Section 6 (Texas Traditional) Report Review

Form emailed to FWS S6 coordinator (mm/dd/yyyy): 11/15/2012

TPWD signature date on report: 10/31/2012

Project Title: Freshwater mussel conservation in Texas: a joint venture between the Dallas Aquarium and Texas Tech University

Final or Interim Report? Interim

Grant #: TX E-140-R-1

Reviewer Station: Clearlake ESFO

Lead station concurs with the following comments: Yes

Interim Report (check one):

- ☒ Acceptable (no comments)
- ☐ Needs revision prior to final report (see comments below)
- ☐ Incomplete (see comments below)

Final Report (check one):

- ☐ Acceptable (no comments)
- ☐ Needs revision (see comments below)
- ☐ Incomplete (see comments below)

Comments: No comments or concerns with document.

INTERIM REPORT

As Required by

THE ENDANGERED SPECIES PROGRAM

TEXAS

Grant No. TX E-140-R

Endangered and Threatened Species Conservation

Freshwater mussel conservation in Texas: a joint venture between the Dallas Aquarium and Texas Tech University

Prepared by:

Dr. David Rogowski

TEXAS PARKS & WILDLIFE

Carter Smith
Executive Director

Clayton Wolf
Director, Wildlife

31 October 2012

INTERIM REPORT

STATE: Texas GRANT NUMBER: TX E-140-R-1

GRANT TITLE: Freshwater mussel conservation in Texas: a joint venture between the Dallas Aquarium and Texas Tech University.

REPORTING PERIOD: 1 Sep 11 to 30 Sep 12

OBJECTIVE(S). To determine habitat associations of freshwater mussels of concern in the upper Trinity and Brazos river watersheds and develop captive husbandry techniques for the eventual propagation and potential translocation of Texas endemic and rare freshwater mussels.

Segment Objectives:

Task 1. January – June 2012. Collate previous survey data from a variety of source (TPWD, DAFP) for the Trinity and Brazos River basins, and conduct additional surveys to identify appropriate mussel beds for monitoring. Begin culturing algae for mussel feeding.
Task 2. April – October 2012. Detailed habitat species surveys of identified mussel beds within the Trinity and Brazos River basin. Begin monitoring selected mussel beds.
Task 3. April 2012- April 2013: Preliminary husbandry techniques: maintaining freshwater mussels in captivity, monitoring feeding and growth.
Task 4. Spring – Fall 2013: husbandry of rare species.

Significant Deviations:

None.

Summary Of Progress:

Please see Attachment A.

Location: Watersheds of the Brazos, Trinity, and Colorado Rivers, Texas.

Cost: Costs were not available at time of this report, they will be available upon completion of the Final Report and conclusion of the project.

Prepared by: Craig Farquhar Date: 31 October 2012

Approved by:  Date: 31 October 2012
C. Craig Farquhar

ATTACHMENT A

Interim Report

Reporting period: 1 January, 2012 to 31 October, 2012

Freshwater mussel conservation in Texas: a joint venture between the Children's Aquarium at Fair Park and Texas Tech University

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Progress Summary

Introduction

Texas is home to 52 species of native freshwater mussels (family Unionidae), several of which are listed as endangered at the state level as well as candidates for protection at the federal level. Aquatic species in general are threatened by habitat modification, i.e. reservoir construction, overharvest, and water pollution. Unionid mussels are no exception and are considered to be the most endangered group of animals in North America. Many populations in Texas have been extirpated from their former habitats and work has begun to monitor and restore mussels for the purpose of improving the ecosystem functionality of Texas rivers and preserving natural heritage.

Although North America has the greatest diversity of Unionid mollusks, relatively little is known about the early life history, physiology, and ecology of these animals. In order to protect and restore these species, a great deal of research is needed. This project focuses on propagation and culture of juvenile mussels in order to better understand their feeding, reproduction, and habitat needs. Improving husbandry techniques through these studies will also improve the ability of fisheries managers to captively culture rare species for repatriation or augmentation of threatened populations.

There are a variety of components to this research. We are conducting research at and in coordination with the Lewisville Aquatic Ecosystem Research Facility (LAERF), Children's Aquarium at Fair Park (AFP), and Texas Tech University, additionally we are conducting field based research. Each component will be discussed separately below.

