

**Environment and Natural Resources Trust Fund
2017 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 117-D

Acquiring Key Information for a Carp Deterrent System at Lock and Dam #5

Category: D. Aquatic and Terrestrial Invasive Species

Total Project Budget: \$ 284,000

Proposed Project Time Period for the Funding Requested: 2 years, July 2017 – June 2019

Summary:

We complete an approach to stop invasive carp by perfecting a sound deterrent system while helping the DNR with feasibility studies and the US Army Corps with improving gate operations.

Name: Peter Sorensen

Sponsoring Organization: U of MN

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Web Address _____

Location

Region: Northwest

County Name: Statewide

City / Township:

Alternate Text for Visual:

The entire state north of Lake pepin would be protected from invasive caqr

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



Environment and Natural Resources Trust Fund (ENRTF)

2017 Main Proposal

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I. PROJECT STATEMENT

Millions of bighead and silver carp (invasive carp) are living in the Mississippi River south of the Iowa border and moving north towards Minnesota. These voracious filter feeders also jump and have the potential to inflict great ecological and economic damage to thousands of miles of back-river habitat and its fisheries. There is no technology to control invasive carp once they are reproducing and established, so it is critical to prevent this. The Sorensen research team has developed an integrated approach to monitor and greatly limit movement of these carp into Minnesota waters. Briefly, our results demonstrate that the swimming performance of adult bighead and silver carp is no better than that of most fish and can be used against them. When their swimming is simulated using computational fluid dynamics models, very few adult carp (<20%) are capable of passing lock and dam gates. Further, carp passage through dam gates can be cut in half by making small modifications to their operating protocols that are acceptable to the US Army Corps of Engineers (USACE). In addition, our ongoing studies demonstrate that sound can be used to deter most (>75%) carp from entering locks. Other studies show that sound can be administered in combination with air curtains to create walls of sound downstream of lock chambers. These laboratory studies have brought this research almost as far as it can go: field tests and implementation of these concepts are needed as soon as possible - and before the carp are established. Because the University (CFANS) administration is unwilling to assume the risks associated with implementation, we contacted Dr. Ann Pierce (DNR, March 14, 2016) who confirms that the DNR will oversee implementation and start feasibility and pre-design studies within the year. To succeed, the DNR will need our help and more information on deterrent design. Our present LCCMR funding for deterrents expires in a year.

This project will gather new key information for a carp deterrent system with velocity and sound components and move implementation forward. We have advised the DNR that Lock and Dam #5, located downstream of the St. Croix and Minnesota Rivers, is an excellent site for a carp deterrent system because it would protect both rivers. This site also has just a couple of spillways, which can also be modified to prevent fish passage, and its gates are out of the water less than 2% of the year (when dams are most vulnerable). Further, we will soon have modeling data available for Lock and Dam #5, but while we have a basic understanding that sound can repel carp, we do not yet know whether and how it might be optimally combined with air curtains or light. In the present study, we will: 1) identify specific combinations of sound that can be used with air curtains to deter carps but not native fishes; 2) determine whether light could be used with air curtains and sound to make them more effective for carps without affecting native fish; 3) help the MN DNR develop a feasibility and pre-design of a sound deterrent system for this lock and dam to determine the costs so construction can proceed quickly; 4) work with the USACE to alter gate operations at this site using data we are collecting now. This work will largely be conducted in the laboratory and build off ongoing work while employing designs and equipment that could be moved to the field and implemented (hopefully as soon as possible). The St. Paul District of the USACE has expressed willingness to work with us to evaluate and implement operational changes at Lock and Dam #5 and to permit installation of sound systems that do not have adverse effects on navigation at this location.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Identify specific combination(s) of sounds based on work to date that could be used with air curtains to deter carps in the field. This work will identify the characteristic(s) of sound that deters carp most efficiently and consistently and that affects native fish least in the lab -- and could (should) be confirmed in the field. We will continue to partner and collaborate with Fish Guidance Systems Ltd. (FGS), an English company that has been implementing sound/ air/ light deterrents in the field for 20 **Budget:** \$132,000



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years but has not yet been able test all combinations of their technologies on silver and bighead carp. We will compare their technologies with those already developed in Minnesota and work together to optimize them. Work will be lab-based unless the opportunity for field tests arises.

Outcome	Completion Date
1. Test different frequencies of sound on carp and 2 native fishes within an air curtain system	Dec, 2017
2. Test different temporal patterns of sound on carp and 2 native fishes in lab, Final report	June, 2018

Activity 2: Determine whether light could be used with a combined sound and air curtains to create a more effective deterrent for carps which is less likely to repel native fishes in the lab. We will test various light intensities, spectra and pulses (strobes). FGS will be a partner in this work too and work will be lab-based unless opportunities arise.

