



# United States Department of the Interior

## NATIONAL BIOLOGICAL SURVEY

Washington, D.C. 20240

Virginia Cooperative Fish and Wildlife Research Unit

Department of Fisheries & Wildlife Sciences

106 Cheatham Hall, Virginia Tech

Blacksburg, VA 24061-0321

### MEMO

TO: Peter Comanor, NBS  
FROM: R. J. Neves  
DATE: February 22, 1995  
SUBJECT: Quick Response Peer Review of Waller et al.

Enclosed is my evaluation form for the proposal. I guess I don't understand a proposal process that conducts a peer review after approving the project for funding. In my opinion, this is an overfunded project that could be done for much less than \$80 K. Handling mortality really is not a significant mortality factor, based on my 15 years of sampling, transplanting, and relocating mussels. Hence, the research results would not be a significant contribution to science or to the recovery of endangered mussels.

/cwl

**A  
Quick Response  
Research Proposal**

**BEHAVIORAL AND ORGANISMAL RESPONSES OF UNIONID MUSSELS  
TO VARIOUS TEMPERATURES DURING AERIAL EXPOSURE**

**Prepared by**

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La Crosse, Wisconsin 54602-0818**

**February 14, 1995**

## JUSTIFICATION AND BACKGROUND

The success of conservation activities designed to protect unionid mussels, such as relocations, reintroductions, and status surveys depends on the ability of mussels to survive handling and to re-establish in the substrate following displacement. Unionids have been shown to survive brief periods of emersion at moderate air and water temperatures (Schanzle and Kruze 1994; Waller et al. in review). However, scientific data are not available on the ability of freshwater unionids to withstand emersion in extreme temperatures. Handling mussels in extreme water and air temperatures cause significant mortality to mussels. In extremely cold temperatures, mussels have a low metabolic rate and may be slow or unable to reposition and burrow. Mussels lying on top of the substrate are more vulnerable to predation and displacement by water currents. Additionally, emersion at cold temperatures could result in tissue damage due to ice crystal formation in the hemolymph and soft tissues. Handling mussels in extremely warm conditions may cause high metabolic stress associated with repositioning and burrowing in new substrate. Emersion of mussels in very warm air temperatures could also cause stress related to desiccation.

The U.S. Fish and Wildlife Service's Ecological Services Field Office in Bloomington, Minnesota has expressed the need for research on the effects of handling and emersion of freshwater mussels during temperature extremes. This research is urgently needed to establish guidelines for U. S. Fish and Wildlife Service permit conditions related to the safe handling of endangered species. Currently, two unionid mussels in the Upper Mississippi River, the Higgins' eye *Lampsilis higginsii* and the winged mapleleaf *Quadrula*

*fragosa* are included on the federal endangered species list. The recovery plan for *L. higginsii* is currently undergoing reevaluation and the recovery plan for *Q. fragosa* is in draft form. Both plans call for status surveys to improve knowledge on density and distribution of the endangered species.

The proposed research would provide temperature guidelines for conducting status surveys as well as address several other tasks included in the *L. higginsii* and *Q. fragosa* recovery plans. Tasks in the *L. higginsii* recovery plan that this study will address are: (1) Task 115. Relocation, (2) Task 213. Determine best transplant methodology, and (3) Task 1122. Potential detrimental activities (U.S. Fish and Wildlife Service 1982). Tasks in the *Q. fragosa* recovery plan that this study will address are: (1) Task 2B6. Determine the effects of dewatering and low and high temperatures, and (2) Task 4A1. Evaluate translocation techniques and establish a translocation protocol (U.S. Fish and Wildlife Service 1993).

We propose to evaluate the effects of handling and emersion on unionid mussels at extreme water and air temperatures that are likely to be encountered during survey and relocation activities. We established minimum water and air temperature and emersion treatments based on recommendations from state, federal, and private personnel who routinely conduct mussel surveys and relocation projects. Additionally, the maximum water and air temperature were also based on temperature records for the upper Midwest and the Upper Mississippi River. The effect of handling and emersion on a \* mussel will be measured at both the gross and sublethal level. Sublethal stress indicators

are an especially critical measurement because physiological changes are often more rapid than gross measurements such as survival and growth.

## GOALS AND OBJECTIVES

5, 10, 25°C

The goal of this research is to determine minimum and maximum temperature guidelines for handling unionid mussels. The specific objectives of this study are to evaluate the behavioral and physiological responses of mussels after emersion at various water-air temperature differentials.

