



Environment and Natural Resources Trust Fund (ENRTF) M.L. 2017 LCCMR Work Plan

Date of Submission: September 14, 2016
Date of Next Status Update Report: December 31, 2017
Date of Work Plan Approval: 06/07/2017
Project Completion Date: December 31, 2019
Does this submission include an amendment request? No

PROJECT TITLE: Adapting Stream Barriers to Remove Common Carp

Project Manager: Przemyslaw Bajer

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Location: Statewide

Total ENRTF Project Budget:	ENRTF Appropriation:	\$301,000
	Amount Spent:	\$0
	Balance:	\$301,000

Legal Citation: M.L. 2017, Chp. 96, Sec. 2, Subd. 06d

Appropriation Language:

\$301,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to conduct field tests at existing barrier sites and laboratory experiments to adapt a technology to remove common carp from streams during carp spawning migrations in Minnesota.

I. PROJECT TITLE: Adapting stream barriers to remove invasive fish during their seasonal migrations

II. PROJECT STATEMENT:

The overarching goal of this proposal is to develop a system that can remove large numbers of invasive common carp during their spawning and seasonal migrations at existing barrier sites in streams. Specifically, we will focus on testing and adapting a technology recently developed for salmon in western United States to achieve this goal. This technology, called the Whooshh System, is comprised of an artificial riffle (i.e. a simple fish ladder) that the fish climb and then follow a slight downward slope (slide) into an entry chamber. Once the fish enter the front chamber, they are pneumatically pushed through a flexible plastic tube that can be hundreds of feet long. By doing so, the fish can be safely and quickly transported over dams and other man-made structures to allow their spawning migrations. In case of invasive fish, such as carp, the tube could lead to cages for removal. Thus, while Whooshh was originally designed to restore salmon populations along the west coast, we will use it to manage invasive common carp in the Midwest. Carp employ similar spawning migrations like salmon.

Common carp (*Cyprinus carpio*) are the most wide-spread and damaging invasive fish in Minnesota. In the spring, up to 90% of carp migrate from lakes to marshes to spawn. Often, thousands of carp are seen moving through small streams and creeks over the course of few weeks in May and June (Fig. 1). These fish are driven to reach their destinations and are often seen trying to jump over existing stream barriers, which they can usually cross with some effort. If these carp could be removed, many populations could be managed in a sustainable way. Unfortunately, it is difficult to predict exactly when carp will migrate, most move at night, and the ones that are seen at barrier sites during the day scare easily and are difficult to capture. If whoosh systems could be incorporated into existing carp barriers, many thousands of carp could be removed from streams with relatively little effort, which would allow for sustainable management strategies in many locations. Further, Whooshh engineers are currently developing species recognition capacities, which could be used to direct invasive carp into containment while allowing native fish a safe passage across barriers. **The direct goal** of this proposal is to test and adapt the existing Whooshh system to allow for selective removal of common carp during their spawning migrations. This will be accomplished by conducting field trials during two springs and summers at sites where carp barriers already exist (or where temporary barriers could be easily built) and where spring migrations have been documented in the past. We will also conduct laboratory tests during fall and winter to optimize systems that guide carp into the Whooshh System. Finally, if species-recognition component of the Whooshh System is developed by the onset of the project, we will also conduct laboratory trials to determine if carp can be selectively distinguished from native fish, such as the northern pike (*Esox lucius*), during spring migrations to remove the former and conserve the latter.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of December 31, 2017:

Project Status as of June 30, 2018:

Project Status as of December 31, 2018:

Project Status as of June 30, 2019:

Project Status as of December 31, 2019:

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Field tests of the Whooshh System or its components during carp migrations

