

## MUSSEL FAUNA OF THE WOLF RIVER, FENTRESS AND PICKETT COUNTIES, TENNESSEE.

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**ABSTRACT**—A 31-km-long reach of the Wolf River, from near the town of Pall Mall, Fentress County, to the backwaters of Dale Hollow Lake, Pickett County, Tennessee was surveyed by snorkeling and wading using visual and tactile methods. A total of 45 sites were sampled and live mussels were observed at 24. We collected nine species alive (seven are considered to be species of concern) and shells of three additional species. Although mussel densities were low ( $\bar{X} = 5.4$  individuals/person-h), recruitment of most species was occurring. The Wolf River contains the last known populations of the fluted kidneyshell (*Ptychobranthus subtentum*) and the purple lilliput (*Toxolasma lividus*) and some of the last known populations of the pheasantshell (*Actinonaias pectorosa*), the Cumberland moccasinshell (*Medionidus conradicus*), and the Tennessee clubshell (*Pleurobema oviforme*) in the Cumberland River drainage within Tennessee. Populations of these five species in the Wolf River could provide a parental source for propagation and subsequent reintroductions into other Cumberland River tributaries.

The freshwater mussel fauna of Tennessee is among the richest in North America; at least 129 species once occurred within the state (Parmalee and Bogan, 1998). Many of these species still exist in Tennessee; however, many populations have declined precipitously leading to global extinction of some species and extirpation of others from the state. Many factors have contributed to this decline including: coal mining, deforestation, impoundments, and sedimentation (Schmidt et al., 1989; Anderson et al., 1991; Layzer et al., 1993; Heinricher and Layzer, 1999; Hughes and Parmalee, 1999; Layzer and Scott, 2006).

In the Cumberland River system, 94 mussel species once occurred, including 21 "Cumberlandian" species endemic to the Cumberland and Tennessee river systems (Ortmann, 1924; Layzer and Gordon, 1989). Shoup et al. (1941) sampled 10 sites in the Obey River system and found a diverse assemblage of mussels (35 species), including several species that are now federally listed as endangered. Most of these sites are now inundated by Dale Hollow Lake and acid mine drainage in the headwaters has eliminated nearly all mussels from the East and West forks of the Obey River (Layzer and Anderson, 1992).

The Wolf River is the largest tributary of the Obey River. Although Dale Hollow Lake has inundated the lower portion of the river, much of the river upstream remains free-flowing. Limited sampling at a few sites along the Wolf River indicated the presence of two rare species (Tennessee clubshell, *Pleurobema oviforme*; and fluted kidneyshell, *Ptychobranthus subtentum*) (Layzer and Anderson, 1992; Layzer and Madison, 1999). The occurrence of these species within the Cumberland River drainage is often associated with the presence of the federally endangered Cumberland bean (*Villosa trabalis*), a species found by Shoup et al. (1941) in the mainstem of the Obey River. Discovering unreported populations of *V. trabalis*

is important for its recovery (US Fish and Wildlife Service, 1984). Therefore, the objectives of our study were to survey the free-flowing Wolf River for *V. trabalis* and other listed species, and to document the present and historical mussel fauna.

### METHODS

A 31-km-long reach of the Wolf River, from near the town of Pall Mall, Fentress County to the backwaters of Dale Hollow Lake, Pickett County, was surveyed from September 2005 to June 2006 (Fig. 1). We used visual and tactile methods to locate live mussels and shells while snorkeling and wading the entire reach. All suitable mussel habitats were sampled, including gravel shoals, riffle areas, and bedrock fissures. At each site, we conducted a timed search (0.5 person-h) to locate live mussels. In areas where there were large slab-rocks, the rocks were flipped-over to locate mussels hidden underneath. All mussels found were identified, measured to the nearest millimeter, and when possible gender was determined. Additionally, exposed gravel bars and depositional areas were searched for fresh dead and relic shells, and dead shells were retained as voucher specimens. A Global Positioning System (GPS) unit was used to determine latitude and longitude (WGS84 datum) at all sampling sites and muskrat midden locations.