Lewisville Aquatic Ecosystem Research Facility (LAERF)

Raceways were loaned for use at the LAERF (US Army Corps of Engineers, Lewisville, Texas) and are supplied with water from Lewisville Lake. Details of the facility reported in Smart, et al (1995). Two raceways were tested for use as a low maintenance holding facility for mussels collected from the wild with potential for eventual captive culture and experimentation. Several designs were tested to prevent heavy silt accumulation and filamentous algae from smothering mussels and fouling the system. A shaded wire cover was constructed to prevent raccoon and otter predation, as well as discourage filamentous algae growth. Sediment quantities and types were adjusted to promote burrowing by mussels of different species and size classes, to prevent scour and instability, as well as facilitate recovery of mussels for data collection and monitoring. The current configuration is shown in Figures 1-2. Temperature and water quality were monitored at the input of the raceways throughout summer to ensure suitable conditions for animal survival and growth. Adult *Lampsilis teres* held in the raceway have spawned in early autumn 2012, facilitating experimental use of the larvae (glochidia) upon their maturation in host trials and for propagation of juveniles for future research.

The recent discovery of zebra mussels (*Dreissena polymorpha*) in Lake Ray Roberts will eventually lead to fouling of water intake and distribution infrastructure as the invasive mussels move into Lewisville Lake, including at LAERF. Planning is in progress to meet these challenges onsite. Staff at LAERF are actively involved in chemical and biological control of aquatic nuisance species (macrophytes

generally) as well as aquatic vegetation restoration. Several avenues for future research incorporating native mussels, invasive zebra mussel control, invasive macrophytes and native plant-mussel restoration projects have been identified and are being investigated for potential collaborative projects in the coming season.

Children's Aquarium at Fair Park (AFP)

The aquarium supervisor at AFP (Dallas Zoo) is currently culturing mussels in coordination with University researchers. "Mucket Buckets" (Barnhart 2006) are housing juvenile *Lampsilis siliquoidea* donated as 4 day post-metamorphosis juveniles from Missouri State University on July 27, 2012 (Fig3). Sub-adult *Utterbackia imbecillis, Toxolasma parvus,* and *Quadrula apiculata* collected from drying pools on the periphery of Lewisville Lake throughout summer 2012 are being held in a circulating sediment tray system (Fig 4) in testing for future culture use. As animals outgrow the "mucket buckets" an intermediate culture system is needed until mussels reach a size large enough for tagging and culture in outdoor systems. Three sub-adult *Pyganodon grandis* are being held in an 80 liter aquarium to test for suitability of this species as display organisms at the Aquarium (Fig 5). All mussels at the Aquarium are fed a mixed ration of commercially available microalgae (Reed Mariculture "Shellfish Diet 1800") and several species of algae cultured in house (Fig 5) including *Nannochloropsis oculata,* as well as a wild collected *Scenedesmus sp.* and an unidentified cyanobacterium. Growth and health of the mussels are monitored on a weekly basis.

A modified AHAB (Aquatic Habitats™) system was constructed at AFP for future host suitability tests and for propagation of juvenile mussels (Fig 6). The system can be operated as flow through, semi-open, or closed with multiple sumps for experimental purposes.

In effort to collect gravid female mussels to begin propagating offspring for dietary and early-life physiology experiments, Christie and Bosman collected a large female *Lampsilis hydiana* from Denton Creek on 3 September, 2012 and transported it to DAFP for later extraction of glochidia. This individual released her entire brood of fertilized embryos prematurely upon sampling the brood. The embryos had not yet matured to the glochidial stage and were thus not able to infect a host as necessary for transformation to the juvenile stage. An ad hoc experiment was set up to test the ability of several antimicrobial agents to prolong the viability of these embryonic cells. If the embryos are capable of maturing outside of the mother's marsupia, they may be used to infect a host or be transformed using in vitro methods which also rely on antimicotics and antibiotics (Lima et al, 2012). All embryos expired within 2 weeks of setup. Fungal and microbial contamination was not detected in the culture plates, suggesting that another required element for the development of the embryos was lacking.

Preliminary Field Surveys

Identification of stable mussel populations is a first step in propagation. Reservoir shorelines local to AFP and LAERF were first sampled, as well as access points to their inflowing and outlet channels for shells and live mussels. Denton Creek downstream of Grapevine Lake and the Elm Fork of the Trinity

River downstream of Lake Ray Roberts were found to have relatively constant flows, several access points, and abundant mussel populations for future collection of gravid adults. The upstream reservoirs supply large quantities of algae for mussels to feed upon and prevent low water conditions, which aids in growth and access to host fishes as well as preventing mortality due to stranding and desiccation. Local reservoirs contain populations of lentic system-adapted mussels which are exposed and easily accessed during low water events. Table 1 summarizes live mussels collected for initial system testing and for future broodstock and experimentation.

References:

Barnhart, M. C. 2006. Buckets of muckets: a compact system for rearing juvenile freshwater mussels. Aquaculture. 254:227–233

Lima, P., Lima, M. L., Kovitvadhi, U., Kovitvadhi, S., Owen, C., & Machado, J. 2012. A review on the "in vitro" culture of freshwater mussels (Unionoida). Hydrobiologia 691(1). p21-33.

