# Environment and Natural Resources Trust Fund
# 2009 Phase 2 Request for Proposals (RFP)

**LCCMR ID: 077-C1**

**Project Title:** Lake Superior: Invasive Species and Ecosystem Change

**Total Project Budget: $** $204,000

**Proposed Project Time Period for the Funding Requested:** 2 years; Jan 2009-Dec 2010

**Other Non-State Funds: $** $689,000.00

**Priority:** C1. Aquatic and Terrestrial Invasive Species


**First Name:** Steve **Last Name:** Colman

**Sponsoring Organization:** U of M, Duluth

**Address:** 2205 E 5th Street
Duluth MN 55812

**Telephone Number:** 218-726-6723

**Email:** scolman@d.umn.edu

**Fax:** 218-728-6979

**Web Address:** http://www.d.umn.edu/llo


| Region: | County Name: | City / Township: |
|---|---|---|
| NE | Cook, Lake, St. Louis | N/A |


**Summary:** Shiptime is requested to study invasive aquatic species and ecosystem changes, related to multiple stresses, in Lake Superior. Results: establishment of systematic monitoring and assessment of changing lake conditions.


**Main Proposal:** 1008-2-012-proposal-2009_LCCMR_main_LLO6.doc

**Project Budget:** 1008-2-012-budget-RFP_2009_Project Budget-LLO.xls

**Qualifications:** 1008-2-012-qualifications-Project Manager-Institution.doc

**Map:**

**Letter of Resolution:**

# MAIN PROPOSAL

## PROJECT TITLE: Lake Superior: Invasive Species and Ecosystem Change

## I. PROJECT STATEMENT

This proposal is for shiptime support related to two specific categories of collaborative research that link directly to the funding priorities of the LCCMR 2009 Phase 2 RFP, namely, aquatic invasive species (C1) and aquatic communities and their environment in deep-water lakes (B4). This support will enable us to:

- Establish baseline conditions for the lake in terms of both native and invasive aquatic species.
- Assess the degree of departure from past conditions, based on fragmentary past data.
- Establish the beginnings of a systematic, reproducible monitoring program for detecting changes in the lake's aquatic community.

This work will augment or leverage several other types of studies and funding. With previous LCCMR funding, we have had great success with this augmentation-and-leveraging process for state and federal funds (see section III-A and budget sheet). All studies using the requested ship time will be peer-reviewed as part of requests to other agencies and(or) by an internal ship-time allocation committee.

UMD's research vessel, the Blue Heron, is capable of all the sampling and measurements needed to characterize the lake's aquatic community and their environment (see Organization Description). Shiptime is the single critical factor that determines the spatial extent and sampling frequency that can be accomplished. So, this proposal is intended to meet the common need of the participating researchers to establish a monitoring and assessment program for off-shore waters of Lake Superior, Minnesota's greatest water resource.

## II. DESCRIPTION OF PROJECT RESULTS

**Result 1: _Aquatic invasive species in Lake Superior__ Budget: $ ___84,000_____**

Our ongoing research activities provide limited direct examination of the many organisms occurring in Lake Superior and its coastal waters, ranging from microbes to fish. The infrastructure and capacity to do these time consuming observations exist in our various laboratories and our funded research interests provide technical support. The only limitation to conducting a comprehensive multi-season monitoring program that would scan for invasive species is adequate shiptime to extend observations over the spring to autumn period when organism are most active and mobile. The monitoring activities would include:

- Sample characterization, specifically for new or potential invasive species e.g. gobies and other invasives that are spreading through the lower lakes
- Population ecology studies on known exotics such as rainbow smelt, spiny water fleas, and fish hook fleas, that would determine if their populations are increasing or waning

The monitoring of this range of organisms (microbes to fish) will allow us to compare our observations with previous fragmentary studies of these groups in Lake Superior. Sampling and study would enable characterization of currently neglected microscopic organism using both traditional microscopic and counting methods as well as genetic screening to detect new genomes entering Superior. Initially, studies of algae, bacteria, and viruses (especially possible VHS) would produce baseline information in order to enable future observations to detect new organisms. The laboratory research infrastructure to perform all requisite analyses already exists with the participating researchers. The Blue Heron has all the required ship-board infrastructure and instrumentation to support the sampling and monitoring activities. Although some of the sampling for this Result would take place in conjunction with the work of Result 2, we request 7 days of shiptime each year (14 days * $6000/day) devoted to sampling for invasive species.

