New Distributional Records for Four Rare Species of Freshwater Mussels (Family: Unionidae) in Southwestern Louisiana

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NEW DISTRIBUTIONAL RECORDS FOR FOUR RARE SPECIES OF FRESHWATER MUSSELS (FAMILY: UNIONIDAE) IN SOUTHWESTERN LOUISIANA

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Abstract—Recent studies of mussels have documented a gradient of extirpation that extends from Toledo Bend Dam to United States Highway 190 in the lower Sabine River. A similar pattern has been documented for the diversity and abundance of cyprinids. To evaluate whether impacts of the project have extended into nearby tributaries, we assessed the distribution and abundance of threatened species of mussels in Anacoco and Toro bayous, within Vernon and Sabine parishes, respectively. In total, 1,474 live mussels representing 15 species were collected during our survey. Of these, four are considered state-threatened: *Fusconaia askewi* (Texas pigtoe), *Lampsilis satura* (sandbank pocketbook), *Obovaria jacksoniana* (southern hickorynut), and *Pleurobema riddellii* (Louisiana pigtoe). In general, *L. satura*, *O. jacksoniana,* and *P. riddellii* appear to be rare in Anacoco Bayou and absent from Toro Bayou, whereas *F. askewi* is more abundant and widely distributed. Effects of backwater related to releases from impoundments, discharge from paper mills, and use of land within the watershed appear to be plausible factors contributing to the constrained distribution of freshwater mussels throughout both bayous.

Resumen—Estudios recientes de mejillones han documentado un gradiente de extirpación que se extiende desde Toledo Bend Dam hasta la Highway 190 en Estados Unidos en el bajo río Sabine. Un patrón similar ha sido documentado para la diversidad y abundancia de ciprínidos. Para evaluar si los impactos del proyecto se han extendido en las inmediaciones afluentes, evaluamos la distribución y abundancia de especies de mejillones amenazados en los pantanos Anacoco y Toro, dentro de los distritos Vernon y Sabine, respectivamente. Durante nuestro muestreo, se colectaron 1,474 mejillones vivos, representando 15 diferentes especies. De ellas, cuatro son clasificadas como amenazadas por el estado de Texas: *Fusconaia askewi*, *Lampsilis satura*, *Obovaria jacksoniana*, y *Pleurobema riddellii*. Por lo general, *L. satura*, *O. jacksoniana* y *P. riddellii* parecen ser raras dentro del pantano Anacoco y ausentes dentro del pantano Toro, mientras que *F. askewi* es más

abundante y ampliamente distribuida. Efectos de remanso relacionado a la liberación de agua de embalses, descargo de agua por fábricas de papel, y uso de la tierra dentro de la cuenca parecen ser posibles factores que contribuyen a la limitada distribución de mejillones de agua dulce dentro de los dos pantanos.

Historically, North America contained the most diverse and abundant populations of freshwater mussels (Bivalvia: Unionidae) in the world, with ca. 297 species in the United States (Williams et al., 1993). Unfortunately, elimination of host fish and destruction of habitats due to sedimentation, impoundment of streams and rivers, release of environmental contaminants, and introduction of invasive species have reduced this number (Lydeard et al., 2004; Strayer et al., 2004). In Louisiana, 30 of 64 described species of unionid mussels are ranked by the state as critically imperiled or imperiled (Louisiana Natural Heritage Program, http://www.wlf.louisiana.gov). Four of these species are federally protected. Such statistics have prompted state and federal agencies to monitor the remaining populations and to implement conservation programs. However, these efforts are hindered by a lack of basic biological, ecological, and biogeographic data for rare and common species of mussels (National Native Mussel Conservation Committee, 1998). Because of this lack of information, the status of a given species may be worse than is recognized by conservation biologists.

Currently, Toledo Bend Reservoir is being relicensed by the Federal Energy Regulatory Commission. Part of this process is to assess the potential impacts of releases from Toledo Bend Dam on biological communities downstream. Recent studies of mussels have documented a gradient of extirpation that extends from Toledo Bend Dam to United States Highway 190. These studies have shown that species richness and abundance of unionids increase as a function of distance downstream (C. R. Randklev et al., in litt.). A similar pattern has been documented for diversity and abundance of cyprinids (Suttkus and Mettee, 2009). The results from the survey of mussels have prompted Texas Parks and Wildlife and the Sabine River Authority to initiate studies to evaluate whether impacts of the project have extended into nearby tributaries. To determine whether this is the case, surveys of mussels were performed in Anacoco and Toro bayous, within Vernon and Sabine parishes, respectively (Fig. 1). The results we present are part of this effort but pertain only to state-threatened species collected during that survey. Thus, we report new distributional records and observations of habitat for state-threatened species of mussels in southwestern Louisiana.

