# A COMPARATIVE STUDY OF LATE PREHISTORIC AND MODERN MOLLUSCAN FAUNAS OF THE LITTLE PIGEON RIVER SYSTEM, TENNESSEE

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## ABSTRACT

Shells of freshwater gastropods and naiads recovered during the period June - December 1985 at the McMahan site, an aboriginal Mississippian (Dallas component: AD 1300-1600) mound and village complex situated adjacent to the West Prong Little Pigeon River, Sevierville, Sevier County, Tennessee comprised the largest prehistoric molluscan species assemblage from a small river in East Tennessee yet known. Six species of aquatic gastropods (7,411 shells) and 3,855 valves of freshwater mussels (Bivalvia: Unionidae), representing 45 species, were identified. Three of the six species of gastropods and 31 of the 45 species of mussels no longer occur in the Little Pigeon River system. For a 24 month period, June 1985 - May 1987, extant mussel populations in the West Prong Little Pigeon River adjacent to the McMahan site were monitored and shells collected, primarily from muskrat feeding stations. Only 11 species occur as viable populations; urbanization with its accompanying pollution probably represents the major cause in decimating the rich molluscan assemblage present during the late prehistoric period.

The McMahan site (40SV1), a multi-component, late prehistoric aboriginal village and mound complex situated adjacent to the West Prong Little Pigeon River, now within the city limits of Sevierville, Sevier County, Tennessee has aroused the interest of both amateur and professional archaeologists for over a century. The mound, Late Mississippian (Dallas component: AD 1300-1600) in origin, was reported to have been 125 yards (112 m) from the river and was 16 feet (4.8 m) in height and 240 feet (72 m) in circumference at the time Edward Palmer "opened" it in September, 1881 (Holmes, 1884). Palmer, then employed by the Bureau of Ethnology, recovered numerous lithic artifacts, ceramic vessels, engraved marine shell gorgets and three species of marine gastropods (listed as *"Marginella*?, *Oliva*?, *Busycon perversum"*) that had been fashioned into beads and other objects. These were found as burial accouterments. Also listed in the 1884 report were three species of freshwater gastropods and four species of naiads.

Approximately 50 years passed before the mound was again excavated, this time by George Barnes, a relic collector from Tennessee who, like Palmer, removed numerous burials and quantities of lithic, ceramic and shell artifacts encountered in association with them. Except for surface collecting, little attention was given to the surrounding village areas until June - August 1978 when highway (TN Rt. 441 N Bypass) salvage excavations were carried out by Dr. Brian Butler for the Tennessee State Division of Archaeology. A series of test pits in the area to be affected by highway construction, ca. 1,500 m south of the mound, revealed former occupation of the site by Middle Woodland (Connestee: AD 300-600), Mississippian (Dallas: AD 1300-1600), and Cherokee (ca. AD 1650-1800) peoples. Bone from the various excavation units was generally well preserved, but shell was not. For this reason, and particularly because the majority of faunal material recovered came from pits and various other features that contained a mixture of Connestee, Dallas and/or Cherokee cultural materials, shell identifications and counts from these excavations were not incorporated in this study. It should be noted, however, no species were recovered in Butler's excavations that were not represented in the mound and adjacent village areas occupied by Dallas inhabitants.

## METHODS

Owner of the property that included the mound and remaining former village areas of the McMahan site, Mr. James A. Temple of Sevierville arranged for the removal and sale of the site (but preserving most of the mound) for topsoil

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in the early 1980s. By the end of 1983, the soil on the north side of the mound had been removed and stockpiled. It was not possible to undertake salvage operations at that time, so only a small sample of bone and shell was recovered periodically from the stockpiles as they were removed over a period of months. In order to determine the perimeter of the mound along its south-facing edge so as not to destroy that portion of it during soil removal, Mr. Richard R. Polhemus, Research Associate, Frank H. McClung Museum, University of Tennessee, at the owner's request excavated a north - south trench (0.5 m wide, 21 m long, and 1.2 - 2.0 m deep from about mid-point to the south edge) to determine stages of construction and location of its outermost edge. Preservation of bone and shell from the mound fill was generally good to excellent; since the mound was built by Late Mississippian (Dallas) peoples and was part of the adjoining village complex from which the majority of faunal materials were recovered, shell from the trenching excavation was combined with the village material for this analysis.

Removal of the remaining village area south of the mound began in May 1985 and was completed by December of that year. Funds could not be made available for an organized archaeological salvage operation, so the only alternative, if any data were to be obtained from the wealth of both cultural and faunal materials present, was to recover as much as possible in the allotted time by the author's personal effort. I visited the site on 34 days during the period of soil removal, averaging ca. five hours each visit. On six occasions volunteers provided assistance with the excavation of material which was accomplished for the most part by shovelling and trowel sorting. The area was surface collected on each visit and the growing stockpiles of topsoil were also searched for cultural and faunal remains. Days in which soil removal was in progress, each newly exposed feature resulting from cuts (profiles) made by the heavy equipment was carefully examined for its content. Shell recovered from two five-foot test squares excavated at the south edge of the mound in October 1985 by Richard Polhemus was incorporated with those from the village excavations, surface collections, and mound. All recovered cultural and faunal specimens were washed and cleaned with a soft brush; after drying each collection lot was labelled and eventually a large series of the identifiable shells was also given the site designation number and date recovered. All specimens have been incorporated into the Frank H. McClung Museum collections, The University of Tennessee, Knoxville.

Recognizing the species diversity present in the archaeological molluscan samples from the McMahan site, a study of gastropod and freshwater mussel populations presently inhabiting the Little Pigeon River system was undertaken to determine possible changes in extant assemblages compared with those that existed in late prehistoric times. The Little Pigeon River is fed by two major tributaries, the East Fork, a small second order stream, and the West Prong Little Pigeon River, a fifth order stream only slightly less in size than the Little Pigeon itself (Fig. 1). Although the East Fork and the Little Pigeon were collected periodically, survey and collecting emphasis was placed on a ca. 0.7 km stretch of

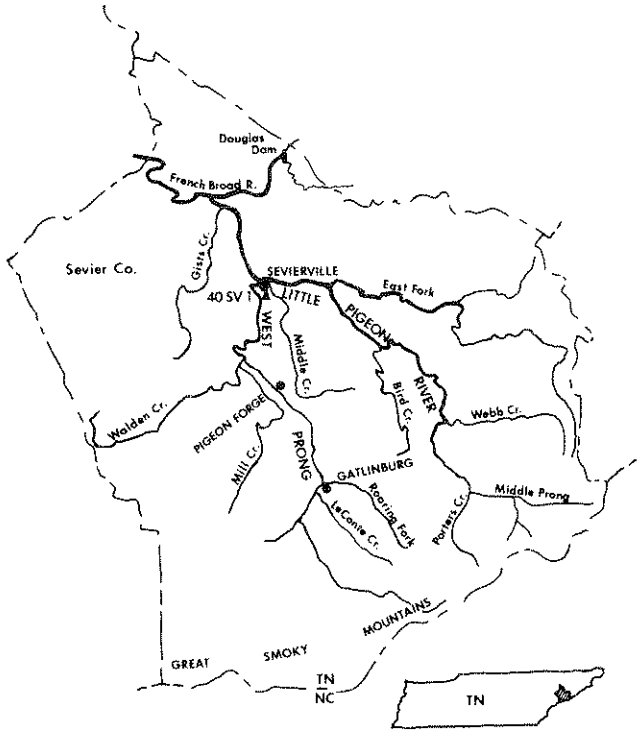


**Fig. 1.** Map showing the Little Pigeon River system and location of the McMahan site.

the West Prong Little Pigeon River that flowed above, adjacent to and below the McMahan site. Collecting trips were made in this section of the river at least twice each month for a 24-month period beginning in June 1985 and ending in May 1987. A total of 54 collecting and survey trips were made in this section of river during this period. Muskrats (*Ondatra zibethica* Linnaeus, 1766) inhabit the banks of the river and are the major predator of bivalves; utilization of this food resource is greatest during the winter months, ca. November through March. Shells obtained from muskrat feeding stations and those scattered along the river bottom, also probably discarded after the animal had been eaten by muskrats, formed the basis on which an evaluation of species occurrence and population density was made. Notations were made of live individuals and their number when encountered, but with the exception of less than a dozen specimens no living naiads were collected. Voucher specimens of most species represented have been placed in the Department of Malacology, Academy of Natural Sciences of Philadelphia, Philadelphia, Pennsylvania and the Museum of Zoology, The Ohio State University, Columbus, Ohio; most of the remaining specimens obtained during this study are housed in the Malacology Collection, Frank H. McClung Museum.