Budget: \$132,000

Outcome	Completion Date
1. Testing and documenting the effectiveness of a combined light-sound-bubble curtain to repel carp and 2 native fishes in the laboratory, Report to LCCMR, MN DNR and USACE.	Dec, 2018

Activity 3: Assist the DNR with feasibility and pre-design studies of a sound and air curtain for Lock & Dam #5.

Budget: \$10,000

Outcome	Completion Date
1. Assist our partner, the MN DNR, with pre-design of deterrent system by sharing expertise	June, 2018

Activity 4: Assist the USACE with implementing changes in their gate operations.

Budget: \$10,000

Outcome	Completion Date
1. Provide the results of our modeling (with explanations) to assist the USACE with changing its gate operations at Lock and Dam #5 and perhaps other sites	Dec, 2017

I. PROJECT STRATEGY

A. Project Team/Partners

We will work with the MN DNR, as well as scientists and engineers from Fish Guidance Systems Ltd. (FGS) to conduct critical lab tests with sound and air curtains that will include our ideas as well as FGS equipment, sounds and lights. For the feasibility study and pre-design, we will provide information to the DNR to assess whether, how, and what type of system, might best be deployed while addressing present and future research and implementation needs. We will work with the USACE to modify gate operations at Lock and Dams meantime.

B. Project Impact and Long-Term Strategy

The results of this project have genuine potential to spare the majority of the state of Minnesota from bighead and silver carp for many decades and until real solutions that reduce carp abundance are found.

C. Timeline Requirements

It will take just over a year to test a few iterations of a combined sound and air curtain system in the lab. Key findings would be provided to the DNR for a pre-design which we hope can be completed by the next legislative session so we can together ask for funding for implementation and the second phase of the present project which must including testing and perfecting these concepts using a deterrent system in the river.

2017 Detailed Project Budget

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IV. TOTAL ENRTF REQUEST BUDGET 2 years

<u>BUDGET ITEM</u>	<u>AMOUNT</u>
Personnel: 1 Professor, P.I.: Peter Sorensen (6 weeks) 6%FTE with 35% benefits (20K) 1 Ph.D. student with tuition, (2 years) 50% FTE with (37%tuition, 9%fringe) (81k) 1 Lab Technican, two thirds-time, (2 years) 67%FTE with 35% benefits (67K) 1 MAISRC administrator, 1%FTE with 35% benefits (5K)	\$ 173,000
Professional/Technical/Service Contracts: fish lab use fee MAISRC (10K). Equipment (air curtain and lights) lease from Fish Guidance Systems Ltd. for 1 year (12K)	\$ 22,000
Equipment/Tools/Supplies: Fish tracking system with computer (Noldus, \$20K); fish and fish supplies (\$15K), lab supplies (\$25K)	\$ 60,000
Acquisition (Fee Title or Permanent Easements): n.a.	\$0
Travel: Travel to Lock and Dams and lodging (\$10K); local and national conferences and workshops (\$10K, FGS scientist (5K)	\$ 25,000
Additional Budget Items: Shipping experimental air curtain and sound gear (FGS) from England (4K)	\$ 4,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 284,000

