

MEETING DATE: May 12, 2016

TITLE: Authorization to enter into agreement with the USGS to contribute towards a Zebra Mussel Control Study pending final approval of USGS grant award from the Minnesota Aquatic Invasive Species Research Center.

RESOLUTION NUMBER: 16-XXX

PREPARED BY: Eric Fieldseth, AIS Program Manager

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REVIEWED BY: Administrator Counsel Dept. Director.(Name) Craig Dawson
 Board Committee Engineer Other: Kelly Dooley

WORKSHOP ACTION:

<input checked="" type="checkbox"/> Advance to Board mtg. Consent Agenda.	<input type="checkbox"/> Advance to Board meeting for discussion prior to action.
<input type="checkbox"/> Refer to a future workshop (date):_____	<input type="checkbox"/> Refer to taskforce or committee (date):_____
<input type="checkbox"/> Return to staff for additional work.	<input type="checkbox"/> No further action requested.
<input type="checkbox"/> Other (specify): Recommend Approval	

PURPOSE or ACTION REQUESTED:

Authorization to enter into agreement with the USGS to contribute towards a zebra mussel control study pending final approval of USGS grant award from the Minnesota Aquatic Invasive Species Research Center.

PROJECT/PROGRAM LOCATION:

Lake Minnetonka
USGS Lab in LaCrosse, WI

PROJECT TIMELINE:

July 31, 2016 – June 30, 2017
MCWD contribution will occur in 2016

PROJECT/PROGRAM COST:

Fund name and number: Research and Monitoring: AIS Program (5005)
Requested amount of funding: \$20,000
Budgeted amount in 2016 work plan: \$20,000
Is a budget amendment requested? No
Is additional staff requested? No

PAST BOARD ACTION:

March 24, 2016 – Staff presented AIS updates to the Board, which included this zebra mussel control project with the USGS.

SUMMARY

In the 2016 work plan, staff identified a need to further develop research on zebra mussel control products, and budgeted \$20,000 to put towards a smaller scale study evaluating a couple control products with the Minnesota Aquatic Invasive Species Research Center. This research would build off of the information MCWD gained from the Christmas Lake Zebra mussel rapid response, where three different products were used for zebra mussel control.

The Minnesota Aquatic Invasive Species Research Center; however, identified an opportunity to conduct a larger scale study, looking at more products and variables. The USGS was identified as a research agency who may be best to perform this research and apply for the grant funding. The USGS has been a leader in zebra mussel control research, with recent work focused on the product Zequanox. The contributed funds from MCWD would aide in the competitive grant process, and the fact that this project would have local support and contributions would elevate the status for funding.

While MCWD gained valuable knowledge from the Christmas Lake treatments there is still not enough hard science on the best doses and exposure times needed for each product, as well as how they perform in different water temperatures. This research will provide better information about the use and dosage of the zebra mussel control products that will allow organizations, such as the Watershed District, to make more informed decisions during rapid assessment situations.

Deliverable for the District

The final product from this research will be the creation of a temperature-dependent treatment protocol with four different control products. This decision support tool will greatly aid in future rapid response decisions and control options for zebra mussels.

Current status of Grant Award

The USGS is awaiting final approval on the grant award, in an amount of \$186,999. The grant decision is close to being finalized. It is timely that authorization for agreements between the District and the USGS is approved in May, pending final approval of the grant award. Work is set to begin in July 2016.

Funding

USGS Grant Award from MAISRC: \$186,999

MCWD Contribution: \$20,000

USGS Appropriated & In-Kind: \$141,330

The District would be contributing the \$20,000 that was budgeted in the 2016 work plan towards the research, with the report being the final deliverable to the District. District staff will also assist by monitoring lake water temperature, collecting test zebra mussels from Lake Minnetonka, and providing review of testing protocols and dissemination products.



