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A NEW MUSSEL RECORD FOR TENNESSEE: *LAMPSILIS SILIQUOIDEA* (MOLLUSCA: UNIONIDAE) FROM THE WOLF RIVER

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ABSTRACT—This is a report of a new mussel record for Tennessee, *Lampsilis siliquoidea* (Barnes, 1823), the fat mucket. We found this unionid mussel to be abundant in the Wolf River, Benton Co., Mississippi, and Fayette Co., Tennessee. Shell length-frequency distributions and length-age relationships show these mussels grow larger and more quickly than those in northern populations.

There have been few published surveys of the mussels of the Mississippi River and its major tributaries in West Tennessee. First, Pilsbry and Rhoads (1896, as cited in Ortmann, 1926) listed 12 species of mussels from Reelfoot Lake and five species from the Wolf River, Shelby Co., Tennessee. Later, Ortmann (1926) reported seven species from Reelfoot Lake and 12 species from the Obion River. Hoff (1943) and Najarian (1955) reported on unionids from Reelfoot Lake. One of us (Manning, 1989) reported 33 species of mussels from the Hatchie National Scenic River. None of these surveys reported *Lampsilis siliquoidea* (Barnes, 1823), the fat mucket. However, relic shells of *L. siliquoidea* were found by one of us (D. Manning) during a survey of Reelfoot Lake in 1985. This record was not published because of the possibility that these shells had been transported to the area by aborigines (Hill, 1983). Starnes and Bogan (1988) did list *L. siliquoidea* as occurring in West Tennessee based on these relic shells. These relic shells are deposited in the Frank H. McClung Museum malacology collections, The University of Tennessee, Knoxville, (voucher no. 947).

METHODS

We collected living mussels by hand along the banks of the Wolf River, from Michigan City, Benton Co., Mississippi, downstream to Rossville, Fayette Co., Tennessee, from the water's edge to a depth of ca. 1 m. We sampled at Batemen Bridge in October 1994 and spent 20 person-hours in the water sampling other sections of the river during September-October 1995. We measured all living *L. siliquoidea* for length according to Hinch et al. (1989), recorded by sex based on external shell morphology, and returned them to the specific location from which they were taken.

David H. Stansbery (The Ohio State University, Columbus, Ohio) and Paul W. Parmalee (The University of Tennessee, Knoxville, Tennessee) later verified the identity of shells of *L. siliquoidea*. While D. H. Stansbery prefers *L. radiata luteola* (Lamarck, 1819) for the specimens from the Wolf River, our nomenclature follows Turgeon et al. (1988). Voucher specimens are housed in the Frank H. McClung Museum malacology collections, The University of Tennessee, (voucher no. 948).

We determined the length-age relationship of *L. siliquoidea* by observing the external annuli of 72 live individuals and from internal annuli of 16 thin-sectioned, empty shells according to Neves and Moyer (1988). Internal annuli were defined as lines crossing the nacreous layer and extending through the prismatic layer to the periostracum. Double and triple lines were frequently encountered and scored as a single annulus. Internal lines from the first 4 years of age were difficult to read; so, based on shell size, the first conspicuous annulus was arbitrarily assumed to indicate an animal starting its 3rd year of growth. The age-length relationships of internally and externally-aged individuals were fitted with the von Bertalanffy equation: $L_t = L_\infty (1-e^{-k(t-t_0)})$.

DESCRIPTION OF THE STUDY SITE IN THE WOLF RIVER

The Wolf River is in the West Tennessee Plain physiographic region or part of the western mesophytic deciduous forest (Barbour and Billings, 1988). We sampled the Wolf River between Michigan City, Benton Co., Mississippi, and Rossville, Fayette Co., Tennessee (Fig. 1). Approximately midway between the ends of the River is Batemen Bridge. The River at Batemen Bridge is a third- to fourth-order stream, and it receives water from an extensive cypress-gum swamp upstream that was formed by a natural sand dam deposited by Mount Tena Creek. The River at Batemen Bridge has a conductivity of 35 µS/cm and, during the fall of 1993, had a discharge of 3.4×10^5 m^3/day and a total particulate suspended load of 3.7×10^3 kg/day (Neff and Hearnsberger, 1994).

