Freshwater mussel surveys within Travis County properties

Dr. Neal Wilkins, Director
Julie Groce, Extension Program Specialist
Institute of Renewable Natural Resources, Texas A&M University

Dr. Neil Ford, Professor of Biology
Department of Biology, University of Texas at Tyler

November 2010

EXECUTIVE SUMMARY

Fifteen species of freshwater mussels were recently placed on the Texas state threatened species list. Six of the species have potential ranges within central Texas. We conducted freshwater mussel surveys along 4 properties managed by Travis County to determine the occurrence of these state-listed species. These surveys were part of a larger research project in central Texas that focused on mussel occurrence and abundance relative to bridge crossings and low-head dams. We used visual and tactile searches to depths of 1 m in the rivers and creeks. Of the state-listed species, we detected live Texas fatmuckets (*Lampsilis bracteata*) along Onion Creek near State Highway 71. Because our surveys were restricted to wadeable areas, we are unable to conclude absence of the state-listed species at the survey sites.

INTRODUCTION

Freshwater mussels (Bivalvia: Unionida) are considered the most rapidly declining group of freshwater organisms in North America (Williams et al. 1993, Lydeard et al. 2004, Strayer et al. 2004). There are approximately 300 freshwater mussel species in the U.S. (Bogan 2008), 110 of which are listed as endangered, threatened, or candidate species (Neves 2004). Over 50 species have been documented in the rivers and streams of Texas (Howells 2010a). In November 2009, the Texas Parks and Wildlife Department (TPWD) listed 15 freshwater mussel species as state threatened (TPWD 2009a): Triangle pigtoe (*Fuscnaia lananensis*)*, Texas pigtoe (*Fusconaia askewi*), Texas fatmucket (*Lampsilis bracteata*)*, Sandbank pocketbook (*Lampsilis satura*), Southern hickorynut (*Obovaria jacksoniana*), Louisiana pigtoe (*Pleurobema riddelli*)*, Texas hornshell (*Popenaias popeii*), Texas heelsplitter (*Potamilus amphichaenus*)*, Salina mucket (*Potamilus salinasensis*)*, Golden orb (*Quadrula aurea*)*, Smooth pimpleback (*Quadrula houstonensis*)*, False spike (*Quadrula mitchelli*)*, Texas pimpleback (*Quadrula petrina*)*, Mexican fawnsfoot (*Truncilla cognata*)*, and Texas fawnsfoot (*Truncilla macrodon*)*. The U.S. Fish and Wildlife Service (USFWS) is currently conducting status reviews for 11 species to determine whether listing under the US Endangered Species Act is warranted.

As sedentary, bottom-dwelling filter feeders that depend on fish hosts for part of their reproductive cycle, mussels are susceptible to numerous environmental impacts, such as sedimentation and pollutants (e.g, Bogan 1993, Mehlhop and Vaughn 1994). Additional threats to mussels include sand and gravel mining, dredging and channelization, impoundments, and water fluctuation. Sedimentation and siltation can negatively affect freshwater mussels by burying individuals, interfering with feeding and respiration, and limiting available habitat (Ellis 1936, Marking and Bills 1979). Construction of roads and bridges may result in such effects in nearby streams. Activities along the bridge and stream banks could result in scouring of the stream substrate, stream bank erosion, and deposition of materials into the stream (e.g., Little and Mayer 1993, Levine et al. 2003). Impoundments, in the form of major dams or low-head dams, can alter water flow, water temperatures, macrophyte development, and act as barriers to mussel and fish movement, all of which may negatively impact mussel occurrence (Watters 1996, Vaughn and Taylor 1999, Burlakova and Karatayev 2007).

Six of the state-listed species in Texas have historic or potential current ranges within central Texas, including Travis County (Howells 2010b, c, d, e, f, g): Texas fatmucket, Golden orb, Smooth pimpleback, False spike, Texas pimpleback, and Texas fawnsfoot (Table 1). Because a large portion of the rivers and creeks in central Texas are crossed by bridges and low-head dams, we focused our survey effort near these structures to determine how the structures may influence mussel distribution and abundance. Given the historic diversity of mussels along the Colorado River, we further focused our surveys to the Colorado River and its tributaries, including 2 Travis County properties each on Onion Creek and the Pedernales River. Findings from this project will improve our knowledge of the status of these populations, and also will serve as a foundation for conducting more intensive surveys in the future.

