# Characterization of a Freshwater Mussel (Unionidae) Community in the Big Sunflower River, Sharkey County, Mississippi

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**Abstract**

Twenty-two species of freshwater bivalves (Mollusca: Unionidae, and the Asian clam *Corbicula fluminea* (Muller, 1774), Corbiculidae) were collected at a sandy shoal in the Big Sunflower River, a low gradient, alluvial river in west-central Mississippi. The fauna was numerically dominated by *Amblema plicata plicata* (Say, 1817), *Plectomerus dombeyanus* (Valenciennes, 1827), and *Quadrula pustulosa pustulosa* (I. Lea, 1831), which together comprised 92.6 and 88.7% of the bivalves at three shallow and three deep-water, more erosional sites, respectively. Total bivalve density was slightly greater at shallow (93.8 ± 5.0 individuals/sq m, ± SE) than at deep-water sites (73.3 ± 7.3 individuals/sq m) ($F = 5.4$; $p = 0.0272$). Total bivalve biomass at shallow-water sites (18,319.0 ± 1135.5 g/sq m) was greater than at deep-water sites (10,113.3 ± 1291.5 gm/sq m) ($F = 22.8$, $p = 0.0001$). Species diversity and evenness were similar at shallow (1.009, 0.394) and deep-water sites (1.184, 0.494). The fauna was characterized by little evidence of recent recruitment. Percentage of individuals less than 30-mm total shell length was low and similar at shallow (0.85%) and deep-water sites (1.45%). Stable shoals are uncommon habitats in alluvial rivers in Mississippi; regular assessment of community and population indices should be part of protecting these valuable habitats.

Key Words: Mussels; Bivalves; Big Sunflower River; Sharkey County, Mississippi

## Introduction

Freshwater bivalves (especially mussels in the family Unionidae) usually achieve their greatest density and richness in medium- sized to large rivers throughout the central, and south eastern United States (Coker 1919, Hynes 1970, Cummins 1974, Fuller 1974). Thick-shelled, long-lived species typically inhabit stable sand-gravel shoals free of excessive erosion or sediment deposition. Thin-shelled, rapidly growing species are usually more common in lentic habitats with fine-grained sediments. The majority of rivers in Mississippi are alluvial, low gradient, with substratum consisting of clay, fine-grained sediments, or shifting sand. Extensive stable sand-gravel shoals, which can support large numbers of bivalves, are uncommon.

In Mississippi, freshwater bivalves tend to be scattered, located in pools or runs stabilized by woody debris or aquatic macrophytes. As a result, most bivalve surveys in Mississippi have been qualitative, with investigators collecting live mussels or shells by hand. Qualitative data on Mississippi bivalves have been obtained by Hinkley (1906), Frierson (1911), Isom and Yokley (1968), Grantham (1969), Stern (1976), Yokley (1979), Cooper and Johnson (1980), Hartfield and Rummel (1985), Hartfield and Ebert (1986), and Bogan et al. (1987). The only published records of the Big Sunflower River mussel fauna are by Grantham (1969). He recorded 13 species of mussels form the Yazoo Basin, with only two (*Potamilus purpuratus* (Lamarck, 1819), *Amblema plicata plicata* (Say, 1817)) confirmed as occurring in the Big Sunflower River drainage.

The purpose of this paper is to describe results of a survey for bivalves, using quantitative techniques, at a stable sandy shoal in the Big Sunflower River, Sharkey County, Mississippi.

## Study Area

The Big Sunflower River originates in Moon Lake, Coahoma County, flows south through agricultural land, and enters the Yazoo River between Sharkey and Yazoo counties, Mississippi. It is deep and slow moving, with steep clay banks. The shoal was approximately 1 km long and located near River Mile (RM) 35.2 (Figure 1). Mussels were locally abundant in stable sand substratum. Upstream and downstream of the shoal, substratum consisted mainly of clay or silt, and live mussels were rare or absent.

