Environment and Natural Resources Trust Fund
2011-2012 Request for Proposals (RFP)

LCCMR ID: 139-F1+2+5

Project Title: Sustaining Lake Trout, Walleye Habitat in Minnesota Lakes

Category: F1+2+5. Climate Change and Air Quality

Total Project Budget: $ $307,000

Proposed Project Time Period for the Funding Requested: 3 yrs, July 2011 - June 2014

Other Non-State Funds: $ 0

Summary:

Changes in lake fish habitat for lake trout, bass and walleye in response to changes in climate and land cover/use will be projected for MNDNR Fisheries

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Location

Region: Statewide

Ecological Section: Statewide

County Name: Statewide

City / Township:

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

2011-2012 MAIN PROPOSAL

PROJECT TITLE: Sustaining lake trout, walleye habitat in Minnesota lakes

I. PROJECT STATEMENT

Anglers and managers have noted declines of cisco (tullibee), an important prey for lake trout, pike, and walleye, and have become concerned about the future for coldwater fish species in Minnesota. In addition, they have noted that largemouth and smallmouth bass, both warmwater species, have been expanding their range and abundance in northern Minnesota and Wisconsin. When bass invade lake trout lakes, they reduce abundance of minnows near shore; the growth of lake trout is then reduced unless cisco remain common offshore. Cold- and cool-water fish are therefore in double jeopardy, first from loss of thermal habitat in response to climate change, second from increasing numbers of warmwater predators. Competition for food will also be an issue for cool-water species such as walleye and pike.

Some very deep, clear lakes will probably be able to support lake trout even after significant climate warming. Other lakes will only be able to support warmwater fish such as bass. The Minnesota DNR needs detailed temperature and dissolved oxygen models of lakes to anticipate where these direct and indirect effects will be most severe. Then they can develop and locate climate change adaptation strategies to effectively manage these fish populations. Since degraded water quality often leads to oxygen depletion in deep water, protecting potential refuge lakes from increased nutrient loading will also be required to maintain the oxygen necessary for coldwater fish to survive in deep Minnesota lakes. Changes in lake watersheds and associated nutrient yields therefore pose an additional threat to fish habitat.

The specific goal of the proposed work is to identify (a) potential refuge lakes where lake trout can survive, and (b) potential lakes where bass habitat will expand and competition with walleye may become an issue in northern Minnesota. Goal (a) builds on current work in progress for cisco habitat in Minnesota lakes. Goal (b) relates to previous work on warm water fishes. The potential loss of lake trout habitat can be projected by the increase in the occurrence of lethal conditions for lake trout. The potential expansion of black bass productivity can be projected by the increase in number of days and lake volume with good growth conditions, and by a spawning/nesting model to predict reproductive success rates. The investigation of thermal fish habitat under a changed climate, will be accompanied by an investigation of changes in land cover in the watershed and associated changes in lake trophic states.

The project will use extensive computer simulations in cooperation with Minnesota DNR and MPCA staff. Water temperature (T) and dissolved oxygen (DO) conditions are crucial components of fish habitat in lakes. The work will focus on current and future temperature and oxygen conditions in lakes, and their impact on lake trout and black bass. The work will be executed in six steps: First, temperature and oxygen criteria for survival of lake trout and good reproduction/growth of black bass and walleye will be developed. Second, daily temperature and oxygen profiles in lakes will be simulated for past climate and validated against observations for model calibration. Third, temperature and oxygen profiles in lakes with different geometry and trophic state will be simulated for projected climate scenarios. Fourth, the fish habitat criteria will be imposed on the simulated temperature and oxygen conditions to project the fate of a fish species in a lake. Fifth, potential changes in land cover/land use will be determined and related to potential changes in lake trophic states. Sixth, simulations and fish habitat assessment results will be summarized for lakes of different characteristics.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Assemble existing lake trout, bass, lake, and climate data Budget: $ 41,000
Assemble lakeshed land use, nutrient yield, and loading data Budget $ 60,000

Outcome	Completion Date
1. Relationships and/or tables on fish habitat criteria	*Dec 2011*
2. Lake database for model input	*Mar 2012*
3. Climate database of 5 climate parameters, past and future	*Mar 2012*
4. T and DO profiles in Minnesota lakes for current climate	*Mar 2012*
5. Lakeshed size, current and potential future land use	*Jun 2012*
6. Nutrient yields of lakesheds	*Sep 2012*

Activity 2: Adapt existing models and simulate future scenarios Budget: $ 90,000
Adapt and use loading models to determine lake trophic status Budget $ 60,000

