Project Title: **ENRTF ID:**   025-A

Evaluation of Thermal Regimes For Optimizing Trout Habitats

Category: A. Foundational Natural Resource Data and Information

Total Project Budget: $ 450,489

Proposed Project Time Period for the Funding Requested: 3 years, July 2015 - June 2018

Summary:

We will develop thermal models, quantify food resources, and incorporate a new citizen monitoring program approach to optimize planning for enhancing habitat and trout production in streams of SE Minnesota.

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Sponsoring Organization: U of MN

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Location

Region: SE

County Name: Fillmore, Goodhue, Houston, Olmsted, Wabasha, Winona

City / Township:

Alternate Text for Visual:

No visual or map is included in this application

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage		_____ TOTAL

PROJECT TITLE: Evaluation of Thermal Regimes For Optimizing Trout Habitats

I. PROJECT STATEMENT: The goal of this project is to provide thermal models for decision-makers (e.g., DNR, landowners, Trout Unlimited) to prioritize conservation, management, and development activities as they relate to the growth and survival of brook trout and brown trout in SE Minnesota.

This project builds on previous work in 40 SE Minnesota streams (ML 2010 Chap. 362, Sec. 2, Subd. 5i) showing that groundwater:

- buffers stream temperatures from summer heat and winter cold,
- inputs can be highly variable with a short stretch of stream
- supports year-round abundance of invertebrates (the trout food base) that varies substantially in relation to groundwater inputs and thermal regimes, and
- buffering of thermal regime ultimately promotes trout growth and abundance.

We will intensively map and sample 8 streams per year at each of 5 sample locations that span a range of groundwater input intensities, leading to management guidance. Our objective are to:

- identify specifically how groundwater, air temperature, geology and streambed conditions interact to determine optimal habitat for macroinvertebrates that trout feed on and are critical for trout habitat;
- understand how changes in geology, groundwater input, and vegetation affect stream temperatures and therefore influence food availability and ultimately trout productivity;
- create quantitative models relating thermal regimes to food availability to optimize habitats;
- recommend ways that the quantitative models can guide efforts to enhance trout productivity via changes that protect or improve stream temperature.

Trout in Minnesota's nearly 700 designated streams have great economic, sport and aesthetic importance. Trout depend on cold, clean stream water, a resource that is threatened by gradual warming (e.g., as a result of agriculture, climate change, resource extraction, urbanization). Minnesota's managers and landowners need ways to understand what actions can reduce the impacts of warming and by how much. Consequently, we will also **develop an outreach program that educates and utilizes citizen volunteers** to assist in monitoring the dynamics of macroinvertebrate populations in a large number of trout streams in SE Minnesota.
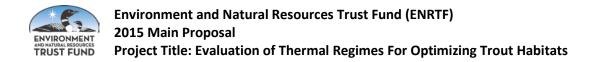
II. PROJECT ACTIVITIES AND OUTCOMES:

Activity 1: *Thermal Modeling---Build on Calvin Alexander's spring mapping work and*   **Budget:$210,048**
leverage the MN DNR's Long Term Monitoring program to understand how groundwater
inputs along 8 streams per year (at 5 sites/stream) interact with geology and streambed
conditions to buffer trout streams from summer heat and winter cold.

This activity allows us to predict the ranges of thermal suitability for trout, and how they vary longitudinally within streams, and will enable managers to position restoration efforts to have the greatest impact in extending the moderating influence of groundwater on stream temperature. We will use air and water temperatures and water chemistry (5 sites/stream, 5 sampling events/year) to map groundwater inputs at fine spatial scales, and quantify local geology and streambed conditions at coarse spatial scales. We will relate these conditions in a statistical model for identifying highest-priority management actions.

Include detailed description of the activity you are proposing to do here.

Outcome	Completion Date
1. Specific, measureable outcome: **Develop thermal models, 8 streams, 5 sites/str, year 1**	*June 2016*
2. Specific, measureable outcome: **Thermal models for 8 more streams, 5 sites/str, year 2**	*June 2017*
3. Specific, measureable outcome: **Thermal models for 8 more streams, 5 sites/str, year 3**	*June 2018*

1

Activity 2: *Relate changes in macroinvertebrate abundances* and *genetics along 5 sites*   **Budget:$219,400**
at 8 streams per year to thermal models developed in Activity 1.