Table 1. State-listed freshwater mussel species that may occur in rivers and creeks in central Texas.

Species	**Historic**	**Current**
Texas Fatmucket (*Lampsilis bracteata*)	Historical occurrence include the upper Colorado, Guadalupe, and San Antonio systems and their associated tributaries.	Limited number confirmed since 2004. Sites in Tom Green, Kerr, Gillespie, Runnels, and Menard.
Golden Orb (*Quadrula aurea*)	historic range including the Guadalupe-San Antonio River basin and Nueces-Frio River basin	Limited number confirmed since 2004. Sites in Kerr, Gonzalez, Victoria, Live Oak, and San Patrico.
Smooth Pimpleback (*Quadrula houstonensis*)	lower reaches of the Brazos and Colorado rivers and their tributaries	appears to be maintaining small populations in portions of Colorado River drainage, Leon River, and Brazos basin
False Spike (*Quadrula mitchelli*)	Guadalupe-San Antonio and Colorado drainages and some locations in the Brazos River basin	No locations of living populations are currently known
Texas Pimpleback (*Quadrula petrina*)	Colorado and Guadalupe-San Antonio drainage basins	Found alive or recently dead at 2 locations since 2005, Concho and Victoria counties, though may still persist in Menard and Hays
Texas Fawnsfoot (*Truncilla macrodon*)	ranged throughout much of the basins of the Brazos and Colorado rivers	Limited number recent findings. Sites in Young, Austin, Waller, Washington, and Colorado counties

METHODS

We conducted timed searches to determine presence of freshwater mussel species between August and September 2010 within certain areas of the Pedernales River and Onion Creek (Strayer et al. 1997, Vaughn et al. 1997, Strayer and Smith 2003). The surveys involved wading or snorkeling in water and conducting visual and tactile searches for live mussels and mussel valves. For the tactile searches, we felt along the substrate surface and dug with our fingers into the substrate down to about 15 cm (6 in). Stream banks were also visually surveyed. Surveys occurred within 100-m reaches (i.e., survey sites) both upstream and downstream of select bridges near Travis County properties. The number of survey sites per bridge depended on river

access and water depths, with the goal of at least 1 site upstream and 2 sites downstream from the bridge. Survey duration ranged 60–80 person-minutes per site depending on site conditions. Sites were visited one time. We accessed the survey sites by wading or kayaking from either the bridge right-of-way or through access points along the Travis County properties.

We identified live mussels and valves using taxonomic information provided by Howells (1996, 2010a) and TPWD (2009b). Live mussels were placed back into the substrate from which they were taken. We considered valves to be recently dead if they contained tissue remains or if the external colors were not faded. We considered valves to be long dead if they had lost most of their coloration and were worn, aged, and flaking. For the non-native, invasive Asian clams (*Corbicula fluminea*), we noted whether they were absent, rare, common, or abundant within each survey site (i.e., qualitative assessment).

We collected information on habitat characteristics along a transect through the center of the survey site (perpendicular to river flow) and within 50 m upstream and 50 m downstream from the center transect (i.e., the full 100-m survey site). We recorded the UTMs for the center transect using a handheld GPS unit. At the center transect, we recorded the following information: percent instream canopy closure, bank slope, stream width, and stream depth. We used a spherical densiometer at the center of the stream to measure instream canopy closure (i.e., percent of tree closure at stream center). We measured bank slope for both left and right banks using a compass, measuring from the stream center to bankfull height. We measured stream width (i.e., width of surface water at time of survey) with measuring tape and measured water depth at the stream center with an extendable elevation rod. Within the 100-m survey site, we recorded percent of the substrate that was gravel or larger (various classes of gravel range in size from approximately 2 to 60 mm) and general land cover categories along the banks (e.g., percent cover of trees, shrubs, grass).