Environment and Natural Resources Trust Fund (ENRTF) M.L. 2013 Minnesota Aquatic Invasive Species Research Center Sub-Project Work Plan

Date of Report: April 20, 2016

Date of Next Status Update Report: July 31, 2016

Date of Work Plan Approval:

Sub-Project Completion Date: June 30, 2017

Project Completion Date: June 30, 2019

Does this submission include an amendment request? No

SUB-PROJECT TITLE: MAISRC Sub-Project [#]: [Sub-Project Title]

Sub-Project Manager: James A Luoma

Organization: USGS, Upper Midwest Environmental Sciences Center

Mailing Address: 2630 Fanta Reed Road

City/State/Zip Code: La Crosse, Wisconsin 546043

Telephone Number: (608) 781-6391

Email Address: jluoma@usgs.gov

Web Address: <http://www.umesc.usgs.gov/>

Location: Statewide

Total ENRTF Sub-Project Budget:

Sub-Project Budget:

\$186,999

Amount Spent:

\$0

Balance:

\$186,999

Legal Citation: M.L. 2013, Chp. 52, Sec. 2, Subd. 06a

Appropriation Language:

\$4,350,000 the first year and \$4,350,000 the second year are from the trust fund to the Board of Regents of the University of Minnesota to develop and support an aquatic invasive species (AIS) research center at the University of Minnesota that will develop new techniques to control aquatic invasive species including Asian carp, zebra mussels, and plant species. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

I. SUB-PROJECT TITLE: Temperature-dependent toxicity of molluscicides to zebra mussels

II. SUB-PROJECT STATEMENT:

Currently, water-temperature dependent treatment protocols to eradicate localized zebra mussel infestations in a rapid response scenario are lacking. Recent attempts in Minnesota to eradicate localized zebra mussel infestations in open waters (Christmas Lake and Lake Independence) demonstrated how the absence of these protocols hindered decision making, particularly, the choice of agent and dosing regimens as water temperature decreased in autumn. Since the probability of detecting new infestations is likely higher in late summer to autumn, during which water temperature decreases, lack of knowledge of temperature dependence (and of concentration/exposure time relationships for these agent in general) are major impediments to progress on zebra mussel management through the use of molluscicides. Development of temperature-dependent treatment protocols will provide a critically needed decision support tool for 1) selecting the correct molluscicide for a rapid-response action, 2) determining the treatment parameters required at a specific water temperature, 3) determining the probability of treatment success, and 4) estimating treatment related costs.

The objective of this project is to develop water-temperature specific rapid response treatment protocols for the complete kill of localized zebra mussel infestations which include: (1) molluscicide selection, (2) treatment concentration, and (3) treatment duration. Specifically, for each of four products/chemicals (Zequanox, Earthtec QZ, potassium chloride, and niclosamide), we will evaluate the dose and duration of exposure required to achieve a complete kill of zebra mussels at four water temperatures ranging from ~7 to 22°C.

The project will involve conducting a series of toxicity tests, ranging from 24 hours to 14 days in duration, with zebra mussels. The water temperature of Lake Minnetonka will be monitored throughout the summer and fall of 2016. When the lake water temperature reaches each of the target test temperatures (~22, 17, 12, and 7°C) zebra mussel test animals will be collected from the lake and transported to a temperature-controlled environmental chamber at the Upper Midwest Environmental Sciences Center (La Crosse, WI) which will be set to match temperature at the time of collection. Modified procedures from ASTM E2455-06 (2013) will be used to conduct static and static renewal toxicity tests (for exposures > 96-h in duration) to determine the dose and duration of exposure required to achieve zebra mussel mortality. A temperature unit based recovery period in flowing clean water will be used prior to assessing zebra mussels for mortality. The duration of the recovery period will vary between 10 and 31 days, depending on water temperature during the exposure and holding periods.

Observed water chemistry parameters and measured exposure concentrations will be summarized using simple descriptive statistics calculated using statistical software and/or Microsoft Excel. The lethal concentration of the test article to cause mortality in 50 and 99% of the test animals (LC₅₀ and LC₉₉, respectively) will be calculated and survival of test animals in each treatment group will be compared in statistical software using a generalized linear mixed effects model with a binomial. Shell length to tissue dry weight comparison of test animals will be compared by treatment group. Statistical procedures used will be described in detail in the final study report and retained in the study records.

This project will have an immediate impact to natural resource managers by providing them the data required to implement a rapid response action to eradicate a new, localized zebra mussel infestation. This project will expedite the time required to select the treatment parameters and it will reduce the potential of treatment failure due to selecting the incorrect molluscicide or incorrect exposure duration. The results of this project could be used as basis for developing additional molluscicide studies to answer specific questions such as the effects of pH or water hardness on molluscicide activity.

