

**Environment and Natural Resources Trust Fund
2010 Request for Proposals (RFP)**

LCCMR ID: 020-A3

Project Title:

Sustainable, Cost-Effective Approaches to Management of Shallow Lakes

LCCMR 2010 Funding Priority:

A. Water Resources

Total Project Budget: \$ \$262,880

Proposed Project Time Period for the Funding Requested: 2 years, 2010 - 2012

Other Non-State Funds: \$ \$190,896

Summary:

We propose studies of 160 shallow lakes in Minnesota. Results will clarify major causes for deterioration and evaluate results of current management efforts. Goals are cost-effective future lake management.

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Sponsoring Organization: DNR

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Web Address: _____

Location:

Region: Statewide

County Name: Statewide

City / Township:

_____ Knowledge Base	_____ Broad App.	_____ Innovation
_____ Leverage	_____ Outcomes	
_____ Partnerships	_____ Urgency	_____ TOTAL

PROJECT TITLE: Sustainable, Cost-Effective Approaches to Management of Shallow Lakes

I. PROJECT STATEMENT

Minnesota is fortunate to retain shallow lakes and wetlands that provide valuable ecosystem services and direct human benefits including **clean water, groundwater recharge, support of diverse plant and animal communities, recreational opportunities (wildlife observation, fishing, hunting), and sequestration of carbon, nutrients, pollutants**. Shallow lakes provide critical habitat for North American waterfowl migrating between breeding and wintering areas along the Mississippi Flyway. Unfortunately, water and habitat quality of Minnesota's shallow lakes have deteriorated dramatically during the past century. Conversion of native land covers, widespread wetland drainage and surface-water consolidation to facilitate agricultural and urban/residential land uses are implicated. This deterioration of shallow lakes in Minnesota has contributed to sharp declines in fall use by waterfowl and other wildlife, as well as loss of clean water and appealing natural landscapes. Perhaps more immediately, if not more importantly, deterioration of our shallow lakes and wetlands also means deterioration of our ground and surface water supplies, a problem that is extremely difficult to resolve. Shallow lakes in Minnesota are especially challenging for managers because:

- Importance of shallow lakes (delivery of clean water, wildlife habitat) has gone unnoticed, thus degradation is especially severe and widespread
- Deteriorated lakes tend to stay that way and resist management efforts aimed at improving lake characteristics
- Causes of lake deterioration are poorly known, most restoration strategies have limited effectiveness, producing only short-term benefits

Many shallow lakes occur in traditional grassland regions, thus have long been threatened by agriculture, urban and shoreland development, and spread of invasive species. Some problems are well known; others are surprising. For example, non-native invasive earthworms may represent a new threat to shallow lakes in Minnesota by increasing leaching of phosphorus from uplands into lakes. Recently, conservation groups and government agencies have supported measures aimed at reversing water quality and habitat deterioration in shallow lakes (e.g., the MDNR recently proposed a holistic plan to "Recover Ducks, Wetlands, and Shallow Lakes"). To date, such efforts are severely hindered by our poor understanding of shallow lake ecology; even costly flagship restoration efforts such as those at Christina and Heron lakes have shown that achieving long-term success is difficult and, so far, unpredictable in shallow lakes.

Recent observations indicate that improvement in shallow lakes is sometimes achieved through management but rigorous analysis of such patterns across the state is lacking. Therefore, we propose to study approximately 160 shallow lakes in 6 areas of Minnesota (Figure 1) to identify cause and effect patterns leading to deterioration of shallow lakes, and to evaluate effectiveness of specific lake management strategies, with special attention given to how lake problems and recovery may differ among state regions. Some shallow lake monitoring in MN is currently underway and is supported by the Habitat Conservation Partnership. However, work proposed here is unique and extends beyond the previous partnership to clarify cause and effect mechanisms for lake deterioration and increase effectiveness of lake rehabilitation strategies. Ultimately, our results will allow municipalities, state, county, and local governments, and private organizations to identify regionally specific, cost-effective approaches for maintaining and restoring ecological integrity of shallow lakes across Minnesota.

II. DESCRIPTION OF PROJECT RESULTS

Result 1 (Budget \$135,000): Identify and estimate magnitude of major factors responsible for deterioration of shallow lakes in 6 areas of Minnesota; we propose to:

- Document shallow lake water quality conditions, community characteristics, and wildlife suitability in 6 geographic areas of Minnesota

- Identify main factors reducing water quality and ecological characteristics of shallow lakes
- Clarify mechanisms causing clear-water lakes to shift to turbid-water systems, then stay that way
- Determine the extent to which invasive earthworms increase external phosphorus loading into shallow lakes by increasing transport of soil phosphorus to shallow lakes

Deliverables	Completion Date
1. Provide a clear understanding of specific roles of fish as determinants of shallow lake water quality and habitat features along regional gradients	<i>June 30, 2012</i>
2. Develop recommendations for management of fish populations, surface connectivity, and landscape use to improve habitat conditions in shallow lakes	<i>June 30, 2012</i>

Result 2 (Budget \$98,000): Evaluate and refine specific strategies for improving water quality and ecological characteristics of shallow lakes across Minnesota. Historically, shallow lake management in Minnesota has been limited by extreme lake variability across regions of the state. Rather than seeing this variability as an intractable problem, our study will take advantage of this regional variability to identify and measure key variables causing and maintaining poor water quality in shallow lakes across the state.

