

**DISTRIBUTIONAL SURVEYS OF
FRESHWATER BIVALVES IN TEXAS:
PROGRESS REPORT FOR 1999**

by
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ABSTRACT

During 1999, over 3,000 unionid specimens were documented from 136 locations (152 sample sites) statewide in Texas where specimens were either directly surveyed by the Heart of the Hills Research Station (HOH) staff or were sent to HOH by volunteers. Living specimens to relatively-recently-dead shells were found in 60% of the collections, 8% yielded only long-dead or subfossil shells, and 31% produced no unionids or their remains.

In conjunction with previous 1992-1998 field-survey work, unionids appear completely or almost extirpated from the Pedernales, Blanco, San Marcos, Llano, Medina, upper Guadalupe, upper Sulphur, areas of the San Jacinto, and much of the San Saba rivers. Sections of other river systems and many tributaries have also experienced major unionid population losses in recent years. However, relict individuals and small populations were found in the San Marcos River near Luling, the upper Guadalupe River near Hunt, and in Spring Creek off the West Branch San Jacinto River in 1999. A drought which began in 1995 and continued through 1999 caused water-level declines statewide with subsequent negative impacts on freshwater mussel populations. Although drought conditions were briefly interrupted in some areas by heavy rains and damaging floods in 1996, 1997, and 1998, even these were lacking in 1999. Many water bodies experienced dramatic increases in water levels in 1997 and 1998 after being severely dewatered in late 1995 and most of 1996, but in 1999, levels fell even more dramatically. Some major rivers ceased flowing in summer and fall 1999. Although no sampling efforts were mounted to document impact on rare endemic unionids, species like golden orb, Texas pimpleback, Texas fatmucket, and Texas fawnsfoot were almost certainly reduced in numbers, especially at sites that dried completely.

An exception to general drought conditions, however, occurred in the Rio Grande drainage in 1999. Extensive rainfall in New Mexico prompted large water releases that, in turn, resulted in high- and fast-water conditions from El Paso to Del Rio and precluded some sampling. Similarly, heavy rainfall in the lower Rio Grande Valley in May, June, and July also elevated water levels and confounded some sampling efforts in that area.

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INTRODUCTION

Beginning in January 1992, Texas Parks and Wildlife Department's (TPWD) Heart of the Hills Research Station (HOH) began surveys of freshwater mussel populations within the state to better understand this resource and manage the fishery for them. A questionnaire survey of mussel license holders in 1992 was reported by Howells (1993). Field surveys of unionid populations also began in 1992 and have continued through the present. These have been reported on an annual basis (Howells 1994, 1995, 1996a, 1996b, 1997a, 1997b, 1998, 1999). These data were ultimately used to compile *Freshwater Mussels of Texas* (Howells *et al.* 1996). Discussed here are findings from continuing surveys conducted in 1999, with comments relating to prior findings.

MATERIALS AND METHODS

Various habitats were sampled at each collection site. Collection methods and sampling effort varied between sites depending upon personnel, equipment, and time available as well as field conditions at the time of sampling. Minimal sampling efforts involved visual examination of shoreline and shallow-water habitats with hand collection. Where possible, sites were sampled by wading and snorkeling with hand collection. On several occasions, SCUBA or hookah-pump diving was used to sample deeper waters. Previous annual reports discuss details of these methods (Howells 1994, 1995, 1996a, 1996b).

Results are presented in numbers collected (retained or released) and percent composition of the collection. Caution should be used in considering percentages calculated from small sample sizes, where mussel abundance and species composition may have been altered (e.g., after harvest by musselers), or where collection efforts focused on obtaining selected species (e.g., for laboratory work or reference specimens). Where a species at a given locality was represented only by fragments or numbers were not documented, it may have been excluded from percent-composition calculations.

Mussels taken were identified to species whenever possible. Some subfossil or badly weathered specimens could not be identified to species. Ill-defined taxonomic status of some "species" also sometimes precluded assigning specific identifications at this time. Other non-unionid bivalves were also documented when encountered. Where "no bivalves" including Asian clams (*Corbicula*) were found, this was indicated, but where unionids were absent and Asian clams were not documented as either present or absent at a particular site, it was reported as "no unionids present." Common and scientific names used generally follow Turgeon *et al.* (1988), Williams *et al.* (1993), and Howells *et al.* (1996), and are presented in Howells (1995, 1996a, 1996b) and Appendix I.

Varying environmental conditions can confound attempts to define how long a given specimen has been dead; however, a number of terms have been used herein to convey an approximation of this. While inherently imprecise, these attempts to characterize time since death are useful in distinguishing between shells that have been dead for many years or decades from others which clearly died only days or weeks before collection. Terminology relating to condition of dead shells and shell counting methods are summarized in Howells (1996a, 1996b) and Appendix I.

RESULTS AND DISCUSSION

Red River Drainage

Lake Texoma, Briar Creek boat ramp (N 33°55.455', W 96°51.870'), Marshall County, Oklahoma, 14 January 1999.

A random, 10-minute shoreline search by a volunteer produced the following specimens:

Lake Texoma, Briar Creek boat ramp				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
White heelsplitter	0	2.0	recently dead	2.6
Pink papershell	0	2.0+0.5x4	recently to long dead	7.7
Mapleleaf spp.	2	67.0+0.5x1	recently dead	89.7

Lake Texoma, Hagerman National Wildlife Refuge (N 33° 45.46', W 96° 47.280"), Grayson County, Texas, 4 January 1999.

A random, 20-minute shoreline search by a volunteer produced:

Lake Texoma, Hagerman National Wildlife Refuge				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Flat floater	0	3.0+0.5x1	recently dead	33.3
Pink papershell	0	4.0	relatively-recently to recently dead	33.3
Pondhorn	0	2.0+0.5x2	relatively-recently dead	33.3

Lake Texoma, Hagerman National Wildlife Refuge (N 33° 43.38', W 96° 46.74"), Grayson County, Texas, 4 January 1999.

A random, 93-minute shoreline search by a volunteer produced:

Lake Texoma, Hagerman National Wildlife Refuge				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Flat floater	0	198.0+0.5x1	recently dead	97.1
Pink papershell	0	1.0+0.5x1	relatively-recently dead	1.0
Giant floater	0	3.0	recently dead	1.5
Mapleleaf spp.	0	1.0	recently dead	0.5
Asian clam - present				

Lake Texoma, Little Mineral Arm, Grayson County, Texas, January 1999.

Specimens found on exposed bottoms during a low-water period included:

Lake Texoma, Little Mineral Arm				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
White heelsplitter	0	10+0.5x1	recently dead	14.5
Fragile papershell	0	22.0	very-recently to very-long dead	28.9
Threehorn wartyback	0	5.0+0.5x3	recently dead	10.5
Pink papershell	0	13.0	very-recently to very-long dead	17.1
Bleufer	0	1.0	recently dead	1.3
Giant floater	0	5.0+0.5x1	recently to very-long dead	7.9
Mapleleaf spp.	0	14.0	very-recently to recently dead	18.4
Lilliput	0	1.0	recently dead	1.3
Asian clam – present				

Fred Cook Farm Pond, near F.M. 1753 and Cook Lane east of Denison, Grayson County, Texas, 16 February 1999.

The landowner of this 0.75-hectare spring pond reported to local fishery biologists that mussels had been present in this impoundment for over 20 years. Specimens examined were giant floaters which ranged in size from 70 to 152 mm shell length.

Red River, downstream of Denison Dam at Lake Texoma on the south side of the river (N 33° 49.140', W 96° 33.500'), Grayson County, Texas, 4 January 1999.

A random, 25-minute shoreline search by a volunteer produced:

Red River, downstream of Denison Dam				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Flat floater	0	1.0	relatively-recently dead	10.0
Wabash pigtoe	0	1.0	recently dead	10.0
Yellow sandshell	0	1.0	recently dead	10.0
White heelsplitter	0	1.0	recently dead	10.0
Fragile papershell	0	1.0	recently dead	10.0
Threehorn wartyback	0	2.0	recently dead	20.0
Pink papershell	0	1.0	recently dead	10.0
Bleufer	0	0.5x1	recently dead	10.0
Giant floater	0	0.5x1	relatively-recently dead	10.0
Asian clam – present				

This collection demonstrates that, despite small numbers of specimens found, a number of unionid species appear to be surviving in the Red River downstream of Denison Dam. The

collection of a Wabash pigtoe (or any *Fusconaia*) from the main channel of Red River drainage of Texas is known from Oklahoma tributaries of the Red River, but rarely, if ever, from those in Texas.

Confluence of the Kiamichi River and Red River, Choctaw County, Oklahoma (opposite Red River County, Texas), 28 October 1998.

Random shoreline collections made by U.S. Fish and Wildlife Service personnel produced:

Confluence of the Kiamichi River and Red River				
Species	N alive	N shells	Condition	Percentage
Pocketbook spp. (<i>Lampsilis</i>)	0	0.5x1	subfossil	10.0
Yellow sandshell	0	0.5x1	subfossil	10.0
Pink papershell	0	1.0+0.5x7	relatively-recently to long dead	80.0

The high and inflated beaks of this pocketbook specimen suggest it may be sandbank pocketbook.

Sabine River Drainage

Lake Fork, Recreational Vehicle Park Island, Wood County, Texas, 10 October 1999.

A volunteer reported the following species in a random-shoreline search:

Lake Fork				
Species	N alive	N shells	Condition	Percentage
Pond mussel	0	23.0	recently to long dead	37.1
Giant floater	0	32.0	recently to long dead	51.6
Lilliput	0	7.0	recently dead	11.3
Asian clam (present)				

Neches River Drainage

B.A. Steinhagen Reservoir (Neches River drainage), Sandy Creek Park off F.M. 777, Jasper County, Texas, 20 January 1999.

A 15-minute timed search of exposed bottoms and shallow areas produced:

B.A. Steinhagen Reservoir, Sandy Creek Park, 15-minute timed search

Species	N alive	N shells	Condition	Percentage
Threeridge	1	0.0	-	1.3
Rock-pocketbook	0	0.5x1	relatively-long dead	1.3
Louisiana fatmucket	2	2.0	relatively-long dead	5.1
Yellow sandshell	10	20.0+0.5x4	very-recently to very-long dead	43.6
Fragile papershell	3	0.0	-	3.8
Pond mussel	1	0.0	-	1.3
Threehorn wartyback	3	0.0	-	3.8
Bankclimber	2	4.0+0.5x1	relatively-long dead	9.0
Texas heelsplitter	0	1.0	recently dead	1.3
Bleufer	5	2.0	relatively-long dead	9.0
Giant floater	2	0.0	-	2.6
Southern mapleleaf	6	0.0	-	7.7
Western pimpleback	5	1.0+0.5x1	relatively-recently dead	9.0
Paper pondshell	1	0.0	-	1.3
Asian clam – present (few)				

Random-area search produced:

B.A. Steinhagen Reservoir, Sandy Creek Park, additional random-area search

Species	N alive	N shells	Condition	Percentage
Threeridge	2	0.0	-	4.1
Rock-pocketbook	1	0.0	-	2.0
Louisiana fatmucket	2	0.0	-	4.1
Yellow sandshell	1	1.0	recently dead	4.1
Threehorn wartyback	1	2.0	relatively-recently dead	6.1
Bankclimber	3	0.0	-	6.1
Texas heelsplitter	5	5.0	very-recently to recently dead	20.4
Bleufer	5	0.0	-	10.2
Giant floater	2	0.0	-	4.1
Southern mapleleaf	3	0.0	-	6.1
Western pimpleback	15	1.0	recently dead	32.7
Asian clam – present (few)				

B. A. Steinhagen Reservoir (Neches River drainage), boat ramp area on the southwest corner of U.S. 190, Tyler County, Texas, 20 January 1999.