III. SUB-PROJECT STATUS UPDATES:

Sub-Project Status as of July 31, 2016

Sub-Project Status as of January 31, 2017

Sub-Project Status as of July 31, 2017

Overall Sub-Project Outcomes and Results:

IV. SUB-PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Test animal holding system, exposure test system, post-exposure holding system, effluent treatment system, range find studies, and development of procedures to determine molluscicide concentrations in water.

Description:

A test animal holding system will be constructed and installed in a climate-controlled environmental chamber. The holding system will be used to house, acclimate, and feed newly collected test animals prior allocation to the test chambers. The holding system will consist of a 350-L fiberglass tank plumbed to receive temperature-controlled well water fortified with a continuous 6 mg/L supply of Reed Mariculture Instant Algae as a food source.

The test system will consist of a series of 216 glass jars (~3.8-L) positioned on support shelving that will be installed in a climate-controlled environmental chamber.

Two independent post-exposure holding system will be constructed and each will consist of twelve 75-L fiberglass tanks plumbed to receive temperature-controlled well water along with a continuous 6 mg/L supply of Reed Mariculture Instant Algae as a food source. Each system will be placed in a separate climate-controlled environmental chamber and used to maintain test animals up to 31 days after exposure at the same temperature at which they were collected and exposed.

An exposure water effluent treatment system will be constructed to remove the chemical from the effluent and to kill any potential veligers in the water prior to discharge through the centers water systems. The treatment system will include a minimum of a 1,100-L tank and an activate carbon filter. Exposure chemicals will be captured in the activated carbon prior to the water being treated to kill any potential veligers and then released to the centers effluent system.

Prior to initiating definitive toxicity tests, a separate group of zebra mussels will be collected and a series of range finding tests will be conducted at multiple temperatures. The range find tests will be 96-h in duration and will consist of a broad range of treatment concentrations. The results from the range finding studies will be used to select the appropriate exposure concentrations for test articles during the definitive tests.

Analytical methods will be developed and used to verify the concentration of test article in each experimental unit. It is anticipated that UV-VIS spectroscopy methods will be used to analyze for Zequanox and Earthtec QZ, high performance liquid chromatography will be used to analyze for niclosamide, and an ion selective electrode will be used to analyze for potassium chloride. Alternative methods will be developed as necessary to verify treatment concentrations.

Summary Budget Information for Activity 1:

ENRTF Budget: \$ 36,788

Amount Spent: \$ 0

Balance: \$36,788

Activity Completion Date:

Outcome	Completion Date
1. Animal holding, exposure, post-exposure and effluent treatment systems are constructed	June 30, 2016
2. Range finding tests are completed	August 15, 2016
3. Analytical methods are developed	August 15, 2016

Activity Status as of July 31 2016:

Activity Status as of January 31, 2017:

Activity Status as of July 31 2017:

Final Report Summary:

ACTIVITY 2: Conduct static toxicity tests at four water temperatures with zebra mussels using potassium chloride, EarthTec QZ, Zequanox, and niclosamide.

Description: A series of static and static renewal (for exposures >96 h in duration) zebra mussel toxicity trials (Table 1) will be conducted at four test temperatures (~22, 17, 12, and 7°C) using each of four products/chemicals (Zequanox, Earthtec QZ, potassium chloride, and niclosamide). Results from the range finding exposures conducted in activity 1 will be used to set the exposure concentrations for all test articles with the exception of Zequanox, which will utilize four treatment concentrations (0, 50, 100, and 200 mg/L as active ingredient).

Table 1. Exposure duration, number of exposure concentrations, number of replicates, and total number of experimental chambers by molluscicide.

Test article	Exposure duration	Number of concentrations (including control)	Number of replicates	Total number of experimental chambers
Earthtec QZ	24 h	4	4	16
Earthtec QZ	96 h	6	4	24
Earthtec QZ	14 d	4	4	16
Niclosamide	24 h	4	4	16
Niclosamide	96 h	6	4	24
Niclosamide	14 d	4	4	16
Potassium chloride	24 h	4	4	16
Potassium chloride	96 h	6	4	24
Potassium chloride	14 d	4	4	16
Zequanox	8 h	4 (0, 50, 100, 200 mg/L)	4	16
Zequanox	24 h	4 (0, 50, 100, 200 mg/L)	4	16
Zequanox	96 h	4 (0, 50, 100, 200 mg/L)	4	16

To account for seasonality variation in molluscicide sensitivity, zebra mussels will be collected when Lake Minnetonka is as close to the target test temperatures as possible. The zebra mussels will then be held, exposed, and observed for latent exposure-related effects within 2°C of the collection temperature. At the conclusion of the post-exposure holding period, each zebra mussel will be individually assessed for survival and a group of indiscriminately selected test animals from each treatment group will be assessed for condition using a shell length/tissue dry weight comparison.