RESULTS AND CONCLUSIONS

We surveyed for freshwater mussels along a Travis County greenbelt property and Southeast Metro Park (Onion Creek) on 26 August; along Hamilton Pool Preserve (Pedernales River and Hamilton Creek) on 2 September; and along Milton Reimers Ranch Park (Pedernales River) on 3 September. Surveys occurred at a total of 12 sites (Table 2, Figures 1 and 2). Survey duration averaged 67 person-minutes per site. We detected only 1 live individual of a state-listed species, Texas fatmucket (Figure 3), in Onion Creek along the greenbelt (Table 2). We detected no other live freshwater mussels during the surveys, nor did we find shells of other state-listed species. At the Pedernales River sites, we found long-dead shells of Bleufer (*Potamilus purpuratus*), Southern mapleleaf (*Quadrula apiculata*), and Tampico pearlymussel (*Cyrtonaias tampicoensis*), along with several shell fragments of unidentified species (Table 2). In addition, we opportunistically looked for mussels while moving between survey sites and found a Bleufer shell (long dead), a Threeridge shell (*Amblema plicata*, long dead) a young Giant floater (*Pyganodon grandis*, recently dead), a young Tampico pearlymussel (recently dead), and unidentifiable, long dead shell fragments. At the Onion Creek sites, we found long dead shells of Threeridge, Tampico pearlymussel, and Yellow sandshell (*Lampsilis teres*), along with unidentifiable, long-dead shell fragments (Table 2). While opportunistically looking for mussel between survey sites at Onion Creek, we found 2 Texas fatmuckets (recently dead) and a

Pistolgrip shell (*Quadrula verrucosa*, long dead). Asian clams were common or abundant at most sites (Table 3).

Survey sites along the Pedernales River, including Hamilton Creek, contained 0–76% instream canopy closure, 5–32° bank slopes, surface water width of 3–38 m, mostly shallow stream centers of ≤ 1m water depth, with most sites comprised of gravel as the dominant stream substrate (Table 3). Survey sites along Onion Creek contained 5–76% instream canopy closure, 4–32° bank slopes, surface water width of 8–16 m, stream center depths of 0.4–1.2 m, and gravel as the dominant stream substrate (Table 3). Because we found so few live mussels at the study sites, we did not gather more detailed habitat data nor conduct an analysis of mussel locations relative to habitat characteristics.

Most freshwater mussels occupy shallow habitats (1–5 m; Cummings and Graf 2010), but may also be found to depths of > 10 m (e.g., Howells et al. 1996). Because of our inability to survey deeper waters (i.e., >1 m), we cannot conclude that Texas state-listed mussel species are absent from the areas surveyed. While the likelihood of finding state-listed species may be low given their limited distribution and abundance (Howells 2010b, c, d, e, f, g), additional surveys in deeper waters are necessary to determine their absence in these areas.

Table 2. Survey site center point, distance from bridge, and mussel species detected during surveys conducted on Travis County properties, August–September 2010.

	Survey site					
	Center point		Location from bridge:			
Bridge	Northing	Easting	Distance (m)	Location	Mussels detected	Survey notes
Hamilton Pool Rd & Pedernales River	3356829	582756	10-110[a]	Downstream	None	
	3357192	582854	380-480[a]	Downstream	Shell fragments, long dead, unknown species	
	3357683	583004	930-1030[a]	Downstream	None	Site on Hamilton Creek, approx. 100 m upstream from confluence with Pedernales River.
	3357838	582917	1050-1150[a]	Downstream	None	
	3359595	583779	3300-3400[b]	Downstream	None	Some sections within the 100-m reach too deep to survey.
	3359762	583531	3600-3700[b]	Downstream	1 Bleufer (long dead); several long dead shell fragments, unknown species	Some sections within the 100-m reach too deep to survey.
	3360576	583865	4590-4690[b]	Downstream	1 Southern mapleleaf (long dead); several long dead shell fragments, unknown species	
	3360959	584602	5430-5530[b]	Downstream	2 Tampico pearlymussels (long dead)	Some sections within the 100-m reach too deep to survey.
State Hwy 71 & Onion Creek	3340578	631977	1200-1300	Upstream	Shell fragments, long dead, unknown species	
	3340425	632522	550-650	Upstream	1 Threeridge (long dead)	Some sections within the 100-m reach too deep to survey.
	3340566	632847	80-180	Upstream	1 live Texas fatmucket; 2 Tampico pearlymussel (long dead), 1 Yellow sandshell (long dead)	Some sections within the 100-m reach too deep to survey.
	3341691	633906	4450-4550	Downstream	1 shell fragment, long dead, unknown species	

[a] Hamilton Pool Preserve

[b] Milton Reimers Ranch Park

Table 3. Habitat characteristics within survey sites on Travis County properties. Percent instream cover, bank slope, and stream width and depth were measured along the center transect while percent gravel, bank cover, and amount of Asian clams were measured within the 100-m survey site.

