



## Zebra Mussel Veliger Chemical Control Treatments do not Impact Rainbow Trout Eyed Egg Survival

Kathleen M. Crank<sup>1</sup>, Michael E. Barnes<sup>2\*</sup>

<sup>1</sup>Benedictine College, 1020 N 2<sup>nd</sup> Street, Atchison, Kansas 66002, USA

<sup>2</sup>McNenny State Fish Hatchery, South Dakota Department of Game, Fish and Parks, 19619 Trout Loop, Spearfish, South Dakota 57783, USA

**\*Corresponding Author:** Michael E. Barnes, McNenny State Fish Hatchery, South Dakota Department of Game, Fish and Parks, 19619 Trout Loop, Spearfish, South Dakota 57783, USA

**Abstract:** Treatments have been developed to prevent the spread of zebra mussel (*Dreissena polymorpha*) veligers during fish transportation, but the effects of these treatments on eggs have not been evaluated. This study examined rainbow trout (*Oncorhynchus mykiss*) egg survival after one of four chemical treatment regimens: 1. 100mg/L formalin for two hours, 2. potassium chloride at 750 mg/L for one hour followed by 20mg/L formalin for two hours, 3. potassium chloride at 750 mg/L for one hour followed by 20mg/L formalin for three hours, and 4. no chemical treatment (control). No significant differences in egg mortality were observed among the treatments. If needed to prevent the spread of zebra mussel veligers, any of the chemical treatments used in this study can be safely administered to eyed rainbow trout eggs.

**Keywords:** Zebra mussels; Rainbow trout eggs; Edwards protocol; Egg transport.

**Acknowledgements:** We thank Patrick Nero, Jeremy Kientz, and Mike Smith for their assistance with this study.

### 1. INTRODUCTION

Zebra mussels (*Dreissena polymorpha*) are invasive species to North America, with native populations in the Black and Caspian seas in Ukraine and southwest Russia [1]. The mussels arrived in the late 1980s in Lake St. Clair and have since spread to at least 29 states. To help prevent further spread of the mussels resulting from fish hatchery and fish stocking operations, Edwards et al. [2] developed chemical treatments to exterminate mussel veligers (larvae) without harming juvenile fish. The most effective treatments for salmonids used formalin or a pretreatment of potassium chloride followed by formalin.

While these treatments effectively control mussels and are safe for fish, no research has been published on their possible effects on fish egg survival. This is of particular interest in South Dakota, where there is a high possibility of zebra mussel introduction into Lake Oahe, a reservoir containing a unique population of landlocked fall Chinook salmon (*Oncorhynchus tshawytscha*). This population is maintained entirely by spawning feral fish from the reservoir and then transporting the eggs to off-reservoir hatcheries [3]. Thus, the objective of this study was to evaluate established treatments commonly used to prevent the spread of zebra mussels during fish transportation on salmonid egg survival. In addition, a modified, longer-duration treatment protocol with specific application to salmon spawning operations in South Dakota was also evaluated for its effects on egg mortality.

### 2. MATERIALS AND METHODS

Experimentation occurred at McNenny State Fish Hatchery, rural Spearfish, South Dakota, using Shasta-strain rainbow trout (*Oncorhynchus mykiss*) eggs. After 396 temperature units of incubation, 20 aliquots of 15 eggs each from a common egg pool were transferred to 20, 9.5-cm diameter Petri dishes (300 eggs total) containing hatchery well water (total hardness as CaCO<sub>3</sub>, 360 mg/L; alkalinity as CaCO<sub>3</sub>, 210 mg/L; pH, 7.6; total dissolved solids, 390 mg/L) and incubated at 11°C using the technique described by Barnes and Durben [3].

Four treatments were used in this study, with five Petri dishes of eggs per treatment ( $N = 5$ ). The first treatment consisted of no chemical application and served as a control. Two treatments were used from the Edwards et al. [2] study: 100mg/L formalin for two hours and 750 mg/L of potassium chloride (Bulk.supplements.com, Henderson, Nevada, USA) for one hour followed by 20mg/L formalin (Fisher Scientific, Chicago, Illinois, USA) for two hours. The final treatment evaluated was 750 mg/L of potassium chloride for one hour followed by 20mg/L formalin for three hours. This treatment was designed to account for the four hours required to transport salmon eggs from Lake Oahe to a hatchery for incubation. Mortality was recorded throughout the experiment, with dead eggs, dead fry, and hatched fry removed daily from the dishes.

Data was analyzed using the SPSS (24.0) statistical analysis program (Systat Software, Inc., Chicago, Illinois, USA). Percent mortality was analyzed using One-way Analysis of Variance, with significance predetermined at  $P < 0.05$

### 3. RESULTS AND DISCUSSION

Egg mortality was not significantly different among any of the chemical treatments or control (Table 1), indicating that all three of the chemical treatments used in this study can be safely used on eyed rainbow trout eggs. Because either formalin alone, or pretreatment of potassium chloride followed by formalin, are effective on eliminating zebra mussel veligers in water during the transportation of fish [2, 5], it is also highly probable that all of the chemical treatments used in this study would also effectively control zebra mussel veligers. Thus, the results from this study combined with the results observed by Edwards et al. [2, 5] indicate that transport of eggs treated with formalin or a pretreatment of potassium chloride followed by formalin are both effective ways to eliminate mussel veligers without harming eggs. However, no chemical treatments have been identified that kill all zebra mussel life stages without harming fish [1]. If the response to chemical treatments by eggs and fish are similar, it may not be possible to decontaminate eggs if zebra mussels are present in a post-veliger stage.

