A Survey for Endangered Mussels in the Middle Fork Holston River (MFHRM 42.0 to 50.7), Nick's Creek, and Staley Creek, Smyth County, Virginia

A Report Submitted to

Smyth County Board of Supervisors
for Dewberry and Davis

by

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EXECUTIVE SUMMARY

The planned Adkins Sewage Line Extension will require thirteen subteranean crossings of the Middle Fork Holston River or its tributaries. The purpose of our study was to determine the presence or absence of the tan riffle shell pearly mussel and the little-winged pearly mussel in river reaches which could be affected by construction activities. The area surveyed consisted of about 8.7 river miles, and field work required 92 man-hours to complete. We found no evidence that either of these species were present in the area surveyed (MFHRM 42.0 to 50.7, the mouth of Staley Creek, and the lower 0.4 miles of Nick's Creek). Freshwater mussels in general exhibited low diversity and very low abundance in the river reaches examined.

Although Endangered mussels were not present in the areas encompassed by the planned pipeline crossings, the best available technology should be used during construction to minimize siltation and damage to the resident rainbow trout population and to reaches further downstream, which are known to provide critical habitat for the tan riffle shell pearly mussel and the little-winged pearly mussel.

BACKGROUND

The tan riffle shell pearly mussel (Epioblasma walkeri), a federally listed Endangered species, is thought to be limited in distribution to the Middle Fork Holston River, Virginia (USFWS 1984a). It has been collected from the Middle Fork Church in Smyth County to Craig Bridge in Washington County (Stansbery and Clench 1975). The upstream distribution of the tan riffle shell is not known, since that portion of the river has never been thoroughly surveyed. Another freshwater mussel species, the little-winged pearly mussel (Pegias fabula), is a candidate for federal listing, and it has been reported to occur in the Middle Fork Holston River near Chilhowie,

Virginia (Stansbery 1976a).

The planned Adkins Sewage Line Extension project will require 13 subteranean crossings of the main channel or tributaries of the Middle Fork Holston River. The purpose of our study was to determine the presence or absence of the tan riffle shell mussel and little-winged pearly mussel in river reaches which could be impacted by construction activity. The survey work included the Middle Fork Holston River between Adkins and Marion, Virginia, the mouth of Staley Creek, and the lower 0.4 stream miles of Nick's Creek. We also determined the distribution of other freshwater mussel species in these river reaches. We surveyed an additional 1.4 river miles of the Middle Fork Holston River above the most upstream crossing site, #12 (MFHRM 49.2), to obtain a more complete description of the mussel fauna of the upper river reaches; based on the distribution of factories on the river, this stretch of river should be relatively unaffected by industrial activities.

INTRODUCTION

The Cumberland Plateau Region of the southeastern United States is one of the major centers of mussel speciation, diversity, and abundance in North America. The headwaters of the Tennessee and Cumberland Rivers are inhabited by 45 endemic or "Cumberlandian" mussel species (Ortmann 1918). Major rivers of the Cumberland Plateau include the Cumberland, Duck, Elk, Buffalo, and headwaters of the Tennessee. Eleven of the 23 Endangered mussel species in the United States are Cumberlandian (USFWS 1984b). Eight of the thirteen Cumberlandian Endangered mussels occur in Virginia, and all of these are found in the headwaters of the Tennessee in the Clinch, Powell, and Holston River drainages (Sheehan et al. 1986). There is general agreement among biologists that the entire Cumberlandian fauna is threatened. Three anthropogenic factors have been chiefly responsible for

the declines of Cumberlandian species. These are impoundment, siltation, and pollution.

The tan riffle shell, Epioblasma (=Dysnomia) walkeri, is a Cumberlandian mussel species that has been extirpated in most of the rivers in which it once occurred. It is a medium-sized mussel species with a brownish-green to yellowish-green periostracum with numerous faint green rays distributed over the valve surface (Bogan and Parmalee 1983). This species exhibits sexual dimorphism; the female shell has a pronounced marsupial swelling posteriorly. E. walkeri is considered a headwater form that inhabits course substrates in riffle areas of small to medium sized rivers (USFWS 1984a). It was listed as endangered in 1977 (Federal Register 42:42351-42353). The historical distribution of this species was apparently restricted to the Cumberland and Tennessee River systems. Collection records for the tan riffle shell include: Big South Fork; Beaver, Flint, Hurricane, and Limestone Creeks; the South Fork Holston, Middle Fork Holston, Holston, Clinch, Cumberland, East Fork Stones, Stones, Red, Harpeth, Buffalo, Duck, and Flint Rivers; and possibly the Obey River (USFWS 1984a). It was believed that populations of the tan riffle shell remained in the Duck and Red Rivers (Stansbery 1976b). However, more recent surveys indicate these populations have been eliminated (Ahlstedt 1980; Bogan and Parmalee 1983). The only known remaining population of tan riffle shells occurs in the Middle Fork Holston River between MFHRM 18.4 and 29.1.

