

Conservation Status of Selected Freshwater Mussels in Texas

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Abstract. Surveys of freshwater mussels in Texas found many species have declined dramatically in recent years. Among the 52 species recognized in the state, the American Fisheries Society lists 17 as threatened, endangered, or of special concern, and an additional federally endangered species has been recently found. However, recent statewide surveys now indicate many species appear far less secure than initially believed. Several species appear to occur at only a few locations, and a number have not been found alive in recent years. Mussel harvest regulations, first put in place in 1992 and 1993, offer limited protection to some of these species. Among 28 no-harvest mussel sanctuaries designated throughout Texas, several contain populations of some of the most threatened species. Additionally, a minimum size limit of 63.5 mm (shell height) completely precludes harvest of several species and offers protection to all but a few very large individuals of several others. Population declines likely reflect poor land and water management practices with subsequent loss of mussel habitat. Commercial and sport mussel harvest appear to have had little impact on the most seriously threatened species. Because poor land and water use practices are continuing, prospects for reversing mussel declines are not encouraging.

Introduction

The central United States has historically held an abundant and diverse assemblage of freshwater mussels (Family Unionidae). Nearly 300 taxa occurred in the U.S. (Neves 1993) with 52 species present in Texas waters (Howells et al. 1996). However, dramatic declines in abundance, diversity, and distribution have been noted in recent years (Williams et al. 1993). These declines have impacted mussel populations in Texas so significantly that many waters no longer support any unionid fauna.

Freshwater mussels and the fisheries they supported were studied in the Mississippi Valley around the turn of the century, with the U.S. Fish Commission directing a significant amount of effort in this area. However, far less has been known historically about the unionid fauna in Texas waters. Strecker (1931) summarized species reported for the state. Thereafter, only a limited number of papers were published, and most reported species present at specific sites during low-water surveys. Detailed accounts of distribution and abundance were generally lacking.

When the Texas Parks and Wildlife Department (TPWD) initiated studies of freshwater mussels in January 1992, it immediately became apparent that many areas had experienced significant mussel declines in recent years and still others had lost mussel fauna entirely. Williams et al. (1993) assigned conservation status designations to

all North American unionids, including 17 species from Texas listed as threatened, endangered, or special concern. An additional species, *Arkansia wheeleri* (Ouachita rock-pocketbook), has since been found in Texas. Based on field survey work by TPWD (1992-1995) and other field collections by C.M. Mather and J.A.M. Bergmann (1980-1995), the current conservation status of freshwater mussels in Texas can now be more clearly defined.

Materials and Methods

Data from field survey efforts presented here include varying degrees of intensity ranging from casual, qualitative shoreline or gravel-bar collections to more intense quantitative transect or 0.25-m² grid samples. Mussels were collected by wading, snorkeling, hookah pump and SCUBA diving, brail, and skimmer dredge. TPWD made over 500 collections statewide from January 1992 through September 1995 (Figure 1). Over 200 collections from 1980 through 1995 also are reported here by Mather (CMM) and Bergmann (JAMB), including material in the University of Science and Arts of Oklahoma (USAO) collection.

Mussel distribution ranges presented here are from Howells et al. (1996) unless otherwise stated. General historical ranges are ill-defined for some

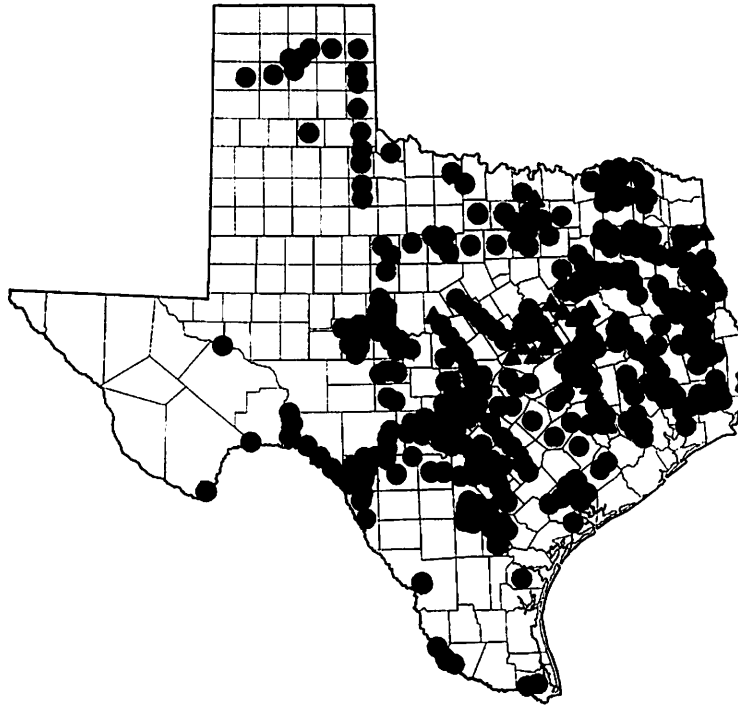


Figure 1. Freshwater mussel survey sites (dots) examined by Texas Parks and Wildlife Department (1992-1995) and C.M. Mather and J.A.M. Bergmann (1990-1995). Additional sites where specimens were collected by volunteers and sent to Heart of the Hills Research Station for identification (1992-1995) are indicated by triangles.

species due to limited numbers of surveys and specimens found as well as major environmental changes that confound reconstructing historical ranges. Subsequently, ranges given here are sometimes "best guess" estimates based on habitat similarity to known collection sites, area ecology, unionid species associations, fossil records, and similar inferences.