### RESULTS AND DISCUSSION

We sampled 45 sites and found live mussels at 24 sites and fresh-dead individuals at 5 additional sites (Table 1). Because we waded or canoed the entire reach, apparent distances between sites (Fig. 1) reflect the occurrence of suitable habitat; bedrock or unconsolidated gravel predominated the areas in

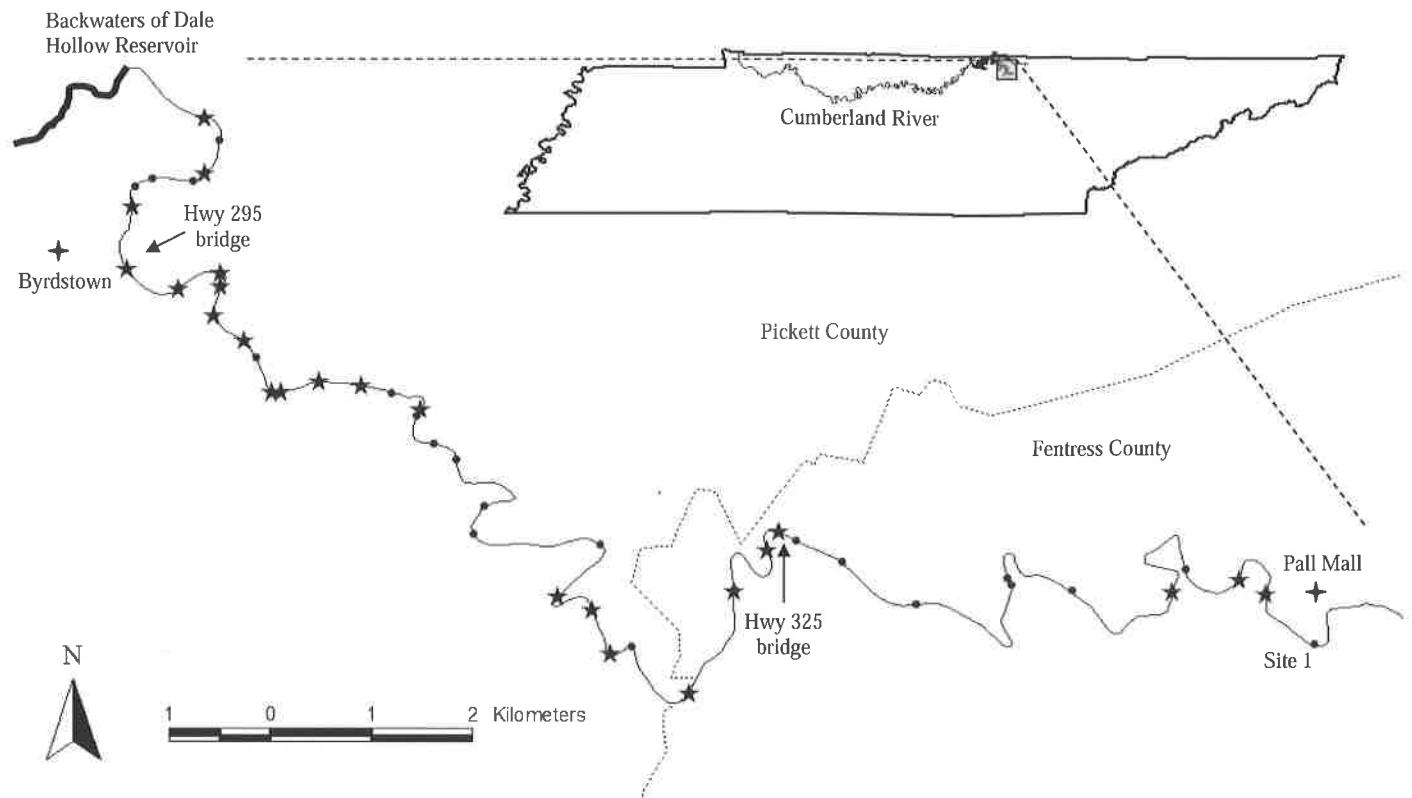


FIG. 1. Freshwater mussel sample sites in the Wolf River, Tennessee. Stars indicate sites where live mussels were present.

between sites and also at sites where no mussels were found. Mussel abundance (reported as numbers collected/person-h) ranged from 0 to 52 ( $\bar{X} = 5.4$ ,  $SD = 10.9$ ). Most live individuals were found in the lower one-third of the sampling area (Fig. 2). A total of 12 species (9 alive and 3 dead) were collected (Table 2).