RESULTS

We first encountered this mussel during a Rhodes College ecology field trip to the Wolf River on 31 October 1994. We found 22 living and two dead individuals upstream from Batemen Bridge east of Moscow, Fayette Co., Tennessee. We subsequently collected *L. siliquoidea* in the Wolf River from Michigan City, Benton Co., Mississippi, to Rossville, Fayette Co., Tennessee. The relative abundance of this mussel and the number collected per hour per person collecting are given in Table 1.

Resulting length frequencies for three groups of living mussels (males and females) and all dead shells are given in Fig. 2. Sexual dimorphism in shell lengths is obvious from these distributions (mean length $\pm$ 1 *SD* for males was 101.7 $\pm$ 11.0 mm and for females was 92.2 $\pm$ 13.3 mm). These length-frequency distributions for the sexes were significantly different (Kolmogorov-Smirnov test $\chi^2 = 17.01$; $n = 82$

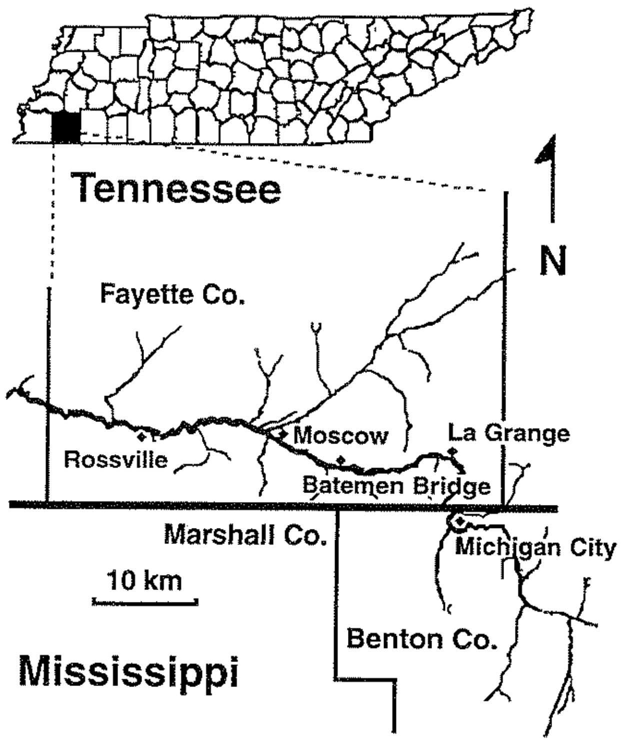

FIG. 1. Map of area of the Wolf River sampled in Benton Co., Mississippi, and Fayette Co., Tennessee.

males and 65 females; $P = 0.039$). The length-frequency distribution of dead shells reflects the lengths of the living individuals (mean length of all living mussels was 97.7 ± 12.8 mm and of dead shells was 101.2 ± 11.4 mm); these distributions were not significantly different (Kolmogorov-Smirnov test $\chi^2 = 2.28$; $n = 147$ living mussels and 28 dead shells; $P = 0.45$).

Length-at-age data for external and internal rings are given in Fig. 3, based on internal examination of empty shells and external examination of living individuals. The internal lines were difficult to read; often multiple lines converged on the periostracum. Possibly, rapid temperature changes or reproductive events resulted in these "disturbance" rings. These rings were counted as a single year's growth, and our estimates of age from internal annuli, being conservative, may overestimate growth. Nevertheless, using external lines resulted in faster estimates of growth compared to using internal lines. Parameter estimates (and asymptotic standard errors) from the von Bertalanffy equation, using internal and external rings, were $L_\infty = 107.0$ mm (2.403), k = 0.1033 (0.24), and $t_0 = -4.59$ (3.01). We did not observe any indication of mesoconch (sensu Clarke, 1986) shell stage.