In August 1978, a major hurricane stalled over central Texas. Total precipitation for that month was over 17 inches as opposed to normal August levels, which are typically about 2 inches. Some areas experienced 20- to 30-foot rises in river levels. Many rivers were scoured down to bedrock with subsequent deposition of deep shifting sands or deep soft silt in some reservoirs or downstream locations. Both the immediate mechanical damage from this flood and subsequent associated environmental modifications were probably the single most destructive event to unionid populations in much of Texas. Although 1978 was climatically unremarkable, summer 1980 saw virtually no precipitation in many areas and corresponding high temperatures.

Because catastrophic environmental events that occurred from 1978 to 1980 appear to have been a major turning point in mussel declines in Texas, this report focuses on living or recently dead shells found since 1980 (which confirm or suggest living

populations still remain). Particular attention focused on living or recently dead specimens documented from January 1990 through September 1995. Specimens considered recently dead had soft tissue remaining on their valves (very recently dead) or interior surfaces glossy, uneroded, without calcium deposits or disintegration, algal staining, or significant color fading. Those termed relatively recently dead displayed one or more of these traits suggesting a longer period of time where the nacre was exposed to external environmental influences. Specimens termed long dead showed significant signs of internal and external erosion, calcium deposition, or both, often with iridescence lost, faded natural colors, staining, and epidermal layers aged and flaking. Subfossil specimens had most or all of the epidermis absent, internal and external surfaces largely faded to chalky white and often were brittle.

Results and Discussion

Arkansia wheeleri - Ouachita rock-pocketbook

This federally listed endangered species has historically been known from the Little River of Arkansas and Kiamichi River of Oklahoma (Martinez and

Jahrsdoerfer 1991; Vaughn and Pyron 1995). Collection in Lamar County, Texas, of a recently dead shell from Pine Creek in 1992 (JAMB) and a second recently dead shell in 1993 (CMM) from adjacent Sanders Creek placed this species in Texas for the first time (Figure 2). Both streams are tributaries of the Red River just upstream from the Kiamichi River. Subsequent surveys in Pine and Sanders creeks and adjacent waters by TPWD, CMM and JAMB, and the Oklahoma Biological Survey (C.C. Vaughn, pers. comm.) in 1994 failed to find additional specimens.

***Fusconaia askewi* - Texas pigtoe**

This pigtoe occurs in southeastern Texas and adjacent Louisiana, with most Texas records from the Neches and Sabine rivers (Figure 2). Confusion between *F. askewi*, *F. lananensis* (triangle pigtoe), and *F. flava* (Wabash pigtoe), which also occur in Texas, has been problematic. Over 150 specimens that were collected alive or as recently dead shells between 1980 and 1986 are present in CMM, JAMB, and USAO collections including material from the Sabine ($N > 20$ specimens; 1981-1984), Neches (> 70 ; 1980-1986), Trinity (> 20 ; 1980-1981), and San Jacinto (> 30 ; 1986) rivers. None taken alive or recently dead from 1990 through 1995 are present in the CMM, JAMB, or USAO collections. The only living or recently dead specimens collected by TPWD (< 15 ; over 130 collections) were found in limited numbers in the Sabine River at several sites above Toledo Bend Reservoir in 1994 and 1995.

***Fusconaia lananensis* - Triangle pigtoe**

This endemic pigtoe has been reported from the Neches River drainage and the San Jacinto River of southeastern Texas (Figure 2). The taxonomic validity of this unionid has been questioned and CMM, JAMB, and USAO collections combine *lananensis* forms with either *F. askewi* or *F. flava*. Based on TPWD collections (45 collections on the Neches River drainage and 13 on the San Jacinto River), it appears extirpated from the type locality (Lanana and Banita [=Bonita] creeks, near Nacogdoches, Nacogdoches County, Texas), but six living or recently dead specimens were found in adjacent Attoyac Bayou off the Angelina River, Nacogdoches and Shelby counties, Texas, by TPWD in 1994 and 1995. None were found elsewhere in the Neches or Angelina rivers, including at two sites on the central Neches River where abundant, diverse unionid assemblages remain. None were found in the San Jacinto River where environmental disturbances causing extensive sand deposition in many areas may have extirpated it, or might do so in the near future.

***Lampsilis bracteata* - Texas fatmucket**

Although endemic to the San Antonio, Guadalupe, and Colorado rivers of central Texas, only long-dead and subfossil shell remains at most locations (Figure 3). No specimens collected alive or recently dead since 1980 are present in the CMM collection. However, JAMB, USAO, and TPWD (1991-1995) collections contain several specimens found living or recently dead from one small stream and its tributaries in the upper Colorado River in Runnels County, Texas. TPWD made over 220 collections within the range of this species and found only 11 living specimens (1993 and 1995) at the Runnels County site. TPWD also documented relatively recently dead shells in a tributary of the Concho River, Tom Green County, Texas (1993), and an apparently recent fragment from the type locality on the Llano River, Menard County, Texas (1995). Scouring floods or associated sand deposition within the last two decades appear to have been the primary factors in eliminating this species from nearly all of its previous range.

***Lampsilis cardium* - Plain pocketbook**

This species appears to be restricted to the Red River drainage of northeastern Texas (Figure 3), but ranges more widely in other areas of the Mississippi River valley. Confusion with *L. ovata* (pocketbook), which apparently does not occur in Texas, and local *L. satura* (sandbank pocketbook) has been problematic. No specimens were taken by TPWD in surveys (over 30 collections) on the Sulphur River, Big Cypress Bayou, or Red River tributaries; none were found by Mather and Bergmann (1994) in their survey of the Big Cypress Bayou system (1980-1989). None from Texas are present in CMM, JAMB, or USAO collections. However, a report of *L. ovata* from Big Cypress Bayou in 1992 (Shafer et al. 1992) may represent this species or *L. satura*. Although apparently rare in Texas, northeastern Texas is the southwestern range limit for *L. cardium*.