Based on records kept since 1949, gage height at RM 39.4, just upriver of the study area, ranged from 6.3 to 15.4 m (20.70 to 50.52 ft). Discharge (which has been measured four to five times each year since 1964) ranged from 9.6 to 860.9 $m^3$/sec (gage height equivalents were 22.40 and 48.32 ft, respectively). When this study was conducted, gage height was 6.43 m (21.1 ft), which was only 13 cm (0.4 ft) above

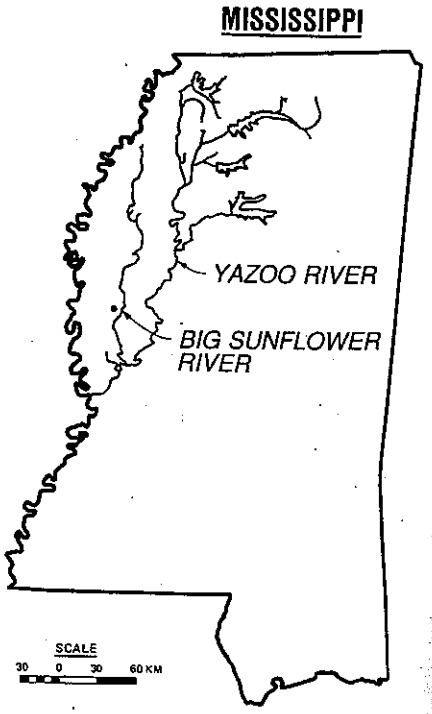


**Figure 1. Location of the study area on the Big Sunflower River.**

the lowest value recorded since 1949.

Mussels were collected at six sites within a 20-m radius of an exposed shoal along the right descending bank of the river. Low water prior to the survey had exposed approximately 30% of the shoal and caused considerable mussel mortality. Close to the exposed portion of the shoal the water was shallow and slow moving. Quantitative samples were obtained at three sites within 5 m of the exposed shoal where water was 30-50 cm deep. Moving away from the exposed part of the shoal, the water became gradually deeper and conditions were slightly more erosional. A second set of quantitative samples was taken at sites where the water was slightly deeper (60-90 cm). Two of these sites were 10 to 20 m upriver and one site was downriver of the shoal. The substratum at all sites (regardless of water depth or distance from the shoal) consisted of 95% sand and silt (<5.0-mm diameter), with the remainder coarse sand and gravel (5.0-75.0-mm diameter). The shoal appeared to be stabilized mainly by live mussels, dead shells, and shell fragments.

