

**DISTRIBUTIONAL SURVEYS OF  
FRESHWATER BIVALVES IN TEXAS:  
PROGRESS REPORT FOR 1997**

by

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## ABSTRACT

During 1997, over 1,500 unionid specimens were documented from 87 locations (106 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 or recently-dead shells were found at 59% of the locations, 14% yielded only long-dead or subfossil shells, 24% produced no unionids or their remains, and 3% could not be accessed due to private lands or other local site problems which precluded sampling.

In conjunction with previous field-survey work 1992-1996, unionids appear completely or almost completely 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. A drought which began in 1995 and continued through 1996 caused water-level declines statewide with subsequent negative impacts on freshwater mussel populations. Heavy rains in late October and early November 1996 and again January-February and May-June 1997 caused extensive flooding statewide. Many water bodies experienced dramatic increases in water levels in 1997 after being severely dewatered in late 1995 and most of 1996. This seriously confounded sampling efforts at most sites in 1997. Additionally, travel restrictions ordered by the Texas legislature and other research projects served to direct effort away from field survey activities.

Primary sport and commercial species are still present in some waters in relative abundance. Many other species have declined in distribution and abundance in recent years due largely to wide-ranging environmental degradation and poor land management rather than to harvest. However, several rare species were discovered to have additional populations not previously recognized. Texas pimpleback *Quadrula petrina* and Texas fatmucket *Lampsilis bracteata* were only known to survive at two sites each in Central Texas. In 1997, one additional population of Texas pimpleback and two of Texas fatmucket were discovered in different drainage basins than the previously known survivors. An additional small population of golden orb *Q. aurea* was also found in the upper Guadalupe River.

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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). These data were ultimately used to compile *Freshwater Mussels of Texas* (Howells et al. 1996). Discussed here are findings from continuing surveys conducted in 1997.

## MATERIALS AND METHODS

Various habitats were sampled at each collection site examined. 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 were used to sample deeper waters. Brails and skimmer dredge were also used to sample deeper waters at several sites. Transects or quadrats were also employed in higher-density situations. 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).

Varying environmental conditions can confound attempts to accurately 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 inaccurate, these attempts to characterize time since death are useful in distinguishing between shells which have been dead for many years or decades from others which clearly died only days or weeks before collection. Terminology relating to specimen condition was summarized in Howells (1996a, 1996b).

# RESULTS AND DISCUSSION

## Red River

Stretches of the Wichita River and its associated impoundments and tributaries were surveyed 8-10 September 1997 at the request of the TPWD Inland Fisheries Management office at Wichita Falls, Texas. Except for three old museum reports from Wichita County (Strecker 1931) and several HOH collections at Lake Wichita, little had been reported about the unionid fauna of the Wichita River. Howells (1997b) presented additional site description details and further discussions of these collections. Specific identification of mapleleaves from this system and elsewhere in the Red River drainage is problematic. Ranges of mapleleaf *Quadrula quadrula* and southern mapleleaf *Q. apiculata* apparently overlap in this area. Specimens from the Wichita River drainage usually show very little sculpturing. However, immediately downstream, the Little Wichita River contains specimens which often show an increase in pustule size and tendency to concentrate in a dorsal to ventral row along the mid-disk (suggesting *Q. quadrula*). Still further downstream in the Pine Creek drainage, some specimens have similar sculpturing but others are clearly *Q. apiculata* with numerous small pustules across the entire disk. This suggests the Wichita River mapleleaves may simply be very poorly sculptured *Q. quadrula*, but genetic confirmation is lacking to date.

Wichita River at U.S. 283 downstream from Lake Kemp dam, Baylor County, Texas, 9 September 1997:

Wading and snorkeling this area produced only a single recently dead fragment of pink papershell.

Lake Diversion (two sites combined), Baylor County, Texas, 9 September 1997:

Wading shallow areas and snorkeling at these locations yielded:

Lake Diversion				
Species	N live	N shells	Condition	Percentage
Pink papershell	2	29.0+0.5x1	recently dead	97.0
Giant floater	0	1.0	recently dead	3.0

Shoreline access sites on this reservoir were limited to two locations with soft, mud bottoms. Commercial musselers have been observed taking mapleleaves spp. elsewhere in this reservoir (M. Howell, TPWD - Wichita Falls; pers. comm.).

Wichita River at hatchery discharge canal downstream of Lake Diversion dam, upstream of F.M. 1180, Archer County, Texas, 9 September 1997:

Wading and snorkeling at this site produced:

Wichita River at hatchery discharge canal				
Species	N live	N shells	Condition	Percentage
Fragile papershell	0	1.0	recently dead	6.3
Pink papershell	0	6.0+0.5x9	recently dead to subfossil	93.8

Wichita River at F.M. 1180, second crossing downstream of Lake Diversion, Wichita County, Texas, 9 September 1997:

Wading this area produced:



Second crossing below Lake Diversion at F.M. 1180				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Pink papershell	0	0.5x1	subfossil in bank	100.0

Wichita River at S.H. 25, Wichita County, Texas, 9 September 1997:  
No bivalves or their shells were found during examination of this site.

Wichita River at F.M. 369, Wichita County, Texas, 9 September 1997:  
Wading this area produced:

Wichita River at F.M. 369				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Yellow sandshell	0	0.5x1	very long dead	9.1
Pink papershell	0	0.5x10	long dead-very long dead	90.9

Wichita River at River Road downstream of Wichita Falls, Wichita County, Texas, 10 September 1997:  
Wading this area produced:

Wichita River at River Road downstream of Wichita Falls				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Mapleleaf sp.	0	0.5x2	subfossil	100.0

Wichita River at F.M. 2393, Clay County, Texas, 10 September 1997:  
Wading this area produced only a limited number of small Asian clams.

