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ENDANGERED FRESHWATER MUSSEL SURVEY

OF

**THE CLINCH, DUCK, ELK, HOLSTON and POWELL RIVERS
Tennessee and Virginia**

Prepared for:

UPPER DUCK RIVER DEVELOPMENT AGENCY

Shelbyville, Tennessee

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TABLE OF CONTENTS

| | |
|----------------------------------|-----|
| Title Page | i |
| Table of Contents | ii |
| List of Figures | iii |
| List of Tables | iii |
| List of Appendices | iii |
| | |
| INTRODUCTION | 1 |
| | |
| METHODS | 2 |
| | |
| POWELL RIVER SURVEY | |
| RESULTS | 4 |
| DISCUSSION | 5 |
| SUMMARY | 7 |
| | |
| CLINCH RIVER SURVEY | |
| RESULTS | 8 |
| DISCUSSION | 9 |
| SUMMARY | 12 |
| | |
| ELK RIVER SURVEY | |
| RESULTS AND DISCUSSION | 12 |
| SUMMARY | 13 |
| | |
| HOLSTON RIVER SURVEY | |
| RESULTS | 14 |
| DISCUSSION | 15 |
| SUMMARY | 16 |
| | |
| DUCK RIVER SURVEY | |
| RESULTS | 17 |
| DISCUSSION | 19 |
| SUMMARY | 21 |
| | |
| COMMENTS | 22 |
| | |
| LITERATURE CITED | 24 |
| | |
| FIGURES | |
| | |
| TABLES | |
| | |
| APPENDICES | |

LIST OF FIGURES

1. Powell and Clinch River Quantitative Mussel Sites.
2. North Fork Holston River Quantitative Mussel Sample Sites.
3. Duck River Quantitative Mussel Sample Sites.

LIST OF TABLES

1. Number of Mussels per Square Meter in YMA Powell River Quantitative Sampling, 1989 and 1990.
2. Number of Mussels per Square Meter in YMA Clinch River Quantitative Sampling, 1989 and 1990.
3. Number of Mussels per Square Meter in YMA Elk River Quantitative Sampling, 1990.
4. Number of Mussels per Square Meter in the North Fork Holston River Quantitative Sampling, 1990.
5. Number of Mussels per Square Meter in YMA Duck River Quantitative Sampling, 1989 and 1990.

LIST OF APPENDICES

- A. Abundance and Frequency Data of Mussels from TVA And YMA Powell River Surveys
- B. Abundance and Frequency Data of Mussels from TVA And YMA Clinch River Surveys
- C. Abundance and Frequency Data of Mussels from TVA And YMA Duck River Surveys
- D. Number of Mussels Collected During YMA River Surveys

INTRODUCTION

Young-Morgan & Associates (YMA) was retained by the Upper Duck River Development Agency to re-evaluate and update the endangered mussel population data collected in the late 1970's and 1980's during TVA's Cumberlandian Mollusk Conservation Program (CMCP). Cumberlandian mussels are a group of species which are found only in streams of the Tennessee and Cumberland River Systems flowing out of the Southern Appalachians and the Cumberland Plateau (Stansbery, 1972). YMA proposed to survey the mussel fauna of the Powell, Clinch, Elk, Holston and Duck Rivers.

Several mussel species that occur in the Duck River are listed on the federal Endangered Species List, specifically, Epioblasma walkeri, Lemiox rimosus (= Conradilla caelata) and Quadrula intermedia. Others, such as Epioblasma capsaeformis, Lexingtonia dolabelloides, Pleurobema oviforme, Quadrula cylindrica and Toxolasma lividus, are listed as candidates for addition to the endangered list should data become available to support an endangered status listing (USFWS, 1989). It is therefore useful to document the occurrence of these mussels in the Duck River as well as in other rivers within their historic ranges. This information will provide a basis to assist future decision-making.

METHODS

For our 1989 surveys of the Clinch, Powell and Duck Rivers we selected a modified random design which utilized sampling of 40 half-meter quadrats selected by random number tables from 160 potential sites along a zig-zag line transect (see detailed methodology--Green and Young, 1990--for 1990 surveys using similar techniques).

Based on our experience with this technique and the fact that, when sampling for rare species, the number of samples taken is more important than the size of each individual sample (see Elliott, 1977; Green, 1979), we altered our protocol in 1990 to include taking 80 samples 0.25 m² in size instead of 40 samples 0.50 m² in size. This particular methodology was instituted after consultation with Roger Green (University of Western Ontario, London, Ontario, Canada), who re-analyzed the quantitative data from the 1979 TVA study and determined a statistically valid sample size (= 80 quadrats) and sampling area (= 0.25 m²) (Green and Young, 1990).

The sampling procedures for the 1990 surveys are described below. Four line transects, each 10 meters long, were placed in a zig-zag configuration covering a portion of a shoal. On broad shoal areas, ten 0.25 m² quadrats were randomly sampled on each transect (10 quadrats/transect x 4 transects = 40 quadrats). The zig-zag configuration was then repeated a second time over a separate portion of the shoal (= 80 quadrats per site). If the

shoal existed in a more confined area (e.g., head or tail of an island), a single set of four transect lines was used, with 20 quadrats sampled along each transect (= 80 quadrats per site). Thus, regardless of the size of the shoal area, a total number of 80 quadrats per site was always sampled, except at two sites in the Duck River (see Table D5). Samples were collected by hand within the 0.25 m² frame which was placed at the randomly selected points along the transect. All sampled sites consisted of riffles or runs with water depths of 0.25 to 1.00 m. Maximum substratum sampling depth was approximately 15 cm. Each mussel was identified, then verified by Dr. Paul Yokley (University of North Alabama, Florence, Alabama) and the identification recorded in field logs. Length, height, width, sex and age determinations were made on all Lemiox rimosus (= Conradilla caelata) specimens. All live specimens were returned to the place where collected. Photographs were taken of each species collected. As discussed with Upper Duck River Development Agency personnel, shoal site locations were selected which were deemed by Dr. Yokley to be the most likely places which mussels would inhabit, and not necessarily the same locations that TVA sampled in previous years.

Qualitative searches were conducted prior to quantitative sampling to determine if any mussels were located in a selected sampling site and were limited to approximately one manhour per site. Qualitative collections were made by randomly hand picking specimens from selected areas or habitats not falling within the quantitative sampling grid itself. The presence and condition

(living or dead) of each species were noted and the mussels returned to the river. A representative collection of relic shells was retained by Dr. Yokley.

Excessive rainfall prohibited the completion of the river surveys in 1989. YMA did not resample the specific site locations visited in 1989 in each river. Rather, other sites were selected, and the data from both years (1989 + 1990) combined. Because of the relatively small number of samples collected in 1989 and similar methodology, we assume the data are comparable. The numbers of shoal sites (with four - eight transects [generally 20 m²] per site) and the reaches sampled in these two years were as follows:

| River | Reach (RM) Surveyed | Dates of Survey | Number of Sites Surveyed |
|---------|---------------------|-----------------|--------------------------|
| Duck | 133.6, 179.2 | Sep, Oct 1989 | 2 |
| | 133.4--179.2 | Jul, Aug 1990 | 10 |
| Clinch | 183.5--194.2 | Aug 1989 | 4 |
| | 213.1--270.9 | Aug 1990 | 8 |
| Powell | 94.8, 110.2 | Sep 1989 | 2 |
| | 115.4--117.9 | Aug 1990 | 8 |
| Holston | 53.2-- 91.5 | Jul, Sep 1990 | 6 |

POWELL RIVER SURVEY

RESULTS

Twenty-two species of mussels were collected during the quantitative sampling. Endangered mussels collected included the

following four species: Dromus dromas, Fusconaia cor, Quadrula intermedia and Q. sparsa (see Table 1a for specific locations and densities). Mean density of Dromus dromas (0.14 individuals/m²) was higher during YMA surveys than reported by TVA in 1988 (0.01 individuals/m²). Fusconaia cor, Quadrula intermedia and Q. sparsa collected by YMA had lower mean densities (0.003, 0.005 and 0.003 individuals/m², respectively) than those of TVA in 1988 (0.01, 0.03 and 0.02 individuals/m², respectively). Lemiox rimosus was not collected live at any sample location. One relic L. rimosus valve was collected at PRM 115.4.

Results from the qualitative survey are shown in Table 1b. Twenty-nine species of mussels were collected, of which 25 were live specimens. The four dead specimens were Elliptio crassidens, Epioblasma capsaeformis, Lemiox rimosus and Quadrula intermedia.