Description: We will select two sites with existing carp barriers, or where temporary barriers could be constructed, and where large carp migrations occur each year. We will adapt the existing or newly-built barriers by attaching specially designed entry ways that will direct fish into the Whooshh System. These entry ways will be developed in the fall of 2017, in anticipation of the first spring field season, and installed during April-August of 2018 and then again in April-August of 2019 (carp migrate predominantly in the spring and summer). The entry way to the whoosh system will be equipped with an antenna capable of detecting Passive Integrated Transponders (miniature electronic PIT tags) that we will use to quantify the efficacy with which carp enter the Whooshh System and are removed by it. Similar antennas will be also placed 5m upstream and downstream of the barrier to quantify the number of attempts and successful passages. During each season, up to 500 carp will be captured in the stream using backpack electrofishing during their migrations and released below (or above depending on the direction of movement) the barriers. This will be repeated as many times as possible during each season to increase sample size for statistical analyses. Similar numbers of native fish will also be implanted with PIT tags to assess if they are also attempting to migrate through the Whooshh System. To optimize cost-efficiency and flexibility of study site selection (testing the Whoosh System does not require full installation of all components and power supply because tests in the fall of 2015 already showed that carp will be removed with the Whooshh System if the enter the entry chamber), tests of the Whooshh System during the first field season might be conducted using only the entry chamber.

Summary Budget Information for Activity 1:

ENRTF Budget: \$ 169,000
Amount Spent: \$ 0
Balance: \$ 169,000

Outcome	Completion Date
1. Study sites selected for season 1 (spring 2018)	December 31, 2017
2. Field tests of Whoosh or its components during 1 st spawning migration under way	June 30, 2018
3. Tests of Whoosh or its components completed during 1 st season of carp migrations	December 31, 2018
4. Field tests of Whoosh or its components during 2 nd spawning migration under way	June 30, 2019
5. Tests of Whoosh or its components completed during 2 nd season of carp migrations; final report written.	December 31, 2019

Activity 1 Status as of December 31, 2017:

Activity 1 Status as of June 30, 2018:

Activity 1 Status as of December 31, 2018:

Activity 1 Status as of June 30, 2019:

Activity 1 Status as of December 31, 2019:

Final Report Summary:

ACTIVITY 2: Laboratory tests of the Whooshh System or its components to optimize entry ways for carp migrating up- or downstream.

Description: We will conduct laboratory tests to optimize the design of entry ways into the Whooshh System for carp migrating up- or downstream. We will focus on designing shallow riffles and flow attractants that the carp might cue on while migrating upstream. This work will be conducted during the off-season (September-March) under controlled laboratory conditions, or a field site where conditions could be easily manipulated, where different flow velocities and water temperatures will be tested. Separate tests will be conducted during the day and at night to mimic realistic field conditions (carp often migrate at night). One to two species of native fish (such as the northern pike (*Esox lucios*) or bigmouth buffalo (*Ictiobus cyprinellus*)) that often migrate together with the carp will also be tested to maximize species-specificity of the Whooshh System so that the carp might be removed while the migration of native fish is unobstructed.

Summary Budget Information for Activity 2:

ENRTF Budget: \$ 132,000
Amount Spent: \$ 0
Balance: \$ 132,000

Outcome	Completion Date
1. Preliminary tests of prototype entry ways in progress	December 31, 2017
2. Prototype entry way designed for use during the first field season	June 30, 2018
3. Laboratory tests to perfect entry ways in progress	December 31, 2018
4. Improved entry way designed for use during the second field season	June 30, 2019
5. Final tests of entry ways completed; final report written	December 31, 2019

Activity 2 Status as of December 31, 2017:

Activity 2 Status as of June 30, 2018:

Activity 2 Status as of December 31, 2018:

Activity 2 Status as of June 30, 2019:

Activity 2 Status as of December 31, 2019:

Final Report Summary:

V. DISSEMINATION:

Description: We anticipate publishing at least 1 peer-reviewed publication on the overall effectiveness of the Whooshh system to remove invasive common carp during their seasonal migrations. We will also present our findings at the national meeting of the American Fisheries Society, at the regional Midwest Fish and Wildlife Meeting, and at the regional AIS meetings. In addition, we will post our findings at the MAISRC website/Facebook account via monthly updates, and at the MAISRC annual showcase. Finally, we will communicate our findings with MAISRC extension to develop educational material for the public.