Wichita River at F.M. 810, Clay County, Texas, 10 September 1997:  
Wading this area produced:

Wichita River at F.M. 810				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Yellow sandshell	0	0.5x1	subfossil	16.7
Fragile papershell	0	1.0	relatively recently dead	16.7
Pink papershell	0	0.5x4	relatively recently dead- very long dead	66.7

Wichita River at F.M. 171, Clay County, Texas, 10 September 1997:  
Wading this area produced:

Wichita River at F.M. 171				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Yellow sandshell	0	0.5x1	very long dead	14.3
Fragile papershell	0	2.0	relatively recently dead	28.6
Pink papershell	0	0.5x4	very long dead	57.1

Beaver Creek at U.S. 283 (Wichita River drainage), Wilbarger County, Texas, 9 September 1997:

Wading this area produced:

Beaver Creek at U.S. 283				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Pink papershell	3	2.0+0.5x1	recently dead-long dead	15.9
Mapleleaf sp.	7	20.0+0.5x1	recently dead-long dead	73.7
Pondhorn	2	2.0	very long dead	10.5

Beaver Creek at F.M. 1781 (Wichita River drainage), Wilbarger County, Texas, 9 September 1997:

Wading this area produced:

Beaver Creek at F.M. 1781				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Pink papershell	0	3.0+0.5x4	recently dead-very long dead	70.0
Mapleleaf sp.	0	0.5x3	recently dead-very long dead	30.0

Buffalo Creek Reservoir (Wichita River drainage), boat ramp embayment, Wichita County, Texas, 10 September 1997:

Wading and snorkeling this site produced:

Buffalo Creek Reservoir				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Giant floater	4	2.0	recently dead	42.9
Mapleleaf sp.	7	0.0	-	50.0
Paper pondshell	0	1.0	recently dead	7.1
Asian clam - abundant				

Buffalo Creek at F.M. 1814 (Wichita River drainage), Wichita County, Texas, 9 September 1997:

Wading this area produced:

Buffalo Creek at F.M. 1814				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Yellow sandshell	0	1.0+0.5x5	relatively long dead-subfossil	40.0
Pink papershell	0	1.0	very recently dead	6.7
		2.0+0.5x5	relatively recently dead-subfossil	46.7
Mapleleaf sp.	0	0.5x1	long dead	6.7
Asian clam - common				

Gordon Lake, boat ramp area (Wichita River drainage), Wichita County, Texas, 8 September 1997:

Wading and snorkeling this reservoir produced:

Gordon Lake				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage

Giant floater	5	5.0	recently dead-very long dead	58.8
Mapleleaf sp.	6	0.0	-	35.3
Pondhorn	1	0.0	-	5.9
Asian clam - moderately abundant				

Kirby School Pond (Wichita River drainage), Wichita County, Texas, 9 September 1997:  
Wading and snorkeling this pond produced:

Kirby School Pond				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Giant floater	1	47.0+0.5x1	long dead	96.0
Mapleleaf sp.	1	0.0	-	2.0
Paper pondshell	0	0.5x1	relatively long dead	2.0

Plum Lake at sports center (Wichita River drainage), Wichita County, Texas, 8 September 1997:  
Wading and snorkeling this site produced:

Plum Lake				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Giant floater	3	2.0	recently dead	45.5
Pondhorn	4	0.0	-	36.4
Paper pondshell	2	0.0	-	18.2
Asian clam - common				

Holiday Creek upstream of Lake Wichita (Wichita River drainage), Archer County, Texas, 9 September 1997:  
Wading this site produced:

Holiday Creek upstream of Lake Wichita				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Giant floater	0	1.0	relatively recently dead	100.0

Lake Wichita (Wichita River drainage), Archer County, Texas, 10 September 1997:  
Wading and snorkeling one access site on this reservoir produced:

Lake Wichita				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Pink papershell	0	4.0+0.5x11	recently dead-very long dead	19.2
Giant floater	1	3.0	recently dead	5.1
Mapleleaf sp.	15	39.0+0.5x5	recently dead-very long dead, one subfossil	75.6
Asian clam - present				

Holiday Creek, crossing downstream of dam, Wichita County, Texas, 10 September 1997:

This location was found to essentially be a large drainage ditch with little standing water and extensive growths of terrestrial vegetation and so was not examined in greater detail.

Holiday Creek, at Spur 447, Wichita County, Texas, 9 September 1997:

Wading this area produced:

Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Yellow sandshell	2	1.0+0.5x3	recently dead-subfossil	23.1
Pink papershell	0	16.0+0.5x1	relatively recently dead-long dead	65.4
Mapleleaf sp.	1	2.0	relatively recently dead-long dead	11.5
Asian clam - present				

Lake Arrowhead (two sites)(Little Wichita River drainage), Clay County, Texas, 9 September 1997:

Wading and snorkeling waters to about 3 m failed to produce any unionids or their shells. Shells of Asian clam were present along the shoreline. However, this reservoir had experienced low-water conditions in 1996 which likely caused unionids to move away from exposed bottoms. Subsequent increase in water level in 1997 then placed most living mussels at depths greater than those sampled during this survey.

In July and August 1997, the U.S. Fish and Wildlife Service, TPWD, and other individuals conducted fish surveys of the Red River downstream of Lake Texoma. During these collections, unionids found were bagged, labelled, and sent to HOH for identification. The following locations represent the sites where mussels or their shells were obtained.