Discussion

We are unclear why living *L. siliquoidea* has not been reported in Tennessee. It is common in rivers in Arkansas directly across the Mississippi River from West Tennessee (Jenkinson and Ahlstedt, 1987), in oxbows of the Mississippi River to the south (Cooper, 1984), and in streams in Mississippi south of Tennessee (Cooper and Johnson, 1980; Hartfield and Rummel, 1985; Hartfield and Ebert, 1986) and has been collected in a direct tributary of the Mississippi River in Kentucky just north of the Tennessee state line (W. Haag, pers. comm.). This mussel is a substrate generalist (Clarke, 1981). Many of its potential fish hosts (Watters, 1994) are found in the Wolf River (Medford and Simco, 1971) and are widely distributed in Tennessee (Etnier and Starnes, 1993). We found *L. siliquoidea* to be the second most abundant mussel species. Our first and third through sixth most abundant species also were found by Pilsbry and Rhoads (1896, as cited in Ortmann, 1926) in their study of the Wolf River. If *L. siliquoidea* was present in the late 1800s at its present abundance, it seems unlikely Pilsbry and Rhoads (1896, as cited in Ortmann, 1926) would have missed this species in their survey.

TABLE 1. Relative abundance (percentage) and rate (number collected per hour per person) of *Lampsilis siliquoidea* collected along the Wolf River from Benton Co., Mississippi, to Fayette Co., Tennessee, during September-October 1995.

Location	Relative abundance	Rate
Michigan City to LaGrange	38.5	16.0
LaGrange to Batemen Bridge	33.1	10.8
Batemen Bridge to Moscow	7.0	3.9
Moscow to Rossville	1.0	0.4

Results given in Table 1 indicate that *L. siliquoidea* is more abundant in the Wolf River, relative to other unionids and in absolute abundance, the farther one goes upstream from Rossville, Tennessee. The patchy distribution of mussels and the uneven and often debris-covered bottom made quadrat sampling impractical. Searching efficiency and strategy did not change during collecting trips; so, reporting abundances based on person-hours is presumably appropriate. According to Strayer et al. (1995), catch rates from timed searches correlate well with actual population densities if applied under carefully defined conditions.

The microhabitat that often yielded high densities of *L. siliquoidea* was vegetated areas (*Sparganium* sp.) below or along swiftly moving parts of the River. Perhaps, dredging activities of the early 1970s in the Wolf River to Moscow, Tennessee, significantly reduced this type of habitat in the lower reaches that we sampled (Hartfield, 1993).

The difference in size-frequency distributions between male and female shells was expected. Members of the subfamily Lampsilinae show such sexual dimorphism in shell structure (Cummings and Mayer, 1992). The agreement between the length-frequency distributions of living and dead shells suggests that mortality is not falling disproportionately at one end of the size range we observed.

The length of the smallest living male and female was 54.2 and 67.7 mm, respectively. According to Nalepa and Gauvin (1988), *L. siliquoidea* of these lengths in the Great Lakes are ca. 5 and 8 years old. Likewise, the maximum shell length we recorded was 119.7 mm for males and 115.5 mm for females. The longest *L. siliquoidea* that Nalepa and Gauvin (1988) report was ca. 80 mm and estimated to be 16 years old. *L. siliquoidea* from the Wolf River, thus, seem to grow longer and faster than individuals collected by Nalepa and Gauvin (1988) in Lake Erie (Fig. 3). This is consistent with the work of Tevesz et al. (1985) who found that stream-dwelling *L. siliquoidea* are larger than lake-dwelling forms.

The population of *L. siliquoidea* in the Wolf River appears to be older than that sampled by Tevesz et al. (1985) in the Vermilion River in northern Ohio. The mean age of live-collected *L. siliquoidea* in the