***Lampsilis satura* - Sandbank pocketbook**

This pocketbook has been reported from the San Jacinto River east into Louisiana and Arkansas (Vidrine 1993) (Figure 3). The CMM, JAMB, and USAO collections include > 50 specimens found alive or recently dead in the Sabine (> 30 ; 1981-1984) and Neches (> 20 ; 1980-1986) drainages. Several living specimens ($N = 3$) and several other relatively recently dead shells were found by TPWD in both the Neches and Sabine rivers (> 130 collections). However, habitat degradation in the San Jacinto, Trinity, and lower Neches rivers has reduced or eliminated this species from many areas. A population once found in Village Creek, Hardin County,

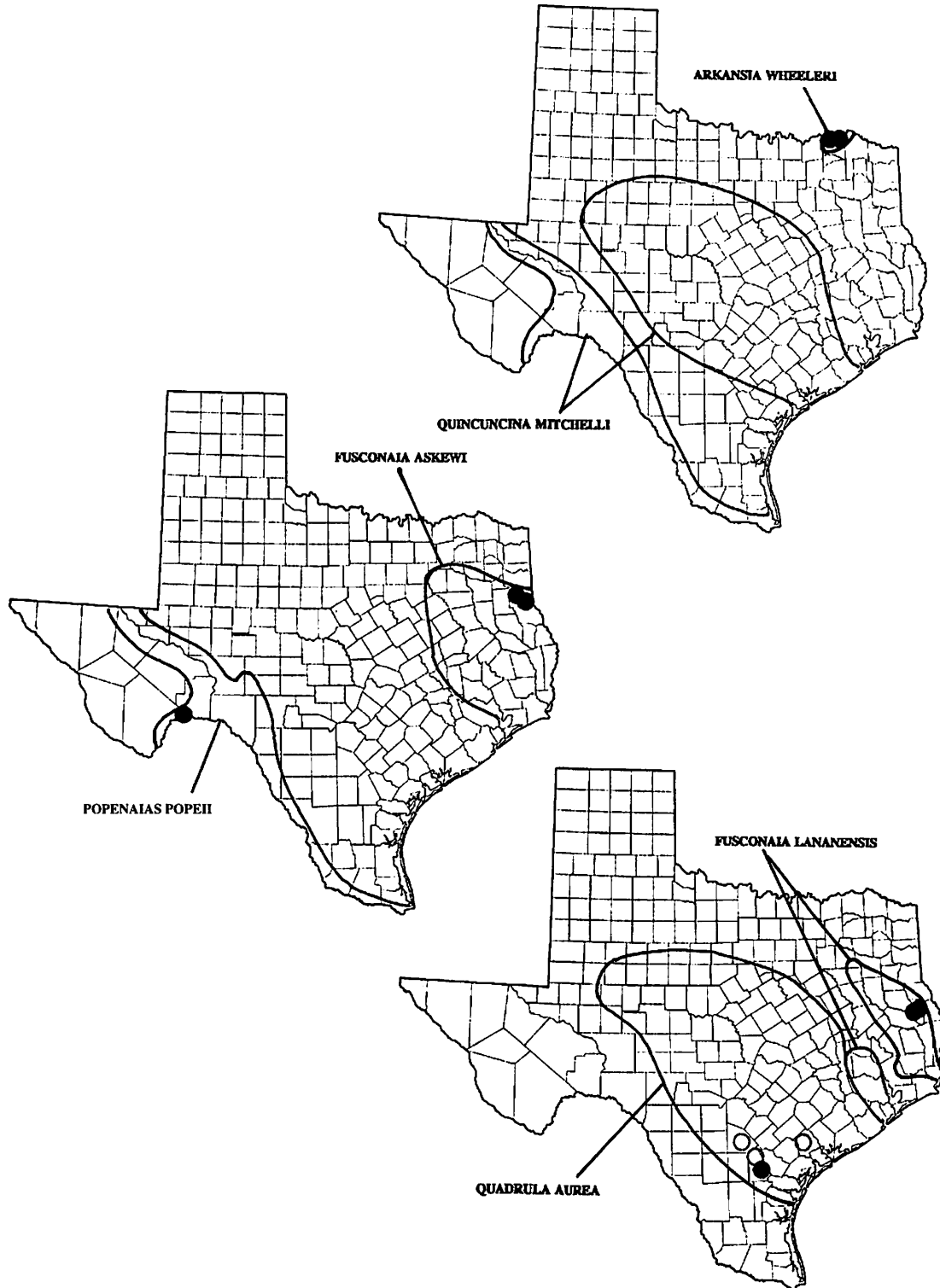


Figure 2. General historical distribution of *Arkansia wheeleri*, *Quincuncina mitchelli*, *Fusconaia askewi*, *Popenaias popeii*, *Fusconaia lananensis*, and *Quadrula aurea* in Texas. Filled dots represent collections of living specimens or recently dead shells and open circles represent collections of relatively recently dead shells based on collections made by Texas Parks and Wildlife Department, C.M. Mather (University of Science and Arts of Oklahoma, Chickasha), and J.A.M. Bergmann (Boerne, Texas) from January 1990 through September 1995. Lines indicate historically known or potential ranges (Howells et al. 1996).

Texas, (Vidrine 1990; R.W. Neck, pers. comm.) could not be located when surveyed by TPWD in 1994.

