Propagation of the Federally Endangered Higgins' Eye Pearlymussel (*Lampsilis higginsi*) at the Genoa National Fish Hatchery as a Survival Strategy

Interim Report
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INTRODUCTION

The Higgins' eye pearlymussel (*Lampsilis higginsi*) is endemic to the Mississippi River basin fauna (Becker 1928). Found in the gravel and sand of the main channel borders (Duncan 1981) of the Mississippi River and some of its northern tributaries (Cummings 1992), the Higgins' eye pearlymussel has a thick valve suitable for commercial exploitation. This occurred first as material for buttons (Becker 1928) and later as the nucleus of high quality cultured pearls (Lopinot 1967).

The Higgins' eye pearlymussel was placed on the Federal Endangered Species List in 1976, based primarily upon its relative scarcity in the Upper Mississippi River (UMR) and the diminished extent of its range. Today, zebra mussels (*Dreissena polymorpha*) exacerbate the original justification for that listing. Stress induced by zebra mussels weakens the physiological condition of vulnerable native mussel species, ultimately causing increased mortality and diminished recruitment of native mussels. Zebra mussel densities, infestation rates upon native unionids, and the areal extent of zebra mussel colonization are at peak levels of observation at many UMR locations.

Zebra mussels became established in the UMR in 1991-1992 and have continued to increase in numbers and extent. The physical habitat of some UMR mussel beds has experienced general deterioration (e.g., decreased dissolved oxygen, increased biological oxygen demand, and reduced or altered plankton communities) synchronous with zebra mussel proliferation. While zebra mussels have recently flourished, members of native unionid communities have suffered marked declines in density and diversity. The east channel of the UMR in navigation Pool 10 (near Prairie du Chein, Wisconsin) historically contained one of the most dense and diverse mussel beds in the UMR, with an abundance of Higgins' eye pearlymussels. Over 30 mussel species have been collected in this area. With equal sampling effort in 1996, 1998, and 1999, only 27, 20, and 7 species of native mussels were collected here, respectively. No Higgins' eye pearlymussels and no recruitment of any native mussel species were detected in the 1999 sampling, however, a carpet of zebra mussels several inches thick covered the mussel bed. Higgins' eye pearlymussel populations in the Mississippi River are at imminent danger of extirpation by zebra mussels. Should that occur, the gene pool would be fragmented and survival of the Higgins' eye pearlymussel would depend on two small, less-than-robust populations: one in the St. Croix River and the other in the Wisconsin River.

The documented declines experienced by UMR native mussel communities are attributed to the continuing population explosion of zebra mussels. Agencies actively monitoring adult and larval zebra mussel populations have found very high zebra mussel concentrations in navigation Pools 5-11, where Higgins' eye pearlymussels presently occur. Conversely, navigation Pools 1-4 are located upstream of Lake Pepin (part of the historical range of Higgins' eye pearlymussels) and have low densities of zebra mussels despite having been continuously inoculated with zebra mussel veligers. Furthermore, no zebra mussels have been reported in the Chippewa and Wisconsin Rivers, two large tributaries of the UMR. Recent investigations have established a

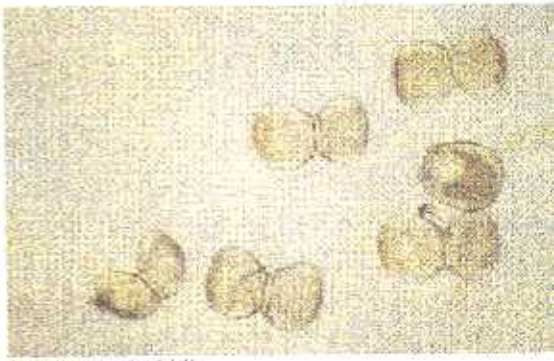
dependable and accurate compilation of native mussel community dynamics, as well as locations and characteristics of suitable habitats, and techniques for relocation of native mussels.

To salvage, protect, and enhance UMR populations of Higgins' eye pearlymussels, a suite of complimentary efforts are needed. The Genoa National Fish Hatchery (NFH) has a record of successful partnerships and was the first NFH to obtain U.S. Fish and Wildlife Service authorization to house native mussels. The mission and infrastructure of the Genoa NFH makes this facility a unique and logical site for holding and propagating Higgins' eye pearlymussels.