DISCUSSION

The mussel diversity and density at PRM 94.8 were greater during YMA's survey than in TVA's 1988 estimates. TVA found 10 species at this site with a density of approximately 2.3 individuals/m², while YMA collected 16 species with a density of ~7 mussels/m². In YMA samples, diversity and density at PRM 110.2 were lower than observed at PRM 94.8. Only nine species of mussels were collected at this site, at a density of 1.8 mussels/m². Total density and diversity from PRM 115.4 through 117.9 increased and remained above levels observed at PRM 110.2, except at PRM 117.8, where diversity was the same as at PRM 110.2 (Table 1a). Greater

diversity occurred in this section of the Powell (PRM 110.2 to 117.9) in 1989-90 than was observed by TVA in 1988 (each of the 8 YMA sites had 9-15 species; the 2 TVA sites had 8-11 species). Density, however, was slightly lower in 1989-90 than in 1988 (3.21 compared with 4.06 individuals/m²) for this section of the Powell. Mussel density at Fletcher Ford (PRM 117.3) continued to decline from previous surveys: 24.2/m² were collected in 1978 (Neves et al., 1980); 11.14/m² in 1979, 10.29/m² in 1983 and 5.52/m² in 1988 by TVA (Jenkinson and Ahlstedt, 1988); 6.5/m² in 1988 (Wolcott and Neves, 1990); and 4.0/m² by YMA in 1990. While differences in sampling methodology could account for some variability in density estimates, this long term downward trend is more likely a response to perturbation occurring within this watershed (e.g., coal mining, agricultural or municipal activities). Juvenile mussels (mainly Actinonaias ligamentina, A. pectorosa and Lampsilis fasciola) were collected infrequently from several sites between PRM 115.4 to 117.9. Io fluviialis (spiny river snail), a current status review species, was common throughout the section of river sampled during this survey.

Abundance data, rank order of abundance data, frequency data and rank order of frequency data have been tabulated for the previous TVA and YMA quantitative surveys (Appendix A, Tables A1-A4). Although five of the 32 taxa were scarcer according to the results of the TVA surveys than in the YMA survey, the first six species in rank abundance in the 1989-1990 survey closely tracked the results of the previous surveys, with the exception of Amblema

plicata in the 1983 survey. Actinonaias ligamentina and A. pectorosa consistently ranked first and second in abundance (App. A, Tables A1, A2). Dromus dromas was the only endangered mussel showing greater abundance in 1989-1990 compared with the previous surveys (App. A, Table A1). Fusconaia cor occurred in three of the four surveys, always at the lowest abundance ranking (App. A, Table A2). F. cuneolus was collected quantitatively during the 1983 TVA survey only, ranking next to last in abundance, order of abundance, frequency, and order of frequency (App. A, Tables A1-A4). Quadrula intermedia remained rare, but occurred during all surveys. Q. sparsa was collected during the 1979 and 1989-90 surveys. It ranked last in order of abundance and order of frequency in both instances (App. A, Tables A2, A4). Other Cumberlandian species which are rare in the Powell include Epioblasma brevidens, E. capsaeformis, E. triquetra, Lexingtonia dolabelloides, Pleurobema oviforme, Ptychobranthus subtentum, Q. cylindrica and Villosa vanuxemensis (App. A, Tables A1 - A4).

SUMMARY

Ten quantitative mussel surveys were conducted in 1989-90. Two hundred square meters of mussel habitat were sampled. This resulted in the collection of 760 mussels distributed across 22 taxa at an average density of 3.8 mussels/m² (App. D, Table D1). Four endangered species were represented among the 22 taxa (Dromus dromas, Fusconaia cor, Quadrula intermedia and Q. sparsa). The average density of mussels from the 1989-90 survey was slightly

higher than the 2.41/m² reported in 1988 (TVA 1988), but lower than the average densities reported in the 1979 (7.31/m²) and 1983 (6.1/m²) TVA surveys. Juvenile mussels were collected at several sites, indicating that recruitment still occurs in the Powell at a detectable level. Juvenile taxa collected include: Actinonaias ligamentina, A. pectorosa, Elliptio dilatata and Lampsilis fasciola. However, the status of the mussel fauna of the Powell River is dependent on future mining, agricultural activities and development within the watershed.

CLINCH RIVER SURVEY

RESULTS

Thirty-four species of mussels were collected during this survey. Endangered mussels collected included Cyprogenia stegaria, Dromus dromas, Fusconaia cor, F. cuneolus, Hemistena lata and Lemiox rimosus (see Table 2a for specific locations and densities).

The birdwing pearly mussel, L. rimosus, was collected from three locations. One live specimen was found at CRM 183.5 (Brooks Island), two live specimens were found at CRM 192.4 and one relic shell was found at CRM 189.6. A complete listing of all mussels found during quantitative surveys is provided in Table 2a.

Juvenile mussels were collected quantitatively from most sites which supported good mussel populations. Juveniles of Actinonaias ligamentina, A. pectorosa, Epioblasma brevidens, Ptychobranthus fasciolaris and P. subtentum were found at CRM 226.7.

The abundance of Io fluvialis (spiny river snail) ranged from common to very abundant at the sites surveyed by YMA.

Thirty-seven species of mussels were collected during the qualitative survey, of which 35 were living specimens (Table 2b). The two dead specimens were Epioblasma triquetra and Pleurobema pyramidatum.

DISCUSSION

In 1979 and 1988, TVA quantitatively sampled 11 sites on the Clinch River (CRM 159.2, 172.2, 184.5, 189.6, 206.9, 211.1, 219.1, 219.2, 226.3 (1979 only), 235.1 (1988 only), 270.9 and 321.7). L. rimosus was collected from only one site (CRM 189.6) in 1979 and two sites (CRM 189.6, 219.1) in 1988. YMA sampled 12 sites quantitatively and live specimens of L. rimosus were collected at two of the locations (CRM 183.5, 192.4). Mean densities (sum of #/m² for each site divided by # of sites) of L. rimosus collected by TVA from the 11 sites were 0.01 and 0.02 for 1979 and 1988, respectively. Analysis of the samples from the 12 sites sampled by YMA (240 m² total area sampled) resulted in a mean density of 0.01 L. rimosus per square meter.

Two of the endangered species, Cyprogenia stegaria and Fusconaia cuneolus, were slightly less abundant during the 1989-1990 survey (0.004/m² and 0.06/m², respectively) than during the TVA 1988 survey (0.03/m² and 0.09/m², respectively). Fusconaia cor (0.004/m² during the YMA survey) was not collected by TVA. Density estimates for Dromus dromas indicate higher densities during the

YMA survey compared to the TVA survey (0.03 individuals/m² cf. 0.01/m²).

Comparison of data collected from CRM 183.5 to 270.9 reveals higher diversity in the YMA 1989-90 survey than in the TVA 1988 survey, but generally lower densities. The lower density could be attributed to reduced recruitment resulting from continued mining activities, recent drought, increased use of agricultural chemicals or some other anthropogenic perturbation. However, direct site duplication was not possible in some instances due to weather, remoteness or habitat alteration, and this variable could account for some of the differences between the YMA and TVA surveys.

Data from the previous TVA and YMA quantitative surveys on the Clinch were used to compute abundance data, rank order of abundance data, frequency data and rank order of frequency data (Appendix B, Tables B1-B4). Abundances of approximately three-quarters of the mussel species collected in the Clinch River remained relatively unchanged from 1979 to 1989-90. Some (e.g., Actinonaias ligamentina, A. pectorosa, Dromus dromas, Fusconaia subrotunda, Lampsilis fasciola, Medionidus conradicus, Ptychobranthus fasciolaris, P. subtentum and Villosa iris) of the 37 species were more abundant in the 1990 samples than in previous surveys, while others (e.g., Cumberlandia monodonta, Cyclonaias tuberculata, Epioblasma capsaeformis, Lampsilis ovata, Lasmigona costata and Quadrula cylindrica) were scarcer than levels found in at least one of the previous surveys (App. B, Table B1). Actinonaias ligamentina and A. pectorosa consistently ranked first and second

in abundance (App. B, Table B2).

Of the six endangered species collected, F. cuneolus exhibited both the highest abundance and highest numbers of occurrences (frequency), which were very similar in both the 1979 and 1989-90 surveys. Both the endangered mussels Dromus dromas and Lemiox rimosus were found in greater abundance and higher frequency during the period of these surveys (App. B, Tables B1, B3), although the difference for L. rimosus was slight. Other listed endangered mussels were slightly less abundant in 1989-90 than in 1979. It should be noted that Q. cylindrica, with an average density of 0.17/m² and frequency of three in 1979, was not collected quantitatively from the Clinch in subsequent surveys (App. B, Table B1).

The number of species collected was similar among the 1979, 1988 and 1989-90 surveys, ranging from 30 in 1988 to 34 in 1979 and 1989-90 (see App. B, Table B1). Six species collected in 1979 were not collected in 1989-90, and six species collected in 1990 were not collected in 1979. Two species collected in 1988 were not collected in 1989-90, and six species collected in 1989-90 were not found in 1988. Epioblasma triquetra, Pleurobema cordatum, Quadrula cylindrica and Villosa perpurpurea were found in 1979, but not in the 1988 nor 1989-90 surveys. However, Alasmidonta marginata and Lexingtonia dolabelloides were not collected quantitatively in 1979 but were collected in both the 1988 and 1990 surveys.