Examination of exposed bottoms produced the following specimens:

B.A. Steinhagen Reservoir, boat ramp southwest of U.S. 190				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Louisiana fatmucket	0	1.0	relatively-long dead	25.0
Yellow sandshell	0	1.0	long dead	25.0
Giant floater	0	2.0	relatively-recently dead	50.0

B. A. Steinhagen Reservoir (Neches River drainage), boat ramp area on the northwest corner of U.S. 190, Tyler County, Texas, 20 January 1999.

Examination of exposed bottoms produced the following specimens:

B.A. Steinhagen Reservoir, boat ramp northwest of U.S. 190				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Louisiana fatmucket	0	1.0	relatively-recently dead	16.7
Bankclimber	0	3.0	relatively-recently dead	50.0
Giant floater	0	2.0	relatively-recently dead	33.3

B.A. Steinhagen Reservoir (Neches River drainage), Martin Dies State Park swimming area, Jasper County, Texas, 20 January 1999.

A random-area search of exposed bottoms and shallow waters produced:

B.A. Steinhagen Reservoir, Martin Dies State Park swimming area, random-area search				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Threeridge	0	1.0	recently dead	0.7
Rock-pocketbook	2	0.0	-	1.4
Louisiana fatmucket	4	2.0	relatively-recently dead	4.1
Yellow sandshell	10	15.0	very-recently to very-long dead	17.1
Fragile papershell	8	3.0	relatively-recently dead	7.5
Threehorn wartyback	12	4.0	relatively-recently dead	11.0
Bankclimber	6	4.0	relatively-recently dead	6.8
Bleufer	10	8.0	very-recently to very-long dead	12.3
Giant floater	5	5.0	very-recently to very-long dead	6.8
Southern mapleleaf	5	0.0	-	3.4
Western pimpleback	15	8.0	relatively-recently to relatively-long dead	15.8
Gulf mapleleaf	18	0.0	-	

Paper pondshell	0	1.0	recently dead	0.7
Asian clam – present				

B.A. Steinhagen Reservoir (Neches River drainage), west side of Town Bluff Dam, Tyler County, Texas 21 January 1999.

A 5-minute timed search on exposed bottoms and shallow waters produced:

B.A. Steinhagen Reservoir, west side of Town Bluff Dam				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Threeridge	3	1.0	recently dead	4.9
Louisiana fatmucket	4	0.0	-	4.9
Yellow sandshell	5	2.0	recently dead	8.5
Fragile papershell	3	0.0	-	3.7
Washboard	2	0.0	-	2.4
Threehorn wartyback	10	1.0	relatively-recently dead	13.4
Bankclimber	32	0.0	-	39.0
Bleufer	6	0.0	-	7.3
Western pimpleback	11	1.0	recently dead	14.6
Deertoe	1	0.0	-	1.2
Asian clam – present				

An additional random-area search produced:

B.A. Steinhagen Reservoir, west side of Town Bluff Dam, random-area search				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Threeridge	2	0.0	-	4.7
Rock-pocketbook	2	0.0	-	4.7
Louisiana fatmucket	5	0.0	-	11.6
Sandbank pocketbook	0	1.0	relatively-long dead	2.3
Fragile papershell	0	1.0	very-recently dead	2.3
Washboard	6	0.0	-	14.0
Threehorn wartyback	1	1.0	very-recently dead	4.7
Southern mapleleaf	3	0.0	-	7.0
Western pimpleback	12	3.0	recently dead	34.9
Gulf mapleleaf	1	3.0	recently dead	9.3
Pistolgrip	1	0.0	-	2.3
Deertoe	1	0.0	-	2.3
Asian clam – present				

B.A. Steinhagen Reservoir (Neches River drainage), Campers Cover area on the southwest side of the reservoir, Tyler County, Texas, 21 January 1999.

A 10-minute timed search produced:

B.A. Steinhagen Reservoir, Campers Cove, 10-minute timed search				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Threeridge	0	33.0	recently dead	24.4
Louisiana fatmucket	0	8.0	recently dead	5.9
Yellow sandshell	0	36.0	recently dead	26.7
Fragile papershell	0	10.0	recently dead	7.4
Threehorn wartyback	0	2.0	recently dead	1.5
Bankclimber	0	13.0	recently dead	9.6
Bleufer	0	5.0	recently dead	3.7
Giant floater	0	25.0	recently dead	18.5
Western pimpleback	0	3.0	recently dead	2.2
Asian clam – present				

Several additional specimens retained during a random-area search included:

B.A. Steinhagen Reservoir, Campers Cove, random-area search				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Threeridge	6	1.0	recently dead	36.8
Louisiana fatmucket	7	2.0	very-recently to recently dead	47.4
Bankclimber	2	0.0	-	10.5
Western pimpleback	1	0.0	-	5.3

Trinity River Drainage

Lake Lewisville, Arrowhead Park, Denton County, Texas, 31 August and 1, 7, and 22 September 1999.

A volunteer examined this area several times in late summer and reported finding an unidentified pimpleback species alive as well as living specimens of apparent pink papershell and Texas heelsplitter.

Lake Lewisville, Queen's Point, Westlake Park, Hickory Creek area, Denton County, Texas, 30 August 1999.

A volunteer examined exposed bottoms and shallow waters as water levels declined and reported the following specimens in about 400-m search:

Lake Lewisville, Queen's Point				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Threeridge	12	>30.0	-	12.2+
Louisiana fatmucket	>30	>30.0	-	17.4+
Yellow sandshell	2	4.0	-	1.7
Fragile papershell	16	25.0	-	11.9
Giant floater	>30	>30.0	-	17.4+
Texas heelsplitter (?)	1	8.0	-	2.6
Pink papershell	6	2.0	-	2.3
Bleufer	6	2.0	-	2.3
Southern mapleleaf	>30	>30	-	17.4+
Pimpleback sp(p).	2	7.0	-	2.6
Lilliput	>40	2.0	-	12.2
Asian clam – present				

See comments below.

Lake Lewisville, Westlake Park, north of Lake Dallas dam, Hickory Creek area, Denton County, Texas, 7 September 1999.

A volunteer examined 250-300 m of shoreline as water levels declined and documented the following specimens:

Lake Lewisville, north of Lake Dallas dam				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Threeridge	18	0.0	-	8.9
Rock-pocketbook	0	2.0	recently dead	1.0
Louisiana fatmucket	22	0.0	-	10.9
Yellow sandshell	16	0.0	-	7.9
Fragile papershell	21	0.0	-	10.4
Giant floater	>30	0.0	-	14.9+
Pink papershell	12	0.0	-	5.9
Bleufer	12	0.0	-	5.9
Southern mapleleaf	28	0.0	-	13.9
Pimpleback sp(p).	11	0.0	-	5.4
Lilliput	>30	0.0	-	14.9+
Asian clam – present				

See comments below.

Lake Lewisville, three locations (south corner of old Lake Dallas dam, inlet northwest of Lake Dallas Dam, and the north side of the Hickory Creek Arm of Lake Lewisville south of Lake Dallas

City – combined), Denton County, Texas, 30 October 1999.

A volunteer and TPWD staff member examined exposed shorelines and shallow waters during a low-water period and found the following species:

Lake Lewisville, three sites combined				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Threeridge	X	X	-	-
Yellow sandshell	X	X	-	-
Louisiana fatmucket	X	X	-	-
Fragile papershell	X	X	-	-
Bleufer	X	X	-	-
Pink papershell	X	X	-	-
Texas heelsplitter	?	?	-	-
Giant floater	X	X	-	-
Southern mapleleaf	X	X	-	-
Pimpleback sp(p).	X	X	-	-
Lilliput	X	-	-	-
Deertoe	-	X	-	-
Paper pondshell	-	X	-	-
Asian clam (present – moderate numbers)				

Lake Lewisville, south side of the old Lake Dallas dam, Denton County, Texas, 11 November 1999.

A volunteer visited this site and reported finding the species above as well as two living rock-pocketbooks, two of the elongate morphs of deertoe, and an abundance of pimplebacks. Collection efforts focused on obtaining specimens of pink papershell/Texas heelsplitter, pimplebacks, and lilliputs relative to taxonomic problems with these groups. Deertoe was represented by a single shell and paper pondshell by a single valve, both of which were relatively-long dead. Otherwise, other taxa were common to relatively abundant. Rock-pocketbook (very-recently dead) has also been reported in an earlier collection by a volunteer in this reservoir. Previously, Neck (1990) reported sandbank pocketbook and pistolgrip here as well.

A number of taxonomic problems remain to be resolved regarding unionids in the upper Trinity River drainage. Initially, Neck (1990) reported Texas heelsplitter in Lake Lewisville, but not pink papershell. Indeed, pink papershell appears not to have been documented in the upper Trinity River drainage until Flook and Ubelaker (1972) found it in this same reservoir and TPWD found it in nearby Eagle Mountain Reservoir (Howells *et al.* 1996). The current population(s) in Lake Lewisville are problematic. Some externally appear to be Texas heelsplitter, with straight hinge lines, but others are more oval and winged like pink papershell. Virtually all but the smallest juveniles have completely pink (purple) nacre like pink papershell, but unlike Texas heelsplitter. Although Neck and Howells (1994) were unable to separate these species with electrophoretic methods, Roe and Lydeard (1998) successfully used DNA analysis to confirm both as valid species. None the less, no specimens from the Lewisville population have been genetically examined. It is possible early reports of Texas heelsplitter in this area

were misidentified, straight-hinged pink papershells or that initial reports were correct with pink papershell later invading and either replacing or intergrading with Texas heelsplitter. Only appropriate genetic analysis will resolve the status of the current population(s).

Pimplebacks in this reservoir are taxonomically confusing. Although Neck (1990) considered them western pimpleback *Quadrula mortoni*, they have also been considered "common" pimpleback *Q. pustulosa* and smooth pimpleback *Q. houstonensis*. Certainly some specimens from Lake Lewisville and elsewhere in the Dallas-Fort Worth area could morphologically be grouped with any of these three species. Indeed, except for some *pustulosa*-type specimens from Red River tributaries in Lamar County, Texas, (Howells *et al.* 1996), some Lewisville pimplebacks look as much like classic *Q. pustulosa* as any in Texas. Preliminary genetic analysis by TPWD (unpublished data) found at least two unique alleles among nearby Eagle Mountain Reservoir pimplebacks that differed from other pimplebacks found in the state. Lewisville pimplebacks have not been genetically studied to date and their exact identification remains uncertain.

Neck (1990) reported a single, long-dead sandbank pocketbook he found here and suggested an earlier report of plain pocketbook (*Lampsilis cardium*) in the Dallas area (Reed 1954) was probably sandbank pocketbook as well. However, the Louisiana fatmucket specimens in Lake Lewisville, and elsewhere in the area, are often atypically large (> 120 mm shell length) and heavy. Additionally, although some females are more elongate, others are quite short and inflated. Shells of large, inflated fatmuckets could easily be mistaken for pocketbooks, especially if long-dead and bleached or eroded. It may be questionable if sandbank pocketbook does occur in the upper Trinity River drainage and almost a certainty plain pocketbook has never been part of the unionid fauna locally.