## RESULTS

### SPECIES ACCOUNTS: GASTROPODA

Shells of six species of aquatic gastropods were recovered at the McMahan site (Table 1); 93% of the 7,411

**Table 1.** Freshwater gastropod shells identified from the Dallas component, McMahan site (40SV1), Sevierville, Sevier County, TN.

| Species | No. of Shells | % of Shells |
|---|---|---|
| *Campeloma* cf. *decisum* (Say, 1816) | 38 | .51 |
| *Io fluvialis* (Say, 1825) | 374 | 5.05 |
| *Leptoxis praerosa* (Say, 1821) | 3,860 | 52.08 |
| *Lithasia (Angitrema) verrucosa* (Rafinesque, 1820) | 10 | .13 |
| *Pleurocera canaliculatum* (Say, 1821) | 94 | 1.27 |
| *P. parvum* (Lea, 1862) | 3,035 | 40.95 |
| Totals | 7,411 | 99.99 |

specimens identified were those of *Pleurocera parvum* (Lea, 1862) and *Leptoxis praerosa* (Say, 1821), shells of the latter species representing over half of all the aquatic gastropods from the site. Most specimens of *Leptoxis* compared well with *L. praerosa*, many reaching a very large size characteristic of big river forms. Shell length (tip of the apex to the tip of the anterior aperture canal) of 20 of the largest specimens recovered had a mean of 18.4 mm. Although numerous small specimens of *Leptoxis* appeared intermediate between *L. praerosa* and the small river species *L. subglobosa* (Say, 1825) in shell characteristics, they could simply reflect juvenile stages of the former.

Specimens of the Spiny River Snail *Io fluvialis* (Say, 1825), comprised 5.0% of the aquatic snails. The taxonomy of this unique species, once widespread in the upper Tennessee River system, has been of special interest to malacologists for nearly 100 years. Adams (1915) provided the most definitive work on this gastropod up to that time; he recorded 14 species, characterized in part on shell size and obesity but especially on variation in spinosity. Generally, the small river species (forms) lacked spines while those populations established in big river shoals exhibited maximum development of spine size. Three distinct forms of *I. fluvialis* occurred at the McMahan site, and Parmalee and Bogan (1987) have discussed their taxonomy and ecological implications. Thirty-two percent lacked spines (small river form), 47% possessed low spines only on the last shoulder whorl ("intermediate" form) and 21% had well developed spines (big river form). It can be concluded that the West Prong Little Pigeon River possessed a varied substrate, shallow riffles and deep shoals within a 1.6-3.2 km stretch of the site that allowed the establishment of varied forms of *Io*.

Combined, shells of the three remaining species of gastropods represented at the McMahan site comprised <2% of the total. Although somewhat variable in habitat preference, *Pleurocera canaliculatum* (Say, 1821) and *Campeloma* cf. *decisum* (Say, 1816) can be found most often partially buried in mud or under matts of vegetation or debris near the shore. Although *Lithasia (Angitrema) verrucosa* (Rafinesque, 1820) can also occur in similar habitats, it apparently prefers rocks and submerged logs in stretches of river with pronounced current. Possibly they were less visible to the Indians while gathering mollusks than other species that inhabit more exposed river substratum. However, probable pristine river conditions at that time did not include a mud or silt substratum favorable to these species and therefore they were relatively uncommon to rare. Judging from the size range and numbers of gastropod shells recovered, occupants of the McMahan site gathered whatever was available.

## SPECIES ACCOUNTS: PELECYPODA

The number of naiad species represented in the molluscan assemblage from the McMahan site relative to the quantity of valves recovered and period of accumulation is unequaled among other archaeologically derived samples from Tennessee. A total of 3,855 valves, representing a minimum of 45 species (Table 2), was identified to the generic and/or species level. Forty-three species of freshwater mussels were identified from the Clinch River Breeder Reactor Plant site, Roane County (Parmalee and Bogan, 1986), but this involved a sample of ca. 23,900 valves and a time span of accumulation of at least 1,500 years. Parmalee *et al.* (1982) recorded 45 species of naiads from 15 aboriginal sites in the Chickamauga Reservoir (Tennessee River), based on the identification of nearly 27,900 valves, but again this involved approximately a 1,500 year time period. Nearly 3,800 valves, representing 38 species of naiads, were recorded by Bogan (1980) from Dallas and Cherokee occupational zones at the Toqua site, Little Tennessee River, Monroe County. The diverse naiad assemblage reflected in the McMahan site molluscan sample is indicative of the rich late prehistoric populations that inhabited this small river and provides some evidence of the varied aquatic habitats that apparently once existed in the West Prong Little Pigeon River.

*Amblema plicata* (Say, 1817): Parmalee and Bogan (1986) noted that the Three-ridge Mussel possibly could not have been as numerous in prehistoric times as it is at present, judging by the relatively small numbers (2.19% of ca. 23,900 valves) recovered at the Clinch River Breeder Reactor Plant site. It accounted for <1% of 27,875 valves identified from 15 sites in the Chickamauga Reservoir (Parmalee *et al.*, 1982). Although valves of both juveniles and adults were noted in the naiad sample from the McMahan site, their number accounted for <1% of the total.

*Fusconaia* Simpson, 1900: Valves of both forms of *F. barnesiana* (Lea, 1838), the Tennessee Pigtoe *F. barnesiana tumescens* (Lea, 1845), a heavy, swollen shell, and *F. barnesiana bigbyensis* (Lea, 1841), a thinner, more compressed form occurred in the McMahan site samples. Ortmann (1918) noted that "...we have the phenomenon that flat and compressed forms are found in the headwaters, swollen forms in the larger rivers, with the intergrades between them in rivers of medium size." Ortmann (1918) reported both forms from the Little Pigeon River; combined, shells of both forms and "intergrades" totalled 347, representing 9.0% of the sample.

Nearly 11% of all identified valves were those of the Long Solid *Fusconaia subrotunda* (Lea, 1831), and the number of shells (409) of this species in the McMahan site sample ranked second in the total assemblage. At least two distinct forms were present, one of which Ortmann (1918)

**Table 2.** Freshwater mussels identified from the Dallas component, McMahan site (40SV1), Sevierville, Sevier County, TN. [I = Interior Basin (Mississippi); C = Cumberlandian; U = Unknown].

| Species | No. of Valves | % | Region of Origin |
|---|---|---|---|
| *Amblema plicata* (Say, 1817) | 22 | .57 | I |
| *Fusconaia barnesiana* (Lea, 1838) | 347 | 9.00 | C |
| *F. subrotunda* (Lea, 1831) | 409 | 10.60 | U |
| *Quadrula cylindrica* (Say, 1817) | 6 | .15 | U |
| *Q. pustulosa* (Lea, 1831) | 5 | .12 | I |
| *Q. sparsa* (Lea, 1841) | 50 | 1.29 | C |
| *Cyclonaias tuberculata* (Rafinesque, 1820) | 74 | 1.91 | I |
| *Elliptio crassidens* (Lamarck, 1819) | 23 | .59 | I |
| *E. dilatata* (Rafinesque, 1820) | 70 | 1.81 | U |
| *Hemistena lata* (Rafinesque, 1820) | 1 | .02 | C |
| *Lexington dolabelloides* (Lea, 1840) | 96 | 2.49 | C |
| *Plethobasus cooperianus* (Lea, 1834) | 11 | .28 | I |
| *P. cyphyus* (Rafinesque, 1820) | 46 | 1.19 | I? |
| *Pleurobema cordatum* (Rafinesque, 1820) | 33 | .85 | I |
| *P. oviforme* (Conrad, 1834) | 24 | .62 | C |
| *P. plenum* (Lea, 1840) | 21 | .54 | I |
| *P.* cf. *rubrum* (Rafinesque, 1820) | 1 | .02 | I |
| *Alasmidonta marginata* (Say, 1819) | 1 | .02 | I |
| *A. viridis* (Rafinesque, 1820) | 31 | .80 | I |
| *Anodonta, A.* cf. *grandis* (Say, 1829) | 1 | .02 | I |
| *Lasmigona costata* (Rafinesque, 1820) | 8 | .20 | U |
| *L. holstonia* (Lea, 1831) | 5 | .12 | C |
| *Actinonais ligamentina* (Lamarck, 1819) | 148 | 3.83 | I |
| *Toxolasma lividus* (Rafinesque, 1831) | 131 | 3.39 | C |
| *Epioblasma arcaeformis* (Lea, 1831) | 26 | .67 | C |
| *E. brevidens* (Lea, 1834) | 1 | .02 | C |
| *E. capsaeformis* (Lea, 1834) | 42 | 1.08 | C |
| *E.* cf. *florentina* (Lea, 1857) | 1 | .02 | C |
| *E. haysiana* (Lea, 1833) | 23 | .59 | C |
| *E. stewardsoni* (Lea, 1852) | 2 | .05 | C |
| *E. torulosa* (Rafinesque, 1820) | 11 | .28 | C |
| *Lampsilis fasciola* (Rafinesque, 1820) | 385 | 9.98 | I |
| *L. ovata* (Say, 1817) | 79 | 2.04 | I |
| *Lemiox rimosus* (Rafinesque, 1831) | 8 | .20 | C |
| *Ligumia recta* (Lamarck, 1819) | 2 | .05 | U |
| *Medionidus conradicus* (Lea, 1834) | 172 | 4.46 | C |
| *Obovaria subrotunda* (Rafinesque, 1820) | 9 | .23 | I |
| *Potamilus alatus* (Say, 1817) | 9 | .23 | I |
| *Villosa iris* (Lea, 1830) | 167 | 4.33 | C |
| *V. trabilis* (Conrad, 1834) | 183 | 4.74 | C |
| *V. vanuxemensis* (Lea, 1838) | 302 | 7.83 | C |
| *V.* spp. | 200 | 5.18 | — |
| *Cyprogenia stegaria* (Rafinesque, 1820) | 5 | .12 | U |
| *Dromus dromas* (Lea, 1834) | 32 | .83 | C |
| *Ptychobranchus fasciolaris* (Rafinesque, 1820) | 124 | 3.21 | U |
| *P. subtentum* (Say, 1825) | 508 | 13.17 | C |
| Totals | 3,855 | 99.74 | |