***Obovaria jacksoniana* - Southern hickorynut**

Within Texas, this species has been reported from the Neches, Sabine, and possibly Red rivers of eastern Texas (Figure 4). CMM, JAMB, and USAO collections include two specimens from the Sabine River (1981 and 1984) and over 100 specimens from the Neches River (1980-1986) that were alive or recently dead when collected; none found during 1990-1995 are present in these collections. Only a single pair of relatively recently dead valves of questionable identity from the lower Neches River has been found by TPWD in over 100 collections within its range in Texas, including survey efforts at all previous collection sites reported by Strecker (1931).

***Pleurobema riddellii* - Louisiana pigtoe**

Historically this species has been reported from the Trinity, Neches, and Sabine rivers, and apparently the Red and San Jacinto River drainages, of eastern Texas (Figure 3). Strecker (1931) suspected this species may already have been extirpated from the type locality in the upper Trinity River at Dallas earlier in this century. Mather and Bergmann (1994) found two living specimens in Little Cypress Bayou (Red River drainage), Marion and Harrison counties, Texas, 1981-1988. CMM, JAMB, and USAO collections include specimens from the Little Cypress Bayou (<10; 1981-1984), Sabine (<5; 1981-1984), Neches (>130; 1980-1986), and the San Jacinto (<10; 1984-1986) rivers. JAMB found a single recently dead specimen in Little Cypress Bayou, Marion County, Texas, in 1991. Over 150 collections made within its range in Texas by TPWD produced only a single recently dead shell from a gravel bar on the lower Neches River in 1994.

***Popenaias popeii* - Texas hornshell**

No specimens of this species endemic to the Rio Grande (Figure 2) are present in the CMM and USAO collections. JAMB documented specimens from the Devils River in 1975 and 1978. Murray (1975) reported that a population in Las Moras Creek at Fort Clark Spring, Kinney County, Texas, had been extirpated due to mechanical removal of vegetation; subsequent paving of the spring and chlorination in conjunction with use as a swimming pool likely prevented reintroduction. Examination of the Fort Clark spring in 1995 by TPWD failed to find even subfossil valves of any native unionid. In over 40 collections made by TPWD on the Rio Grande and its tributaries, only a single, relatively

recently dead pair of valves was taken at the confluence of the Rio Grande and San Francisco Creek, Brewster County, Texas, in 1992. A specimen in the Ohio State Museum of Biological Diversity from the Llano River in 1972 is well outside the recognized range for this species and may represent questionable collection locality data.

***Potamilus amphichaenus* - Texas heelsplitter**

The status of this species was reviewed by Neck and Howells (1994). It is restricted to the Neches, Sabine, and Trinity rivers of Texas and adjacent Louisiana (Figure 4); they considered material from the Brazos River drainage to be *P. ohiensis* (pink papershell). Based on reference collection specimens and published accounts, Neck and Howells (1994) reported only about 150 specimens had been found since the species was described in 1898. Further, only two living specimens had been found within the last 15 years; however, several additional individuals were very recently dead. Among the living specimens, one was taken by TPWD in the Sabine River above Toledo Bend Reservoir in 1994 and the other in B.A. Steinhagen Reservoir on the Neches River by TPWD in 1993. Status of this species has been confounded by confusion with *P. ohiensis*. Preliminary electrophoretic analysis of both Texas heelsplitter and pink papershell tissues at Heart of the Hills Research Station (HOH) thus far has failed to find significant genetic differences between these two species. However, Neck and Howells (1994) recommended this species tentatively be considered as distinct until additional genetic analyses have been performed.

***Potamilus (Disconaias) salinasensis* - Salina mucket**

Endemic to the Rio Grande drainage (Figure 4), *P. salinasensis* has been represented in TPWD surveys by only a single, relatively recently dead pair of valves taken just downstream of the confluence of the Rio Grande and San Francisco Creek, Brewster County, Texas, in 1992. Other collections made from Brownsville to Big Bend (>40), including tributaries in Texas and Mexico, failed to find it. CMM, JAMB, and USAO collections contain no recent specimens of this species.

***Quadrula aurea* - Golden orb**

Golden orb was endemic to central Texas including the Frio, Nueces, San Antonio, Guadalupe, Colorado, and Brazos rivers (Figure 2); however, the identity of specimens from the Colorado and Brazos River systems may be questionable. CMM, JAMB, and USAO collections contain over 20 recently dead