Pond between Kingswood, Royal, and Bluebonnet roads, Colleyville, Tarrant County, Texas, 6 December 1999.

A volunteer reported finding the following specimens in a 1-m² quadrat:

Pond, Colleyville Species	N alive	N shells	Condition	Percentage
Paper pondshell	30	1.0	unstated	100.0

Bardwell Reservoir (Trinity River drainage), Ellis County, Texas, two dates.
Volunteers reported the following specimens at this impoundment on 6 June 1999:

Bardwell Reservoir, 6 June 1999 Species	N alive	N shells	Condition	Percentage
Giant floater	0	1.0+0.5x1	unstated	100.0

24 August 1999:

Bardwell Reservoir, 24 August 1999				
Species	N alive	N shells	Condition	Percentage
Southern mapleleaf	0	3.0+0.5x2	recently dead	100.0

The same volunteer reported threeridge, southern mapleleaf, Louisiana fatmucket, and an unidentified pigtoe (*Fusconaia*) at a prehistoric archeological site in the area as well.

Pond A adjacent to Lake Livingston at Camp Olympia outdoor education center (Trinity River drainage), Trinity County, Texas, 1 September 1999.

Volunteers collected the following species:

Pond A, Camp Olympia				
Species	N alive	N shells	Condition	Percentage
Flat floater	1	4.0+0.5x3	recently to long dead	12.3
Giant floater	11	28.0+0.5x15	recently dead	83.1
Texas lilliput	2	1.0	recently dead	4.6

Vines Pond adjacent to Lake Livingston at Camp Olympia, Trinity County, Texas, several dates:
Volunteers reported the following species on
15 September 1999:

Vines Pond, Camp Olympia, 15 September 1999				
Species	N alive	N shells	Condition	Percentage
Giant floater	1	3.0+0.5x12	recently to long dead	94.1
Texas lilliput	1	0.0	-	5.9

29 September 1999:

Vines Pond, Camp Olympia, 29 September 1999				
Species	N alive	N shells	Condition	Percentage
Flat floater	0	6.0+0.5x14	recently to relatively-recently dead	6.9
Unidentified floater	0	5.0x1	relatively-recently dead	0.3
Giant floater	0	13.0+0.5x235	recently to long dead	85.2
Southern mapleleaf	0	1.0+0.5x17	recently to long dead	6.2
Lilliput spp.	0	2.0+0.5x1	recently to relatively-recently dead	1.0

Paper pondshell	0	0.5x1	relatively-recently dead	0.3
Asian clam – present				

7 October 1999:

Vines Pond, Camp Olympia, 7 October 1999

Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Flat floater	1	6.0+0.5x5	recently to relatively-recently dead	16.9
Giant floater	1	14.0+0.5x41	relatively-recently to long dead	78.9
Lilliput sp.	0	1.0	long dead	1.4
Paper pondshell	0	1.0+0.5x1	recently dead to long dead	2.8

Lake Livingston (Trinity River drainage), at Caney Creek, Trinity County, Texas, 6 October 1999.
Volunteers examining shorelines and shallows reported the following species.

Lake Livingston at Caney Creek

Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Flat floater	0	1.0+0.5x6	recently to long dead	6.8
Giant floater	0	7.0+0.5x72	recently to long dead	76.7
Lilliput spp.	2	9.0+0.5x4	recently to long dead	14.6
Paper pondshell	0	0.5x2	relatively-recently dead	1.9

Lake Livingston (Trinity River drainage), Dad's Creek at Olympia, Trinity County, Texas, 1 April 1999.

A volunteer reported finding the following specimens during a random shoreline search:

Lake Livingston at Dad's Creek

Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Yellow sandshell	0	0.5x1	long dead	4.8
Giant floater	0	1.0	relatively-recently dead	4.8
Southern mapleleaf	0	0.5x1	very-long dead	4.8
Southern mapleleaf	0	0.5x6	long dead	28.6
Southern mapleleaf	0	0.5x5	relatively-recently dead	23.8
Texas lilliput	0	2.0+0.5x3	relatively-recently dead	23.8
Texas lilliput	0	0.5x2	long dead	9.5

Lake Livingston, point at Camp Olympia, Trinity County. Texas, several dates.

A volunteer reported finding the following specimens during a random shoreline search on 3 December 1998:

Lake Livingston, point at Camp Olympia, 3 December 1998				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Giant floater	0	0.5x1	recently dead	9.1
Giant floater	0	0.5x8	relatively-recently dead	72.7
Southern mapleleaf	0	0.5x2	recently dead	18.2

31 March 1999:

Lake Livingston, point at Camp Olympia, 31 March 1999				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Pink papershell?	0	0.5x1	relatively-recently dead	6.3
Giant floater	0	0.5x1	long dead	6.3
Southern mapleleaf	0	2.0+0.5x10	relatively-recently dead	75.0
Southern mapleleaf	0	0.5x2	long dead	12.5
Unidentified fragments				

21 September 1999:

Lake Livingston, point at Camp Olympia, 21 September 1999				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Flat floater	0	1.0	recently dead	4.5
Giant floater	0	6.0+0.5x6	recent to relatively-recently dead	54.5
Southern mapleleaf	0	2.0+0.5x5	recently to long dead	31.8
Lilliput sp.	0	0.5x1	recently dead	4.5
Pondhorn sp.	1	0.0	-	4.5

The pondhorn specimen was taken inside the mouth of an adjacent creek.

28 September 1999:

Lake Livingston, point at Camp Olympia, 28 September 1999				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Flat floater	0	2.0	recently to relatively-recently dead	7.1

Giant floater	0	11.0+0.5x8	very recently to long dead	67.9
Southern mapleleaf	0	0.5x3	long dead	10.7
Lilliput spp.	0	1.0+0.5x3	recently to relatively-recently dead	14.3

30 September 1999:

Lake Livingston, point at Camp Olympia, 30 September 1999

Species	N alive	N shells	Condition	Percentage
Flat floater	1	0.5x1	recently dead	13.3
Giant floater	0	1.0+0.5x6	recently to long dead	46.7
Southern mapleleaf	0	1.0+0.5x4	relatively-recently to long dead	33.3
Lilliput sp.	0	0.5x1	long dead	6.7

September 1999 (no day specified):

Lake Livingston, point at Camp Olympia, September 1999 (no day specified)

Species	N alive	N shells	Condition	Percentage
Flat floater	0	2.0	recently dead	6.1
Yellow sandshell	0	0.5x1	long dead	3.0
Giant floater	1	8.0+0.5x1	very-recently to recently dead	30.3
Southern mapleleaf	0	0.5x9	relatively-recently to long dead	27.3
Texas lilliput	6	1.0+0.5x2	recently to long dead	27.3
Tapered pondhorn (?)	0	1.0+0.5x1	recently dead	6.1

7 October 1999:

Lake Livingston, point at Camp Olympia, 7 October 1999

Species	N alive	N shells	Condition	Percentage
Flat floater	0	1.0	very recently dead	5.0
Giant floater	0	2.0+0.5x5	very-recently to recently dead	35.0
Southern mapleleaf	0	0.5x1	long dead	5.0
Lilliput spp.	1	3.0+0.5x7	recently to relatively-recently dead	55.0

Lake Livingston, small bay near Camp Olympia, Trinity County, Texas, 31 March 1999.

A volunteer reported finding the following specimens during a random shoreline search

Lake Livingston, bay near Camp Olympia				
Species	N alive	N shells	Condition	Percentage
Pink papershell?	0	0.5x2	long dead	11.1
Southern mapleleaf	0	0.5x5	very-long dead	27.8
Southern mapleleaf	0	0.5x5	long dead	27.8
Southern mapleleaf	0	1.0+0.5x4	relatively-recently dead	27.8
Paper pondshell	0	1.0	relatively-recently dead	5.6

San Jacinto River Drainage

Unnamed pond adjacent to Spring Creek (West Branch San Jacinto River tributary), Montgomery County, Texas, 20 May 1999.

A volunteer reported finding the following specimens:

Pond adjacent to Spring Creek				
Species	N alive	N shells	Condition	Percentage
Giant floater	0	0.5x1	relatively-recently dead	33.3
Lilliput	0	2.0	recently dead	66.7

Previous TPWD collections in lower Spring Creek in 1996, found no unionids. This collection indicates at least two taxa are still surviving in this area.

Lake Houston, Harris County, Texas, 17 November 1999.

This impoundment was not surveyed, but HOH did receive a call from a local resident reporting water levels to be down 4.9 m and vast numbers of stranded unionids. A noteworthy assemblage was found in earlier survey work by HOH on sandy flats in the upper end of the reservoir in 1996. However, because this large area was only about 1.3 m deep, the current report suggests many mussels in this area have been lost.

Brazos River Drainage

MacKenzie Park Lake (North Fork of the Double-Mountain Fork of the Brazos River), Lubbock, Lubbock County, Texas, 20 April 1999.

Examination of banks and shallow waters produced no bivalves.

Leftwich Park Lake (North Fork of the Double-Mountain Fork of the Brazos River), Lubbock, Lubbock County, Texas, 20 April 1999.
 Examination of exposed bottom and shallow waters produced no bivalves. Additionally, adjacent McCullough Park Lake was also visited but only superficially examined; no bivalves were noted.

Buffalo Springs Reservoir, upper end park embayment and sandy beach adjacent to boat houses (North Fork of the Double-Mountain Fork of the Brazos River), Lubbock County, Texas, 20 April 1999.

Banks and very shallow areas were examined, but no bivalves were found.

Sand Creek at U.S. 84 north of the South Fork of the Double-Mountain Fork of the Brazos River at U.S. 84, Garza County, Texas, 19 April 1999.

This location contained only damp spots or was completely dry. No permanent water was apparent and no bivalves were noted.

South Fork of the Double-Mountain Fork of the Brazos River at U.S. 84, Garza County, Texas, 19 April 1999.

This location contained only damp spots or was completely dry. No permanent water was apparent and no bivalves were noted.

Lake Kirby (Clear Fork of the Brazos River drainage), Taylor County, Texas, 16 July 1999.

Exposed reservoir substrates were examined during a low-water period. Deep mud prevented access to areas still retaining water. The following specimens were noted:

Lake Kirby Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	0	3.0+0.5x5	very-recently to very-long dead	25.8
Giant floater	0	9.0+0.5x3	relatively-recently to relatively-long dead	38.7
Southern mapleleaf	0	7.0	very-recently to relatively-recently dead	22.6
Texas lilliput	0	1.0	long dead	3.2
Pondhorn sp.	0	1.0+0.5x2	very long dead	9.7
Asian clam – present				

Water levels that dropped here in 1998 have remained low. Although numerous unionids were stranded and lost, enough water remains in deeper areas to suggest survivors are still present.

Fort Phantom Hill Reservoir (several sites), Jones County, Texas, 16-17 July 1999.

Locations on this reservoir were examined on 16 July in preparation for a training class on mussel sampling and on 17 July by class members.

