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

LCCMR ID: 096-D1

Project Title: Minnesota Wetlands: An Important CO2 Sink?

Total Project Budget: $ $261,805

Proposed Project Time Period for the Funding Requested: Jul 2009 to 30 Jun 2012

Other Non-State Funds: $ $0.00

Priority: D1. Renewable Energy Life Cycle Costs and Impacts

First Name: James **Last Name:** Cotner

Sponsoring Organization: U of M

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Region:	County Name:	City / Township:
NW, NE, Central, Metro, SW		

Summary: Minnesota's lakes sequester CO2. What if we knew more about managing these systems to remove CO2? We will determine how fish and land use affect this process in lakes.

Main Proposal: 1008-2-022-proposal-Cotner-2009-MainProposal.pdf

Project Budget: 1008-2-022-budget-Cotner LCCMR Budget Form 9-08.xls

Qualifications: 1008-2-022-qualifications-Cotner-Qualifications-2009.pdf

Map: 1008-2-022-maps-Cotner-2009-ProjectMap.pdf

Letter of Resolution:

MAIN PROPOSAL

PROJECT TITLE: Minnesota wetlands: An important CO_2 sink?

I. PROJECT STATEMENT

Minnesota's lakes sequester CO_2. What if we knew more about managing these systems to remove CO_2? We will determine how fish and landuse affect this process in lakes.

II. DESCRIPTION OF PROJECT RESULTS

New estimates of the number of lakes and ponds in Minnesota indicate that we are not the 'land of 10,000 lakes, but rather the land of 4.3 million lakes (J. Downing, personal communication). We know that these systems have been important in the recent past in Minnesota in terms of removing carbon dioxide from the atmosphere. However, it is likely that lakes and wetlands may not be as efficient in terms of removing carbon in the future because management and land use changes have facilitated increased nutrient availability (eutrophication) as well as increased invasions of species of fish, such as carp, further accentuating eutrophication processes. The short-term outcome is diminished water quality, with less potential utility to Minnesotans both for consumptive use of water (drinking water, agriculture, industry) and non-consumptive uses (recreation, duck hunting, fishing).

However, little is know about how eutrophication, land use and the dominant plant communities in a wetland (algae vs. macrophytes) affect the ability of lakes and wetlands to sequester CO_2 from the atmosphere. Our measurements in two western Minnesota wetlands indicates that the rate of organic carbon burial has increased in the past 130 years.

Table 1. Rates of burial of organic carbon in two wetland lakes in western Minnesota near Fergus Falls. Note that the rate of carbon burial in these lakes has increased by about 10 times since 1880. This project will help determine what the most important factors contributing to this increase are.

Burial rates	Mavis East	Mavis West
Since 1880 A.D.	174-265	149-203
1100 A.D. to 1880	11.1-37.6	24.3-36.7

This study will examine how the water quality (water clarity, algal abundance, etc.) of Minnesota wetlands are impacted by (a) nutrient loading, (b) landscape characteristics (how connected wetlands are to other aquatic systems, allowing dispersal of organisms), (c) land use in the watershed (agriculture, commercial development, native vegetation, etc.), (d) climate (inter-annual rainfall, temperature, etc.), and rough fish such as carp and bullheads. Most importantly, we will examine how these factors impact the ability of wetlands to remove significant amounts of carbon dioxide from the atmosphere and store it in sediment, benefiting Minnesota in terms of carbon trading and credits. This study will quantify the influence of each factor, provide information and management recommendations to the state's natural resource managers, and ultimately increase our ability to improve water quality in the state's wetlands.

We propose to study 60 wetlands in 6 clusters stretching across MN from the NE to SW (low to high nutrient gradient, see enclosed map). The wetlands will be studied for three years (2009-2012) to fully characterize relationships and establish data for future monitoring efforts. We will measure wetland and watershed characteristics in each site two times per year and monitor

productivity and gas exchange using sampling devices deployed in a subset of wetlands. Some wetlands will be used to monitor the effects of biomanipulation (fish removal) on both eutrophication and carbon exchange properties of these systems. Results from this study will aid resource managers in making decisions about how to manipulate these systems for both water quality and carbon burial purposes.

