

DISTRIBUTIONAL SURVEYS OF
FRESHWATER BIVALVES IN TEXAS:
PROGRESS REPORT FOR 1995

by

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ABSTRACT

During 1995, over 1,700 unionid specimens were obtained. A total of 179 locations around the state were directly examined or actively sampled, or were represented by specimens sent to Heart of the Hills Research Station. Living specimens or recently-dead shells (indicating mussels may still persist in the area) were found at 42% of the sites examined. However, many such sites contained few mussels and little likelihood of large, healthy populations. Only long-dead or subfossil shells were found at 14% of the sites examined and no evidence of unionids was found at approximately 39% of the locations.

Based on previous survey work from 1992 through 1994 in conjunction with the present 1995 findings, unionids appear extirpated, or nearly so, from the Pedernales, Blanco, San Marcos, Llano, Medina, upper Guadalupe, upper Sulphur, areas of the San Jacinto, and much of the San Saba rivers. Tributaries of these and others off the Rio Grande, Sabine, and Neches rivers also have lost most or all of their mussel populations. Good species abundance and diversity were found in the Sabine, central Neches, parts of the Concho, central Colorado, central Brazos, portions of Buffalo Bayou, lower-central Guadalupe, and portions of the Frio and Nueces river systems.

Primary sport and commercial species of unionids are generally still sufficiently abundant that regulated fisheries can be maintained. However, many other species have declined dramatically in abundance and distribution in recent years. Unique endemic forms have been particularly impacted. Some species have been found alive (1992-1995) at only one to three locations and others have not been found at all. Losses appear to most often reflect wide-reaching ecological modifications, especially poor land management, rather than point-source pollution or over harvest.

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INTRODUCTION

Beginning in January 1992 (Howells 1994) and continuing through the present (Howells 1995; 1996), Texas Parks and Wildlife Department (TPWD) began surveys of freshwater mussels to increase understanding of this resource in the state. Indeed, there have been relatively few scientific studies in Texas waters to provide even baseline data. Field survey information has centered on freshwater mussel populations and habitat condition to help define status of the resource.

Around the turn of the century, a major industry developed in the Mississippi Valley harvesting freshwater mussel shells to produce buttons. This fishery generally reached as far southwest as Arkansas and the Red River (Coker 1919; Coker et al. 1921), but Texas was largely spared from what could be considered massive overharvest seen elsewhere. Mussel harvest for button shells did occur in Texas (Garrett 1929), but was comparatively minor by contrast to that seen in eastern rivers. The development of plastic buttons ultimately helped cause the demise of this fishery.

Although the intense Mississippi Valley fishery provoked study by the U.S. Fish Commission (Jones 1950), such scientific attention largely overlooked Texas unionids. A number of papers that have addressed local mussels have typically focused on site-specific species composition reports (e.g., Murray 1972, 1978; Littleton 1979; Metcalf 1982; Neck 1982a, 1982b, 1982c, 1986a, 1986b, 1989a, 1989b, 1990; Neck and Metcalf 1988). Shira (1913) discussed mussels associated with a pearl fishery in Caddo Lake. Two manuscripts listed species reported in Texas (Strecker 1931; Murray and Roy 1968). Studies of species distribution, abundance, changes in population structure, and associated fisheries were essentially lacking.

By late 1991, the commercial fishery in Texas for mussel shells used by the cultured pearl industry had increased to levels that could no longer be ignored. In the absence of baseline data, initial TPWD at Heart of the Hills Research Station (HOH) efforts first focused on a questionnaire survey of mussel-license holders (Howells 1993). Concurrently, in spring 1992, TPWD began statewide surveys of mussel populations in Texas. Results from preliminary field work beginning in 1992 have since been reported (Howells 1994; 1995; 1996). Discussed here are findings from continuing surveys conducted in 1995.

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-waters 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 examine deeper-water situations. Dive protocols followed Prentice (1995). A brail, similar to that reported by

Starrett (1971), was used at several locations when waters were too deep, fast, or cold to be otherwise sampled safely.

At some locations where mussel densities were initially estimated to exceed 1-2/m², quantitative samples were taken by placing a grid (PVC pipe, 0.25 m²) on the substrate and removing all bivalves and their shells found within the grid. Where mussel densities were estimated to be somewhat lower than 1-2/m², a 6.1-m rope was stretched between two poles and all specimens located 0.6 m on either side of this transect line were enumerated. In still lower-density situations (approximately 1-2/100 m²), where mussels present appeared to have been clearly disturbed or numbers altered (numbers present were not representative of undisturbed populations), or where time constraints or environmental conditions restricted sampling effort, more-broadly ranging, random hand-collections were made. Additionally, use of a 0.09-m² Peterson dredge (sampled a 30.5 x 30.5 cm area) in an unrelated HOH fish spawning habitat study occasionally produced unionids or their shells which were subsequently documented. Efforts in 1995 focused more on examining a large number of locations for estimates of presence or absence and general species composition than on obtaining density estimates. Additionally, in 1995, an increased number of low-probability sites where unionids were unlikely to have survived were examined for the possible presence of rare species or in certain upstream areas not previously checked for the presence of unionids. Because densities of mussels at most sites were so low, large numbers of replicate samples needed for statistically valid density estimates would have been prohibitive.

Results are presented in numbers collected and percent composition of the collection. Caution should be used in considering calculated percentages from collections where few specimens were taken, where mussel abundance and species composition had been altered (e.g., after harvest by musselers), or where collection efforts focused on obtaining large numbers of particular species (for laboratory work or reference specimens). Where a species at a given locality was represented only by fragments, it was recorded as present but fragments were not used in percent-composition calculations unless those fragments could clearly be associated with a specific specimen.

Mussels taken were identified to species whenever possible. Some subfossil or badly-weathered individuals could not be identified to species. Ill-defined taxonomic status of some "species" also precluded assigning specific identifications at this time. Other, non-unionid bivalves were also documented. Where identifications were in doubt, H.D. Murray (Trinity University), C.M. Mather (University of Arts and Sciences of Oklahoma, Chickasha), or J.A.M. Bergman (Boerne, Texas) were consulted. Electrophoretic analysis using horizontal starch gel techniques following Morziot and Schmidt (1990) was employed in some instances to assist with species identification.

Common and scientific names used generally follow Turgeon et al. (1988) and include:

Family: Unionidae

Threeridge (Amblema plicata),
Giant floater (Anodonta grandis),

Paper pondshell (Anodonta imbecillis),
 Flat floater (Anodonta suborbiculata),
 Floater sp. (Anodonta sp.) - Collections in B.A. Steinhagen Reservoir in 1993 produced specimens of an undescribed (or at least unrecognized) floater somewhat intermediate between giant floater and flat floater. This same species has been found by P. Hartfield (U.S. Fish and Wildlife Service, Jackson, Mississippi; personal communication, pers. comm.) in Mississippi. Whether it is actually an undescribed species, local 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),
 Louisiana fatmucket (Lampsilis hydiana),
 Sandbank pocketbook (Lampsilis satura),
 Yellow sandshell (Lampsilis teres),
 White heelsplitter (Lasmigona complanata),
 Fragile papershell (Leptodea fragilis),
 Pond mussel (Ligumia subrostrata),
 Washboard (Megalonaias nervosa),
 Threehorn wartyback (Obliquaria reflexa),
 Southern hickorynut (Obovaria jacksoniana),
 Bankclimber (Plectomerus dombeyanus),
 Louisiana pigtoe (Pleurobema riddelli),
 Texas heelsplitter (Potamilus amphichaenus),
 Pink papershell (Potamilus ohioensis),
 Bluefer (Potamilus purpuratus),
 Southern mapleleaf (Quadrula apiculata),
 Rio Grande monkeyface (Quadrula couchiana),
 "Gulf mapleleaf" (Quadrula nobilis - This species was originally described by Conrad (1854) as Unio nobilis and later by Simpson (1900) as Tritogonia verrucosa obesa; however, subsequent electrophoretic analyses at Heart of the Hills Research Station (HOH) successfully distinguished this species as distinct from both Q. quadrula and Q. apiculata. Examination of gill morphology places it in Quadrula and not with Tritogonia. No common name has been recognized, so the term "Gulf mapleleaf" has been applied herein,
 "Mapleleaf sp(p)." or Quadrula sp(p). - used when Q. apiculata and Q. quadrula could not be distinguished (pending electrophoretic analysis),
 Golden orb (Quadrula aurea),
 "Pimpleback sp(p)." - used where confusion between Q. aurea, Q. houstonensis, Q. mortoni, or Q. pustulosa (but not Q. petrina) could not be resolved,
 Smooth pimpleback (Quadrula houstonensis),
 Western pimpleback (Quadrula mortoni),
 Wartyback (Quadrula nodulata),
 Texas pimpleback (Quadrula petrina),

Pimpleback (Quadrula pustulosa),
 Mapleleaf (Quadrula quadrula),
 False spike (Quincuncina mitchelli),
 Squawfoot (Strophitus undulatus),
 Lilliput (Toxolasma parva),
 Texas lilliput (Toxolasma texasensis) - including T. mearnsi-types,
 Pistolgrip (Tritogonia verrucosa),
 Mexican fawnsfoot (Truncilla cognata)
 Fawnsfoot (Truncilla donaciformis),
 Texas fawnsfoot (Truncilla macrodon),
 Deertoe (Truncilla truncata),
 Tapered pondhorn (Uniomerus declivis),
 Pondhorn (Uniomerus tetralasmus),
 Pondhorn sp. or spp. (Uniomerus spp.),
 Little spectaclecase (Villosa lienosa),
 Family: Corbiculidae,
 Asian clam (Corbicula sp(p).) - no effort was made to define species,
 Family: Mactridae,
 Atlantic rangia (Rangia cuneata), and
 Family: Sphaeriidae,
 Fingernail clams - no effort was made to define species

Although once dead, varying environmental conditions can confound attempts to accurately define how long a given specimen has been dead, a number of terms have been used herein to convey an approximation of this. While inherently inaccurate, none the less, these attempts to characterize time since death are useful in distinguishing between animals that have been dead for many decades from others that clearly died only days or weeks before collection. Terminology related to specimen condition was summarized in Howells (1996).

RESULTS AND DISCUSSION

Canadian River

Canadian River at USH 385, Oldham County, 12 September 1995:

Wading and snorkeling along four bank-to-bank transects and 1.6 km of river bank areas at this site yielded no bivalves. Substrate was primarily deep-shifting sand.

Canadian River at USH 87, Potter County, 12 September 1995:

Wading and snorkeling along four bank-to-bank transects and 0.4 km of river bank areas at this site yielded no bivalves. Substrate was primarily deep-shifting sand.

