FRESHWATER BIVALVES OF LAKE TAWAKONI, SABINE RIVER, TEXAS

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ABSTRACT.—Lake Tawakoni, a reservoir on the upper mainstem of the Sabine River, Texas, supports a bivalve fauna of 12 species (10 mussels, one fingernail clam, and the Asiatic clam). Species present tend to be tolerant of slow-moving, turbid waters. Species native to the Sabine River but absent from Lake Tawakoni include most of a suite of taxa characteristic of rivers of the southeastern United States, including eastern Texas. *Key words*: freshwater bivalves; Lake Tawakoni, Texas.

Most of eastern Texas is characterized by slow-moving streams with normally dependable volumes of water. The bivalve fauna of this area differs significantly in species composition from that of central Texas (Strecker 1831, Neck 1982b). The natural bivalve fauna of eastern Texas long has been impacted by water pollution (Shira, 1913). More recently, a series of reservoirs has been constructed in eastern Texas, but the effects of these impoundments on the bivalve fauna are totally unknown. Indeed, little work has been reported (Parks 1938, Parks and Batchel, 1939) concerning mussels in the eastern part of the state since Strecker's (1931) work. Surveys of bivalves of the reservoirs of eastern Texas are needed to elucidate the effect of these impoundments on this fauna.

The main purpose of this survey was to record the bivalve fauna of Lake Tawakoni, a reservoir on the upper mainstem of the Sabine River, in eastern Texas. Preferred habitats of the species present also were characterized in order to initiate an understanding of the processes that determine which species can survive and reproduce in reservoir habitats.

STUDY AREA

The Sabine River arises in the eastern part of north-central Texas (Hunt, Collin, and Rockwall counties) and flows southeastward to Sabine Lake, an estuary of the Gulf of Mexico that also receives the waters of the Neches River (Fig. 1). Total drainage area of the Sabine River is about 25,100 square kilometers (9690 square miles). Presently, two impoundments, Toledo Bend Reservoir and Lake Tawakoni, exist on the main stem of the Sabine River, but there are no published reports on the bivalve fauna of either.

Lake Tawakoni is located in Hunt, Rains, and Van Zandt counties behind the Iron Bridge Dam, which is situated at river kilometer 822 (mile 514). Impoundment of water began on 7 October 1960. At spillway crest, Lake Tawakoni covers about 14,900 hectares (36,700 acres) and impounds about 115,530 hectare meters (936,200 acre feet of water). Drainage area above Iron Bridge Dam is approximately 1960 square kilometers (756 square miles). The above information was taken from Dowell and Breeding (1967).

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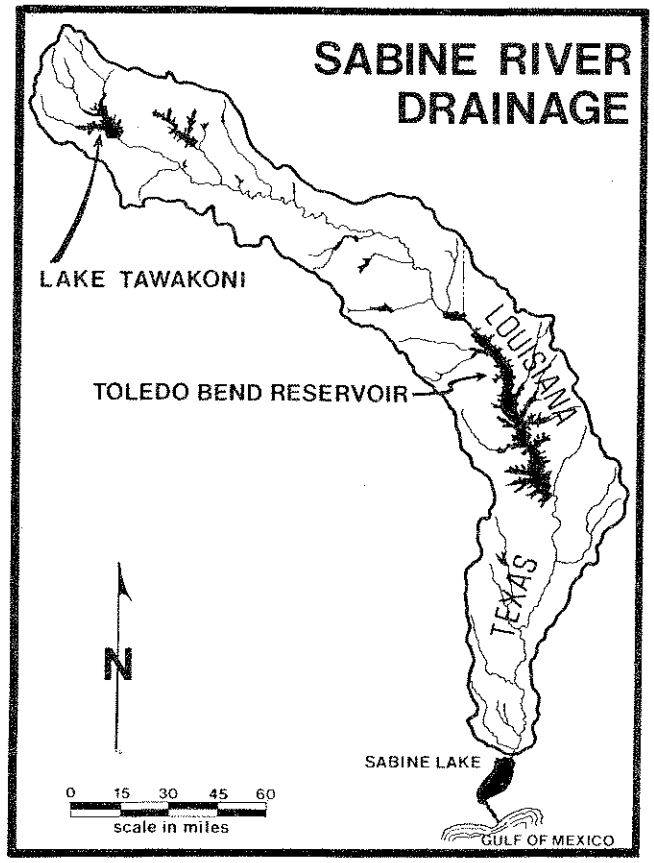

FIGURE 1. Map of Sabine River drainage, Texas and Louisiana, showing location of Lake Tawakoni in the eastern part of north-central Texas.