Red River, Oklahoma bank (33°51.007'N, 95° 59.507'W), sandy shoreline, Bryan County, Oklahoma, opposite Fannin County, Texas, 23 July 1997:

Red River, Oklahoma bank, Bryan County				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Pink papershell	0	1.0	recently dead	100.0

Blue River ca 3.2 km upstream of the confluence with the Red River, Bryan County, Oklahoma, opposite Fannin County, Texas, 23 July 1997:

Blue River				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Threeridge	0	0.5x1	subfossil	5.9
Yellow sandshell	0	0.5x6	long dead-very long dead	35.3
Pink papershell	0	1.0	very recently dead	5.9
Bleufer	0	0.5x9	very long dead-recently dead	52.9

Red River, sand bar just upstream of Bois d'Arc Creek, Fannin County, Texas, 24 July 1996:

Red River upstream of Bois d'Arc Creek				
Species	N live	N shells	Condition	Percentage
Pink papershell	0	0.5x1	very long dead	100.0

Red River at the confluence of Bois d'Arc Creek (33°51.181' x 95°52.215'), Fannin/Lamar counties, Texas, 24 July 1997:

Red River at Bois d'Arc Creek				
Species	N live	N shells	Condition	Percentage
Pink papershell	0	1.0	very long dead (juvenile)	100.0

Red River downstream from U.S. 259 (33°38.778' x 94°35.656), McCurtain County, Oklahoma opposite Bowie County, Texas, 27 August 1997:

Red River downstream of U.S. 259				
Species	N live	N shells	Condition	Percentage
Pink papershell	1	2.0+0.5x6	recently dead-long dead (juvenile)	42.9
Pocketbook sp. <i>Lampsilis</i> sp(p).	0	0.5x12	subfossil	57.1
Unidentified	0	fragments	subfossil	-

Collection of pocketbook sp(p). shells here was noteworthy. Plain pocketbook *Lampsilis cardium* has been reported in the Red River drainage (Lake Texoma) and sandbank pocketbook *L. satura* may occur here as well. Plain pocketbook is near the southwest limit of its range in this area and has not been taken by TPWD to date (it can be abundant elsewhere within its range). Howells et al. (1996) did not include the Red River as part of the range of sandbank pocketbook (believing the local species to be plain pocketbook). These species can be difficult to distinguish. Subfossil shells in this collection had very large, high umbos more typical of sandbank pocketbook and had the beak apex set slightly farther back than most plain pocketbooks (though plain pocketbook can be extremely variable). Unfortunately these shells are too broken and worn to allow definite identification.

Red River, dry sand bar upstream of S.H. 8 and Hurricane Lake (33°38.271' x 94°30.078'), Bowie County., Texas, 26 August 1997:

Red River upstream of S.H. 8				
Species	N live	N shells	Condition	Percentage
Pink papershell	0	6.0	recently dead-very long dead	100.0

Red River, sand island, 11.3 km upstream of rock shoals at Norwood Creek, McCurtain County, Oklahoma, opposite Bowie County, Texas, 26 August 1997:

Red River 11.3 km upstream of Norwood Creek				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Pink papershell	0	1.0+0.5x2	relatively recently dead	100.0

Additionally, the land snail *Anguispira alternata* (*N*=2) and two-ridged ramshorn snail *Helisoma anceps* (2) were also taken in this collection.

### Sabine River

Sabine River ca. 3.2 km downstream of S.H. 1794 (downstream of U.S. 59), Panola County, Texas, 15 October 1997:

During other work in the area, the following specimens were found:

Sabine River downstream of S.H. 1794				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Fragile papershell	0	1.0	long dead	20.0
Yellow sandshell	0	3.0+0.5x1	relatively recently dead	80.0

Toledo Bend Reservoir (upper reaches), Shelby County, Texas, 15 October 1997:

A single, relatively-recently dead shell of flat floater was taken in a gill net set to catch paddlefish. This specimen is the atypically dark, shallow-bodied, inflated form reported previously from sites on the Neches and Angelina rivers.

### Neches River

Angelina River downstream of S.H. 103, Nacogdoches County, Texas, 31 July 1997:

The following specimens were taken during other work in the area:

Angelina River downstream of S.H. 103				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Flat floater	1	2.0	recently dead	75.0
Giant floater	0	1.0	recently dead	25.0

All four specimens were juveniles. The flat floaters are the atypical local form which are less deep bodied and more inflated than normal.

Sam Rayburn Reservoir (Angelina River drainage), San Augustine/Angelina counties, Texas, 29 October 1997:

The following specimens were taken during other work in the area:

Sam Rayburn Reservoir				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Yellow sandshell	0	0.5x1	relatively recently dead	33.3

Fragile papershell	0	0.5x1	relatively recently dead	33.3
Threehorn wartyback	0	0.5x1	relatively recently dead	33.3

Fragile papershells are reported to occasionally produce gem-quality pearls, though few are actually taken by pearlers. The specimen above had a noteworthy pearl embedded in its nacre.

## Trinity River

Honey Creek (Trinity River drainage upstream of Lake Lavon) SW of Roland, Collin County, Texas, 13 October 1997:

A volunteer examined this area and found pondhorn present both in the creek and at an adjacent archaeological site.

Lake Lavon (Trinity River drainage), Collin County, Texas, summer 1996:

A local aquarist collected several unionid species here last year for transfer to his koi pond. Examples of each species were sent to HOH for identification in June 1997 and included: Louisiana fatmucket, fragile papershell, pink papershell, and southern mapleleaf, all of which were found alive. This reservoir has not been surveyed by HOH to date.

Creek at Plano (Trinity River drainage), Collin County, Texas, summer 1996:

A volunteer collected pondhorns sp. *Uniomerus* sp. and an example was sent to HOH for identification in June 1997.

Liberty Springs, Collin County, Texas, 24 November 1996:

A volunteer collected a single, relatively recently dead tapered pondhorn at this site and sent it to HOH for examination.