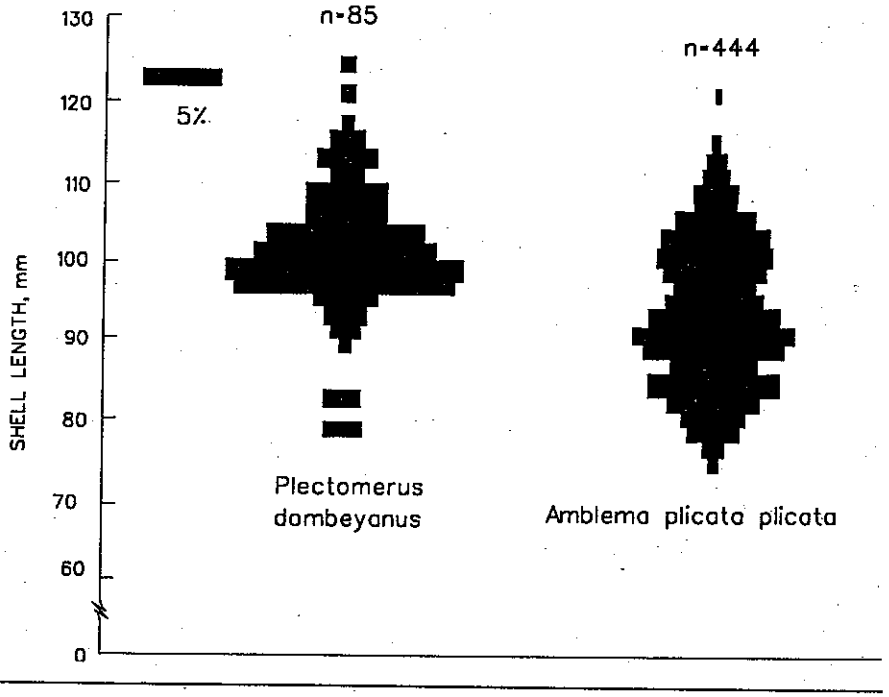


**Figure 2. Length-frequency histograms for *Amblema plicata plicata* and *Plectomerus dombeyanus* from the Big Sunflower River.**

## Methods

Quantitative samples were obtained by randomly placing a 0.25-sq m aluminum quadrat five times at each of six sites. All sediment within the quadrat was removed to a depth of 10-15 cm and placed in a 20-L bucket. Sediment was carried to shore, sieved through a nested screen series (12.7, 6.3, and 0.5 mm), and picked for live organisms. Bivalves were returned to the laboratory, identified, weighed to the nearest 0.01 g on an electric Ohaus top-loading balance, and total shell length (SL) measured to the nearest 0.1 mm with a dial caliper. Specimens not needed for voucher were returned to the river.

Major community and population indices (total density and biomass, species diversity, evenness, richness, etc.) were compared between deep-water and shallow-water sites. However, SL data from both sites were combined since there were no intersite demographic differences.

After quantitative sampling was complete, the shoal was searched by two individuals for species not taken in quantitative samples. The study was conducted on October 14-15, 1987.

## Results and Discussion

Twenty-two species of live unionid mussels and the Asian clam (*Corbicula fluminea* (Muller, 1774) were collected from the study area (Table 1). Of particular note are the first reported occurrence of *Actinonaias ligamentina* (Lamarck, 1819) from Mississippi, and the presence of *Pleurobema pyramidatum* (I. Lea, 1840), known only from the Big Black River in the state. The qualitative collection consisted of species too uncommon to be taken in the quantitative samples, or species usually more common in depositional areas (for example *Anodonta grandis* (Say, 1829), and *Toxolasma texasensis* (I. Lea, 1857)).

The quantitative samples contained 13 species of unionids and *C. fluminea* (Table 1). These collections were dominated by *A. p. plicata, Plectomerus dombeyanus* (Valenciennes, 1827), and *Quadrula pustulosa pustulosa* (I. Lea, 1831), which together comprised 92.6% and 88.7% of the bivalves at the shallow-water and deep-water sites, respectively. With the exception of *Leptodea fragilis* (Rafinesque, 1820), which comprised about 2% of the bivalves collected alive, the fauna consisted almost entirely of thick-shelled species.

Total bivalve density was slightly greater at shallow-water (93.8 ± 5.0 individuals/sq m, ± SE) than at deep-water sites (73.3 ± 7.3 individuals/sq m). These differences in density were not significantly different at the 0.01 level ($F = 5.4$; $p = 0.0272$). Total bivalve biomass at shallow-water sites (18,319.0 ± 1135.5 g/sq m) was significantly greater than at deep-water sites (10,113.3 ± 1291.5 g/sq m) ($F = 22.8$, $p = 0.0001$). Species diversity and evenness were similar at shallow-water (1.009, 0.394) and deep-water sites (1.184, 0.494). Low values for these indices were the result of reduced species richness (13 and 11 species were found at shallow-water and deep-water sites, respectively) and high dominance of *A. p. plicata* (Table 1). The shallow-water sites provided only slightly better habitat for mussels than the deeper, slightly more erosional sites.