| Deliverable | Completion Date |
|---|---|
| **1. Year 1 report to LCCMR on baseline conditions of invasive species** | **Dec 31, 2009** |
| **2. Year 2 report to LCCMR on changes in invasive species populations** | **Dec 31, 2010** |

**Result 2: Ecological change in Minnesota's largest deep-water lake Budget: $** _120,000_

A major program objective of LCCMR for 2009 is to conduct studies of "aquatic communities [and environments] of high quality deep water lakes in Minnesota through inventory and evaluation of cold water aquatic communities in the lakes." Lake Superior is by far Minnesota's largest and deepest lake. It is also undergoing dramatic changes due to:

- Recovery from major food web perturbations by past exotic invaders.
- Continuing nitrification combined with recovery from a period of mild eutrophication.
- Climate change, which is leading to rapid summer warming, longer periods of summer stratification, and less winter ice cover.

The interactions of these different stresses may lead to transformational change in the food webs and productivity of Superior, and yet there is no dedicated monitoring program to detect, evaluate, and model these ongoing trends. This proposal would provide shiptime that would enable a consortium of UMD and UMTC researchers to conduct a comprehensive monitoring of food web structure and ecosystem functioning. Measurements and samples made during monitoring expeditions will include a wide variety of things related to nutrients, food webs, and population dynamics.

The expertise and laboratory capacities of the participating scientists are complementary and can provide a full "ecosystem-based" characterization of deep water processes in this period of rapid transformation. Their time and analytical work also constitute a large in-kind contribution to the project (see budget). Understanding the interactions of multiple stresses is fundamental to understanding how this mix of positive and potentially negative changes in ecosystem functioning will impact the water quality and productivity of deep water environments in Superior. Although some of the sampling for this Result would take place in conjunction with the work of Result 1, we request 10 days of shiptime each year (20 days * $6000/day) devoted to sampling, observations, and monitoring of the essential features and functions of offshore Lake Superior's aquatic communities.

| Deliverable | Completion Date |
|---|---|
| **1. Year 1 report to LCCMR on baseline population conditions** | **Dec 31, 2009** |
| **2. Year 2 report to LCCMR on changes in aquatic communities** | **Dec 31, 2010** |

## III. PROJECT STRATEGY AND TIMELINE

**A. Project Partners:** National Science Foundation, USGS, Minnesota Sea Grant, Minnesota DNR

**B. Project Impact**

A significant portion of the state of Minnesota lies in and beneath Lake Superior, the largest body of fresh water on the planet. Accordingly, Lake Superior must be considered (one of) the most important natural resources in the state. Yet, because of its size, political status, and history, the functioning of the lake and its ecosystem remain relatively poorly understood. It is thought to be relatively pristine compared to other large lakes, but faces a variety of threats, including those from pollution, invasive species, development, and climate change. The proposal will help to significantly increase our understanding Lake Superior and its ecosystem, especially with respect to aquatic communities and invasive species. This magnificent natural resource deserves no less.

**C. Time**

Funds are requested for two field seasons (2009 and 2010). Costs are entirely for field activities, observations, and data collection on board the RV Blue Heron, accounted for at the ship's day rate ($6000/day average for 2009 and 2010). The day rate includes crew, technician and ship manager salaries; insurance; and operational costs (fuel, food, garbage, dock fees, etc).

**D. Long-Term Strategy (if applicable)**

Past support by LCCMR has yielded critical results that have led to our current appreciation of the risk that exotics and other contemporaneous ecosystem changes pose for Lake Superior. Continued support will allow the evolving collaborative network of Lake Superior scientists to acquire critical information to not only better understand current changes in Superior but also to enable preparation of well grounded collaboration research proposals to ensure future research and monitoring on Lake Superior.