Cedar Creek Reservoir (15 sites combined)(Trinity R. drainage), Kaufman/Henderson counties, 8 October 1997:

The HOH staff and several volunteer musselers used hookah diving to perform timed searches and take 0.25-m<sup>2</sup> quadrat samples. The following species (both methods combined) were taken:

Cedar Creek Reservoir				
Species	N live	N shells	Condition	Percentage
Yellow sandshell	2	1.0	-	1.1
Giant floater	1	0.0	-	0.4
Southern mapleleaf	228	29.0	-	98.5
Asian clam - (one dead in samples, other shells observed at boat ramps)				

Because this reservoir had been surveyed earlier in 1993 (Howells 1995), comparisons of past and current data were possible. Species composition was essentially the same in both years with southern mapleleaves comprising over 98% of all unionids. Shell height frequency also remained relatively unchanged between years at about 6% of the southern mapleleaves larger than the minimum legal harvest size. In 1993, mean number/ 2, 4-min searches was 14.6 (all living); however, in 1997 mean number/7, 4-min searches was 7.0 live and 7.8 total (live + dead shells). Density estimates from 12 quadrats at 6 sites in 1993 was 15.4/m<sup>2</sup> (all living). In 1997, density dropped to 3.3/m<sup>2</sup> living and 5.2/m<sup>2</sup> total (living and dead shells). The dramatic decrease in catch per unit effort and density likely reflects losses associated with a decrease in water level during drought conditions in 1996. The general lack of change in species composition and southern mapleleaf size distribution suggests losses occurred across all species and sizes. Although dead

shells found were not returned to HOH, divers reported all appeared to have been dead about the same length of time (probably dying during drought conditions in 1996).

## Brazos River

Lake Sweetwater (Brazos River drainage), Nolan Co., Texas, 28 December 1996:

Examination of shoreline and shallow waters of this reservoir by a volunteer found only Asian clams.

Lake Trammell (Brazos River drainage), Nolan Co., Texas, 28 December 1996:

Examination of shoreline and shallow waters of this reservoir by a volunteer found only Asian clams.

Lake Abilene (Brazos River drainage), Taylor County, Texas, 17 August 1997:

A volunteer obtained only a single specimen of Asian clam during examination of shallows and shoreline areas. This reservoir had been low during the drought in 1996 but recently experienced a significant increase in water depth which likely placed any unionids present in deeper waters.

New Hamlin Reservoir (Brazos River drainage), Jones County, Texas, 26 June 1997:

The survey crew examining this site was told by local anglers that although mussels had been present in the reservoir, it had been completely dry as recently as two months earlier. Though the reservoir had recently filled, any unionids which may have survived the dewatering (assuming any did), would likely have been located in now-deep water.

Possum Kingdom Reservoir (Brazos River drainage), Pal Pinto County, Texas, August 1997:

A volunteer recovered a single, relatively long dead Tampico pearlymussel valve during a SCUBA dive at 7.6-m deep. This reservoir has not been surveyed by HOH to date except for a brief boat-ramp area examination at a single site.

Hubbard City Lake No. 2 (Brazos River drainage); Hill County, Texas, 10 September 1997:

Examination of the shoreline and shallow waters here produced a single recently-dead giant floater.

## Colorado River

Colorado River at County Road 2111 upstream from Ballinger, Runnels County, Texas, 15 July 1997:

Attempts to sample this area by wading were confounded by water levels which were elevated about 0.75 m and swift currents. No bivalves were found. The extremely rocky bottom here did contain living unionids several years earlier when it was examined at lower water levels. This site needs to be reexamined again during low, clear-water periods where unionids can be visually observed.

Ballinger City Park Lake (2 sites, Elm Creek, Colorado River drainage), Runnels County, Texas, 15 July 1997:

Examination of this area by wading and snorkeling produced:

Ballinger City Park Lake				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	21	5.0+	relatively recent-long dead	63.4
Bleufer	0	0.5x1	long dead	2.4
Southern mapleleaf	5	6.0+0.5x3+	relatively recent-long dead	34.1



Water levels were higher here than previously encountered. Water was flowing over the full length of the dam. During an earlier trip to this site Tampico pearl mussels and southern mapleleaves were found along the upstream side of the dam in significant numbers which suggested floods may concentrate them at this location. Although some specimens were again found along the dam, extensive concentration of specimens by flood waters was not especially evident; however, dead shell did seem to be sorted and deposited in some areas more than in others (presumably by water currents). Unionids were still present in soft clay and mud along the impoundment banks upstream of the dam. Only a single bleufer valve was found. Bleufer has never been found to be abundant here in prior HOH surveys.

Elm Creek downstream of Ballinger City Park Lake (Colorado River drainage), Runnels County, Texas, 15 July 1997:

This area was examined by snorkeling: Banks at the access site were unstable and the creek bottom was swept bedrock. No bivalves were found; however, some unionids probably do occur along the banks at more stable sites. Flooding here in May and June appears to have reached 5-6 m above normal creek levels. If mud and silt had covered the stream bottom earlier, flooding may have swept it away.

South Concho River from impoundment at Cristoval upstream (S) about 2 km, Tom Green County, Texas, 22 August 1996:

A kayak was used to access this area which was examined by wading and snorkeling. Substrate in the upper reaches was almost exclusively bedrock with only a limited amount of heavy cobble and gravel at a few sites. Banks were vegetated and largely intact; however, one site smelled of sewage and, in much of the area, water had a natural gas or oil scent. Relatively few fish were observed and gastropods were lacking. Asian clam was present in very limited numbers and only a single subfossil unionid fragment was found. Down-river at the headwaters of the impoundment the substrate was also bedrock or heavy cobble with dense cover of *Riccia* and occasional patches of yellow pond lily *Nuphar* but only a limited number of Asian clams were present.

Cristoval Reservoir immediately upstream of the dam (South Concho River), Tom Green County, Texas, 22 August 1997:

This area was examined by wading. The substrate was heavy cobble with dense growths of yellow pond lily and other emergent macrophytes. Only a limited number of Asian clams was found.

South Concho River immediately downstream of Cristoval Reservoir dam (fast-water areas), Tom Green County, Texas, 22 August 1997:

This area was examined by wading. The substrate was bedrock and heavy cobble with dense growths of emergent macrophytes. Only a limited number of Asian clams was found.

South Concho River, low-water crossing downstream of Cristoval Reservoir dam, Tom Green County, Texas, 5 August 1997:

This area was examined by wading. The substrate was bedrock, heavy cobble, and gravel. Only a limited number of Asian clams was found. Although this site was surveyed by HOH in the past, N. Strenth (Angelo State University, San Angelo, Texas; pers. comm.) recently reported the collection of a recently dead Texas hornshell valve at this site on 21 July 1991. Texas hornshell is believed endemic to the Rio Grande drainage. This and a previous specimen from the Llano River on 28 August 1992 (Ohio State University Museum OSUM:1976.356) prompted additional search efforts for it in the South Concho River drainage.

