of native rough fish species and identify potential areas for protection, additional monitoring, or restoration across the state. This appropriation may also be used to build an interactive mapping tool and share results.

**Appropriation End Date:** June 30, 2028

## Narrative

**Project Summary:** To support future conservation and research efforts and enhance knowledge of Minnesota’s native rough fish, we propose species distribution models to predict their presence and abundance across Minnesota streams.

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

Fish are one of the most important natural resources to Minnesotans for their value as food, recreational opportunities, and deep cultural value. Specifically, there is growing appreciation of “native rough fish” (including suckers, buffalo, redhorses, and many others) which provide unique fishing opportunities and serve important roles in ecosystem functioning. The Minnesota Department of Natural Resources (DNR) emphasized the need for conservation of these native rough fish with a report published in December of 2023. In the DNR report, several research priorities were detailed including establishing monitoring efforts, age structure, and habitat use for many of these species. However, research on many of these species is many years (even decades) behind that of popular game species such as walleye. In particular, there is limited knowledge on the distributions of many of these species in Minnesota. Developing rigorous, statewide species distribution models for these species and establishing a reference library of young native rough fish for further study (e.g., growth or diet studies) would support the research priorities outlined in the DNR report, aid in prioritizing locations for future monitoring and research, and improve accessibility to fishing opportunities for all Minnesotans.

**What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.**

We propose a project to construct species distribution models for 21 native rough fish species in Minnesota, predicting presence and abundance across the state’s rivers and streams. We will utilize data from over 5000 complete-community fish surveys conducted by the Minnesota Pollution Control Agency Biological Monitoring program and gather publicly available covariate data from state and federal datasets such as hydrology, land use/land cover, climate, and water chemistry variables. We will use two high-performance predictive models: (1) a top-performing species distribution model that can incorporate numerous covariates, boosted regression trees, and (2) spatial statistical network models, which account for the inter-connectedness and flow of river systems. We will evaluate these models to provide the best predictions of presence and abundance, then we will identify: (1) “hot spots” where species diversity is highest, (2) “bright spots” where a species is more abundant than predicted, and (3) “dark spots” where a species is less abundant than predicted. These hotspots and bright spots can then be targets for protection, while the dark spots may be targets for additional monitoring or restoration efforts. We will construct an interactive mapping tool to make the predicted distributions of these native rough fish available to all.

**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?**

We will submit scientific publications to document the distributions and preferred environmental conditions of native rough fish in Minnesota, for utilization in future conservation and research efforts. We will construct an online interactive mapping tool intended to serve as documentation of fish diversity for local conservation organizations and interested Minnesotans, enhancing public knowledge of native rough fish and enabling their further protection. Our outreach efforts will utilize fish specimens to grow knowledge of native rough fish through participation in regional blogs, e-newsletters, events with local fishing groups and nature centers, and a workshop targeting native rough fish scientists and managers.

## 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: Building species distribution models and identifying bright spots

**Activity Budget:** \$100,000

**Activity Description:**

We will construct species distribution models for 21 native rough fish species (of 26 that occur in Minnesota) which were detected in at least 15 locations for sufficient predictive power, including all species indicated as priorities in the DNR report, and excluding state or federally listed species whose specific locations are protected by law. To predict each species' occurrence and abundance throughout the state, we will gather covariate data from state and federal datasets including hydrology (e.g., stream flow), land use/land cover (e.g., % agricultural, % wetland), climate, and water chemistry. We will integrate boosted regression trees, a high-performing machine learning model commonly used for species distribution models, with a spatial statistical network model which accounts for the interconnectedness of stream networks. We will compare the separate predictive power of these two models with a “stacking” approach that combines the two models. We will evaluate these models using best practices (including cross-validation and independent test sets) and select the approach (separate or combined) that gives the best estimates. Given these estimates, we will then identify the “hotspots”, “bright spots” and “dark spots”.