This activity links stream conditions to trout through food availability and quality. Given that many food species look the same, we will use a type of DNA (MtDNA) to efficiently and accurately identify those insects that provide the most reliable energy to trout in summer and winter. We will determine how genetic patterns of numerically dominant insects differ among the most abundance insects, and if genetic variability aligns with water temperatures and seasons along 6 streams.

Outcome: The following outcomes will be accomplished at 5 sites in each of 8 stream/year	Completion Date
1. **Assessment of density & genetic variability of the most abundant invertebrate species**	*June 2016*
2. **Assessment of density & genetic variability of the most abundant invertebrate species**	*June 2017*
3. **Assessment of density & genetic variability of the most abundant invertebrate species**	*June 2018*

Activity 3: develop an outreach program that educates and utilizes citizen volunteers to   **Budget:$21,041**
assist monitoring the dynamics of macroinvertebrate populations in additional trout streams in SE Minnesota.

We have worked with volunteers to assist their monitoring of streams in the Minneapolis/Saint Paul area. We will locate and use similar methods to develop coordinated groups of volunteers to help with winter monitoring of macroinvertebates in trout streams that have catch & release fishing seasons in SE Minnesota during winter. We will equip them with techniques and gear appropriate for sampling during winter months. This activity will substantially extend our ability to develop models for streams in addition to the 24 that will be assessed by us.

Outcome	Completion Date
1. **Train and equip at least 20 volunteers from areas near streams worked on in year 1**	*June 2016*
2. **Train and equip at least 20 volunteers from areas near streams worked on in year 2**	*June 2017*
3. **Train and equip at least 20 volunteers from areas near streams worked on in year 3**	*June 2018*

III. PROJECT STRATEGY
A. Project Team/Partners: Our **project team** consists of Principal Investigator (PI) Leonard Ferrington, to graduate students, and undergraduate field assistants. As previously, we will integrate non-funded team members as volunteers and advisors (Jim Perry and Bruce Vondracek) as appropriate. **We will** consult with and seek guidance from the Minnesota DNR Division of Fish and Wildlife (e.g., Doug Dieterman, SE Research Biologist), and Trout Unlimited. In our previous grant work related to trout stream dynamics the assistance from these partners has been critical to our success and we will continue to nurture these collaborations.
B. Project Impact and Long-Term Strategy: This project will optimize decisions & activities that affect trout streams in SE Minnesota. We will disseminate findings to the public through Trout Unlimited, the National Trout Center (Preston, MN), and the Minnesota Master Naturalist program, and to technical audiences (researchers, managers, policymakers) through state conferences and meetings with the MN DNR. This project is part of a larger, long-term effort by the UMN, the MN DNR, and Trout Unlimited to understand, preserve, and enhance trout streams and trout fishing in SE Minnesota. This project builds on our previous effort (ML 2010 Chap. 362, Sec. 2, Subd. 5i), that established the importance of groundwater to healthy trout populations in SE Minnesota.

C. Timeline Requirements: years: This project requires three field seasons so that we can intensively survey and sample all 24 streams and develop the statistical tools for translating management and restoration efforts into trout productivity and availability.

