Research Note

New and confirmed fish hosts for the threatened freshwater mussel *Lampsilis bracteata* (Gould, 1855), the Texas Fatmucket (Bivalvia: Unionidae)

The widespread decline of the freshwater mussel fauna endemic to Texas indicates fundamental changes to the ecology of the river systems inhabited by these species. In order to appropriately manage these declining species, it is imperative to understand their life history characteristics. *Lampsilis bracteata* (Gould, 1855) has experienced a precipitous decline in recent decades (Howells, 2010). Historically, the species was dispersed throughout the headwaters of the Edwards Plateau region and was found in the Colorado and Guadalupe–San Antonio drainages (Howells, 2010). However, as only several small populations are currently known to exist within these basins, the species is listed as state threatened by the Texas Parks and Wildlife Department (Texas Register 35, 2010) and as a candidate species for federal protection by the U.S. Fish and Wildlife Service (USFWS) (USFWS, 2011).

The purpose of this study was to confirm previously identified host fishes (Howells, 1997) and identify additional hosts on which *L. bracteata* glochidia may successfully transform. Although the reproductive biology of this species has been studied to some degree in the past (Howells, 1997), the quality of glochidia transformation on previously identified host fishes and their suitability for large-scale artificial propagation efforts remain unknown.

Two trials of glochidial infestations were performed on potential hosts, including *Lepomis cyanellus* (Rafinesque, 1819), *Lepomis macrochirus* (Rafinesque, 1819), *Micropterus salmoides* (Lacépède, 1802), and *Micropterus treculii* (Vaillant and Bocourt, 1883) (Table 1). Our methods followed standard host-identification protocols (Jones et al., 2004) and utilized a passive infestation technique. Each trial was conducted independently using new batches of fish and glochidia from different females. At the time of the study, the only fish available were species already housed at the USFWS San Marcos National Fish Hatchery and Technology Center (Table 1).

Displaying gravid *L. bracteata* females were observed in the San Saba River in Menard County, Texas, between July and October 2011. Females were found by searching bedrock crevices in the river bottom while diving with the aid of a mask and snorkel. We checked displaying females for gravidity by carefully opening the valves and inspecting for inflated marsupial gills. Glochidia were collected from gravid mussels in July of 2011 by flushing well water through the marsupial gills using a hypodermic needle. Potential host fishes were placed in a plastic container holding 7.5 L of water. Glochidia from two females also were placed in the container. Airstones were used to agitate the water in the container for 45 min. After infestation, fish were separated by species and placed in individual aquaria. We performed infestations on the same days that glochidia were collected. Shell length, height, and hinge length were measured for glochidia and newly transformed juveniles (to the nearest 0.01 mm). Infested fish were maintained in aquaria between 21 and 24 °C, which were siphoned every 2 d for the first 14 d of the trial and daily thereafter. We counted the total number of juvenile mussels produced per fish (Table 1).

We were able to successfully transform a moderate to high number of glochidia on all four of the tested fish species. We confirmed two previously identified hosts and identified two new hosts (Table 1). Transformation time among the four fish species ranged from 17 to 26 d. *Lepomis cyanellus* produced the greatest number of juveniles per fish (Table 1). Glochidia of *L. bracteata* had a mean height of 0.21 mm, mean length of 0.18 mm, and mean hinge length of 0.10 (SE < 0.01 and $n = 10$). Glochidia grew only slightly during transformation on the hosts. Newly transformed juveniles had a mean height of 0.25 mm, mean length of 0.22 mm, and mean hinge length of 0.10 mm (SE < 0.01 and $n = 10$).

The use of a mantle flap lure (Figure 1) and centrarchid hosts by *Lampsilis bracteata* parallels what researchers have recorded for other *Lampsilis* spp. throughout the United States (Zale and Neves, 1982, Haag et al., 1999). The successful transformation of *L. bracteata* on fish species that are readily available to state and federal fish hatcheries is

Table 1. Results of fish host trials for *Lampsilis bracteata* conducted in 2011. (*) previously identified by Howells (1997)

	Number Tested		Days to Transformation		Mean number of juveniles per fish	
	Trials		Trials		Trials	
Fish Species	1	2	1	2	1	2
*Lepomis cyanellus**	5	5	24	18	434	129
*Lepomis macrochirus**	-	6	-	17	-	95
Micropterus salmoides	-	5	-	26	-	69
Micropterus treculii	-	10	-	26	-	60

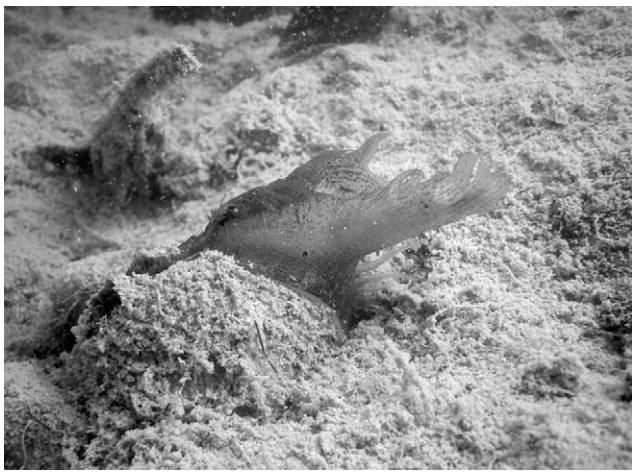

Figure 1. Mantle display of a gravid female *Lampsilis bracteata* observed in the San Saba River, Menard Co., Texas on July 22, 2011.

promising for future artificial propagation. Furthermore, the successful propagation and advancement of juvenile grow-out procedures for other *Lampsilis* spp. provides a guide for the production of juveniles that may be used to augment wild populations or reintroduce the species into areas where it has been extirpated. Although such a strategy has already been developed, researchers within Texas still need to invest time and resources into elucidating the details of this species' life history and ecological requirements.

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LITERATURE CITED

Haag, W.R., M.L. Warren Jr., and M. Shillingsford. 1999. Host fishes and host-attracting behavior of *Lampsilis altilis* and *Villosa vibex* (Bivalvia: Unionidae). American Midland Naturalist 141:149–157.

Howells, R.G. 1997. New fish hosts for nine freshwater mussels (Bivalvia: Unionidae) in Texas. Texas Journal of Science 49: 255–258.

Howells, R.G. 2010. Rare mussels: Summary of selected biological and ecological data for Texas. Report submitted to U.S. Fish & Wildlife. Report on file with Save Our Springs Alliance.

Jones, J.W., R.J. Neves, S.A. Ahlstedt, and R.A. Mair. 2004. Life history and propagation of the endangered dromedary pearlymussel (*Dromus dromas*) (Bivalvia: Unionidae). Journal of the North American Benthological Society 23: 515–525.

Texas Register 35. 2010. Threatened and endangered nongame species. Chapter 65. Wildlife Subchapter G. 31 TAC §65.175. Adopted rules. January 8, 2010: 249-251. Texas Secretary of State.

U.S. Fish and Wildlife Service (USFWS). 2011. Endangered and threatened wildlife and plants: 90-day finding on petitions to list nine species of mussels from Texas as threatened or endangered with critical habitat. Federal Register 74: 66260–66271.

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