*Actinonaias pectorosa*—One live pheasantshell (*A. pectorosa*) was collected at Site 26. Previously, Layzer and Anderson (1992) reported only relic shells from the Wolf River (Table 2). The large size (125-mm long) of the individual we found and the absence of fresh-dead shells suggests the population is very small and perhaps on the brink of extirpation. Williams et al. (1993) considered this Cumberlandian species to be of special concern. Although a few populations of the pheasantshell are extant in the Tennessee River system, the only other extant population in the Cumberland River within Tennessee is in the Big South Fork Cumberland River (Parmalee and Bogan, 1998; Ahlstedt et al., 2005).

*Alasmidonta viridis*—Only two fresh-dead specimens (25 and 46-mm long) of the slippershell (*A. viridis*) were collected at Site 1. Although the slippershell is an Interior Basin species occurring throughout the upper Mississippi River drainage (including the Cumberland River system), the Great Lakes and St. Lawrence River drainages, it is of special concern (Williams et al., 1993). The collection of the 25-mm long individual indicates recent recruitment in the Wolf River.

*Lampsilis cardium*—Two live plain pocketbooks (*L. cardium*) were collected at widely separated locations (sites 3 and 45). This seemingly disjunct distribution may simply reflect its rarity in the Wolf River. Frequently, this widespread Interior Basin species is not very abundant in other Cumber-

land River tributaries (Starnes and Bogan, 1982; Anderson et al., 1991; Layzer and Madison, 1995). Although the two individuals collected were gravid females (55 and 69-mm long), we did not find any evidence of recent recruitment. The plain pocketbook is considered to be a species of concern (Williams et al., 1993).

*Lampsilis fasciola*—The wavyrayed lampmussel (*L. fasciola*) is also an Interior Basin species of special concern. Its distribution in the Wolf River was similar to the distribution of plain pocketbooks and was collected at the upper (sites 2 and 5) and lower extent (sites 38 and 39) of the study area and at only one location (site 19) in between. Both male and female individuals were collected. The four females collected were gravid and ranged in length from 50 to 65 mm. We also collected a young fresh-dead individual (27-mm long) from a muskrat midden at site 34, indicating recent recruitment had occurred.

*Medionidus conradicus*—We collected the Cumberland moccasinshell (*M. conradicus*) alive at three sites (26, 31, and 35) and fresh-dead individuals at sites 31, 35 and 36. Williams et al. (1993) considered the Cumberland moccasinshell to be a species of concern. Although this Cumberlandian species is extant in several Tennessee River tributaries and in Kentucky, the population in the Wolf River represents one of the last remaining populations in the Cumberland River system within Tennessee. The size range (32 to 44-mm long) of individuals we collected does not indicate recent recruitment; however, this diminutive species was difficult to locate. Most of the Cumberland moccasinshells were found under large slab rocks in swift current, a habitat not conducive to locating juveniles during qualitative searches.

TABLE 1. Locations of sample sites and numbers of live and fresh-dead freshwater mussels collected at each site in the Wolf River, Tennessee.