Southwest corner access point, 16 July 1999, examination of exposed bottoms and shallows with snorkeling in deep water produced:

Fort Phantom Hill Reservoir, southwest corner access point				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	2	3.0	relatively-long dead	45.5
Fragile papershell	0	1.0	long dead	9.1
Bleufer	0	1.0+0.5x1	relatively-long dead	18.2
Giant floater	1	0.0	-	9.1
Southern mapleleaf	2	0.0	-	18.2
Pistolgrip	0	fragments	relatively-long dead	-
Asian clam – present				

This location is subjected to heavy wave activity from southern and southeastern winds. Prior low water levels and wave activity appeared to be responsible for restricting most living specimens to water 2 m or more in depth.

Southeastern corner, lakeside of a marina jetty, 16 July 1999:
Wading waters to 1.5 m depths adjacent to the jetty and associated rockwork produced:

Fort Phantom Hill Reservoir, southeastern corner marina jetty				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	1	0.0	-	10.0
Giant floater	1	1.0	long dead	20.0
Southern mapleleaf	1	0.0	-	10.0
Pistolgrip	6	0.0	-	60.0
Asian clam – present				

Northeast corner, point adjacent to the east side of the dam, 17 July 1999:
Training class individuals and TPWD personnel examined exposed bottoms and shallow waters with snorkeling in deeper areas. The following specimens were collected:

Fort Phantom Hill Reservoir, northeast corner, point adjacent to east side of dam				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	0	5.0x0.5x23	recently to very-long dead	32.9
Fragile papershell	0	3.0x0.5x4	relatively-recently to long dead	8.2
Southern mapleleaf	0	19.0x0.5x22	very-recently to relatively-long dead	48.2
Bleufer	0	1.0	relatively-long dead	1.2

Pistolgrip	0	5.0x0.5x3	relatively-recent to recently dead	9.4
Asian clam - present				

Clear Fork Brazos River, S.H. 283 near Fort Griffin, Shackelford County, Texas, 19 October 1999.
Texas Natural Resources Conservation Commission (TNRCC) staff reported the following specimens at this location:

Clear Fork Brazos River, S.H. 283				
Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	0	3.0+0.5x1	long dead	57.1
Yellow sandshell	0	1.0	subfossil	14.3
Pondhorn	0	2.0	long dead	28.6

T and P Lake (Brazos River drainage), near Baird, Callihan County, Texas, 11 October 1999.
TNRCC personnel examined this site and reported the following specimens:

T and P Lake, near Baird				
Species	N alive	N shells	Condition	Percentage
Giant floater	5	36.0	recently dead	71.9
Southern mapleleaf	1	15.0	recently dead	28.1
Asian clam - present				

Hubbard Creek Reservoir (Brazos River drainage), Stephens County, Texas, several dates.
The following species were found by volunteers during a low-water period on 4 February 1999:

Hubbard Creek Reservoir, 4 February 1999				
Species	N alive	N shells	Condition	Percentage
Fragile papershell	0	1.0	recently dead	25.0
Pink papershell	0	0.5x1	very-recently dead	25.0
Giant floater	0	2.0	very-recently dead	50.0

29 July 1999:

Hubbard Creek Reservoir, 29 July 1999				
Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	10	5.0+0.5x1	recently to long dead	51.6

Pink papershell	8	4.0	recently dead	38.7
Southern mapleleaf	0	3.0	recently dead	9.7

Lake Whitney, Lofers Bend Park, Bosque County, Texas, 14 August 1999.
A volunteer SCUBA diver reported finding the following specimens:

Lake Whitney, Lofers Bend Park				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Fragile papershell	0	2.0	very-recently to recently dead	33.3
Unidentified pimpleback	0	4.0	long dead	66.7
Asian clam - present				

Lake Waco, Speegleville Park III (N 31°32'18", W 97°14'15" to N 31°31'35", W 97°14'49"),
McLennan County, Texas, 18 January 1999.
A random shoreline search by a volunteer produced:

Lake Waco, Speegleville Park III				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Yellow sandshell	0	0.5x4	recently to long dead	33.3
Bleufer	0	0.5x2	relatively-recently dead	16.7
Southern mapleleaf	0	0.5x6	recently to long dead	50.0
Asian clam - abundant				

Lake Proctor, Bosque Arm boat ramp (Leon Rive drainage), (N 31°59.34', W 97°28.91'), Comanche
County, Texas, 2 December 1999.
Brazos River Authority (BRA) personnel reported finding two, recently dead southern
mapleleafs in a random shoreline search.

Sulphur Creek (Lampasas River tributary), east side of Lampasas city, downstream of waste-water
treatment plant (N 31°04'15.05", W 98°10'06.57"), Lampasas County, Texas, 29 December
1998.
Random shoreline searches by BRA personnel located only Asian clam shells.

Sulphur Creek (Lampasas River tributary), at C.R. 7 Sparks Crossing, 4 km east of Lampasas city (N
31°04'15.31", W 98°08'04.99"), Lampasas County, Texas, 24 November 1998.
Random shoreline searches by BRA personnel located only Asian clam shells.

Sulphur Creek (Lampasas River tributary), Deadman's Cut, 2.5 km upstream of C.R. 8 (N 31° 04'30.36", W 98°03'52.48"), Lampasas County, Texas, 24 November 1998.
 Random shoreline searches by BRA personnel located only Asian clam shells.

Elm Creek, 4.8 km east of Lake Mexia on S.H. 84 (Navasota River drainage), Limestone County, Texas, 22 December 1999.
 A volunteer examining this site reported finding:

Elm Creek, east of Lake Mexia				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tapered pondhorn	0	0.5x3	recently dead	100.0
Fingernail clam (sp.)	0	0.5x2	recently dead	-

Lake Limestone (Navasota River drainage), F.M. 337 (N 30°25.97', W 96°22.60'), Limestone County, Texas, 6 October 1999.
 A random-shoreline collection by BRA personnel included:

Lake Limestone				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Yellow sandshell	0	2.0	very-recently dead	100.0
Fragile papershell	0	fragment	recently dead	-

Brazos River, immediately upstream of S.H. 21, Burleson and Brazos counties, Texas, 17 October 1999.
 A volunteer found the following species at this site and transported them to HOH for confirmation of the initial identification:

Brazos River, upstream of S.H. 21				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Fragile papershell	0	1.0	recently dead	33.3
Texas fawnsfoot	0	2.0	very-recently dead	66.7

Brazos River, immediately downstream of S.H. 21, Burleson and Brazos counties, Texas, 17 October 1999.
 A volunteer found the following species at this site and transported them to HOH for confirmation:

Brazos River, downstream of S.H. 21				
Species	N alive	N shells	Condition	Percentage
Fragile papershell	0	2.0	recently dead	5.3
Pink papershell	0	2.0	relatively-recently dead	5.3
Texas fawnfoot	0	34.0	very-recently dead	89.5

Endemic Texas fawnfoot has been extremely rare in recent years with just over 100 specimens documented since 1980, only five of which were alive when found. All 36 specimens from the S.H. 21 sites were very-recently dead (soft tissue still attached to valves). This collection included both sexes as well as mixed sizes and ages of Texas fawnsfoot.

Roadside ditch at the northwest corner of S.H. 35 and S.H. 288 near Angleton, Brazoria County, Texas, 2 November 1999.

A volunteer found the following specimens during examination of this site:

Roadside ditch near Angleton				
Species	N alive	N shells	Condition	Percentage
Giant floater	0	1.0	relatively-recently dead	4.5
Pondhorn sp(p).	0	5.0	relatively-recently dead	22.7
Texas lilliput	0	16.0	relatively-recently dead	72.7
Asian clam - abundant				

Pondhorns here included one specimen that appeared to be tapered pondhorn *Uniomereus declivis*, one which resembled pondhorn *U. tetralasmus*, and others that were intermediate between the two.

Colorado River Drainage

Lake J.B. Thomas (Colorado River drainage), boat ramp southwest of the dam, Scurry County, Texas, 19 April 1999.

Examination of exposed shorelines and shallow waters produced the following specimens:

Lake J.B. Thomas				
Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	0	0.5x1	very-recently dead	3.1
Tampico pearlymussel	0	fragments	very-long dead	-
Giant floater	0	2.0+0.5x11	recently to relatively-long dead	40.6

Southern mapleleaf	0	10.0+0.5x8	recently to relatively- long dead	56.3
Asian clam – common (mixed sizes)				

This reservoir appears never to have been surveyed for unionid populations before and represents upstream and western records in this system for all three freshwater mussel taxa.

Concho River, Indian Pictographs landing area, Concho County, Texas, 11 November 1999.

Very-recently dead shells of Tampico pearlymussel, fragile papershell, bleufer, southern mapleleaf, and Texas pimpleback were found in abundance as were millions of Asian clam shells. Concho River water levels had dropped so low, the river had completely stopped flowing and contained only a few standing pools of water. This site was perhaps the largest population of rare, endemic pimplebacks found to date. Although living specimens of most species were present, drought conditions have dramatically reduced unionids in much of the Concho River.

Concho River, downstream of the low-water crossing at Paint Rock City Park, Concho County, Texas, 11 November 1999.

As with the site above, most of this area was completely dry. Only a few deeper pools remained with standing water. Very-recently dead shells of Tampico pearlymussel, fragile papershell, bleufer, southern mapleleaf, and Texas pimpleback were found, as were Asian clams.

Small pond on the south side of the Concho River downstream of the low-water crossing at Paint Rock City Park, Concho County, Texas, 11 November 1999.

Examination of this site found it completely dry. Very-recently dead shells of Tampico pearlymussel, fragile papershell, bleufer, southern mapleleaf, and Asian clam were found, as was a single shell of tapered pondhorn. Most of the species found here were probably deposited in the pond during flooding about two years earlier and are otherwise not "pond" species.

Elm Creek upstream of O.H. Ivie Reservoir (Colorado River drainage), Coleman County, Texas, 19 May 1999.

During other work in this area, a single, relatively-recently dead Tampico pearlymussel was found.

Brownwood Reservoir (Pecan Bayou, Colorado River drainage), Brown County, Texas, 18 August 1999.

Casual observations along the shoreline during other work at this site found numerous fragile papershells, somewhat fewer giant floaters, and five threeridges in about a 200-m stretch of beach. Asian clam was extremely abundant.

O.H. Ivie Reservoir (Colorado River drainage), Coleman County, Texas, several dates.

Mussels were encountered here several times during other work in the area, including on 24 March 1999:

O.H. Ivie Reservoir, 24 March 1999				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	0	2.0	recently dead	40.0
Fragile papershell	0	2.0	very-recently dead	40.0
Paper pondshell	0	0.5x1	recently dead	20.0
Asian clam – present				

26 April 1999:

O.H. Ivie Reservoir, 26 April 1999				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	0	1.0	recently dead	25.0
Fragile papershell	0	3.0	recently dead	75.0

21 July 1999:

O.H. Ivie Reservoir, 21 July 1999				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Fragile papershell	1	0.0	-	100.0

Brady Lake (Brady Creek, Colorado River drainage), shoreline near the north corner of the dam, McCulloch County, Texas, 14 November 1999.

The following specimens were collected during examination of exposed bottoms, shoreline, and shallow waters during a low-water period:

Brady Lake, north shore near dam				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	14	18.0+0.5x2	very-recently to very-long dead	53.1
Giant floater	0	2.0	very-recently dead	3.1
Southern mapleleaf	11	17.0	very-recently to very-long dead	43.8
Asian clam - present				

Brady Lake (Brady Creek, Colorado River drainage), dry pond (borrow pit) near the north corner of the dam, McCulloch County, Texas, 14 November 1999.