recorded as *F. pilaris* (Lea, 1840) and viewed it as "...the upper Tennessee representative of *F. subrotunda* Lea of the Ohio drainage, and it could be merely a dwarfed, globular form of the latter." Apparently this form, which dominated the McMahan site *F. subrotunda* "complex," was typical of the large river such as the Tennessee and the lower Little Tennessee and French Broad. A few valves of the compressed headwaters form of this species were recovered. The Long Solid appears to have been a major component of the West Prong Little Pigeon River prehistoric naiad fauna and the predominance of the thick globular form suggests stretches of large river habitat.

*Quadrula* Rafinesque, 1820: Three species belonging to this genus were represented in the McMahan site naiad assemblage; however, only six valves of the Rabbit's Foot *Quadrula cylindrica* (Say, 1817) and five valves of the Pimpleback *Q. pustulosa* (Lea, 1831) were recovered. At present both can be found locally common in small to large river habitats throughout the state, but it has been noted (Parmalee *et al.*, 1982; Parmalee and Bogan, 1986) that these were uncommon shells in the Tennessee River system in aboriginal times. Fifty valves of the Appalachian Monkey Face *Q. sparsa* (Lea, 1841), a species generally associated with small tributary streams of the upper Tennessee River drainage, occurred in the archaeological sample. It is a rare species and remaining populations appear limited to the unimpounded stretches of the Powell and Clinch rivers in upper East Tennessee and southwestern Virginia. Parmalee and Bogan (1986) reported 113 valves of *Q. sparsa* from Middle Woodland and Mississippian components at the Clinch River Breeder Reactor Plant site, Roane County, Tennessee and a single valve of this species was recovered at the Starnes site, a historic Cherokee farmstead along the lower Tellico River, Monroe County, Tennessee (Parmalee and Klippel, 1984).

*Cyclonaias tuberculata* (Rafinesque, 1820): The Purple Warty-back is a widely distributed and locally common mussel in Tennessee in both small and large rivers. As evidenced by the quantity of valves recovered from aboriginal sites, it was an abundant shell also in prehistoric times. For example, Morrison (1942), in his analysis of shells from the Pickwick Basin mounds (Tennessee River, northern Alabama), commented that it "...was extremely abundant in all the mounds. It constituted one of the major fractions of the mussel fauna that was used for food in building up the shell deposits." Although there appears to have been a viable population present prehistorically in the West Prong Little Pigeon River, the number of valves recovered at the McMahan site (74, $<2\%$ of the total) suggests it was not abundant.

*Elliptio* Rafinesque, 1820: Shells of the Elephant's Ear *Elliptio crassidens* (Lamarck, 1819) and the Spike *E. dilatata* (Rafinesque, 1820) have been recovered in considerable numbers at aboriginal sites located along large rivers such as the Tennessee (see Parmalee *et al.*, 1982). *E. crassidens* is typically a large river species where it can become abundant locally, but occasionally a few individuals will become established in small- to medium-sized streams such as the West Prong Little Pigeon River. The Spike, on the other hand, is often the most abundant species present in small rivers. Although there were three times the number of shells of *E. dilatata* than *E. crassidens* in the McMahan site sample, suggesting a predominance of small river habitat, combined they accounted for $<3\%$ of the total.

*Hemistena lata* (Rafinesque, 1820): The Cracking Pear-

ly Mussel was reported to have occurred in the Ohio, Cumberland and Tennessee River systems. Ortmann (1918) commented that "It is undoubtedly a rare shell;" in some rivers such as the upper Clinch, however, it is locally common (Ahlstedt, 1984). It appears to have been a rare species in the West Prong Little Pigeon River during the time the McMahan site was occupied as evidenced by the recovery of only one valve.

*Lexingtonia dolabelloides* (Lea, 1840): The former ecological environs of the Slab-side Mussel included shoal areas of the Tennessee River downstream at least as far as Pickwick Landing Basin in northern Alabama and its larger tributaries in upper East Tennessee. Impoundment has eliminated its habitat in the Tennessee River, and *L. dolabelloides* is now limited to and is generally uncommon in rivers such as the Duck, Clinch and Powell. Ortmann (1918) observed that "...here we have a case where a swollen form (*dolabelloides*) is found in the larger rivers, and a compressed one (*conradi*) in the smaller stream, with the intergrades existing between them." This condition was apparent in the McMahan site material, where valves of this species comprised ca. 2.5% of the total, but the thick-shelled, swollen form predominated.

*Plethobasus* Simpson, 1900: Combined, shells of *Plethobasus cooperianus* (Lea, 1834), the Orange-footed Pimple-back and *P. cyphyus* (Rafinesque, 1820), the Sheepsnose, totaled ca. 2.5% of the naiad sample. In Tennessee the former species was considered an inhabitant of the deep stretches of the Cumberland and Tennessee rivers and their large tributaries. With reference to *P. cooperianus*, Ortmann (1918) stated that "I also found it in French Broad River, at Boyd Creek, Sevier County, Tenn. Records from 'Holston River' probably refer to the Tennessee, at any rate, it must be a rare shell above Knoxville." Only 11 valves of it were identified while 46 specimens of *P. cyphyus*, a shell that can be found in small rivers as well as large, were recovered. Valves of the Sheepsnose from the McMahan site appeared intermediate between the typical large river form that is drawn out posteriorly with a distinct row of pronounced knobs, and the small river form with the radial row of knobs on the disk poorly developed and nearly obliterated in some specimens.

*Pleurobema* Rafinesque, 1820: A total of 79 valves (2.0% of the sample), representing four species in this genus, were recovered in the sample. Three of these, *P. cordatum* (Rafinesque, 1820), Ohio River Pigtoe; *P. plenum* (Lea, 1840), Rough Pigtoe; and *P. rubrum* (Rafinesque, 1820), Pyramid Pigtoe, are generally considered large river, deep water species that only rarely become established in small- to medium-size streams. Of the approximately 40,500 valves (ca. 50 species) identified from 15 aboriginal sites in the Chickamauga Reservoir (Tennessee River), those of these three species of *Pleurobema* accounted for nearly 13% of the total (Parmalee *et al.*, 1982). Although these and certain other big river species are represented in the McMahan sample, their limited numbers suggest the probability that stretches of deep water habitat in the West Prong Little Pigeon River were limited compared with greater riffle and shoal areas typical of small- to medium-size rivers.

The fourth species of *Pleurobema* recorded from the site, *P. oviforme* (Conrad, 1834), the Tennessee Clubshell, is restricted to the upper Cumberland and Tennessee River drainages and is one that typically inhabits the smaller streams and rivers. The taxonomic position of this species is not entirely clear: it is characteristic of small rivers of the upper Tennessee River drainage and probably represents *P. clava* (Lamarck, 1819) of the Ohio and lower Cumberland and Tennessee rivers. Ortmann (1918) lists *P. oviforme argenteum* (Lea, 1841) as "...the compressed form of *oviforme*, peculiar to the headwaters and other small streams. It also generally attains a larger size than the typical *oviforme*, and is more rhomboidal in outline. It is in Little Pigeon River, at Sevierville, Sevier Co., TN., but not very well developed here, the majority of the specimens belonging to *oviforme*." Ortmann implied by this that the medium-sized river form *P. oviforme* closely resembled the upper Ohio River form of *P. clava*, but he made note of the extreme shell variability, a condition apparent in the McMahan site specimens.