Lake Meredith (two sites), 12 September 1995:

Hookah pump diving along 120-m transects produced the following bivalves:

a) Martin Canyon cove, Moore County:

| Lake Meredith, Martin Canyon | | | | |
|------------------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant floater | 0 | 2.0 | recent | 100.0 |
| Asian clam | 2 | 0.5 x 3 | recent | |

b) Harbor Bay, Hutchinson County:

| Lake Meredith, Harbor Bay | | | | |
|---------------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Asian clam | 4 | 1.0 | recent | - |

Canadian River at SH 207, Hutchinson County, 13 September 1995:

This site was essentially dry except for a small, shallow pool of standing water. It was examined from bank to bank for a distance of 0.4 km and no bivalves were found. Substrate was primarily deep-shifting sand.

Canadian River at SH 70, Roberts County, 13 September 1995:

Wading and snorkeling along four bank-to-bank transects and 0.8 km of river bank areas at this site yielded no bivalves. Substrate was primarily deep-shifting sand.

Canadian River at USH 83, Hemphill County, 13 September 1995:

Wading and snorkeling along six bank-to-bank transects and 0.4 km of river bank areas at this site yielded no bivalves. Substrate was primarily deep-shifting sand.

Red River Drainage

Sweetwater Creek at USH 83, Wheeler County, 13 September 1995:

This site was dry when examined and the substrate was deep sand.

North Fork Red River at USH 83, Wheeler County, 13 September 1995:

This site was dry when examined and the substrate was deep sand.

Salt Fork Red River at USH 83, Collingsworth County, 13 September 1995:

Although this site had several small pools of water and limited amounts of gravel, most of the area was dry and covered in deep sand.

Lake Theo, Caprock Canyons State Park, Briscoe County, 14 April 1995:

Park personnel obtained specimens found on exposed bottom areas during a low-water period and sent them to HOH for identification.

| Lake Theo | | | | |
|-----------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant floater | 0 | 0.5 x 5 | recent | 83.3 |
| Unidentified floater | 0 | 0.5 x 1 | recent | 16.7 |
| Asian clams (present) | | | | |

This collection was of interest because approximately 15 years earlier, blueback herring (*Alosa aestivalis*) were obtained from South Carolina and stocked in Lake Theo experimentally as a possible forage fish. Several eastern floaters (*A. cataractae* and *A. implicata*) use this fish as a host during its spawning runs. Because these herring were captured in the wild and stocked directly into Lake Theo, fishes which may have been infected with floater glochidia might have been a source of introduction for one or more non-native unionids as well. Indeed, among the valves recovered by park personnel and sent to HOH, one was more elongate and less deep bodied than any native giant floaters examined to date. However, this valve was too badly eroded for positive identification. Additional material from this area will need to be examined to confirm its identity.

Prairie Dog Fork Red River at USH 83, Childress County, 13 September 1995:
Little water was present at this site and the substrate was deep sand.

North Pease River at USH 83, Cottle County, 13 September 1995:
Little water was present at this site and the substrate was deep sand.

Copper Breaks State Park Lake (Pease River drainage), Hardeman Co., May 1995:
Park superintendent, O. Okerstrom, at HOH request, obtained bivalve specimens and sent them to HOH for identification. All proved to be Asian clams which Okerstrom indicated were sufficiently abundant as to be a problem in the swimming area there. No unionid shells were found.

North Fork Wichita River at USH 83, King County, 13 September 1995:
This site was dry when examined and contained only deep sand.

South Fork Wichita River at USH 83, King County, 13 September 1995:
This site was dry when examined and contained only deep sand.

Riverine sites in the upper Red River drainage of the Texas panhandle examined to date appear to experience regular dewatering, periodic scouring, and typically contained deep-shifting sand substrates which collectively preclude significant bivalve populations. Some small impoundments like Lake Theo and Lake Copper Breaks, and possibly others in the region, support populations of unionids, Asian clams, or both.

Big Cypress Bayou Drainage

Big Cypress Bayou near West Jefferson RR bridge, Marion County, 29 June 1995:
Brief examination of bars and shallows produced two specimens.

| Big Cypress Bayou at West Jefferson | | | | |
|-------------------------------------|--------|---------|----------------|---------|
| Species | N live | N shell | Condition | Percent |
| Pigtoe sp. | 0 | 1.0 | very long dead | 50.0 |
| (<i>Fusconaia</i> sp.) | | | | |
| Fragile papershell | 1 | 0.0 | - | 50.0 |

Black Cypress Bayou between SH 155 and USH 59, Marion and Cass counties, 9 March 1995:

Attempts to sample this area were thwarted by flooding and high waters. Depth soundings indicated sufficient depths to require hookah pump diving to survey local unionids in the future.

Big Cypress Bayou upstream of Caddo Lake between SH 155 and USH 59, Marion and Harrison counties, 9 March 1995:

Although flooding and high waters again confounded sampling efforts during this period, a skimmer dredge was used in deeper waters. Snags resulted in partial tows and precluded estimating sampling effort.

| Big Cypress Bayou upstream of Caddo Lake | | | | |
|------------------------------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Unidentified unionid fragment | 0 | 0.5 x 1 | long dead | 100.0 |
| Fingernail clams | 25 | 3.0 | recent | - |
| Asian clams | 10 | 10.0 | recent | - |

Caddo Lake, upper reaches, Marion and Harrison counties, 9 March 1995:

This area was sampled by wading, brailing, and dredging without success. However, flood conditions and numerous snags precluded efficient sampling. Much of the area sampled may have been flooded terrestrial habitat.

Sabine River Drainage

Sabine River USH 49, Harrison and Panola counties, 29 June 1995:

Gravel bars and shorezone areas were examined.

| Sabine River at USH 49 | | | | |
|------------------------|--------|---------|----------------|---------|
| Species | N live | N shell | Condition | Percent |
| Western pimpleback | 0 | 0.5 x 1 | long dead | 50.0 |
| Yellow sandshell | 0 | 1.0 | very long dead | 50.0 |
| Asian clam - present | | | | |

Sabine River between USH 59 and Boards Ferry, Harrison and Panola counties, 28 June 1995:

Gravel bars and shorezone areas were examined.

| Sabine River between USH 59 and Boards Ferry | | | | |
|----------------------------------------------|--------|---------|----------------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 0 | 1.0 | very long dead | 50.0 |
| Yellow sandshell | 1 | 0.0 | - | 50.0 |

Sabine River near Carthage, Panola County, 10 July 1995:

Wading and examining exposed bars and banks produced 11.5 yellow sandshells which were very-recently dead. Shells of this species were very abundant. General mussel habitat was being lost due to excessive sand deposition, the apparent cause of so many recently-dead shells.

Sabine River between USH 59 and Black Shoals, Panola County, 28 June 1995:
Gravel bars and shorezone areas were examined.

| Sabine River between USH 59 and Black Shoals | | | | |
|----------------------------------------------|--------|---------------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 0 | 2.0 | very long dead | 8.7 |
| Texas pigtoe | 2 | 3.0 + 0.5 x 1 | relatively recent | 26.1 |
| Louisiana fatmucket | 1 | 0.0 | - | 4.3 |
| Sandbank pocketbook | 0 | 1.0 | very long dead | 4.3 |
| Yellow sandshell | 0 | 3.0 | relatively recent | 13.0 |
| Fragile papershell | 1 | 1.0 | recently dead | 8.7 |
| Bankclimber | 0 | 2.0 | long dead | 8.7 |
| Bleufer | 0 | 1.0 | long dead | 4.3 |
| Western pimpleback | 0 | 1.0 | relatively recent | 4.3 |
| Pistolgrip | 2 | 2.0 | relatively recent | 17.4 |
| <u>Asian clam - present</u> | | | | |

Toledo Bend Reservoir, three sites, Sabine County, 5 December 1995:
Exposed bottom areas and shallow, shoreline waters were examined during a low-water period (reservoir levels were down 2.5-3.0 m because of limited rainfall). Asian clams were present.

| Toledo Bend Reservoir west side at CR 3121 | | | | |
|--------------------------------------------|--------|----------------|---------------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant Floater | 0 | 13.0 + 0.5 x 4 | recently dead | 40.5 |
| Unidentified floater | 0 | 3.0 | recently dead | 7.1 |
| Louisiana fatmucket | 0 | 5.0 + 0.5 x 2 | recently dead | 16.7 |
| Yellow sandshell | 0 | 1.0 | recently dead | 2.4 |
| Pond mussel | 0 | 10.5 | recently dead | 26.2 |
| Texas lilliput | 1 | 0.5 | long dead | 4.8 |
| Tapered pondhorn | 0 | 0.5 | long dead | 2.4 |

Toledo Bend Reservoir west side reservoir at CR 944, 5 December 1995:
This site was found to be private land and, in the absence of legally-required prior written permission, could not be surveyed by TPWD personnel.

| Toledo Bend Reservoir west side at SH 87 | | | | |
|------------------------------------------|--------|-----------------|---------------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant Floater | 1 | 10.0 + 0.5 x 2 | recently dead | 23.2 |
| Paper pondshell | 1 | 0.0 | - | 1.8 |
| Louisiana fatmucket | 0 | 1.0 | long dead | 1.8 |
| Pond mussel | 4 | 23.0 + 0.5 x 14 | recently dead | 73.2 |

Neches River Drainage

Neches River, Davy Crockett National Forest, between SH 94 and Holly Bluff Branch, Trinity and Angelina counties, 25 July 1995:
A single living yellow sandshell was collected during paddlefish stocking at this site.

Sandy Creek at SH 2913 off Attoyac Bayou, Shelby Co., 7 June 1995:
Wade sampling this stream produced:

| Sandy Creek | | | | |
|----------------------------|--------|----------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Triangle pigtoe | 1 | 0.0 | - | 50.0 |
| Louisiana fatmucket | 1 | 0.0 | - | 50.0 |
| Unidentified fragment | 0 | fragment | - | |
| Asian clam - present (few) | | | | |

Only these two living specimens were found indicating a decrease in abundance and diversity since prior examination on 25 July 1994 when seven, living or recently-dead unionid taxa (29 total specimens) were located (equal sampling effort in both years). Like many East Texas streams, sand appears to be smothering local mussel populations here. Aside from the dramatic decline of local mussels in general, this site was one of only two found to date which still supports rare, endemic triangle pigtoe (found in 1994 to have been extirpated from its type localities in Nacogdoches).