# Project Budget

## IV. TOTAL PROJECT REQUEST BUDGET

| BUDGET ITEM | AMOUNT | % FTE |
|---|---|---|
| **Other**: Shiptime, Research Vessel Blue Heron. See Section 3C of Main proposal. Average day rate $6000 in 2009 and 2010, 7 days for Result 1 and 10 days for Result 2 in each year, 34 days total. | $ 204,000 | |
| **TOTAL PROJECT BUDGET REQUEST TO LCCMR** | $ 204,000 | |

## V. OTHER FUNDS

| SOURCE OF FUNDS | AMOUNT | Status |
|---|---|---|
| **Remaining $ From Previous Trust Fund Appropriation (if applicable):** Appropriation: M.L. 2006, Chap. 243, Sec. 20, Subd. 6, $295,000 total | $ - | Completed pending final report |
| **Remaining $ From Previous Trust Fund Appropriation (if applicable):** 2008 Supplement to 2006 Appropriation, $86,000 | $ 30,000 | To be completed in 2009 |
| **Other Non-State $ Being Leveraged During Project Period:** Estimate, based on the ratio (about 3.4:1) of federal funds leveraged by the amount of a similar 2006 LCCMR appropriation | $ 689,000 | |
| **Other State $ Being Spent During Project Period:** Estimate, based on the ratio (about 1.2:1) of state funds leveraged by the amount of a similar 2006 LCCMR appropriation | $ 241,000 | |
| **In-kind Services During Project Period:** Estimated salary and analytical costs for the duration of the project. | $ 150,000 | |
| **Past Spending:** N/A. This is a new project. | $ - | |

## Project Manager Qualifications

**Steve Colman** is a Professor of Geological Sciences and Director of the Large Lakes Observatory at the University of Minnesota Duluth, having also had a productive research career with the US Geological Survey in Woods Hole, MA. He has published more than 100 scientific articles in leading journals, including *Science* and *Nature*. He currently holds two large grants from the National Science Foundation. He has won several scientific awards and has served as an officer or on the steering committees for many national and international scientific organizations. He has successfully managed a previous LCCMR-funded project, begun in 2006 and now drawing to a close.

## Organization Description

The **Large Lakes Observatory** (LLO) is a research institute at the University of Minnesota Duluth. It is the only institute in the country dedicated to the study of large lakes throughout the world. We focus on the global implications of our investigations in areas such as aquatic chemistry, circulation dynamics, geochemistry, acoustic remote sensing, fish ecology, plankton dynamics, sedimentology, and paleoclimatology. LLO's research ranges from lakes in the East African Rift Valley and Central Asia, to the Great Lakes of North America. Close ties have been formed with institutes in Canada, Uganda, France, Norway, Kyrgyzstan, Kenya, Nicaragua, Malawi, Tanzania and England, as well as with many universities within the United States.

The Large Lakes Observatory operates the largest university-owned research vessel in the Great Lakes, the R/V Blue Heron. The only member of the University National Oceanographic Laboratory System (UNOLS), she is outfitted with state-of-the-art research equipment. The geophysical equipment available on the Blue Heron for lake floor mapping and bottom characterization is extensive. The Blue Heron also has a broad suite of equipment for the physical and geochemical study of the water column. This equipment includes a SeaBird 911+ CTD and Carousel sampler for determining temperature, salinity, chlorophyll concentration, transparency, dissolved oxygen content and pH of the water column as well as sampling water at desired depths using Niskin bottles. In addition, we have available a Maclane in situ filtration system. The R/V Blue Heron is unique among Great Lakes research vessels in having an Acoustic Doppler Current Profiler (ADCP) as well as a Triaxus. The ADCP is used to measure current speed and direction (both horizontally and vertically) in 2 m increments throughout the water column while the ship is underway. The Triaxus is a towed vertically undulating vehicle with an extensive instrument package that can measure temperature, salinity, chlorophyll concentration, transparency, dissolved oxygen content and plankton size and distribution. Users of the Blue Heron also have a broad set of sediment and biological sampling gear available to them. Biological sampling gear includes plankton nets and a 60' Stauffer midwater trawl with a trawl sonar system.

Although LLO is the lead organization on this proposal, researchers from other parts of the University of Minnesota Duluth and the University of Minnesota Twin Cities will be involved in the collaborative research proposed.