- Evaluate shallow lake responses to lake restoration treatments such as drawdowns or manipulations of fish community composition (e.g., rotenone, predatory fish stocking). Estimate water quality improvements in response to upland restoration efforts within upstream lakeshed areas.
- Estimate water quality improvement costs for various lake restoration approaches and compare costs and benefits resulting from application of various techniques

Deliverables	Completion Date
1. Identify most effective shallow lake restoration strategies	<i>June 30, 2012</i>
2. Develop region-specific guidelines for identifying cost effective reclamation approaches enabling optimization strategies from a costs-benefit perspective	<i>June 30, 2012</i>

Result 3 (Budget \$15,000): Identify surface connectivity elements threatening water quality and biodiversity in shallow lakes. Increasing surface connectivity is especially important because it threatens shallow lake biodiversity through increasing spread of invasive species.

- Document water quality and habitat characteristics in response to various connectivity scenarios
- Develop models to assess results of increased surface connectivity for water quality and biodiversity

Deliverables	Completion Date
1. Delineations of shallow lake watersheds and extensive surface connectivity networks; electronic data to be made available through DNR web links	<i>June 30, 2012</i>
2. Improved strategies for controlling spread of invasive species by identifying key connectivity elements needed to preserve natural biodiversity of shallow lakes	<i>June 30, 2012</i>

III. PROJECT STRATEGY

A. Project Team/Partners. Our project team has 9 collaborators representing one NGO, state, and tribal representatives. Scientific investigations will be lead by S. Bowe (Red Lake DNR), J. Cotner, (UM), N. Hansel-Welch, M. Hanson, B. Herwig, J. Younk (MDNR), and K. Zimmer (University of St. Thomas). Logistical and financial support will be provided by Ducks Unlimited (DU, J. Schneider), NSF (through REU to Cotner). Hydrological interpretations, data summaries, and analysis will be conducted and overseen by S. Vaughn (MDNR). Study areas will include approximately 10 shallow lakes currently targeted for restoration by MDNR, USFWS, and MN DU using new LOHC funds.

B. Timeline Requirements. Data gathering will occur during 2010, 2011, and 2012. Preliminary results will be available through the study. Final results and formal recommendations will be provided in a project synthesis document to be completed by December 2012.

C. Long-Term Strategy. None expected at this time.

Project Budget

IV. TOTAL PROJECT REQUEST BUDGET (2 Years)

BUDGET ITEM	AMOUNT
Personnel: 4 seasonal student interns for extensive data gathering from 150 lakes; 3.5 mo.s during each of 2010 and 2011	\$ 54,000
4 seasonal student interns for intensive data gathering from target rehabilitation lakes; 3.5 mo.s during each of 2010 and 2011	\$ 54,000
1 MDNR Hydrologist (25 % full time; staff position will be backfilled to cover operational duties) during 2010-2012	\$ 15,000
1.5 mo. salary for co-investigator (Zimmer) during 2010-2012 (University of St. Thomas)	\$ 10,000
1 University technician (50 % full time; supervised by Cotner) during 2010-2012 (University of Minnesota)	\$ 29,000
1 Graduate student research stipend; 12 mo.s during each of 2 academic years 2010/11 and 2011/12	\$ 30,000
Equipment/Tools/Supplies: Field sampling gear and laboratory chemicals and supplies during 2010 and 2011; this includes specialized trap nets, extensive sampling equipment for aquatic invertebrates, plants, and water quality data; intensive sampling of 10 rehabilitation lakes will require 2 14-ft flat bottom boats with small outboard motors	\$ 18,000
Travel: Travel for data gathering to approximately 160 study lakes during 1 July - 15 September 2010 and 2011; we anticipate up to 14,000 mi. of travel for field sampling during each study yr (total annual fleet cost per yr \$10,000); we anticipate \$9,000 per yr will be needed for per diem and lodging for at 6 field research crews	\$ 38,000
Additional Budget Items: MDNR governance costs (6% of total request)	\$ 14,880
TOTAL PROJECT BUDGET REQUEST TO LCCMR	\$ 262,880

