Environment and Natural Resources Trust Fund
M.L. 2026 Draft Work Plan

General Information

ID Number: 2026-499

Staff Lead: Noah Fribley

Date this document submitted to LCCMR: December 12, 2025

Project Title: Identifying Climate-Resilient Fisheries to Guide Minnesota Lake Management

Project Budget: $643,000

Project Manager Information

Name: Gretchen Hansen

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

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Project Reporting

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

Project Completion: June 30, 2029

Final Report Due Date: August 14, 2029

Legal Information

Legal Citation:

Appropriation Language:

Appropriation End Date: June 30, 2029

Narrative

Project Summary: We will assess factors supporting multi-species resilience to climate change, identify "bright spots" where fisheries thrive despite changing habitats, and develop decision options within the Resist-Accept-Direct framework for fisheries management.

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

Minnesota's lakes and fisheries are changing as climate warming reshapes aquatic habitats. Warming temperatures have resulted in loss of coldwater and coolwater habitat habitat in a significant number of Minnesota lakes, while others have gained warmwater habitat. However, we do not yet fully understand what these changes mean for fish populations. Fish populations respond to climate change through multiple pathways, including shifts in growth, abundance, and recruitment, but these responses are shaped by local conditions such as shoreline development, in-lake habitat, water levels, and species interactions. Popular sport fish such as walleye are declining in some lakes, while warmwater species like largemouth bass are increasing. Yet, responses to warming are highly variable—some lakes are faring worse than expected, while others maintain strong fisheries despite habitat loss. Identifying these "bright spots" and the conditions that support them is critical to informing effective management. Some lakes may support healthy populations of multiple species, while others face tradeoffs—such as high walleye abundance occurring only when northern pike numbers are low. Understanding these dynamics is essential to guiding Minnesota's Department of Natural Resources (DNR) as it implements Resist-Accept-Direct (RAD) strategies in lake management.

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.

This project will identify factors that promote resilience across species and explore management actions that can help sustain Minnesota's multispecies fisheries in a warming climate. We will conduct a multi-lake study to evaluate how fish populations respond to warming and assess what makes some lakes "bright spots" of resilience. Using long-term fish habitat data, we will identify case study lakes that have gained or lost key fish habitat and assess their fish communities using metrics of abundance, growth, and recruitment. We will identify characteristics of bright spot lakes based on input from fishery managers and field data collection. Field sampling will measure habitat, fish community structure, species interactions, food web dynamics, and limnological conditions. Additionally, we will engage fisheries managers and conservation practitioners to gather input on defining "good" fisheries and identifying actionable management strategies. Findings will be integrated into the Resist-Accept-Direct (RAD) framework to guide management options for multiple objectives across species in a changing environment, prioritizing conservation actions based on lake-specific resilience. We will develop practical tools, such as a fisheries resilience "cheat sheet," to support science-based decision-making and ensure Minnesota's lakes continue to provide ecological, economic, and recreational benefits for future generations.

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?

By pinpointing factors under management control that support fish populations, this research will provide science-based solutions to protect the economic, ecological, and recreational value of Minnesota's lakes for future generations. Specific outcomes include:
-Assessment of the distribution, biological interactions, and relative abundance of fish species with varying thermal tolerances across Minnesota lakes.
-Comprehensive understanding of lake factors and fish community compositions contributing to resilience in Minnesota lakes using observational data, statistical modeling, and semi-structured conversations with managers.
-Classification of Minnesota lake fisheries as bright, dark, hot, or cold spots to identify areas thriving despite environmental change.
Resist-Accept-Direct decision options

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: Identify multispecies bright spots in Minnesota fisheries

Activity Budget: $127,398

Activity Description:

Bright spots are unexpected successes that have been used in a variety of fields to identify hidden factors contributing to unpredicted outcomes. In this activity, researchers will use long-term fish thermal habitat and fish abundance, size structure, and recruitment data to identify responses of multiple species of fish to thermal habitat using statistical models. Model predictions will be used to identify bright spot lakes where fisheries metrics of multiple species are higher than expected given habitat availability. Results from this analysis will quantify the relationship between fish habitat availability and fish abundance and quantify trends in multiple metrics for Minnesota lakes. Predictions will be used to classify lakes into four categories: bright (highly resilient lakes), dark (highly vulnerable lakes), hot (highly productive lakes), and cold (highly unproductive lakes). Through classification, researchers will analyze potential trade-offs for each lake type (e.g., a given lake may support walleye but only if northern pike are in low abundance). Tradeoffs between these fisheries metrics, will directly inform potential management strategies produced in activity 4 and be summarized in reports, presentations, and scientific papers.

Activity Milestones:

Description	Approximate Completion Date
Fisheries and limnological data sourced and combined for statistical analyses	December 31, 2026
Quantify relationship between thermal habitat and fish populations for multiple species	June 30, 2027
Identification of multispecies fisheries bright spots	June 30, 2027
Analysis of potential fisheries trade-offs identified for each lake type	December 31, 2027
Scientific report and manuscript classifying lakes across multiple fisheries species and metrics	June 30, 2028

Activity 2: Identify potential factors that make a lake a bright spot

Activity Budget: $129,957

Activity Description:

In this activity, researchers will use a multifaceted approach to identify factors that support bright spots in Minnesota fisheries, including a literature review and semi-structured conversations with fisheries and lake managers. The literature review will synthesize factors associated with bright spots in other systems including stocking and fishing history, land use change, biodiversity trends, species compositions, food web dynamics, habitat availability, water levels, and plant communities. This information will guide semi-structured discussions with resource managers to understand the importance of elements in driving fisheries resilience, as well as identify local factors contributing to unexpected success. Local factors that will be discussed include governance/management structure, management capacity, and local (e.g., lake association) priorities. We will then synthesize literature review and manager perspectives from conversations with existing biological knowledge of Minnesota fisheries (growth, reproduction, size structure, thermal tolerances, species composition) to generate hypotheses about mechanisms driving resilience. This activity will result in a comprehensive understanding of what and predictions of how these elements are driving fisheries resilience and vulnerability across Minnesota's lakes. The literature review will be formalized in a scientific report and major takeaways from meetings with resource managers will be shared in a public webinar.

Activity Milestones:

Description	Approximate Completion Date
Literature review of factors associated with fisheries bright spots	December 31, 2026

Semi-structured conversations with fisheries and lake managers to identify hypothesized drivers of bright spots	June 30, 2027
Literature review published and shared with broader community via presentations and webinars	December 31, 2027

Activity 3: Identify characteristics that promote resilient fisheries

Activity Budget: $277,326

Activity Description:

We will test hypotheses of factors that influence bright and dark spot lakes using multiple approaches. We will collate data on management history, land use, clarity, and other factors available at large scales and add them to statistical models from activity 1 to evaluate their explanatory power and influence on bright spots. We will also sample 12 case study lakes representing both bright and dark spots. Sampling metrics will be identified in activity 2 however, previous research has identified watershed and shoreline land use, physical habitat, fish community structure, species interactions, and limnological conditions and we will measure these factors for case study lakes. Fish community will be sampled by MN DNR and supplemented by additional sampling where needed. Species interactions will be indexed using fish diets. Physical habitat and shoreline development will be measured using existing protocols. Limnological measurements will include water clarity (e.g., chlorophyll a, turbidity) and nutrient availability (e.g., total nitrogen, total phosphorus) . We will evaluate differences in characteristics of bright vs dark spot lakes for multiple species and metrics. Lake classifications and influential factors will be summarized in a scientific publication and presentations.