Outcome	Completion Date
1. T and DO lake profile validation and model calibration	*Jun 2012*
2. Currently viable trout habitat and good-growth habitat for bass	*Sep 2012*
3. Projected future profiles in calibration and non-calibration lakes	*Dec 2012*
4. Projections of viable trout habitat, and good-growth habitat for bass	*Jun 2013*
5. Lake nutrient loadings, current and potential future	*Dec 2012*
6. Lake trophic state, current model validation, future prediction	*Jun 2013*

Activity 3: Summarize, interpret and report results Budget: $ 56,000

Outcome	Completion Date
1. Write eight quarterly progress reports and a final report for the DNR	*ongoing*
2. Organize and hold three video conferences	*ongoing*
3. A written summary for the DNR of all important results	*Dec 2013*

III. PROJECT STRATEGY

A. Project Team/Partners

The project team will include 1) Dr. Heinz Stefan, Dr. Lucinda Johnson, Dr. William Herb and Timothy Erickson, University of Minnesota. 2) Dr. Don Pereira, Dr. Charles Anderson, and Mr. Peter Jacobson, DNR Fisheries, 3) Bruce Wilson, MPCA, as a cooperator, 4) Dr. X. Fang, Auburn University. Dr. Stefan and university colleagues will carry out the bulk of the work, i.e. data assembly, model adaptations, simulations, tabulating and graphing of results etc. No Environment and Natural Resources Trust Fund funds will be provided to the Minnesota DNR or the MPCA. DNR and MPCA staff will provide guidance and advice. DNR has posed the fish management problem and will use and distribute the results. Their input will be provided through review of quarterly progress reports, video conferences, e-mails and phone messages.

B. Timeline Requirement

It is estimated that the project can be completed in 30 months. Availability of data for model validation and calibration is crucial to the timeline. No field data collection is envisioned. This project is an extension of similar studies currently being conducted for the MN DNR.

C. Long-Term Strategy and Future Funding Needs

This project is part of a broader effort by the University of Minnesota and the Minnesota DNR to understand climate change effects on fish in Minnesota. Previous research has been funded by the EPA and DNR.

2011-2012 Detailed Project Budget

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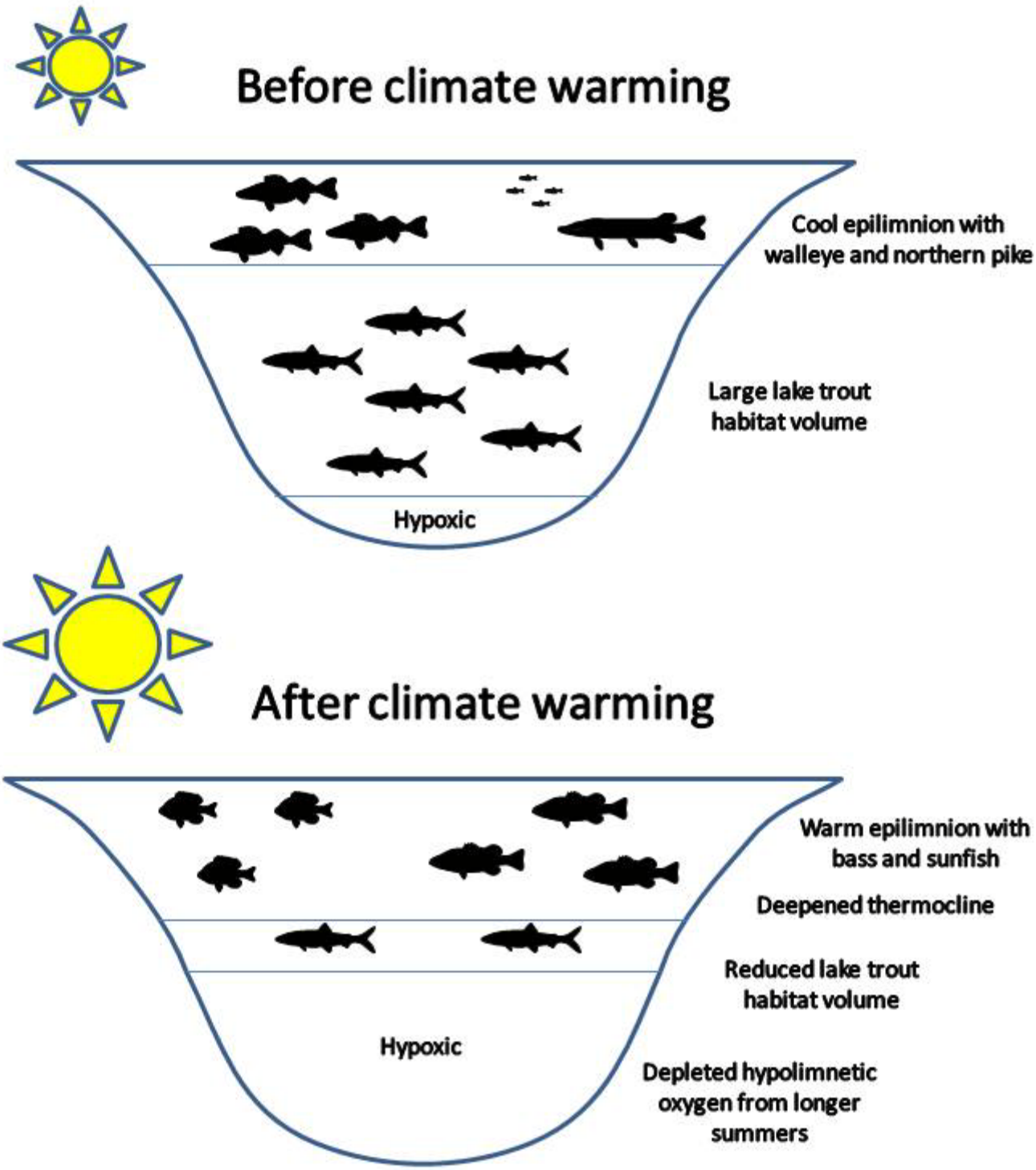
IV. TOTAL TRUST FUND REQUEST BUDGET *[Insert # of years for project]* **years**