MATERIALS AND RESULTS

Field surveys were made in early October 1984 during a short-term period of low water. At open reservoir sites, all bivalves in a transect measuring 50 meters by five meters were recorded; normally inundated creek bottoms were sampled for a distance of 30 meters. A total of 1469 bivalves consisting of 10 mussels, one fingernail clam, and the Asiatic clam (Table 1) was identified from 28 collection sites (Fig. 2) on Lake Tawakoni. Voucher specimens have been deposited in the Dallas Museum of Natural History.

Anodonta grandis Say, 1829, was present at more sites (22) than any other species and was the second most abundant bivalve in Lake Tawakoni. The largest shell recovered was 132.5 mm in length. Shells tend to be low in height and short in length, with pinkish or rose-beige highlights to the nacre. Greenish rays on the posterior slope are more

prominent than on most shells of *A. grandis* from Texas. Hints of fine greenish rays are present on the main portion of the shell. Specimens from a stock tank (locality 5) have a more prominent umbo than those from the reservoir, and exhibit a flexure of the hinge line below the umbo. In sloughs (locality 7), young shells were found in small side drainages but not in the mainstem of the slough. *A. grandis* is generally found in ponds, reservoirs, or slow-moving streams (lentic waters) on sandy or mud substrates.

Anodonta imbecilis Say, 1829, was uncommon in Lake Tawakoni, ranking sixth in abundance. Shells are horn brown with greenish brown rays of increasing obscurity as they approach the periphery. *A. imbecilis* normally is found in ponds or protected coves of reservoirs on soft bottoms.

Plectomerus dombeyanus (Valenciennes, 1827), was represented in recovered samples by a single pair of valves (from locality 8) representing an individual that may have been dead for two or more years. The adult shell (105.1 mm length) still possessed dark grayish-brown periostracum. *P. dombeyanus* is most abundant in slow-moving, but generally large, streams with sandy substrates.

Quadrula quadrula apiculata (Say, 1829), was the most abundant bivalve in Lake Tawakoni, although two species were found at more localities. Pustules are abundant over all portions of young shells, but age reduces pustule formation such that only nodular-shaped bumps are produced in later-formed shell. The largest specimen recovered measured 91.2 mm in shell length. *Q. q. apiculata* is most commonly encountered in slow-moving waters on sandy, mud, or hard clay substrates.

Uniomerus tetralasmus (Say, 1830), was uncommon in Lake Tawakoni but may be locally abundant in the sluggish waters of normally inundated (but occasionally dry) feeder creeks; dense populations develop in stock tanks. The periostracum is dark yellowish horn to honey brown; young specimens have green rays on the posterior slope, but these rays become almost nonexistent on older shells. A ventro-posterior projection is present but is not as exaggerated as in *Uniomerus declivus*. One large specimen (133.3 mm shell length) from a stock tank (locality 5) has a prominent ventro-posterior projection (shell outline similar to that of *Tritogonia verrucosa*), but the periostracum is still mostly smooth (rather than flaggy as in *U. declivus*). *U. tetralasmus* is found in ponds or sluggish creeks with mud bottoms; it is characteristic of temporary ponds and streams.