Activity Milestones:

Description	Approximate Completion Date
Collation of data identified in Activity 2 to add to statistical models	December 31, 2027
Field sampling examining factors contributing to lake classifications	October 31, 2028
Statistical analysis evaluating drivers of bright spot lakes	June 30, 2029
Results disseminated via written and online publications and presentations	June 30, 2029

Activity 4: Co-producing Resist-Accept-Direct strategies for each lake classification

Activity Budget: $108,319

Activity Description:

Resist-Accept-Direct (RAD) framework is a tool to help managers make informed strategies for responding to environmental changes. The RAD framework lays out three paths for management decisions: 1) Resist, work to maintain/restore historical conditions; 2) Accept, allow change to occur; and 3) Direct, actively shape towards new conditions. In this activity, researchers will integrate findings from activities 1-3 into the RAD framework to guide management options for multiple objectives across species, prioritizing conservation actions based on lake-specific resilience. Following lake classifications and driving factors, researchers will conduct semi-structured conversations with managers to co-produce feasible RAD strategies for each lake type. Conversations will focus on understanding past management decisions and feasibility of future options. For example, 'super-bright spots' that support multiple fish species resilience will require different strategies compared to 'super-dark spots' that don't support fisheries resilience despite suitable conditions. We will summarize RAD options for each lake classification into practical tools, such as fisheries resilience "cheat sheets" to facilitate incorporation of RAD options into management planning, support science-based decision-making, and ensure Minnesota's lakes continue to provide benefits for future generations. Findings will also be summarized in a scientific publication and shared in a public webinar.

Activity Milestones:

Description	Approximate Completion Date
Conversations with fisheries managers to understand feasibility of potential management actions	January 31, 2029
RAD options identified for each lake classification type	May 31, 2029
Fisheries management 'cheat sheets' communicating RAD decision options for each classification type	June 30, 2029
Results disseminated via written and online publications and presentations	June 30, 2029

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Camille Mosley	University of Minnesota	Post doctoral research fellow	Yes
Holly Embke	United States Geological Survey	Dr. Embke is a research scientist at the Midwest Climate Adaptation Science Center and an expert in climate change impacts on freshwater fish populations and working with partners to develop effective management strategies in the face of change. She will consult on study design, analysis, partner input, and communication.	No
Heidi Rantala	Minnesota Department of Natural Resources	Fisheries Research Scientist Dr. Heidi Rantala will provide her expertise in lake and food web ecology, contribute to and review publications, communicate results, and serve as a liaison between the project partners and MNDNR Fisheries.	No

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 target audience for results of this research will be fisheries managers and aquatic biologists. Specifically, managers and scientists in academia, federal agencies, state agencies and environmental consultants. Results will be disseminated through scholarly publications in peer-reviewed journals. Results from the research project will also be presented at conferences such as the Minnesota chapter of American Fisheries Society and targeted seminars, such as the Minnesota DNR's Climate Action Conversations, and public webinars hosted by the University of Minnesota or other partners such as the Midwest Glacial Lakes Partnership Webinar Series. Additionally, all publications, data, and reproducible code will be publicly available. The Environment and Natural Resources Trust Fund will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENRTF Acknowledgment Guidelines.

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?
Results from this project will be implemented into new and existing management plans by lake and fisheries managers statewide. The co-production of Resist-Accept-Direct strategies will determine management strategies for different levels of resilience in fish populations and will be reported in agency reports, public webinars, and scientific publications. All data and the literature review developed through project activities will be available online in a published data repository, including the assessment of local lake factors fostering fish resilience. One page graphics displaying our findings will be available to aid in optimization of conservation efforts.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Uncovering the Past to Protect Minnesota's Walleye Fisheries	M.L. 2024, , Chp. 83, Art. , Sec. 2, Subd. 04m	$1,121,000