Site	County	Latitude and longitude	Alive	Fresh-dead
1	Fentress	36° 32' 29"N 84° 57' 49"W	-	3
2	Fentress	36° 32' 50"N 84° 58' 11"W	1	1
3	Fentress	36° 32' 55"N 84° 58' 23"W	1	-
4	Fentress	36° 32' 58"N 84° 58' 49"W	-	-
5	Fentress	36° 32' 49"N 84° 58' 56"W	3	1
6	Fentress	36° 32' 51"N 84° 59' 44"W	-	-
7	Fentress	36° 32' 59"N 85° 00' 13"W	-	-
8	Fentress	36° 32' 54"N 85° 00' 11"W	-	-
9	Fentress	36° 32' 47"N 85° 00' 52"W	-	1
10	Fentress	36° 33' 04"N 85° 01' 30"W	-	-
11	Fentress	36° 33' 12"N 85° 01' 51"W	-	1
12	Fentress	36° 33' 17"N 85° 02' 01"W	2	3
13	Fentress	36° 33' 10"N 85° 02' 06"W	2	1
14	Fentress	36° 32' 54"N 85° 02' 21"W	2	-
15	Fentress	36° 32' 16"N 85° 02' 43"W	3	1
16	Pickett	36° 32' 34"N 85° 03' 11"W	-	-
17	Pickett	36° 32' 32"N 85° 03' 22"W	7	1
18	Pickett	36° 32' 47"N 85° 03' 29"W	1	-
19	Pickett	36° 32' 53"N 85° 03' 45"W	2	-
20	Pickett	36° 33' 12"N 85° 03' 25"W	-	-
21	Pickett	36° 33' 18"N 85° 04' 24"W	-	1
22	Pickett	36° 33' 28"N 85° 04' 18"W	-	-
23	Pickett	36° 33' 45"N 85° 04' 31"W	-	-
24	Pickett	36° 33' 51"N 85° 04' 41"W	-	1
25	Pickett	36° 34' 02"N 85° 04' 49"W	-	-
26	Pickett	36° 34' 04"N 85° 04' 47"W	14	-
27	Pickett	36° 34' 11"N 85° 05' 01"W	-	-
28	Pickett	36° 34' 15"N 85° 05' 18"W	1	1
29	Pickett	36° 34' 16"N 85° 05' 35"W	2	-
30	Pickett	36° 34' 12"N 85° 05' 52"W	4	-
31	Pickett	36° 34' 12"N 85° 05' 57"W	7	25
32	Pickett	36° 34' 26"N 85° 06' 05"W	-	-
33	Pickett	36° 34' 32"N 85° 06' 10"W	1	-
34	Pickett	36° 34' 43"N 85° 06' 24"W	22	77
35	Pickett	36° 34' 52"N 85° 06' 20"W	2	1
36	Pickett	36° 34' 57"N 85° 06' 20"W	26	114
37	Pickett	36° 34' 52"N 85° 06' 42"W	2	-
38	Pickett	36° 35' 00"N 85° 07' 04"W	9	1
39	Pickett	36° 35' 24"N 85° 07' 01"W	4	-
40	Pickett	36° 35' 29"N 85° 07' 02"W	-	-
41	Pickett	36° 35' 34"N 85° 06' 50"W	-	-
42	Pickett	36° 35' 33"N 85° 06' 33"W	-	-
43	Pickett	36° 35' 36"N 85° 06' 26"W	3	-
44	Pickett	36° 35' 50"N 85° 06' 19"W	-	1
45	Pickett	36° 35' 56"N 85° 06' 27"W	1	-
Total			122	235

*Pleurobema oviforme*—The Tennessee clubshell (*P. oviforme*) is a species of concern (Williams et al., 1993). Populations of this Cumberlandian species occur in several tributaries to the Tennessee River but are uncommon in Cumberland River tributaries. Although we collected only one

live individual (32-mm long) and a fresh-dead individual (49-mm long) at site 34, the relatively small size of these individuals indicates a reproducing population in the Wolf River. Only relic shells of larger individuals (55 to 72-mm long) were collected at other sites (2, 12, and 33). Shells of the Tennessee clubshell from the Cumberland River system look different than those from Tennessee River tributaries; the individuals we collected in the Wolf River and other tributaries to the Cumberland River in Kentucky resemble the federally endangered clubshell (*P. clava*). Shoup et al. (1941) reported collecting *P. clava* from the Obey River. Ortmann (1924) and Starnes and Bogan (1982) noted the similarities between *P. clava* and *P. oviforme* in the Cumberland River system; however, the taxonomy remains unresolved. We believe the morphological differences between forms of *P. oviforme* in the Tennessee and Cumberland river drainages need to be resolved by genetic analyses. The status of the Cumberland River form is precarious; the Kentucky State Nature Preserves Commission lists it as endangered (KSNPC, 2000), and in Tennessee it is extant only in the Wolf River and the Big South Fork Cumberland River. Ahlstedt et al. (2005) found only one *P. oviforme* among the 7,885 mussels they collected in the Big South Fork Cumberland River.

*Potamilus alatus*—We only found relic shells of the purple heelsplitter (*P. alatus*) at Site 2. Layzer and Anderson (1992) also reported finding relic purple heelsplitter shells in the Wolf River. If this species is extant, it may exist as a very small population.