Surveys were conducted during the summer and early fall of 2010 and 2011. We conducted timed searches using snorkeling, wading, and handpicking techniques. Sampling methodology followed those of Metcalfe-Smith et al. (2000) to ensure that rare species of mussels, if present, were collected. Specifically, sampling time (total time spent searching for mussels) was evaluated for each site but generally ranged from 2–3 h; the exception was Site A3, which was surveyed for 5 h. Collected mussels were brought to shore, identified, and immediately returned to the river. Standard taxonomic references (e.g., Vidrine, 1993; Howells et al., 1996) were used for identification. Data from the timed searches were analyzed to provide a list of species for each site, species richness by site (number of species observed), total abundance per site (number of individuals observed per timed search) and catch per unit effort (number of mussels per hour). Surveys were conducted during low flow to maximize the effectiveness of sampling.

In total, 1,474 live mussels representing 15 species were collected from Anacoco and Toro bayous (Table 1). Of these species, *Lampsilis satura* (I. Lea, 1852), *Obovaria jacksoniana* (Frierson, 1912), and *Pleurobema riddellii* (I. Lea, 1861) are considered critically imperiled or imperiled in Louisiana, and the three species plus *Fusconaia askewi* (Marsh, 1896) are listed as threatened in Texas (Texas Parks and Wildlife, http://www.tpwd.state.tx.us/huntwild/wild/species/endang/animals/invertebrates/; Louisiana Natural Heritage Program, http://www.wlf.louisiana.gov/wildlife/rare-animals-fact-sheets). *Pleurobema riddellii* is being petitioned for protection under the Endangered Species Act (United States Fish and Wildlife Service, 2009). *Strophitus undulatus* (Say, 1817), or *Strophitus subvexus* (Conrad, 1834), also was collected and is state-ranked as critically imperiled to imperiled (Louisiana Natural Heritage Program, http://www.wlf.louisiana.gov/wildlife/rare-animals-fact-sheets); however, it is not considered further because of uncertainties relating to its taxonomic status in southwestern Louisiana (see Vidrine, 1993, for further details). In general, the four species of concern occur in southwestern Louisiana, with ranges that extend into eastern Texas (R. G. Howells, in litt.). *Pleurobema riddellii* and *O. jacksoniana* are more widely distributed, and both are known to occur outside Texas and Louisiana (R. G. Howells, in litt.). Historical records for the four species are limited in our study area, but collections by R. D. Suttkus in the late 1960s and early 1970s have documented their presence in the lower portions of Anacoco Bayou near its confluence with the Sabine River (C. R. Randkev, pers. observ.).

In general, *L. satura*, *O. jacksoniana,* and *P. riddellii* appear to be rare in Anacoco Bayou and absent from Toro Bayou. For Toro Bayou, it is important to note that unionid mussels were collected at four additional sites; however, none of these sites were inhabited by threatened species of mussels. In contrast, *F. askewi* was abundant at all sites in Anacoco Bayou and appeared to be widely distributed within that system (Table 1). Shell length for the four species indicate that recruitment has occurred