Leptodea fragilis (Rafinesque, 1820), was the fifth most abundant bivalve in Lake Tawakoni. The periostracum is brownish yellow with dark brown rays on the posterior slope. The nacre is pale pinkish purple with less pigment in the muscle scars. Shells are more inflated than those of this species from central Texas. Anterior wings are slightly developed

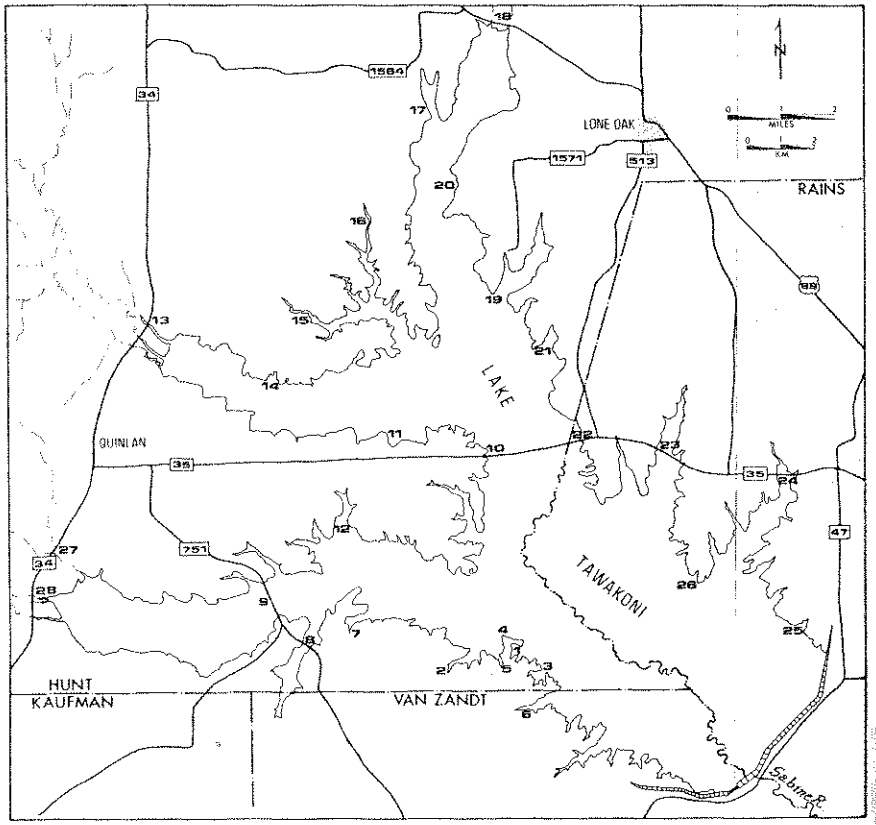

FIGURE 2. Map of Lake Tawakoni, Sabine River, Texas, showing location of collecting sites (numbered 1-28).

in some specimens. *L. fragilis* is characteristic of mud, sand, or gravel substrates with slowly moving water or clear water.

Ligumia subrostrata (Say, 1831), was the third most abundant species of bivalve in Lake Tawakoni, although it was found at more sites than all species but *A. grandis*. Dark greenish rays are present over the entire shell, although they are generally more prominent (darker and wider) between the umbo and the posterior margin; older shells become suffused with brownish black, which almost totally obscures these rays. The nacre of younger shells is suffused with mauve, especially along the periphery of the shell. Eventually the nacre becomes a dull white with limited mauve highlights. The largest specimen measured 102.7 mm in shell length. *L. subrostrata* normally is found in ponds or stream pools of sluggish streams, but is generally not found in places that are periodically dry.

TABLE 1. Numbers and site abundance of freshwater bivalves taken at Lake Tawakoni, Sabine River, Texas (28 collecting sites yielded 1469 individuals).

Species	Individuals		Collecting sites	
	Number	Ranking	Number	Ranking
Anodonta grandis	346	2	22	1
Anodonta imbecilis	46	6	11	6
Plectomerus dombeyanus	1	11*	1	11*
Quadrula quadrula apiculata	561	1	17	3
Uniomerus tetralasmus	22	7	5	7*
Leptodea fragilis	85	5	12	4*
Ligumia subrostrata	286	3	21	2
Potamilus amphichaenus	5	10	3	9
Potamilus purpuratus	1	11*	1	11*
Toxolasma texasensis	7	9	5	7*
Corbicula fluminea	95	4	12	4*
Sphaerium partumeium	14	8	2	10

*Tie.