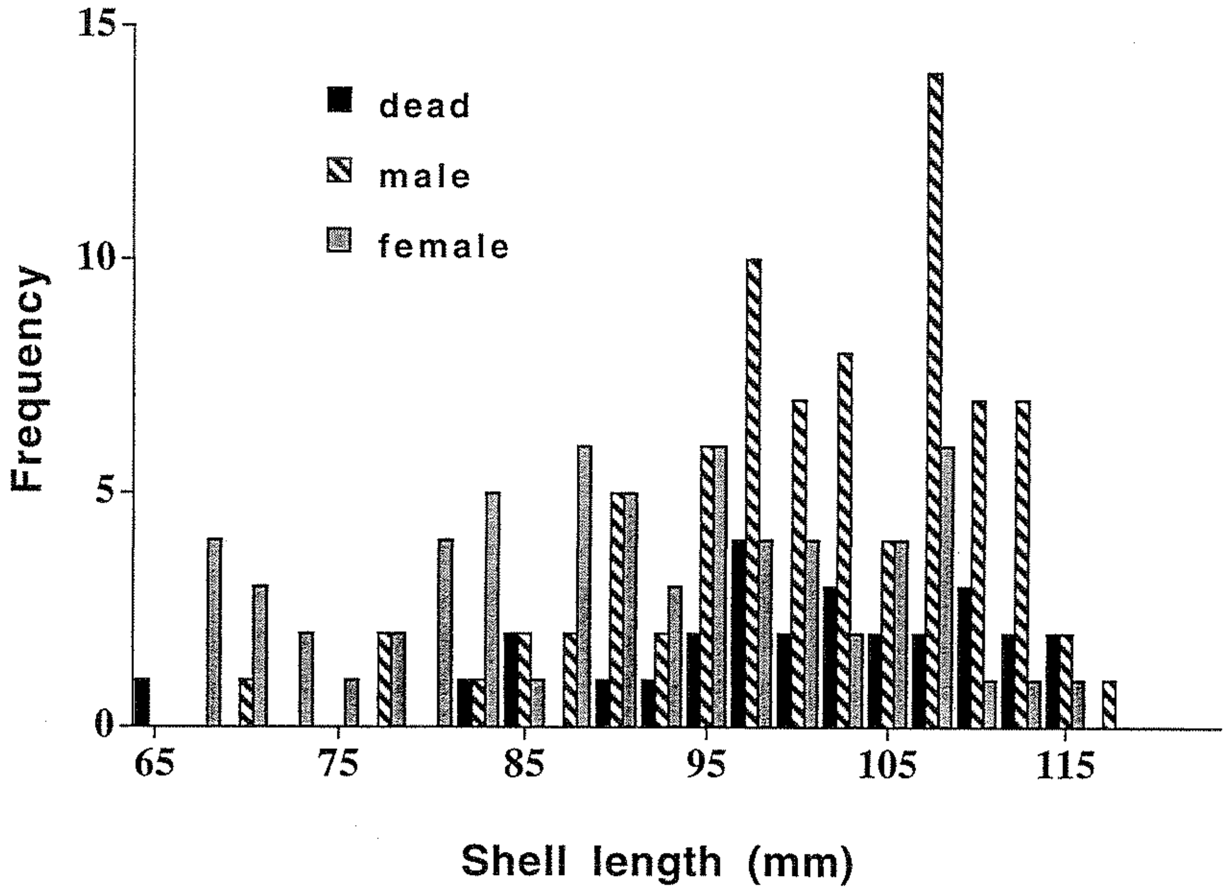

FIG. 2. Length-frequency distribution of live male, live female, and dead *Lampsilis siliquoidea* from the Wolf River.

Wolf River was 20+ years, while the mean age of those collected by Tevesz et al. (1985) was only 5.55 years. The Wolf River population, thus, may be dominated by very old individuals, as is indicated by the prevalence of large individuals. The mean length of all live-collected *L. siliquoidea* in our study was greater than that of the nine populations examined by Tevesz et al. (1985).

Based on this survey, *L. siliquoidea* in the Wolf River from Michigan City, Mississippi, to Rossville, Tennessee, appears to be most abundant immediately upstream from Batemen Bridge (Fig. 1). A large swamp is located just upstream from Batemen Bridge. Increased phytoplankton-periphyton production and export of organic seston from this swamp may greatly benefit the native unionids. This typical pattern of increased abundance of filter-feeders below lake outlets is discussed by Richardson and Mackay (1991). They describe an exponential decline in filter-feeder density with distance downstream from the outlet. Seston quality and quantity are important causes of this distribution. Rapid decline in mussel abundance with distance from a lake outlet was described by Brönmark and Malmqvist (1982, 1984), again apparently due to food of higher quality being washed out of the lake. While the explanation of abundance based on food quality is intuitively satisfying, there may be other factors affecting mussel distribution below lake outlets. For example, lakes and wetlands may moderate stream flow and temperature, while reducing sediment load and pollution.