Result 1: We will determine the relative importance of landscape characteristics (watershed size, soil type, etc.), land use (row-crop agriculture, native grasses, etc.), ambient and human-induced nutrient loading (phosphorus and nitrogen), and rough fish (carp and bullheads) on carbon removal in wetlands across the state of Minnesota. We will also assess the threat of non-native invasive species spreading among wetland basins by assessing connectivity at the scale of individual basins and larger landscapes involving multiple basins. Finally, we will also assess the utility of biomanipulation (removal of undesirable fish) for improving carbon removal. **Budget:** $261,805

Deliverable	Completion Date
1. Management recommendations for landscape influences on carbon burial.	Jul 1, 2012
2. Management recommendations for nutrient loading and invasive species on carbon burial.	Jul 1, 2012

III. PROJECT STRATEGY AND TIMELINE

A. Project Partners
Minnesota DNR

B. Project Impact
This project will have direct impact of management of wetlands and lakes throughout the state because it introduces a new management strategy, i.e., specifically managing systems for more efficient carbon removal. Removal of rough fish could greatly facilitate carbon removal in wetlands and lakes.

C. Time
The spatial and scientific scale of this project requires a minimum of three years to quantify carbon burial and impacts of management strategies on carbon removal.

D. Long-Term Strategy (if applicable)
Cotner has been working on a similar project that is much more limited in scope for the past three years. In addition, along with other collaborators, we are seeking funding from the National Science Foundation to understand other mechanisms, such as dissolved oxygen content, on the ability of lakes and wetlands to remove CO_2 from the atmosphere.

Project Budget 3 Years

IV. TOTAL PROJECT REQUEST BUDGET

BUDGET ITEM	AMOUNT	% FTE
Personnel: PI (1 sum. mo. per year)- will have overall responsibility for the project and supervise a technician, 2 undergraduates, and a graduate student	$ 38,402	8%
Graduate Student -- will assist with field supervision, data acquisition, and analyses	$ 88,280	50%
Undergraduate Student (1-2 per year)	$ 10,236	14%
Technician -- will perform analyses (production, respiration, carbon fluxes)	$ 45,746	25%
	$ -	
	$ -	
Equipment/Tools: 2 Multi-parameter water quality sondes for long-term monitoring of dissolved oxygen, pH, turbidity and temperature in the wetlands	$ 16,000	
In situ gas sampler for measurements of dissolved CO2	$ 21,000	
	$ -	
Other: Lab Supplies (analytical standards, reagents, solvents, disposable labware, filters, fluorescent probes, maintenance costs, etc.	$ 28,094	
Travel for field work - vehicle rental, lodging, & per diem	$ 14,047	
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$ 261,805	

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Remaining $ From Previous Trust Fund Appropriation (if applicable):	$ -	
Other Non-State $ Being Leveraged During Project Period:	$ -	
Other State $ Being Spent During Project Period:	$ -	
In-kind Services During Project Period:	$ -	
Past Spending:	$ -	

Project Manager Qualifications and Organization Description

Project Manager: Dr. James Cotner, Professor, Department of Ecology, Evolution and Behavior, 1987 Upper Buford Circle, St. Paul 55108, 612-625-1706; cotne002@umn.edu

Organization description: University of Minnesota, Twin Cities Campus; Education and research facility serving the entire state of Minnesota.

Project responsibilities: Professor Cotner will assist with site selection and supervise the graduate student on this project. He will also be in charge of collecting, analyzing, interpreting, and making management recommendations for carbon sequestration.

Research Interest: Microbial ecology and biogeochemistry of wetlands and large lakes; human influences on water quality in wetlands and lakes.

Relevant Publications:

Tranvik, L., J. Downing, J.B. Cotner and others. In preparation. Lakes and impoundments as regulators of carbon cycling and climate. Invited synthesis paper for a special issue of Limnology and Oceanography on 'The role of lakes in the carbon cycle'.

Cotner, J.B., and B.A. Biddanda. 2002. Small players, large role: Microbial influence on auto-heterotrophic coupling and biogeochemical processes in aquatic ecosystems. Ecosystems 5, 105-121.

Cotner, J.B., J. Kenning and J.T. Scott. In press. The microbial role in littoral zone biogeochemical processes: Why Wetzel was right. Proceeding of the SIL Conference, Montreal, Canada, Aug 2007.

Hall, E. K.; Cotner, J. B. 2007. Interactive effect of temperature and resources on carbon cycling by freshwater bacterioplankton communities. Aquatic Microbial Ecology 49: 35-45.

Waples, J.T., B. Eadie, J.V. Klump, M. Squires, J. Cotner, and G. McKinley. 2008. The Laurentian Great Lakes in Halles, B. Continental Margins: A synthesis and planning workshop. Report of the North American Continental Margins Working Group for the U.S. Carbon Cycle Scientific Steering Group and Interagency Working Group. U.S. Carbon Cycle Science Program, Washington, DC, 110 pp.