*Alasmidonta* Say, 1818: Shells of two species representative of this genus were recovered at the McMahan site. One, the Elk Toe *Alasmidonta marginata* (Say, 1819), is widespread throughout the small streams and medium-size rivers of East Tennessee. However, it appears to have been a rare shell prehistorically in the West Prong Little Pigeon River as only one right valve of a mature individual was recovered. The other species, the Slipper Shell *A. viridis* (Rafinesque, 1820), although not abundant (31 valves) suggests a former viable population at this point in the river. Ortmann (1918) states that it, *A. (Pressodonta) minor* Lea, 1845, is "A characteristic small creek species, locally abundant. It is found all over the region, but strictly avoids the medium-sized and larger rivers." He recorded it from the Little Pigeon River at Sevierville.

*Anodonta*, cf. *A. grandis* (Say, 1829): Although at present one of the most widely distributed and locally abundant shells throughout impounded stretches of Tennessee rivers, a slow current and mud/silt substratum most favorable to the Common Floater was probably limited prehistorically. Of interest is the statement by Ortmann (1918) that "No *Anodonta* has ever been reported from the upper Tennessee region"; however, he does make reference to two specimens (in the collection of Bryant Walker) collected in a small pond near the French Broad River eight miles above Knoxville. Bogan (1980) identified a single valve of *A. grandis*, found as a burial accouterment, from the Toqua site, Little Tennessee River, Monroe County. In his treatment of the mollusks from Pickwick Basin (Tennessee River), Morrison (1942) listed *A. grandis*, along with four other species in the subfamily Anodontinae, as "...present in small numbers only." No valves of *A. grandis* were identified from the thousands of naiads recovered from aboriginal sites along the Cumberland, Clinch and Tennessee rivers in Middle and East Tennessee (Parmalee *et al.*, 1980, 1982; Parmalee and Bogan, 1986). Only one incomplete right valve from the McMahan site suggests that *A. grandis* was prehistorically a rare shell in the West Prong Little Pigeon River.

*Lasmigona* Rafinesque, 1831: *Lasmigona costata* (Rafinesque, 1820), the Fluted Shell, occurs in both large

rivers like the Cumberland and Tennessee and in small- to medium-sized rivers like the middle Duck and the upper Powell and Clinch. Ahlstedt (1984) noted that it "...is an extremely common species in the upper Clinch in Tennessee and Virginia." Judging by certain extant unmodified stretches of the West Prong Little Pigeon River (Fig. 2), assuming them to be not unlike prehistoric conditions, it would seem this river would have provided favorable habitat for *L. costata*. However, only eight valves were recovered at the McMahan site. *L. holstonia* (Lea, 1831), the Tennessee Heelsplitter, a species often found locally abundant in small and/or headwater streams, was also poorly represented at the site (5 valves, 3 individuals). All three were juveniles, the largest measuring 35.5 mm total length. Ortmann (1918) recorded it for the Little Pigeon River, Sevier County.

*Actinonaias ligamentina* (Lamarck, 1819): Prehistorically the Mucket was widely distributed and common throughout the major rivers in Tennessee such as the Clinch, Holston, Tennessee, French Broad, and Cumberland. At present, however, except for local populations in these rivers (primarily the Holston), populations of *A. ligmentina* are restricted mainly to the unimpounded upper stretches of the Clinch and Powell rivers in East Tennessee. In archaeological context, the percentage of shells of the Mucket varied from 7.5% of those recovered in 15 sites in the Chickamauga Reservoir (Tennessee River) (Parmalee *et al.*, 1982), and 13.5% at the Clinch River Breeder Reactor Plant site (Parmalee and Bogan, 1986), to nearly 16% in two sites along the middle Cumberland River (Parmalee *et al.*, 1980). The total of 148 valves, representing 3.8% of all identified shells recovered at the McMahan site, suggests a former viable population of this mussel in the West Prong Little Pigeon River. A right valve of a mature individual exhibited a high degree of polish on its external surface; this modification possibly resulted from its use as some form of shaping or smoothing tool in the manufacture of ceramic vessels.

*Toxolasma lividus* (Rafinesque, 1831): A total of 131 shells belonging to the genus *Toxolasma* were assigned to the species *T. lividus*, the Little Purple. With respect to the *Toxolasma* complex in this region, the comments of Ortmann (1918) are appropriate: "What Lea has described as *U. moestus* (from French Broad River, Tenn.) undoubtedly is this *[T. lividus]*: I have specimens from Little Pigeon River (tributary to French Broad), which are fully identical with *moestus*. *U. [Toxolasma] cylindrellus* Lea (Duck River, TN.) is in shape absolutely identical with *T. lividium*; however, it differs by paler color of epidermis and nacre." In light of these comments, it is possible that some of the specimens from the McMahan site are *T. cylindrellus* (Lea, 1868), assuming it is a good species. Many valves of *Toxolasma* from the site still exhibited a faded but uniform purple nacre. This small naiad appears to have been fairly common prehistorically in the West Prong Little Pigeon River.

*Epioblasma* Rafinesque, 1831: Seven species belonging to this genus were represented in the molluscan sample from the McMahan site, but combined the number of shells totaled only 106, 3.0% of all identified valves. Three of these species, *Epioblasma arcaeformis* (Lea, 1831), the Sugar Spoon; *E. haysiana* (Lea, 1833), the Acornshell; and *E. stewardsoni* (Lea, 1852), the Cumberland Leafshell, are now considered extinct (Stansbery, 1971). The Yellow Blossom *E. florentina* (Lea, 1857), represented at the McMahan site by a single right valve of a male and identified as probably *E. f.* form *florentina* based on the descriptions of Ortmann (1918) and Bogan and Parmalee (1983), is probably close to extinction. The large river, nodular form of the Tubercled Blossom

**Fig. 2.** View of West Prong Little Pigeon River, north edge of Pigeon Forge, TN. Unmodified stretch of river, but at present poor mussel habitat.

*E. torulosa torulosa* (Rafinesque, 1820), can also be considered extinct. Ortmann (1918) commented that *E. arcaeformis* was found in large and medium-sized rivers and that it was present in the French Broad River at Boyd Creek, Sevier County. *E. stewardsoni* also occurred in shoal areas of the larger rivers, but, unlike the once abundant *E. t. torulosa*, it was apparently "A rare species" (Ortmann, 1918).

Of the seven species of *Epioblasma* identified from the site, valves of *Epioblasma capsaeformis* (Lea, 1834), the Oyster Mussel, were the most numerous (42). This mussel is at present locally abundant in the upper unimpounded stretches of the Clinch and Powell rivers; it also can be found in limited numbers in other small- to medium-sized rivers in Middle and East Tennessee. Ortmann (1918) reported it from the Little Pigeon River. Surprisingly, only one valve of the Cumberlandian Combshell *E. brevidens* (Lea, 1831), was recovered at the McMahan site; it was widely distributed and locally common in medium-sized rivers such as the Big South Fork Cumberland, Clinch and Powell in the Cumberland and Tennessee River drainages of East Tennessee.

*Lampsilis* Rafinesque, 1820: A total of 385 valves of the Wavy-rayed Lampmussel *Lampsilis fasciola* (Rafinesque, 1820), representing ca. 10% of the naiad sample, was recovered at the McMahan site. Ortmann's (1918) comment that this species of *Lampsilis* is "practically everywhere in the larger rivers as well as in smaller streams, but apparently more abundant toward the headwaters" is appropriate relative to the West Prong Little Pigeon River. On the basis of the archaeological record, it was a very common shell at the time the McMahan site was occupied. However, extensive naiad samples from large rivers in East Tennessee indicate that *L. fasciola* was rare, at least in the stretches near the sites: Cumberland River, 2 sites, 7 specimens in a sample of 827 valves (.12%) (Parmalee *et al.*, 1980); Tennessee River, 15 sites, 3 specimens in a sample of 27,875 valves (.01%) (Parmalee *et al.*, 1982); Clinch River, 1 site, 21 specimens in a sample of 23,905 valves (.09%) (Parmalee and Bogan, 1986).

Seventy-nine valves of *Lampsilis ovata* (Say, 1817), the Pocketbook, about 2% of the sample, were found at the McMahan site. The "typical" shell of *L. ovata* is characterized by the distinct and sharp posterior ridge and, according to Ortmann (1918), it is restricted to the larger rivers. However, he points out (Ortmann, 1918) that "All along its range, and chiefly *above* Knoxville, it is accompanied by the var. *ventricosa*, and intergrades with it;" specimens examined from the Little Pigeon River, Sevierville were identified by Ortmann as *L. ovata ventricosa*. However, all valves from the McMahan site complete enough to ascertain the angle of the posterior ridge were *L. ovata* and not *L. o. ventricosa* (more rounded, lacking the sharp-angled posterior ridge). Although less abundant than *L. fasciola*, there appears to have been a viable population of *L. ovata* in the West Prong Little Pigeon River during aboriginal occupation of the McMahan site.