The lethal concentration of the test article to cause mortality in 50 and 99% of the test animals (LC₅₀ and LC₉₉, respectively) and the corresponding 95 percent fiducial limits will be calculated. A generalized linear mixed effects model with a binomial error term will be used to analyze survival by exposure concentration and exposure duration.

Statistical significance for all analyses will be declared at $\alpha \leq 0.05$, and the four independent treatment group replicates (test chambers) will be the experimental units in all analyses.

At each test temperature, a shell length/tissue dry weight ratio of the test animals by treatment group will be modeled using a mixed effects model. Water chemistry (DO, pH, temperature, alkalinity, water hardness, conductivity, and ammonia) and exposure concentration data analyses will be limited to simple descriptive statistics calculated using SAS software (version 9.3 or 9.4) and/or Microsoft Excel.

Preliminary and confidential milestone updates will be provided after the completion of each temperature to the MAISRC, select Minnesota Department of Natural Resources personnel, the Minnesota Department of Natural Resources aquatic invasive species advisory committee, and the Minnehaha Creek Watershed District.

Summary Budget Information for Activity 2:

ENRTF Budget: \$ 135,211
Amount Spent: \$ 0
Balance: \$135,211

Activity Completion Date:

Outcome	Completion Date
1. Completion of the first toxicity test series (~22°C)	September 30, 2016
2. Completion of the second toxicity test series (~17°C)	October 31, 2016
3. Completion of the third toxicity test series (~12°C)	November 30, 2016
3. Completion of the fourth toxicity test series (~7°C)	December 31, 2016
3. Completion of shell length to dry weight comparisons	December 31, 2016

Activity Status as of July 31 2016:

Activity Status as of January 31, 2017:

Activity Status as of July 31 2017:

Final Report Summary:

ACTIVITY 3: Summarize and report findings on the use of potassium chloride, EarthTec QZ, Zequanox, and niclosamide as a rapid response treatment tool to eradicate a localized zebra mussel infestation

Description: All data collected during the course of the study will be proofed and reviewed before being placed into the study files. The data will then be placed into electronic files which will be verified for accuracy. The data will be summarized, analyzed, and incorporated into a final study report. The lethal concentration of the test article to cause mortality in 50 and 99% of the test animals (LC₅₀ and LC₉₉, respectively) and the corresponding 95 percent fiducial limits will be calculated. Statistical significance for all analyses will be declared at $\alpha \leq 0.05$, and the four independent treatment group replicates (test chambers) will be the experimental units in all analyses. A generalized linear mixed effects model with a binomial error term will be used to analyze survival by exposure concentration and exposure duration. At each test temperature, the shell length/tissue dry ratio of the test animals will be modeled using a mixed effects model. Water chemistry (DO, pH, temperature, alkalinity, water hardness, conductivity, and ammonia) and exposure concentration data analyses will be limited to simple descriptive statistics calculated using SAS software (version 9.3 or 9.4) and/or Microsoft Excel.

Preliminary and confidential updates will be provided, as the results are available, to the MAISRC, select Minnesota Department of Natural Resources personnel, the Minnesota Department of Natural Resources aquatic invasive species advisory committee, and the Minnehaha Creek Watershed District.