*Ptychobranchnus subtentum*—Eleven live individuals of the fluted kidneyshell (*P. subtentum*) were collected at five sites (26, 31, 34, 36, and 38) in the lower section of the Wolf River. Additionally, 14 fresh-dead individuals were collected. Lengths of the live and fresh-dead specimens ranged from 21 to 83 mm, indicating a healthy reproducing population. This Cumberlandian species once occurred throughout much of the upper Tennessee and Cumberland river drainages; however, few populations remain (Parmalee and Bogan, 1998). The Wolf River contains the only known population in the Cumberland River drainage in Tennessee. The Kentucky State Nature Preserves Commission lists the fluted kidneyshell as endangered (KSNPC, 2000), and it is a candidate for listing by the US Fish and Wildlife Service.

*Pyganodon grandis*—A 48-mm-long fresh-dead giant floater (*P. grandis*) was collected at site 31. This is the first reported occurrence of this Interior Basin species from the Wolf River. Giant floaters are more commonly found in lentic habitats and its occurrence in the Wolf River probably resulted from glochidia-infested fish moving upriver from Dale Hollow Lake.

*Toxolasma lividus*—The purple lilliput (*T. lividus*) is part of the Interior Basin fauna and is considered to be a species of concern (Williams et al., 1993), and the Kentucky State Nature Preserves Commission lists it as endangered (KSNPC, 2000). In the Wolf River, it was restricted to the downstream reaches of the study area. We found one live female at site 34, and nine fresh-dead specimens at sites 31, 34, and 36. The six males and four females ranged in length from 20 to 35 mm. In other streams in the Cumberland River drainage containing the purple lilliput, live individuals were rarely encountered and fresh-dead shells were uncommon (Anderson et al., 1991; Layzer and Anderson, 1992; Layzer and Madison, 1995). The number and size of individuals collected