The number of individuals and species less than 30-mm total SL provides an index of recent recruitment. Specimens less than 30 mm total SL are typically less than 2 or 3 years old. With the exception of three species (*C. fluminea, Truncilla truncata* (Rafinesque, 1820), and *Truncilla donaciformis* (I. Lea, 1820)) all of the other bivalve species collected in the quantitative samples reach a maximum shell length of 60-150 mm or more total SL. Based on this criterion, the bivalve fauna in this reach of the Big Sunflower River was characterized by little evidence of recent recruitment. The percentage of individuals less than 30-mm total SL was low and similar at shallow-water (0.85%) and deep-water sites (1.45%). Only three species (*C. fluminea, Truncilla donaciformis* (I. Lea, 1820), and *Quadrula nodulata* (Rafinesque, 1820)) had individuals less than 30-mm total SL. One of the five *Q. nodulata* was 23.7 mm total SL, and the only *T. donaciformis* collected was 26.1 mm total SL. Only two species had representatives less than 30 mm total SL at the shallow (*C. fluminea* and *T. donaciformis*) and deep water (*C. fluminea and Q. nodulata*) sites.

Clearly, most bivalves at this shoal do not successfully recruit annually and most have not recruited in the last several years. Information on recruitment in this reach of the Big Sunflower River can be compared with data collected from other mussel beds using similar techniques. Miller and Payne (1991) reported that percentage of individuals less than 30-mm SL ranged from 16.1% to 64.1% at mussel beds located at RM 299.4, 504.8, and 634.7 in the upper Mississippi River.

The *A. p. plicata* population (all sites combined) had relatively few individuals less

**TABLE 1. Summary statistics for bivalves collected at three shallow-water and three deep-water sites in the Big Sunflower River, Sharkey County, Mississippi 15-16 October 1987.**

| Species | Shallow-water Sites (%) | Deep-water Sites (%) |
|---|---|---|
| *Amblema p. plicata* (Say, 1817) | 74.15 | 66.55 |
| *Plectomerus dombeyanus* (Valenciennes, 1827) | 10.51 | 17.45 |
| *Quadrula p. pustulosa* (I. Lea, 1831) | 7.95 | 4.73 |
| *Fusconaia flava* (Rafinesque, 1820) | 1.42 | 0.73 |
| *Quadrula quadrula* (Rafinesque, 1820) | 1.14 | 1.45 |
| *Megalonaias nervosa* (Rafinesque, 1820 | 1.14 | 1.09 |
| *Leptodea fragilis* (Rafinesque, 1820) | 1.14 | 2.55 |
| *Obliquaria reflexa* (Rafinesque, 1820) | 0.85 | 2.55 |
| *Corbicula fluminea* (Muller, 1774) | 0.57 | 1.09 |
| *Pleurobema pyramidatum* (I. Lea, 1840) | 0.28 | — |
| *Quadrula nodulata* (Rafinesque, 1820) | 0.28 | 1.45 |
| *Truncilla donaciformis* (I. Lea, 1820) | 0.28 | — |
| *Truncilla truncata* (Rafinesque, 1820) | 0.28 | — |
| *Uniomerus declivis* (Say, 1831) | — | 0.36 |
| Total mussels | 352 | 275 |
| Total sites | 3 | 3 |
| Total samples | 15 | 15 |
| Species richness | 13 | 11 |
| Species diversity | 1.009 | 1.184 |
| Evenness | 0.394 | 0.494 |
| Simpson's dominance | 0.567 | 0.476 |
| Individuals < 30 mm (%) | 0.85 | 1.45 |
| Number of species < 30 mm | 2 | 2 |
| Density (no./sq m) | 93.8 | 73.3 |
| Standard error | 5.0 | 7.3 |
| F-Value | 5.4 | |
| Pr > F | 0.0272 | |
| Biomass (gm/sq m) | 18,319.0 | 10,113.3 |
| Standard error | 1135.5 | 1291.5 |
| F-value | 22.8 | |
| Pr > F | 0.0001 | |

Mussels collected alive near the shoal using qualitative methods that were not obtained in the quantitative collection.