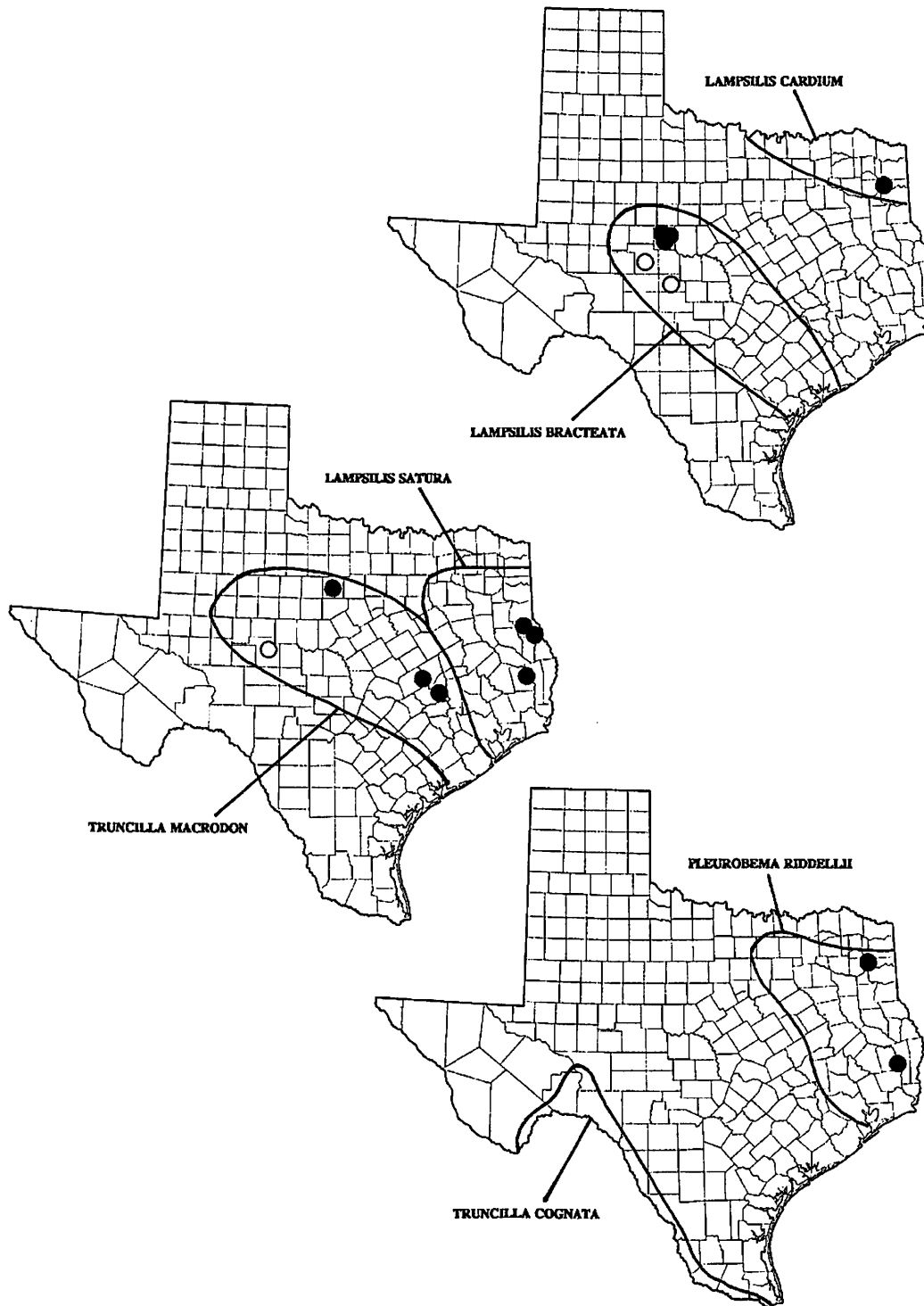


Figure 3. General historical distribution of *Lampsilis cardium*, *L. bracteata*, *L. satura*, *Truncilla macrodon*, *Pleurobema riddellii*, and *T. cognata* in Texas. Filled dots represent collections of living specimens or recently dead shells and open circles represent collections of relatively recently dead shells based on collections made by Texas Parks and Wildlife Department, C.M. Mather (University of Science and Arts of Oklahoma, Chickasha), and J.A.M. Bergmann (Boerne, Texas) from January 1990 through September 1995, except for the collection of *L. cardium* (reported as *L. ovata*) by Shafer et al. (1992). Lines indicate historically known or potential ranges (Howells et al. 1996).

specimens from the Guadalupe River drainage (1980). JAMB also documented recently dead specimens in the Atascosa River in 1982. TPWD sampled over 330 sites within its range. Although shells continue to be collected at sites from the Guadalupe to the Nueces rivers, living specimens were not found by TPWD until 1994 when four were taken in Lake Corpus Christi on the Nueces River. Two recently dead shells were also collected at this site in 1989 (H. McCullagh, pers. comm.) and several additional living specimens were also taken at this site in 1994 (A. Gettleman, pers. comm.). Collection sites on the Frio, Nueces, and lower Guadalupe River produced shells that appeared relatively recently dead, suggesting other living populations may occur in those systems as well.

***Quadrula couchiana* - Rio Grande monkeyface**

Among over 40 collections by TPWD in the Rio Grande, where this species is endemic (Figure 4) from Brownsville to Big Bend, as well as additional collections in tributaries in Mexico, not even shell fragments were found. Likewise CMM, JAMB, and USAO collections do not contain this species. Fort Clark Spring in Kinney County once supported *Q. couchiana* (Taylor 1967), but all unionids now appear extirpated from this site. There seem to be no records of living specimens in Texas in recent decades.

***Quadrula houstonensis* - Smooth pimpleback**

This pimpleback is endemic to the Trinity, Colorado, and Brazos drainages, and possibly the San Jacinto River, of central and east-central Texas (Figure 4). Confusion between *Q. houstonensis* and *Q. aurea* to the southwest and with *Q. mortoni* (western pimpleback) to the north and east have been, and continue to be, problematic. CMM, JAMB, and USAO collections contain nearly 100 specimens collected alive or recently dead in these systems from 1980 through 1985. TPWD sampled over 240 sites within this species' range and found small populations in the upper Trinity River (Eagle Mountain Reservoir) and at several adjacent locations on the Brazos and Little Brazos rivers in central Texas. JAMB found a single recently dead specimen in Pecan Bayou, a tributary of the central Colorado River in 1991. No living or recently dead specimens were taken by TPWD within the Colorado River drainage or the San Jacinto River.

***Quadrula petrina* - Texas pimpleback**

Endemic to the Colorado and Guadalupe rivers of central Texas (Figure 4), this species has declined dramatically in recent years. CMM, JAMB, and USAO collections include over 20 specimens found

alive or recently dead in the Colorado River drainage basin (1980-1988). Since 1992, surveys by TPWD, which included over 220 collections within its range, have found it alive at only two adjacent sites on the Concho River, Concho County, and a small tributary of the Colorado River, Runnels County. JAMB also found living and recently dead specimens at several sites on the Runnels County stream (1991-1993). At present, the only population where more than 2-3 individuals were located per survey occurs in the TPWD mussel sanctuary on the Concho River upstream from Paint Rock. Apparently it has been extirpated from the type locality in the Llano River, Texas.