**Activity Milestones:**

Description	Approximate Completion Date
Identify and collect data on hydrological, land use/land cover, climate, and water chemistry covariates.	August 31, 2025
Collect and process available Minnesota Pollution Control Agency data for fish surveys	October 31, 2025
Build spatial statistical network models to predict species presence and abundance	February 28, 2026
Build boosted regression tree models to predict species presence and abundance	April 30, 2026
Evaluate, combine, and compare the species distribution models, and select the best final model	June 30, 2026

### Activity 2: Building interactive mapping tool to display species distribution models

**Activity Budget:** \$100,000

**Activity Description:**

To share the statewide predictions from our species distribution models, we will construct a “Shiny app”, a web tool that will allow users to view a map of model predictions for their species of interest. We intend for this tool to be dynamic and interactive, such that users can use “check-boxes” to select species of interest to display on the map, while also allowing users to zoom in and click on stream segments and view the observed and predicted species likely present there. This tool will be constructed using RShiny, built and maintained under version control with git, and submitted to USGS hosting to be made publicly available (at no cost) as a webpage (providing a permanent home). To evaluate the effectiveness of this tool, we will consider feedback (and incorporate updates accordingly) gathered as part of Activity 3 from native fish groups, tribal groups, and managers. State or federally listed species' specific locations will be obscured as required by Minnesota state law, and pending newly listed species, the tool will be updated accordingly.

**Activity Milestones:**

Description	Approximate Completion Date
Develop plan of desired functionality of the tool	August 31, 2026
Implement example functioning tool, evaluate effectiveness of the tool towards the plan	December 31, 2026
Develop final version of interactive tool, submit to USGS server	June 30, 2027

### Activity 3: Share results and interactive tool, conduct outreach activities, and support future outreach efforts

**Activity Budget:** \$50,000

#### **Activity Description:**

We will share our results and the interactive tool by presenting it at local scientific conferences (e.g., MN AFS) and to various interested groups (e.g., Native Fish for Tomorrow, a local non-profit organization working to conserve native fish). We will connect with tribal groups and representatives (e.g., Great Lakes Indian Fish and Wildlife Commission) to gauge interest in the tool and model results, making model predictions on tribal lands only with active collaboration and permission. In sharing the interactive tool, we will also incorporate feedback and ground-truth our model predictions, since these groups have detailed local knowledge on these species. We will extend the value of fish specimens collected as part of the MN PCA Biological Monitoring program by using them for further research, education, and outreach. Currently, these fish specimens are stored in the Bell Museum (UMN) for five years as public record, then destroyed. We will sort, store, and distribute those to-be-destroyed specimens for further use and use them for our own outreach activities with local partners. In addition, we will share our work through participation in regional blogs, e-newsletters, events with local groups and nature centers, and a workshop targeting native rough fish managers.

#### **Activity Milestones:**

Description	Approximate Completion Date
Prepare Minnesota PCA specimens for outreach activities, conduct outreach with native rough fish specimens	August 31, 2026
Outreach with native fish groups to ground-truth model predictions, gauge interest and preferences for tool	December 31, 2026
Present at scientific conferences	March 31, 2027
Further outreach activities to share the interactive tool and native rough fish diversity	June 30, 2027
Submit for open-access scientific publication	June 30, 2027

## Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Grant Vagle - Researcher 5	U of MN - College of Food, Agriculture, and Natural Resource Sciences	Project Manager, PI. Leading project management, data analysis, collaboration with partners, and outreach.	Yes
Lynn Waterhouse	U of MN - College of Food, Agricultural, and Natural Resource Sciences	Co-PI. Assisting with project management, data analysis, collaboration with partners, and outreach.	No
Solomon David	U of MN - College of Food, Agriculture, and Natural Resource Sciences	Project Collaborator. Provide native rough fish expertise, assist with science communication and outreach.	No
Kassandra Ford	U of MN - Bell Museum of Natural History; U of MN - College of Food, Agriculture, and Natural Resource Sciences	Project Collaborator. Assisting with specimen processing, guidance of undergraduate tasked with specimen work, and outreach.	No
Undergraduate Researcher (to be named)	U of MN - Bell Museum of Natural History	Assist with specimen work at Bell Museum and outreach activities.	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.**

Throughout the project, we will engage with native rough fish managers, tribes and inter-tribal groups, as well as recreational angling and bowfishing groups (e.g., Native Fish for Tomorrow). We will ground-truth our models with the expertise from these groups, and receive feedback on our models and proposed interactive tool to make them most useful. Near the end of the project, we will host a workshop targeting native rough fish scientists and managers to provide our model results, allow for a question and answer discussion, demonstrate the use of the interactive tool, and receive feedback.