*Lemiox rimosus* (Rafinesque, 1831): A species of the upper Tennessee River drainage, the Birdwing Pearlymussel formerly inhabited shoals of the large rivers as well as small streams, but it is at present restricted to local populations in medium-sized rivers such as the Duck and upper Clinch and Powell. Parmalee and Bogan (1986) recorded 623 valves (2.6% of the total) of this small mussel in a sample of 23,905 shells from the Clinch River Breeder Reactor Plant site, but only 24 (.09% of a total of 27,875 valves) were recovered from 15 sites reported from the Chickamauga Reservoir (Tennessee River) by Parmalee *et al.* (1982). In his study of mollusks from the Pickwick Basin, Morrison (1942) reported *L. rimosus* "...throughout the mounds, but...nowhere in great abundance." Ortmann (1918) considered it a rare shell and, except for one local population in the Duck River (Maury County), Ahlstedt (1984) also noted that it could not be found in any great numbers. Prehistorically it must have been a rare species in the West Prong Little Pigeon River as only eight specimens were recovered in the McMahan site sample.

*Ligumia recta* (Lamarck, 1819): the Black Sandshell is widely distributed from Pennsylvania to Minnesota south to Oklahoma and Alabama (Burch, 1975); it inhabits primarily medium-sized to large rivers where it may become locally numerous. With the recovery of only two valves at the McMahan site, it must have been a rare shell in the West Prong Little Pigeon River during the time the site was occupied. The assumption can be made that in the case of the Black Sandshell, like other species represented by only one or a very few valves, individuals became established from time to time but, for whatever reason(s), the river proved unsuitable for the development of viable populations.

*Medionidus conradicus* (Lea, 1834): The Cumberland Moccasin is a species endemic to the Upper Cumberland and Tennessee River systems, and its distribution was characterized by Ortmann (1918) as "Very abundant in the headwaters and in small streams generally, but quite rare in the larger rivers." In a sample of 761 identified mussel shells from Cheek Bend Cave, a multicomponent (Archaic-Woodland: ca. 7,000-1,000 BP) rockshelter site along the Duck River, Maury County, valves of *M. conradicus* (100) comprised 13.1% of the sample (Parmalee and Klippel, 1986). A total of 172 shells of this species (4.5% of the sample) were recovered at the McMahan site.

A study of species composition and abundance of extant naiad taxa in the West Prong Little Pigeon River adjacent to the McMahan site covered a two year period from June 1985 through May 1987. Results of this investigation will be considered in more detail in this paper under PRESENT NAIAD POPULATIONS: LITTLE PIGEON RIVER SYSTEM, but in the case of aboriginal vs extant *Medionidus* specimens, a brief comment here is appropriate. Only 12 individuals of the Cumberland Moccasin were obtained (at muskrat feeding stations) during this two year period. The right valve of each was measured (mm): Range, 46.0 - 62.0; Mean, 55.23. During the initial identification process, it was noted that the entire series of *Medionidus* from the site was made up of small specimens. Length of the complete valves (N=29) was measured (mm): Range, 24.5 - 42.5; Mean, 32.08. It appears that individuals in the modern population of *M. conradicus* reach a considerably larger mean size (55.23 mm, modern, vs. 32.08 mm, archaeological) than did those from prehistoric context; the largest specimen from the McMahan site had not attained the size of the smallest individual recovered in

1985-87. It is reasonable to assume the Indian would have gathered the large individuals as well as the small had they been present, so for whatever reason(s) the prehistoric population of *M. conradicus* in the West Prong Little Pigeon River consisted of individuals that did not attain the size of those found in living populations.

*Obovaria subrotunda* (Rafinesque, 1820): Once widespread throughout the Ohio, Tennessee and Cumberland river systems, the range and population densities of the Round Hickory Nut are now greatly reduced. This species is adaptable to both large river and small stream habitats. Ortmann (1918) considered it rare in the upper Tennessee region, including the small stream form *O. subrotunda levigata* (Rafinesque, 1820), in tributaries of the Tennessee, Holston and French Broad rivers above Knoxville. It appears to have been a rare shell in the West Prong Little Pigeon River as only nine valves were recovered at the McMahan site.

*Potamilus alatus* (Say, 1817): The Pink Heelsplitter occurs throughout the Mississippi drainage from Pennsylvania south to Arkansas, Tennessee and Alabama (Burch, 1975). Often an abundant shell locally in large and medium-sized rivers, it occurs less commonly in small streams. Like the preceding species, *P. alatus* was an uncommon to rare mussel (nine individuals) prehistorically in the West Prong Little Pigeon River.

*Villosa* Frierson, 1927: A total of 852 valves, representing at least three species within this genus, amounted to 22.0% of all freshwater mussel shells identified from the McMahan site. All are typical of small- to medium-sized streams and locally they can occur in large numbers. For example, Ahlstedt (1981) noted that *Villosa perpurpurea* (Lea, 1861) [probably a purple-nacre form or variety of *V. trabilis* (Conrad, 1834)] was "common" in Copper Creek, VA. Parmalee and Klippel (1984) found *V. iris* (Lea, 1829), the Rainbow, and *V. vanuxemensis* (Lea, 1838), the Mountain Creekshell, to be the two most common mussels inhabiting the Tellico River, Monroe County, TN. Of the 1,125 specimens recorded from this river, these two species of *Villosa* comprised 68.4% of the sample.

*Villosa trabilis*, the Cumberland Bean, is a small- to medium-sized river species that is known from the upper Tennessee and Cumberland River drainages, although its distribution appears spotty. For example, it is one of the few species still surviving as a viable population in the Obed River, Cumberland County, TN on the Cumberland Plateau. Both the Rainbow and the Mountain Creekshell are common and widely distributed in the streams of East and, to a somewhat lesser extent, Middle Tennessee; the latter species is one of the few naiads that often becomes abundant in the headwaters. Judging by the number of identifiable valves (see Table 2) recovered, *V. vanuxemensis* was the most common species of *Villosa* in the West Prong Little Pigeon River during the period of site occupation. However, all three taxa had well established viable populations and their abundance in the archaeological record indicates former extensive stretches of fast current and riffles with a substrate composed of cobbles, gravel and coarse sand.

*Cyprogenia stegaria* (Rafinesque, 1820): The Fanshell was once found rather sparingly throughout the upper Tennessee and Cumberland rivers of Tennessee. It has been poorly represented in some aboriginal molluscan faunas including two recorded by Parmalee *et al.* (1980) from the Cumberland River and at 15 sites along the Tennessee (Chickamauga Reservoir, Parmalee *et al.*, 1982). However, Morrison (1942) reported that it was "...found in moderate abundance, in nearly all the samples studied [from the Pickwick Basin mounds. Tennessee River]." Ahlstedt (1984) found *C. irrorata* to be a relatively common shell in the upper Clinch River in Tennessee and Virginia. Ortmann (1918) noted that "...in the lower Clinch it is quite abundant"; at the Clinch River Breeder Reactor Plant site valves of the Fanshell totaled 2,463, 10.3% of the total naiad sample (Parmalee and Bogan, 1986). Although the West Prong Little Pigeon River would appear to have been suitable for the establishment of a viable population of this mussel, judging by the archaeological species assemblage recovered and local populations that presently exist in rivers such as the upper Clinch, the occurrence of only five valves of *C. irrorata* in the McMahan site molluscan sample attest to its former rarity there.

*Dromus dromas* (Lea, 1834): Prehistorically the Dromedary Pearlymussel was one of the most abundant shells inhabiting the Cumberland and Tennessee River systems. Approximately 9,800 valves, comprising 35.25% of the naiad sample from 15 sites in the Chickamauga Reservoir (Parmalee *et al.*, 1982), and 111 valves (13.42% of the sample) from two sites along the middle Cumberland River in Tennessee (Parmalee *et al.*, 1980) are two examples attesting to its former abundance. Moreover, Morrison (1942), with reference to the Pickwick Basin mounds, Tennessee River, northern Alabama commented that "...*dromas* must have been very abundant here previously. These specimens are of good size for the species, and made up a major part of the total mussel fauna gathered for food." Although not common at the McMahan site (32 identified valves, $<1.0\%$ of the sample), apparently a few individuals and possibly small populations became established from time to time. Except for six shells of juveniles, all specimens of *D. dromas* from the site were the typical big river form, swollen with a large knob or lump on each valve.

*Ptychobranchus* Simpson, 1900: Shells of two species belonging to this genus, *Ptychobranchus fasciolaris* (Rafinesque, 1820), the Kidneyshell, and *P. subtentum* (Say, 1825), the Fluted Kidneyshell, were recovered at the McMahan site and together totaled about 16% of the naiad sample. However, shells of the latter species made up slightly over 13%. Ortmann (1918) stated that the Kidneyshell was "widely and uniformly distributed over the upper Tennessee region, but nowhere in great numbers." After nearly 70 years this statement is still a fairly accurate evaluation of its status in Tennessee, although impoundment and increased pollution and silting problems have brought about some changes. Recovery of 124 shells of *P. fasciolaris*, both juveniles and adults, suggests a former viable population of this species in the West Prong Little Pigeon River.