South Concho River about 1.5 km upstream of the low-water crossing and county park downstream of Cristoval, Tom Green County, Texas, 22 August 1997:

A kayak was used to access this site and areas were examined by wading and snorkeling. The substrate was bedrock and heavy cobble and gravel. However, unlike areas upstream of Cristoval Reservoir, a number of fish species were much more abundant here. Only a limited number of Asian clams and one subfossil threeridge valve were found. One stream-side drift area with numerous shells contained only Asian clam valves.

South Concho River immediately upstream of the low-water crossing and county park downstream of Cristoval, Tom Green County, Texas, 5 August 1997:

This area was examined by wading and snorkeling. The substrate was bedrock and heavy cobble and gravel with yellow pond lily and other aquatic macrophytes. Asian clams were relatively common and a single, relatively long-dead fragment of Texas fatmucket (in addition to subfossil fragments of Tampico pearlymussel and threeridge) was found in stream-side gravel deposits.

South Concho River immediately downstream of the low-water crossing and county park downstream of Cristoval, Tom Green County, Texas, 5 August 1997:

This area was examined by wading and snorkeling. The substrate was bedrock, heavy cobble, and gravel with yellow pond lily and other aquatic macrophytes. Banks on the west side were badly damaged by live stock. Only Asian clam was found.

Nasworthy Reservoir, several locations, Tom Green County, Texas, several dates:

Wading and snorkeling these areas produced collected:

Nasworthy Reservoir, mid-reservoir reed beds near Spring Creek, 5 August 1997				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	4	present	relatively long dead	57.1
Southern mapleleaf	3	present	relatively long dead	42.9
Asian clam - present				

Despite several prior collections in this reservoir, this particular site had not been examined. This location will be one of the areas which will not be modified during planned dredging of the reservoir. Although macrophyte growth was not excessive and substrates were acceptable mussel habitat, relatively few living unionids were located.

Nasworthy Reservoir, Hillside Road opposite Red Bluff peninsula,, 5 August 1997				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	56	present	long dead	59.6
Fragile papershell	4	present	long dead	4.2
Bleufer	9	present	relatively long dead	9.6
Giant floater	1	0.0	-	1.1
Southern mapleleaf	24	present	long dead	25.5
Asian clam - present				

Nasworthy Reservoir, Red Bluff ramp, 4 June 1997				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Tampico pearlymussel	14	12.0	long dead	23.4
Fragile papershell	3	0.0	-	2.7
Southern mapleleaf	49	26.0	long dead	67.6
Bleufer	2	2.0	relatively long dead	3.6
Giant floater	3	0.0	-	2.7
Asian clam - present				

Nasworthy Reservoir, shoreline opposite Red Bluff ramp, 4 June 1997

Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Threeridge	1	0.0	-	1.2
Tampico pearlymussel	24	2.0	long dead	31.3
Fragile papershell	0	2.0	relatively long dead	2.4
Southern mapleleaf	42	5.0	long dead	56.6
Bleufer	2	3.0	relatively long dead	6.0
Giant floater	2	0.0	-	2.4
Asian clam - present				

The threeridge specimen was the first HOH has found alive in this reservoir (subfossil shells are present near the mouth of South Concho River). Musselers report introducing this species years earlier at the site where the living specimen was collected and further indicate the released specimens came from Lake Buchanan (this specimen was morphologically like those from the central Colorado River drainage). Additionally, several relatively-recently dead valve of washboard were found in a boat-house canal on the Middle Concho River side of the Red Bluff area. Musselers also reported introducing washboards into this reservoir as well; these valves were the first confirmation of that introduction.

Spring Creek at Sherwood Cemetery Road crossing to upstream about 0.25 km, Irion County, Texas, 17 and 23 July 1997:

Wading and snorkeling produced:

Spring Creek, Sherwood Cemetery Road				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Texas fatmucket	1	4.0+0.5x1	relatively recent-long dead	85.7
Paper pondshell	0	0.5x1	long dead	14.3
Asian clam - present (both white and purple nacre morphs)				

Most of this area was found to be bedrock with little acceptable mussel habitat. Even in occasional areas of gravel or mud, unionids were generally not found to be present.

Spring Creek at Sherwood Cemetery Road crossing to downstream about 0.25 km, Irion County, Texas, 17 and 23 July 1997:

Wading and snorkeling this area found downstream of the low-water crossing to be almost exclusively bedrock with little acceptable mussel habitat present. Only a small number of Asian clams were present.

Spring Creek, Foster Park impoundment, upstream of Twin Buttes Reservoir (Concho River drainage), Tom Green County, Texas, 17 July 1997:

Wading and snorkeling produced.

Spring Creek, upstream of Foster Park impoundment dam				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Texas fatmucket	0	2.0+0.5x5	relatively long dead	87.5
Paper pondshell	0	1.0	relatively long dead	12.5
Asian clam - present				

Spring Creek downstream of Foster Park impoundment dam, upstream of Twin Buttes Reservoir (Concho River drainage), Tom Green County, Texas, 17 July 1997:  
Wading and snorkeling.

Spring Creek downstream of Foster Park dam				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Threeridge	0	0.5x1	long dead	7.7
Texas fatmucket	2	4.0+0.5x6	relatively recent-long dead	92.3
Asian clam - present				

Examination of the Foster Park site both above and below the dam on Spring Creek in May 1993 also produced Texas fatmucket shells and suggested survivors may still occur here. However, this was our first collection of living specimens and only the third location the species has been found alive. Texas fatmucket has still not been found alive in impoundments and the presence of shells above the dam may indicate another population surviving further upstream in Spring Creek. Efforts to access other sites further downstream were thwarted by new housing developments and fenced, private lands.