The purpose of this project is to prevent zebra mussel-induced extinction of the Higgins' eye pearlymussel through propagation at the Genoa NFH and the subsequent stocking into refugia habitats with no or low zebra mussel densities.

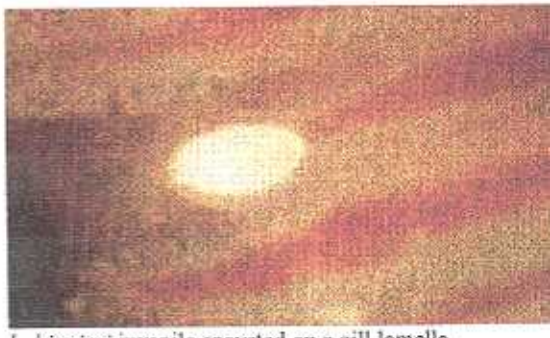
DEFINITIONS

Glochidia: Larval form flushed from the marsupial gill of the female mussel.



L. higginsi glochidia.

Encysted juvenile: Parasitic form encysted in fish tissue and undergoing organogenesis transformation.



L. higginsi juvenile encysted on a gill lamella.

Juvenile: Excysted form, having dropped from the host fish and actively pedal feeding with foot movement.

L. higginsi juvenile.

ACCOMPLISHMENTS

Fall 1999

- Obtained and reared walleye and largemouth bass for use as host fish.
- Initiated modification of hatchery building for mussel culture.

Winter 1999-2000

- Conducted a literature review on *Lampsilis higginsi* and methods of mussel propagation and relocation.
- Interviewed with and toured the facilities of (* = in person)
  Dr. Tom Watters, Ohio State University
  Scott O'Dee Ohio State University (*)
  Dr. Mark Hove, University of Minnesota (*)
  Dr. Jim Layzer, Tennessee Technical University (*)
  Dr. Dick Neves, Virginia Polytechnic Institute and State University (*)
  Dr. Teresa Newton, USGS Upper Midwest Environmental Science Center (*)
  Dr. Diane Waller, Western Wisconsin Technical College (*)
  Dr. Chris Barnhart, Southwestern Missouri State University
  Monte McGregor, Mike Pinder, Virginia Department of Game and Fisheries (*)
  Joe Ferraro Buller State Fish Hatchery, Virginia (*)
  Don Hubbs Tennessee Wildlife Resources Agency
- Applied for endangered species collection permits from state and federal agencies.

Spring 2000

- Obtained five gravid *Lampsilis higginsi* females from the St. Croix River for use in infecting host fish.
- Obtained two gravid *Lampsilis cardium* females from the St. Croix River for use as surrogates while establishing infection procedures.
- Infected 592 largemouth bass (LMB) yearlings at an average rate of 185 glochidia per fish and 752 walleye (WAE) yearlings at an average rate of 100 glochidia per fish on May 9-10. After infection, 482 LMB were placed in a 500-gal tank and 110 LMB were placed in 10-gal aquaria at a rate of 11 fish per aquarium. Similarly, 608 WAE were placed in a separate 500-gal tank and 144 WAE were placed in 10-gal aquaria at a rate of ten, eleven, or twenty fish per aquaria, depending on the fish size. Water temperature in the large flow-through tanks was that of the ambient pond water supply and while recirculated water supplied to the aquaria was heated to 20°C.
- Aquaria were quantitatively monitored, every other day, for premature sloughing of encysted juveniles and for the presence of transformed juveniles. The first transformed juveniles were collected from LMB in aquaria on May 31 (22 days post-infection). The first transformed juveniles were collected from WAE in aquaria on June 2 (24 days post-infection).
- On LMB hosts, 28% of the encysted juveniles were transformed into juveniles.