The most numerous shell recovered in the McMahan site naiad sample was the Fluted Kidneyshell. A total of 508 valves were identified as *Ptychobranchus subtentum*; in ad-

dition, of the nearly 1,000 indeterminate fragmented valves, close to 200 of these could also have been referable to this species judging by incomplete tooth/hinge line and fluted posterior slope sections. *P. subtentum* is an inhabitant of small- to medium-sized streams of the upper Cumberland and Tennessee River systems, becoming most abundant toward the headwaters. It is, for example, a very common shell locally in the unimpounded stretches of the Powell and Clinch rivers in northeastern Tennessee and southwestern Virginia. At the time the McMahan site was occupied, the Fluted Kidneyshell was an abundant mussel in the naiad assemblage and, in addition to its value as a food resource, the Indian utilized (almost exclusively) shells of this species as some type of tool (Fig. 3). Approximately 175 valves exhibited modification to the posterior ventral margin; the shells appeared to have been used as some form of scraper, the ventral edge of each having been ground or worn down at an angle toward the posterior end. Riggs (1987) illustrates two valves of *Actinonaias ligamentina*, recovered at an early 19th century Cherokee farmstead (Bell Rattle Cabin site, Monroe County, TN), that were modified in a like fashion as those from the McMahan site. He attributed the modified edges to the shells use as a potter's tool; i.e. the valves were used to scrape and smooth clay vessels before they were fired. Harrington (1922) mentions that "...the cherokee formerly used mussel-shells and a marine shell, probably some species of *Cardium*, for this purpose" (pottery smoothing tool). Shells of *P. subtentum* from the McMahan site were obviously preferred for this function as only three

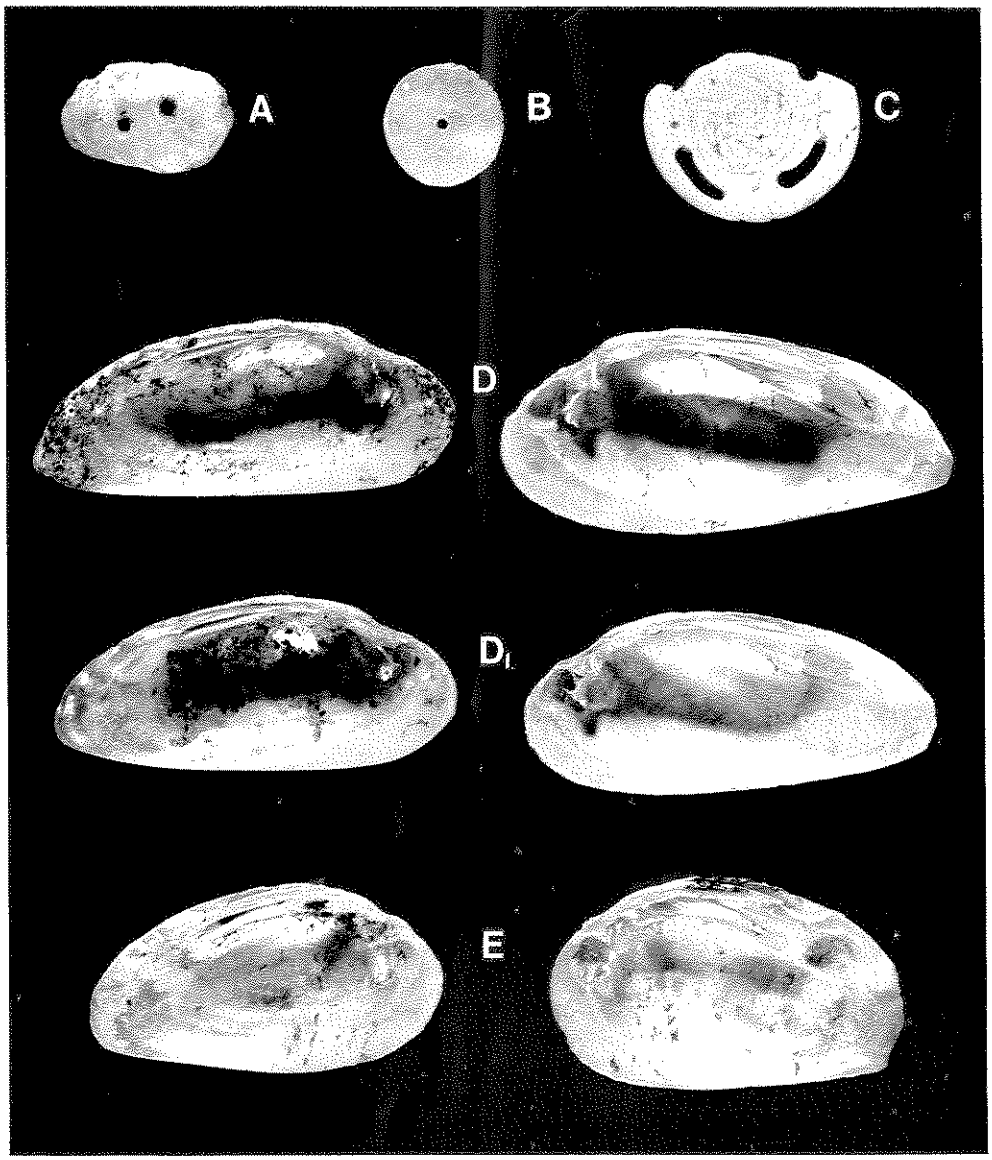


**Fig. 3.** Modified shells from the McMahan site. Valve section (length, 27.0 mm) with two perforations (A); thin shell disc (diameter, 19.5 mm) with center drilled and partially serrated edge (B); marine shell gorget (diameter, 34.0 mm), rattlesnake design (C); shell scrapers, *Ptychobranchus subtentum* (D, $D_1$) and *Ptychobranchus fasciolaris* (E).

**Fig. 4.** Widened and relocated channel of West Prong Little Pigeon River, Sevierville, TN, May 1967, looking upstream from U.S. 411 and 441 Highway bridge. McMahan site on left bank beyond bend in the river. Photo courtesy Tennessee Valley Authority.

valves of other species, one specimen of *Elliptio dilatata* and two of *P. fasciolaris*, were encountered that exhibited the ground ventral margin.

## PRESENT NAIAD POPULATIONS: THE LITTLE PIGEON RIVER SYSTEM

The Little Pigeon River system flows generally northwest from the Great Smoky Mountains National Park to its confluence with the French Broad River (River Mile 27.4; 43.8 km: Fig. 1), ca. 8.0 km below Douglas Dam. The entire watershed, consisting of 914 km², is in Sevier County, TN. Middle Prong and Porters Creek join to form the Little Pigeon River; downstream it is joined by Webb and Bird creeks, East Fork, and Middle Creek and West Prong Little Pigeon River at Sevierville (referred to as West Fork until ca. 1970). Principal tributaries of the West Prong Little Pigeon River are LeConte Creek, Roaring Fork, and Mill and Walden creeks. Total length of the Little Pigeon River is 45.4 km, that of the West Prong Little Pigeon River, 43.0 km. With minor exceptions the upper three-fourths of the drainage system flows in steep, narrow, mountain gorges, heading at elevations up to over 1,830 m at the southern boundary of the Great Smoky Mountains National Park (Tennessee Valley Authority, 1964). With the exception of the East Fork, tributaries of the Little Pigeon and West Prong Little Pigeon rivers are now apparently devoid of mussel populations. In light of the steep gradient, rapid current, and bedrock and boulder substratum characteristic of the majority of smaller streams making up this system, it is doubtful whether viable and varied mussel assemblages ever existed in all but the lower reaches of the Little Pigeon and West Prong Little Pigeon rivers.