We will present the project in ongoing and final stages at local conferences (e.g., MN American Fisheries Society meeting) to broadcast the project to scientists and managers. The work will result in 1-2 manuscripts submitted to open-access (free-to-read) journals for publication, and our code, model results, and interactive tool will be submitted for

hosting on United States Geological Survey servers, to be made publicly available in perpetuity.

Throughout the project we will connect with local partners such as local and regional nature centers, natural history museums, etc. (e.g., Bell Museum, Three Rivers Park District), to support and/or conduct outreach activities utilizing preserved specimens to showcase the diversity and demonstrate the ecological importance of Minnesota's native rough fish. Additionally, to bring further awareness to these fish, we will submit articles to local and regional publications (e.g., Minnesota Conservation Volunteer, Outdoor News) to communicate our results and to provide links to our interactive tool so that Minnesotans may explore the mapped model results for their local rivers and streams.

Fish specimens processed and preserved as part of this project will be distributed to interested partners (e.g., local nature centers, educational organizations, research labs) or stored temporarily in the Bell Museum for further use in research, education, and outreach activities. All fish specimens to-be-used in this project would be destroyed under the standard protocol, so any use and further preservation of specimens for this project is extending their value, though we cannot guarantee long-term storage at Bell Museum due to space constraints.

In all venues, we will ensure that support from the Environment and Natural Resources Trust Fund is properly acknowledged.

## 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 work be funded?**

The project will be shared via multiple outreach activities and presentations with various local groups. The resulting manuscript(s) and accompanying code will be submitted to free, open-access scientific journals. The interactive tool will be submitted for USGS web hosting (free with L. Waterhouse's USGS position), with ongoing maintenance by G. Vagle. Additionally, we will archive a static version of the interactive tool via Zenodo.org (a free repository) for long-term reproducibility. The project will also be shared with broad audiences via submissions to regional publications such as the Minnesota Conservation Volunteer, Outdoor News, etc.

## Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Predicting the Future by Understanding the Past	M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 03g	\$170,000

## Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
<b>Personnel</b>								
Researcher 5 (9742R5) - Grant Vagle		Lead data collection, analysis, and outreach efforts.			37.1%	2		\$202,772
Undergraduate researcher (to be named) (500 hours each year)		Assist with specimen work at Bell Museum and outreach activities.			0%	0.48		\$17,655
							<b>Sub Total</b>	<b>\$220,427</b>
<b>Contracts and Services</b>								
							<b>Sub Total</b>	-
<b>Equipment, Tools, and Supplies</b>								
	Tools and Supplies	Plush native rough fish, laminated cards, maps, game materials	Materials for outreach activities					\$2,569
	Tools and Supplies	Glass jars for specimen storage	For specimen storage and sorting at Bell Museum of native rough fish					\$2,500
	Tools and Supplies	Labels for glass jars	For specimen storage and sorting at Bell Museum of native rough fish					\$100
	Tools and Supplies	Ethanol	For specimen storage and sorting at Bell Museum of native rough fish					\$100
							<b>Sub Total</b>	<b>\$5,269</b>
<b>Capital Expenditures</b>								
							<b>Sub Total</b>	-
<b>Acquisitions and Stewardship</b>								
							<b>Sub Total</b>	-