The little-winged pearly mussel (Pegias fabula) is a candidate for listing as Threatened or Endangered that has been reported to occur in the Middle Fork Holston River at Chilhowie, Virginia. P. fabula is a rather dimunutive species with a relatively heavy shell. The periostracum typically appears eroded. This species typically occurs in small, cool, high-gradient streams, and it has never been reported outside of the

Tennessee and Cumberland River systems (Stansbery 1976a). Stansbery (1976a) reported that there is no evidence indicating this species was ever very common. Recent collection records (including living and dead specimens) include four rivers or creeks of the Cumberland River system, and the North Fork Holston and Middle Fork Holston Rivers of the Tennessee River System. Pollution, siltation, and impoundment have eliminated the little-winged pearly mussel from much of its historical geographic range (Stansbery 1976a).

The planned Adkins Sewage Line Extension project will require thirteen subteranean crossings of the Middle Fork Holston River and its tributaries between MFHRM 42.4 and 49.2. This portion of the Middle Fork Holston River has never been thoroughly surveyed for its mussel species assemblage. The tan riffle shell pearly mussel and the little-winged pearly mussel have been reduced in numbers to the point where their continued existence is in great jeopardy. Any further reductions in their numbers or essential habitat will greatly diminish the liklihood that they will remain extant. To determine whether the planned Adkins Sewage Line Extension could reduce critical habitat for these headwater forms, we conducted a survey of the mussel species assemblage of portions of the Middle Fork Holston River, Staley Creek, and Nick's Creek that could be directly affected by construction activities associated with the planned subteranean crossings.

STUDY AREA

The Middle Fork Holston River originates near Groseclose, Virginia, in the Ridge and Valley Physiographic Province. The river is formed by a number of cold springs, and it meanders in a southwesterly direction until it joins the South Fork Holston River at the South Holston Impoundment. Its valley is composed of soluble limestone bedrock. Much of the valley is still forested, and due to plentiful rainfall, the river receives cool,

clear water throughout the year. It is a high-gradient stream with course substrate, resulting in numerous, well-oxygenated riffles and shallow runs. Stansbery and Clench (1975) believe that the karst topography, vegetated slopes, and relatively long, narrow valley may indicate a stream well provided with cold ground water, which would maintain a headwater habitat for an unusual distance downstream. Stansbery and Clench (1975) felt that a number of factors, such as industrial and municipal wastes, and silts and pesticides associated with valley farming, may exert deleterious effects on the molluscan fauna of the Middle Fork Holston River.

METHODS

We surveyed the Middle Fork Holston River on 10-12 June 1986 from a bridge about 0.4 miles below the mouth of Staley Creek, MFHRM 42.0, to the Rt. 81 bridge, MFHRM 50.7 (Fig. 1). We also examined the lower 0.4 miles of Nick's Creek. The survey area consisted of about 8.7 river miles; a total of about 1.6 miles of this was channelized (1.3 river miles of the Middle Fork Holston River above Staley Creek, and about 0.3 river miles below crossing site #10 on Nick's Creek).

A team of biologists conducted the survey using masks and snorkels. The survey required a total of 92 man-hours; all riffle-run habitats were examined intensively. The river was near low-flow conditions, and water clarity was excellent with the exception of some portions of the Middle Fork Holston between crossings #9 to #12 in the upper reaches of the survey area. All live mussels and shell material encountered were collected, identified to species, and locations were recorded. Voucher specimens were retained for all species. Streambanks were examined for relic shells and muskrat middens. Habitat characteristics between each planned crossing site were also recorded.