Although Sevier County, formed in 1794, is considered predominantly rural, the past three decades have seen a phenomenal growth in urbanization, especially as it relates to the tourist industry. This has come about as the popularity of the Great Smoky Mountains National Park continues to escalate and the cities of Gatlinburg, Pigeon Forge and, to a lesser extent, Sevierville enlarge and diversify their facilities to accommodate the ever-increasing number of tourists. Environmental degradation of the Little Pigeon River system also continues to increase as a result of siltation, discharge from waste water treatment plants, and trash in general. Surprisingly, however, viable populations of several species of endemic fishes, turtles and mollusks continue to survive in very local areas in the lower stretches of the Little Pigeon River, and particularly in the West Prong Little Pigeon River in Sevierville. In the case of freshwater mussels, it seems even more suprising that the greatest diversity of species (albeit not large) and abundance in the Little Pigeon River system can be found in a 1.0 km stretch of the West Prong Little Pigeon River that was widened by the Tennessee Valley Authority during the period from June 1967 to May 1968 (see Figs. 4 and 5). Beginning at the TN Hwy 441 bridge (channel width, 36 m), the width was expanded to 62 m at a point 152 m downstream for a distance of 1.9 km. In addition, the mouth of the river was relocated ca. 0.6 km below its former junction with the Little Pigeon River: this modification eliminated two 180° bends and allowed discharge farther downstream, thus eliminating extreme periodic flooding that

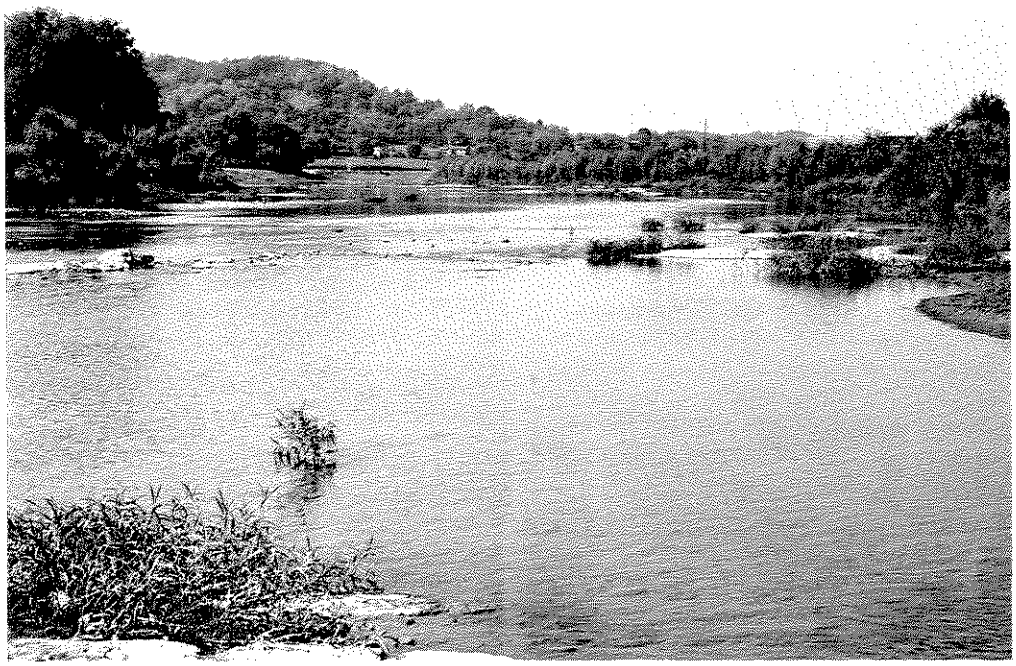

**Fig. 5.** West Prong Little Pigeon River, looking downstream, during period of low water (July, 1986). McMahan site along right bank.

inundated the main business district and suburbs of Sevierville.

During the period June 1985-May 1987, a total of 15 collecting trips were made in the Little Pigeon River in a stretch from the TN Hwy 66 bridge in Sevierville to just below the confluence with the West Prong Little Pigeon River, a distance of ca. 0.9 km. A total of 118 specimens, representing 11 species, were recovered (Table 3); shells of *Fusconaia barnesiana, Lampsilis fasciola, Villosa vanuxemensis* and *V. iris* comprised 93.2% of the sample. The one individual of *Anodonta grandis* (Say, 1829), the Common Floater, taken here (shell length 85.5 mm) was the only specimen of this species encountered during this study. Except for one individual and a left valve of *Elliptio dilatata* (Rafinesque, 1820), the Spike, found in the West Prong Little Pigeon River, one relic shell (chalky, periostracum badly eroded) recovered in this stretch of the Little Pigeon River was the only other example of this species found in the river system.

Although several locations on the Little Pigeon River from immediately below the confluence with the West Prong Little Pigeon River to its mouth (confluence with the French Broad River), a distance of ca. 7.5 km, were surveyed on six occasions during this two year study, no freshwater mussels were encountered. A substratum of shifting sand, private homes and small businesses lining the east bank and croplands and pastures adjacent to the west bank, plus the last ca. 1.1 km above the mouth being impounded, probably contribute the void in mussel populations. In his study of the effect of rechanneling on the fish population of Middle Creek, Sevierville, Etnier (1972) was of the opinion that substratum instability and the decreased variability of the physical habitat were the most significant factors responsible for changes in the fish fauna. Widening and other modifications of the Little Pigeon River in Sevierville by the TVA, plus the aforementioned conditions downstream, all contributed to reducing the environmental quality of the river for most aquatic organisms. Less than six specimens of *Villosa iris* and *Lampsilis fasciola* were found in the Little Pigeon River at the Walnut Grove Bridge in Sevierville (River Mile 6.7; 10.7 km); these were relic specimens and the apparent paucity of naiads inhabiting this stretch of the river could be due in part to urban development along the banks at this point and upstream. No mussels were found in the Little Pigeon River upstream from the southern city limits of Sevierville, so with the possible exception of an occasional individual becoming established, viable mussel

**Table 3.** Species of freshwater mussels inhabiting the Little Pigeon River, TN Hwy. 66 bridge to confluence with West Prong Little Pigeon River, Sevier County, TN. Specimens obtained primarily from muskrat feeding stations, June 1985-May 1987.

| Species | No. of Specimens | % of Specimens |
|---|---|---|
| *Fusconaia barnesiana* (Lea, 1838) | 35 | 29.41 |
| *Pleurobema oviforme* (Conrad, 1834) | 3 | 2.52 |
| *Anodonta grandis* (Say, 1829) | 1 | .84 |
| *Lasmigona costata* (Rafinesque, 1820) | 1 | .84 |
| *Toxolasma lividus* (Rafinesque, 1831) | 2 | 1.68 |
| *Epioblasma capsaeformis* (Lea, 1834) | 1 | .84 |
| *Lampsilis fasciola* (Rafinesque, 1820) | 26 | 21.85 |
| *L. ovata* (Say, 1817) | 1 | .84 |
| *Villosa iris* (Lea, 1830) | 16 | 13.45 |
| *V. vanuxemensis* (Lea, 1838) | 33 | 27.73 |
| Totals | 119 | 100.00 |

populations in the Little Pigeon River are at present restricted to the stretch between the TN Hwy 66 bridge and its confluence with the West Prong Little Pigeon River. A small but apparently stable population of *V. vanuxemensis* was found inhabiting a ca. 0.2 km stretch of the East Fork, but this is apparently the only naiad species living in this small tributary stream.

As previously mentioned (see METHODS), emphasis on surveying the molluscan fauna of the Little Pigeon River system centered on that stretch of the West Prong Little Pigeon River adjacent to the McMahan site. This was started initially after noting a number of shells of endemic species, along with large quantities of shells of *Corbicula fluminea* (Müller, 1774), the Asiatic Clam, scattered along the bottom and at muskrat feeding stations. It was felt that monthly surveys for a period of time (as it turned out, two years) would provide an accurate index to extant species and the relative size of their populations still inhabiting the river, and a comparison of the present mussel assemblage with that from a prehistoric context at the McMahan site.

No quantitative data were obtained for the species of gastropods still inhabiting the Little Pigeon River system. Two species, *Leptoxis praerosa* (most can be referred to the smaller species/form, *L. subglobosa*) and *Pleurocera parvum,* are locally distributed throughout the Little Pigeon River system, including some of the smaller tributaries such as the East Fork, but they appear most abundant in those stretches of the Little Pigeon and West Prong Little Pigeon rivers supporting viable mussel populations. *Io fluvialis, P. canaliculatum* and *Lithasia verrucosa*, taxa represented in the McMahan site molluscan assemblage, have been extirpated from the Little Pigeon River system. *Campeloma* sp. occurs in moderate numbers in the silt/mud substratum in the West Prong Little Pigeon River adjacent to the McMahan site, the only locale where it has been noted. Two other species, *Pseudosuccinea columella* (Say, 1817) and *Physella gyrina* (Say, 1821), have been noted in some numbers under boards and other trash caught in vegetation along the banks; these taxa could be recent, or historic, additions to the molluscan fauna and their numbers could well increase as they appear tolerant of low water quality and a mud/silt substratum.

Table 4 provides a list of the naiad species and the number of each collected in the West Prong Little Pigeon River from June 1985 through May 1987. "Number of Specimens" reflects the quantity of paired valves collected that were judged to be fresh or "recently dead" because they either contained remains of soft parts or the shell had not yet become heavily stained with algae, the periostracum was not eroded (other than normal erosion of the beak), and the nacre was not chalky. The only specimen of *Alasmidonta viridis*, the Slipper Shell, encountered during the two year survey was not included in Table 4 because, although paired, the valves were badly eroded; this individual had probably been dead for several years. The same was true of a right and left valve (two individuals) of *Cyclonaias tuberculata*, the Purple Wartyback; these valves were badly eroded and represent individuals that had died at least several years ago.