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ Being Applied to Project During Project Period: Minnesota Ducks Unlimited	\$ 5,000	Secured
University of St. Thomas, St. Paul - non-capital equipment	\$ 4,000	Secured
University of St. Thomas, St. Paul - undergraduate student support summer/wtr	\$ 9,500	Secured
REU (support for undergraduate assistants at UM) 2 students	\$ 10,000	Secured
Red Lake DNR - Wetland Biologist, permanent salary (50%)	\$ 91,133	Secured
Red Lake DNR - equipment and supplies	\$ 15,563	Secured
Red Lake DNR - travel and lodging expenses	\$ 6,000	Secured
Red Lake DNR - graduate student	\$ 30,000	Secured
Red Lake DNR - interns	\$ 19,700	Secured
Other State \$ Being Applied to Project During Project Period:		Pending
Sections of Wildlife and Fisheries MDNR - Permanent salary Hanson, Herwig, Vaughn, Younk	\$ 167,220	
Sections of Wildlife and Fisheries MDNR - Intern (non-permanent) salaries	\$ 28,440	Pending
Sections of Wildlife and Fisheries MDNR - Research supplies and non-capital equipment	\$ 7,620	Pending
Sections of Wildlife and Fisheries MDNR - Travel to research sites	\$ 29,510	Pending
In-kind Services During Project Period: Ducks Unlimited Minnesota - Sampling equipment, vehicles	\$ 5,000	Secured
Remaining \$ from Current Trust Fund Appropriation (if applicable): .	none	
Funding History: Indicate funding secured prior to July 1, 2010 for activities directly relevant to this specific funding request. State specific source(s) of funds.		