Dove Creek at S.H. 2335 upstream of Twin Buttes Reservoir (Concho River drainage), Tom Green County, Texas, 23 July 1997:

This area was examined to about 200 m downstream and 800 m upstream by wading. Only a limited number of Asian clams were found. Asian clams appeared less abundant than when previously examined by HOH in 1993. No trace of any unionids was found. Additionally, lush growth of filamentous algae present suggested excessive nutrient input from somewhere upstream.

Concho River at Ben Ficklin Road, San Angelo, Tom Green County, Texas, 5 August 1997:  
Wading and snorkeling produced:

Concho River at Ben Ficklin Road				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Fragile papershell	0	1.0	relatively long dead	50.0
Bleufer	1	0.0	-	50.0
Asian clam - present				

Concho River, upstream of washed out dam on Simm's Ranch upstream of Paint Rock (sanctuary), Concho County, Texas, 31 July 1997:  
Wading and snorkeling produced:

Concho River upstream of Simms dam				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Fragile papershell	1	6.0	relatively recent-long dead	21.9
Southern mapleleaf	8	6.0	relatively recent-long dead	43.8
Texas pimpleback	2	3.0+0.5x1	relatively recent-long dead	18.4
Bleufer	0	5.0	relatively recent-long dead	15.6
Asian clam - present				

Concho River, from washed out dam on Simm's Ranch downstream about 1 km (upstream of Paint Rock; sanctuary), Concho County, Texas, 31 July 1997:  
Wading and snorkeling produced:

Concho River, Simms dam downstream about 1 km				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Fragile papershell	3	8.0	very recent-long dead	8.0
Southern mapleleaf	21	12.0	very recent-long dead	24.1
Texas pimpleback	9	58.0+0.5x16	very recent-long dead	60.6
Bleufer	1	9.0	relatively recent-long dead	7.3
Asian clam - present				

This collection of Texas pimplebacks was the greatest number encountered to date. Most specimens of Texas pimpleback were very recently to recently dead (many still had soft tissue attached to their valves) as were some specimens of the other taxa found.

Concho River ca 1 km upstream of the Indian Pictographs upstream of Paint Rock, Concho County, Texas, 12 June 1997:

Wading and snorkeling produced:

Concho River about 1 km upstream of the Indian Pictographs				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Fragile papershell	5	4.0+	long dead	16.7
Southern mapleleaf	32	1.0	long dead	61.1
Texas pimpleback	6	1.0+0.5x1	relatively long dead	14.8
Bleufer	4	0.0	-	9.8
Asian clam - abundant				
Fingernail clam ( <i>Sphaeriidae</i> ) - common as shells; some living				

This was the first HOH survey of this area within the Paint Rock mussel sanctuary. It had deeply-grooved bedrock slabs across the river and several small islands with gravel bars behind each. Unionids were present both in gravel deposits at the bottom of the cracks in the bedrock and around the various islands.

Concho River at Indian Pictographs upstream of Paint Rock, Concho County, Texas, 12 June 1997:

Wading and snorkeling produced:

Concho River at Indian Pictographs				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Fragile papershell	3	1.0+0.5x2	long dead	7.3
Southern mapleleaf	43	7.0+0.5x1	recent-long dead	62.2
Texas pimpleback	16	1.0	relatively long dead	20.7
Bleufer	4	3.0+0.5x1	recent-long dead	9.8
Asian clam - very abundant				

This site contained the largest population of Texas pimplebacks found in TPWD surveys except for the locations above. When first examined in 1993, we located approximately 3.0 living Texas pimplebacks/hour. When reexamined in 1994, 18.7/hour were found. The site was not examined in 1995 or 1996, but on this present survey, 15.0/hour were found (not statistically different from 18.7) suggesting the population has not changed significantly in size. Further, relatively few Texas pimpleback shells were found indicating neither the drought conditions of 1995 and 1996 nor several floods in 1997 have harmed this population. A large percentage of the Asian clams found here was dead (recent to very long dead).

Although different size classes of all unionid species were present, no small juveniles were found. Interestingly, we have never taken Tampico pearlymussel or its shells in this area although it occurs both up- and downstream from this site.

San Saba River about 2 km south of U.S. 190 and 1 km east of S.H. 864, downstream of Fort McKavett, Menard County, Texas, 17 July 1997:  
Wading and snorkeling produced:

San Saba River downstream of Fort McKavett				
Species	N live	N shells	Condition	Percentage
Threeridge	3	0.5x1++	long dead	6.8
Tampico pearlymussel	2	0.0	-	3.4
Texas fatmucket	3	2.0+0.5x6	recent-long dead	18.6
Southern mapleleaf	18	present	long dead	30.5
Texas pimpleback	5	present	long dead	8.5
Unidentified <i>Quadrula</i>	3	present	long dead	5.1
Pistolgrip	14	1.0++	recent-long dead	25.4
Paper pondshell	1	0.0	-	1.7
Asian clam - very abundant - deep purple form				

This was our first collection of living unionids in the San Saba River (however, recent shells had been discovered at several sites downstream), the third population of living Texas pimplebacks found, the fourth population of Texas fatmuckets found, and the largest concentration of living pistolgrips located west of the Neches River. Mussels were generally present in heavy gravel and cobble with moderate flows. Major recent flooding which has impacted river systems throughout Central Texas seems to have missed the upper San Saba River drainage. Indeed, low flows have allowed macrophytes (yellow pond lily and water willow *Justicia americana*) to encroach on the stream and actually grow completely across it in several places. Other living and dead specimens were found in addition to those listed above and the land owner indicated giant floater also occurs at this site. Calcium deposition on shells is so heavy, it was not possible to determine if three specimens were southern mapleleaves or Texas pimplebacks without dissecting them.

Lake Buchanan, upper reaches, Llano and Burnet counties, Texas, several dates:

Several brief shoreline collections were made here during other research in the area.

30 January 1997: A single long-dead southern mapleleaf was collected and returned to HOH because of its atypically large size for this reservoir. Shells of other species generally found in this area were present on bottoms exposed during low-water conditions.