Bridge	Location from bridge	% instream cover	Bank slope (°)		Stream width (m)	Depth (m) at center	% gravel or larger	Bank cover (%)		Asian clams
			Left	Right				Left bank	Right bank	
Hamilton Pool Rd & Pedernales River	10-110 downstream	24	14	5	16.5	0.2	85	70% Trees, 10% Shrubs, 20% Rock	20% Trees, 50% Shrubs, 30% Grass	common
	380-480 downstream	0	12	18	33.0	0.1	75	40% Trees, 20% Shrubs, 40% Grass	30% Trees, 70% Grass	common
	930-1030 downstream	98	28	32	3.0	0.2	95	85% Trees, 15% Grass	85% Trees, 15% Grass	common
	1050-1150 downstream	0	14	16	38.0	0.5	75	35% Trees, 30% Shrubs, 35% Grass	40% Trees, 20% Shrubs, 40% Grass	rare
	3300-3400 downstream	0	12	16	36.0[a]	0.9	70	85% Trees, 15% Grass	20% Trees, 20% Shrubs, 60% Grass	rare
	3600-3700 downstream	0	16	9	19.2	0.3	90	5% Trees, 70% Grass, 25% Rock	30% Grass, 70% Rock	common
	4590-4690 downstream	0	16	19	21.9	0.6	35	40% Trees, 20% Shrubs, 40% Grass	50% Trees, 20% Shrubs, 30% Grass	common
	5430-5530 downstream	0	20	13	21.6[b]	0.2	50	20% Trees, 80% Grass	30% Trees, 70% Grass	common
State Hwy 71 & Onion Creek	1200-1300 upstream	76	32	14	10.3	0.4	95	30% Trees, 30% Shrubs, 40% Grass	35% Trees, 30% Shrubs, 35% Grass	abundant
	550-650 upstream	76	18	18	16.4	1.2	70	50% Trees, 30% Shrubs, 20% Grass	80% Trees, 10% Shrubs, 10% Grass	common
	80-180 upstream	35	4	25	8.1	1.0	75	50% Trees, 40% Shrubs, 10% Grass	30% Trees, 20% Shrubs, 50% Grass	common
	4450-4550 downstream	5	14	10	15.0	0.5	5	75% Trees, 20% Shrubs, 5% Grass	60% Trees, 40% Shrubs	rare

[a] Bank-to-bank width was approximately 70 m.

[b] Bank-to-bank width was approximately 50 m.