RESULTS

The benthic macroinvertebrate fauna of the Middle Fork Holston River in reaches we examined was dominated by snails and crayfish. Crayfish were unusually active during the daytime, perhaps due to the nearly complete absence of centrarchids. Darters, sculpins, and trout were in relatively high abundance. Cyprinids were present, but reduced in diversity and abundance. Periphyton was abundant in most areas of the river that was not shaded by overhanging vegetation.

We did not find any evidence of E. walkeri or P. fabula in Nick's Creek, the mouth of Staley Creek, or between MFHRM 42.0 to 50.7. The freshwater mussel fauna in general exhibited low species richness and low abundance. On the basis of substrate and water flow requirements, most of the river reaches we surveyed offered good habitat for mussels:

MFHRM 42.0 (birdge) to MFHRM 42.4 (mouth of Staley Creek--crossing #13)

This stretch of river consists of an occasional riffle and pool, but was mostly river-run habitat. The substrate type in the riffles and runs was predominately cobble with some pebble, gravel, and sand. Pools exhibited cobble, boulder, and bedrock. The mouth of Staley Creek, an area of deposition, was comprised of an unstable gravel-pebble substrate. Periphyton and snails were abundant throughout this reach of the Middle Fork Holston River. Fish were less abundant than in most other reaches examined. However, we did observe sculpins, darters, stonerollers, and hogsuckers.

We found no evidence of mussels in this stretch of river.

MFHRM 42.4 (mouth of Staley Creek) to MFHRM 43.1

Cobble-pebble substrate dominated this shallow stretch of river, but occasional bedrock outcrops were evident. Substrate appeared stable, and the water was clear and cool. Rainbow trout, darters, sculpins, and snails were abundant. Based on water flow velocity and substrate, much of this

river reach offered excellent habitat for mussels. However, we found no evidence of mussels.

MFHRM 43.1 to 44.4 (channelized section)

This stretch of river is highly modified by channelization, and we only gave it a cursory examination; there was no evidence of mussels.

MFHRM 44.4 to 44.7 (crossing #1)

This river reach consists of an extensive run with few riffles, and its substrate of mixed cobble, pebble, gravel, sand, and little or no silt appeared stable. The river water flowed rapidly and exhibited high clarity. We observed rainbow trout, darters, sculpins, and a few cyprinids (stonerollers and chubs). Snails were abundant. This river reach appeared to provide good habitat for mussels, but we did not observe any live specimens. We did find shells of three mussel species:

Villosa vanuxemi

Villosa nebulosa

Medionidus conradicus

MFHRM 44.7 (crossing #1) to MFHRM 44.9 (crossing #2)

Much of this river reach appeared to offer good habitat for mussels with the exception of the deep and silty pool at the river bend (Fig. 1). The remainder of this stretch of the river was riffle/run habitat with mixed pebble, gravel, and sand substrate. Cobble was less apparent than in downstream reaches. Snails were very abundant, as were darters, sculpins, and stonerollers. We found no living or dead specimens of mussels.

MFHRM 44.9 (crossing #2) to MFHRM 45.3 (crossing #3)

Bedrock predominated in this stretch of river. Small pockets of mixed substrate were evident, but riffle-run habitat was limited. This river reach did not appear to provide good habitat for riffle-run mussel species; we collected no mussel specimens. A small impoundment was evident adjacent

to the old mill just downstream of crossing #3. A coldwater stream entered the river just above the impoundment.

MFHRM 45.3 (crossing #3) to MFHRM 45.4 (crossing #4)

The Middle Fork Holston River between planned crossings #3 and #4 consists of a deep run over bedrock. A considerable amount of silt was evident. A few high-gradient riffles occurred in the upper portion of this reach. Snails and a few fish species, such as darters, sculpins, and rainbow trout were present, but not very abundant. No mussel specimens were encountered.

MFHRM 45.4 (crossing #4) to MFHRM 45.5 (crossing #5)

A coldwater stream enters the Middle Fork Holston River at the site of crossing #4, which made the river considerably cooler below this point. Trout were in greatest abundance downstream of the coldwater tributary. The river between crossings #4 and #5 consists of a shallow run. The riverbottom was composed of slab rock, mixed cobble, pebble, gravel, and sand, with silt in the off-channel areas. This portion of the river offered seemingly good habitat for mussels, but none were located.