Smart, R. Michael, Dick, Gary 0., Honnell, David R., Madsen, John D., and Snow, Joe R. 1995. Physical and environmental characteristics of experimental ponds at the Lewisville Aquatic Ecosystem Research Facility. Miscellaneous Paper A-95-2. 59pp. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Figure 1. Photo of raceway at LAERF. Water flows from top to bottom of photo. Mussels are held in sediment filled plastic shoe boxes behind sandbags that mimic riffles. Inflowing water first enters a settling pool to remove suspended solids and increase dissolved oxygen concentration as it spills over the barrier wall.

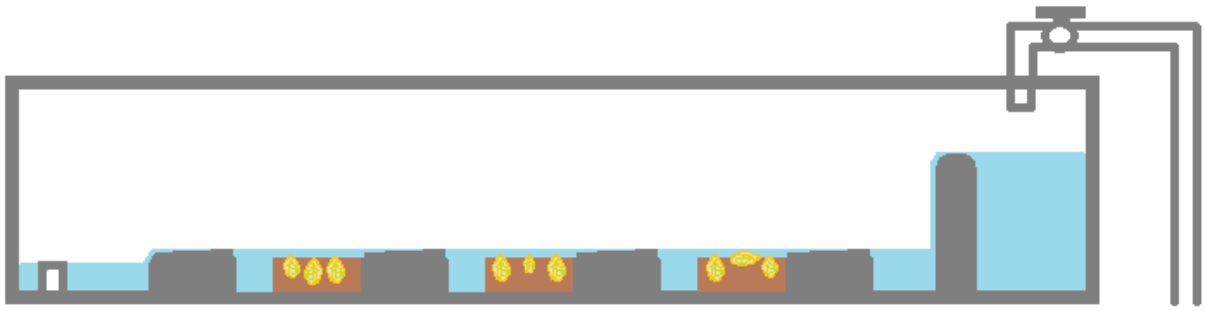

Figure 2. Side-view schematic drawing of raceway at LAERF.

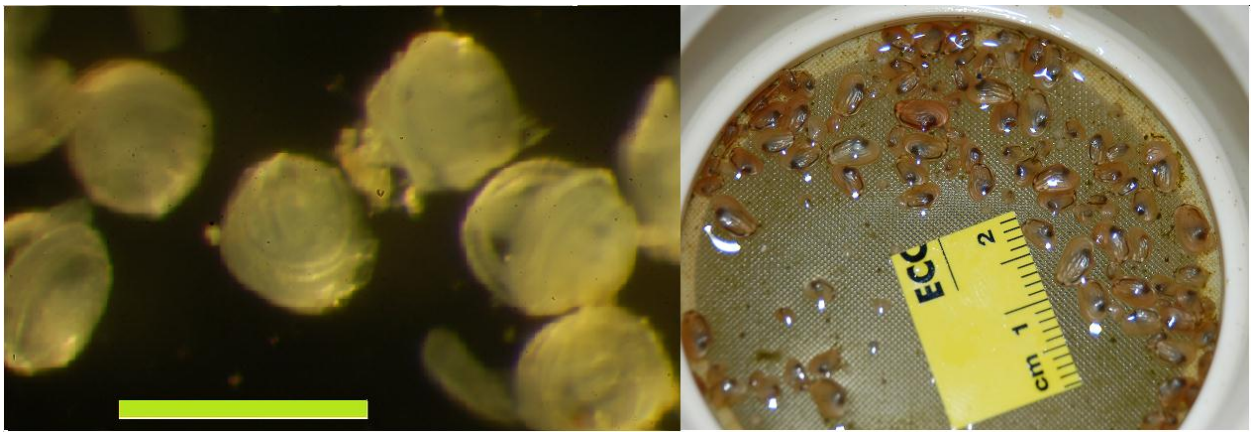

Figure 3. Juvenile *Lampsilis siliquoidea* cultures at AFP. One week post-transformation (on left) with scale bar length of 200 microns. Shown again at 12 weeks post-transformation (on right).

Figure 4. Recirculating sediment tray culture system (left). Water is pumped from the bucket below to the ring above where mussels burrow into sand and filter feed. Weekly water changes maintain water quality and algal diet additions are made either via constant drip or daily feedings. On right, a representative group of animals cultured in this system: wild collected juvenile *Toxolasma parvus, Utterbackia imbecillis, and Quadrula apiculata.*