***Quincuncina mitchelli* - False spike**

Although currently recognized as two disjunct populations including one from the Brazos, Colorado, and Guadalupe (but not San Antonio) rivers of central Texas and another from the Rio Grande drainage (Figure 2), some have questioned whether these represent two species or even two genera. No specimens taken since 1980 are present in the CMM, JAMB, or USAO collections. Only several subfossil fragments of the central Texas populations have been recovered during TPWD surveys in central Texas (over 290 collections); no specimens have been found in the Rio Grande drainage (over 40 collections). No living specimens have been documented in several decades.

***Truncilla cognata* - Mexican fawnsfoot**

Endemic to the Rio Grande system (Figure 3), this species may not have been taken since last found by A. Metcalf in the Rio Grande near Del Rio, Val Verde County, Texas, in 1972. CMM and USAO collections do not contain this species and specimens with JAMB date from 1967. Collections by TPWD (over 40) have failed to find even subfossil fragments of this species.

***Truncilla macrodon* - Texas fawnsfoot**

Endemic to the central Texas Colorado and Brazos and possibly Trinity rivers (Figure 3), only one living specimen has been reported in many years. CMM, JAMB, and USAO collections contain over 10 individuals (1980-1982) from the Brazos River system. TPWD sampled over 190 sites within the range of *T. macrodon* and found no evidence of it at nearly all locations. However, recently dead shells were found in 1994 on the Clear Fork of the Brazos River by JAMB and TPWD, and at several sites between Waco and Bryan on the Brazos River in 1994. Among the 37 specimens found in 1994, several were very-recently dead (predator kills with soft tissue still attached) and one found near the

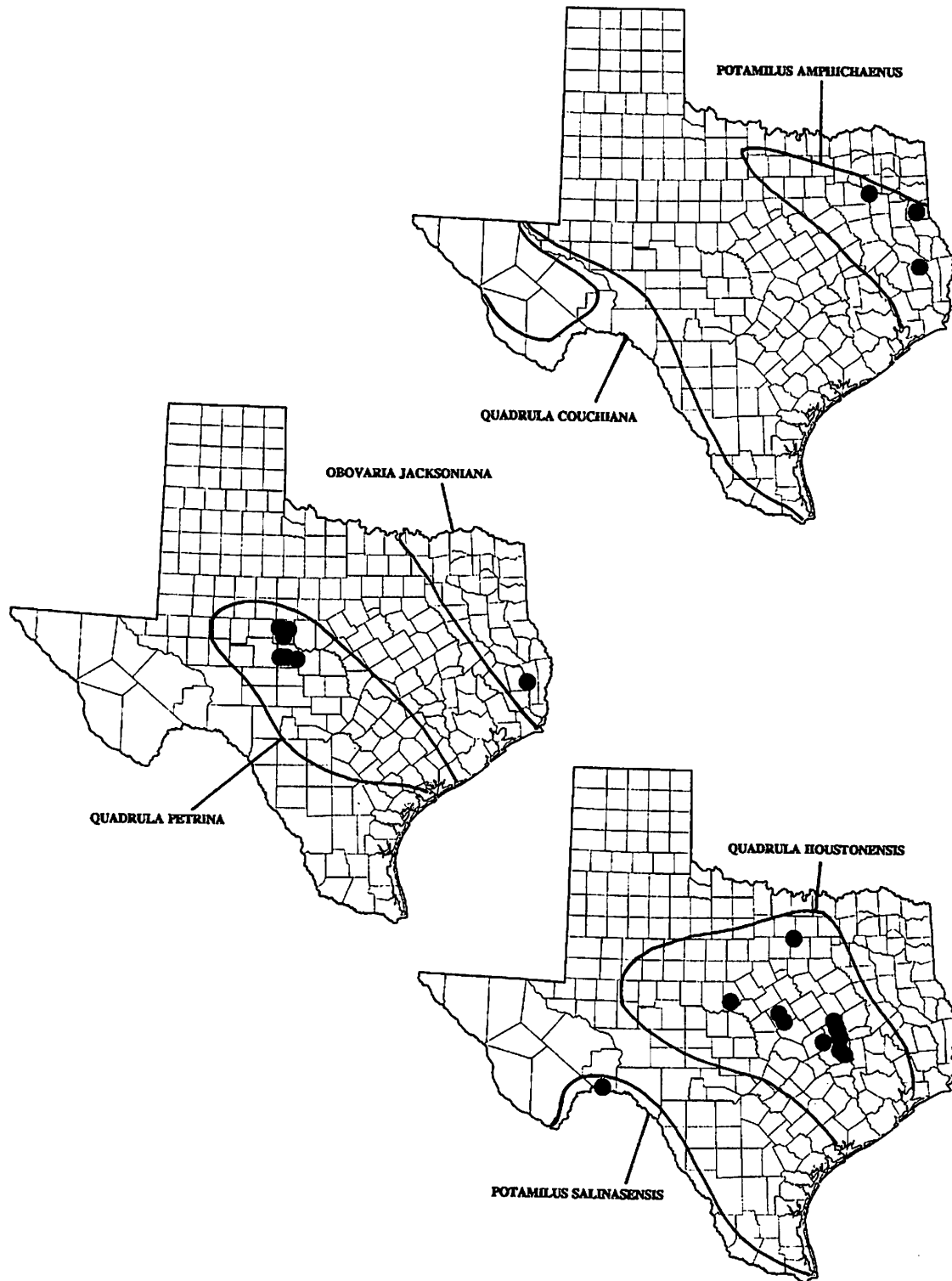


Figure 4. General historical distribution of *Potamilus amphichaenus*, *Quadrula couchiana*, *Obovaria jacksoniana*, *Q. petrina*, *Q. houstonensis*, and *Potamilus (Disconaias) salinasensis* in Texas. Filled dots represent collections of living specimens or recently dead shells and open circles represent collections of relatively recently dead shells based on collections made by Texas Parks and Wildlife Department, C.M. Mather (University of Science and Arts of Oklahoma, Chickasha), and J.A.M. Bergmann (Boerne, Texas) from January 1990 through September 1995. Lines indicate historically known or potential ranges (Howells et al. 1996).