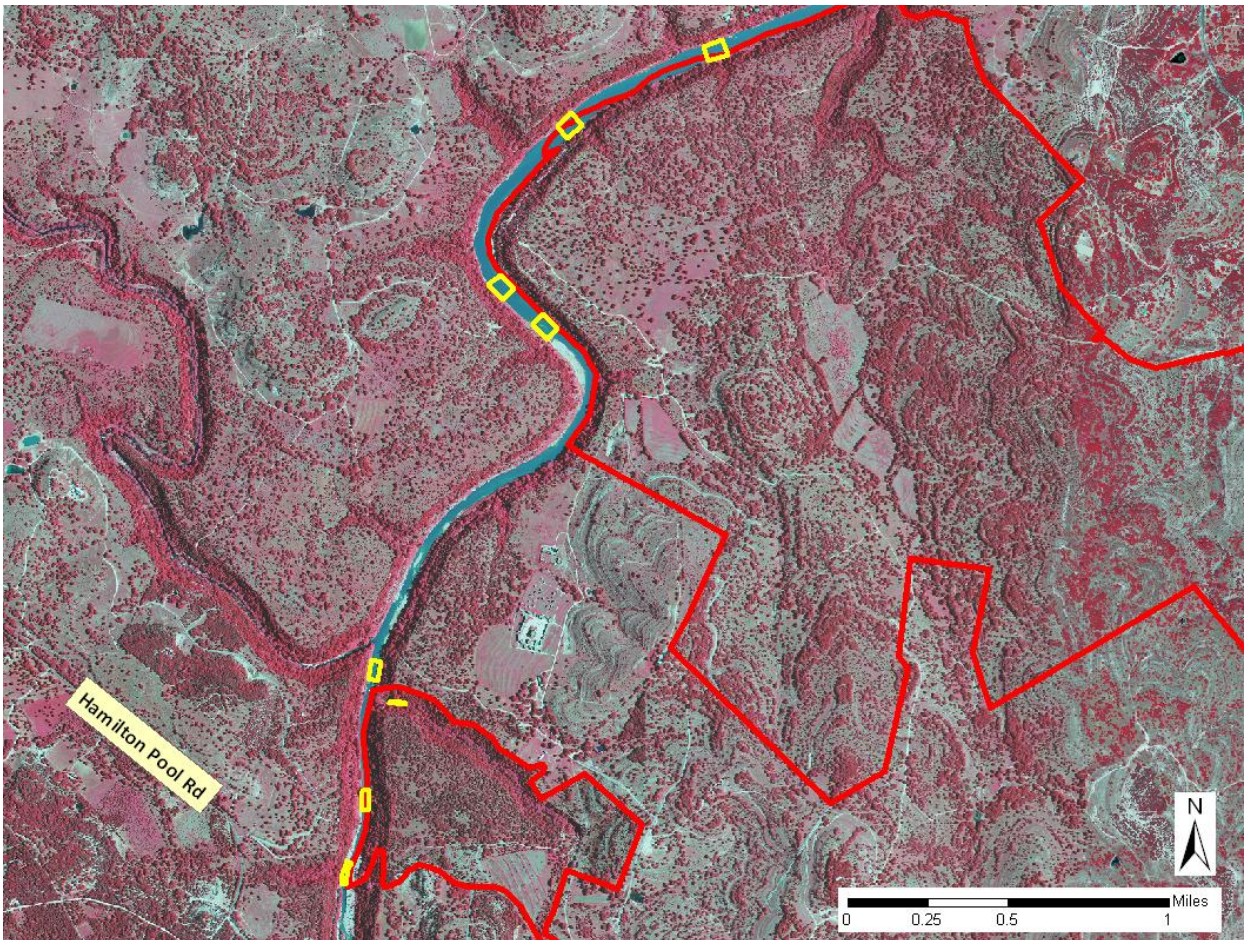


Figure 1. Survey sites (yellow polygons) near Hamilton Pool Preserve and Milton Reimers Ranch Park (red polygons) along the Pedernales River.