SUMMARY

Twelve quantitative mussel surveys were conducted on the Clinch River in 1989-90. Two hundred-forty square meters of mussel habitat were sampled. This resulted in the collection of 1688 mussels distributed across 34 taxa at an average density of 7.0 mussels/m² (App. D, Table D2). Six endangered species were represented among the 34 taxa (Cyprogenia stegaria, Dromus dromas, Fusconaia cor, F. cuneolus, Hemistena lata and Lemiox rimosus), which is up slightly from TVA's 1988 average density of 6.01/m², (cf. 12.10/m² in 1979). Juvenile mussels were collected from most sites which supported good mussel populations. Good recruitment appeared to be occurring at both CRM 270.9 and 226.7. The Clinch River mussel fauna remains one of the most diverse assemblages left in the Upper Tennessee River System.

ELK RIVER SURVEY

RESULTS AND DISCUSSION

The Elk River survey was initiated in 1989 with a qualitative survey at ERM 75.0 to 75.5. This survey was discontinued when alum sludge released from the city of Fayetteville's water treatment plant substantially reduced water clarity before a suitable quantitative sampling site could be selected. Scheduling conflicts and weather prevented further sampling in 1989. In 1990 YMA qualitatively float-surveyed a portion of the Elk River which supported the largest concentrations of mussels encountered during

TVA's 1980 survey (ERM 112.7 to 105.5). One site was located during the float survey that warranted quantitative sampling. Quantitative sampling was completed at ERM 109.7. The four species collected were Actinonaias pectorosa (0.25/m²), Elliptio dilatata (0.05/m²), Fusconaia barnesiana (0.05/m²) and F. cor (0.05/m²) (Table 3a). Fusconaia cor was the only endangered species collected. All specimens collected were members of older cohorts. No juvenile mussels were collected during this survey. The absence of recruitment and paucity of living mussels in this section of the Elk is most likely a result of long term exposure to cool water discharges released from Tims Ford Dam as well as agricultural and quarry washing activities in the watershed.

Qualitative surveys below Fayetteville revealed extensive beds of relic shells, but produced insufficient numbers of living mussels to warrant quantitative sampling. Twenty-five species were collected during the qualitative survey, of which 17 were relic dead (Table 3b). Based on this information, YMA discontinued further sampling efforts on the Elk River.

SUMMARY

One site on the Elk River was quantitatively surveyed in 1990. The 20 m² of mussel habitat contained eight mussels representing four taxa at a density of 0.4/m² (App. D, Table D3). Fusconaia cor was the only endangered species collected. TVA did not collect quantitative samples during the 1980 survey. The mussels of the Elk are scarce and widely dispersed; thus qualitative sampling

would appear to be the most efficient means of assessing their current status. No juveniles were collected during this limited sampling effort. It is possible that recruitment occurs in parts of the Elk, but it likely would be impeded by the cold water released from Tims Ford Dam, ongoing agricultural activities, municipal releases and gravel dredging. The once diverse mussel fauna (evidenced by abundant relic material) of the Elk River has almost been obliterated by these and other perturbations within its watershed.

HOLSTON RIVER SURVEY

RESULTS

After qualitatively searching the North Fork Holston River for available mussel populations, three sites were chosen above Saltville (Smyth County, Virginia) (NFHRM 91.5, 88.5 and 85.6) and three below (NFHRM 60.7, 56.4 and 53.2). A total of 11 species was collected above Saltville, and a total of four species were collected below Saltville, during the quantitative survey (Table 4a). Fusconaia cor was the only listed endangered species collected during the quantitative survey ($0.3/m^2$ at NFHRM 91.5; $0.2/m^2$ at NFHRM 88.5). The Broadford site (NFHRM 91.5) had the greatest diversity (10 species) and density ($17.7/m^2$), while NFHRM 88.5 exhibited the second highest diversity (9 species) and density ($3.8/m^2$). Although the diversity at these two upstream sites was similar, the density was much less at NFHRM 88.5 than at 91.5.

Results from the qualitative survey are presented in Table 4b. Only one species was found at the six sites below Saltville, while 13 species were found at the two sites above Saltville. Three of the 13 species were found as relic or fresh dead shells.

DISCUSSION

Earlier qualitative surveys in 1971 (Stansbery and Clench, 1974) and in 1988 (YMA, 1990) listed 17 and 12 (incorrectly listed as 11) species, respectively, from above Saltville. All of the 12 species found above Saltville in this study were recorded by Stansbery and Clench (1974) or by YMA (1990). Three species found in 1988 (YMA, 1990) were not found in 1990 (this report), and two species found in 1990 (this report) were not found in 1988 (YMA, 1990). Lasmygona holstonia, collected in 1988, had not been previously recorded from the North Fork.

Ortmann (1918) listed 37 species of mussels which occurred below Saltville. Mussel populations inhabiting this reach were eliminated during the period 1894 to 1972 by operations at a chlorine plant, which discharged wastewater into the North Fork at approximately river mile 82. Stansbery (1972) found no living mussels from Saltville to the confluence with the South Fork Holston River. After closure of the plant in 1972, TVA began a transplant program to recolonize the lower reaches of the North Fork with indigenous mussel species. TVA transplanted 3603 mussels of 16 species to four sites from 1975 to 1977.

The recovering mussel fauna below Saltville averaged 0.83

mussels/m², represented by four species during the YMA 1990 survey. Mussels collected from the sites below Saltville could be evidence of recruitment from these transplants, or recolonization by upstream populations.

Juvenile mussels were collected at each site during the quantitative survey, and were abundant at sites above Saltville. Common juvenile mussels encountered above Saltville were: Lampsilis fasciola, Medionidus conradicus, Ptychobranthus fasciolaris, Villosa nebulosa and V. vanuxemensis, and less frequently, Fusconaia cor, an endangered species.

SUMMARY

The North Fork Holston River was the only tributary in the Holston River system quantitatively surveyed by YMA. The area sampled (110 m² sampled) averaged 2.8 mussels/m² (App. D, Table D4). The three sites above Saltville support good populations with average densities of 7.3/m² distributed across 11 species. The recovering mussel fauna below Saltville averaged 0.79 mussels/m², represented by four species (Table 4a). Fusconaia cor was the only listed endangered species collected during this survey. Juvenile mussels were collected quantitatively at each site, and were abundant at sites above Saltville. Common juvenile mussels encountered above Saltville were Lampsilis fasciola, Medionidus conradicus, Ptychobranthus fasciolaris, Villosa nebulosa and V. vanuxemensis. A total of 308 mussels was collected from the North Fork Holston River. The small headwater mussel assemblage of the

North Fork Holston River above Saltville appears to exist in several small shoals, with limited agricultural activity and domestic sewage being the major threats to its future existence.

Scheduling conflicts, the onset of cold, wet weather and the unavailability of authorized sampling personnel prevented further sampling of the Holston River System.

Several other workers recently have completed surveys in the Middle Fork and South Fork Holston Rivers, including Dr. Sally Dennis (Radford College, Radford, Virginia) and Dr. Richard Neves (VPI & S.U., Blacksburg, Virginia). Dr. Dennis (personal communication) indicated that there was a good diversity and density in the Middle Fork, including the federally endangered Epioblasma walkeri, although this species was very rare. Dr. Neves, Dr. Dennis (pers. comm.) and Mr. Steve Ahlstedt (pers. comm., TVA, Norris, Tennessee) all concurred that there were few or no live mussels in the South Fork.

DUCK RIVER SURVEY

RESULTS

Thirty-five species of mussels were quantitatively collected from the Duck River sites (DRM 133.4 to DRM 179.2) during 1989-90. The majority of species (28) occurred at Lillard's Mill (DRM 179.1-179.2) compared to the number (24) in the entire rest of the reach (DRM 133.4-172.0). Thirty-five species of mussels were quantitatively collected from the 12 Duck River sites (DRM 133.4 to

DRM 179.2) during 1989-90. Greater diversity (28 species) occurred in the Lillard's Mill samples (DRM 179.1-179.2) by comparison with the number of species collected (24) in samples from the remaining reaches surveyed (DRM 133.4-172.0). The highest densities (13.00/m² to 13.65/m²) also occurred at the Lillard's Mill sites by comparison with any other sites surveyed (0.22/m² to 5.40/m²), see Table 5a.