mouth of the Little Brazos River was alive. Additionally, a large specimen in possession of the San Angelo Nature Center, San Angelo, Texas, lacks collection data, but was reportedly taken from the Concho River, Tom Green County, Texas, only a few years earlier. The San Angelo specimen appears to have been alive when collected. Condition of the recently dead specimens collected suggests populations persist at sites on the upper and central Brazos River drainages and possibly on the upper Concho River as well.

General Reasons for Mussel Declines

The 17 species listed by Williams et al. (1993) as threatened, endangered, or of special concern and the federally endangered *Arkansia wheeleri* appear to be in serious trouble (Table 1). Most losses of mussel fauna in Texas appear to represent far-ranging environmental problems rather than simple overharvest by commercial musselers or point-source pollution. Historically, Strecker (1931) discussed losses associated with pollution as did

Shira (1913). Bonham (1939) reported scouring floods as the greatest threat to aquatic habitats in south-central Texas. Few observations on mussel declines in Texas have been published since.

In central, north, south, and west Texas, historical and continued mismanagement of terrestrial environments has had major negative impacts on aquatic habitats. Overgrazing, which began in the mid-1800s, continues today. Removal of terrestrial macrophytes and replacement by less-natural vegetative cover and an increase in mean rainfall over the last century have resulted in greater runoff and an increase in the intensity of scouring floods. Scouring in upstream areas often results in excessive deposits of silt at downstream sites where substrates become covered with soft silt or deep-shifting sand and eliminates mussel habitat. Other factors contributing to runoff and flooding, including highway and bridge design and construction and general land clearing and development. A major hurricane that devastated central Texas in 1978 appears to have been the major turning point in many systems.

Table 1. Summary of status listings of selected freshwater mussels in Texas by the Texas Natural Heritage Program (TNHP), U.S. Fish and Wildlife Service (USFWS), American Fisheries Society (AFS; given by Williams et al. 1993), and records of living specimens or recently-dead shells found during surveys by Texas Parks and Wildlife Department (1992-1995) and C.M. Mather and J.A.M. Bergmann (1990-1995). USACE = U.S. Army Corps of Engineers survey.

SPECIES	TNHP Global	TNHP State	USFWS	AFS	Status in Texas (1990-1995)
<i>Arkansia wheeleri</i>	-	-	E	E	known from 2 recently dead shells
<i>Fusconaia askewi</i>	VR	NR	-	SC	few found alive Sabine River
<i>Fusconaia lananensis</i>	E	NR	-	SC	few found alive Attoyac Bayou
<i>Lampsilis bracteata</i>	E	NR	-	SC	one living population known
<i>Lampsilis cardium</i>	-	-	-	SC	not taken; one USACE record 1992
<i>Lampsilis satura</i>	-	-	-	SC	few found Neches & Sabine rivers
<i>Obovaria jacksoniana</i>	CE-E	NR	-	SC	one questionable shell found
<i>Pleurobema riddellii</i>	E	NR	-	SC	one living (Sabine R.), one recently dead (Neches R.)
<i>Popenaias popeii</i>	E	I	P	T	one relatively recent shell
<i>Potamilus amphichaenus</i>	CE	CI	P	T	two known living specimens in ca. 15 years, several recently dead; Neches & Sabine rivers
<i>Potamilus salinasensis</i>	CE	CI	P	T	one relatively recent shell
<i>Quadrula aurea</i>	E-VR	NR	-	SC	one living population confirmed, Nueces R.
<i>Quadrula couchiana</i>	CE	NR	-	E	not found in decades
<i>Quadrula houstonensis</i>	E	NR	-	T	several small populations remain, Colorado, Brazos, & Trinity rivers
<i>Quadrula petrina</i>	E-VR	NR	-	T	found alive at 3 locations, Colorado R. dr.
<i>Quincuncina mitchelli</i>	E	I	P	T	subfossil shell 1990-1995
<i>Truncilla cognata</i>	CE	NR	P	E	not found since 1972
<i>Truncilla macrodon</i>	CE-E	NR	-	E	one found alive; recently dead shell at 3 sites, Brazos R.

Key: TNHP: C (critically), E (endangered), VR (very rare), I (imperiled), NR (not ranked)
USFWS/AFS: E (endangered), T (threatened), SC (special concern), P (proposed for listing)

Many locations in eastern Texas appear to have supported significant unionid populations longer than the rest of the state. However, environmental modifications within the last decade are now having an increasingly negative impact in many areas. Sandy soils of the region are easily disturbed. Lumbering, land clearing for agriculture and construction, and bridge and highway construction often cause local streams to quickly fill with deep sand. Historically significant mussel populations at sites on the Neches and San Jacinto rivers were still present in the 1970s; however, these sites have been so profoundly smothered in sand that they no longer appear to support unionids. Naturally occurring droughts and severely cold winters also have been implicated as factors associated with mussel declines.