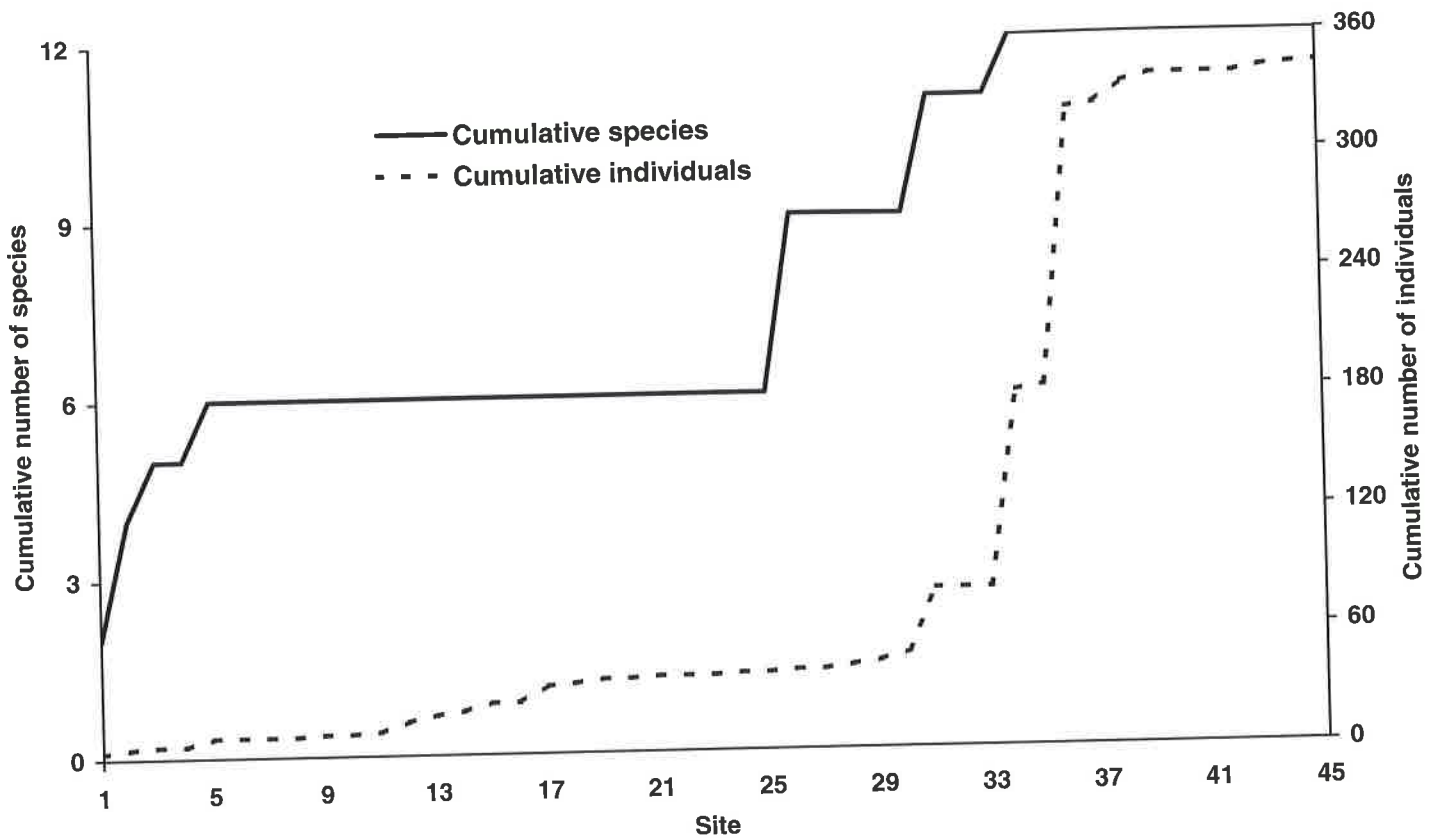


FIG. 2. Cumulative numbers of species and individuals collected from the Wolf River.

indicates a healthy reproducing population. Moreover, this may be the only extant population of the purple lilliput within the Cumberland River drainage in the state of Tennessee.

*Villosa iris*—The rainbow mussel (*V. iris*) was the second most abundant species we collected; it accounted for 30% of all live and fresh-dead shells. We collected this Interior Basin species at 14 sites (between sites 9 and 44). The 109 live and

TABLE 2. Freshwater mussels reported (X = Present; D = dead; L = Alive) from the Wolf River, Pickett and Fentress counties, Tennessee.

Species	Shoup et al. (1941)	Layzer and Anderson (1992)	Layzer and Madison (1998)	Numbers collected this study	
				Alive	Dead <sup>a</sup>
				1	
<i>Actinonaias pectorosa</i>		D			
<i>Alasmidonta viridis</i>		L	L		2
<i>Amblema plicata</i>	X				
<i>Cyclonaias tuberculata</i>	X				
<i>Lampsilis cardium</i>		D	D	2	
<i>L. fasciola</i>		L	D	7	1
<i>Medionidus conradicus</i>		L	D	5	5
<i>Pleurobema oviforme</i>		D	D	1	1
<i>Potamilus alatus</i>		D			2
<i>Ptychobranchus subtentum</i>		D	L	11	14
<i>Pyganodon grandis</i>					1
<i>Strophitus undulatus</i>		D			
<i>Toxolasma lividus</i>			D	1	13
<i>Villosa iris</i>		L	D	30	79
<i>V. taeniata</i>		L	L	64	119

<sup>a</sup> All numbers refer only to fresh-dead shells, except only relic shells of *P. alatus* were collected.

## CONCLUSIONS

Availability of suitable habitat appears to be a major factor limiting mussel abundance and distribution in the Wolf River. The highest diversity and densities of mussels occurred within 1.2 km downstream (site 39) and 3.2 km (site 31) upstream of the Hwy 295 bridge. The habitat in this section of the river contained riffles and abundant, stable gravel bars. In contrast, the substrate in upstream reaches was dominated by bedrock and unstable gravel pockets; these substrates do not provide suitable habitat for mussels. The few mussels collected in upstream areas were usually found in bedrock fissures filled with sand and gravel.

At least 11 species of mussels, including 5 Cumberlandian endemics, are extant in the Wolf River. Although densities (as numbers collected/person-h) of most species were low, they appear to be sufficient for successful reproduction (fertilization), and recent recruitment was evident for eight species. Many populations of Cumberlandian species have been extirpated in the last century (Anderson et al., 1991; Layzer et al., 1993; Hughes and Parmalee, 1999; Schilling and Williams, 2002; Ahlstedt et al., 2005; Layzer and Scott, 2006) and most Cumberlandian species are considered extinct, endangered, or of concern (Williams et al., 1993). Because of their imperilment and restricted distribution, conservation of the remaining populations of Cumberlandian species is imperative for their continued existence. Moreover, the Wolf River contains the last known populations of *Ptychobrancheus subtentum*, a Cumberlandian species, and *Toxolasma lividus* in the Cumberland River drainage within Tennessee. Although possible genetic differences among metapopulations of these species are unknown, the populations of these two species in the Wolf River are significant because they may provide the best source of parental stock for propagation and subsequent reintroduction into other nearby Cumberland River tributaries.