Forty-seven specimens of Lemiox rimosus were taken from 80 m² of mussel habitat sampled from DRM 179.1 - 179.2, resulting in a mean density estimate of 0.59/m² (Table 5a). This species was not found at any other sampling locations. No additional endangered species were collected. However, Epioblasma capsaeformis, Lexingtonia dolabelloides, Pleurobema oviforme, Toxolasma lividus and Quadrula cylindrica, candidates for listing as endangered species, were quantitatively collected (Table 5a). Although no live Q. intermedia were collected, two fresh relics (periostracum and nacre shiny) of one female approximately 7 years of age and one male approximately 4 years of age were collected at DRM 179.1.

Juvenile mussels occurred at most sites. Abundant juvenile taxa were: Amblema plicata, Cyclonaias tuberculata, Elliptio dilatata and Quadrula pustulosa.

The results of the qualitative survey are presented in Table 5b. Thirty-eight species of mussels were found, of which three species were dead (Anodonta imbecillis, Ptychobranthus fasciolaris) or fresh dead (Quadrula intermedia).

DISCUSSION

Three species (Lampsilis teres, Fusconaia ebena and Arcidens confragosus) had not been reported previously from the Duck River. These species are most likely recent introductions to this reach of the river, having moved upstream from the Kentucky Lake impoundment on the Tennessee River. The low density (one specimen each) and probable upstream movement might explain why earlier sampling efforts failed to detect them.

TVA reported L. rimosus density at Lillard's Mill to be 1.70/m² (estimate derived from 10 m² area sampled) (TVA 1988). TVA collected 16 unionid species at DRM 179.2 and calculated a density of 26.8 mussels/m². From this same site YMA collected L. rimosus at an average density of 0.56/m² (estimate derived from 80m² area sampled). Also from this site, YMA collected 20 species with a calculated density of 11.75 mussels/m². YMA collected 17 species with a mean density of 1.6/m² from four locations (60 m²) between DRM 151.9 and 159.5. TVA collected 14 species with a mean density of 7/m² from three locations (14/m²) from this section. YMA sampled a total of 80 m² of mussel habitat from four sites between DRM 133.4 - 133.8 in 1989-90. This quantitative effort resulted in the collection of 18 species with a mean density of 3.3/m². TVA sampled 5 m² at DRM 133.5, collecting six species at a density of 3.60/m² in 1988. A comparison of results from the two surveys is summarized below.

179.2

151.9-159.5

133.4-133.8

| | <u>TVA*</u> | <u>YMA**</u> | <u>TVA</u> | <u>YMA</u> | <u>TVA</u> | <u>YMA</u> |
|------------------------|-------------|--------------|------------|------------|------------|------------|
| Area (m ²) | 10 | 40 | 14 | 60 | 5 | 80 |
| # Species | 16 | 20 | 14 | 17 | 6 | 18 |
| Mussels/m ² | 26.8 | 11.75 | 7 | 1.6 | 3.6 | 3.3 |

*1988

**1989-1990

A comparison of the abundance data (App. C, Table C1,) frequency data (App. C, Table C3), rank order of abundance data (App. C, Table C2) and rank order of frequency data (App. C, Table C4) has been tabulated for the previous TVA surveys and the YMA 1989/90 survey for the Duck River. Generally the number of mussels collected quantitatively during 1989-90 was equal to or greater than the number collected quantitatively during the other two surveys (App. C, Table C1). Substantially higher numbers for 14 species were collected during 1989-90 than during the other two surveys. Actual numbers of L. rimosus did not differ markedly between the three quantitative surveys, varying from 42 in 1979 to 44 in 1988 to 47 in 1989-90. The rank order based on the abundance (App. C, Table C2) shows that Cyclonaias tuberculata ranked number one consistently, as is shown also in the actual abundance values. Most rankings changed little among the years (for the quantitative sampling), with the exception that for Medionidus conradicus, which went from eighth in 1979 and 1988 to twenty-fourth in 1989-90. The frequency data (number of occurrences during a survey) show that most mussels remained the same or increased in frequency when

chronologically comparing the three quantitative surveys (App. C, Table C3). Large increases were observed for approximately 10 species. The quantitative frequency data for L. rimosus (App. C, Table C3) show that the number of times this species was encountered has decreased since 1979, from 10 in 1979 to 6 in 1988 to 4 in 1989-90. Rank ordering of the frequencies (App. C, Table C4) shows that L. rimosus did not rank in the first 10 in 1989-90, as it did in the 1979 and 1988 quantitative surveys. During both the qualitative and quantitative surveys in 1989-90, living L. rimosus was found only at Lillard's Mill, suggesting that this species may be becoming relatively rare in other reaches of the river. Two fresh dead, aged (members of older cohorts) L. rimosus were qualitatively collected at DRM 133.4. During the TVA surveys, this species was found in the quantitative surveys from DRM 155.3 in 1986 and from DRM 151.6 in 1988 to Lillard's Mill, although in lower densities than at Lillard's Mill. Results from the two TVA qualitative surveys indicate that the mussel was found from DRM 132 to Lillard's Mill.

SUMMARY

YMA collected 1412 mussels representing 35 species from 240 m² of mussel habitat at 12 sites on the Duck River in 1989-90 (App. D, Table D4). The average density for this area (5.88/m²) was lower than the 9.33/m² averaged by TVA in 1988, but higher than TVA's average density of 3.89/m² from 1979. Differences between the values observed for the 1988 and 1989-90 surveys could be

attributed to the variability in the number and locations of sites sampled and the number of quantitative samples collected (YMA = 880 vs. TVA 1979 = 509, TVA 1988 = 282). The density estimate calculated by YMA, although lower than that measured by TVA in 1988, was higher than the overall average density reported in the 1979 survey. Other circumstances leading to variability of estimates could include natural population fluctuation or illegal mussel harvesting which was observed during the 1990 survey. Lemiox rimosus was the only live endangered species collected during the 1989-90 survey. The actual number of L. rimosus collected did not change drastically between the three quantitative surveys. Juvenile mussels occurred at most sites. The most abundant juvenile taxa were Amblema plicata, Cyclonaias tuberculata and Elliptio dilatata. New species distribution records were noted for Lampsilis teres, Fusconaia ebena and Arcidens confragosus at Columbia, Maury County, Tennessee. These species had not been reported previously from this section of the Duck River.

COMMENTS

Population estimates were not determined for an entire river due to the limited number of sites surveyed. Although it may be possible to determine population estimates for the areas of habitat selected as survey sites, we feel that these estimates could be erroneous for several reasons: (1) what visually appears to be a "good" mussel site may not support a viable mussel population for

many reasons (e.g., water or sediment unsuitability, predation, tendency to flood); (2) the sites selected during this survey appeared to be "good" sites, with similar conditions among the sites in each river, but the estimates of mussel population varied among the sites, suggesting that they were not all equally "good" sites; (3) mussels probably exist in contagious (clumped) distributions, making replication necessary for accurate population estimates; (4) state and federal permits allow a maximum of only 5% of the habitat to be disturbed. These factors suggest that the most reliable assessment of numbers of mussels is to provide an estimate of the density per area sampled (e.g., numbers per square meter). Scaling up to the population of the whole river would require (1) an adequate survey of the surface area of the river between fixed banks at a pre-determined river level, (2) an accurate assessment of the total area of all mussel beds and (3) an estimate of the average population per fixed area of mussel beds, based on many replicate samples in "poor", "average" and "good" habitats included within the total area of all mussel beds. If rare species are of interest in particular, the number of replicates would need to be exceedingly large. Results from this survey and our own experience indicate that mussels can occur in small isolated pockets, in riffles, in pools, in gravel and sandy areas and lodged in bedrock crevices. To determine proper estimates for any river would prove a costly and timely endeavor.