Texas has only one natural lake, Caddo Lake in northeastern Texas; all others are man-made impoundments. Some unionids that cannot adapt to conditions in impoundments have likely been negatively impacted; however, other species have benefited where impoundments provided additional habitat and protection from scouring floods. Water management practices associated with reservoirs may also contribute to mussel losses. Rapid changes in water level both within and below reservoirs may strand unionids when waters recede or cause scouring conditions with rapid releases or abrupt restriction of flow.

Mussel Harvest Regulations in Texas

Prior to 1992, Texas had only a single \$30 mussel license to cover residents and nonresidents as well as sport and commercial harvest with no limits on size or bag. In 1992 and 1993, both harvest regulations and licensing were modified. Minimum size limits were imposed on all species, bag limits were set on harvest during weekends, licenses were redefined (commercial harvest and shell buyer resident and nonresident), and 28 no-harvest mussel sanctuaries were established statewide (Table 2). Although several of the endemic pimplebacks and pigtoes might enter the commercial harvest if they become large enough, none of the 18 species discussed here were specifically sought by commercial musselers. Commercial-harvest impact, if any, reflects occasional collection of large specimens or indirect disturbance through harvest of other, more abundant species. Minimum harvest size of 63.5 mm shell height effectively eliminates legal harvest of many of the less abundant unionids which rarely, if ever, reach harvestable size.

Mussel sanctuaries at some locations include population sites of some of the rarest Texas mussels.

For example, both streams where *A. wheeleri* was found have been designated sanctuaries. The only known *L. bracteata* population and two of the *Q. petrina* populations are in sanctuaries. Several east Texas species also occur within designated sanctuaries. Unfortunately, where environmental disturbances of terrestrial habitats result in subsequent loss of aquatic habitats, sanctuary designations alone offer little protection.

Summary

The 18 unionid species discussed here are among the most seriously threatened in Texas. Unfortunately, causes for their declines likely reflect far-reaching environmental problems that defy quick-fix solutions. Changing land-use practices is difficult and, even if possible, return to naturally-stable conditions would require decades in many areas of the state. Vast areas of Texas are privately held lands where owners frequently resist any form of environmental regulation. No recovery plans have been developed for any of these species in Texas. None of these unionids, including federally listed *A. wheeleri*, are included on Texas state threatened or endangered species lists. With the present trends in reduced state and federal funding and public resistance to governmental regulations, the likelihood of significantly improving the conservation status of Texas unionids seems remote.

Table 2. Freshwater mussel harvest regulations and licensing laws in place in Texas, 1995. US = U.S. Highway; SH = State Highway; RR = Ranch Road; FM = Farm to Market Road.

Licenses (resident and nonresident):

- o Up to 25 lbs. of whole mussels or 12 lbs. of shell may be taken under a fishing license.
- o Commercial mussel license required for >25 lbs. per day.
- o Shell buyer license required for purchase of shell.

Season: All year.

Harvest Methods: Hand collection only.

Time of Day: 30 min. before sunrise to 30 min. after sunset.

Bag Limits:

- o No bag limits Monday through Friday.
- o No more than 75 lbs. per day Saturday and Sunday.
- o No more than 75 lbs. in possession within 500 yards of public water on Saturday and Sunday.

Size limits (ring size):

- | | |
|------------------------------|-------------|
| o Washboards | 4.00 inches |
| o Threeridges and roundlakes | 2.75 inches |
| o Mapleleafs and pimplebacks | 2.75 inches |
| o Tampico pearlymussel | 2.75 inches |
| o Bleufer | 2.75 inches |
| o All other species | 2.50 inches |

Freshwater Mussel Sanctuaries: No harvest permitted in these streams or their tributaries.

Location	From (County)	To (County)
North Sulphur River	SH 50 (Fannin)	SH 24 (Delta/Lamar)
South Sulphur River	SH 50 (Hunt)	SH 154 (Hopkins)
Sulphur River	SH 37 (Franklin)	US 271 (Titus)
White Oak Creek	SH 37 (Franklin)	US 271 (Titus)
Big Cypress Creek	L. Bob Sandlin (dam)	US 271 (Camp)
Sabine River	L. Tawakoni (dam)	SH 19 (Rains/Van Zandt)
Sabine River	FM 14 (Smith)	SH 155 (Smith)
Sabine River	SH 43 (Harrison/Panola)	US 59 (Harrison/Panola)
Angelina River	Source (Rusk)	Neches R. (Jasper)
Neches River	B.A. Steinhagen (dam)	Pine Island Bayou (Orange)
Pine Island Bayou	Source (Hardin)	Neches R. (Orange)
Trinity River	SH 34 (Kaufman/Ellis)	FM 85 (Navarro)
Trinity River	L. Livingston (dam)	US 59 (Polk)
Brazos River	US 380 (Stonewall)	US 83 (Stonewall)
Brazos River	L. Possum Kingdom (dam)	US 180 (Palo Pinto)
Brazos River	SH 7 (Falls)	RR 413 (Falls)
Colorado River	Source (Dawson)	RR 1205 (Borden)
Colorado River	L. Spence (dam)	US 277 (Coke)
Colorado River	US 377 (McCulloch)	RR 45 (Mills/San Saba)
North Concho River	SH 163 (Sterling)	Water Valley (Tom Green)
Concho River	Kickapoo Creek (Concho)	US 83 (Concho)
San Saba River	RR 1311 (Menard)	US 87 (McCulloch)
Guadalupe River	SH 123 (Guadalupe)	SH 80 (Gonzales)
San Marcos River	Source (Hays)	Guadalupe R. (Gonzales)
Comal River	Source (Comal)	Guadalupe R. (Comal)
Pine Creek	Source (Lamar)	Red R. (Red River)
Sanders Creek	Source (Lamar)	Red R. (Lamar)
Elm Creek	Source (Runnels)	Elm Cr. L. dam (Runnels)

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