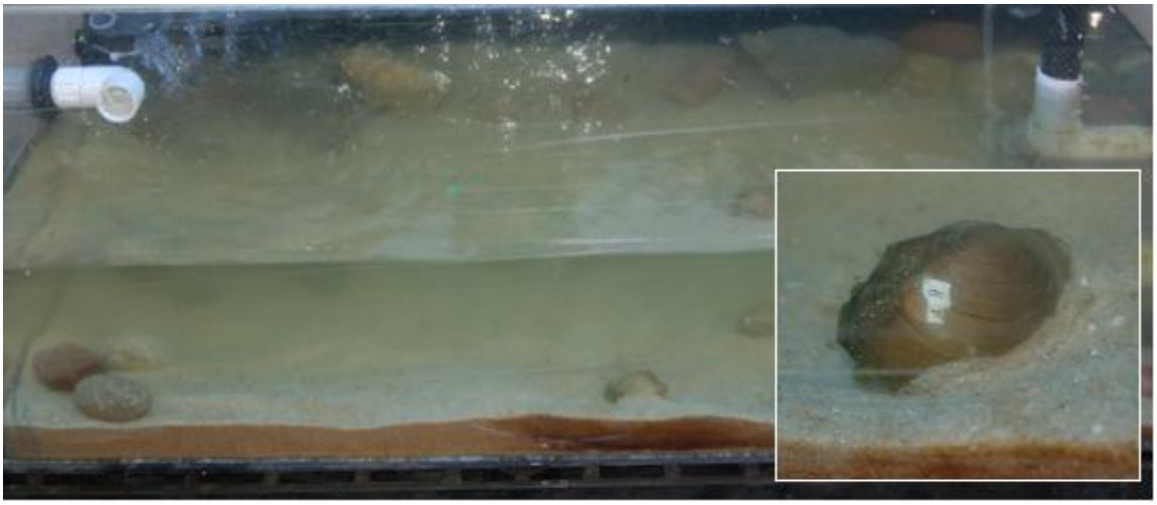

Figure 5. *Pyganodon grandis* being monitored in a typical display-type aquarium at AFP. Eventually, mussels may be on exhibit at the aquarium if their needs can be met in a display tank.

Figure 6. Algae cultures at AFP. Mussels are fed a combination of algae cultured at the Aquarium and commercial micro-algae products for a balanced diet. Cultured algae will be used in feeding trials with newly transformed juveniles.

Figure 7. Fish holding system for mussel propagation and host-mussel experimental trials.

Table 1. List of mussels collected for testing husbandry methods and systems, future broodstock and experimental animals.

Species	Common	Number	Age	Collection site	Collection Date	Location	Survival Rate (%)
Tritigonia verrucosa	Pistolgrip	21	Adult	Elm Fork Green Belt, Denton Co.	17-Jun-12	LAERF	86
Arcidens confragosus	Rock pocketbook	1	Adult	Elm Fork Green Belt, Denton Co.	17-Jun-12	LAERF	100
Quadrula mortoni	Western pimpleback	2	Sub-adult	Elm Fork Green Belt, Denton Co.	17-Jun-12	LAERF	100
Lampsilis teres	Yellow sandshell	1	Adult	Elm Fork Green Belt, Denton Co.	9-Jul-12	LAERF	0
Lampsilis teres	Yellow sandshell	3	Adult	McWhorter's Creek, Denton Co.	18-Jul-12	LAERF	100
*Lampsilis siliquoidea**	Fatmucket	1000*	Juvenile	Missouri State University donated	27-Jul-12	AFP	12
Pyganodon grandis	Giant floater	18	Sub-adult	Lake Lewisville, Denton Co.	18-Jul-12	LAERF	89
Pyganodon grandis	Giant floater	3	Sub-adult	Lake Lewisville, Denton Co.	18-Jul-12	AFP	100
Utterbackia imbecillis	Paper pondshell	4	Sub-adult	Lake Lewisville, Denton Co.	18-Jul-12	LAERF	100
Utterbackia imbecillis	Paper pondshell	3	Sub-adult	Lake Lewisville, Denton Co.	18-Jul-12	AFP	100
Utterbackia imbecillis	Paper pondshell	12	Sub-adult	Lake Lewisville, Denton Co.	18-Jul-12	TTU	100
Potamilus purpuratus	Bluefer	1	Sub-adult	Lake Lewisville, Denton Co.	18-Jul-12	AFP	100
Truncilla truncata	Deertoe	2	Adult	Elm Fork Green Belt, Denton Co.	17-Jun-12	LAERF	100
Toxolasma parvus	Lilliput	13	Sub-adult	Lake Lewisville, Denton Co.	18-Jul-12	TTU	100
Toxolasma parvus	Lilliput	11	Sub-adult	Lake Lewisville, Denton Co.	18-Jul-12	AFP	100
Quadrula apiculata	Southern mapleleaf	1	Sub-adult	Lake Lewisville, Denton Co.	18-Jul-12	AFP	100
Obliquaria reflexa	Threehorn wartyback	3	Sub-adult	Denton Creek, Dallas Co.	3-Sep-12	LAERF	100
Quadrula mortoni	Western pimpleback	2	Sub-adult	Denton Creek, Dallas Co.	3-Sep-12	LAERF	100

**Lampsilis siliquoidea* are from captive bred populations at Missouri State University