Sam Rayburn Reservoir (Angelina River drainage), nine sites, 5 December 1995:
Exposed bottom areas and shallow, shoreline waters were examined during a low-water period (reservoir levels were down 2.5-3 m because of limited rainfall). The following species were collected and Asian clams were noted at all sites.

| Sam Rayburn Reservoir, boat ramp off CR R255 east of dam, Jasper County | | | | |
|-------------------------------------------------------------------------|--------|----------------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant Floater | 2 | 7.0 + 0.5 x 2 | recent | 18.6 |
| Paper pondshell | 0 | 6.0 | recent | 10.2 |
| Unidentified floater | 0 | 0.5 X 1 | recent | 1.7 |
| Louisiana fatmucket | 10 | 21.0 + 0.5 x 1 | recent | 54.2 |
| Yellow sandshell | 0 | 1.0 + 0.5 x 1 | recent | 3.4 |
| Fragile papershell | 2 | 1.0 | recent | 5.1 |
| Bleufer | 0 | 0.5 X 1 | very recent | 1.7 |
| Texas lilliput | 2 | 1.0 | relatively recent | 5.1 |

| Sam Rayburn Reservoir, Ayish Creek arm at CR 1715, San Augustine County | | | | |
|-------------------------------------------------------------------------|--------|----------------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant Floater | 1 | 22.0 | recent | 39.0 |
| Paper pondshell | 0 | 1.0 | recent | 1.7 |
| Unidentified floater | 0 | 5.0 | recent | 8.5 |
| Louisiana fatmucket | 3 | 20.0 + 0.5 x 1 | recent | 40.7 |
| Yellow sandshell | 0 | 0.5 x 1 | long dead | 1.7 |
| Pond mussel | 0 | 0.5 x 1 | long dead | 1.7 |
| Texas lilliput | 0 | 3.0 + 0.5 x 1 | relatively recent | 6.8 |

| Sam Rayburn Reservoir, Ayish Creek arm at SH 83, San Augustine County | | | | |
|-----------------------------------------------------------------------|--------|----------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant Floater | 0 | 1.0 | recent | 2.4 |
| Paper pondshell | 0 | 4.0 | recent | 9.5 |
| Unidentified floater | 0 | 34.0 + 0.5 x 3 | recent | 88.1 |

| Sam Rayburn Reservoir, east side at SH 147, San Augustine County | | | | |
|------------------------------------------------------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant Floater | 2 | 4.0 | recent | 27.3 |
| Unidentified floater | 1 | 2.0 | recent | 13.6 |
| Louisiana fatmucket | 0 | 6.0 | recent | 27.3 |
| Yellow sandshell | 0 | 5.0 | recent | 22.7 |
| Fragile papershell | 0 | 1.0 | recent | 4.5 |
| Texas lilliput | 1 | 0.0 | recent | 4.5 |

| Sam Rayburn Reservoir, west side at SH 147, San Augustine County | | | | |
|------------------------------------------------------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant Floater | 0 | 1.0 | recent | 50.0 |
| Unidentified floater | 0 | 1.0 | recent | 50.0 |

| Sam Rayburn Reservoir, east side Attoyac Bayou arm, San Augustine County | | | | |
|--------------------------------------------------------------------------|--------|----------------|--------------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant Floater | 0 | 2.0 | recently dead | 10.0 |
| Unidentified floater | 0 | 14.0 + 0.5 x 1 | recently dead | 75.0 |
| Texas lilliput | 0 | 3.0 | relatively recently dead | 15.0 |

| Sam Rayburn Reservoir, west side Attoyac Bayou arm, Nacogdoches County | | | | |
|------------------------------------------------------------------------|--------|----------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant Floater | 0 | 3.0 + 0.5 x 1 | recent | 12.1 |
| Unidentified floater | 0 | 26.0 + 0.5 x 3 | recent | 87.9 |

| Sam Rayburn Reservoir, Shirley Creek Park at CR 226, Nacogdoches County | | | | |
|-------------------------------------------------------------------------|--------|----------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant Floater | 1 | 15.0 + 0.5 x 1 | recent | 48.6 |
| Paper pondshell | 0 | 2.0 | recent | 5.7 |
| Unidentified floater | 0 | 5.0 | recent | 14.3 |
| Fragile papershell | 0 | 1.0 | recent | 2.9 |
| Texas lilliput | 0 | 9.0 + 0.5 x 1 | recent | 28.6 |

| Sam Rayburn Reservoir, Angelina River arm at SH 103, Angelina County | | | | |
|----------------------------------------------------------------------|--------|---------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant Floater | 2 | 1.0 | recent | 9.7 |
| Unidentified floater | 1 | 6.0 + 0.5 x 2 | recent | 29.0 |
| Southern mapleleaf | 16 | 0.0 | - | 51.6 |
| Texas lilliput | 0 | 3.0 | recent | 9.7 |

The unidentified floater found at the Sam Rayburn Reservoir sites was similar to others taken at B.A. Steinhagen Reservoir downstream in 1993 (Howells 1994). They resemble flat floater (Anodonta suborbiculata) but are less deep bodied, have higher beaks, are more inflated, and often have a darker, less glossy epidermis. Whether these represent only a local ecophenotype of flat floater, an undescribed species, or a hybrid remains unresolved. Initial concerns they may have been an introduced population of the Asian floater (A. woodiana) have been ruled out.

Private pond (Neches River drainage), Tyler County, 28 August 1995:

During examination of shallow waters and shorezone areas, a single living Texas lilliput was obtained; this species was extremely abundant at the site. Giant floaters were also observed but not collected.

Trinity River Drainage

Fort Richardson State Park Lake, Jack County, 13 Nov 1995:

During other fishery work at this site, the HOH staff found recently-dead shell fragments of four paper pondshells.

Clear Fork Trinity River below Lake Weatherford, Parker County, 14 September 1995:

Examination of gravel bars and shallow areas produced only two recently-dead Asian clams.

West Fork Trinity River south of Decatur, Wise County, 14 September 1995:

Examination of gravel bars and shallow areas produced only a single unionid.

West Fork Trinity River south of Decatur

| Species | N live | N shell | Condition | Percent |
|------------|--------|---------|-----------|---------|
| Pistolgrip | 0 | 0.5 x 1 | long dead | 100.0 |

West Fork Trinity River south of Bridgeport, Wise County, 14 September 1995:

Examination of gravel bars and shallow areas produced two unionids.

West Fork Trinity River south of Bridgeport

| Species | N live | N shell | Condition | Percent |
|------------------------------|--------|---------|----------------|---------|
| Yellow sandshell | 0 | 0.5 x 1 | very long dead | 50.0 |
| Bleufer | 0 | 0.5 x 1 | very long dead | 50.0 |
| <u>Asian clams - present</u> | | | | |

North Lake (Elm Fork Trinity River), Dallas County, 8 June 1995:

Wading shallow and shorezone areas of this impoundment found only Asian clams to be present.

Elm Fork Trinity River at SH 51 west of Gainesville, Cooke County, 14 September 1995:
Examination of gravel bars and shallow areas produced two unionid species.

| Elm Fork Trinity River | | | | |
|------------------------------|--------|---------|----------------|---------|
| Species | N live | N shell | Condition | Percent |
| Yellow sandshell | 0 | 0.5 x 1 | very long dead | 50.0 |
| Bleufer | 0 | 0.5 x 1 | very long dead | 50.0 |
| <u>Asian clams - present</u> | | | | |

East Fork Trinity River at USH 75 north of McKinney, Collin County, 14 September 1995:
Examination of gravel bars and shallow areas produced only a single recently-dead Asian clam.

Bardwell Reservoir (Trinity R. drainage), Ellis County, June 1995:
A single southern mapleleaf taken by two musselers from this reservoir was sent to HOH for identification. Commercial musseling on this impoundment had been prohibited in 1991 by the U.S. Army Corps of Engineers but was again permitted in November 1995. It has subsequently attracted a number of commercial harvesters who are now working this impoundment.

Fairfield Reservoir, Freestone County, 30 August 1995:
Dredge hauls made at the mouth of the heated discharge canal produced no bivalves; extremely hot water temperatures preclude most living animals in this area and the bottom was covered deeply with bacterial-algal slime. Wading and snorkeling at an embayment opposite the power plant intake, between the intake and the dam, and at a boat ramp on the west side of the reservoir (sites combined below) produced several unionids.

| Fairfield Reservoir | | | | |
|-------------------------------|--------|---------------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Paper pondshell | 1 | 2.0 | relatively recent | 6.0 |
| Southern mapleleaf | 28 | 1.0 | relatively recent | 58.0 |
| Lilliput sp.? | 4 | 8.0 + 0.5 x 6 | relatively recent | 36.0 |
| <u>Asian clams - abundant</u> | | | | |

Surface water temperature at the three sites away from the heated discharge canal were 34.4 C with bottom temperatures only slightly cooler. No small juvenile unionids were found and, although several year classes were present, specimens taken were large, mature adults. This reservoir, like Tradinghouse Creek Reservoir (see comments below) contains blue tilapia (Tilapia aurea) which may inhibit successful unionid recruitment.

Trinity River at Richland Creek, Navarro County, 10 July 1995:
Shorezone and shallow areas were sampled by wading.

| Trinity River at Richland Creek | | | | |
|---------------------------------|--------|---------------|---------------|---------|
| Species | N live | N shell | Condition | Percent |
| Pigtoe (<i>Fusconaia</i> sp.) | 0 | 0.5 x 1 | subfossil | 3.6 |
| Louisiana fatmucket | 0 | 1.0 | subfossil | 3.6 |
| Yellow sandshell | 0 | 6.0 + 0.5 x 2 | recently dead | 28.6 |
| Fragile papershell | 0 | 3.0 + 0.5 x 2 | very recent | 17.9 |
| Texas heelsplitter? | 1 | 1.0 | recently dead | 7.1 |
| Fragments | 0 | 0.5 x 11 | subfossil | 39.3 |

The fragments collected included threeridge, pigtoes (*Fusconaia/Pleurobema*), quadrulids, and washboard.

Trinity River, from Big Eddy upstream, seven sites, Houston County, 27 July 1995:

Mussels from seven sites were obtained from gravel bars and shallow waters during paddlefish spawning habitat surveys in this area.

| Trinity River from Big Eddy upstream (sites combined) | | | | |
|-------------------------------------------------------|--------|-----------------|--------------------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 1 | 12.0 + 0.5 x 19 | long dead to subfossil | 22.7 |
| Pigtoe (<i>Fusconaia</i> sp.) | 0 | 0.5 x 1 | long dead | 0.7 |
| Yellow sandshell | 2 | 4.0 + 0.5 x 25 | recent to long dead | 22.0 |
| Fragile papershell | 0 | 5.0 + 0.5 x 1 | very recent to long dead | 4.3 |
| Washboard | 0 | 3.0 + 0.5 x 3 | long dead | 4.3 |
| Threehorn wartyback | 0 | 3.0 | recent | 2.1 |
| Bankclimber | 0 | 4.0 + 0.5 x 12 | recent to long dead | 11.3 |
| Texas heelsplitter or pink papershell | 0 | 4.0 + 0.5 x 3 | recent to very long dead | 5.0 |
| Bleufer | 1 | 4.0 + 0.5 x 6 | recent to subfossil | 7.8 |
| Southern mapleleaf | 0 | 2.0 + 0.5 x 4 | long dead | 4.3 |
| Smooth pimpleback? | 0 | 2.0 + 0.5 x 6 | long dead | 5.7 |
| Pistolgrip | 0 | 4.0 + 0.5 x 10 | relatively recent to long dead | 9.9 |

Trinity River at SH 14, Wood County, 11 July 1995:

Two unionids were found in a Ponar grab sample during a paddlefish spawning habitat survey.

