

**Environment and Natural Resources Trust Fund
2018 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 134-D

An Effective and Practical Invasive Carp Deterrent

Category: D. Aquatic and Terrestrial Invasive Species

Total Project Budget: \$ 998,000

Proposed Project Time Period for the Funding Requested: 2.5 years, July 2018 to December 2020

Summary:

Promising new carp deterrent system is tested in the Mississippi River along with an existing deterrent and predators; 99% blockage is suggested and Fish and Wildlife Service is a partner.

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Sponsoring Organization: U of MN

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

The Mississippi River from Lake Pepin north is shown as it the area of the state that would be protected immediately from Invasive carp by this proposal.

_____ 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)

2018 Main Proposal

Project Title: *An effective and practical carp deterrent*

PROJECT TITLE: An effective and practical invasive carp deterrent

I. PROJECT STATEMENT

Untold millions of bighead and silver carp (“invasive” carp) live in the Mississippi River south of the border with Iowa and are moving north toward Minnesota. These jumping and voracious filter-feeders jump have the potential to inflict great ecological and economic damage. There is no known technology to control invasive carp once they start reproducing and it is critical to prevent this. After five years of laboratory research, the Sorensen team has developed an approach that, if implemented, could reduce the upstream movement of carp into Minnesota by approximately 99%. It uses existing locks and dams and has three components. First, carp movement through spillway gates could be blocked by adjusting gate operations to create balanced and rapid flows that carp cannot swim against and that do not harm dam structures. This effort is already underway: the U.S. Army Corps of Engineers (USACE) has already adjusted gate operations at Lock and Dam #8 following our recommendations and is considering tentative recommendations for Lock and Dam #5 (see letter). Second, aversive sounds could be played into lock chambers to deter carp, which are extraordinarily sensitive to sound. A set of speakers is already serving this function at Lock and Dam #8 and, while we estimate it is about 65% effective, new laboratory research shows repeated 90% deterrence with a new sound system. Third, predatory fish above locks and dams could be managed so that, if carp did pass and reproduce, their offspring would be consumed. **Data thus demonstrate that each lock and dam could stop 90% of carp and that if all 3 techniques were implemented at multiple structures, and function as predicted, overall blockage will exceed 99%.**

Studies have brought carp research almost as far as it can go in the laboratory and it is now necessary to test and develop these concepts in the Mississippi River where they would, of course, stop the carp. The USACE, U.S. Fish and Wildlife Service (USFWS), U.S. Geological Service (USGS), and MN DNR recently reviewed our data and concur. Further, the USFWS is now partnering with us (see letter) to facilitate this work in Minnesota while pursuing funding to expand our approach into Iowa. In the meantime, we must test and improve the science of carp deterrence and protect Minnesota. Briefly, our new lab experiments have shown a simple outboard motor sound to be 65% effective against carp, and a chirping sound produced by a much more sophisticated system designed by Fish Guidance Systems Ltd. (FGS; U.K.) to be over 90% effective, with little effect on native fish. The FGS system could be improved to 99% in the lab by adding an air curtain (not proposed at this time because of cost) and it is possible that light (proposed here) could further increase efficiency. FGS has over 20 years of experience in behavioral fish deterrence; their equipment and stimuli are ahead of American counterparts. We propose to lease a customized FGS system (with an option to buy) and temporarily mount it on lock gates in a manner that requires no new engineering (so the USACE will approve) and would enable it to be moved to other locations if appropriate later (ex. IA). This proof-of-concept demonstration is planned at Lock and Dam #5 which is ideally suited for this work from both an engineering and fisheries perspective (it has many common carp which are an excellent surrogate for bigheaded carps), and which will protect the entire Upper Mississippi, St. Croix and Minnesota rivers from carp. Meanwhile predatory fish populations in the river will be evaluated by analyzing DNR data and an existing sound deterrent at Lock and Dam #8 maintained as a deterrent while a new sound is tested (the simple motorboat sound is presently being tested using DNR funds) -- and MN further protected from carp. Carp and native fish passage will be precisely monitored throughout the entire system. At the conclusion of this study, the FGS system could be purchased and left in place, improved, and/or moved downriver (perhaps with USFWS funds; see letter). The USACE has expressed its willingness to continue to work with the UMN (attached letter), which does not involve construction or work on lock and dam structures.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: *Determine the efficacy of a new sound deterrent system on carp and native fish passage at Lock and Dam #5 and determine whether it could be enhanced with light.*

Budget: \$748,000

A new, highly promising sound deterrent system shown to be over 90% effective in the laboratory will be added to the lock gates at Lock and Dam #5 and its efficacy tested by



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releasing tagged fish below it for two years while sounds are played (or not). The USACE will work with us to adjust spillway gates to further reduce carp passage and improve the entire system’s ability to fully protect Minnesota waters from Lake Pepin north. Light will be tested in addition to sound. Common carp will be used as surrogates for invasive carp to test effects on passage rates as will two native fish (likely walleye and sturgeon).