MFHRM 45.5 (crossing #5) to MFHRM 45.7 (crossing #6)

The Middle Fork Holston River between crossings #5 and #6 was comprised of a shallow river run with substrate similar to that between crossings #4 and #5. We observed three size classes of trout, indicating that they may be naturally reproducing in the river. We found one valve of Villosa vanuxemi just below crossing #6, but we did not find any live mussel specimens.

MFHRM 45.7 (crossing #6) to MFHRM 46.8 (crossing #7)

The river between these two crossings consists of an occasional riffle, but shallow runs are most evident. Slab rock, boulder, cobble, pebble, and sand dominated the substrate in riffles; the riverbottom in runs was

similar, but more sand and silt were apparent. Snails were abundant, and darters, sculpins, and stonerollers were common. Sphaerids were also common in off-channel areas of the river.

We found six live specimens of Villosa vanuxemi just behind an island immediately upstream of the island that will be crossed by the pipeline at site #6. Three of these were males (TL 55.5, 51.4, and 49.5 mm; mean = 52.1, SD 3.1), and three were females (TL 45.0, 42.4, and 39.8; mean = 42.4, SD 6.5).

MFHRM 46.8 (crossing #7) to MFHRM 47.3 (crossing #8)

We found an extensive river run with a predominantly cobble substrate between these two crossings. Cobble, gravel, pebble, sand, and bedrock ledges were also present. Silt was evident in areas not exposed to the river flow. Fish and snails were greatly diminished in this river reach. We did locate several shell fragments of Villosa vanuxemi, but no live mussel specimens.

MFHRM 47.3 (crossing #8) to MFHRM 48.6 (crossing #9, mouth of Nick's Creek)

Bear Creek is a relatively large, warm tributary that enters the Middle Fork Holston River just upstream of crossing #8. Bear Creek and its mouth were the only areas of the river complex where we observed centrarchids. Darters, trout, sculpins, and a few species of cyprinids were also present in this river reach. Snails were not as abundant as in most other areas of the river.

This portion of the Middle Fork Holston River was composed of extensive runs with occasional riffles, and a few deep pools over bedrock. The flow rate of the river in the runs was reduced, and the predominately cobble substrate was coated with silt. The river immediately below crossing #9 exhibited long, shallow riffle-runs with cobble-pebble substrates that were free of silt. Although river conditions appeared favorable in much of the

area between crossings #8 and #9, no mussel specimens were encountered.

Mouth of Nick's Creek (crossing #9) and Nick's Creek (crossing #10)

Most of the creek below crossing #10 is channelized and the stream is confined in a concrete channel. The lower 0.1 mile of the creek is not channelized, and the substrate consists of cobble, pebble, and gravel. Trout and cyprinids were abundant in the creek. However, we found no mussel specimens.

The river below the mouth of Nick's Creek exhibits a steep gradient with long shallow riffle-runs. The substrate is comprised of slab rock, cobble, pebble, and gravel. No mussel specimens were encountered.

Mouth of Nick's Creek to MFHRM 49.1 (crossing #11)

Short deep runs are interspersed by shallow runs in this section of river. Water clarity was somewhat reduced below crossing #11 as compared to lower river reaches. There was some evidence of streambank erosion and slumping; portions of the streambank had been denuded of vegetation by heavy equipment. The riverbottom was comprised of gravel, pebbles, sand, and silt in the shallow areas, whereas silt was dominant in deeper areas. Fish were not very abundant, but a few cyprinids were present. We found no evidence of mussels in this river reach.

MFHRM 49.1 (crossing #11) to MFHRM 49.2 (crossing #12)

The river ecosystem has been severely disturbed by man between these two crossings. The streambanks were eroded and had been bulldozed. Concrete blocks and reinforcing bar occuppied much of the river channel. Wood products materials and other debris from a nearby factory littered the stream. The river channel consisted of a series of pools and deep runs which were filled with silt. Very little riffle-run habitat was evident. Fish were in low abundance, and no mussel specimens were encountered.

MFHRM 49.2 (crossing #11) to MFHRM 50.7 (Rt. 81 bridge)

This river reach consists of shallow to deep runs interspersed by riffles. The substrate (cobble, pebble, and gravel) appeared to offer good habitat for mussels in much of this river reach, but we were unable to locate any specimens. Darters, sculpin, and rainbow trout were common.