The following specimens were collected during examination of the exposed bottom during a low-water period:

Brady Lake, dry pond near dam				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	0	35.0	very-recently to recently dead	67.3
Giant floater	0	6.0+0.5x1	recently dead	13.5
Southern mapleleaf	0	9.0	recently dead	17.3
Paper pondshell	0	1.0	recently dead	1.9
Asian clam - present				

Brady Lake (Brady Creek, Colorado River drainage), mid-reservoir shoreline north side of the impoundment, McCulloch County, Texas, 14 November 1999.

The following specimens were collected during examination of exposed bottoms, shoreline, and shallow waters during a low-water period:

Brady Lake, mid-reservoir north side				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	3	7.0	very-recently to very-long dead	47.6
Giant floater	0	2.0	relatively-recently dead	9.5
Southern mapleleaf	2	6.0	very-recently to very-long dead	38.1
Paper pondshell	0	1.0	relatively-recently dead	4.8
Asian clam - present				

Llano River (Colorado River drainage), Llano City Park, Llano, Llano County, Texas, 16 May 1999.

A volunteer reported finding the following specimens:

Llano River, Llano City Park				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Threeridge	0	0.5x2	subfossil	100.0

Colorado River, 3.2 km upstream of S.H. 16, Mills and San Saba counties, Texas, 22 August 1999.

TPWD Spills and Kills team personnel collected the following specimens:

Colorado River, 3.2 km upstream of S.H. 16				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	0	6.0	very-recently to recently dead	35.3
Fragile papershell	0	2.0	very-recently dead	11.8
Bleufer	0	0.5x2	relatively-long dead	11.8
Southern mapleleaf	0	3.0	very-recently dead	17.6
Texas pimpleback	0	3.0	very-recently dead	17.6
Texas fawnsfoot	0	1.0	very-recently dead	5.9
Asian clam – present				

One Tampico pearlymussel (156 mm shell length) was the largest documented to date. The Texas pimplebacks represent only the forth surviving population of this endemic species. The Texas fawnsfoot also represented an additional surviving population and the only one confirmed in the Colorado River drainage, but was also the largest specimen reported to date (56 mm shell length).

Lake Travis, Grelle Recreation Area (Colorado River drainage), Burnet County, Texas, 23 October 1999.

Volunteers conducted a random-area search (2,200 m²) in shallow waters and located the following specimens:

Lake Travis, Grelle Recreation Area				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	0	1.0+0.5x2	long to very-long dead	21.4
Giant floater	0	5.0	recently dead	35.7
Southern mapleleaf	0	1.0+0.5x2	relatively-recently dead	21.4
Paper pondshell	0	2.0+0.5x1	recently dead	21.4
Asian clam – present (37.0+0.5x234; recently to long dead)				

Lake Travis, The Narrows (Colorado River drainage), Burnet County, Texas, 25 September 1999.

Volunteers conducted a random-area search (3,012 m²) in shallow waters and located the following specimens:

Lake Travis, The Narrows				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Bleufer	0	1.0	recently dead	4.3
Giant floater	1	12.0+0.5x3	recently dead	69.6

Paper pondshell	1	4.0+0.5x1	recently dead	26.1
Asian clam – present (2.0+0.5x230; relatively-recently to long dead)				

Colorado River, island sandbar 1.2 km downstream of U.S. 90A, Colorado County, Texas, 10 July 1999.

Random shoreline and shallow-water collections produced:

Colorado River, island 1.2 km downstream of U.S. 90A				
Species	N alive	N shells	Condition	Percentage
Threeridge	1+	4.0+0.5x1	recently dead	27.3
Tampico pearlymussel	0	0.5x4	long dead	18.2
Yellow sandshell	2	0.0	-	9.1
Southern mapleleaf	0	1.0+0.5x1	relatively-recently dead	9.1
Smooth pimpleback	3+	2.0+0.5x3	-	36.4
Asian clam – present				

Guadalupe River Drainage

North Fork Guadalupe River, fifth crossing upstream of Hunt on F.M. 1340, southwest bank, Kerr County, Texas, 4 March 1999.

Personnel with the Upper Guadalupe River Authority collected the following specimens:

North Fork Guadalupe River, upstream of Hunt				
Species	N alive	N shells	Condition	Percentage
Texas fatmucket	0	2.0+0.5x1	recently dead	42.9
Texas lilliput	0	0.5x1	relatively-recently dead	14.3
Paper pondshell	0	1.0+0.5x2	recently to relatively-long dead	42.9

Dietert Creek, Kerrville, Kerr County, Texas, 12 September 1999.

Examination of shallow areas produced the following specimens:

Dietert Creek				
Species	N alive	N shells	Condition	Percentage
Texas lilliput	0	0.5x2	recently dead	66.7
Paper pondshell	0	0.5x1	recently dead	33.3

San Marcos River, midway between U.S. 90 and S.H. 80 upstream of Luling, Caldwell County, Texas, October 1999.

A local teacher found a single living golden orb at this location and provided a photograph to HOH for identification. Asian clams were also found at the site. Although in the 1960s freshwater mussel populations persisted in the San Marcos River (Howells *et al.* 1996), none of the TPWD surveys conducted since 1992 have found any living specimens other than a single golden orb valve located downstream of Palmetto State Park that appeared to have been relatively-recently dead. This specimen from the site upstream of Luling confirms that not only do some unionids remain in the San Marcos River, but an additional population of rare, endemic golden orbs appears to be present too.

San Marcos River, midway between U.S. 90 and S.H. 80 upstream of Luling, Caldwell County, Texas, 24 October 1999.

A volunteer collected the following specimens and sent them to HOH for identification:

San Marcos River, between U.S. 90 and S.H. 80				
Species	N alive	N shells	Condition	Percentage
Threeridge	0	1.0	recently dead	20.0
Threeridge		0.5x1	relatively-recently dead	20.0
Threeridge		1.0+0.5x2	very-long dead	60.0

Rio Grande Drainage

Rio Grande at the mouth of the Rio Conchos Canyon (N 29°35'10.07", W 104°25'22.58"), Presidio County, Texas, 10 August 1999.

A local volunteer and HOH staff attempted to sample this site, but high flow rates from upstream water releases prevented accessing the main channel at this location. However, no evidence of bivalve shells was found on the banks or adjacent levees and dredge spoils.

Rio Grande at the mouth of Alamido and lower-most Alamido Creek (N 29°31'11.72", W 104°17'26.69"), Presidio County, Texas, 10 August 1999.

A local volunteer and HOH staff examined sand substrates of the lower creek, gravel and cobble bars, and softer mud substrates nearly to the Mexican bank of the Rio Grande without locating any bivalves or their shells.

Rio Grande, upstream of Colorado Canyon (N 29°17'52.9", W 103°57'10.3" to N 29°17'15.8", W 103°57'10.3"), Presidio County, Texas, March 1999.

Examination of shorelines and shallow waters by U.S. Geological Survey (USGS) personnel produced no unionids, but Asian and fingernail clams were present. Some fingernail clams were very-recently dead and were reproductively active at the time of death.

Rio Grande, Santa Elena canoe takeout (N 29°09'20.4", W 103°35'54.9" to N 29°09'11.7", W 103°35'48.1"), Brewster County, March 1999.
Examination of shorelines and shallow waters by USGS produced no bivalves.

Rio Grande, International Boundary Water Commission Gage site downstream of Castolon, (N 29°02'05.1", W 103°23'22.5" to N 29°01'54.7", W 103°23'11.4"), Big Bend National Park, Brewster County, Texas, March 1999.
Examination of shorelines and shallow waters by USGS produced no bivalves.

Rio Grande, Solis canoe takeout (N 29°02'38.9", W 103°06'19.4"), Big Bend National Park, Brewster County, Texas, 9 February 1999.
Examination of shorelines and shallow waters by USGS and TPWD only produced a single living Asian clam and several valves of this species.

Rio Grande, San Vincente Crossing (N 29°07'48.4", W 103°01'19.9"), Big Bend National Park, Brewster County, Texas, 9 February 1999.
Examination of shorelines and shallow waters by USGS and TPWD produced no bivalves.

Rio Grande, Hot Springs (N 29°10'46.3", W 102°59'39.2"), Big Bend National Park, Brewster County, Texas, 8 February 1999.
Examination of shorelines and shallow waters by USGS, TPWD, and a volunteer produced no bivalves.

Rio Grande, downstream of Rio Grande Village pumping station (N 29°02'38.9", W 103°06'19.4"), Big Bend National Park, Brewster County, Texas, 9 February 1999.
Examination of shorelines and shallow waters by USGS, TPWD, and a volunteer produced no bivalves. A living Texas hornshell reportedly had been observed in a gravel bar adjacent to this pumping station several years earlier. However, on this occasion, the entire gravel bar was no longer present.

Rio Grande, upstream of Boquillas Canyon and downstream of Boquillas Crossing, (N 29°11'30.8", W 102°55'14.8" to N 29°11'32.3", W 102°55'04.3"), Big Bend National Park, Brewster County, Texas, March 1999.
Examination of shorelines and shallow waters by USGS produced the following bivalves.

Rio Grande, upstream of Boquillas Canyon				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Salina mucket	0	0.5x1	relatively-recently dead	100.0
Asian clam - present				

The area upstream of this site was examined in 1998, except for the pool at the Boquillas Crossing site itself. No unionids were found upstream of this crossing, but the valve found just upstream of Boquillas Canyon indicates a need to examine the pool at Boquillas Crossing itself

more closely. Attempts to do so in August 1999 were thwarted by high-water conditions and a large number of Mexican nationals directing attention to the survey team.

Rio Grande, Black Gap Wildlife Management Area (N 29°35'34.5", W 102°46'07.9" to N 29°35'46.2", W 102°46'05.3"), Brewster County, Texas, 7 February 1999.

Examination of shorelines and shallow waters in this area by USGS produced only Asian clam and its shells.

Pecos River, U.S. 190 upstream to wash about 0.5 km (N 30°54'17.17", W 101°52'45.07"), Crockett and Pecos counties, Texas, 28 July 1999.

Examination of this area by wading produced no bivalves or their shells. Water salinity was 13 ppt and was probably too high to support either unionids or Asian clams.

Pecos River, low-water crossing about 0.5 km downstream of U.S. 190 upstream (N 30°53'16.28", W 101°53'23.54"), Crockett and Pecos counties, Texas, 28 July 1999.

Examination of this area by wading produced no bivalves or their shells. Water salinity was 9 ppt and was probably too high to support either unionids or Asian clams.

Pecos River, low-water crossing about midway between U.S. 190 and U.S. 10 (N 30°47'19.84", W 101°50'5.44"), Crockett and Pecos counties, Texas, 28 July 1999.

Examination of this area by wading produced no bivalves or their shells, but three small unionid shell fragments (long dead to subfossil) were found in a stream-side gravel deposit. Water salinity was 9 ppt and was probably too high to support either unionids or Asian clams. Chara was extremely abundant.

Pecos River, first access point at a wash downstream of the low-water crossing midway between U.S. 190 and U.S. 10 (N 30°45'18.33", W 101°49'13.26"), Crockett and Pecos counties, Texas, 28 July 1999.