*Actinonaias ligamentina* (Lamarck, 1819)
*Anodonta grandis* (Say, 1829)
*Arcidens confragosus* (Say, 1829)
*Elliptio crassidens* (Lamarck, 1819)
*Glebula rotundata* (Lamarck, 1819)
*Lampsilis teres* (Rafinesque, 1820)
*Potamilus ohiensis* (Rafinesque, 1820)
*Potamilus purpuratus* (Lamarck, 1819)
*Toxolasma texasensis* (I. Lea, 1857)

than 80 mm and the remainder consisted of several closely related cohorts (Figure 2). The population structure of *P. dombeyanus* was similar to that of *A. p. plicata*, although the former species was dominated by a single cohort, 96 to 104 mm, which comprised about 50% of the population. No evidence of recent recruitment was found for either species.

Grantham (1969) found *A. p. plicata* throughout much of Mississippi and reported that it inhabited mud, sand, and gravel. In silt and sand in the upper Mississippi River, *A. p. plicata* usually comprises 50% or more of bivalve assemblages (Miller et al. 1990, Miller and Payne 1991). Grantham (1969) considered *P. dombeyanus* to be the most frequently encountered mussel in Mississippi with densities ranging between 10 and 15/sq m. The high frequency of occurrence of this species throughout Mississippi is probably the result of its tolerance to clay or firmly packed silt where it is often completely buried (Grantham 1969). In the 30 samples taken from the Big Sunflower River, density of *P. dombeyanus* ranged from 4.8 to 26.4 individuals/sq m.

Hartfield and Ebert (1986) reported moderate to low numbers of mussels in Bayou Pierre, Cole's Creek, and the Homochitto River in southwestern Mississippi. When present, mussels were usually found where sediments were stabilized by partially submersed woody vegetation. Total densities at the shoal in the Big Sunflower River were higher than those usually found in most Mississippi streams (Hartfield, unpublished data), but are within the range of values reported for mussel beds in large rivers. At RM 967 in the lower Ohio River, Miller and Payne (1988) collected 23 species of mussels and reported that average density ranged from 47 to 80 individuals/sq m. In the lower Tennessee River near Paducah, Kentucky, 22 species were collected and density ranged from 73.7 to 187.7 individuals/sq m (Way et al. 1989).

Although densities at this shoal were similar to those reported from large rivers in the central United States, species diversity was comparatively low. The Shannon-Weaver species diversity index was less than half the values reported at dense and diverse mussel beds in the upper Mississippi River. Miller and Payne (1991) reported that species diversity ranged from 1.467 to 2.339 at sites on three mussel beds where 15 to 21 species were identified. Mussel beds in the Mississippi River were part of heterogeneous habitat complex that included sloughs, macrophyte beds, and extensive shoals. In contrast, the shoal on the Big Sunflower River was isolated and located in a river reach without much habitat diversity.

The shoal in the Big Sunflower River was comparable in terms of density and biomass to larger mussel beds in the upper Mississippi, Tennessee, and Ohio Rivers. However, species diversity and evidence of recent recruitment were low when compared to many large river assemblages. Stable shoals are uncommon habitats in alluvial rivers in Mississippi. Regular assessment of density biomass, species richness, diversity, population structure of dominant species, and evidence of recent recruitment should be part of a program of protecting these important habitats.

### Acknowledgments

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# CORRECTION:

In the last issue of *The Journal of the MAS* (vol. 37, no. 2) a table was inadvertently omitted from the article "Avian Nesting Activities in Rural Habitats in East-Central Mississippi" by Dean W. Stewart and George A. Hurst. We apologize for the error. This article has been reprinted to include the missing table. Interested readers can obtain a reprint from: George A. Hurst, Department of Wildlife and Fisheries, Mississippi State, MS 39762.

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