Shells of four species, *Fusconaia barnesiana, Lampsilis fasciola, Pleurobema oviforme* and *Villosa iris* comprised nearly 83.0% of all specimens recorded. Specimens of *F. barnesiana*, a locally common species in numerous small streams of the upper Tennessee River drainage, accounted for 45.4% of the present naiad assemblage from the West Prong Little Pigeon River. Prehistorically it appears to have also been a common species in this stretch of the river; 347 valves identified from the McMahan site (9.2%) ranked it as one of the four most numerous taxa in the assemblage. Of the 13 species recorded from the Tellico River by Parmalee and Klippel (1984), shells of *F. barnesiana* amounted to 9.1% of the total. *P. oviforme*, another locally common shell in small- to medium-sized rivers, totaled 8.8% and 8.7% respectively in the Tellico and West Prong Little Pigeon river mussel assemblages. Both *V. iris* and *V. vanuxemensis* exhibit viable populations in the West Prong Little Pigeon and Little Pigeon rivers, but the number of individuals from the West Prong accounted for only 8.7% of the total number of specimens while those from the Little Pigeon River amounted to 41.5%. *V. vanuxemensis* is a species adaptable to medium-sized rivers as well as small tributary and headwater streams, and one that often becomes locally abundant; 48.2% of the mussels (543 specimens) obtained by Parmalee and Klippel (1984) from the Tellico River were this species.

One of the most numerous of the naiad species inhabiting both the Little Pigeon and West Prong Little Pigeon rivers is *Lampsilis fasciola*; individuals collected from both rivers over the two year survey period accounted for approximately 22.0% of all specimens in each. Nearly 10.0% of the valves recovered from the McMahan site were those of this species. At least five other taxa, *Potamilus alatus, Lasmigona costata, Lampsilis ovata, Epioblasma capsaeformis,* and *Medionidus conradicus* appear to be maintaining viable populations in the West Prong Little Pigeon River, although the latter species is rare. Of special interest is the occasional establishment of an individual of a species generally

**Table 4.** Species of freshwater mussels inhabiting the West Prong Little Pigeon River, Sevier County, Tennessee. Specimens obtained primarily from muskrat feeding stations, June 1985-May 1987.

| Species | No. of Specimens | % of Specimens |
|---|---|---|
| *Fusconaia barnesiana* (Lea, 1838) | 689 | 45.39 |
| *Quadrula pustulosa* (Lea, 1831) | 2 | .13 |
| *Elliptio crassidens* (Lamarck, 1819) | 1 | .06 |
| *E. dilatata* (Rafinesque, 1820) | 1 | .06 |
| *Pleurobema oviforme* (Conrad, 1834) | 132 | 8.69 |
| *Lasmigona costata* (Rafinesque, 1820) | 47 | 3.10 |
| *Toxolasma lividus* (Rafinesque, 1831) | 50 | 3.29 |
| *Epioblasma capsaeformis* (Lea, 1834) | 46 | 3.03 |
| *Lampsilis fasciola* (Rafinesque, 1820) | 330 | 21.74 |
| *L. ovata* (Say, 1817) | 53 | 3.49 |
| *Leptodea fragilis* (Rafinesque, 1820) | 1 | .06 |
| *Medionidus conradicus* (Lea, 1834) | 12 | .79 |
| *Potamilus alatus* (Say, 1817) | 21 | 1.38 |
| *Villosa iris* (Lea, 1830) | 103 | 6.78 |
| *V. vanuxemensis* (Lea, 1838) | 30 | 1.98 |
| Totals | 1,518 | 99.97 |

associated in the Mississippi or Interior Basin drainage: these include *Quadrula pustulosa* (2 juvenile specimens, ca. 5 and 6 years of age, plus 2 relic right valves); *Elliptio crassidens* (1 living adult, 2 relic pairs and 1 relic left valve); *E. dilatata* (1 specimen, 1 left valve); *Leptodea fragilis* (1 specimen: shell length 88.5 mm; left valve of a juvenile: shell length 43.4 mm). Probably included in this category is *Cyclonaias tuberculata*, based on the relic right and left valves previously mentioned. Very possibly migratory host fishes, moving up the Little Pigeon River from the French Broad River, provide the mechanism for this dispersal. Thus far their numbers have not become great enough to result in the establishment of viable populations. Of the living taxa of freshwater mussels reported here from the Little Pigeon River system, *L. fragilis* is the only species that was not represented in the archaeological assemblage from the McMahan site.

## SUMMARY

The prehistoric molluscan fauna of the West Prong Little Pigeon River, Sevier County, Tennessee is one of the richest and most diverse known for a small river in the upper Tennessee River drainage. Archaeological salvage excavations carried out periodically from June through December 1985 at the McMahan site, a late Mississippian (AD 1300-1600) village and mound complex situated adjacent to the West Prong Little Pigeon River, resulted in the recovery of ca. 7,400 identified aquatic gastropod shells (6 taxa) and 3,855 freshwater mussel valves (45 taxa). Shells of *Leptoxis praerosa* and *Pleurocera parvum* composed 93% of the gastropod specimens recovered. The naiad assemblage was dominated by *Fusconaia barnesiana, F. subrotunda, Lampsilis fasciola, Villosa* spp. and *Ptychobranchus subtentum* (ca. 65% of all identified valves). Although several taxa represented in the archaeological sample, e.g. *F. subrotunda, Elliptio crassidens, Cyclonaias tuberculata, Pleurobema cordatum*, and *Dromus dromas* can inhabit the deep water of large rivers as well as shallow small rivers (in some instances reflected by differences in shell form), all species identified from the McMahan site are known to occur in small- to medium-sized rivers. However, approximately 30 of these reach their widest distribution and greatest population densities in small- to medium-sized rivers with normal depths of 1 m, a coarse gravel/small cobble/sand substratum, riffles and swift current.

Ortmann (1925) concluded "...that originally there must have existed a separation of two faunistic types in two different drainage systems, a Cumberlandian River and an Interior Basin River, and that subsequently these two systems became connected, so that their faunas had a chance to mingle." He noted earlier (Ortmann, 1924) that "At the present time, the distribution of the Cumberlandian Naiad fauna is markedly discontinuous, being found in the upper Cumberland, the upper Duck, and the Tennessee above the Mussel Shoals, but not in the lower Cumberland, the lower Duck, and probably also the lower Tennessee (downward from some point below the Mussel Shoals, which has not yet been ascertained)." Of those species whose origin has been determined with some degree of certainty (e.g. Ortmann, 1925; van der Schalie, 1973), the naiad taxa represented at the McMahan site consist of about 43% from the Interior Basin (Mississippian) drainage and 57% from the Cumberlandian region (see Table 2). Former stretches of pool and riffle habitat in the West Prong Little Pigeon River within close proximity of the McMahan site apparently provided ideal conditions for the establishment of an abundant and varied molluscan fauna. Naiad taxa whose origin was the Interior Basin drainage reached the Little Pigeon River system via the French Broad River.

Analyses of a sample of substratum taken from a stretch of the West Prong Little Pigeon River that appeared to provide the best mussel habitat, judging by the number of live individuals and taxa observed during periods of low summer water levels, was composed of the following particle sizes (after Wentworth, 1922): medium sand, 16.34%; coarse sand, 66.87%; very coarse sand, 13.48%. The balance was composed of small pebbles, granules, fine sand and very fine sand. This type of substratum, whether in large uniform expanses, e.g. 30 x 90 $m^2$, or in small patches among large cobbles or between layers of bedrock, provides the most suitable habitat for present day molluscan populations. A river habitat (Fig. 2) probably not unlike the present one adjacent to the McMahan site, clear cut banks and channel widening by TVA notwithstanding, existed in late prehistoric times and supported a rich molluscan fauna that was heavily exploited by the Indian.

Data on species distribution and population densities of freshwater mussels inhabiting the Little Pigeon River system were obtained from June 1985 through May 1987. The primary source of quantitative data was obtained from shells discarded by muskrats at feeding stations. Although the Little Pigeon River and several tributaries that could have supported mussel populations were surveyed, emphasis was placed on a ca. 1.0 km stretch of the West Prong Little Pigeon River adjacent to the McMahan site. In spite of, or as a result of a widening and straightening of the channel by TVA in 1966-1967, viable mussel populations of 11 species of mussels still exist in this stretch in spite of continued severe degradation of the river environment. Occasionally individuals of other naiad species (in this study, five taxa) become established in the Little Pigeon and West Prong Little Pigeon rivers, but apparently in such low numbers that viable populations are unable to develop.

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