Examination of this area by wading produced no bivalves or their shells, but four small unionid shell fragments (long-dead to subfossil) were found. Water salinity was 4 ppt and was probably too high to support either unionids or Asian clams.

Pecos River, second access point downstream of the low-water crossing midway between U.S. 190 and U.S. 10 (N 30°45'13.23", W 101°49'1.15"), Crockett and Pecos counties, Texas, 28 July 1999.

Examination of this area by wading produced no bivalves or their shells. Water salinity was 5 ppt and was probably too high to support either unionids or Asian clams.

Pecos River, low-water crossing downstream of U.S. 290 (N 30°37'1.34", W 101°39'27.96"), Crockett and Terrell counties, Texas, 28 July 1999.

Although salinity here had dropped to less than 0.5 ppt, neither unionids, Asian clams, or their shells were found. Only three, small subfossil fragments were located. This area of riffles and pools had mixed bottom types and apparently acceptable habitat. A local government trapper interviewed reported massive flooding had occurred in this area one year earlier. Additionally somewhere between U.S. 10 and U.S. 290 upstream, the system receives a heavy organic load input. Clear waters observed at the 5 upstream locations became turbid with obvious organic

material in substrates downstream of U.S. 290. Other than limited numbers of livestock (cattle and sheep) and a few homes in the area, only a small recreational vehicle hookup area at U.S. 10 and the small town of Sheffield on U.S. 290 appear as possible sources of this organic input.

Pecos River, 5.9 km downstream of Pandale Crossing, Val Verde County, Texas, 16 October 1999.
Volunteers examining this section of river collected the following material:

Pecos River, 5.9 km downstream of Pandale Crossing				
Species	N alive	N shells	Condition	Percentage
Texas hornshell	0	2.0	relatively-long dead	100.0

Pecos River, 59.3 km downstream of Pandale Crossing at Old Ingram Dam and Pump site, Val Verde County, Texas, 19 October 1999.

Volunteers examining this section of river collected the following material:

Pecos River, 59.3 km downstream of Pandale Crossing				
Species	N alive	N shells	Condition	Percentage
Texas hornshell	0	2.0	relatively-long dead	100.0

Pecos River, 63.1 km downstream of Pandale Crossing and 1.9 km upstream of Painted Canyon, Val Verde County, Texas, 20 October 1999.

Volunteers examining this section of river collected the following material:

Pecos River, 63.1 km downstream of Pandale Crossing				
Species	N alive	N shells	Condition	Percentage
Texas hornshell	0	0.5x1	relatively-long dead	100.0

Los Olmos Creek at U.S. Customs office, Rio Grande City, Starr County, Texas, 5 July 1999.

Examination of shorelines and shallow areas found only black, highly-organic substrates and no bivalves present. Three other sites on this creek (adjacent to a Walmart store, at U.S. 83, and at its confluence with the Rio Grande) could not be sampled due to high-water conditions.

Rio Grande at La Grulla access road, Starr County, Texas, 5 July 1999.

Examination of shorelines and shallows found very soft bottom and no bivalves present.

Rio Grande at Los Ebanos Crossing, Hidalgo County, Texas, 5-6 July 1999.

Examination of shorelines and shallows found algal mats in shallow waters, Asian clams were abundant, but no unionids were taken. However, this site should be reexamined under low-flow conditions.

Walker Lake (N 26°14'19.97", W 98°28'44.56"), southeast of La Joya, Hidalgo County, Texas, 16 June 1999.

Wading and snorkeling this oxbow produced:

Walker Lake Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	10	0.0	-	55.6
Southern mapleleaf	8	0.0	-	44.4
Asian clam - present				

This shallow oxbow had shallow (< 1 m) waters and a sandy bottom. Although most of the shoreline was bulkheaded with homes and yards, the substrate was excellent unionid habitat.

Intake Canal to the Edinburg Canal and adjacent Rio Grande (N 26°13'25.23", W 98°26'59.50"), Hidalgo County, Texas, 16 June 1999.

Wading shallows and snorkeling deeper waters, produced only a limited number of living Asian clams and their shells from the bottom of the intake canal. Although washboards have been reported in dredge spoils at this site, none were found during this examination.

Edinburg Canal, start at Zamora Street in Penitas (N 26°13'47.85", W 98°26'31.54"), Hidalgo County, Texas, 16 June 1999.

Examination of exposed levies and snorkeling deeper waters produced:

Edinburg Canal, at Zamora Street, Penitas Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	2	0.5x1+frags.	relatively-long dead	75.0
Southern mapleleaf	0	0.5x1	relatively-long dead	25.0
Asian clam - present.				

Water depth at the time of sampling (2-3 m) and current made specimen collection difficult. A return to this site during slow-flow and shallow-water conditions is recommended.

Cemetery Pond, southeast of the start of the Edinburg Canal and north of Border Pacific RR tracks (N 26°13'47.85", W 98°26'31.54"), Hidalgo County, Texas, 16 June 1999.

Wading this pond produced:

Cemetery Pond Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	0	8.0+0.5x9	relatively-recently dead	100.0

B. Loya (TPWD, Mission, Texas) reported finding unionids here in abundance some 40 years earlier. During this examination, the approximately 0.5-acre pond was found to be surrounded by cattails and covered about 0.4 m deep in silt and organic debris. Mussel shells were still present on the gravel substrate below the deep silt layer. Interestingly, the nacre on many of these specimens was still relatively pearly and shells were not stained black by organic material (suggesting mortality and silt cover may have been relatively recent).

Bentsen State Park Lake (N 26°10'36.67", W 98°23'34.43"), Bentsen State Park (BSP), Hidalgo County, Texas, 16 June 1999.

Examination of exposed shorelines and shallow areas and snorkeling deeper waters produced:

Bentsen State Park Lake				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	0	1.0	relatively-recently dead	100.0
Asian clam – present				

The substrate in this oxbow was very soft, but was also pitted by blue tilapia activity. Both can discourage mussel populations.

Rio Grande at Chimney Park boat ramp upstream of Anzalduas, Hidalgo County, Texas, 6 July 1999.
This site was located, but not sampled due to high-water conditions.

Rio Grande overflow site at Anzalduas Park entrance, Hidalgo County, Texas, 6 July 1999.
Examination of this area produced:

Rio Grande, overflow at Anzalduas Park entrance				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	0	3.0+0.5x3	relatively-long dead	100.0
Asian clam – present				

Canal at the west side of Anzalduas Park, Hidalgo County, Texas, 6 July 1999.
The following specimens were found during wading at this site:

Canal, west side of Anzalduas Park				
Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	2	7.0+0.5x4	relatively-recently dead	100.0
Asian clam - present				

Anzalduas Reservoir, upstream of Anzalduas Dam (N 26°08'27.03", W 98°19'54.77"), park on the Texas bank, Hidalgo County, Texas, 15 June 1999.

Examination of banks and adjacent reservoir bottom in this area but found no bivalves. The substrate was rip-rap along the bank and deep, anoxic silt and plant debris beyond.

Rio Grande, downstream of Anzalduas Dam (N 26°08'5.62", W 98°19'56.91"), Hidalgo County, Texas, 6 July 1999.

Fast currents and high water hampered sampling. Only Asian clam was found.

Canal adjacent to Pharr Settling Basin (N 26°04'48.10", W 98°15'00.49"), east of Hidalgo, Hidalgo County, Texas, 15 June 1999.

Examination of steep banks and snorkeling deeper areas produced no bivalves in the soft mud-silt bottom and walls which were heavily covered with mats of algae.

Pharr Settling Basin (N 26°04'48.10", W 98°15'00.49"), east of Hidalgo, Hidalgo County, Texas, 15 June 1999.

Wading and snorkeling at this site produced only a limited number of small Asian clam shells. Most of the substrate at this site was sandy mud and appeared to be good mussel habitat. However, the pitted nature of this substrate suggested a large blue tilapia population was present. Digging activities associated with tilapia spawning and feeding have been suggested as potential harmful to mussels at other such sites throughout Texas.

Oxbow pond, La Coma Tract, Lower Rio Grande National Wildlife Refuge (N 25°55'39.14., W 97°20'59.50"), Hidalgo County, Texas, 15 June 1999.

Examined exposed substrates and wading shallow areas produced:

Oxbow Pond Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	2	0.5x1	long dead	37.5
Yellow sandshell	0	0.5x1	very long dead	12.5
Paper pondshells	0	0.5x4	relatively-recently to very-long dead	50.0
Asian clam – present				

Although this pond reportedly retained water when the adjacent oxbow became dry one year ago, all but two mussels here were dead. Adjacent agricultural fields only a few m from this pond are regularly sprayed with pesticides and associated agricultural chemicals.

Dry oxbow pond, La Coma Tract, Lower Rio Grande Valley National Wildlife Refuge (N 25°55'39.14., W 97°20'59.50"), Hidalgo County, Texas, 15 June 1999.

Examination of the exposed pond bottom produced:

Dry Oxbow Pond Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	0	5.0+0.5x2	long dead	100.0

This pond dewatered in 1998 after many years of maintaining water.

Rio Grande, downstream of Retamal Dam adjacent to the La Coma Tract (N 26°03'03.50", W 98°02'04.52"), Lower Rio Grande Valley National Wildlife Refuge, Cameron County, Texas, 15 June 1999.

Wading shallows and snorkeling deeper areas produced only a limited number of small Asian clam shells. Substrate areas in the main channel were swept, shifting sand; those along the Texas bank and behind an island downstream were soft silt. Both are undesirable mussel habitats.

Sapo Lake (N 26°24'16.77", W 98°14'42.37"), west of Lake Edinburg, Hidalgo County, Texas, 5 July 1999.

Wading and snorkeling produced:

Sapo Lake Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	7	1.0	recently dead	72.7
Southern mapleleaf	1	1.0	recently dead	18.2
Paper pondshell	0	1.0	recently dead	9.1
Asian clam – present				

Lake Edinburg (N 26°22'46.68:, W 98°10'13.37"), Hidalgo County, Texas, 16 June 1999.

Examined exposed bottoms and shallow waters produced:.

Lake Edinburg Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	2	4.0+0.5x1	recent-subfossil	58.3
Southern mapleleaf	0	5.0	relatively-recently to relatively-long dead	41.7
Asian clam - present				

Sand and mud bottom areas of this shallow reservoir appeared to be good mussel habitat, but it seems probable much of this water body was dry during drought periods 1-3 years earlier. Living unionids remain, but their populations have been dramatically reduced.

Delta Lake, public park area (N 26°24'37.63", W 97°57'28.28"), Hidalgo County, Texas, 16 June 1999.

Examination of exposed substrates and wading shallow water produced:

Delta Lake Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	4	0.5x10	long dead	93.3
Southern mapleleaf	0	0.5x1	long dead	6.7
Asian clam - present				

Although the sandy bottom of this reservoir appeared to be good mussel habitat, pits from extensive blue tilapia activity and very high water temperature (38°C) probably make this site relatively inhospitable to unionids.

Llano Grande Lake (Main Floodway Canal) at golf course, Mercedes, Hidalgo County, Texas, 6 July 1999.

Wading and snorkeling this area found apparently acceptable substrates in some areas, but with softer bottoms near the golf course; however, no bivalves were found.

Mercedes Main Floodway Canal, south side, Mercedes, Hidalgo County, Texas, 6 July 1999.