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FIGURES

TABLES

Table 2b. Results of YMA Qualitative Sampling of the Clinch River, 1989 and 1990.

| SPECIES | RIVER MILE | | | | | | | | | | | | | |
|--------------------------------------|------------|-------|-------|-------|-------|-------|-------|-------|--------|--------|-------|--------|--------|--|
| | 183.5 | 189.3 | 189.6 | 192.4 | 194.2 | 213.1 | 223.3 | 226.4 | 226.7a | 226.7b | 236.3 | 270.9a | 270.9b | |
| <i>Actinonaias ligamentina</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Actinonaias pectorosa</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Alasmidonta marginata</i> | | | ** | | | | | | | | * | * | * | |
| <i>Amblema plicata</i> | | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Cumberlandia monodonta (C)</i> | | * | ** | * | * | ** | ** | * | * | * | * | * | * | |
| <i>Cyclonaias tuberculata</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Cyrogenia stegaria (E)</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Dromus dromas (E)</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Elliptio crassidens</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Elliptio dilatata</i> | * | * | ** | * | * | * | * | * | * | * | * | * | * | |
| <i>Epioblasma brevidens (C)</i> | * | ** | * | * | * | * | ** | * | * | * | * | * | * | |
| <i>Epioblasma capsaeformis (C)</i> | * | ** | * | * | * | ** | ** | * | * | * | * | * | * | |
| <i>Epioblasma triquetra (C)</i> | ** | ** | ** | * | * | ** | ** | * | * | * | * | * | * | |
| <i>Fusconaias barnesiana</i> | * | * | ** | * | * | * | * | * | * | * | * | * | * | |
| <i>Fusconaias cor (E)</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Fusconaias cuneolus (E)</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Fusconaias subrotunda</i> | | | | | | * | * | * | * | * | * | * | * | |
| <i>Lampsilis cardium</i> | | | | | | * | * | * | * | * | * | * | * | |
| <i>Lampsilis fasciola</i> | * | * | ** | * | * | * | * | * | * | * | * | * | * | |
| <i>Lampsilis ovata</i> | * | * | ** | * | * | * | ** | * | * | * | * | * | * | |
| <i>Lasmigona costata</i> | * | * | ** | * | * | * | * | * | * | * | * | * | * | |
| <i>Hemistena lata (E)</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Ligumia recta</i> | * | * | * | * | * | * | ** | * | * | * | * | * | * | |
| <i>Lemiox rimosus (E)</i> | * | * | ** | * | * | * | ** | * | * | * | * | * | * | |
| <i>Lexingtonia dolabelloides (C)</i> | | | | | | * | * | * | * | * | * | * | * | |
| <i>Medionaidus conradicus</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Pleurobema oviforme (C)</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Pleurobema pyramidalatum</i> | | | | | | ** | * | * | * | * | * | * | * | |
| <i>Plethobasus cyphus</i> | | | | | | * | * | ** | * | * | * | * | * | |
| <i>Potamilius alatus</i> | * | * | ** | * | * | * | ** | * | * | * | * | * | * | |
| <i>Psychobranchus fasciolaris</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Psychobranchus subtentum</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Quadrula cylindrica (C)</i> | * | * | * | * | * | * | ** | * | ** | * | * | * | * | |
| <i>Quadrula pustulosa</i> | * | * | ** | * | * | * | ** | * | * | * | * | * | * | |
| <i>Strophitus undulatus</i> | | | | | | * | * | * | * | * | * | * | * | |
| <i>Truncilla truncata</i> | * | * | ** | * | * | * | * | * | * | * | * | * | * | |
| <i>Villosa iris</i> | * | * | * | * | * | * | ** | * | * | * | * | * | * | |
| TOTAL SPECIES | 29 | 19 | 23 | 16 | 11 | 22 | 22 | 19 | 17 | 17 | 6 | 19 | 19 | |

E = Federally Listed Endangered C = Candidate for Federal List

*Live Specimens **Dead Specimens

Table 1a. Number of Mussels per Square Meter in YMA Powell River Quantitative Sampling, 1989 and 1990.

| SPECIES | RIVER MILE | | | | | | | | | |
|--------------------------------------|------------|-------|--------|--------|--------|--------|-------|--------|-------|-------|
| | 94.8 | 110.2 | 115.4a | 115.4b | 117.3a | 117.3b | 117.6 | 117.65 | 117.8 | 117.9 |
| <i>Actinonaias ligamentina</i> | 3.30 | 1.00 | 2.85 | 1.55 | 2.05 | 1.76 | 1.65 | 1.70 | 1.10 | 1.60 |
| <i>Actinonaias pectorosa</i> | 0.75 | 0.25 | 0.70 | 0.20 | 0.55 | 0.10 | 1.10 | 0.65 | 1.50 | 1.20 |
| <i>Amblema plicata</i> | 0.20 | 0.05 | 0.05 | 0.15 | 0.20 | 0.25 | 0.05 | 0.05 | 0.15 | 0.05 |
| <i>Cyclonaias tuberculata</i> | 0.15 | 0.05 | 0.15 | | 0.05 | 0.15 | 0.10 | 0.05 | | 0.05 |
| <i>Dromus dromas (E)</i> | 0.25 | 0.10 | | | | 0.05 | | | | 0.05 |
| <i>Elliptio dilatata</i> | 0.10 | 0.10 | 0.20 | 0.20 | 0.10 | 0.05 | 0.25 | 0.10 | 0.10 | 0.10 |
| <i>Epioblasma brevidens (C)</i> | 0.05 | | | | | | 0.10 | 0.05 | 0.10 | |
| <i>Epioblasma triquetra (C)</i> | 0.15 | | | | | | | | 0.05 | |
| <i>Fusconaia barnesiana</i> | 0.45 | 0.15 | | | | | | | | |
| <i>Fusconaia cor (E)</i> | | | | | 0.05 | | | | | |
| <i>Fusconaia subrotunda</i> | | | 0.55 | 0.25 | 0.85 | 0.75 | | 0.25 | 0.10 | 0.25 |
| <i>Lampsilis fasciola</i> | 0.05 | | 0.05 | 0.05 | 0.15 | 0.05 | 0.05 | 0.05 | 0.05 | 0.10 |
| <i>Lampsilis ovata</i> | 0.05 | | | | 0.05 | 0.10 | 0.05 | | | 0.05 |
| <i>Lasmigona costata</i> | 0.10 | | 0.05 | | 0.05 | 0.20 | | 0.05 | | |
| <i>Lexingtonia dolabelloides (C)</i> | | | | | | 0.05 | | | | 0.05 |
| <i>Ligumia recta</i> | 0.05 | | | | | | | | | 0.20 |
| <i>Medionidius conradicus</i> | 0.80 | 0.05 | 0.35 | 0.05 | 0.10 | 0.15 | 0.40 | 0.15 | | |
| <i>Plethobasus cyphus</i> | 0.05 | | | | | | 0.05 | | | |
| <i>Ptychobranchus fasciolaris</i> | 0.10 | | | | | | 0.05 | 0.05 | | |
| <i>Quadrula intermedia (E)</i> | | 0.05 | | | | | | | | |
| <i>Quadrula sparsa (E)</i> | | | | | 0.05 | | | | | |
| <i>Villosa iris</i> | | | 0.25 | | 0.15 | | 0.05 | | 0.05 | 0.05 |
| TOTAL SPECIES | 16 | 9 | 10 | 7 | 15 | 12 | 12 | 10 | 9 | 12 |
| MUSSELS/M | 6.60 | 1.80 | 5.20 | 2.45 | 4.40 | 3.66 | 3.90 | 3.10 | 3.20 | 3.75 |

E = Federally Listed Endangered Species C = Candidate for Federal List

Table 1b. Results of YMA Qualitative Sampling of the Powell River, 1989 and 1990.

| SPECIES | RIVER MILE | | | | | | | | | | | | |
|--------------------------------------|------------|-------|-------|-------|-------|--------|--------|--------|--------|-------|--------|-------|-------|
| | 94.8 | 103.2 | 106.7 | 106.9 | 110.2 | 115.4a | 115.4b | 117.3a | 117.3b | 117.6 | 117.65 | 117.8 | 117.9 |
| <i>Actinonaias ligamentina</i> | * | ** | * | * | * | * | * | * | * | * | * | * | * |
| <i>Actinonaias pectorosa</i> | * | | | * | * | * | * | * | * | * | * | * | * |
| <i>Amblyema plicata</i> | * | * | * | ** | * | * | * | * | * | * | * | * | * |
| <i>Cyclonaias tuberculata</i> | * | | | * | * | * | * | * | * | * | * | * | * |
| <i>Dromus dromas (E)</i> | * | | ** | ** | * | * | * | * | * | * | * | * | * |
| <i>Elliptio crassidens</i> | * | ** | ** | ** | ** | * | * | * | * | * | * | * | * |
| <i>Elliptio dilatata</i> | * | | | ** | * | * | * | ** | ** | * | * | * | * |
| <i>Epioblasma brevidens (C)</i> | * | | ** | ** | ** | * | * | ** | ** | * | * | * | * |
| <i>Epioblasma capsaeformis (C)</i> | * | ** | ** | ** | ** | ** | * | * | * | * | * | * | * |
| <i>Epioblasma triquetra (C)</i> | * | ** | ** | * | * | * | * | * | * | * | * | * | * |
| <i>Fusconaias barnesiana</i> | * | ** | ** | ** | * | * | * | * | * | * | * | * | * |
| <i>Fusconaias cor (E)</i> | * | | | * | * | * | * | * | * | * | * | * | * |
| <i>Fusconaias subrotunda</i> | * | | | * | * | * | * | * | * | * | * | * | * |
| <i>Lampsilis fasciola</i> | * | ** | ** | ** | * | * | * | * | * | * | * | * | * |
| <i>Lampsilis ovata</i> | * | ** | ** | ** | ** | * | * | * | * | * | * | * | * |
| <i>Lasmigona costata</i> | * | ** | ** | ** | ** | * | * | * | * | * | * | * | * |
| <i>Lemiox rimosus (E)</i> | * | | ** | ** | ** | ** | * | * | * | * | * | * | * |
| <i>Lexingtonia dolabelloides (C)</i> | * | | ** | ** | ** | * | * | * | * | * | * | * | * |
| <i>Ligumia recta</i> | * | | ** | ** | ** | * | * | * | * | * | * | * | * |
| <i>Medionidius conradicus</i> | * | | * | * | * | * | * | * | * | * | * | * | * |
| <i>Plethobasus cyphus</i> | * | | ** | ** | * | * | * | * | * | * | * | * | * |
| <i>Pleurobema oviforme (C)</i> | * | ** | ** | ** | ** | * | * | * | * | * | * | * | * |
| <i>Potamilus alatus</i> | * | ** | ** | ** | ** | ** | * | * | * | * | * | * | * |
| <i>Psychobranchus fasciolaris</i> | * | | ** | ** | ** | * | * | * | * | * | * | * | * |
| <i>Psychobranchus sibtentum</i> | * | | ** | ** | ** | * | * | * | * | * | * | * | * |
| <i>Quadrula intermedia (E)</i> | * | | ** | ** | ** | ** | * | * | * | * | * | * | * |
| <i>Quadrula sparsa (E)</i> | * | | ** | ** | ** | ** | * | * | * | * | * | * | * |
| <i>Quadrula cylindrica (C)</i> | * | ** | ** | ** | ** | ** | ** | ** | ** | * | * | * | * |
| <i>Villosa iris</i> | ** | ** | ** | ** | ** | * | * | * | * | * | * | * | * |
| TOTAL SPECIES | 20 | 7 | 14 | 2 | 20 | 21 | 20 | 21 | 21 | 12 | 10 | 10 | 12 |