Potamilus amphichaenus (Frierson, 1898), is represented by five specimens from three localities. This species apparently has long been confused with *Potamilus laevissimus* but differs in the following characters: 1) presence of an incipient pallial sinus posteriorly; 2) noticeable inter-valve gap that is truncated dorsally; 3) ventral margin more flattened; 4) periostracum dark brown; and 5) shells less compressed laterally. The largest specimen measured 124.2 mm in shell length. *P. amphichaenus* is found in quiescent waters with sandy or mud substrates.

Potamilus purpuratus (Lamarck, 1819), was represented in the samples by a single, large, obese specimen with a heavy shell (from locality 14). Nacre is paler purple than in most Texas specimens I have observed. Shell length of the specimen measured 147.4 mm. It was found in the only protected cove in Caddo Inlet (locality 14). *P. purpuratus* is found in quiet or moving waters with sandy or mud substrates.

Toxolasma texasensis (Lea, 1857), was found to be uncommon in Lake Tawakoni. The periostracum is silky brown, and the nacre is a dull iridescent white with limited ochre highlights. A gradual sloping of the posterior ridge to the shell margin is a major character separating *T. texasensis* from *Toxolasma parvus*. *T. texasensis* in Lake Tawakoni is most abundant in inundated feeder creeks. In Texas, this species is typically found in protected or ponded waters with mud or sandy substrates.

Corbicula fluminea (Muller, 1774), was the fourth most abundant bivalve in Lake Tawakoni. Most specimens were of moderate size; the largest specimenn measured 37.9 mm in shell length. All specimens are referable to the white form of the species. *C. fluminea* is common in

areas with a sandy substrate; few occur in areas of clay. Shores may accumulate large windrows of unarticulated shells. A few errant valves were found in the mouths of sloughs, but significant population recruitment is unlikely in this habitat. *C. fluminea* is most abundant in sandy substrates with moving water.

Sphaerium partumeium (Say, 1822), was the only fingernail clam recovered during this survey of Lake Tawakoni. It was found only in feeder creeks, which normally are inundated. Shells were abundant in mud within gaping valve pairs of *Uniomerus tetralasmus*. Living animals were found in water less than two centimeters deep. *S. partumeium* usually is found in sandy or mud substrates of ponds and sluggish streams.

Discussion

The bivalves of Lake Tawakoni illustrate the reaction of an eastern Texas bivalve fauna (which is adapted to sandy substrates) to reservoir conditions with clay and marl substrates. Whereas some river terrace areas are inundated by Lake Tawakoni, much of the substrate (including most of the shallows suitable for unionids) is composed of Tertiary deposits, generally clays of various types.

While faunal diversity in reservoir conditions is expected to be low, the dominant species in Lake Tawakoni were not those anticipated from field surveys of other Texas reservoirs (Neck, unpublished data). *Quadrula quadrula apiculata* and *Anodonta grandis* are dominant species in some Texas reservoirs (including Lake Tawakoni), but the large number of *Ligumia subrostrata* is surprising, because this species generally occurs in small ponds, sloughs, and pools in intermittent creeks. Also noteworthy is the apparent absence of *Lampsilis teres, Lampsilis radiata hydiana,* and *Truncilla truncata*, and the rarity of *Anodonta imbecilis, Potamilus purpuratus*, and *Plectomerus dombeyanus* (these last two were represented only by a single specimen each). Conditions for successful population recruitment of these species may occur only seldomly. *P. purpuratus* and *P. dombeyanus* may be susceptible to local extirpation in the future.

Absence of various species native to the Sabine River (Strecker, 1931) is noteworthy (Table 2). Species such as *Tritogonia verrucosa* (Rafinesque, 1820), *Fusconaia askewi* (Marsh, 1896), *Fusconaia chunii* (Lea, 1861), *Megalonaias gigantea* (Barnes, 1823), *Obliquaria reflexa* Rafinesque, 1820, and *Obovaria castanea* (Lea, 1831) generally are found in lotic habitats with sand or gravel substrates, or both. Some of these species may not have occurred as far upstream in the Sabine River as the present location of Lake Tawakoni.