Wading and snorkeling this area found soft mud bottoms with silt deposition near the center of the canal. Only Asian clams were found.

Arroyo Colorado at Florida Avenue (N 26°07'44.11", W 97°54'32.91"), Mercedes, Hidalgo County, Texas, 6 July 1999.

Wading and snorkeling this site produced:

Arroyo Colorado, Florida Avenue Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	20	2.0	recently dead	100.0
Asian clam – present (including very large specimens).				

Moon Lake at Progresso Lakes, Hidalgo County, Texas, 6 July 1999.

Wading and snorkeling this lake found soft bottoms and no bivalves present.

Lion Lake at Progresso Lakes, Hidalgo County, Texas, 6 July 1999.

Wading and snorkeling this lake found soft bottoms and no bivalves present.

Mercedes Settling Basin (N 26°03'55.92", W 97°53'36.93"), Hidalgo County Texas, 6 July 1999.

Wading and snorkeling this site found apparently acceptable bottom types, but no bivalves present.

Oxbow lake immediately west of Santa Maria on U.S. 281, Hidalgo County, Texas, 6 July 1999.

Wading and snorkeling at this location produced only Asian clams.

La Feria Reservoir, Cameron County, Texas, 14 June 1999:

This location was not sampled due to an intense sewage smell in the area suggesting concerns about water quality. No shells were noted along its banks or levees.

Adams Garden Reservoir (N 26°06'23.27", W 97°47'09.70"), Cameron County, Texas, 14 June 1999.

Examination of exposed bottoms and wading shallows produced:

Adams Garden Reservoir Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	0	2.0+0.5x14	relatively long dead- very long dead	100.0
Asian clam – present (all long dead)				

Mud cracks patterns in the substrate virtually everywhere suggest this impoundment likely became dry, or nearly so, during drought conditions over the past 1-3 years. It is questionable if any bivalves survive here.

Confluence of canal and Reservoir Number 1 northeast of Los Indios (26°03'09.62", W 97°44'10.25"), Cameron County, Texas, 14 June 1999.

Examination of exposed shorelines and shallows and snorkeling deeper areas in the canal produced:

Canal at Reservoir Number 1 Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	18	6.0+0.5x9	very-recently to long dead	80.5
Southern mapleleaf	7	1.0	relatively long dead	19.5
Asian clam - present				

Although the reservoir bottom was very soft as were areas within the canal, some sites with sufficient flow rate apparently had enough silt swept away to allow mussels to survive.

Dixieland Reservoir, north shore (N 26°09'59.99", W 97°43'09.21"), Harlingen, Cameron County, Texas, 14 June 1999.

Wading shallow waters and snorkeling deeper areas produced:

Dixieland Reservoir Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	1	2.0	relatively recently dead	75.0
Southern mapleleaf	1	0.0	-	25.0
Asian clam - present				

This reservoir, which receives treated sewage effluent, has rip-rap along its banks, but mussels appear to persist in limited numbers in deeper waters.

Harlingen City Lake, Harlingen, Cameron County, Texas, 14 June 1999.

Wading shallow areas here produced no bivalves of any species. In March 1992, fishery management biologists found shells of Tampico pearlymussels here during other work in the area.

Resaca de los Fresnos, third access point off S.H. 345 northeast of San Benito (N 26°09'47.37", W 97°36'22.10"), Cameron County, Texas, 15 June 1999.

Samples were obtained from material dredged from the canal bottom by a steam shovel removing water hyacinth from this canal.

Resaca de los Fresnos Species	<i>N</i> alive	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	3	4.0+0.5x1	relatively long dead	88.9
Southern mapleleaf	0	0.5x1	relatively recently dead	11.1
Asian clam - present				

Resaca del Rancho Viejo north-northeast of Rancho Viejo, Cameron County, Texas, 7 July 1999.

A golf course and housing development surrounding this location apparently contributed massive nutrient loads resulting in soft bottoms and excess algal growth. No bivalves were found.

Resaca del Rancho Viejo at S.H. 3248 north of Brownsville, Cameron County, Texas, 7 July 1999.

Examination of this location found only very soft bottoms, but no bivalves were found.

Lake at S.H. 1732 (Resaca del Rancho Viejo) west of Olmito, Cameron County, Texas, 7 July 1999.

Examination of this location found an apparently-good substrate, but no bivalves were located.

Sweeney Lakes, Cameron County, 7 July 1999.

An attempt to sample this location was precluded by private lands and deep mud following heavy rains. Additionally, vegetation present associated with high-salinity areas suggested unionids would likely not be present.

Canal downstream of Sweeney Lakes at S.H. 1847, Cameron County, Texas, 15 June 1999.

Wading this canal found a deep, soft-silt substrate; no bivalves were located.

Resaca de los Cuates off S.H. 803 north of the water pumping station and north of S.H. 100 (N 26° 05'31.40", W 97°31'18.03"), Cameron County, Texas, 15 June 1999.

Wading and snorkeling this site produced:

Resaca de los Cuates Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	0	many	long dead	-
Tampico pearlymussel	0	1.0	relatively-recently dead	100.0
Asian clam - present				

All bivalves at this site were dead. It is possible this site may have been dry during recent droughts or periodic canal maintenance.

Indian Lake east of S.H. 803 and adjacent to Resaca de los Cuates near the Cameron County Water District office, Cameron County, Texas, 7 July 1999.

Examination of this site produced only Asian clams.

Canal (Resaca de los Cuates) adjacent to the Cameron County Water District office at S.H. 803, Cameron County, Texas, 7 July 1999.

Examination of this site produced:

Canal at Cameron County Water District office Species	N alive	N shells	Condition	Percentage
Tampico pearlymussel	0	0.5x2	very-long dead	100.0

Arroyo Colorado Cutoff, Adolphus Thomas Park, Cameron County, Texas, 26 December 1999.

A volunteer examined this site and reported no unionids or Asian clams were present.

However, estuarine dark falsemussel *Mytiliopsis leucophaeata* (abundant and alive), Atlantic rangia *Rangia cuneata* (2 alive; 2.0+0.5x1 recently to long-dead), and stout tagelus *Tagelus plebeius* (2.0 recently dead) were found.

Loma Alta Lake, northeast of Brownsville, Cameron County, Texas, 15 June 1999.

This lake was found to be a high-salinity water body and sampling efforts were aborted.

Rio Grande, dirt road access point east of Brownsville adjacent to Border Patrol station on S.H. 4 (N 25°55'39.09", W 97°20'59.50"), Cameron County, Texas, 15 June 1999.

Wading and snorkeling this site produced no bivalves despite an apparently-good substrate. Salt wedges that reportedly penetrate this location from downriver during low-flow periods appear to preclude freshwater species here.

Water Body and Species Summary

The number of specimens examined was not documented in 1992, but from 1993 through 1998 was >2,500; >3,000; >1,700; >7,200; >1,500, >1,200, respectively, and >3,000 in 1999. The number of specimens was somewhat inflated in 1999 due to a reexamination of B.A. Steinhagen Reservoir, Jasper and Tyler counties, in January 1999 during a drawdown period. The number of locations examined each year from 1992 through 1998 was 56, 162, 202, 179, 232, 87, and 118 respectively, with 136 locations covered in 1999. Although new data collected in 1997 and 1998 were less than in some previous years and a high proportion of 1999 data originated from volunteers, there was generally no particular suggestion of dramatic changes in abundance, distribution, or composition at most locations. However, dramatic declines in water levels in many rivers, streams, and reservoirs were clearly contributing to mortality by mid- to late 1999. Stranded mussel assemblages found or reported in 1999 were typically similar to those observed previously. Declines in both abundance and diversity can probably be anticipated in many areas for some time into the future.

In eastern Texas, B.A. Steinhagen Reservoir on the Neches River experienced a drawdown in 1999 associated with control of noxious aquatic macrophytes. Similar drawdowns also occurred in 1993-4 and 1996, with extremely cold weather in 1996 causing extensive mortalities among unionids. However, virtually all taxa documented previously were found surviving and most of those displayed signs of successful reproduction between February 1996 and January 1999. These prior drawdowns and the 1999 evaluation of survivors were described in Howells *et al.* (1999).

Dewatering problems in Central Texas were especially troubling. Most locations supporting rare endemic taxa experienced low water conditions and in many cases, became completely dry. Some populations were certainly reduced, if not eliminated completely. Previously-unrecognized populations of Texas pimpleback and Texas fawnsfoot were found in the Colorado River, but only after being killed by desiccation. Whether any individuals survived remains unknown.

Surveys on the Rio Grande from upstream of Presidio, through Big Bend National Park, downriver to the lower river valley downstream of Brownsville were able to cover many miles of river which have not been examined recently, if at all. Although efforts in this area were able to find valves of Texas hornshell and Salina mucket, no living specimens were located. None of the other endemic unionids were located either. Indeed, except for populations of Tampico pearlymussel and southern mapleleaf at sites in the lower Rio Grande Valley, even populations of taxa like giant floaters and yellow sandshells,

that are often abundant elsewhere, were absent. Sadly, much of this area is so extensively scoured during floods, subjected to extensive habitat alteration, or exposed to pollution and siltation problems that the continued existence of large, stable unionid populations in this drainage basin is unlikely.

Seasonal Weather Patterns

Years from mid-1995 through 1999 continued to be an alternating series of drought-caused low-water conditions. Drought conditions in 1995 and 1996 lowered river and reservoir levels nearly statewide. In some areas, low-water situations were still problematic in mid-1998 and in 1999, waters were low nearly everywhere statewide. Even several storms that produced scouring floods in 1998 were absent in 1999. Some smaller impoundments and streams were completely dewatered in 1999. Rivers like the Concho and Colorado rivers experienced no-flow conditions and dry, exposed bottoms for long stretches. Negative environmental impacts on local unionids were unavoidable.

Commercial Harvest

Although disease problems among pearl-culture oysters in Japan recently have reduced commercial mussel-shell harvest and exportation of mussel shells, a dramatic increase in harvest activity prompted by shell buyers in Tennessee and Arkansas occurred in Oklahoma in 1999 (Mark Ambler, Oklahoma Department of Wildlife Conservation; pers. comm.). This increase in harvest activity and associated purchase of lower-quality shells was unusual for the industry. Activity was sufficiently intense in Oklahoma that the state agency was prompted to take protective measures in some areas and then to confront legal challenges to these efforts (M. Ambler; pers. comm.). Field work by HOH was limited in 1999 largely to the Rio Grande (which rarely sees commercial harvest) and a two-day drawdown observation at B.A. Steinhagen Reservoir on the Neches River. Subsequently, there is no information available for Texas waters relative any similar increase in harvest here. Certainly if such an increase had occurred along with the current low-water conditions, local mussel populations could have been negatively impacted.

Zebra Mussels in Texas

Zebra mussels, that have invaded the Great Lakes and much of the Mississippi River Valley, had not been documented in Texas until late 1999. They have been introduced into Oklahoma, Arkansas, and Louisiana in the past few years (Howells *et al.* 1996), but despite the absence of monitoring, protective, or educational efforts by TPWD, none had been found locally. However, on 20 November 1999, a large boat that had been brought via truck from Lake Michigan (Michigan) to a marina at Lake Grapevine (Denton and Tarrant counties, Texas; upper Trinity River drainage) was found to be infected with zebra mussels (including living specimens). The marina owner recognized the zebra mussels from a magazine article, prevented the boat from being launched, and called TPWD Law Enforcement. In turn, Inland Fisheries and Spills-and-Kills Team personnel became involved. Although not every specimen on the infected boat was checked, all that were examined were zebra mussel *Dreissena*

polymorpha and not quagga mussel *D. bugensis*. The boat was cleaned and sterilized before being launched.