E = Federally Listed Endangered C = Candidate for Federal List

* = Live Specimens ** = Dead Specimens

Table 2a. Number of Mussels per Square Meter in YMA Clinch River Quantitative Sampling, 1989 and 1990.

| SPECIES | RIVER MILE | | | | | | | | | | | |
|--------------------------------------|------------|-------|-------|-------|-------|-------|-------|--------|--------|-------|--------|--------|
| | 183.5 | 189.3 | 189.6 | 192.4 | 213.1 | 223.3 | 226.4 | 226.7a | 226.7b | 236.3 | 270.9a | 270.9b |
| <i>Actinonaias ligamentina</i> | 13.50 | 4.00 | 1.65 | 2.90 | 1.40 | 1.70 | 0.85 | 3.55 | 2.05 | 0.10 | 0.65 | 0.45 |
| <i>Actinonaias pectorosa</i> | 3.30 | 2.05 | 0.45 | 0.90 | 0.30 | 0.40 | 0.05 | 0.75 | 0.85 | 0.05 | 1.35 | 0.90 |
| <i>Alasmidonta marginata</i> | | | 0.10 | | | | | | | | 0.05 | |
| <i>Amblyema plicata</i> | | 0.10 | 0.15 | | 0.20 | 0.20 | | 0.05 | 0.95 | | 0.20 | 0.10 |
| <i>Cyclonaias tuberculata</i> | | 0.25 | 0.30 | | 0.10 | 0.10 | | | 0.20 | | | |
| <i>Cyprogenia stegaria (E)</i> | | | | | 0.05 | | | | | | | |
| <i>Dromus dromas (E)</i> | 0.15 | 0.05 | 0.10 | | | | | | | | | |
| <i>Elliptio crassidens</i> | | | 0.05 | | | | | | | | | |
| <i>Elliptio dilatata</i> | 0.05 | 0.15 | 0.30 | 0.55 | 0.05 | 0.05 | 0.25 | 0.05 | 0.45 | | 0.80 | 0.20 |
| <i>Epioblasma brevidens (C)</i> | 0.10 | | 0.05 | 0.10 | 0.05 | | | 0.10 | | | | |
| <i>Epioblasma capsaeformis (C)</i> | 0.05 | | 0.45 | | | | | 0.10 | | | | |
| <i>Fusconaia barnesiiana</i> | 0.55 | 0.20 | 0.70 | 0.10 | | 0.05 | 0.05 | | | | 0.20 | 0.10 |
| <i>Fusconaia cor (E)</i> | | | | | | | | | | | 0.10 | 0.05 |
| <i>Fusconaia cuneolus (E)</i> | 0.10 | 0.05 | 0.15 | | 0.05 | | 0.40 | | | | 0.10 | 0.05 |
| <i>Fusconaia flava</i> | | | 0.10 | | | | | | | | 0.20 | 0.20 |
| <i>Fusconaia subrotunda</i> | | | | | 0.55 | 0.70 | 0.40 | 0.25 | 2.05 | | | |
| <i>Hemistena lata (E)</i> | 0.05 | 0.05 | | | 0.05 | | | | | | | |
| <i>Lampsilis cardium</i> | | | | | | | | | | | 0.85 | 0.30 |
| <i>Lampsilis fasciola</i> | 0.05 | 0.15 | 0.20 | 0.35 | 0.10 | 0.05 | 0.10 | 0.15 | 0.15 | | 0.05 | 0.05 |
| <i>Lampsilis ovata</i> | 0.15 | | | 0.10 | | | 0.05 | 0.05 | | | | |
| <i>Lasmigona costata</i> | 0.50 | 0.05 | 0.20 | 0.25 | 0.15 | 0.15 | 0.05 | 0.30 | 0.60 | 0.05 | 0.15 | 0.05 |
| <i>Ligumia recta</i> | | | | | 0.05 | | | | | | | |
| <i>Lemiox rimosus (E)</i> | 0.05 | | | 0.10 | | | | | | | 0.30 | 0.05 |
| <i>Lexingtonia dolabelloides (C)</i> | | | 0.05 | | | | | | | | 0.20 | |
| <i>Medionidius conradicus</i> | 1.30 | 1.60 | 2.35 | 4.15 | | | | | | | | |
| <i>Pleurobema oviforme (C)</i> | | | 0.15 | | | 0.05 | 0.10 | | | | | |
| <i>Plethobasus cyphus</i> | | | | | | | | | | | | |
| <i>Potamilus alatus</i> | | | | | | | | 0.05 | 0.10 | | | |
| <i>Pychebranchius fasciolaris</i> | 0.10 | 0.20 | 0.25 | 0.20 | 0.05 | 0.15 | 0.05 | 0.35 | 0.05 | | 0.40 | 0.15 |
| <i>Pychebranchius subtentum</i> | 1.50 | 0.80 | 1.15 | 1.30 | | | | 0.05 | 0.05 | | 0.25 | 0.20 |
| <i>Quadrula pustulosa</i> | | 0.05 | 0.05 | | 0.05 | | 0.05 | 0.05 | | | | |
| <i>Strophitus undulatus</i> | | | | 0.05 | | | | | | | | |
| <i>Truncilla truncata</i> | 0.05 | | | | | | | | | | 0.60 | 0.20 |
| <i>Villosa iris</i> | | 0.05 | 0.30 | 0.35 | | | | 0.05 | 0.15 | | | |
| TOTAL SPECIES | 17 | 16 | 20 | 16 | 15 | 11 | 12 | 15 | 11 | 4 | 17 | 16 |
| MUSSELS/M ² | 21.55 | 9.80 | 8.65 | 12.00 | 3.20 | 3.60 | 2.40 | 5.90 | 7.60 | 0.25 | 6.45 | 3.00 |

E = Federally Listed Endangered C = Candidate for Federal List

Table 3a. Number of Mussels per Square Meter in YMA Elk River Quantitative Sampling, 1990.

| SPECIES | RIVER MILE |
|------------------------------|------------|
| | 109.7 |
| <i>Actinonaias pectorosa</i> | 0.25 |
| <i>Elliptio dilatata</i> | 0.05 |
| <i>Fusconaiia barnesiana</i> | 0.05 |
| <i>Fusconaiia cor (E)</i> | 0.05 |
| TOTAL SPECIES | 4 |
| MUSSELS/M | 0.4 |

E = Federally Listed Endangered C = Candidate for Federal List

Table 3b. Results of YMA Qualitative Sampling of the Elk River, 1990.