Status as of December 31, 2017:

Status as of June 30, 2018:

Status as of December 31, 2018:

Status as of June 30, 2019:

Status as of December 31, 2019:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:

A. Preliminary ENRTF Budget Overview:

***This section represents an overview of the preliminary budget at the start of the project. It will be reconciled with actual expenditures at the time of the final report.**

Budget Category	\$ Amount	Overview Explanation
Personnel:	\$ 246,000	34% PI, 50% postdoc for 2.5 years, 3 summer techs for 2 years 4 months each year
Professional/Technical/Service Contracts:	\$29,000	Equipment rental and installation, MCL lab use, statistical consulting
Equipment/Tools/Supplies:	\$13,000	PIT tags, PIT antennas, PIT readers, elements to build entry ways to whoosh system, pumps to simulate current, waders, nets.
Capital Expenditures over \$5,000:	\$	
Fee Title Acquisition:	\$	
Easement Acquisition:	\$	
Professional Services for Acquisition:	\$	
Printing:	\$	
Travel Expenses in MN:	\$8,000	Mileage (~4000 miles) to experimental sites x \$0.37 mile + truck rental U of M \$900/month x 3 months x 2 years
Travel outside MN	\$2,000	Attending scientific conferences in USA to present results of this work
Other:	\$3,000	Costs of publishing 2 peer reviewed papers
TOTAL ENRTF BUDGET:	\$301,000	

Explanation of Use of Classified Staff:

Explanation of Capital Expenditures Greater Than \$5,000:

Total Number of Full-time Equivalent (FTE) Directly Funded with this ENRTF Appropriation: 2.1

Total Number of Full-time Equivalent (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 0.04

B. Other Funds:

Source of Funds	\$ Amount Proposed	\$ Amount Spent	Use of Other Funds
Non-state			
	\$	\$	
State			
Rice Creek Watershed District	\$80,000	\$0	To pay for rental of Whooshh System
TOTAL OTHER FUNDS:	\$80,000	\$	

VII. PROJECT STRATEGY:

A. Project Partners:

Partners receiving ENRTF funding

- University of Minnesota: Przemyslaw Bajer – PI, 34% salary and benefits for 2.5 yrs (\$95,000) to oversee and conduct experiments, post-doctoral researcher 50% salary and benefits for 2.5 yrs (\$ 87,000) to conduct the experiments; 3 undergraduate field technicians (\$15/h 4 months x 2 years) to assist in the field during 2 field seasons.
- Whooshh Innovations, LLC – provide Whooshh System or its specific components for field and laboratory trials, \$ 105,000 (of which \$80,000 will be paid by Rice Creek Watershed District). The statement below was prepared by the Office for Technology Commercialization at the University of Minnesota and Whooshh Innovations to describe the nature of the relationships between the two:
 “We (University of Minnesota; UMN) see the relationship strictly as a straightforward transaction, where UMN is paying a fee to rent equipment from Whooshh Innovations (WI) during the study period (two years) for the sole purpose of a biological study with carp as described in an agreed study plan. As part of the standard Whooshh lease agreement, Whooshh personnel will do the initial set-up of the Whooshh system on-site, and provide training on the proper operation and maintenance of the Whooshh equipment. The lease agreement will prohibit reverse engineering or modification of the Whooshh equipment. UMN will identify the location for the initial set-up of the Whooshh equipment and UMN will be responsible for take-down and set-up after initial set-up or if the location changes. The lease agreement will clearly describe the major components to be delivered as part of the lease. If Whooshh develops any modification, derivative work or new technology (hereafter “new work”) for use with the Whooshh equipment during the study period, Whooshh is under no obligation to provide UMN such new work under the lease agreement. If UMN independently and separately files and obtains a patent on an idea arising out of and within the scope of the study project, (and not by reverse engineering or modifying the Whooshh equipment), UMN could, but is not required, to offer Whooshh an opportunity to become a commercial partner. Whooshh has no automatic rights to such technology developed by UMN.”

Partners NOT receiving ENRTF funding

- Rice Creek Watershed District – help with selecting study sites, on-site logistic support, pays for renting the Whooshh System (\$80,000)
- Ramsey-Washington Metro Watershed District - help with selecting study sites, on-site logistic support
- Minnehaha Creek Watershed District - help with selecting study sites, on-site logistic support

B. Project Impact and Long-term Strategy:

Innovative ways to remove invasive fish during their spawning migration would enable effective and practical management strategies for common carp and possibly also other invasive fish in Minnesota. Many watershed districts would be trained on how to use and adopt this technology in their specific locales. This project is also of interest to MN DNR and groups involved in efforts to restore native fishes by increasing passage over dams and improving connectivity between bodies of water.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	\$ Amount
ENRTF 2015: Common carp management using biocontrol and toxins	7/1/15 – 7/31/17	\$413,000
ENRTF 2015: Common carp management using biocontrol and toxins: Phase II	7/1/17 – 7/31/19	\$406,000
		\$

VIII. REPORTING REQUIREMENTS:

- The project is for 2.5 years, will begin on 07/01/17, and end on 12/31/19.
- Periodic project status update reports will be submitted June 30 and December 31 of each year.
- A final report and associated products will be submitted between June 30 and August 15, 2020.