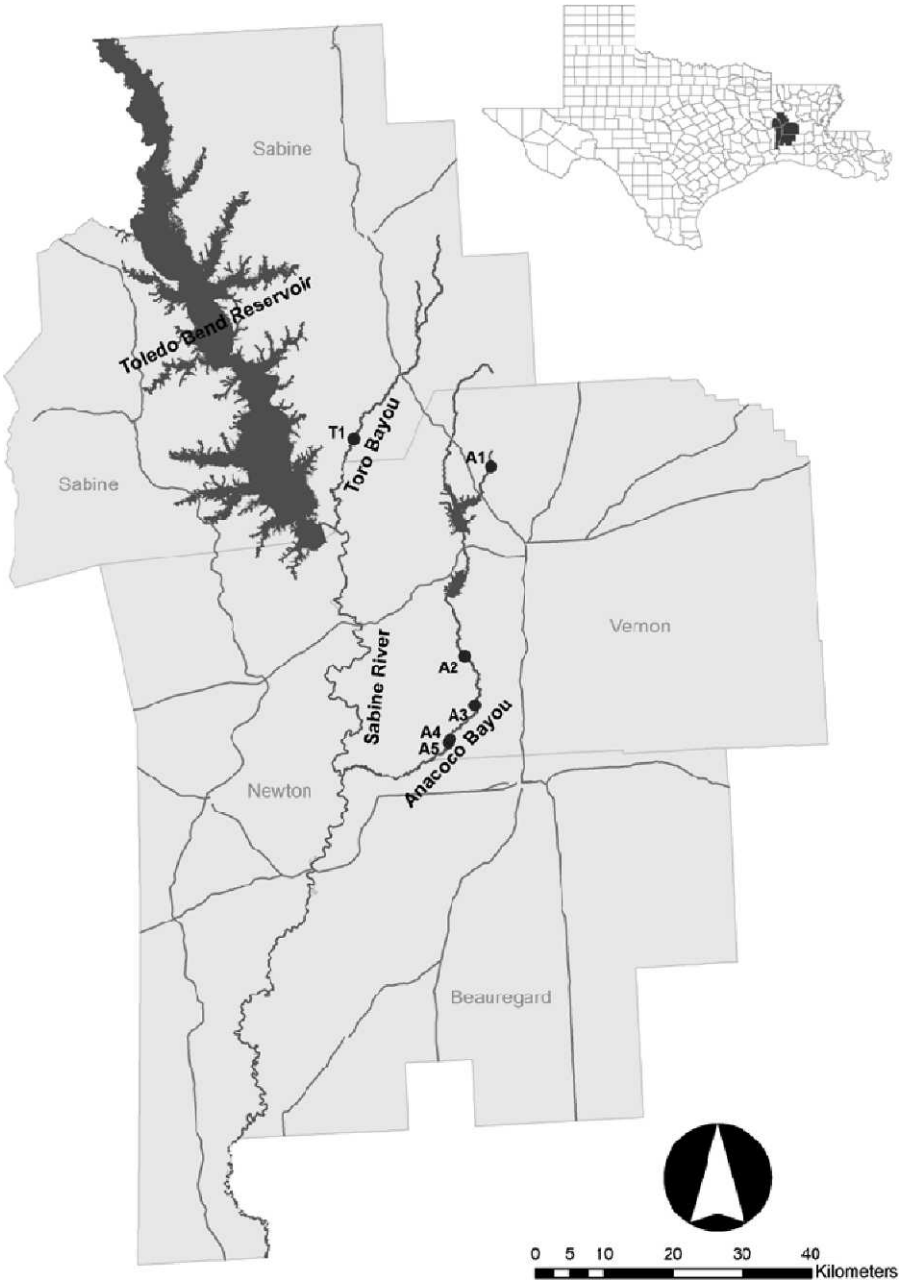

FIG. 1—Map of the study sites in the lower Sabine River basin. Solid circles denote sites with rare species of unionid mussels in Toro and Anacoco bayous, southwestern Louisiana.

for *F. askewi* in Anacoco (Site A3) and Toro bayous, and specimens that were obtained from Site A3 in April 2010 were gravid. Specimens collected from this locality prematurely aborted pink-colored eggs when placed in laboratory aquaria. Gravid female *L. satura* (Fig. 2) were collected at sites A3 and A4 in May 2010.

Species richness and abundance were highest for assemblages of unionids in segments of streams that consisted of coarse woody debris and gravel or sand substrata. C. R. Randklev et al. (in litt.) reported similar observations on the lower Sabine River, suggesting that coarse woody debris may minimize movement and scouring of the river bed when water is released from the impoundment. In general, sites with high abundances of threatened species occurred in segments of streams that were not entrenched and appeared to have good connectivity to the adjacent floodplain. In contrast, sites with low abundances of threatened species were often in segments with deeply incised banks. This observation mirrors those from the Neches River, where threatened species were collected from localities with good connectivity to the floodplain (Troia and Ford, 2011). Generally, streams that are highly entrenched experience severe scouring during high discharges from the river because the energy associated with these events is concentrated within the river channel rather than being dissipated into

TABLE 1—Species of mussels collected, relative abundance, species richness, and catch-per-unit effort for sites surveyed in Anacoco and Toro bayous, southwestern Louisiana.