2

2015 Detailed Project Budget

Project Title: Evaluation of Thermal Regimes For Optimizing Trout Habitats

IV. TOTAL ENRTF REQUEST BUDGET: Three years

BUDGET ITEM *(See "Guidance on Allowable Expenses", p. 13)*					AMOUNT	
	Year One	Year Two	Year Three	Total	$	375,710
PI (Ferrington):						
one month summer salary (9.1%)	7,985	8,225	8,471	24,681		
Faculty Fringe (33.6%)	2,683	2,763	2,846	8,293		
Graduate student salary						
(Two, both Ph.D. level)	45,012	46,362	47,753	139,128		
Fringe (academic year)	7,067	7,279	7,497	21,843		
Adv. Grad Summer Salary						
(Two, both Ph.D level)	15,004	15,454	15,918	46,376		
Summer Fringe	3,466	3,570	3,677	10,713		
Tuition						
(14,290/year, first year per student)	28,480	29,334	30,214	88,029		
UGRA student						
(20 hrs/wk, 48 wks/yr, $11.50/hr)	11,040	11,371	11,712	34,124		
Fringe @ 7.4%	817	841	867	2,525		
					$	-
Equipment/Tools/Supplies:	Year One	Year Two	Year Three	Total	$	74,779
Consummable Lab Supplies	5,800	5,100	3,509	14,409		
Vehicle Rental (25 days @ $ 48.00/day)	1,200	1,236	1,273	3,709		
Travel (9800 miles @ $ 0.55/mile)	5,360	5,521	5,686	16,567		
Room rental (24 nights @ $ 84.00/night X 2 people)	4,032	4,153	4,278	12,463		
Per diem ($ 32/day, 25 days, X 2 people)	1,600	1,648	1,697	4,945		
Licenses and state park fees	160	165	170	495		
Publication costs	0	2,500	3,000	5,500		
Water Temp Recording devices (40@$135.00/device)	5,400	5,562	5,729	16,691		
Acquisition (Fee Title or Permanent Easements): Not applicable					$	-
					$	-
Additional Budget Items: Not Applicable					$	-
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =					$	450,489

V. OTHER FUNDS *(This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)*

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period: *N/A*	$ -	*Indicate: Secured or Pending*
Other State $ To Be Applied To Project During Project Period: *None*	$ -	*Indicate: Secured or Pending*
In-kind Services To Be Applied To Project During Project Period: *None*	$ -	*Indicate: Secured or Pending*
Funding History: One past appropriation (ML 2010 Chap. 362, Sec. 2, Subd. 5i), 2010-2013. Total appropriated = $ 300,000. Total spent = $ 282,582	$ 282,582	
Remaining $ From Current ENRTF Appropriation: *No current appropriations.*	$ -	*Indicate: Unspent? Legally Obligated? Other?*

Map of counties in which research will be conducted.

PROJECT MANAGER QUALIFICATIONS AND RESPONSIBILITIES

Dr. Len Ferrington (UMN) is an expert in stream invertebrate taxonomy and ecology with 32 years of research experience. His laboratory has shown that aquatic insects important to trout in SE Minnesota are adapted to colder temperatures and most abundant in spring-fed streams. Len has developed Rapid Bioassessment Protocols for use in Biological Monitoring and Impact Assessment, and worked with numerous local, state and federal agencies to define responses of aquatic invertebrates to various types of water pollution.

Dr Ferrington has substantial experience working with citizen volunteers in the Minneapolis/Saint Paul area. He has edited a guide that citizens use for identifying macroinvertebrates that are collected and used for monitoring water quality. The guide has sold more than 3,500 copies (please see--- http://www.entomology.umn.edu/People/GradFaculty/Ferrington/). He also has developed on-line verification software that is used for QA/QC purposes by volunteers, and the on-line pages have had more than 1.5 million hits since being posted in 2006. This software can be viewed on-line at--- http://midge.cfans.umn.edu/vsmivp/ He has made many contacts with trout sport-fishing groups in SE Minnesota and will work effectively to use newly developed pedagogical and collaborative techniques to engage the public and create networks of citizen volunteers that will assist in the research effort.

Education: Ph.D. University of Pittsburgh, 1980 (specialty in aquatic ecology)

ORGANZATION DESCRIPTION: The University of Minnesota is one of the largest and most recognized public research universities in the United States. Its mission is to 1) "**conduct high-quality research**, scholarship, and artistic activity that benefit students, scholars, and communities **across the state**, the nation, and the world"; 2) "share that knowledge, understanding, and creativity by providing a broad range of educational programs … and **prepare graduate, professional, and undergraduate students**…for active roles in a multiracial and multicultural world"; and 3) extend, apply, and **exchange knowledge between the University and society** by applying scholarly expertise to community problems, by helping organizations and individuals respond to their changing environments, and by making the knowledge and resources created and preserved at the University accessible to the citizens of the state, the nation, and the world.