Of particular interest is the apparent absence of *Amblema plicata* (Say, 1817) from Lake Tawakoni. This species is quite abundant (often the most abundant species) in certain Texas reservoirs—for example, Lake Lewisville (Neck, 1982). Note should be made that Strecker (1931) did not record *A. plicata* from the upper portion of the Sabine River, although he did list this species for Gladewater, Gregg County, Texas, which is about 100 kilometers downstream from the present location of Lake Tawakoni.

Various habitats and geographical subdivisions of Lake Tawakoni exhibit dominance by different bivalve species. *Anodonta grandis* is the most abundant species in shaded sloughs and shallow coves. Open, broad coves protected from prevailing winds are dominated by *Ligumia*

Table 2. Occurrence of unionid species in Sabine River from published records and this study.

Species	Lake Tawakoni*	Hunt**	Smith**	Gregg**
Anodonta grandis	X		X	X
Anodonta imbecilis	X	X		
Arcidens confragosus				X
Strophitus undulatus				***
Amblema plicata				X
Megalonaias gigantea			X	X
Plectomerus dombeyanus	X			X
Quadrula quadrula	X			X
Quadrula pustulosa				X
Tritogonia verrucosa			X	X
Fusconaia askewi			X	X
Fusconaia chunii			X	
Pleurobema ridelli				***
Uniomerus tetralasmus	X	X		
Lampsilis radiata hydiana				X
Lampsilis satura				***
Lampsilis teres			X	X
Leptodea fragilis	X			X
Ligumia subrostrata	X	X		
Obliquaria reflexa			X	X
Obovaria castanea			X	
Potamilus amphichaenus	X	X		
Potamilus purpuratus	X		X	X
Toxolasma texasensis	X	X		
*Truncilla donaciformis***				
Truncilla truncata				X
Villosa lienosa				X
*Glebula suborbiculata****				
Species Total (28)	10	5	9	19

*Records from this survey.

**County records for Sabine River from Strecker (1931).

***Recorded from Shelby County, Texas (downstream from Gregg County) by Strecker (1931).

****Sabine River records without definite localities from Strecker (1931).

subrostrata, whereas similar coves exposed to wind are dominated by *Quadrula quadrula apiculata*. *Q. q. apiculata* also dominates in open, exposed beach areas. Rock riprap habitats at road crossings are dominated by *Corbicula fluminea*. Stocktanks (localities 2 and 5) support populations of *Anodonta grandis, Uniomerus tetralasmus* (shells heavily eroded), and *Ligumia subrostrata*.

Much of the quiet water in coves of Lake Tawakoni supports large beds of the emergent macrophyte, American lotus (*Nelumbo lutea*). Many of these lotus beds do not support clams. However, certain lotus beds that are exposed to wind-driven waves contain individuals of *Anodonta grandis, Corbicula fluminea, Ligumia subrostrata*, and *Toxolasma texasensis* (in decreasing order of abundance), although densities are less than in adjacent areas without lotus beds. Species present in the lotus beds (with the exception of *C. fluminea*) are those that occur in sloughs and protected coves.

The lack of, or relative scarcity of, bivalves in lotus beds could be due to avoidance by proper fish hosts (not applicable for *C. fluminea*) or presence of some detrimental environmental factor (less than optimal oxygen or food levels, for example). Frierson (1917) noted the lack of unionids in lotus ponds. Bivalves present in the more exposed lotus beds of Lake Tawakoni have broad shells and low specific gravities, which may facilitate movement by benthic water currents (wind driven). The absence from these lotus beds of *Quadrula quadrula apiculata* may be significant because it not only is heavy shelled but also generally has more of its shell below the sediment level than the species that are present.

In general, fewer bivalves were found at sites along the eastern edge of Lake Tawakoni than along the western edge. With prevailing winds from the southeast, the eastern edge experiences less significant wave action than does the western edge. The greater abundance of bivalves at sites along the western edge may be due to concentration of them by water movement or may indicate more favorable conditions. A similar relationship of bivalve densities also was observed in individual coves that possessed definite leeward and windward sides.

Utilization of extant bivalve populations by humans was indicated by large piles of shells. Conversations with local fishermen confirmed their use as fish bait. Species most utilized included *Q. q. apiculata, A. grandis*, and *L. subrostrata*.

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