## METHODS

### *General Approach*

The study will be conducted at the Upper Mississippi Science Center in LaCrosse, WI. Two species of unionids mussels, indigenous and common to the Upper Mississippi River, will be selected as surrogates for the endangered species, *L. higginsii* and *Q. fragosa*. The study will consist of three laboratory tests, each evaluating the behavioral and physiological effects of emersion from a single water temperature. For each water temperature tested, there will be five air temperature and three aerial exposure duration treatments (Figure 1). The water temperatures tested will be 5, 10, and 25°C. Each air temperature treatment will range within  $\pm 20^\circ\text{C}$  of the water temperature. Aerial exposure durations of 15, 30, and 60 minutes will be tested for each air temperature (Fig. 1). Following emersion, mussels will be returned to the water temperature of the

specific test and monitored for behavioral and physiological responses for 14 days.

### *Test Organisms*

Pocketbook *L. cardium* or fat mucket *L. radiata siliquoidea* mussels will serve as surrogates for *L. higginsii*, and pimpleback *Q. pustulosa* or Wabash River pigtoe *F. flava* mussels will serve as surrogates for *Q. fragosa*. Mussels will be collected by SCUBA divers from Navigation Pools 6, 7, 8, and/or 10 of the Upper Mississippi River. Mussels will be held in submerged cages and placed at known mussel bed locations until study initiation. Mussels will be transported to the laboratory when the water temperature of the river reaches the desired test water temperature. During collection and transport, mussels will be continually immersed in river water. In the laboratory, mussels will be acclimated in 121-cm<sup>2</sup> tanks containing 10 cm of sand and well water. Test organisms will be fed a diet of mixed live algae daily.

*how? find period*

### *Experimental Design*

A series of three tests will be performed, each conducted in a randomized block design as a factorial experiment with the main effects confounded (split plot). Mussels will be individually tagged and randomly assigned to each treatment. All treatments will be duplicated with 10 organisms per emersion time and temperature (N=320/test water temperature). For each treatment replicate, 10 mussels will be removed from the water and placed into an environmental chamber for the duration of the emersion period (15, 30 or 60 minutes). The environmental chamber will maintain a constant air temperature

*incubator*

( $\pm 1$ ) and relative humidity (75%) throughout the emersion period. Following emersion, mussels will be returned to one of eight 121-cm<sup>2</sup> tanks. Tanks will contain sand substrate and well water; water temperature in the tanks will be maintained within  $\pm 1^\circ\text{C}$  of the test temperature with Remcor<sup>®</sup> heater/chiller units. A photoperiod that approximates seasonal conditions will be maintained throughout the duration of the study.

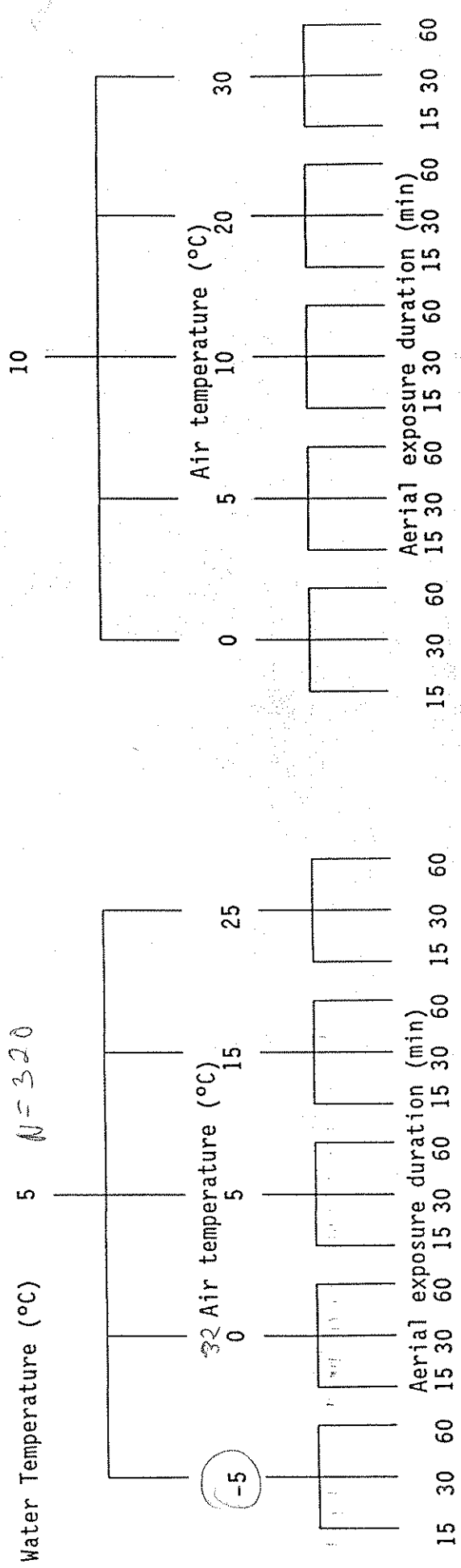
Mortality and behavioral responses, such as orientation and burrowing, will be monitored at 0.5, 1, 3, 6, 12 and 24 h and every 24 h thereafter, for 14 days. A sublethal physiological indicator of stress such as stress protein formation (Veldhuizen-Tsoerkan et al. 1991A; Veldhuizen-Tsoerkan et al. 1991B; Sanders 1988) or amino acid ratios (Gardner et al. 1981) will be measured and compared on subsamples at 6 and 336h.