| SPECIES | RIVER MILE | | |
|--------------------------------------|------------|-----------|----------|
| | 70.5 | 109.7 | 133.4 |
| <i>Actinonaias pectorosa</i> | ** | * | |
| <i>Alasmidonta marginata</i> | | ** | |
| <i>Amblema plicata</i> | ** | ** | * |
| <i>Cyclonias tuberculata</i> | ** | * | * |
| <i>Ellipsaria lineolata</i> | ** | ** | |
| <i>Elliptio dilatata</i> | ** | * | |
| <i>Epioblasma bimarginata</i> (X) | | ** | |
| <i>Epioblasma triquetra</i> (C) | | ** | |
| <i>Fusconaia barnesiana</i> | ** | * | |
| <i>Fusconaia cor</i> (E) | | * | |
| <i>Fusconaia cuneolus</i> (E) | | ** | |
| <i>Fusconaia subrotunda</i> | ** | ** | |
| <i>Lampsilis cardium</i> | | * | |
| <i>Lampsilis fasciola</i> | | ** | |
| <i>Lasmigona costata</i> | ** | ** | |
| <i>Lexingtonia dolabelloides</i> (C) | ** | * | |
| <i>Megalonaias nervosa</i> | ** | ** | |
| <i>Obovaria subrotunda</i> | | ** | |
| <i>Pleurobema oviforme</i> (C) | | ** | |
| <i>Quadrula cylindrica</i> (C) | | ** | |
| <i>Quadrula intermedia</i> (E) | | ** | |
| <i>Quadrula pustulosa</i> | ** | ** | |
| <i>Quadrula quadrula</i> | ** | | |
| <i>Tritogonia verrucosa</i> | | ** | |
| <i>Villosa iris</i> | | ** | |
| TOTAL SPECIES | 12 | 24 | 2 |

E = Federally Listed Endangered C = Candidate for Federal List X = Extinct
 * = Live Specimens ** = Relic Dead Specimens

Table 4a. Number of Mussels per Square Meter in YMA North Fork Holston River Quantitative Sampling, 1990.

| SPECIES | RIVER MILE | | | | | |
|--------------------------------------|------------|------|------|------|------|-------|
| | 53.2 | 56.4 | 60.7 | 85.6 | 88.5 | 91.5 |
| <i>Actinonaias pectorosa</i> | | | | | 0.45 | 0.30 |
| <i>Fusconaia barnesiana</i> | | | | 0.05 | 0.05 | 0.40 |
| <i>Fusconaia cor (E)</i> | | | | | 0.20 | 0.30 |
| <i>Lampsilis fasciola</i> | 0.35 | 0.50 | 0.45 | 0.05 | 0.40 | 0.40 |
| <i>Lampsilis ovata</i> | 0.05 | | | | | |
| <i>Lexingtonia dolabelloides (C)</i> | | | | | 0.95 | 1.70 |
| <i>Medionidius conradicus</i> | | | | 0.05 | 0.60 | 3.10 |
| <i>Pleurobema oviforme (C)</i> | | | | | | 1.40 |
| <i>Ptychobranchus fasciolaris</i> | | | | | 0.80 | 0.30 |
| <i>Ptychobranchus subtentum</i> | | | | | 0.05 | |
| <i>Villosa nebulosa</i> | 0.25 | 0.25 | | | 0.30 | 5.60 |
| <i>Villosa vanuxemensis</i> | 0.10 | 0.30 | 0.10 | | | 4.20 |
| TOTAL SPECIES | 4 | 3 | 2 | 5 | 9 | 10 |
| MUSSELS/M ² | 0.75 | 1.05 | 0.55 | 0.40 | 3.80 | 17.70 |

E = Federally Listed Endangered C = Candidate for Federal List

Table 4b. Results of YMA Qualitative Sampling of the North Fork Holston River, 1990.

| SPECIES | RIVER MILE | | |
|--------------------------------------|------------|------|------|
| | 58.2 | 88.5 | 91.5 |
| <i>Actinonaias pectorosa</i> | | * | * |
| <i>Fusconaia barnesiana</i> | | * | * |
| <i>Fusconaia cor (E)</i> | | * | * |
| <i>Lampsilis fasciola</i> | | * | * |
| <i>Lexingtonia dolabelloides (C)</i> | | * | * |
| <i>Lampsilis ovata</i> | | | |
| <i>Medionaias conradicus</i> | | * | * |
| <i>Pleurobema oviforme (C)</i> | | * | * |
| <i>Ptychobranhus fasciolaris</i> | | | * |
| <i>Ptychobranhus subtentum</i> | | | ** |
| <i>Strophitus undulatus</i> | | | *** |
| <i>Villosa nebulosa</i> | | * | * |
| <i>Villosa vanuxemensis</i> | * | * | * |
| TOTAL SPECIES | 1 | 9 | 12 |

* = Live Specimens

** = Dead Specimens

*** = Fresh Dead Specimens

R.M. 88.5 - Pond to right of bridge (eastern of bridge)
 bridge crossing ≈ 88.4

R.M. 91.5 - Berry Farm
 West end of road - road.

Table 5a. Number of Mussels per Square Meter in YMA Duck River Quantitative Sampling, 1989 and 1990.

| SPECIES | RIVER MILE | | | | | | | | | | | | | |
|--------------------------------------|------------|--------|-------|-------|-------|--------|-------|--------|-------|-------|--------|--------|--------|--------|
| | 133.4a | 133.4b | 133.6 | 133.8 | 151.9 | *156.1 | 156.2 | *159.5 | 172.0 | 179.0 | 179.1a | 179.1b | 179.2a | 179.2b |
| <i>Actinonaias ligamentina</i> | | | | | | | | | | 0.05 | | | | |
| <i>Actinonaias pectorosa</i> | | | | | | | | | 0.05 | | | | | |
| <i>Ambleria plicata</i> | 1.25 | 0.40 | 1.10 | 0.40 | 0.05 | 0.10 | | | 0.05 | | | 1.70 | 1.90 | 1.65 |
| <i>Anodonta grandis</i> | | | | | | | | | | 2.00 | | 0.15 | | |
| <i>Arcidens confragosus</i> | 0.05 | | | | | | | | | | | | | |
| <i>Cyclonaias tuberculata</i> | 1.80 | 0.70 | 1.60 | 0.05 | 0.30 | 0.10 | 0.25 | 0.12 | 0.40 | 3.40 | 3.40 | 3.50 | 5.00 | 2.10 |
| <i>Elliptio dilatata</i> | | | | | 1.35 | 0.20 | 0.25 | | 0.55 | 0.85 | 0.85 | 1.50 | 0.65 | 2.05 |
| <i>Epioblasma capsaeformis (C)</i> | | | | | | | | | | | | 0.05 | | |
| <i>Fusconata barnesiiana</i> | | | | | | | | | | 0.15 | | 0.05 | | |
| <i>Fusconata ebena</i> | | | 0.05 | | | | | | | | | | | |
| <i>Lampsilis cardium</i> | | | | | | 0.10 | | | | | | | | 0.25 |
| <i>Lampsilis fasciola</i> | 0.10 | 0.05 | | 0.20 | 0.20 | 0.30 | 0.35 | 0.10 | 0.20 | 0.15 | 0.15 | 0.20 | 0.15 | 0.25 |
| <i>Lampsilis ovata</i> | 0.10 | | 0.05 | 0.15 | 0.15 | 0.10 | 0.15 | | 0.05 | 0.15 | 0.15 | 0.05 | | 0.05 |
| <i>Lampsilis teres</i> | | | 0.05 | | | | | | | | | | | |
| <i>Lasimigona complanata</i> | 0.05 | | 0.05 | | | | | | | | | | | |
| <i>Lasimigona costata</i> | | 0.05 | | 0.10 | 0.05 | | 0.10 | | 0.10 | 0.40 | 0.40 | 0.20 | 0.15 | 0.35 |
| <i>Leptodea fragilis</i> | 0.30 | | 0.10 | 0.10 | 0.05 | | 0.05 | | 0.20 | 0.20 | 0.20 | 0.15 | 0.05 | 0.20 |
| <i>Lemiox rimosus (E)</i> | | | | | | | | | 0.80 | 0.80 | 0.80 | 1.10 | 0.25 | 0.10 |
| <i>Lexingtonia dolabelloides (C)</i> | | | 0.10 | 0.10 | 0.05 | 0.10 | 0.05 | | 0.10 | 0.50 | 0.50 | 0.45 | 0.25 | 0.05 |
| <i>Medionidus conradicus</i> | | | | | | 0.10 | | | 0.05 | | | | | |
| <i>Meglonaias nervosa</i> | 0.15 | 0.05 | 0.15 | | | | 0.10 | | 0.20 | 0.15 | 0.15 | 0.30 | 0.10 | 0.25 |
| <i>Obliquaria reflexa</i> | 0.20 | 0.15 | 0.40 | 0.40 | 0.05 | 0.10 | | | 0.20 | 0.20 | 0.35 | 0.35 | 0.10 | 0.15 |
| <i>Obovaria subrotunda</i> | | | | | | | | | | 0.10 | | | | |
| <i>Pleurobema oviforme (C)</i> | | | | | 0.05 | | | | 0.05 | 0.10 | 0.10 | 0.05 | 0.15 | 0.20 |
| <i>Potamilus alatus</i> | | | | 0.10 | 0.35 | 0.10 | | | 0.05 | 0.20 | 0.20 | 0.15 | 0.05 | 0.20 |
| <i>Quadrula cylindrica (C)</i> | | | | | | | 0.20 | | | | | | | |
| <i>Quadrula pustulosa</i> | 0.75 | 0.25 | 0.80 | | 0.15 | 0.10 | 0.05 | | 0.20 | 1.30 | 1.30 | 1.35 | 1.65 | 0.65 |
| <i>Quadrula quadrula</i> | 0.45 | 0.10 | 0.20 | | | | | | | | | | | |
| <i>Toxolasma lividus (C)</i> | | | | | | | | | | | | | 0.05 | |
| <i>Tritogonia verrucosa</i> | 0.20 | 0.10 | | 0.05 | | 0.10 | | | | 0.20 | | 0.45 | 0.35 | 0.35 |
| <i>Truncilla donaciformis</i> | | | 0.05 | 0.05 | | | | | | 0.20 | | | | |
| <i>Truncilla truncata</i> | | | 0.05 | 0.05 | 0.10 | | | | | 2.05 | 2.05 | 1.45 | 2.75 | 1.20 |
| <i>Villosa iris</i> | | | | | | | | | | | | 0.10 | | |
| <i>Villosa taenolata</i> | | | | | | | | | | | | 0.15 | 0.05 | |
| <i>Villosa vanuxemensis</i> | | | | | | | | | | | | 0.10 | | |
| TOTAL SPECIES | 12 | 9 | 14 | 8 | 12 | 13 | 10 | 2 | 11 | 20 | 20 | 22 | 17 | 16 |
| MUSSELS/M ² | 5.40 | 1.85 | 4.75 | 1.20 | 2.85 | 1.60 | 1.55 | 0.22 | 1.95 | 13.00 | 13.00 | 13.55 | 13.65 | 9.85 |