| Trinity River at SH 14 | | | | |
|------------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Western pimpleback? | 0 | 0.5 x 1 | long dead | 50.0 |
| Deertoe | 1 | 0.0 | - | 50.0 |

Trinity River immediately upstream of Big Eddy, Leon County, 11 July 1995:
Gravel bars and adjacent shallow-water areas were examined.

| Trinity River upstream of Big Eddy | | | | |
|------------------------------------------|--------|----------------|-------------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 0 | 5.0 + 0.5 x 9 | subfossil | 25.9 |
| Pigtoes (<i>Fusconaia</i> spp.) | 0 | 3.0 + 0.5 x 1 | subfossil | 7.4 |
| Yellow sandshell | 0 | 1.0 + 0.5 x 1 | subfossil | 3.7 |
| Washboard | 0 | 1.0 + 0.5 x 5 | subfossil | 11.1 |
| Bankclimber | 0 | 4.0 + 0.5 x 15 | subfossil | 35.2 |
| Pink papershell or Texas heelsplitter | 0 | 1.0 | recent | 1.9 |
| Bleufer | 0 | 1.0 | very recent | 1.9 |
| Pimpleback spp. | 0 | 0.5 x 2 | subfossil | 3.7 |
| Pistolgrip | 0 | 4.0 + 0.5 x 1 | subfossil | 9.3 |

Trinity River downstream of USH 21, Houston County, 24 July 1995:
Gravel bars and adjacent shallow-water areas were examined.

| Trinity River downstream of USH 21 | | | | |
|------------------------------------|--------|----------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Yellow sandshell | 0 | 10.0 + 0.5 x 1 | recent | 68.8 |
| Fragile papershell | 0 | 3.0 + 0.5 x 2 | recent | 31.3 |

Trinity River at Mussel Shoal Creek and 0.5 km upstream in Mussel Shoal Creek,
San Jacinto County, 26 July 1995:
Gravel bars and adjacent shallow-water areas were examined.

| Trinity River at and upstream in Mussel Shoal Creek | | | | |
|-----------------------------------------------------|--------|---------------|----------------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 0 | 2.0 + 0.5 x 7 | subfossil | 33.3 |
| Louisiana fatmucket | 0 | 0.5 x 2 | subfossil | 7.4 |
| Yellow sandshell | 0 | 0.5 x 3 | subfossil | 11.1 |
| Washboard | 0 | 0.5 x 1 | subfossil | 3.7 |
| Bankclimber | 0 | 0.5 x 3 | subfossil | 11.1 |
| Bleufer | 0 | 0.5 x 2 | subfossil | 7.4 |
| Southern mapleleaf | 0 | 0.5 x 2 | subfossil | 7.4 |
| Pimpleback spp. | 0 | 0.5 x 4 | subfossil | 14.8 |
| Texas lilliput | 0 | 0.5 x 1 | very long dead | 3.7 |

This creek once held a diverse and unique assemblage of unionids (Strecker 1931). In 1993, TPWD examined sites on the upper reaches of this creek and found a limited number of living or recently-dead specimens of six unionid species. Failure to locate even recently-dead shells in the lower reaches of this creek in 1995 suggests mussel abundance and diversity has declined dramatically in recent years.

Trinity River 2.0 km downstream of Muscle Shoal Creek, San Jacinto County, 26 July 1995:
Gravel bars and adjacent shallow-water areas were examined.

| Trinity River at and upstream of Muscle Shoal Creek | | | | |
|-----------------------------------------------------|--------|---------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 0 | 1.0 + 0.5 x 1 | subfossil | 10.5 |
| Pigtoe sp. | 0 | 1.0 | subfossil | 5.3 |
| Yellow sandshell | 0 | 0.5 x 4 | subfossil | 21.1 |
| Washboard | 0 | 1.0 + 0.5 x 3 | subfossil | 21.1 |
| Bankclimber | 0 | 6.0 | subfossil | 31.6 |
| Southern mapleleaf | 0 | 1.0 | subfossil | 5.3 |
| Gulf mapleleaf? | 0 | 1.0 | subfossil | 5.3 |

Trinity River downstream of SH 106, Liberty County, 15 August 1995:
Gravel bars and adjacent shallow-water areas were examined but no unionids were found.

Trinity River 2.8 km upstream of USH 90, Liberty County, 15 August 1995:
Gravel bars and adjacent shallow-water areas were examined.

| Trinity River at and upstream of USH 90 | | | | |
|-----------------------------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Southern mapleleaf | 0 | 0.5 x 2 | subfossil | 100.0 |
| <u>Asian clam - present</u> | | | | |

Trinity River downstream of USH 90, Liberty County, 22 August 1995:
Gravel bars and adjacent shallow-water areas were examined but no unionids were found.

Trinity River upstream of USH 10, Liberty County, 22 August 1995:
Gravel bars and adjacent shallow-water areas were examined but no unionids were found.

Brazos River Drainage

In addition to survey efforts within this drainage basin in 1995, several specimens, which had been collected in 1994 by fishery management biologists and subsequently frozen, were ultimately sent to HOH for examination in 1995 are also included.

Pepper Creek south of FM 2305 near Temple, Bell County, 4 Nov 1995:

A volunteer collected several species on exposed bottoms and in shallow waters during a low-water period and sent them to HOH for identification.

| Pepper Creek, Bell County | | | | |
|---------------------------|--------|-----------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Paper pondshell | 0 | 3.0 | recent | 5.9 |
| Louisiana fatmucket | 3 | 19.0 + 0.5 x 11 | recent | 64.7 |
| Pondhorn sp. | 0 | 3.0 | recent | 5.9 |
| Texas lilliput | 2 | 5.0 + 0.5 x 5 | recent | 23.5 |
| Asian clam - present | | | | |

Possum Creek 19-23 km east of Temple, Bell County, 20 Nov 1995:

A volunteer collected several specimens during a low-water period and sent them to HOH for identification.

| Possum Creek, Bell County | | | | |
|---------------------------|--------|---------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Pondhorn sp. | 2 | 7.0 + 0.5 x 1 | recent | 100.0 |

Salt Creek 1.6 km east Oenaville, Bell Co., 13 December 1995:

A volunteer collected eight living and two recently-dead paper pondshells along the shorelines and in shallow water in soft Taylor marl bottoms and sent them to HOH for identification. No Asian clams were present.

Hubbard City Lakes 1-5 (Brazos River drainage), Hill County, 29 August 1995:

Wading and snorkeling these impoundments yielded no bivalves from lakes 2-5 probably reflecting dense beds of macrophytes and deep deposits of decaying vegetation on the substrate. Two unionid species were found in Lake 1.

| Hubbard City Lake 1 | | | | |
|---------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Paper pondshell | 2 | 0.0 | - | 33.3 |
| Texas lilliput? | 4 | 0.0 | - | 66.7 |

Tradinghouse Creek Reservoir, McClennen County, 29 August 1995:

Cooler areas of this reservoir opposite the power plant intake structure were sampled by hookah-diving transects and random-area searches. Surface water temperature was 35.6 C with bottom waters only slightly cooler.

| Tradinghouse Creek Reservoir - two 40-m transect | | | | |
|--------------------------------------------------|--------|----------------|----------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant floater | 0 | 5.0 | relatively long dead | 9.6 |
| Tampico pearlymussel | 11 | 14.0 + 0.5 x 1 | relatively long dead | 50.0 |
| Southern mapleleaf | 8 | 13.0 | relatively long dead | 40.4 |
| Asian clam - abundant | | | | |

| Tradinghouse Creek Reservoir - random search | | | | |
|----------------------------------------------|--------|---------|----------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant floater | 0 | 0.5 x 1 | relatively long dead | 3.3 |
| Tampico pearlymussel | 15 | 5.0 | relatively long dead | 66.7 |
| Yellow sandshell | 0 | 0.5 x 1 | relatively long dead | 3.3 |
| Southern mapleleaf | 4 | 4.0 | relatively long dead | 26.7 |
| <u>Asian clam - abundant</u> | | | | |

All specimens taken were large, old adults; no small juveniles were found. The substrate was deeply pitted with holes dug by blue tilapia during feeding and nesting activities. Upon return to HOH and sectioning of some of the Tampico pearlymussel valves, it was noted each had at least 15 major growth-rest lines. Blue tilapia were reported introduced here at least as early as 1977 with densities reaching 63 kg/hectare in 1983 and 104 kg/hectare in 1985 (Muoneke 1989). The absence of juvenile unionids may reflect mortality caused by tilapia digging activities or by direct consumption. Assuming the growth-rest lines found in sectioned shells represent annuli, the number of lines corresponds closely to the number of years tilapia have been abundant in the reservoir.

Brazos River at the mouth of the Little River, Milam County, 1 August 1994:

| Brazos River at mouth of Little River | | | | |
|---------------------------------------|--------|---------|-------------|---------|
| Species | N live | N shell | Condition | Percent |
| Fragile papershell | 0 | 1.0 | very recent | 50.0 |
| Pink papershell | 0 | 1.0 | very recent | 50.0 |

Brazos River near the mouth of Little River, Milam County, 3 August 1994:

| Brazos River near mouth of Little River | | | | |
|-----------------------------------------|--------|---------|-------------|---------|
| Species | N live | N shell | Condition | Percent |
| Tampico pearlymussel | 0 | 1.0 | very recent | 100.0 |

Brazos River upstream of the mouth of the Little Brazos River, Brazos County, 26 July 1994:

| Brazos River upstream of the mouth of Little Brazos River | | | | |
|-----------------------------------------------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Smooth pimpleback | 1 | 0.0 | - | 50.0 |
| Texas fawnsfoot | 1 | 0.0 | - | 50.0 |

The collection of a living Texas fawnsfoot represents the first confirmed living individual since at least the 1970s (Howells et al., In Press). Recently-dead shells were found by TPWD in 1994 (Howells 1996), but the species has become extremely rare in recent years.

Little Brazos River upstream of the confluence with the Brazos River, Brazos County, 28 July 1994:

| Little Brazos River upstream of confluence with Brazos River | | | | |
|--------------------------------------------------------------|--------|---------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 0 | 0.5 x 1 | subfossil | 25.0 |
| Yellow sandshell | 0 | 1.0 | relatively recent | 25.0 |
| Southern mapleleaf | 0 | 0.5 x 2 | subfossil | 50.0 |

Brazos River downstream of the mouth of the Little Brazos River, Brazos County, 28 July 1994:

| Brazos River downstream of the mouth of Little Brazos River | | | | |
|-------------------------------------------------------------|--------|---------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Smooth pimpleback | 0 | 1.0 | relatively recent | 25.0 |
| Texas fawnsfoot | 0 | 3.0 | very recent | 75.0 |

Lake Mexia (Navasota River drainage), two sites, Limestone County, 30 August 1995:

Wading and snorkeling shorezone sites in this reservoir produced two unionid species.

| Lake Mexia - city park boat ramp area | | | | |
|---------------------------------------|--------|---------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant floater | 1 | 0.5 x 1 | relatively recent | 7.1 |
| Southern mapleleaf | 25 | 0.5 x 1 | relatively recent | 92.9 |
| Asian clams - none found | | | | |

| Lake Mexia - county road bridge across upper reservoir | | | | |
|--------------------------------------------------------|--------|---------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant floater | 0 | 1.0 | relatively recent | 8.3 |
| Southern mapleleaf | 9 | 2.0 | relatively recent | 91.7 |
| Asian clams - none found | | | | |

Colorado River Drainage

Spring Creek between Nasworthy Reservoir and Twin Buttes Reservoir dam (Concho River drainage), Tom Green County, 27 June 1995:

Shallow areas at this site were examined by wading and snorkeling but found only a few long-dead valves of Tampico pearlymussel, southern mapleleaf, and Asian clam. However, water temperatures here were extremely cold as a result of spring input and discharges from Twin Buttes Reservoir upstream.