Outcome	Completion Date
1. Install FGS sound system at lock in Lock and Dam #5, optimize sound field, deploy	December 2018
1. Tag, release 300 fish of 3 species, monitor movement through lock, test sound	December 2019
2. Tag, release 300 fish of 3 species, monitor movement through lock, test sound + light	December 2020

Activity 2: *Use the existing sound deterrent at Lock and Dam #8 to test a new sound and its ability to enhance the new system at Lock and Dam #5 using fish passage as the metric.* **Budget:** \$150,000

The existing sound deterrent on the lock gates at Lock and Dam #8 will be maintained and tested by releasing tagged fish below it while a new sound is played (or not). Although less effective than the FGS system, we know it to be effective, and its low cost should make it valuable to synergize the actions of the system at Lock and Dam #5. Tests on its efficacy start in 2017 for one sound and will be conducted here for another sound.

Outcome	Completion Date
1. Tag, release 200 fish of 2 species and record movement through lock with new sound	December 2019
2. Analyze data and make recommendations for both systems	December 2020

Activity 3: *Evaluate predator populations above Lock and Dam #8 and Lock and Dam #5 to determine their ability to consume young carp.* **Budget:** \$100,000

Predator populations above Lock and Dams #5 and #8 will be assessed by examining data that has already been collected by the DNR (Lake City) and USGS (LaCrosse) but never analyzed. If needed, additional sampling would be performed with the DNR.

Outcome	Completion Date
1. Evaluate predator populations in pools above Lock and Dam #8 and Lock and Dam #5	December 2020

I. PROJECT STRATEGY

A. Project Team/Partners

We will work with Fish Guidance Ltd. to design and construct a deterrent system for Lock and Dam #5 that a University engineer will install using USACE-contract divers. MAISRC and the USFWS will also be our partners with the latter contributing in-kind support to monitor system performance. DNR provides data on predators.

B. Project Impact and Long-Term Strategy

This project has the genuine potential to protect the Minnesota, Upper Mississippi and St. Croix rivers from invasive carp for many decades. Secondary benefits include enhanced understanding of native fish passage, which is presently very poorly understood, and which we would not want to disrupt in efforts to stop carp. Our long-term strategy (and that of the USFWS and DNR) is to use information from this study to guide eventual implementation of our sound systems at Lock and Dam #14 (IA) to protect all of MN. We are presently working with the USFWS to obtain federal funds for this effort (which could come as match and could involve moving the FGS system south if the carp have not yet advanced to Lock and Dam 5). Our project would provide strong justification for possible new funding. Meanwhile, it is reasonable to advance the science and protect MN.

C. Timeline Requirements

Six months to design and install the new deterrent system and two years to monitor performance/ improve.

2018 Detailed Project Budget

Project Title: An Effective and Practical Invasive Carp Deterrent

IV. TOTAL ENRTF REQUEST BUDGET 2.5 years

<u>BUDGET ITEM</u>	<u>AMOUNT</u>
Personnel: 1 Professor, P.I.: Peter Sorensen (12% time) with 33% benefits- 16K x 2.5 = 40k 1 Postdoctoral researcher (fulltime, 27% benefits; Manage tracking, data) -67K x 2 = 134k 1 Field assistant (full-time, fish tracking; 27% benefits) -57 x 2 =104k 1 Research Fellow (part-time PhD Engineer from SAFL to manage FGS system installation)= 4K 3 Technicians (part-time SAFL enginners to install, maintain FGS system, 40wks; 27%) = 65K	\$ 347,000
Professional/Technical/Service Contracts: USACE certified dive team to install, maintain and remove FGS speaker system Lock #5 and other system at Lock #8 (at project conclusion); Electrician to install power at Lock and Dam #5 for FGS speaker system	\$ 30,000
Equipment/Tools/Supplies: 800 acoustic fish tags (\$194K); field supplies and batteries for tracking (10K/yr), sound system supplies (\$8K/total)	\$ 222,000
Acquisition (Fee Title or Permanent Easements): n.a.	\$0
Travel: Truck lease (\$4K/yr), Travel (mileage) to Lock and Dam #5 (5K/yr) and food & lodging at field sites (10K/yr) conferences and workshops (2K/yr). Travel to L&D 5 for engineers (1K)	\$ 43,000
Additional Budget Items: 2 yr Lease for speaker system for Lock and Dam #5 (\$340,000); power to run deterrrent system (\$1k/yr), equipment repairs (\$2k/yr), shipping FGS system from UK (10K)	\$ 356,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 998,000