28 February 1997: A single long-dead threeridge was collected on the exposed bottom.

6 February 1997, Garrett Island:

Lake Buchanan, Garrett Island				
Species	N live	N shells	Condition	Percentage
Threeridge	0	6.0+0.5x2	relatively recently dead-recently dead	80.0
Tampico pearlymussel	0	1.0	recently dead	10.0
Bleufer	0	0.5x1	recently dead	10.0

Bear Creek at S.H. 2291 (Llano River drainage), Kimble County, Texas, 20 April 1997:

Examination of this site found only a few long-dead valves of Asian clam. The area showed signs of extensive scouring during flooding.

Llano River at Castell (Colorado River drainage), Llano County, Texas, 28 April 1997:

A volunteer collected the following specimens on a gravel bar:

Llano River, Castell				
Species	N live	N shells	Condition	Percentage
Threeridge	0	0.5x8	very long dead-subfossil	80.0
Yellow sandshell	0	0.5x1	subfossil	10.0
Texas pimpleback	0	0.5x1	subfossil	10.0
Asian clam - abundant				

Giddings State School Lake (Colorado River drainage), Lee County, Texas, 6 May 1997:

A casual shoreline collection produced two relatively-recent shells of Texas lilliput.

## Guadalupe River

Guadalupe River adjacent to the public boat ramp upstream of Ingram Lake, Kerr County, Texas, two dates:

10 March 1997: Examination of exposed bottoms produced only Asian clams.

20 September 1997: Examined exposed bottom areas produced the following specimens:

Guadalupe River, ramp upstream of Ingram Lake				
Species	N live	N shells	Condition	Percentage
Giant floater	1	0.0	(juvenile, 8 mm sl)	50.0
Texas lilliput	0	1.0	very recently dead	50.0
Asian clam - abundant				

Ingram Lake (Guadalupe River), upstream of dam during drawdown, Kerr County, Texas, two dates:

11 March 1997:

Ingram Lake, 11 March 1997				
Species	N live	N shells	Condition	Percentage
Texas lilliput	11	1.0	recently dead	37.5
Paper pondshell	20	0.0	-	62.5
Asian clam - abundant				

20 September 1997:

Ingram Lake, 20 September 1997				
Species	N live	N shells	Condition	Percentage
Texas lilliput	9	2.0	very recently dead	18.0
Paper pondshell	40	10.0	very recently dead (1 long dead)	82.0
Asian clam - abundant				

Attempts were made in March 1997 to drain this reservoir for silt removal; however, heavy rainfall

thwarted this effort. HOH staff examined the site on 11 March 1997 during this attempt. On 18 September 1997, drawdown efforts were initiated again and HOH visited the site two days later. Planned removal of silt and debris (nearly 1 m accumulation since floods earlier in the year) will dramatically reduce or eliminate the local unionid species. However, it appears that mussel populations here are rather transitory and species present are fast-growing, short-lived forms. It seems likely mussels are introduced periodically on glochidia-infected fishes, survive for a time, but are then destroyed or dramatically reduced in numbers by floods, droughts, or drawdowns.

Johnson Creek downstream of the Catholic Camp impoundment near HOH (Guadalupe River drainage), Kerr County, Texas, 3 February 1997:

A single recently dead Texas lilliput and abundant Asian clams were found by a local resident and sent to HOH for examination.

UGRA (Upper Guadalupe River Authority) Reservoir (Guadalupe River), Kerr Co., Texas, January 1996:

A river authority biologist reported finding eight paper pondshells in dredge spoils taken from an area near the dam where silt and debris had been deposited during a recent flood.

Guadalupe River, gravel bar downstream of UGRA dam, Kerr County, two dates:

Examination of a gravel bar and adjacent shallow waters following flooding produced:  
21 February 1997:

Guadalupe River below UGRA dam, 21 February 1997				
Species	N live	N shells	Condition	Percentage
Texas fatmucket	0	3.0	very recently dead-recently dead	33.3
Golden orb	0	3.0	very recently dead-recently dead	33.3
Texas lilliput	0	1.0	recently dead	11.1
Paper pondshell	0	0.5x2	relatively long dead	22.2

25 June 1997:

Similar examination of a gravel bar and shallow areas following additional flooding produced only a single, relatively-recently dead valve from paper pondshell and Asian clams. Previously, in November 1996 and February 1997, Texas fatmuckets and golden orbs had been found here following earlier floods. It would appear either the most recent flood failed to scour mussels from the bottom (as seen earlier), scouring was so severe that the limited number of specimens which may have been deposited here were so widely dispersed downstream that they were not detected, or earlier floods had eliminated these populations.

Lake Gonzales (Guadalupe River drainage), Gonzales County, Texas, 30 May 1997:

A group of volunteers assisted HOH staff in examining this area by wading and snorkeling. The following species were located:

Lake Gonzales				
Species	N live	N shells	Condition	Percentage
Threeridge	present	present	-	-
Giant floater	present	present	-	-
Paper pondshell	present	present	-	-
Louisiana fatmucket	1	0.0	-	-
Yellow sandshell	present	present	-	-
Southern mapleleaf	present	present	-	-
Asian clam spp.	present	present	-	-



Neither washboards or Tampico pearlymussels were found. When HOH examined this site in 1992 and 1993, threeridges comprised about 88% of the unionid assemblage. When examined in 1995, they were somewhat less numerous but still the dominant species. Later that same year, Ron Perry (SWTSU) surveyed the area and found threeridges comprised 44% of the unionids throughout the reservoir. Although detailed counts were not made in 1997, threeridge abundance was well below 25% of the unionids in the area. In 1995, HOH found the site heavily covered with filamentous algae, suggesting increased nutrient input. However, if these animals had been smothered by dense algal growths, large numbers of shells should have been present in 1997, but were not. It seems possible the dramatic decrease in abundance of threeridges reflects impacts of commercial harvest rather than mortality (few shells found) or emigration from the area (other unionids still present). The presence of non-commercial taxa and absence of washboards and Tampico pearlymussels also suggests harvest impact. Additionally, both giant floater and paper pondshell were more abundant than observed previously suggesting a faunal composition shift related to increased eutrophication and silt deposition.