BUDGET ITEM *(See list of Eligible & Non-Eligible Costs, p. 13)*	**AMOUNT**
Personnel: Dr. Heinz Stefan, Professor, PI, 0% Dr. William Herb, Research Associate, Co-PI, 50%, sal. Dr. Lucinda Johnson, Director, Project Co-PI, 5%	$167,012
Contracts: Prof. Xing Fang, Auburn University, Data preparation, computer programming and modeling, simulation results for lakes and fish habitat.	$131,669
Equipment/Tools/Supplies:	$859
Acquisition (Fee Title or Permanent Easements): *In this column, indicate proposed # of acres and and name of organization or entity who will hold title.*	NA
Travel: Three roundtrips to Duluth	$5,000
Additional Budget Items: *In this column, list any additional budget items that do not fit above categories. List by item(s) or item type(s) and explain how number was reached. One row per type/category. GIS Lab Service*	$2,460
TOTAL ENVIRONMENT & NATURAL RESOURCES TRUST FUND $ REQUEST	$307,000

V. OTHER FUNDS

SOURCE OF FUNDS	**AMOUNT**	**Status**
Other Non-State $ Being Applied to Project During Project Period:	$ -	
Other State $ Being Applied to Project During Project Period:	$ -	
In-kind Services During Project Period:	$ -	
Remaining $ from Current ENRTF Appropriation (if applicable):	$ -	
Funding History:	$ -	



Conceptual diagram of climate warming effects on Minnesota fish communities

Project Manager's Qualifications

Heinz G. Stefan, Ph.D. is James L. Record Professor of Civil Engineering at the University of Minnesota. He specializes in Water Resources Engineering and conducts his research at the St. Anthony Falls Laboratory where he was Associate Director for 22 years. He has co-authored over 200 refereed papers in professional journals, has published over 200 technical reports, has been and advisor and consultant on over 50 large-scale water projects including cooling water supplies of major power plants, and water intake designs. He has managed over 70 research projects at the SAFL including several for State Agencies. With his graduate student, now Prof. Xing Fang, he has developed the lake simulation methodology that will be applied in this project.

Organization Description

The University of Minnesota's St. Anthony Falls Laboratory is a world-renowned research organization where basic and applied research on water issues has been conducted for over 70 years. It currently provides the research facilities for 12 permanent faculty in multiple disciplines, 50 graduate students, 20 undergraduates and 15 technical staff. It is also the home of the NSF-funded National Center for Earth Surface Dynamics. The Laboratory is a leader in Water Resources, Energy and Geophysical Research, and is rendering professional services to industry, government organizations, and private citizens besides being an educational institution.

The Natural Resources Research Institute (NRRI) of the University of Minnesota in Duluth has studied a broad spectrum of issues related to Minnesota's minerals, forest products, peat biomass, ecology and water since 1985. It has earned the respect of industry leaders, the academic community and environmental watchdogs.