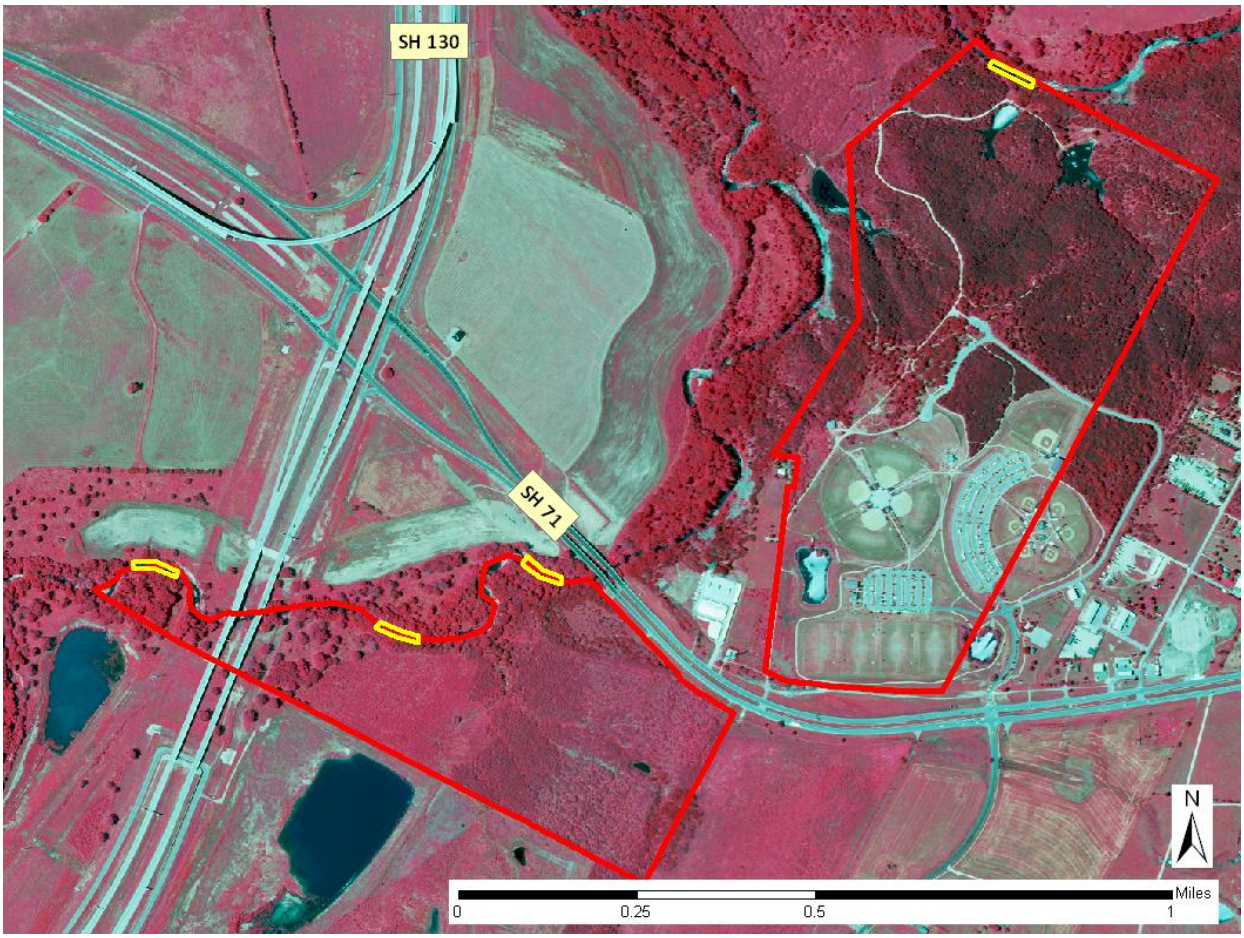


Figure 2. Survey sites (yellow polygons) near Travis County greenbelt property and Southeast Metro Park (red polygons) along Onion Creek.



Figure 3. A live Texas fatmucket (*Lampsilis bracteata*) found near the State Highway 71 bridge over Onion Creek, August 2010.

Literature cited

Bogan, A. E. 1993. Freshwater bivalve extinctions (Mollusca: Unionida): a search for causes. American Zoologist 33: 599–609.

Bogan, A. E. 2008. Global diversity of freshwater mussels (Mollusca, Bivalvia) in freshwater. Hydrobiologia 595: 139–147.

Burlakova, L. E., and A. Y. Karatayev. 2007. The effect of invasive macrophytes and water level fluctuations on unionids in Texas impoundments. Hydrobiologia 586: 291–302.

Cummings, K. S., and D. L. Graf. 2010. Mollusca: Bivalvia. Pages 309–384 *in* J. H. Thorp and A. P. Covich, editors. Ecology and classification of North American freshwater invertebrates. Third edition. Academic Press, Inc., London, United Kingdom.

Ellis, M. M. 1936. Erosion silt as a factor in aquatic environments. Ecology 17: 29–42.

Howells, R. G., R. W. Neck, and H. D. Murray. 1996. Freshwater mussels of Texas. Texas Parks and Wildlife Department Press, Austin, Texas, USA.

Howells, R. G. 2010a. Guide to Texas freshwater mussels. Biostudies, Kerrville, Texas, USA.

Howells, R. G. 2010b. Texas fatmucket, *Lampsilis bracteata* (Gould 1855). Summary of selected biological and ecological data for Texas. Biostudies, Kerrville, Texas, USA.

Howells, R. G. 2010c. Golden orb (*Quadrula aurea*): summary of selected biological and ecological data for Texas. Biostudies, Kerrville, Texas, USA.

Howells, R. G. 2010d. Smooth pimpleback (*Quadrula houstonensis*): summary of selected biological and ecological data for Texas. Biostudies, Kerrville, Texas, USA.

Howells, R. G. 2010e. False spike (*Quadrula mitchelli*): summary of selected biological and ecological data for Texas. Biostudies, Kerrville, Texas, USA.

Howells, R. G. 2010f. Texas pimpleback (*Quadrula petrina*): summary of selected biological and ecological data for Texas. Biostudies, Kerrville, Texas, USA.