DISCUSSION

The presence of three mussel species in the upper reaches of the Middle Fork Holston River was consistent with the findings of other workers. Stansbery and Clench (1975) reported Villosa vanuxemi, V. nebulosa, and Lasmogonia holstonia from sites above Marion. We encountered specimens of the two Villosa species, but we found no evidence of L. holstonia. L. holstonia is typically found in extreme headwater habitats (Stansbery and Clench 1975; Dennis 1985), so it is likely that this species still exists in river reaches upstream of the area surveyed in this study. We did find specimens of Medionidus conradicus, which Stansbery and Clench (1975) found downstream of Mt. Zion Church only.

Dennis (1985) reported that the number of mussels in the Middle Fork Holston River peaked at 15 species at MFHRM 10.0, declined to three species at MFHRM 40.0, and then further declined to two at MFHRM 54.0. This downstream trend towards increased species diversity is supported by our findings, and it is likely attributable to the increased diversity in habitat as the rithron-potamon boarder is approached (Patrick 1961; Hynes 1970).

It may be significant that the six living specimens of Villosa vanuxemi we encountered were located behind an island, since this species is common to small streams and is particularly abundant in areas of quiet water (Dennis 1985). Their location indicates that this relatively small species may be susceptible to hydraulic downstream displacement. Discharge records

for the Middle Fork Holston River indicate that the relatively small channel has been subjected to record flows in recent times (eg. 1977; Neves et al. 1980). Damage to the river channel from the flood of 1977 was still evident during our survey. Scouring of the river bottom from periodic high discharges may be responsible for the low diversity and abundance of mussels in the upper reaches of the Middle Fork Holston River. The island would afford some protectection to organisms immediately downstream that are susceptible to hydraulic downstream displacement.

The contention that the intrusion of cold groundwater into the Middle Fork Holston River may maintain the headwater habitat for considerable distances downstream (Stansbery and Clench 1975) was supported during our survey. Coldwater streams joined the Middle Fork Holston River at MFHRM 45.3 and 45.5, and these appeared to alter the thermal gradient of the river. We found coldwater fish (rainbow trout) in abundance as far downstream as Marion. These unusual thermal conditions may be responsible for the low diversity and abundance of mussels in the survey area. Centrarchids and cyprinids, which are typically more abundant in warmer waters, and which frequently serve as hosts for Cumberlandian mussels (Zale and Neves 1982), were in relatively low abundance. However, the low diversity and abundance of mussels in the river reaches we examined may well be due to anthropogenic impacts. Siltation from agricultural practices, construction of the numerous railroad and highway bridges, and channelization of the river complex may have adversely affected the mussel fauna of the river reaches we examined. Other potential impacts on water quality can be surmised from the proximity of industrial complexes to the river.

CONCLUSIONS

The mussel fauna of the Middle Fork Holston River between MFHRM 42.0 and 50.7 exhibited low diversity and very low abundance; our findings were consistent with those of other workers (Stansbery and Clench 1975; Dennis 1985). No mussels were present in the lower 0.4 miles of Nick's Creek or in the mouth of Staley Creek. We found no evidence indicating the presence of the tan riffle shell pearly mussel, Epioblasma walkeri, or the little-winged pearly mussel, Pegias fabula, within the river reaches we examined; construction activities associated with the Adkins Sewage Line Extension project should have little effect on Endangered mussel species. Possible explanations for the depauperate mussel fauna in the upper reaches of the Middle Fork Holston River include: 1) low abundance of suitable fish hosts; 2) the maintenance of the headwater habitat for an unusually long distance downstream due to intrusions of cold groundwater and coldwater tributaries; 3) low habitat diversity; 4) hydraulic downstream displacement of smaller, headwater forms; and 5) anthropogenic factors, such as siltation and water pollution.

Although Endangered mussels are apparently absent from reaches of the Middle Fork Holston River that are likely to be directly affected by the Adkins Sewage Line Extension, the best technology available should be used to minimize siltation during construction, since the last remaining population of the Endangered mussel, Epioblasma walkeri, is known to occur about 12 miles downstream of the project. Pegias fabula, which is proposed for federal listing, may also occur downstream of the project. The rainbow trout, a highly prized sport fish, is also abundant in the river reaches encompassed by the project.

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Figure 1. Middle Fork Holston River surveyed for Endangered mussels. Closed circles correspond to river miles. Lines indicate planned sites for subteranean pipeline crossings of the river complex.