Nasworthy Reservoir heated-discharge canal (Concho River drainage), Tom Green County, 27 June 1995:

This area was sampled by dredge, brail, and wading and snorkeling.

| Nasworthy Reservoir discharge canal: dredge hauls (N = 2) upper canal | | | | |
|-----------------------------------------------------------------------|--------|---------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Tampico pearlymussel | 0 | 9.0 + 0.5 x 2 | long dead | 52.4 |
| Southern mapleleaf | 0 | 8.0 + 0.5 x 2 | long dead | 47.6 |
| Asian clam - several | | | | |

| Nasworthy Reservoir discharge canal: brail hauls (N = 2) central canal | | | | |
|------------------------------------------------------------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| No bivalves taken | | | | |

| Nasworthy Reservoir discharge canal: random area search, lower canal and adjacent mud flats | | | | |
|---------------------------------------------------------------------------------------------|--------|----------------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant floater | 1 | 4.0 | relatively recent | 17.9 |
| Tampico pearlymussel | 2 | 4.5 | long dead | 25.0 |
| Bleufer | 1 | 0.0 | - | 3.6 |
| Southern mapleleaf | 3 | 11.0 + 0.5 x 1 | long dead | 53.6 |

Dead shell recovered in the upper discharge canal suggests mussels may periodically invade this area during low-temperature discharge periods, but are subsequently lost during times of high discharge temperatures. Most dead shells recovered on the mud flats near the mouth of the discharge canal more likely reflect losses during a draw-down about two years earlier when the area would have been dry (nearly all appeared to have been dead about the same length of time).

Nasworthy Reservoir at Red Bluff boat ramp (Concho River drainage), Tom Green County, 27 June 1995:

Shallow areas at this site were sampled by wading and snorkeling.

| Nasworthy Reservoir, Red Bluff ramp | | | | |
|-------------------------------------|--------|---------|--------------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Tampico pearlymussel | 8 | 2.0+ | long dead | 21.7 |
| Fragile papershell | 1 | 0.0 | - | 2.2 |
| Bleufer | 0 | 2.0 | very recent to long dead | 4.3 |
| Southern mapleleaf | 28+ | 5.0+ | long dead | 71.7 |
| Asian clam - abundant | | | | |

All unionid taxa found included juveniles. This suggests the prior drawdown may not have seriously impacted reproduction among local mussels.

Elm Creek Reservoir (previously Winters Lake; Colorado River drainage), Runnels County, 25 July 1995:

This impoundment was examined by wading and snorkeling; only a single, long-dead Asian clam valve was found. Foot prints found on mud bottoms

under 3 m of water suggest water levels in this reservoir had been much lower but had recently experienced a dramatic increase.

Elm Creek at SH 261 (second crossing above Ballinger), Runnels County, 25 July 1995:

This stream was sampled by wading and snorkeling.

| Elm Creek at SH 261 | | | | |
|-----------------------------|--------|----------------|---------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Tampico pearlymussel | 26 | 11.0 + 0.5 x 4 | recent to long dead | 70.7 |
| Texas fatmucket | 2 | 1.0 + 0.5 x 1+ | recent to long dead | 6.9 |
| Southern mapleleaf | 10 | 0.5 x 1+ | recent to long dead | 19.0 |
| Texas pimpleback | 2 | 0.0 | - | 3.4 |
| <u>Asian clam - present</u> | | | | |

The Elm Creek sanctuary site supports the only currently-known population of Texas fatmuckets and one of only three populations of Texas pimpleback. Examination of other Elm Creek sites between USH 83 and Elm Creek Reservoir at Winters found the stream to be intermittent.

Elm Creek Lake (city park at Ballinger), Runnels County, 25 July 1995:

This impoundment was sampled by wading and hookah pump diving.

| Elm Creek Lake at Ballinger | | | | |
|-----------------------------|--------|----------------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Tampico pearlymussel | 23 | 3.0 x 0.5 x 1+ | relatively recent | 77.1 |
| Southern mapleleaf | 7 | 0.0 x 1+ | relatively recent | 22.9 |
| <u>Asian clam - present</u> | | | | |

Brady Creek at Brady City Park, McCulloch County, 22 August 1995:

Examination of shallow shorezone areas produced a single recently-dead shell of paper pondshell.

Gorman Creek, Colorado Bend State Park, San Saba Co., 16 May 1995:

This stream was examined from its spring source to the falls above the Colorado River. Only a limited number of Asian clams was found. This site was examined as a possible introduction and sanctuary site for rare, endemic unionids; however, upper reaches are spring-like with hard bottom and clear water and lower reaches become choked with vegetation. Two valves of threeridge were found at the cliff edge adjacent to the falls above the Colorado River. These were long dead valves which may have been deposited there by a predator.

Colorado River, inlet below Gorman Falls, Colorado Bend State Park, San Saba Co., 16 May 1995:

No bivalves were found during examination of this site.

Colorado River, two sites ca. 1-2 km upstream of SH 580, San Saba Co., 16 May 1995:

High waters from prior rains prevented access to the river; only a few

Asian clam valves were present. However, on a vast bedrock shelf on the southwest river bank held deposits of flotsam but no gravel or sand suggested the area may not experience the severe flood scouring typical of many other sites in the Hill Country. Terrestrial vegetation on opposing river banks was largely intact. Additionally, three subfossil valves from a pimpleback (*Q. petrina*, *aurea*, or *houstonensis*) were found in earlier flood deposits well above river level (possibly deposited by the 1978 flood).

Cherokee Creek, four sites, San Saba Co., 16 May 1995:

Shorezones and shallow areas at the following sites were examined.
Road crossing to Colorado Bend State Park: Substrate here was bedrock.

Only Asian clams were present.

Cemetery Road east: Substrate at this site was mostly bedrock. Only Asian clams were present.

Cemetery Road west: The substrate was gravel at this location and Asian clams were abundant. One subfossil southern mapleleaf valve was found.

SH 501: This area was mostly bedrock substrate. Access was blocked by private lands.

Unlike most Hill Country streams, Cherokee Creek shows little signs of flooding and scouring typical of other streams. Although actively ranched, the lands in this area are generally well covered with vegetation and stream banks are intact. Unless this creek dries out during droughts, some locations like the Cemetery Road area may represent a potential introduction site for endemic central Texas mussels. However, the near-total absence of unionids or their remains suggests historical dewatering likely occurred.

South Llano River headwaters, Edwards County, 18 Oct 1995:

A volunteer who assists with TPWD mussel surveys examined this area for the presence of bivalve mollusks. Although shells were found and examination of the site was with oral permission of the land owner, no written permission was obtained. Therefore, neither the results of the survey nor its location can be released under current state law.

Llano River at Llano River State Park, Kimble County, 2 February 1995:

Examination of the river in this area produced two subfossil valves of threeridge, but no living unionids or recent remains. This appears to be an upstream record for this species in the Llano River, but it now appears extirpated from this system.

Llano River, several sites between Mason and Junction, 16 June 1995:

These sites were waded, snorkeled, and gravel bars were examined.

Lake Junction, Kimble County: The bottom of this small, main-stream impoundment was largely cobble, but with some mud, silt, and sand in embayments. Asian clam was abundant and a single, living paper pondshell was found. This is the first living unionid TPWD has taken in the Llano system since our mussel work began.

Chapel Road crossing, Kimble County: This area was predominantly bedrock and gravel substrate with Asian clams and unidentified subfossil unionid fragments; a single subfossil valve from false spike was

found.

CR 1871, Mason County: This site was a wide area in the river with a solid bedrock bottom; only a few Asian clams were present.

CR 2389, Mason County: This location included a deep cut through bedrock with fast water, cobble and solid rock substrates. Only a few Asian clams were present.

USH 87, Mason County: This site had cobble and gravel bottom with some aquatic macrophytes. Efforts located subfossil fragments of threeridges and southern mapleleaves/pimplebacks (*Quadrula* spp.), living and dead Asian clams, and two, relatively-recent valve fragments of Texas fatmucket. At present, Texas fatmucket has only been found alive in recent years in one stream off the Colorado River drainage in Runnels County. Fragments at the USH 87 location were relatively-recently dead (apparent predator kills) suggesting somewhere upstream in the Llano River a few survivors may still endure. However, no apparently acceptable habitat has been located by TPWD to date. This location was the type locality for both Texas fatmucket and Texas pimpleback, two rare, endemic unionids.

CR 1723, Mason County: Substrate here was solid bedrock with only a few Asian clams present.

Beaver Creek at USH 87, Mason Co., 16 June 1995:

Shallow areas and gravel bars were examined. There were signs of heavy scouring and deposition of cobble and gravel. Only Asian clams and subfossil fragments of unionids (*Amblema*, *Quadrula*) were found.

Lake Buchanan (Colorado River drainage), westcentral shoreline, Llano County, 27 March 1995:

A single, recently-dead shell from a small juvenile Tampico pearlymussel was located along the shoreline during other research in the area. Recent elevations in water level appear to have placed other unionid specimens in somewhat deeper waters.

Lake Marble Falls (Colorado River), Burnet County, 16 Nov 1995:

Exposed bottoms and shallow waters were examined during a low-water period.

| Lake Marble Falls | | | | |
|-----------------------------|--------|----------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 0 | 2.0 + 0.5 x 2 | subfossil | 6.3 |
| Giant floater | 1 | 7.0 | recent | 12.7 |
| Tampico pearlymussel | 6 | 6.0 | recent | 19.0 |
| Southern mapleleaf | 3 | 2.0 + 0.5 x 1 | recent | 9.5 |
| Smooth pimpleback | 13 | 3.0 + 0.5 x 15 | recent | 27.0 |
| Bleufer | 14 | 1.0 + 0.5 x 1 | recent | 25.4 |
| <u>Asian clam - present</u> | | | | |

This is the first collection of living smooth pimplebacks from the Colorado River drainage in recent years (Howells et al., In Press). Within the last five years, TPWD took one long-dead shell in Inks Lake and J.A.M. Bergmann (Boerne, TX) found a single recently-dead specimen

in Pecan Bayou. Living specimens had previously been found by TPWD in the Little Brazos and adjacent Brazos rivers. This collection represents a second population (with evidence of successful reproduction) in a second Central Texas river system.