<b>Travel In Minnesota</b>								
	Conference Registration Miles/ Meals/ Lodging	2 people, conference registration \$300 (\$150each), mileage 320 miles x \$0.67/mi = \$214 (using 320 miles Duluth as proxy for each trip), lodging \$1,600 (\$200/ng x 4 nights x 2 rooms), meals \$711 (2 people x 2 days travel @ \$59.25, 3 full days@ \$79)	Travel to 2026 Minnesota American Fisheries Society (AFS) meeting (location TBD) to present progress of project.					\$2,825
	Conference Registration Miles/ Meals/ Lodging	2 people, conference registration \$300 (\$150each), mileage 320 miles x \$0.67/mi = \$214 (using 320 miles Duluth as proxy for each trip), lodging \$1,600 (\$200/ng x 4 nights x 2 rooms), meals \$711 (2 people x 2 days travel @ \$59.25, 3 full days@ \$79)	Travel to 2027 Minnesota American Fisheries Society (AFS) meeting (location TBD) to present final results of project.					\$2,825
	Miles/ Meals/ Lodging	6 total trips. 2 people per trip. Mileage 320 miles x \$0.67/mi = \$214 (using 320 miles Duluth as proxy for each trip), lodging \$800 (\$200/ng x 2 nights x 2 rooms), meals \$395( 2 people x 2 days travel @ \$59.25, 1 full day @ \$79). \$1,409 each trip x 6 trips = \$8,454 total.	Trips for project PIs to meet with native rough fish fishers and experts throughout project.					\$8,454
							<b>Sub Total</b>	<b>\$14,104</b>
<b>Travel Outside Minnesota</b>								
							<b>Sub Total</b>	-
<b>Printing and Publication</b>								
	Publication	Publication fees	Scientific publication fees, open access (2 x \$4000)					\$8,000
	Printing	Printed materials (and lamination) for outreach activities	Materials for outreach activities. Materials will be reused for additional future outreach events.					\$1,000
							<b>Sub Total</b>	<b>\$9,000</b>
<b>Other Expenses</b>								
		Coffee, tea, light snacks	Refreshments for meetings with native rough fish experts	X				\$1,000
		Coffee, tea, light snacks	Refreshments for meeting on quantitative methods at UMN to share final models and interactive tool	X				\$200
							<b>Sub Total</b>	<b>\$1,200</b>

							<b>Grand Total</b>	<b>\$250,000</b>
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## Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Other Expenses		Coffee, tea, light snacks	These meetings are integral to our project, specifically to Activity 3, where we incorporate knowledge from native rough fish experts for our interactive tool. Refreshments will ensure our meetings have sufficient turnout of experts and are as productive as possible. Meetings will be half day to full day meetings (3-8 hours) depending on expert availability.
Other Expenses		Coffee, tea, light snacks	This meeting is an important component of Activity 3, to share the final models and interactive tool with native rough fish managers. Meeting will be a half day to a full day long (4-8 hours).

Non ENRTF Funds

Category	Specific Source	Use	Status	\$ Amount
State				
			State Sub Total	-
Non-State				
			Non State Sub Total	-
			Funds Total	-

Total Project Cost: \$250,000

This amount accurately reflects total project cost?

Yes

## Attachments

### Required Attachments

#### *Visual Component*

File: [bb26b4ca-671.pdf](#)

#### *Alternate Text for Visual Component*

Graphic showing steps of data collection, model building, model predictions, and project outcomes (including scientific publication, an interactive tool, and outreach activities) for leveraging statewide datasets on native rough fish....

### Supplemental Attachments

#### *Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other*

Title	File
Letter of support for Bell Museum fish specimen use from Dr. Cassandra Ford	<a href="#">4e761ead-4cc.pdf</a>
Letter of support from Native Fish for Tomorrow	<a href="#">a2b19bcb-fbf.pdf</a>
SPA Approval Letter	<a href="#">6207f013-e5a.pdf</a>
2025-178 Research Addendum revised_Final	<a href="#">1fb17d9d-0dc.docx</a>

### Difference between Proposal and Work Plan

#### *Describe changes from Proposal to Work Plan Stage*

Added dissemination plan description.

## 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 understand that travel expenses are only approved if they 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 understand the UMN Policy on travel applies.

**Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?**

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

**Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing \$10,000 or more or large-scale stream or wetland restoration?**

No

**Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care, treatment, education, training, instruction, or recreation to children")?**

Yes

**Do you certify that background checks are performed for background check crimes, as defined in Minnesota Statutes, section 299C.61, Subd. 2, on all employees, contractors, and volunteers who have or may have access to a child to whom children's services are provided by your organization?**

Yes

**Provide the name(s) and organization(s) of additional individuals assisting in the completion of this project:**

Lynn Waterhouse, U of MN - College of Food, Agriculture, and Natural Resource Sciences

**Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements**

N/A