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## LITERATURE CITED

- AHLSTEDT, S. A., S. BAKALETZ, M. T. FAGG, D. HUBBS, M. W. TREECE, AND R. S. BUTLER. 2005. Current status of freshwater mussels (Bivalvia: Unionidae) in the Big South Fork National River and Recreation Area of the Cumberland River and recreation area of the Cumberland River, Tennessee and Kentucky (1999–2002). *Walkerana*, 14(31), 33–77.
- ANDERSON, R. M., J. B. LAYZER, AND M. E. GORDON. 1991. Recent catastrophic decline of mussels (Bivalvia: Unionidae) in the Little South Fork Cumberland River, Kentucky. *Brimleyana*, 17:1–8.
- HEINRICHER, J. R., AND J. B. LAYZER. 1999. Reproduction by individuals of a nonreproducing population of *Megaloniaias nervosa* (Mollusca: Unionidae) following translocation. *Am. Midl. Nat.*, 141:140–148.

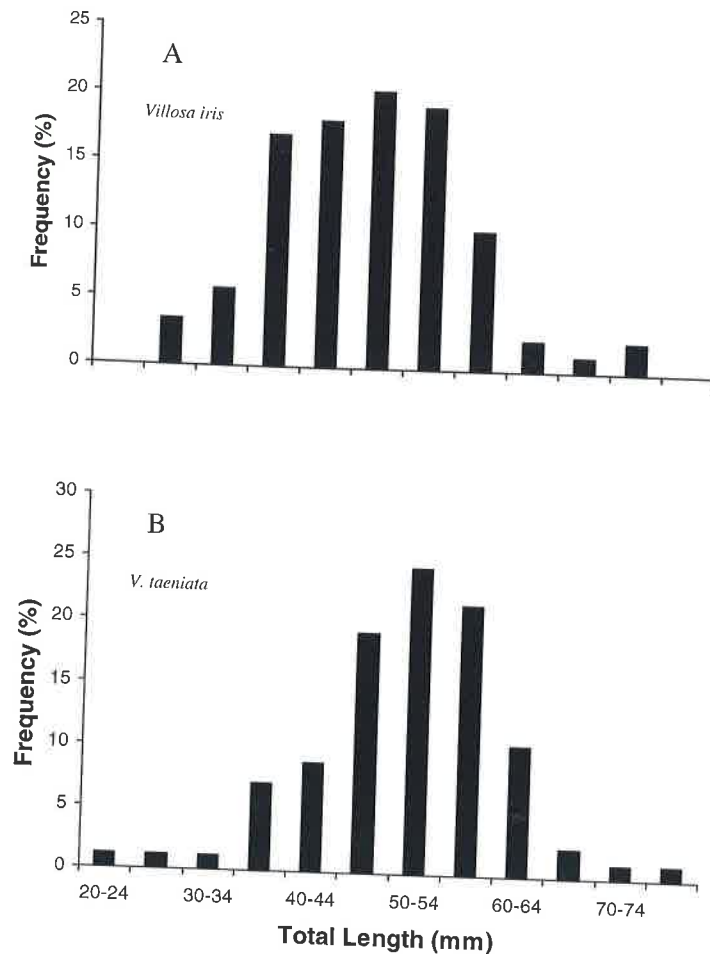


FIG. 3. Length frequency distributions for *Villosa iris* (upper graph) and *V. taeniata* (lower graph) collected from the Wolf River.

fresh-dead individuals ranged from 26 to 72 mm in length (Fig. 3A). Williams et al. (1993) did not consider this species to be in need of any immediate conservation management. The number and sizes of individuals collected indicate a healthy, reproducing population.