Stets, E.G. and J.B. Cotner. Biodegradable dissolved organic carbon in lake ecosystems: Sources and effects on planktonic respiration. In press, Canadian Journal of Fisheries and Aquatic Sciences.

Kerfoot, W. C., JW Budd, SA Green, JB Cotner, BA Biddanda, DJ Schwab and HA Vanderploeg. 2008. Doughnut in the desert: Late-winter production pulse in southern Lake Michigan. Limnology and Oceanography 53: 589-604.

Johengen, T.H., B.A. Biddanda and J. B. Cotner. Stimulation of Lake Michigan plankton by sediment resuspension and river runoff. 2008. Journal of Great Lakes Research 34: 213-227.

Cotner, J B, B A Biddanda, W Makino, and T Stets. 2004. Organic Carbon Biogeochemistry of Lake Superior. Aquatic Ecosystem Health and Management 7: 451-464.

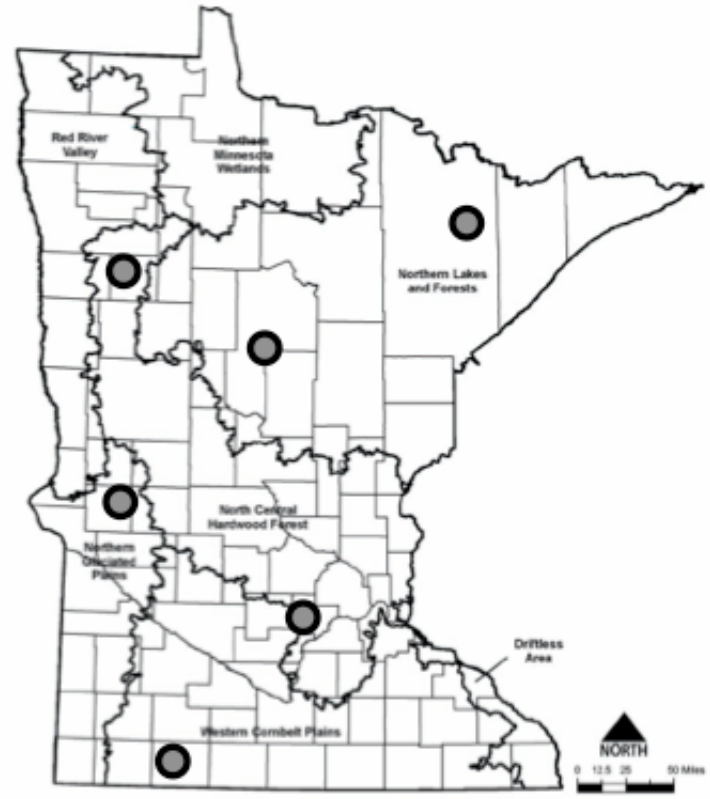
Cotner, J B, T H Johengen, and B A Biddanda. 2000. Intense Winter Heterotrophic Production Stimulated by Benthic Resuspension. Limnology and Oceanography 45(7): 1672-1676.

Education:

Ph.D., University of Michigan, Ann Arbor, 1990, Biology; (Major professor-Dr. Robert Wetzel-deceased).
M.Sc., Kent State University, Kent, Ohio, 1984, Biology; (Major professor-Dr. Robert Heath).
B.A., Wittenberg University, Springfield, Ohio, 1981, Biology.

Other issues relevant to the proposed project:

Cotner has been doing research on shallow lakes in Minnesota for the past 10 years. He is collaborating with Kyle Zimmer at the University of St. Thomas and colleagues at the Minnesota DNR. He is also working with the MN-DNR to develop a long-term monitoring program in sentinel lakes in Minnesota. Relatedly, he has been working at the Itasca Biological Station and Laboratories for the past 10 years and has deployed a buoy with meteorological station and water quality monitoring in Lake Itasca for the past 3 years. This experience will greatly enhance the present project as we plan to deploy similar instrumentation in shallow lakes throughout the state.



Project map showing the Minnesota Pollution Control Agency's ecoregions, and the approximate location of our six proposed study areas. We will study effects of surrounding landscapes, watershed and land use characteristics, nutrient levels, and rough fish on water quality, ecosystem integrity, and carbon burial in 10 wetlands within each of the six study areas for three years. State figure is from the 2005 Minneosta Storm Water Manual (MN PCS).