Walter E. Long Reservoir (Colorado River drainage), Travis County, 21 November 1995:

Examination of this heated, power-plant reservoir shoreline and shallow areas found only Asian clams. Extremely hot water temperature appears to exclude unionids here.

Colorado River, Webberville, Travis County, 21 November 1995:

River banks and shallow areas were examined.

| Colorado River at Webberville | | | | |
|-------------------------------|--------|---------------|------------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 0 | 0.5 x 15 | subfossil | 62.5 |
| Tampico pearlymussel | 0 | 1.0 + 0.5 x 3 | long dead to subfossil | 16.7 |
| Fragile papershell | 0 | 0.5 x 3 | subfossil | 12.5 |
| Southern mapleleaf | 0 | 0.5 x 2 | subfossil | 8.3 |
| <u>Asian clam - present</u> | | | | |

Colorado River, Bastrop, Bastrop County, 20 November 1995:

Brief examination of river banks and shallow areas found only unidentifiable shell fragments and Asian clams. River conditions and cold temperatures prevented examination of deeper waters.

Lake Bastrop (Colorado River drainage), Bastrop County, 20 November 1995:

Examination of this heated, power-plant reservoir shoreline and shallow areas found only Asian clams. Extremely hot water temperature appears to exclude unionids here.

Giddings State School Lake (Colorado River drainage), Lee County, 7 February and 20 November 1995 (dates combined):

Shoreline wading yielded specimens of the following species.

| Giddings State School Lake | | | | |
|----------------------------|--------|----------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant floater | 0 | 1.0 | recent | 3.4 |
| Pond mussel | 0 | 2.0 | recent | 6.9 |
| Texas lilliput | 1 | 17.0 + 0.5 x 5 | recent | 79.3 |
| Tapered pondhorn | 3 | 0.0 | - | 10.3 |

Colorado River at USH 59 at Wharton, Wharton County, 19 July 1995:

This site was examined by wading and snorkeling. Substrates included sand, mud, and gravel which appeared acceptable mussel habitat, but no unionids were found; only Asian clams were present.

Navidad-Lavaca River Drainage

Private pond 14 km northwest of Edna west of SH 111 between the Navidad and Lavaca rivers, Jackson County, 19 July 1995:

Examination of this site by wading produced one unionid species.

| Private pond - Navidad River drainage | | | | |
|---------------------------------------|--------|---------------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Pondhorn sp. | 1 | 1.0 + 0.5 x 2 | relatively recent | 100.0 |

Navidad River upstream of Lake Texana at SH 530, Jackson County, 18 July 1995:

Examination of this site found it choked with vegetation like the upper end of Lake Texana where no bivalves were present.

Upper Lake Texana and associated tributaries, Jackson County, 18 July 1995:

Wading and snorkeling at these sites found no mussels. Excessive coverage by living macrophytes and thick silt and macrophyte debris on the bottom provided no acceptable mussel habitat in this area.

Lake Texana, lower reaches, Jackson County, 18 July 1995:

Wading, snorkeling, and hookah-pump diving found three unionids.

| Lake Texana - lower reaches | | | | |
|-----------------------------|--------|---------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant floater | 1 | 0.0 | - | 2.4 |
| Yellow sandshell | 0 | 1.0 | long dead | 2.4 |
| Southern mapleleaf | 39 | 1.0 | relatively recent | 95.2 |

Most areas were covered with deep silt and no bivalves were present; unionids were only taken at several sites near the dam. No Asian clams were found. The southern mapleleaves here appear morphologically identical to those from Buffalo Bayou in Houston (which themselves are unlike any others in the state). They were quite different from populations in the Guadalupe-San Antonio or Nueces-Frio systems on each side of the Navidad drainage. It is possible construction of Lake Texana eliminated or reduced any pre-impoundment populations present in the area and the present southern mapleleaves represent an introduced

population. Unionids were not abundant; collection of the above specimens required nearly 3-man days of effort.

Navidad River from Lake Texana dam to the Lavaca River, Jackson County, 19 July 1995:

This site was examined by wading, snorkeling, and skimmer dredge but no unionids were found. Substrates included mud, sand, and gravel which appeared to be acceptable mussel habitat but no mussels were present. Local unionid populations may have been extirpated during reservoir construction.

Lavaca River just above confluence with the Navidad River, Jackson County, 19 July 1995:

This site was examined by wading, snorkeling, and skimmer dredge but no

unionids were found. Substrates included mud, sand, and gravel which appeared to be acceptable mussel habitat but no mussels were present.

Guadalupe River Drainage

Guadalupe River at Hunt, Kerr County, 19 August 1995:

Examination of gravel bars in this area produced a single subfossil fragment of a threeridge valve. This appears to be an upstream record for this species which no longer occurs locally.

Guadalupe River downstream of Ingram Lake dam, Kerr County, 18 August 1995: Four relatively-recent shells of Texas lilliput were found in shallow areas at this site.

Johnson Creek (Guadalupe River drainage), Kerr Co., 20 June 1995:

During other research adjacent to HOH, a relatively-recent valve fragment which appears to be giant floater was found. This is the first evidence of living mussels in this stream (previously only subfossil specimens were found).

Guadalupe River downstream of Flat Rock Dam at Kerrville, Kerr County, 21 March 1995:

A biologist from the Upper Guadalupe River Authority found a single, long-dead valve of a juvenile washboard and brought the specimen to HOH for identification. This appears to be an upstream record for the species in the Guadalupe River; however, living specimens no longer appear to occur upstream of Seguin.

Canyon Reservoir (Guadalupe River drainage), off North Shore Park, Comal County, 21 May and 8 August 1995:

On 21 May, a relatively-recently dead shell of Tampico pearlymussel was obtained while SCUBA diving at 13.1 m in depth. A second examination of this site on 8 August by wading and snorkeling shallower areas (to 7 m) produced additional specimens.

Canyon Reservoir at North Shore Park (8 August 1995)

| Species | N live | N shell | Condition | Percent |
|-----------------------|--------|---------|-----------|---------|
| Tampico pearlymussel | 6 | 1.0 | recent | 100.0 |
| Asian clam - abundant | | | | |

Comal River above confluence with Guadalupe River, Comal County, 11 October 1995:

Examination of shallows in this sanctuary area found most sites had banks which were heavily bulkheaded. No unionids were found. However, neither deeper waters nor upstream areas were examined.

Guadalupe River at Storkey Park (Seguin), Guadalupe County, 15 August 1995:
Examination of gravel bars and shallow waters produced long-dead valves of four unionids.

| Guadalupe River at Storkey Park | | | | |
|----------------------------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 0 | 4.0 | long dead | 50.0 |
| Tampico pearlymussel | 0 | 1.0 | long dead | 12.5 |
| Louisiana fatmucket | 0 | 0.5 | long dead | 12.5 |
| Southern mapleleaf | 0 | 2.0 | long dead | 25.0 |
| <u>Asian Clam - extremely abundant</u> | | | | |

Guadalupe River, ca 1 km upstream of Lake Gonzales, Gonzales Co., 26 June 1995:

Two dredge hauls adjacent to the main channel took only Asian clams.

Lake Gonzales, mid-lake island, Gonzales Co., 26 June 1995:

Specimens were obtained by wading and snorkeling:

| Lake Gonzales | | | | |
|------------------------------|--------|---------|---------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 9+ | many | recent to long dead | 22.5 |
| Giant floater | 5 | 3.0 | recent to long dead | 20.0 |
| Paper pondshell | 0 | 1.0 | relatively recent | 2.5 |
| Tampico pearlymussel | 2 | 0.0 | - | 5.0 |
| Louisiana fatmucket | 2 | 0.0 | - | 5.0 |
| Yellow sandshell | 4+ | many | recent to long dead | 10.0 |
| Washboard | 3 | 0.0 | - | 7.5 |
| Southern mapleleaf | 11 | 0.0 | - | 27.5 |
| <u>Asian clam - abundant</u> | | | | |

This site contained a bed dominated by threeridges in 1992 and 1993 (Howells 1994; 1995). This examination found the deeper areas (2-3 m in depth) adjacent to the original bed to have been filled by mud and silt, and the mussel population largely dispersed. Mussels were still present, but no longer concentrated. Additionally, filamentous algae several cm in depth has largely covered the bottom. In some areas, unionids were found laying on the substrate rather than in normal partially-buried positions, possibly as a response to algal smothering. Lastly, elephantears (Xanthosoma sagittifolium), an introduced exotic shorezone plant, had replaced cattails (Typha) in some areas. Impact, if any, from such changes in macrophytes adjacent to mussel populations remains to be determined.

Guadalupe River downstream of Lake Gonzales, Gonzales Co., 26 June and 15 August 1995:

In June, attempts to sample this site by boat were blocked by inability to launch. Wading and snorkeling near shore areas produced no bivalves. Long-dead unionid fragments and valves on the adjacent gravel bank included washboards, threeridge, southern mapleleaf, yellow sandshell, golden orb, and Asian clam. Examination of gravel bars in August produced the following unionids.

| Guadalupe River downstream of Lake Gonzales | | | | |
|---------------------------------------------|--------|---------|---------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 0 | 2.0 | recent to long dead | 50.0 |
| Washboard | 0 | 0.5 x 1 | long dead | 25.0 |
| Golden orb | 0 | 1.0 | relatively recent | 25.0 |
| <u>Asian clam - abundant</u> | | | | |

Guadalupe River mid-way between Lake Wood (two sites) and Lake Gonzales, Gonzales Co., 11 May 1995:

Attempts to sample at the first highway crossing upstream of Lake Wood and immediately downstream of the dam at Lake Gonzales were thwarted by fences and private land which blocked access. However, both sites appear to be capable of supporting unionid populations.

Guadalupe River 2-3 km upstream of Lake Wood, cove on southwest bank, Gonzales County, 11 May 1995:

Two, standard brail hauls produced one threeridge and Asian clams; two dredge hauls produced only Asian clams. Wading and snorkeling with hand collection yielded:

| Guadalupe River 2-3 km upstream of Lake Wood | | | | |
|----------------------------------------------|--------|---------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 17 | 1.0 | relatively recent | 46.2 |
| Giant floater | 1 | 1.0 | relatively recent | 5.1 |
| Tampico pearlymussel | 3 | 0.0 | - | 7.7 |
| Louisiana fatmucket | 2 | 0.0 | - | 5.1 |
| Yellow sandshell | 7 | 3.0 | relatively recent | 25.6 |
| Washboard | 1 | 0.0 | - | 2.6 |
| Southern mapleleaf | 3 | 0.0 | - | 7.7 |
| <u>Asian clam - present</u> | | | | |

Both threeridge and yellow sandshell included juveniles; no juveniles were found in 1992-93 upstream in Lake Gonzales. Asian clam was abundant.

Lake Wood, mid-lake mud flat, Gonzales Co., 11 May 1995:

Wading and hand collection produced only a single valve from a relatively recently dead giant floater and Asian clams.