There are few studies dealing with distribution patterns of mussels relative to stream outlets from lakes or swamps. Surveying other rivers of western Tennessee containing similar swamp-wetland habitats would determine if the pattern of high abundance of native mussels downstream from swamps is an artifact to the Wolf River or a more general ecological phenomenon.

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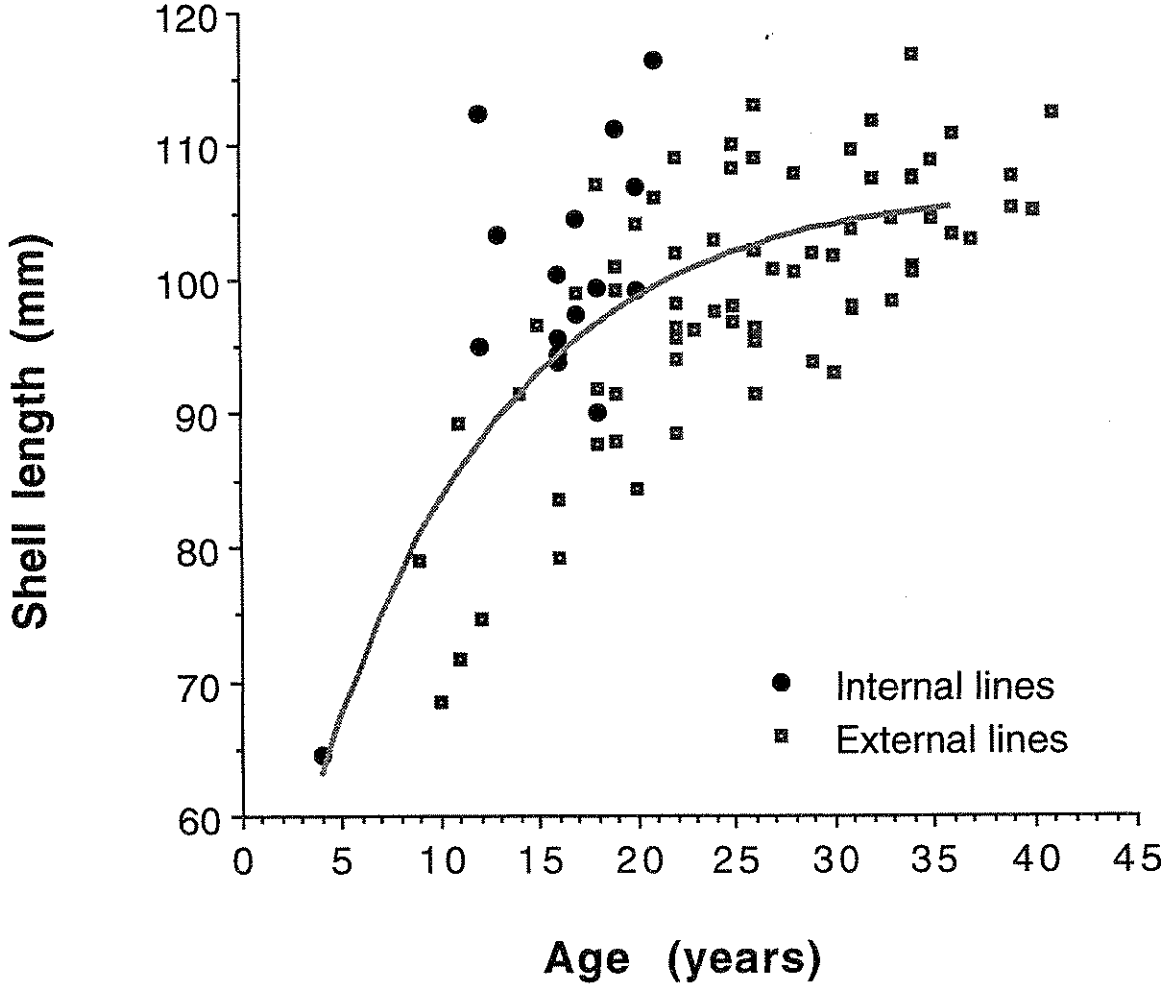

FIG. 3. Length-age relationship of *Lampsilis siliquoidea* from the Wolf River determined from internal sections of empty shells and external examination of living individuals. The line is drawn from the von Bertalanffy equation given in the text.

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