Statistical analysis of all data will be conducted with PC-SAS<sup>®</sup>. Treatments will be judged to be significantly different at  $p > 0.05$  level.

## PRODUCTS

A guidance document and summary report will be drafted that will allow resource managers to set criterion regarding air and water temperatures that are suitable for conducting unionid survey and relocation activities. A manuscript will be prepared for publication in a peer review scientific journal.

Low Temperature Test Regime



$$\frac{2}{15} \left( \frac{320}{30} - 20 \right)$$

High Temperature Test Regime

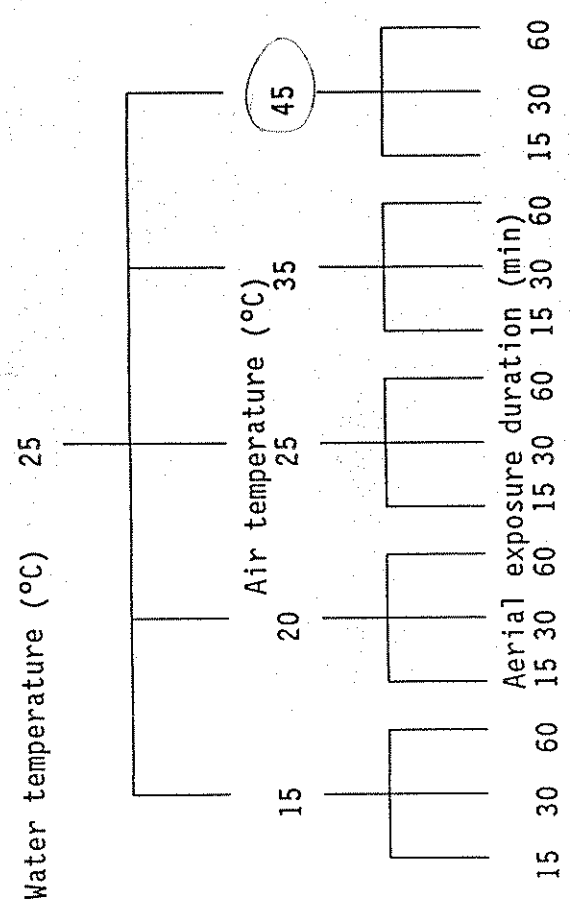


Figure 1. Diagram of experimental design for temperature and aerial exposure tests with unionid mussels.



## TIME SCHEDULE

Initiation Date: March 15, 1995

Termination Date: December 31, 1996

Tentative Schedule:

March-April, 1995: Prepare experimental apparatus and purchase necessary supplies and equipment.

April-December, 1995: Collect test organisms, perform series of three laboratory tests. Tests begin when the ambient Mississippi River water temperature coincides with the desired Test temperature.

January-March, 1996: Conduct statistical analysis, interpret results and prepare interim report.

April-September, 1996: Repeat any tests or analysis as needed.

October-December, 1996: Summarize results , prepare final report and guidance document.

ITEMIZED, PROJECTED BUDGET FOR BEHAVIORAL AND PHYSIOLOGICAL RESPONSES OF  
UNIONID MUSSELS TO EMERSION AT EXTREME WATER AND AIR TEMPERATURES STUDY

ITEM	COST
Salaries and Benefits:	
Fisheries Biologists (GS-12) (2@0.05 FTE each)	\$ 9,000.00
Physical Science Technician (GS-7) (1.0 FTE)	25,500.00
Equipment and Supplies	
Mussel collection (contracted SCUBA diver)	4,000.00
Environmental Chambers (5)	20,000.00
Expendable Supplies	4,000.00
Travel	1,500.00
Subtotal	64,000.00
Indirect Costs (25%)	16,000.00
Total	\$80,000.00

## LITERATURE CITED

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Waller, D.L., J.J. Rach, and W.G. Cope. In review. Effects of aerial exposure in spring and fall on survival of relocated unionid mussels. Submitted to Freshwater Biology.