V. OTHER FUNDS

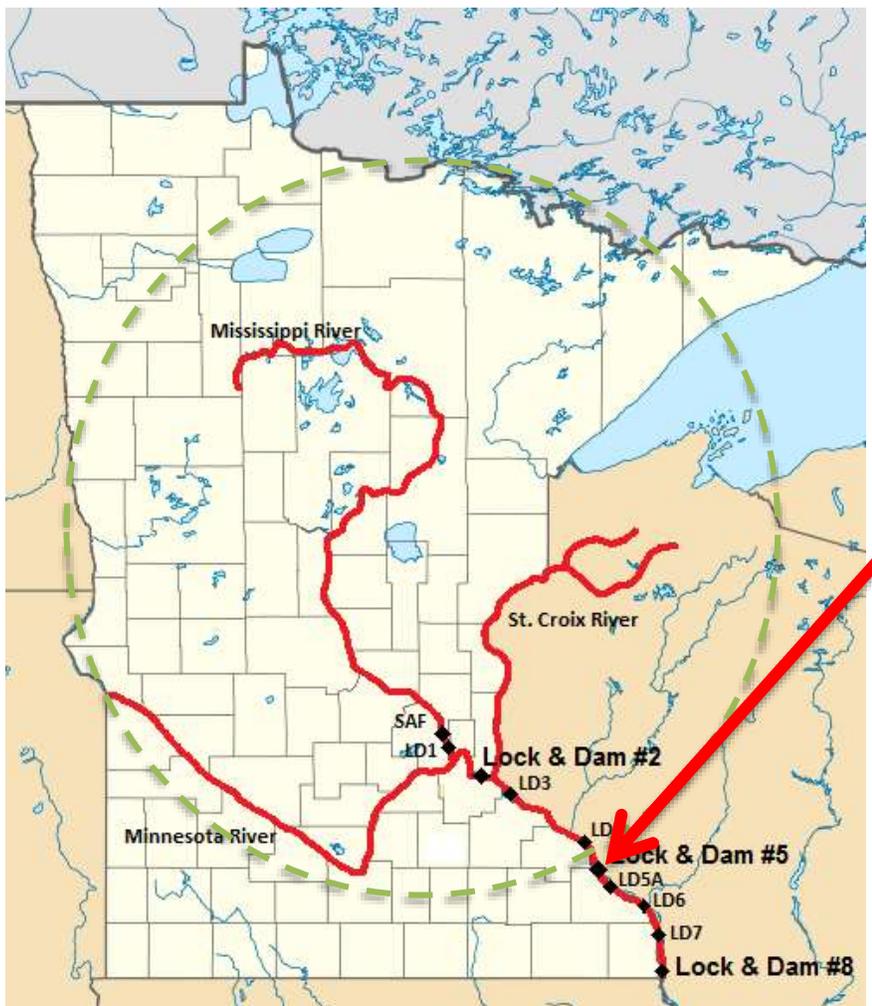
<u>SOURCE OF FUNDS</u>	<u>AMOUNT</u>	<u>Status</u>
Other Non-State \$ To Be Applied To Project During Project Period:	N/A	<i>Indicate: Secured or Pending</i>
Other State \$ To Be Applied To Project During Project Period:	NA	<i>Indicate: Secured or Pending</i>
In-kind Services To Be Applied To Project During Project Period: USACE will implement gate changes	N/A	<i>Indicate: Secured or Pending</i>
Funding History: ENRTF2012 \$981K (for carp); ENRTF2013 (eDNA work \$753K); ENRTF2014 (\$853K), MN DNR (\$880K); USGS (\$90K)	\$ 3,557,000	
Remaining \$ From Current ENRTF Appropriation: \$203K unspent from ENRTF2013 Phase II of attractant study; (also about \$120K from ENRTF2012 but fully obligated; \$350K from ENRTF2013 (Phase I) but fully obligated; about \$350K from ENRTF2014 but fully obligated)	\$ 203,000	<i>Indicate: Unspent</i>

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Sorensen Proposal.

Location of Lock and Dam #5 just downstream of Lake Pepin. If a carp deterrent system is implemented at this location (our ultimate goal), the entire state upstream of that location will be protected from invasive carp. This would include the St. Croix, Minnesota and Upper Mississippi Rivers as shown by the dashed ring.



Lock and Dam #5

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PETER W. SORENSEN, PROJECT MANAGER - QUALIFICATIONS

Professor Peter Sorensen (Dept. Fisheries, Wildlife and Conservation Biology, U of MN) will assume overall responsibility for this project. He is currently directing three other LCCMR projects on carp, two of which, including one on deterrents (which this project extends), end in 2017. Dr. Sorensen is the major professor for the Ph.D. graduate student, Clark Dennis, who will conduct the behavior experiments. Dr. Sorensen founded the Minnesota Aquatic Invasive Species Research Center (MAISRC) and was its director until 2014 before returning to the Faculty.

Interests and expertise:

Peter is broadly interested in aquatic invasive species and their control as well as the physiological basis of fish behavior and its ramifications for controlling invasive fish and carp. Sensory cues including sound are of special interest as are pheromones, chemical signals that pass between members of the same species. He has been studying invasive fish since 1989. His goal is stop the invasion of bigheaded carps.

Professional preparation:

Bates College (Maine), Biology, B.A. 1976

University of Rhode Island, Biological Oceanography, Ph.D., 1984

University of Alberta, Zoology/Medical Science, Postdoctoral Fellow, 1984-1988.

Recent experience:

Assistant professor, 1988- 1993

Associate professor, 1993-1997

Professor, 1997-

Grant management: Dr. Sorensen has received over 80 competitive grants while at the University of Minnesota worth over 25 million dollars.

Publications: 141 peer-reviewed publications, 26 book chapters, 1 patent (sea lamprey pheromone identification and its use in control), 1 book, 30+ non-peer reviewed publications

Graduate students: 26 total, 20 postdocs

Teaching: Fish Physiology & Behavior, Marine Biology

PROJECT ORGANIZATION

Dr. Sorensen will serve as the scientific director for this project and oversee the activities of the Ph.D. student (Clark Dennis III) while coordinating activities with project partners including the MN DNR, U.S. Army Corps of Engineers, and Fish Guidance Systems Ltd. Peter and Clark will meet weekly and other partners monthly. MAISRC will also assist with project administration. We will have regular coordination meetings amongst all key collaborators and partners as we coordinate the feasibility plans for eventual implementation at Lock and Dam #5 and altering gate operations at that site.

March 17(20), 2016