Howells, R. G. 2010g. Texas fawnsfoot (*Truncilla macrodon*): summary of selected biological and ecological data for Texas. Biostudies, Kerrville, Texas, USA.

Levine, J. F., A. E. Bogan, K. H. Pollock, H. A. Devine, L. L. Gustafson, C. B. Eads, P. P. Russell, and E. F. Anderson. 2003. Distribution of freshwater mussel populations in relationship to crossing structures. Final report. North Carolina State University, Raleigh, North Carolina, USA.

Little, J. D., and J. J. Mayer. 1993. Bridge and road construction. Pages 221–226 in C. F. Bryan and D. A. Rutherford, editors. Impacts on warmwater streams: guidelines for evaluation. Southern Division, American Fisheries Society, Little Rock, Arkansas, USA.

Lydeard, C., R. H. Cowie, W. F. Ponder, A. E. Bogan, P. Bouchet, S. A. Clark, K. S. Cummings, T. J. Frest, O. Gargominy, D. G. Herbert, R. Hershler, K. E. Perez, B. Roth, M. Seddon, E. E. Strong, and F. G. Thompson. 2004. The global decline of nonmarine mollusks. BioScience 54:321–330.

Marking, L. L., and T. D. Bills. 1979. Acute effects of silt and sand sedimentation on freshwater mussels. Pages 204–211 *in* J. L. Rasmussen, editor. Proceedings of the Upper Mississippi River Conservation Committee symposium on upper Mississippi River bivalve mollusks. UMRCC, Rock Island, Illinois, USA.

Mehlhop, P., and C. C. Vaughn. 1994. Threats to and sustainability of ecosystems for freshwater mollusks. Pages 68–77 *in* W. Covinton and L. F. Dehand, editors. Sustainable ecological systems: implementing an ecological approach to land management. General technical report RM-247. U.S. Forest Service, Rocky Mountain Range and Forest Experimental Station, Fort Collins, Colorado, USA.

Neves, R. 2004. Propagation of endangered freshwater mussels in North America. Journal of Conchology, Special Publication 3: 69–80.

Strayer, D. L., and D. R. Smith. 2003. A guide to sampling freshwater mussel populations. American Fisheries Society Monograph 8, Bethesda, Maryland, USA.

Strayer, D. L., S. Claypool, and S. J. Sprague. 1997. Assessing unionid populations with quadrats and timed searches. Pages 163–169 *in* K. S. Cummings, A. C. Buchanan, C. A. Mayer, and T. J. Naimo, editors. Conservation and management of freshwater mussels II: initiatives for the future. Proceedings of an Upper Mississippi River Conservation Committee (UMRCC) symposium, 16-18 October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois, USA.

Strayer, D. L., J. A. Downing, W. R. Haag, T. L. King, J. B. Layzer, T. J. Newton, S. J. Nichols. 2004. Changing perspectives on pearly mussels, North America's most imperiled animals. BioScience 54:429–439.

Texas Parks and Wildlife Department [TPWD]. 2009a. 15 Texas Freshwater Mussels Placed on State Threatened List. <http://www.tpwd.state.tx.us/newsmedia/releases/?req=20091105c>. Accessed 5 October 2010.

Texas Parks and Wildlife Department [TPWD]. 2009b. Texas Mussel Watch: Unionids of Texas. Texas Parks and Wildlife Department, Austin, Texas.

Vaughn, C. C., and C. M. Taylor. 1999. Impoundments and the decline of freshwater mussels: a case study of an extinction gradient. Conservation Biology 13: 912–920.

Vaughn, C. C., C. M. Taylor, and K. J. Eberhard. 1997. A comparison of the effectiveness of timed searches vs. quadrat sampling in mussel surveys. Pages 157–162 *in* K. S. Cummings, A. C. Buchanan, C. A. Mayer, and T. J. Naimo, editors. Conservation and management of freshwater mussels II: initiatives for the future. Proceedings of an Upper Mississippi River Conservation Committee (UMRCC) symposium, 16-18 October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois, USA.

Watters,G. T. 1996. Small dams as barriers to freshwater mussels (Bivalvia, Unionoida) and their hosts. Biological Conservation 75: 79–85.

Williams, J. D., M. L. Warren, Jr., K. S. Cummings, J. L. Harris, and R. J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. Fisheries 18:6–22.