**Table 1:** Mean ( $\pm$  SE) percent mortality of eyed rainbow trout eggs subjected to one of three zebra mussel chemical treatments or a control (no chemical treatment) ( $N = 4$ ).

| Treatment  | Mortality (%)       |
|--|---------------------|
| 100mg/L formalin for 2 hours                                     | 13.34( $\pm$ 2.11)  |
| 750 mg/L KCl for 1 hour followed by 20 mg/L formalin for 2 hours | 20.00 ( $\pm$ 3.65) |
| 750 mg/L KCl for 1 hour followed by 20 mg/L formalin for 3 hours | 14.67 ( $\pm$ 5.33) |
| Control (no chemicals)   | 24.00( $\pm$ 4.00)  |

This study used rainbow trout eggs that have developed to the eyed stage of development. Because salmonid egg sensitivity varies during development [6, 7, 8], these results may not be applicable to other developmental stages. Caution should also be used in applying these results to other salmonid species, given the inter-species differences in egg sensitivity [9]. Thus, while the initial results from this study on eyed rainbow trout eggs are promising, additional research is needed to verify the use of any of these chemical treatments on newly fertilized Chinook salmon eggs transported from Lake Oahe, South Dakota.

These chemical treatments evaluated in this study are specific to zebra mussels. While treatments with formalin or a pretreatment of potassium chloride followed by formalin effectively exterminate zebra mussel veligers [2, 5] they may not be effective on quagga mussel (*Dreissena bugensis*) veligers [10]. Sykes [11] noted that the concentrations of chemicals needed to exterminate quagga mussel veligers were lethal to fish. If quagga mussels became established in Lake Oahe or the Missouri River system, novel chemical treatments would need to be developed and their effects on salmonid egg mortality evaluated.

### 4. CONCLUSIONS

Due to the success of both formalin and a pretreatment of potassium chloride followed by formalin on eliminating zebra mussel veligers without affecting mortality of eyed rainbow trout eggs, both are reasonable methods to remove zebra mussel veligers from stocking water after spawning. The potassium chloride pretreatment followed with formalin and the exclusively formalin techniques outlined by Edwards et al. [2] are non-lethal to rainbow trout eggs and further studies can be

performed on eggs that are only available in limited supply, such as fall Chinook salmon eggs. The addition of an extra hour of formalin use to the potassium and formalin treatment described by Edwards et al. [2] by was also nonlethal to eggs while lasting a longer duration that may be necessary for egg transport.

### REFERENCES

- [1] Ontario Ministry of Natural Resources and Forestry. The potential effects of zebra mussels and other invasive species on aquaculture and related activities. Fish Culture Technical Bulletin. 2015, 2015-06.
- [2] Edwards W. J., Babcock-Jackson L. and Culver D.A. Prevention of the spread of zebra mussels during fish hatchery and aquaculture activities. North American Journal of Aquaculture. 2000, 62: 229-236.
- [3] Barnes M. E., Cordes R. J., and Sayler W. A. Use of formalin during incubation of eyed eggs of inland fall Chinook salmon. The Progressive Fish-Culturist. 1997, 59: 303-306.
- [4] Barnes M. E. and Durben D. J. Petri dish incubation of eyed eggs from rainbow trout and splake. North American Journal of Aquaculture. 2008, 70: 410-414.
- [5] Edwards W. J., Babcock-Jackson L. and Culver D.A. Field testing of protocols to Prevent the spread of zebra mussels (*Dreissena polymorpha*) during fish hatchery and aquaculture activities. North American Journal of Aquaculture. 2002, 64: 220-223.
- [6] Jensen J. O. T. and Alderdice D. F. Changes in mechanical shock sensitivity of coho salmon (*Oncorhynchus kisutch*) eggs during incubation. Aquaculture. 1983, 32: 303-312.
- [7] Alderman D. J. The toxicity of iodophors to salmonid eggs. Aquaculture. 1984, 40: 7-16.
- [8] Crisp D. T. Some effects of application of mechanical shock at varying stages of development upon the survival and hatching time of British salmonid eggs. Hydrobiologia. 1990, 194: 57-65.
- [9] Jensen J. O. T. and Alderdice D. F. Comparison of mechanical shock sensitivity of eggs of five Pacific salmon (*Oncorhynchus*) species and steelhead trout (*Salmo gairdneri*). Aquaculture. 1989, 78: 163-181.
- [10] Pucherelli S. F., Portz D. E., Bloom K. Carmon J., Brenimer S., and Hosler D. Quagga mussel contamination of fish hauls trucks by fish and development of effective potassium chloride and formalin treatments. Journal of Applied Aquaculture. 2014, 26: 132-148.
- [11] Sykes C.L. Development of an efficient method for removal of quagga mussel veligers from transport tanks at Willow Beach National Fish Hatchery. Report of US Fish and Wildlife Service to Bureau of Reclamation, Boulder City, Nevada. 2010.

**Citation:** K. M. Crank, M. E. Barnes, " Zebra Mussel Veliger Chemical Control Treatments do not Impact Rainbow Trout Eyed Egg Survival ", *International Journal of Innovative Studies in Aquatic Biology and Fisheries*, vol. 3, no. 2, p. 15-17, 2017. <http://dx.doi.org/10.20431/2454-7670.0302003>

**Copyright:** © 2017 Authors. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.