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Project manager Gretchen Hansen		Lead all aspects of project, including study design, supervision of staff and students, data collection and analysis, interpretation and communication of results, and engagement with partners.			36.6%	0.12		$29,844
Graduate student		To conduct statistical analyses, assist with fieldwork, and coordinate with partners on implementation and integration of research			23.2%	1.5		$170,308
Research scientist		To coordinate and lead field work with state partners, coordinate data acquisition, assist with analysis and communication. (Researcher 5 salary 3 yrs + fringe)			36.6%	3		$319,808
Undergraduate student workers (2)		To assist with field work during summer 2027 and fall 2028, sampling processing at UMN lab facility, and data entry. (2 students @$16/hour for 11 weeks of field work at 40 hrs/week for 2 years, plus 10 hours per week for 14 weeks per semester for 4 semesters).			0%	1.38		$46,080
							Sub Total	$566,040
Contracts and Services								
University of Minnesota Natural Resources Research Institute Water Quality Testing	Internal services or fees (uncommon)	Water chemistry analysis for 12 lakes at 3 sites per lake . Costs calculated based on per sample cost for Dissolved organic carbon ($17.44), Total phosphorus + Total Nitrogen ($49.80), chlorophyll-A ($32.30), turbidity ($11.70), Total Suspended Solids ($21.90) and filtration ($9.10).				0		$5,121
							Sub Total	$5,121
Equipment, Tools, and Supplies								
	Equipment	Field equipment : Waders [4@$100], PFDs [4@$80], Electrofishing poles [2@$751], Electrode ring for	Equipment for sampling fish and habitat in case study lakes					$8,955

		electrofishing [$184], Lithium battery for electrofishing [$1187], Battery charger [$427], beach seines [2@$1187], minnow traps [50 traps @$25], gastric lavage [2@$200], viewing tube for assessing substrate [2@$50], Rangefinder [2@$200], field measuring tapes [2@64]]							
	Tools and Supplies	Bottles for water samples [108@$10], sample jars and dissecting kits for diets [$1248], coolers [2@$100], Ethanol [$450], formalin for fish preservation [$200], ice [$240], whirl packs [$110], decontamination supplies [$500]	Supplies for sampling fish, habitat, water diets, and analyzing in lab						$4,028
	Equipment	Digital camera	"Digital camera for documenting shoreline, riparian zone, nearshore underwater environment"						$180
	Tools and Supplies	Rite in the Rain paper	Paper for datasheets for field sampling (fish, limno, food web) and lab processing. Waterproof physical data archive						$135
	Tools and Supplies	Boat gasoline	Gasoline for boat for field work related to studying shoreline development, collecting water quality samples, collecting fish samples.						$260
	Capital Equipment	Smith root backpack electrofishing unit	For sampling fish in nearshore environments following established community sampling protocols	X					$10,915
								Sub Total	**$24,473**
Capital Expenditures									
								Sub Total	-
Acquisitions and Stewardship									
								Sub Total	-
Travel In Minnesota									
	Miles/ Meals/ Lodging	Fieldwork in case study lakes (bright and dark). Travel to and from lakes ~ 12 lakes and lodging. Costs estimated for 12 travel weeks for year 2, and 3 travel weeks for year 3. Total based off weekly	Fieldwork to visit case study lakes to collect data on lake habitat, water quality, fish community interactions						$35,280