Guadalupe River immediately downstream of Lake Wood dam, Gonzales Co., 11 May and 14 November 1995:

Wading and hand collection in May produced three living washboards and Asian clams. Dead shell (primarily washboards and several threeridges) was abundant; musselers had harvested a large number of washboards but were unable to sell the shell (too brittle) to shell buyers, so dumped their catch down the river bank and into the river (according to a local river authority ranger). A second examination of this site in November found a second dump of shells (predominately threeridges) along the river banks here near the previous dump of washboard shells found by TPWD in June 1995. These were apparently low-quality shells which musselers could not sell.

Blanco River (San Marcos River drainage) ca 4 km upstream of Wimberly, Hays County, 8 August 1995;
Wading and snorkeling at this site found only bedrock bottoms and a few Asian clams present.

Blanco River (San Marcos River drainage) at Wimberly, Hays County, 8 August 1995;
Wading and snorkeling at this site found only bedrock bottoms and a few Asian clams present.

Cypress Creek (Blanco River drainage) ca 2 km downstream of Wimberly, Hays County, 8 August 1995:
Wading and snorkeling this area found only bedrock and cobble bottom with a small number of Asian clams present.

Creek off the Blanco River at CR 3237 ca 4 km downstream of Wimberly, Hays County, 8 August 1995:
Examination of this area found only bedrock and no bivalves present.

San Marcos River, 5.6 km downstream of Palmetto State Park low-water crossing, Gonzales County, 14 November 1995:
During other fishery work in this area, HOH staff found remains of three unionids on a gravel bar.

| Guadalupe River 2-3 km upstream of Lake Wood | | | | |
|----------------------------------------------|--------|---------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Tampico pearlymussel | 0 | 0.5 | very long dead | 25.0 |
| Golden orb | 0 | 1.0 | relatively recent | 25.0 |
| Texas lilliput | 0 | 0.5 x 2 | subfossil | 50.0 |

No living or recently dead unionids have been collected by TPWD anywhere in the San Marcos River although H.D. Murray (Trinity University) found numerous species here in the 1960s and a single living pondhorn was previously found by TPWD in an oxbow lake at Palmetto State Park. The golden orb specimen (though not alive) appears not to have been dead more than a few months. This suggests some living unionids may still persist in this sanctuary and golden orb may still survive at locations other than at Lake Corpus Christi where the only living specimens have been found in recent years (Howells et al., In Press).

Millers Pond (San Antonio River drainage), Bexar County, 29 January 1995:
Examination of shallow shorezone waters of this small impoundment produced only a single, long-dead valve from a paper pondshell.

Nueces River Drainage

Turkey Creek (Nueces River drainage) at USH 90, Uvalde County, 26 April 1995:
This site was dry when examined and had a cobble bottom indicative of periodic scouring floods. No bivalves were found.

Upper Nueces River at USH 90, Uvalde County, 26 April 1995:

When examined, this area contained several pools of standing water with no downstream flow. The site was covered with deep deposits of heavy cobble resulting from heavy scouring floods. No bivalves were found.

Boone Slough (Nueces River drainage) at USH 90, Uvalde County, 26 April 1995:

Although this site was damp when examined, it was completely filled with terrestrial grasses. No bivalves were present.

Leona River (Nueces River drainage) at US 83, Uvalde County, 26 April 1995:

This site was dry when examined and had a cobble bottom indicative of periodic scouring floods. No bivalves were found.

Deep Creek (Nueces River drainage) at US 83, Uvalde County, 26 April 1995:

This site was dry when examined and had a cobble bottom indicative of periodic scouring floods. No bivalves were found.

Rocky Creek (Nueces River drainage) at US 83, Uvalde County, 26 April 1995:

This site was dry when examined and had a cobble bottom indicative of periodic scouring floods. No bivalves were found.

Long Hollow Creek (Nueces River drainage) at US 83, Uvalde County, 26 April 1995:

This site was dry when examined and had a cobble bottom indicative of periodic scouring floods. No bivalves were found.

Shut-in Creek (Frio River drainage) at USH 83, Uvalde County, 26 April 1995:

This site was dry when examined and had a cobble bottom indicative of periodic scouring floods. No bivalves were found.

Sycamore Creek (Frio River drainage) at USH 83, Uvalde County, 26 April 1995:

This site was dry when examined and had a cobble bottom indicative of periodic scouring floods. No bivalves were found.

Elm Creek (Frio River drainage) at USH 83, Uvalde County, 26 April 1995:

This site was dry when examined and had a cobble bottom indicative of periodic scouring floods. No bivalves were found.

Dry Frio River at USH 83, Real County, 26 April 1995:

This site had several small pools of stagnant water but was otherwise filled with cobble indicative of scouring floods. No bivalves were found.

West Frio River at USH 83, Real County, 26 April 1995:

This site had several small pools of stagnant water but was otherwise filled with cobble indicative of scouring floods. No bivalves were found.

Fish Creek (Frio River drainage) at USH 83, Real County, 26 April 1995:

This site was dry when examined and had a cobble bottom indicative of periodic scouring floods. No bivalves were found.

Cedar Creek (Frio River drainage) at USH 83, Real County, 26 April 1995:
 This site was dry when examined and had a cobble bottom indicative of periodic scouring floods. No bivalves were found.

Kent Creek (Frio River drainage) at USH 83, Real County, 26 April 1995:
 This site was dry when examined and had a cobble bottom indicative of periodic scouring floods. No bivalves were found.

Choke Canyon Reservoir (Frio River drainage), McMullen County, 16 March 1995:
 A brief shoreline collection yielded the following specimens:

| Choke Canyon Reservoir | | | | |
|-----------------------------|--------|---------------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant floater | 0 | many (not retained) | recent | - |
| Paper pondshell | 0 | 1.0 | recent | - |
| Tampico pearlymussel | 0 | 2.0 | recent | - |
| Yellow sandshell | 0 | many (not retained) | recent | - |
| Southern mapleleaf | 0 | 2.0 | recent | - |
| Texas lilliput | 1 | 2.0 | recent | - |
| <u>Asian clam (present)</u> | | | | |

Because giant floaters and yellow sandshells were abundant but not collected, percentages here represent only those specimens actually retained.

Nueces River east of George West, Live Oak County, August 1995:
 A single relatively recently-dead golden orb shell was found in this area during other fishery work.

Lake Corpus Christi, two sites, Live Oak Co., 7 November 1995:
 Shallow waters and exposed bottom areas were examined during a low-water period (lake level about 1 m below average) at two sites:

| Lake Corpus Christi, point at SH 888 | | | | |
|--------------------------------------|--------|----------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Threeridge | 2 | 1.0 | recent | 4.7 |
| Giant floater | 4 | 0.0+ | recent | 6.3 |
| Tampico pearlymussel | 18 | 4.0+ | recent | 34.4 |
| Yellow sandshell | 2 | 0.0+ | recent | 3.1 |
| Bleufer | 1 | 2.0+ | recent | 4.7 |
| Southern mapleleaf | 1 | 1.0 + 0.5 x 2 | recent | 6.3 |
| Golden orb | 9 | 11.0 + 0.5 x 3 | recent | 35.9 |
| Western lilliput | 3 | 0.0 | - | 4.7 |
| <u>Asian clam - abundant</u> | | | | |

| Lake Corpus Christi, at KOA camp grounds | | | | |
|------------------------------------------|--------|---------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Giant floater | 3 | 0.0+ | recent | 4.5 |
| Paper pondshell | 0 | 2.0 | recent | 3.0 |
| Tampico pearlymussel | 8 | 0.0+ | recent | 12.1 |
| Yellow sandshell | 8 | 0.0+ | recent | 12.1 |
| Bleufer | 1 | 0.0+ | recent | 1.5 |
| Southern mapleleaf | 5 | 0.0 | recent | 7.6 |
| Western lilliput | 21 | 18.0 | recent | 59.1 |
| <u>Asian clam - abundant</u> | | | | |

Numbers and percentages given only indicate those taken for research purposes; many others living and dead were found on exposed bottoms or in shallow waters. These specimens and others found by H. McCullagh (Jacksonville, Florida: pers. comm.) in 1989 off FM 359 (San Patricio County) may be the first records of threeridge from this system. Neither Murray (1978) or Taylor (undated) found it in earlier surveys in this area. Previously, TPWD had only found four living golden orbs; finding these additional specimens confirms the only known living population is still surviving and apparently reproducing (Howells et al., In Press).

Irrigation canal north of Robstown, Nueces County, 3 June 1995:

Two subfossil Tampico pearlymussel shells and several Asian clams were found at this site during other research in the area.

Rio Grande Drainage (Texas)

Balmorhea State Park, San Solomon Springs and adjacent waters, Pecos and Jeff Davis counties, 16 February 1995:

No bivalves were found here during other related work with endangered fishes in the area. Relatively saline waters here likely restricted bivalve abundance even before human disruption in the area. An introduced Asian snail (Melanooides tuberculata) was extremely abundant in some areas.

Amistad Reservoir, Val Verde County, 11 January 1995:

Sites near the mouth of the Devils River were examined during a low-water periods when reservoir levels were reduced by about 12 m and exposing a great deal of previously submerged bottom. The following species were collected by hand on exposed bottoms or in shallow waters.

| Amistad Reservoir | | | | |
|----------------------|--------|-----------------|-----------|---------|
| Species | N live | N shell | Condition | Percent |
| Tampico pearlymussel | 59 | 31.0 + 0.5 x 12 | recent | 94.4 |
| Bleufer | 3 | 0.5 x 3 | recent | 5.6 |

Although bleufers had been previously reported from the Rio Grande (Strecker 1931), the specimens ultimately proved to be misidentified Tampico pearlymussels (R.W. Neck and C.E. Boone, Houston Museum of

Natural Science; pers. comm.). Shells resembling bleufers were collected by TPWD at this site in December 1994. Tissue from the living specimens taken in the January 1995 collection was compared electrophoretically to bleufers from other areas of Texas and no differences were detected. Apparent absence from the fossil record (Metcalf 1982) suggests this species may be an introduction into the Rio Grande system. However, some of the shells collected were larger, older adults, indicating such an introduction was probably not especially recent.

Two locations on Amistad Reservoir (Salem Point off Box Canyon Road and Castle Canyon, Val Verde County) were examined by HOH on 20 October 1995 during other fishery-related work. Living and recently dead Tampico pearlymussels were present at both sites.

Brackettville Reservoir above Fort Clark Springs, Kinney County, 26 April 1995:

Examination of this site found the reservoir dry and its bottom supporting terrestrial vegetation. It apparently retains water only during extremely wet periods. No bivalves were present.

Las Moras Creek, above Fort Clark Springs, Brackettville, Kinney County, 26 April 1995:

This area is now dry and filled with terrestrial vegetation.

Fort Clark Springs, spring pool and swimming pool, Kinney County, 26 April 1995:

Both sites at the headwaters of this spring now have paved sides and the swimming pool below the spring pool has a paved bottom as well. No bivalves were found.