Guadalupe River immediately downstream of Lake Wood, Gonzales County, Texas, 31 May 1997:

The team from the Lake Gonzales site above examined earlier shell dumps found here, but were unable to sample living unionids in the river due to fast, deep waters associated with precipitation and water releases upstream. Impacts on the local unionid population should be assessed when water levels and flow rates return to normal to assess possible flood impacts.

Guadalupe River, 29 km downstream of Gonzales (city), Gonzales County, Texas, 12 May 1997:

The following specimens were collected on a gravel bar:

Guadalupe River, 29 km downstream of Gonzales				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Threeridge	0	0.5x1	subfossil	8.3
Washboard	0	2.0+0.5x5	very long dead-subfossil	58.3
Southern mapleleaf	0	1.0+0.5x1	subfossil	16.7
Golden orb	0	1.0	relatively recently dead	8.3
False spike?	0	0.5x1	subfossil	8.3

San Marcos River, gravel bars downstream of S.H. 1977 (Staples), Guadalupe/Caldwell counties, Texas, 7 November 1997:

Shells and valves of threeridge and golden orb were obtained on gravel bars at river bends below Staples dam. In general, nearly all were subfossil and crumbling, but several specimens were still somewhat glossy interiorly and had apparently not been dead as long. All specimens were lost when the collection boat overturned several km further down stream.

Comal River just upstream of the confluence with the Guadalupe River, New Braunfels, Comal County, Texas, 29 July 1997:

During a SCUBA examination of about 2 km of river bottom in this area, only Asian clams were found in limited numbers with no evidence of unionids.

Southside Lions Camp Pond (San Antonio River drainage), Bexar County, Texas, 3 September 1997:

The following specimens were found during other work in the area:

Southside Lions Camp Pond, San Antonio				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Threeridge	0	0.5x1	very long dead	50.0
Texas lilliput	0	1.0	long dead	50.0

## Nueces River

Nueces River 1 km downstream of S.H. 359 below Lake Corpus Christi dam, San Patricio/Jim Wells counties, Texas, 11 December 1997:

A gravel bar at this site produced the following specimens:

Nueces River, 1 km downstream of S.H. 359				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Yellow sandshell	0	11.0	recently dead	91.7
Giant floater	0	1.0	recently dead	8.3

Extremely cold temperatures precluded wading or diving and a malfunctioning depth finder obscured our ability to locate snags, so dredge samples were not taken (previous snorkeling examination upstream earlier found heavy concentrations of timber on the bottom). This site needs to be reexamined during warmer weather. The specimens taken appeared to be recent predator kills. Another gravel bar was also located ca 1 km upstream of S.H. 359 just below the Lake Corpus Christi dam but was not examined.

## Baffin Bay

Lake Alice near Alice, Jim Wells County, Texas, 11 December 1997:

Efforts to examine shorelines and use a skimmer dredge in deeper waters were thwarted by very cold weather and high-water conditions. This site will be reexamined in the future during warmer weather and more-normal water levels.

## Rio Grande

Lake Balmorhea (Pecos River drainage), Reeves County, Texas, 26 August 1997:

The following specimens were collected during other work in this area:

Lake Balmorhea				
Species	<i>N</i> live	<i>N</i> shells	Condition	Percentage
Paper pondshell	0	2.0	recently dead	100.0
Asian clam - abundant				

This is the first time we have collected unionids in the Balmorhea Springs drainage and the farthest west this species has been taken in Texas.

## Waterbody Summary

Except for collections made in the Wichita and Concho river drainages and Cedar Creek Reservoir (Trinity River drainage), most collections in 1997 were made during other scheduled

research and did not provide sufficient information to allow much elaboration about waterbody status. Results of the Wichita River surveys were presented in Howells (1997b) and those for the Concho River, its tributaries, and Cedar Creek Reservoir are included above.

### **Species Summary**

Decreased sampling effort in 1997 prevents wide-ranging conclusion about the status of most unionid species. In general, no new data suggested dramatic changes from previously reported status for most species. A decrease in abundance of southern mapleleafs in Cedar Creek Reservoir probably corresponded to a large extent with lower water levels experienced there in 1996. No particular change in abundance was noted in Nasworthy Reservoir or Lake Wichita from previous surveys. Notable collections in 1997 included the location of a fourth population of golden orb in Kerr County, a third location in Menard County where Texas pimpleback still occurs, and two new populations of Texas fatmucket, one each in Tom Green and Menard counties.

### **Seasonal Weather Patterns**

Many areas in Texas saw drought conditions begin in mid-1995 and continue through most of 1996. During this time, some reservoirs experienced water level drops over 14 m. Exposed substrates resulted in unionid losses around the state with surviving mussels often concentrated below the water line nearer main channel areas. In late October and early November 1996, intense rains and flooding impacted some areas of the state. Heavy rainfall and flooding occurred again widely in February, May, and June 1997. The double combination of drought and flood periods collectively served to complicate mussel survey efforts. Unionid numbers were reduced at many locations when water levels dropped during drought conditions and survivors moved to areas still under water. Subsequent precipitation and floods then increased water levels thus either placing mussels in very deep waters or scattering surviving animals over much wider areas than they would normally inhabit under more-stable conditions. The full extent of both droughts and floods on local mussel populations will probably not be examined in many areas until well into 1998. Further, as climatic and environmental conditions moderated in later 1997, the Texas Legislature moved to require state agencies to dramatically reduce travel with a subsequent impact on field activities.

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**Figure 1.** Texas locations examined for the presence of freshwater mussels (Family: Unionidae) in 1997 by Texas Parks and Wildlife Department (TPWD) Inland Fisheries Research staff or where mussels were collected by other TPWD personnel or volunteers and sent to TPWD for examination.