		costs of 600 miles@$0.70/mi + 4 lodging nights per person @$165/night + 5 days of meals @$68/full day per person & @$51/travel day (2 days of trip) for 2 people (meal estimate based on state per diem rate; actual costs will be reimbursed)	to identify characteristics of bright spot lakes.						
	Miles/ Meals/ Lodging	Travel for two people to attend two project coordination and co-production of knowledge meetings in each of years 1 and 3. Costs estimated per meeting as 400 miles@$0.70/mi + 2 lodging nights@$165/night per person + 1 day of meals @$68/day + 2 travel days of meals @$51 day for 2 people (meal estimate based on University per diem rate; actual costs will be reimbursed)	Travel for two people to attend two project coordination and co-production of knowledge meetings in each of years 1 and 3 to identify characteristics of bright spot lakes and integrate project results into fisheries conservation planning tools.						$5,120
	Conference Registration Miles/ Meals/ Lodging	Travel for in state meetings and conferences 1 person attending 1 per year in years 2 and 3. Costs estimated as $250 registration fee, 400 miles@$0.70/mi + 2 lodging nights@$165/night + 1 day of meals @$68/day + 2 travel days of meals @$51 day (estimates based on University per diem rates, actual costs will be reimbursed)	Travel for one person to travel to an in state conference (e.g., the Minnesota chapter of the American Fisheries Society or the Water Resources Conference) to present and communicate results						$2,060
								Sub Total	**$42,460**
Travel Outside Minnesota									
								Sub Total	-
Printing and Publication									
	Publication	Open access publication fee for peer reviewed journal article	Publishing research results in open access journal so that the public can read results without being behind a paywall						$3,200
								Sub Total	**$3,200**
Other Expenses									
		Boat Maintenance (780100)	Maintenance of lab-owned boats used for experimental field sampling, including paying local boat repair shops for winterizing, regular maintenance, and repairs, and						$1,706

			purchasing tools and supplies for minor fixes when possible					
							Sub Total	**$1,706**
							Grand Total	**$643,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Equipment, Tools, and Supplies		Smith root backpack electrofishing unit	A backpack electrofishing unit is a critical sampling gear for assessing entire fish communities and one that has not been requested in previous proposals to ENTRF from this PI. This piece of equipment is needed to complete Activity 3. **Additional Explanation :** This unit will be dedicated to this project for its entire duration. Upon completion of the project it will be used for fish sampling in other ENTRF funded projects in the lab

Non ENRTF Funds

Category	Specific Source	Use	Status	$ Amount
State				
In-Kind	Fish and Game funds	Fisheries Research Scientist Dr. Heidi Rantala will provide her expertise in lake and food web ecology, contribute to and review publications, communicate results, and serve as a liaison between the project partners and MNDNR Fisheries. In this role, Dr. Rantala will provide $33,500 in match (salary and fringe) over the 3-year duration of the project totaling 624 hours.	Secured	$33,500
			State Sub Total	**$33,500**
Non-State				
In-Kind	University of Minnesota foregone indirect costs (54% MTDC)	Administrative costs associated with support of research activities including payroll and human resources, finance, facilities, and IT. If this award is reduced from the requested amount, the proposed cost sharing will be reduced proportionately.	Secured	$347,220
			Non State Sub Total	**$347,220**
			Funds Total	**$380,720**

Total Project Cost: $1,023,720

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [86579bfc-be7.pdf](86579bfc-be7.pdf)

Alternate Text for Visual Component

Graphics representing warming temperatures, changes in fish species composition and size resulting from climate change. Project outcomes including identifying bright spots and factors that create them as well as developing management plans for adaptation. Includes diagram showing possible actions in response to climate change, and UMN and MNDNR logos....

Supplemental Attachments

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

Title	File
Sponsored projects approval letter	[40a860bf-f27.pdf](40a860bf-f27.pdf)
MN DNR support letter	[86fd3adf-be4.pdf](86fd3adf-be4.pdf)
LCCMR climate bright spots research addendum_Final	e800df0c-5d6.docx

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

Due to budget reductions, we removed stable isotope sampling from our budget. Instead, activity 3 will rely on collating existing data as well as fish community sampling and diet analysis. To support this we added a backpack electrofishing unit to the budget (capital expense). PI Hansen's time was substantially reduced in the budget. Other small changes to the budget to reflect sampling needs given the updated work plan include changes to undergraduate work hours and equipment/supplies

11/03/2025: In response to LCCMR staff comments, we added language to the dissemination plan committing to acknowledging ENRTF funds in all communications. We reclassified water quality testing as an internal expense, and we added language to the budget line item for boat maintenance providing more details. This is its own category at UMN so we believe it has been properly classified.

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?

No

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")?

No

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

Camille Mosley, Holly Embke

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