IX. VISUAL COMPONENT or MAP(S):

Adapting stream barriers to remove invasive fish during their seasonal migrations

Each spring, up to 90% of common carp migrate from lakes to marshes using small streams



Thousands of common carp below a barrier in Purgatory Creek, MN. These fish migrate each year from the lake in which they overwinter into a shallow marsh 1 mile upstream.

Capturing these fish would accelerate carp management in many locales. Carp's tendency to challenge barriers could be used against them by creating openings in barriers that lead into devices that remove carp.



An existing technology developed to transport salmon over dams could be modified to remove migratory common carp from many barrier sites in MN

Photo: Whooshh Innovations

Videos:

<http://www.whooshh.com/fish-passage1.html>

We propose two activities:

1. Field: Adapt the existing technology for carp removal in MN
2. Lab: Optimize entry ways into Whoshh System for carp migrating upstream or downstream.

Environment and Natural Resources Trust Fund
M.L. 2017 Project Budget



Project Title: Adapting Stream Barriers to Remove Common Carp

Legal Citation: M.L. 2017, Chp. 96, Sec. 2, Subd. 06d

Project Manager: Bajer, Przemyslaw

Organization: University of Minnesota/MAISRC

M.L. 2017 ENRTF Appropriation: \$ 301,000

Project Length and Completion Date: 2.5 Years, December 31, 2019

Date of Report: 9/14/2016

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	Field tests of the Whooshh System			Laboratory tests of the Whooshh System				
Personnel (Wages and Benefits)	\$123,000	\$0	\$123,000	\$123,000	\$0	\$123,000	\$246,000	\$246,000
Przemyslaw Bajer, Project Manager: \$98,000 (66.5% salary, 33.5% benefits), 34% FTE for 2.5 years								
Postdoctoral researcher to run experiments: \$67,000 (66.5% salary, 33.5% benefits), 50% FTE for 2.5 years								
Three undergrad summer technicians to help with experiments for 2 years, 3 months								
Professional/Technical/Service Contracts	\$26,000	\$0	\$26,000	\$3,000	\$0	\$3,000	\$29,000	\$29,000
Renting equipment from Whooshh, equipment installation and calibration for 2 field seasons	\$25,000	\$0	\$25,000				\$25,000	\$25,000
Statistical consulting U of M	\$1,000	\$0	\$1,000	\$0	\$0	\$0	\$1,000	\$1,000
MLCL space; lab tabks rental				\$3,000	\$0	\$3,000	\$3,000	\$3,000
Equipment/Tools/Supplies	\$8,000	\$0	\$8,000	\$5,000	\$0	\$5,000	\$13,000	\$13,000
2000 PIT tags, antenna wires, supplies to build entry ways, waders, nets, PIT readers, pumps to simulate current.	\$8,000	\$0	\$8,000	\$5,000	\$0	\$5,000	\$13,000	\$13,000
Capital Expenditures Over \$5,000								
Fee Title Acquisition								
Easement Acquisition								

Professional Services for Acquisition								
Printing								
Travel expenses	\$9,000	\$0	\$9,000	\$1,000	\$0	\$1,000	\$10,000	\$10,000
Mileage (~5000 miles) to experimental sites x \$0.37 mile + truck rental U of M \$900/month x 4 months x 2 years.	\$8,000	\$0	\$8,000				\$8,000	\$8,000
Travel outside MN: attending conferences in USA to present results of this work.	\$1,000	\$0	\$1,000	\$1,000	\$0	\$1,000	\$2,000	\$2,000
Other	\$3,000	\$0	\$3,000				\$3,000	\$3,000
Costs of publishing 2 scientific publications	\$3,000	\$0	\$3,000				\$3,000	\$3,000
COLUMN TOTAL	\$169,000	\$0	\$169,000	\$132,000	\$0	\$132,000	\$301,000	\$301,000