Spring 2000 (*continued*)

- Aquaria with WAE experienced a serious ectoparasite infection (Ichthyophthirius multifilis) that resulted in total fish mortality within 48 hours (May 31- June 1). In response, we excised the encysted gill tissues from dead WAE for continued incubation in a separate recirculating water system. This system consisted of a five-inch length of four- inch diameter polyvinyl chloride (PVC) pipe fitted at both ends with 150 μm Nytex® nylon screening and three air stones that were oriented inside the pipe to create a circular "surf" of highly oxygenated water in which many of the encysted juveniles were able to excyst from the gill tissue. Gill tissue was removed and separated into individual arches before placement in this system where they were held 48-60 hours in water heated to 21°C. Thirty nine percent of the WAE encysted juveniles (22-23 days post-infection) placed into this treatment were recovered as transformed juveniles. Overall, WAE hosts transformed 6% of the encysted juveniles into transformed juveniles.
- Some LMB also died from Ich infections. Recovery of transformers from LMB gill arches (22-27 days post-infection) placed in the circulating housings averaged 55%.
- The project employed three different holding/culturing treatments for transformed juveniles.
- Two lots of mussels (one lot hosted on WAE and one lot hosted on LMB) excysted directly from the host fish into the receiving treatment. These treatments consisted of standard hatchery flow-through fiberglass raceways measuring 15 ft long by 3 ft wide by 2 ft deep and lined with 3 to 5 inches of 1-3 mm diameter crushed rock.

Transformed juveniles which excysted from host fish held in aquariums were collected by siphoning aquarium floors. These mussels were placed into either:

A. Miniature raceways constructed from PVC rain gutters lined with 0.5-inch of 1-3 mm diameter crushed rock and measuring 10 ft long by 3 inches wide by 3 inches deep. Three gutters were embedded into the bottom of a standard hatchery raceway (see above). Two raceways were established in this manner for a total of six gutters.

B. Suspended filter baskets, constructed by fixing 150μm Nitex® nylon screening to the bottom of an 8-inch diameter PVC pipe. Each filter basket measured 6 inches deep and was submerged 4 inches below the water surface in the runway. Filter baskets were lined with 2 inches of 1-3 mm diameter crushed rock. Baskets were individually supplied with inflow from an obligate spigot.

All holding-culture treatments received pond surface water at a flow rate of approximately 10 cm/sec. All treatments accreted sediment that was suspended in the inflow.

Summer 2000

- Established a 300-gal algal culture tank to produce plankton for feeding juvenile mussels. All treatments received a daily ration of concentrated algal solution. Each raceway and miniature-raceway gutter treatment received a three gallon drip of algal solution which took approximately 0.5-hour to administer. Basket treatments were drained then filled with 2 L of algal solution per basket. Water flow into the baskets was resumed after one hour.
- Continued to monitor transformed juveniles; photographing and video taping their development.
- Identified potential refugia locations on the Wisconsin, Chippewa and Upper Mississippi Rivers.
- Released 3750 juveniles, which were approximately 250μm in diameter, into the Wisconsin River on July 10.
- Collected 30 adult mussels of 11 species from the Wisconsin River and maintained them in tanks to assess holding mortality.
- Placed 1100 juveniles, averaging 510μm in diameter, into four screened trays that were placed at three sites in the Wisconsin River on August 1. Growth and survival of these mussels will be monitored periodically beginning in spring 2001.

PRESS COVERAGE

- Fox News May 31, 2000
- La Crosse Tribune June, 2000
- Courier Press, Prairie du Chien, WI June 7, 2000
- Coulee News June 22, 2000
- Minnesota Public Radio July 14, 2000
- Wisconsin State Journal July 20, 2000
- Wisconsin State Journal July 23, 2000
- Upper Mississippi River Conservation Committee Newsletter July/August 2000
- Wisconsin Council of Sport Fishing Organizations "Newsline" July/August 2000
- La Crosse Tribune August 24, 2000
- Ellipsaria (Freshwater Mollusk Conservation Society newsletter) August, 2000
- Arcadia News-Leader August 2000

LITERATURE CITED

Becker F. C. 1928. The fresh water mollusca of Wisconsin. Bulletin of the University of Wisconsin, Madison, WI.

Duncan R. E. and P. A. Thiel 1983. A survey of the mussel densities in Pool 10 of the upper Mississippi River. Technical bulletin 139, Wisconsin Department of Natural Resources, Madison, WI.

Cummings K. S. and C. A. Mayer. 1992. Field guide to freshwater mussels of the midwest. Illinois Natural History Survey, Champaign, IL.

Lopinot, A. C. 1967. The Illinois mussel. Outdoor Illinios 6:8-15.