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:		
Other State \$ To Be Applied To Project During Project Period:		
In-kind Services To Be Applied To Project During Project Period: A USFWS boat crew and boats will be dedicated to this work at Lock and Dam #8 and as available, at Lock and Dam #5 (letter attached)	\$ 15,000	<i>Secured</i>
Funding History: ENRTF2012 (carp attractant, eDNA, and barrier work; \$520,656); ENRTF2013 (eDNA and barrier sound work \$682,969); ENRTF2014 (barrier sound and modeling work; \$853,000), MN DNR (\$880,000 -LSOHC funds and USFWS funds); USGS (carp attractant work; \$140,000)	\$ 3,076,625	
Remaining \$ From Current ENRTF Appropriation: Unspent Phase 3 funds from ENRTF2013 which are curenly held by MAISRC	\$ 21,032	<i>Unspent</i>

PROJECT TITLE: An effective and practical invasive carp deterrent

The location of Lock and Dam #5, our primary study site located just downstream of Lake Pepin, is shown. If a highly effective carp deterrent system were to be implemented here as proposed, almost all of Minnesota including the St. Croix, Minnesota and Upper Mississippi rivers would all be protected (dashed ring). The efficacy of this system would be further enhanced by maintaining the system we already have at Lock and Dam #8 and managing predators (also proposed), resulting in an overall blockage rate of 99%. Eventually at the conclusion of this project, this system could be optimized and either left in place, or with our USFWS partnership, moved downstream to Iowa, protecting the entire state (for details of long-range plan see below).



Lock and Dam #5



Lock and Dam #8



Lock and Dam #14 (IA): Our long-term goal (and that of our partner the USFWS) is to use information and experience gleaned from this project to justify matching funds from other states and the federal government to eventually place an optimized FGS sound deterrent system at this location (current extent of active carp breeding and also the last location before MN where locks and dams can be altered). If timely and successful, this action would protect the entire state of MN from carp. The proposed project will enable this activity. It is possible the FGS system we lease and test could be purchased and used in this manner (or left in place).

PROJECT TITLE: A practical and efficient invasive carp deterrent

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 uniquely qualified to direct this project. Peter is currently directing three LCCMR projects on carp, two of which end June 2017 and which have identified the new sounds that would be tested here. His remaining project in 2018 (ENRTF2013) is examining water flows through Lock and Dams and possible effects of new sounds on native fish in the lab- work which compliments this. Peter also directs a DNR-funded field project on fish movement through Lock and Dam #2 and #8 but that work (which adds to understanding of fish movement) will end June 2018. Peter will thus have time available for the proposed work which is also very timely because it would maintain progress and continuity in the overall effort to stop invasive carp from entering Minnesota.

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. 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 to 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: 145 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, 22 postdocs

Teaching: Fish Physiology & Behavior, Marine Biology

Other Scholarship and Activities: Peter is on the editorial boards of three international journals on fish and invasive fish as well as two national AIS committees that guide invasive carp work. Dr. Sorensen founded the Minnesota Aquatic Invasive Species Research Center (MAISRC) and was its director until 2014.

PROJECT ORGANIZATION

Dr. Sorensen will serve as the manager for this project and will oversee the activities of the research fellow who will run the field project and the University engineers who will install it. Peter will coordinate activities with project partners including the U.S. Fish and Wildlife Service, MN DNR, U.S. Army Corps of Engineers, MAISRC, and Fish Guidance Systems Ltd. Peter and the research fellow will meet weekly and the entire group will meet every 6 months.

May 8 2017