Las Moras Creek immediately below the swimming pool at Fort Clark, Kinney County, 26 April 1995:

This area had bulkheaded, concrete banks but retained a mud and rock bottom. No bivalves were found; however, an introduced Asian snail (Melanoides tuberculata) was extremely abundant.

Las Moras Creek immediately below the bulkheaded-bank area of Fort Clark, Kinney County, 26 April 1995:

This location had more-natural grass-covered banks, but was otherwise similar to the above site. No bivalves were found.

Las Moras Creek, Southern Pacific RR crossing just east of SH 3384, Kinney County, 26 April 1995:

Substrate at this site was mud and rock. Only two, long-dead Asian clam valves were found.

Las Moras Creek at SH 1908 east of SH 3348, Kinney County, 26 April 1995:

Substrate at this site was rock and mud. No bivalves were found.

Las Moras Creek at SH 1908 north of the Maverick County line, Kinney County,
26 April 1995:
Substrate at this site was rock and mud. No bivalves were found.

Las Moras Creek north of Quemado above confluence with the Rio Grande,
Maverick County, 26 April 1995:
This site had a bedrock bottom with a slight covering of silt. Some mud
was present along collapsing grass-covered banks, but in general,
suitable bivalve habitat was lacking. Only a small number of Asian clam
valves were found in drift areas.

Historically, Las Moras Creek supported a diverse mollusk fauna. Taylor
(1967) reviewed Boundary Survey collections made by Mearns 1892-1898 in
the spring areas near Fort Clark. These included such species as Rio
Grande monkeyface and Texas hornshell. Texas hornshell survived here
into the 1970s when Murray (1975) reported it extirpated by mechanical
removal of vegetation in the Fort Clark area which caused extensive
environmental disturbance and alteration. Subsequent chlorination of a
swimming pool constructed below the main spring pool likely contributed
to the demise of native mollusks here as well.

Canyon Grande Creek at US 277 at Quemado, Maverick County, 26 April 1995:
Examination of this site found areas downstream of the highway were
rock- and cobble-fill substrate and those upstream were covered with
deep, soft silt (probably originating from adjacent farm lands). Only a
few Asian clam valves were found in the downstream fill area.

Lindsey Creek at USH 90, Kinney County, 26 April 1995:
This site was dry and filled with cobble. It is apparently only wet
during occasional scouring floods.

Elm Creek at USH 90, Kinney County, 26 April 1995:
This site was dry and filled with cobble. It is apparently only wet
during occasional scouring floods.

Falcon Reservoir, several sites, Zapata County, January and April 1995:
Falcon State Park, 13 January 1995:
Brief shoreline collections produced the following specimens:

| Falcon Reservoir, Falcon State Park | | | | |
|-------------------------------------|--------|---------------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Paper pondshell | 0 | 2.0 | recent | 15.4 |
| Tampico pearlymussel | 0 | 5.0 | recent | 38.5 |
| Southern mapleleaf | 0 | 4.0 + 0.5 x 2 | relatively recent | 46.2 |
| <u>Asian clam (present)</u> | | | | |

At USH 277 near Zapata (city), 11 April 1995:
More intense shorezone and shallow water collections were made to obtain
spawning condition information on several local species by taking
advantage of a low-water period when levels were reduced 8.5 m .

| Falcon Reservoir, USH 277 near Zapata | | | | |
|---------------------------------------|--------|---------------|-------------|---------|
| Species | N live | N shell | Condition | Percent |
| Paper pondshell | 2 | 1.0 | recent | 8.6 |
| Tampico pearlymussel | 16 | 1.0 + 0.5 x 5 | recent | 62.9 |
| Southern mapleleaf | 9 | 1.0 | very recent | 28.6 |
| <u>Asian clam (present)</u> | | | | |

At USH 277 near Zapata (city), 17 April 1995:

More intense shorezone and shallow water collections were made to take advantage of a low-water period when levels were reduced 8.5 m to obtain spawning condition information on several local species.

| Falcon Reservoir, USH 277 near Zapata | | | | |
|---------------------------------------|--------|---------|-------------------|---------|
| Species | N live | N shell | Condition | Percent |
| Paper pondshell | 5 | 4.0 | recent | 17.6 |
| Tampico pearlymussel | 16 | 0.0 | - | 31.4 |
| Southern mapleleaf | 21 | 1.0 | relatively recent | 43.1 |
| Lilliput | 4 | 0.0 | - | 7.8 |
| <u>Asian clam (present)</u> | | | | |

Rio Grande Drainage (Mexico)

Central Rio Conchos, Chihuahua, Mexico, 21-24 October 1995:

During desert fishes surveys in this area, TPWD examined four sites for the presence of freshwater mussels including:

- 1) Ojo del Alamo (NW of Coyame)
- 2) Rio Coyame and adjacent hot springs at Coyome
- 3) Ojo de Laguna (endorheic drainage N of Ciudad Chihuahua)
- 4) Rio Chuviscar and hot springs at San Diego de Alcala

No living unionids, shells, or subfossil remains were found at any of these locations (Howells and Garrett 1995).

SPECIES SUMMARY

Threeridge, washboard, and southern mapleleaf, which are the major commercial-shell species in Texas, remain sufficiently abundant in many areas of their ranges to support harvest. Mapleleaf occurs in moderate abundance in some tributaries of the Red River. However, some populations have shown little evidence of successful reproduction and recruitment in recent years. Whether this reflects a periodic limited reproductive success typical of some unionid populations or failure for more sinister causes remains to be defined. Dense concentrations of adults which can preclude successful recruitment of small juveniles does not appear to be a significant consideration in Texas waters.

Tampico pearlymussel remain abundant at some locations and continues to support a pearl fishery. Dramatic drawdowns of Amistad and Falcon reservoirs on the Rio Grande may have caused significant losses and revaluation of its

status at these sites in the future is recommended. Bleufer, which is also occasionally taken by pearlbers, remains abundant at many locations as well. Bleufer has also been introduced into Lake Corpus Christi (Nueces River) and Amistad Reservoir (Rio Grande) and is relatively abundant in Lake Corpus Christi.

Among the unionids which are frequently abundant at sites within their ranges are: giant floater, paper pondshell, Louisiana fatmucket, yellow sandshell, fragile papershell, threehorn wartyback, western pimpleback, pink papershell, Texas lilliput, tapered pondhorn, and pondhorn. The unidentified floater, which resembles flat floater, is abundant in Sam Rayburn Reservoir (Angelina River) but more sporadic in B.A. Steinhagen Reservoir (Neches River) and Toledo Bend Reservoir (Sabine River). Flat floater did not apparently occur in Texas earlier in this century (Strecker 1931), but has invaded in recent decades (Mather et al. 1990). Pond mussel is sometimes locally abundant in desirable habitats. White heelsplitter has been found in abundance in only one tributary of the Red River to date. Smooth pimpleback still maintains viable populations at some sites in the Colorado and Brazos River drainages. Gulf mapleleaf has only been found in noteworthy numbers in B.A. Steinhagen Reservoir and the Neches River immediately downstream.

Taxa which have been more-sporadically encountered include: rock-pocketbook, round pearlshell, deertoe, fawnsfoot, and lilliput. Pistolgrip was collected fairly frequently in the Sabine and Neches rivers, but very few living specimens appear to have survived west of the Neches River. Rare or relatively-rare species for which only a limited number of living or recently-dead specimens have been found include: Ouachita rock-pocketbook, Texas pigtoe, triangle pigtoe, Texas fatmucket, sandbank pocketbook, Louisiana pigtoe, southern hickorynut, Texas hornshell, Texas fawnsfoot, golden orb, Texas pimpleback, wartyback, Texas heelsplitter, Salina mucket, and little spectaclecase. Species previously reported from Texas which have not been taken alive or recently dead in TPWD surveys include: Wabash pigtoe, plain pocketbook, Mexican fawnsfoot, false spike, squawfoot, and Rio Grande monkeyface.

Field observations suggest some species which have been eliminated from some areas by scouring floods, dewatering during droughts, or other human-related impacts may be periodically reintroduced. Giant floater, paper pondshell, pond mussel, Texas lilliput, and both pondhorns appear to reenter areas, presumably on stocked, wild-caught fishes. These populations likely survive for brief periods only to disappear again due to dewatering or flood scouring.

RIVER SUMMARY

Status of unionid populations throughout Texas remains largely unchanged from that reported by Howells (1996) based on field surveys from 1992 through 1994. Noteworthy unionid populations remain in some tributaries of the Red River, upper and central Sabine and Neches rivers, reservoirs in the upper and central Trinity River drainage, Buffalo Bayou, central Brazos and Colorado

ivers, Concho River, central Guadalupe River, Frio River from just upstream of Choke Canyon Reservoir downstream into the Nueces River and Lake Corpus Christi, and Falcon and Amistad reservoirs on the Rio Grande.

Areas where mussel populations have been reduced dramatically or extirpated entirely include: the upper and central Sulphur River; lower Neches River; many areas of the Trinity River; much of the San Jacinto River; stretches of the Brazos River; much of the San Saba River; virtually all of the Llano, Pedernales, Blanco, San Marcos, and Medina rivers; the upper Guadalupe, San Antonio, Frio, and Nueces rivers; and much of the Rio Grande and its tributaries. In general, these losses reflect wide-reaching, complex impacts of extensive habitat alteration and environmental degradation (Howells 1996). Harvest regulations and protective no-harvest sanctuaries offer limited protection from these problems.

Areas which have not been surveyed by TPWD to date or have received only superficial attention through 1995 include: the Red River along the Oklahoma border and most of its tributaries; lower Sulphur River; Big Cypress Bayou and Caddo Lake; the Sabine River below Toledo Bend Reservoir; Lake Livingston (Trinity River drainage); lower Brazos, Colorado, Guadalupe, San Antonio, and Nueces rivers; and the Rio Grande and some of its tributaries. A variety of river authority canals associated with the lower reaches of several Texas rivers have yet to be surveyed as well.

Several areas examined in 1995 were noteworthy because of little or no prior work on unionids in those areas. The Canadian River of the upper Texas Panhandle was examined by TPWD in 1995; its unionid fauna appears restricted to a small population of giant floaters in Lake Meredith. The upper Red River and its tributaries were found to be largely devoid of both unionids and acceptable mussel habitat. Lake Texana on the Navidad River (apparently not previously surveyed) harbored a small population of southern mapleleaves which may have originated as a transplant from Buffalo Bayou in the Houston area. Finally, Las Moras Creek between Brackettville and the Rio Grande, which once contained a variety of rare endemic unionids, was found unable to support any unionids; even Asian clam survives here only in small numbers.

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Figure 1. Texas locations examined for the presence of freshwater mussels (Family: Unionidae) by Texas Parks and Wildlife Department Inland Fisheries staff in 1995 (dots), where mussels were collected by other parties and sent to TPWD for examination (triangles), and sites sampled by TPWD in 1994 from which specimens were sent to HOH in 1995 (half-filled circles).