*Villosa taeniata*—The painted creekshell (*V. taeniata*) was the most commonly encountered mussel in our survey and accounted for 51% of all live mussels collected. We found this Cumberlandian species at 21 sites spanning most of the study area (Site 1 through Site 43). A total of 183 live and fresh-dead individuals ranging in length from 23 to 76 mm were collected (Fig. 3).

Three additional species (all part of the Interior Basin fauna) have been reported from the Wolf River. Shoup et al. (1941) collected the threeridge (*Amblema plicata*) and the purple wartyback (*Cycloniaias tuberculata*) from sites now inundated by Dale Hollow Lake. The extent of their historical distribution in the Wolf River is unknown. However, if these two thick-shelled species had inhabited our study area in recent years, we would expect to have found relic shells. Layzer and Anderson (1992) reported finding a dead creeper (*Strophitus undulatus*) in the Wolf River. This species may still persist in the Wolf River. The thin shells of dead individuals would likely erode quickly or be displaced by high water, and live individuals are often difficult to locate in other streams where they are known to occur.

- HUGHES, M. H., AND P. W. PARMALEE. 1999. Prehistoric and modern freshwater mussel (Mollusca: Bivalvia: Unionoidea) faunas of the Tennessee River: Alabama, Kentucky, and Tennessee. *Reg. Riv.: Res. Mgmt.*, 15:25-42.
- KENTUCKY STATE NATURE PRESERVES COMMISSION (KSNPC). 2000. Rare and extirpated biota of Kentucky. *J. Kentucky Acad. Sci.*, 61:115-132.
- LAYZER, J. B., AND R. M. ANDERSON. 1992. Impacts of the coal industry on rare and endangered aquatic organisms of the upper Cumberland River basin. Final Report. Submitted to Kentucky Dept. of Fish and Wildl. Res., and Tennessee Wildl. Res. Agency.
- LAYZER, J. B., M. E. GORDON, AND R. M. ANDERSON. 1993. Mussel: The forgotten fauna of regulated rivers. A case study of the Cancy Fork River. *Reg. Riv.: Res. Mgmt.*, 8:63-71.
- LAYZER, J. B., AND L. M. MADISON. 1995. Microhabitat use by freshwater mussels and recommendations for determining their instream flow needs. *Reg. Riv.: Res. Mgmt.*, 10:329-345.
- . 1999. Zebra mussel impacts on endangered unionids. Final Report. Submitted to Kentucky Dept. of Fish and Wildl. Res., and Tennessee Wildl. Res. Agency.
- LAYZER, J. B., AND E. M. SCOTT. 2006. Restoration and colonization of freshwater mussels and fish in a southeastern United States tailwater. *River Res. Applic.*, 22:475-491.
- ORTMANN, A. E. 1924. The naiad-fauna of Duck River in Tennessee. *Am. Midl. Nat.*, 9:18-62.
- PARMALEE, P. W., AND A. E. BOGAN. 1998. *The freshwater mussels of Tennessee*. Univ. Tennessee Press, Knoxville.
- SCHMIDT, J. E., R. D. ESTES, AND M. E. GORDON. 1989. Historical changes in the mussel fauna (Bivalvia: Unionoidea) of the Stones River, Tennessee. *Malacol. Rev.*, 22:55-60.
- SCHILLING, E. M., AND J. D. WILLIAMS. 2002. Freshwater mussels (Bivalvia: Margaritiferidae and Unionidae) of the Lower Duck River in Middle Tennessee: A historic and recent review. *Southeast. Nat.*, 1:403-414.
- SHOUP, C. S., J. H. PEYTON, AND G. GENTRY. 1941. A limited biological survey of the Obey River and adjacent streams in Tennessee. *J. Tennessee Acad. Sci.*, 16:48-76.
- STARNES, L. B., AND A. E. BOGAN. 1982. Unionid Mollusca (Bivalvia) from Little South Fork Cumberland River, with ecological and nomenclatural notes. *Brimleyana*, 8:101-119.
- US FISH AND WILDLIFE SERVICE. 1984. Recovery plan for the Cumberland Bean Pearly Mussel. Atlanta, Georgia.
- WILLIAMS, J. D., M. L. WARREN JR., K. S. CUMMINGS, J. L. HARRIS, AND R. J. NEVES. 1993. Conservation status of freshwater mussels of the United States and Canada. *Fisheries*, 18(9), 6-22.