## COOPERATORS

University of Wisconsin-LaCrosse Biology Department, LaCrosse, WI:

Dr. Mark Sandheinrich, Aquatic Toxicologist

Dr. Ron Rada, Aquatic Microbial Ecologist

Dr. Tom Weeks, Sr., Physiologist

Contributions:

Assistance in experimental design, analytical analysis of physiological stress indicator, statistical analysis and peer review.

U.S. Fish and Wildlife Service, Ecological Services Field Office, Bloomington, MN:

Assisting in experimental design and supply funding.

## Qualifications of Project Personnel:

### Resume of W. Gregory Cope

Position: Research Microbiologist, Section of Toxicology, Upper Mississippi Science Center

Education: Ph.D. 1991 Iowa State University  
 M.S. 1988 University of Wisconsin-La Crosse  
 B.S. 1983 Lenoir-Rhyne College

Research Emphasis: Effects of anthropogenic stresses on biotic communities in fresh waters.  
 Bioavailability, fate, and ecological effects of pollutants. Biology of nonindigenous aquatic nuisance species

#### Experience (last 10 years):

1991-1994. Research Microbiologist, Upper Mississippi Science Center, La Crosse, Wisconsin  
 1991-1994. Adjunct Faculty, University of Wisconsin-La Crosse  
 1988-1991. Graduate Research Assistant (Ph.D. Candidate), Iowa State University and National Fisheries Contaminant Research Center, La Crosse, Wisconsin  
 1985-1988. Graduate Teaching Assistant (M.S. Candidate), University of Wisconsin-La Crosse  
 1981-1984. Fisheries Technician, Duke Power Company Environmental Laboratories, Huntersville, North Carolina

#### Selected Recent Publications:

- Cope, W. G., and D. L. Waller. 1995. Evaluation of mussel relocation as a conservation and management strategy. *Regulated Rivers--Research and Management*. 10:in press.
- Cope, W. G., J. G. Wiener, M. T. Steingraeber, and G. J. Atchison. 1994. Cadmium, metal-binding proteins, and growth in bluegill (*Lepomis macrochirus*) exposed to contaminated sediments from the Upper Mississippi River Basin. *Canadian Journal of Fisheries and Aquatic Sciences*. 51(6):1356-1367.
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- Waller, D. L., S. W. Fisher, H. Dabrowska, J. J. Rach, W. G. Cope, and L. L. Marking. 1993. Toxicity of candidate molluscicides to zebra mussels *Dreissena polymorpha* and selected nontarget organisms. *Journal of Great Lakes Research*. 19(4):695-702.
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- Cope, W. G., and R. G. Rada. 1992. Accumulation of mercury by *aufwuchs* in Wisconsin seepage lakes: implications for monitoring. *Archives of Environmental Contamination and Toxicology*. 23(2):172-178.
- Cope, W. G., J. G. Wiener, and R. G. Rada. 1990. Mercury accumulation in yellow perch in Wisconsin seepage lakes: relation to lake characteristics. *Environmental Toxicology and Chemistry*. 9(7):931-940.

## Resume of Diane L. Waller

Position: Research Fisheries Biologist, Section of Toxicology, Upper Mississippi Science Center

Education: Ph.D. 1987 Iowa State University  
B.S. 1983 Luther College

Research Emphasis: Biology of freshwater bivalves, aquatic toxicology

### Experience:

- 1991-1994. Research Fisheries Biologist, Upper Mississippi Science Center, La Crosse, Wisconsin
- 1991-1994. Adjunct Faculty, University of Wisconsin-La Crosse
- 1988-1991. Graduate Faculty, Mankato State University
- 1987-1988. Research Fisheries Biologist, National Fisheries Research Center, La Crosse, Wisconsin
- 1984-1987. Cooperative Education Student, National Fisheries Research Center, La Crosse, Wisconsin and Iowa State University

### Selected Recent Publications:

- Cope, W. G., and D. L. Waller. 1995. An evaluation of freshwater mussel relocation as a conservation and management strategy. *Regulated Rivers--Research and Management*. 10:in press.
- Waller, D. L., S. W. Fisher, H. Dabrowska, J. J. Rach, W. G. Cope, and L. L. Marking. 1993. Toxicity of candidate molluscicides to zebra mussels and selected nontarget organisms. *Journal of Great Lakes Research*. 19:695-702.
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