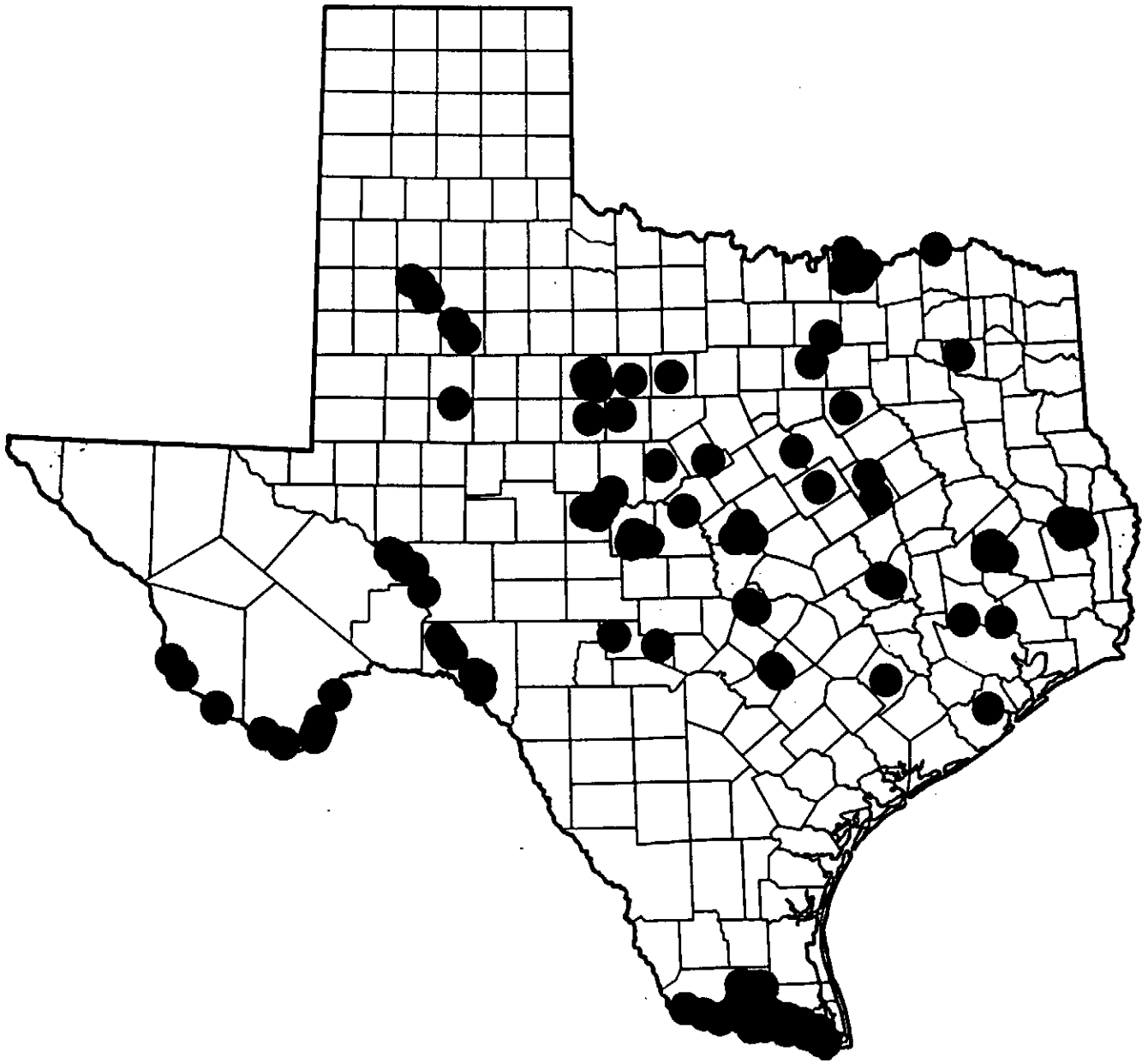
This “near miss”, thwarted only by an observant private citizen, demonstrates how important zebra mussel monitoring and informational programs can be. Lake Grapevine is upstream of the Dallas-Fort Worth Metroplex. An introduction at that lake with subsequent downstream distribution could have been an environmental and economic disaster.

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Figure 1. Locations surveyed for freshwater mussels (Family: Unionidae) in 1998 by Texas Parks and Wildlife Department personnel or by volunteers who subsequently provided data on these sites.



APPENDIX I.

Common and Scientific Names

Common names used in this and previous TPW mussel-distribution reports and associated scientific names include:

Family: Unionidae

Threeridge *Amblema plicata*

Flat floater *Anodonta suborbiculata*

Floater sp. *Anodonta* sp. – Collections in B.A. Steinhagen Reservoir in 1993 produced specimens that appear intermediate between giant floater and flat floater. They have higher beaks and darker coloration than flat floater and are more inflated and less-deep bodied. Similar specimens have been found by P. Hartfield (U.S. Fish and Wildlife Service, Jackson, Mississippi; pers. com.) in Mississippi. Whether these represent an undescribed species, unusual ecophenotype of flat floater, or a hybrid remains unresolved.

Rock-pocketbook *Arcidens confragosus*

Ouachita rock-pocketbook *Arkansia wheeleri*

Tampico pearlymussel *Cyrtonaias tampicoensis*

Spike *Elliptio dilatata*

Texas pigtoe *Fusconaia askewi*

Wabash pigtoe *Fusconaia flava*

Triangle pigtoe *Fusconaia lananensis*

Round pearlshell *Glebula rotundata*

Texas fatmucket *Lampsilis bracteata*

Plain pocketbook *Lampsilis cardium*

Louisiana fatmucket *Lampsilis hydiana*

Sandbank pocketbook *Lampsilis satura*

Yellow sandshell *Lampsilis teres*

Pocketbook *Lampsilis ovata* – not present in Texas

Pocketbooks – collectively refers to plain pocketbook, sandbank pocketbook, or both

Fatmuckets – collectively refers to Texas fatmucket, Louisiana fatmucket, or both

White heelsplitter *Lasmigona complanata*

Fragile papershell *Leptodea fragilis*

Pond mussel *Ligumia subrostrata*

Washboard *Megaloniaias nervosa*

Threehorn wartyback *Obliquaria reflexa*

Southern hickorynut *Obovaria jacksoniana*

Bankclimber *Plectomerus dombeyanus*

Louisiana pigtoe *Pleurobema riddellii*

Texas heelsplitter *Potamilus amphichaenus*

Pink papershell *Potamilus ohioensis*

Bleufer *Potamilus purpuratus*

Salina mucket *Potamilus salinasensis* – this species has also been called *Disconaias salinasensis* and

Potamilus metnecktayi

Giant floater *Pygaonodon grandis*
 Rio Grande monkeyface *Quadrula couchiana*
 Southern mapleleaf *Quadrula apiculata*
 Golden orb *Quadrula aurea*
 Smooth pimpleback *Quadrula houstonensis*
 Western pimpleback *Quadrula mortoni* – also known as *Quadrula pustulosa mortoni*
 Gulf mapleleaf *Quadrula nobilis*
 Wartyback *Quadrula nodulata*
 Texas pimpleback *Quadrula petrina*
 Pimpleback *Quadrula pustulosa*
 Mapleleaf or common mapleleaf *Quadrula quadrula*
 Pimpleback sp. or sp(p). – refers to golden orb, smooth pimpleback, western pimpleback, Texas pimpleback, pimpleback, or some combination of those species; identification of worn specimens and others from the Trinity River drainage can be difficult or impossible
 False spike *Quincuncina mitchelli*
 Squawfoot *Strophitus undulates* – also called creeper
 Lilliput *Toxolasma parvus*
 Texas lilliput *Toxolasma texasiensis* – western lilliput *Toxolasma mearnsi* is considered only a form of Texas lilliput herein
 Pistolgrip *Tritogonia verrucosa*
 Mexican fawnsfoot *Truncilla cognata*
 Fawnsfoot *Truncilla donaciformis*
 Texas fawnsfoot *Truncilla macrodon*
 Deertoe *Truncilla truncata*
 Tapered pondhorn *Uniomerus declivis*
 Pondhorn *Uniomerus tetralasmus*
 Paper pondshell *Utterbackia imbecillis*
 Little spectaclecase *Villosa lienosa*

Family: Corbiculidae

Asian clam *Corbicula* sp(p). – Most recognize all American corbiculas as *Corbicula fluminea*; however, some genetic studies suggest a second species may be present in Texas; no efforts were made to define species in this study

Family: Dreissenidae

Zebra mussel *Dreissena polymorpha*
 Quagga mussel *Dreissena bugensis*
 Zebra mussels – collectively zebra mussel, quagga mussel, or both

Family : Mactridae

Atlantic rangia *Rangia cuneata*

Family: Sphaeriidae

Fingernail clams and their relatives – no effort was made to identify species herein

SHELL CONDITION TERMINOLOGY

It is not usually possible to determine exactly how long a freshwater mussel shell has been dead. Different conditions such as water and substrate pH, erosive or corrosive environments, and exposure to sun can impact specimen condition and rate of disintegration. None the less, some qualitative estimate of time-since-death can be very useful. The following terms are used in TPW freshwater mussel surveys:

Very-recently dead: Soft tissue remains attached to the shell; shell in good condition, essentially as it would be in a living specimen; internal and external colors are not faded.

Recently dead: No soft tissue remains, but shell otherwise in good condition (looking like a living specimen that had been killed and cleaned); internally nacre is glossy and without evidence of algal staining, calcium deposition, or external erosive effects; internal and external colors are not faded.

Relatively-recently dead: Shell in good condition, but internally nacre is losing its glossy nature; algal staining, calcium deposition, or external erosive effects (or some combination of these) is evident on the nacre; internal and external colors often faded somewhat.

Long dead: Shell shows early signs of internal and external erosion, staining, calcium deposition, or some combination of these; most or all of the internal coloration and glossy nature has faded (especially in species with colored nacre); shell epidermis with major sections absent, or, if present, clearly aged and flaking.

Very-long dead: Shell shows significant signs of erosion, staining, and calcium deposition more widely pronounced than above; coloration often faded white or nearly so; relatively little intact epidermis left; for specimens in erosive environments, internal features (e.g., pseudocardinal teeth) and external features (e.g., pustules) often weathered and smoothed, or otherwise exfoliated; shells often chalky, brittle, and crumbling.

Subfossil: Shells with little or no epidermis; nacre faded white and entire shell often white; sometimes with signs of erosion, staining, or calcium deposition; typically chalky and powdery to the touch; shells often brittle and crumbling.

SHELL COUNTING METHODS

0.5×1 = one valve (one half shell); counted as one specimen in some calculations.

1 = one living specimen with a complete shell (two matched valves);

1.0 = one complete shell consisting of two, matching valves.

0.5×2 = one valve from each of two individuals; counted as two specimens in some calculations.

$3.0 + 0.5 \times 2$ = three complete shells (pairs of matched valves) and two additional unpaired valves from two additional individuals; counted as five specimens in some calculations.