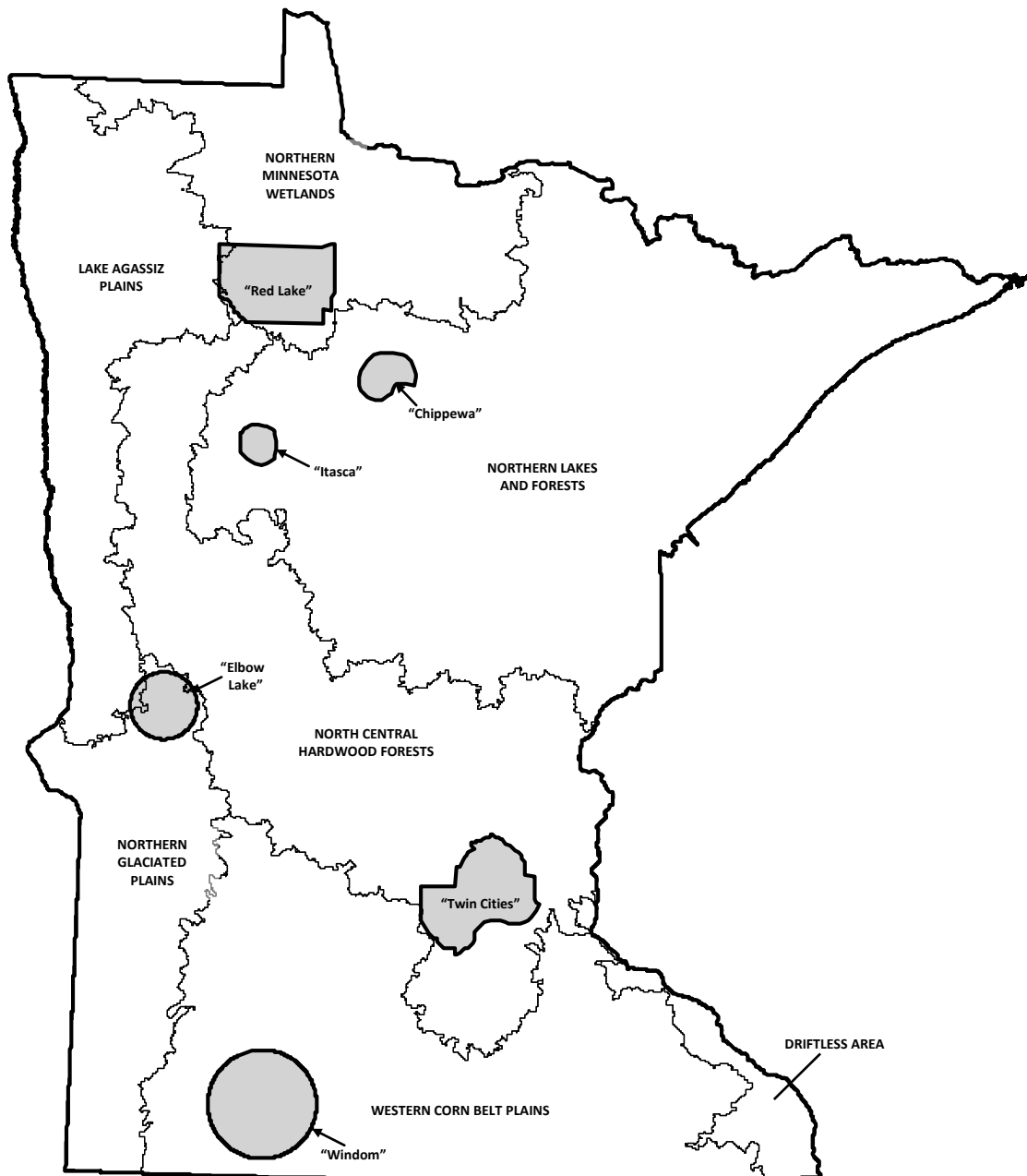


Figure 1. Map showing locations of proposed study landscapes (shaded gray) in relationship to Minnesota's aquatic ecoregions (thick black lines).

Project Manager Qualifications and Organization Description

Manager: Mark A. Hanson, Ph.D., E-mail: mark.hanson@dnr.state.mn.us, Ph. 218.208.2283

Organization: Wetland Wildlife Populations & Research Group (WWPRG), MDNR, Bemidji, MN; MDNR's mission is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life. DNR is committed to conserving natural resource systems - working with citizens and partners to achieve its three-part mission. The WWPRG conducts research and monitoring on wetland wildlife and ecological characteristics of wetlands and shallow lakes statewide.

Research Experience and perspective: 1991 – Present: Wetland research scientist. I serve as a project leader for research on wetlands and shallow lake ecology, waterfowl, and wetland-dependent processes and wildlife. Since 1991, I have managed approximately \$900,000 in research support and I have supervised approximately 50+ undergraduate and graduate students, and seasonal employees. Current research focuses on scale-dependent influences on shallow lake characteristics and water quality, on measuring effects of fish in prairie lakes and wetlands, and clarifying relationships between small wetlands and upland management in forest regions. My dissertation research (1980s) focused on ecological responses of fish removal from Lake Christina, MN, a large shallow prairie lake managed primarily for migrating waterfowl.

Related Professional and Service Experience:

Member of MFRC Riparian Science Technical Committee for riparian management (2004-08)

President, Minnesota Chapter of the Wildlife Society (2003-04)

Organizer, Inter-Agency Workshop on Needs for Wetlands and Waterfowl in Forested Landscapes (2003)

Organizing Committee: Ecology of Wetlands and Shallow Lakes: Alternative Stable States, Anthropogenic Influences, and Management Options. International workshop held at Delta Marsh, Manitoba (2001)

Wildlife Program Chair, 62nd Annual Midwest Fish and Wildlife Conference (December 2000)

Associate Editor, *Wetlands* (1995-1997)

MDNR Division of Wildlife Aquaculture Task Force, member (1992-1993)

MDNR Division of Wildlife Wetland Policy Committee, member (1991-present)

Over 100 presentations at local, state, national, and international conferences, meetings, and workshops

Selected Related Publications:

Zimmer, K.D., **M.A. Hanson**, B.R. Herwig, and M.L. Konsti. In press. Thresholds and stability of alternative regimes in shallow prairie-parkland lakes of central North America. *Ecosystems*.

Potthoff, A.J., B.R. Herwig, **M.A. Hanson**, K.D. Zimmer, M.G. Butler, J.R. Reed, B.G. Parsons, and M.C. Ward. 2008. Cascading effects of piscivore introductions in shallow lakes. *Ecological Applications* 45: 1170-1179.

Hanson, M.A., K.D. Zimmer, M.G. Butler, B.A. Tangen, and N.H. Euliss, Jr. 2005. Biotic Interactions as determinants of ecosystem structure in prairie wetlands. *Wetlands* 25:764-775.

Zimmer, K.D., **M.A. Hanson**, and M.G. Butler. 2003. Relationships among nutrients, phytoplankton, macrophytes, and fish in prairie wetlands. *Canadian Journal of Fisheries and Aquatic Sciences* 60:721-730.

Angeler, D.G., P. Chow-Frazer, **M.A. Hanson**, and S. Sanchez-Carillo. 2003. Biomanipulation: a useful tool for freshwater wetland mitigation? *Freshwater Biology* 48:2203-2213.

Zimmer, K.D., **M.A. Hanson**, and M.G. Butler. 2001. Effects of fathead minnow colonization and removal on a prairie wetland ecosystem. ***Ecosystems* 4:346-357.**

Bouffard, S.H., and **M.A. Hanson**. 1997. Fish in waterfowl marshes: waterfowl managers' perspective. *Wildlife Society Bulletin* 25:146-157.

Hanson, M.A., and M.G. Butler. 1994. Responses of plankton, turbidity, and macrophytes to biomanipulation in a shallow prairie lake. *Canadian Journal of Fisheries and Aquatic Sciences* 51:1180-1188.