Species	T1	A1	A2	A3	A4	A5
Amblema plicata	—	—	4	295	2	20
Fusconaia askewi[a]	52	84	26	286	10	96
Lampsilis hydiana	82	51	21	50	1	14
Lampsilis satura[a]	—	—	—	5	1	3
Lampsilis teres	14	—	26	15	1	6
Leptodea fragilis	1	—	1	—	—	—
Obovaria jacksoniana[a]	—	2	—	—	—	—
Pleurobema riddellii[a]	—	—	—	10	—	4
Quadrula mortoni	3	—	8	18	8	6
Quadrula verrucosa	42	—	4	54	7	33
Strophitus undulatus[a]	—	—	-	2	—	3
Toxolasma parvum	1	1	5	—	—	—
Toxolasma texasense	1	7	4	—	—	—
Utterbackia imbecillis	1	—	—	—	—	—
Villosa lienosa	30	23	9	17	—	4
Total	227	168	108	752	30	189
Species richness	10	6	10	10	7	10
Catch-per-unit-effort	114	84	54	150	15	95

[a] Rare and threatened in Louisiana.

the adjacent floodplain (Troia, 2010). This observation may explain why abundance of threatened mussels was greatest at sites with good connectivity to the floodplain.

Associations between species and habitat showed *F. askewi* and *L. satura* as generalists. Both species were collected from woody-debris snags and littoral areas with sandy substrata. Velocities of currents in these habitats were slow to moderate. These species also occur in similar habitats within the lower Sabine River although they are not as abundant or widely distributed in that area (C. R. Randklev et al., in litt.). In contrast, *P. riddellii* was only observed in littoral areas with coarse woody debris, gravel or sand substrata, and currents of moderate velocities. Associations with habitat for *O. jacksoniana* are more difficult to infer because this species was only observed at one site (A1). However, at this locality, live individuals were collected from a small pool in areas with depths of 0.5 m in sand or silt substrata containing substantial

FIG. 2—Mantle display of gravid *Lampsilis satura* from Anacoco Bayou, southwestern Louisiana.

amounts of detritus. This species has been observed in similar habitats within the Neches River (Troia and Ford, 2011).

Our findings represent new records for species of unionid mussels that are rare and threatened in southwestern Louisiana. The preliminary physical and biological characteristics that have been noted for these species are important because specific aspects of their biology are poorly understood (Howells et al., 1996). From a conservation standpoint, the information presented here could be combined with other data to provide meaningful summaries of habitat and distribution for these species. In light of the recent study of unionids on the lower Sabine River (C. R. Randklev et al., in litt.), our results indicate that threatened species of mussels are abundant and, in some cases, widely distributed in two nearby tributaries. This observation raises the question of why these species have persisted in portions of Toro Bayou and throughout Anacoco Bayou but not in the mainstem of the lower Sabine River.

Anthropogenic impacts, such as logging and the release of environmental contaminants, have occurred and still occur throughout much of this river basin. Despite such impacts, the four species of concern have persisted in the upper portions of Anacoco Bayou and at one locality in Toro Bayou but are now absent or rare in the lower Sabine River. The major difference between the sites we sampled in both bayous and the mainstem is that the latter is impacted daily by changes in flow and water temperature that result from releases associated with hydroelectric power. These impacts also may explain why mussels are largely absent from downstream portions of both bayous.

Hydrologic alteration combined with effluent discharged from a nearby pulp and paper mill are plausible explanations for the absence of mussels from Anacoco Bayou near its confluence with the Sabine River. It is well known that impoundments and point and non-point pollution are detrimental to mussels (Vaughn and Taylor, 1999). What is unknown is the degree to which they are constraining abundance and distribution of mussels in Anacoco Bayou. For Toro Bayou, the impact of releases from Toledo Bend dam is certainly more severe given its close proximity to the reservoir. As such, effects of backwater are evident along much of the lower portion of this bayou. However, these impacts appear to become ameliorated with distance upstream. Thus, it is puzzling that threatened species of mussels are largely absent from portions of Toro Bayou not directly impacted by Toledo Bend Reservoir. A plausible explanation for this apparent absence is that sampling was inadequate, in terms of the number of sites, to detect and collect rare species in Toro Bayou. However, this explanation seems unlikely because the number of sites surveyed at both localities was similar: seven sites were surveyed along the mainstem of Toro Bayou, whereas five localities were examined in Anacoco Bayou. Another reasonable explanation is that ongoing changes in use of land in this region have resulted in widespread impacts to populations of mussels in Toro Bayou. Recent studies have demonstrated that small morphologic changes in channels can radically impact the distribution of mussels (Gangloff and Feminella, 2007). However, it is curious that these impacts have not been as detrimental to threatened populations of mussels in Anacoco Bayou. Such questions and uncertainties require further investigation so that conservationists can identify and minimize the factors responsible for declines of mussels in this region.

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