Summary Budget Information for Activity 3:

ENRTF Budget: \$ 15,000

Amount Spent: \$ 0

Balance: \$15,000

Activity Completion Date:

Outcome	Completion Date
1. Proof and review all raw study data	January 15, 2017
2. Compile study data into electronic format	February 15, 2017
3. Complete statistical analyses and data summarization	March 15, 2017
4. Prepared final study report and/or peer reviewed publication	June 30, 2017

Activity Status as of July 31 2016:**Activity Status as of January 31, 2017:****Activity Status as of July 31 2017:****Final Report Summary:****V. DISSEMINATION:**

Description: Research findings will be disseminated to AIS managers, policy makers, and planners, through oral and/or written presentations at scientific meetings, at the annual MAISRC Showcase event, and as requested by specific groups. Preliminary and confidential milestone updates will be provided after the completion of each temperature to the MAISRC, select Minnesota Department of Natural Resources personnel, the Minnesota Department of Natural Resources aquatic invasive species advisory committee, and the Minnehaha Creek Watershed District. The project manager, or a designee, will coordinate and collaborate with the MAISRC and the University of Minnesota Extension on media efforts and communications. The results of this project will be prepared for a peer-reviewed publication in a scientific journal. Preliminary and confidential drafts will be made available as previously described.

Activity Status as of July 31 2016:**Activity Status as of January 31, 2017:****Activity Status as of July 31 2017:****Final Report Summary:****VI. SUB-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. See the Sub-Project Budget document for an up-to-date project budget, including any changes resulting from amendments.

Budget Category	\$ Amount	Explanation
Personnel:	\$ 186,999	1 research fish biologist/project manager at 0.2 FTE (\$36,035); 1 fish biologist at 0.3 FTE (\$52,251); 1 general biologist at 0.36 FTE (\$38,951); 2 biological technicians at 0.31 FTE each (\$46,912 combined); 1 chemist at 0.09 FTE

		(\$8,397); and 1 assistant professor at 0.04 FTE (\$4,453)
Professional/Technical Services and Contracts:	\$0	
Equipment/Tools/Supplies:	\$0	
Capital Expenditures over \$5,000:	\$0	
Travel:	\$0	
Other:	\$0	
TOTAL ENRTF BUDGET:	\$186,999	

Add or remove rows as needed

Explanation of Use of Classified Staff: N/A

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

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 1.61

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

B. Other Funds:

Source of Funds	\$ Amount Proposed	\$ Amount Spent	Use of Other Funds
Non-state			
USGS appropriate and in-kind	\$141,330	\$0	USGS overhead, equipment and supplies, laboratory space, analytical equipment, project management support
State			
Minnehaha Creek Watershed District	\$20,000	\$0	Equipment and expendable supplies
TOTAL OTHER FUNDS:	\$161,330	\$0	

Add or remove rows as needed

VII. SUB-PROJECT STRATEGY:

A. Sub-Project Team/Partners:

Project Partners Receiving funds

- MAISRC, A research assistant professor will assist in outreach activities by providing updates to the Minnesota Department of Natural Resources statewide AIS advisory committee and the pilot project committee that oversee the issuance of open-water pesticide treatments. The research assistant professor will also provide testing protocol and dissemination product reviews.

Project Partners Not Receiving funds

- Minnehaha Creek Watershed District, The Minnehaha Creek Watershed District is providing funds to assist in the conduct of this study. Staff will also assist by monitoring the lake water temperature, collecting test animals, and providing review of testing protocols and dissemination products.

B. Sub-Project Impact and Long-term Strategy: This project will have an immediate impact to natural resource managers by providing them the data required to implement a rapid response action to eradicate a new, localized zebra mussel infestation. The data from this project will provide the required dose and exposure duration required to achieve complete zebra mussel mortality at a variety of water temperatures. Therefore, this project will expedite the time required to select the treatment parameters and it will reduce the potential of treatment failure due to selecting the incorrect molluscicide or incorrect exposure duration. The results of this project could be used as basis for developing additional molluscicide studies to answer specific questions such as the effects of pH or water hardness on molluscicide activity.

C. Spending History:

Funding Source	M.L. 2008 or FY09	M.L. 2009 or FY10	M.L. 2010 or FY11	M.L. 2011 or FY12-13	M.L. 2013 or FY14
M.L. 2013, Chp. 52, Sec. 2, Subd. 06f: Zebra Mussel Control Research and Evaluation in Minnesota Waters					\$600,000

VIII. ACQUISITION/RESTORATION LIST: N/A

IX. VISUAL ELEMENT or MAP(S): N/A

X. ACQUISITION/RESTORATION REQUIREMENTS WORKSHEET: N/A

XI. RESEARCH PROPOSAL: See attached research addendum

XII. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted no later than July 31, 2016, January 31, 2017 and July 31, 2017. A final report and associated products will be submitted within two months of the anticipated sub-project completion of June 30, 2017.