E = Federally Listed Endangered C = Candidate for Federal List
 * Half Site (= 40 quadrats)

Table 5b. Results of YMA Qualitative Sampling of the Duck River, 1989 and 1990.

| SPECIES | RIVER MILE | | | | | | | | | | | | | |
|--------------------------------------|------------|--------|-------|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|--|
| | 133.4a | 133.4b | 133.6 | 133.8 | 151.9 | 156.1 | 156.2 | 159.5 | 172.0 | 179.1a | 179.1b | 179.2a | 179.2b | |
| <i>Actinonaias ligamentina</i> | | | | | | | ** | | | | | | | |
| <i>Actinonaias pectorosa</i> | * | * | * | * | * | * | ** | * | * | * | * | * | * | |
| <i>Amblema plicata</i> | | | | | | | | | | | | | | |
| <i>Anodonta grandis</i> | ** | ** | | | | | | | | | | | | |
| <i>Anodonta imbecillis</i> | * | * | * | * | * | * | ** | * | * | * | * | * | * | |
| <i>Arcidens confragosus</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Cyclonaias tuberculata</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Elliptio dilatata</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Epioblasma capsaeformis (C)</i> | | | | | | | | | | | | | | |
| <i>Fusconaia barnesiiana</i> | | | * | | | | | | | | | | | |
| <i>Fusconaia ebena</i> | | | | | | | | | | | | | | |
| <i>Lampsilis cardium</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Lampsilis fasciola</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Lampsilis ovata</i> | ** | ** | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Lampsilis terres</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Lasmigona complanata</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Lasmigona costata</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Leptodea fragilis</i> | ** | ** | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Lemiox rimosus (E)</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Lexingtonia dolabelloides (C)</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Medionidus conradicus</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Meglonaias nervosa</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Obliquaria reflexa</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Obovaria subrotunda</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Pleurobema oviforme (C)</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Potamilus alatus</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Psychobranchus fasciolaris</i> | ** | ** | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Quadrula cylindrica (C)</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Quadrula intermedia (E)</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Quadrula pustulosa</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Quadrula quadrula</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Toxilasma lividus (C)</i> | ** | ** | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Tritogonia verrucosa</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Truncilla donaciformis</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Truncilla truncata</i> | ** | ** | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Villosa iris</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Villosa taeniata</i> | * | * | * | * | * | * | * | * | * | * | * | * | * | |
| <i>Villosa vanuxemensis</i> | ** | ** | * | * | * | * | ** | * | * | * | * | * | * | |
| TOTAL SPECIES | 25 | 24 | 14 | 8 | 12 | 13 | 13 | 2 | 11 | 24 | 23 | 27 | 28 | |

E = Federally Listed Endangered C = Candidate for Federal List

* = Live Specimens ** = Dead Specimens

APPENDICES

APPENDIX A

Abundance and Frequency Data of Mussels from
TVA and YMA Powell River Surveys

Table A1. Abundance data of Powell River Quantitative mussel surveys. Numbers are totals per survey, regardless of area sampled or specific location.

| | TVA | | | YMA |
|------------------------------------|-----|-----|----|-----|
| | 79 | 83 | 88 | 890 |
| <u>Actinonaias ligamentina</u> | 272 | 132 | 70 | 370 |
| <u>Actinonaias pectorosa</u> * | 197 | 200 | 65 | 140 |
| <u>Alasmidonta marginata</u> | 1 | 0 | 0 | 0 |
| <u>Amblema plicata</u> | 44 | 2 | 12 | 24 |
| <u>Cyclonaias tuberculata</u> | 10 | 3 | 10 | 15 |
| <u>Dromus dromas</u> *+ | 2 | 4 | 1 | 9 |
| <u>Elliptio crassidens</u> | 6 | 4 | 1 | 0 |
| <u>Elliptio dilatata</u> | 24 | 29 | 21 | 26 |
| <u>Epioblasma brevidens</u> * | 10 | 5 | 3 | 6 |
| <u>Epioblasma capsaeformis</u> * | 8 | 2 | 0 | 0 |
| <u>Epioblasma triquetra</u> | 2 | 6 | 5 | 4 |
| <u>Fusconaia barnesiana</u> * | 13 | 3 | 0 | 12 |
| <u>Fusconaia cuneolus</u> *+ | 0 | 2 | 0 | 0 |
| <u>Fusconaia cor</u> *+ | 5 | 0 | 1 | 1 |
| <u>Fusconaia subrotunda</u> | 44 | 33 | 18 | 60 |
| <u>Lampsilis fasciola</u> | 14 | 15 | 10 | 11 |
| <u>Lampsilis ovata</u> | 15 | 5 | 4 | 6 |
| <u>Lasmigona costata</u> | 20 | 6 | 1 | 9 |
| <u>Leptodea fragilis</u> | 5 | 0 | 0 | 0 |
| <u>Lexingtonia dolabelloides</u> * | 0 | 0 | 0 | 1 |
| <u>Ligumia recta</u> | 1 | 1 | 2 | 2 |
| <u>Medionidus conradicus</u> * | 49 | 52 | 46 | 45 |
| <u>Plethobasus cyphus</u> | 9 | 2 | 1 | 2 |
| <u>Pleurobema oviforme</u> * | 3 | 0 | 1 | 0 |
| <u>Potamilus alatus</u> | 11 | 4 | 0 | 0 |
| <u>Ptychobranchus fasciolaris</u> | 10 | 11 | 7 | 4 |
| <u>Ptychobranchus subtentum</u> * | 11 | 1 | 0 | 0 |
| <u>Quadrula cylindrica</u> | 1 | 0 | 1 | 0 |
| <u>Quadrula intermedia</u> *+ | 3 | 2 | 4 | 1 |
| <u>Quadrula sparsa</u> *+ | 1 | 0 | 0 | 1 |
| <u>Villosa iris</u> | 1 | 0 | 1 | 11 |
| <u>Villosa vanuxemensis</u> * | 7 | 0 | 0 | 0 |

79: Quantitative data, App. B, Table 1, TVA 1988

83: Quantitative data, App. B, Table 2, TVA 1988

88: Quantitative data, App. B, Table 3, TVA 1988

890: Quantitative data, YMA 1989 and 1990

*Cumberlandian species

+Endangered species

Table A2. Rank order of abundance data from Powell River quantitative mussel surveys. Numbers are based on data shown in Table A1.

| | TVA | | | YMA |
|-------------------------------------|-----|----|----|-----|
| | 79 | 83 | 88 | 890 |
| <u>Actinonaias ligamentina</u> | 1 | 2 | 1 | 1 |
| <u>Actinonaias pectorosa</u> * | 2 | 1 | 2 | 2 |
| <u>Alasmidonta marginata</u> | 25 | 0 | 0 | 0 |
| <u>Amblema plicata</u> | 4 | 17 | 6 | 6 |
| <u>Cyclonaias tuberculata</u> | 13 | 14 | 7 | 7 |
| <u>Dromus dromas</u> ** | 24 | 12 | 16 | 11 |
| <u>Elliptio crassidens</u> | 19 | 14 | 16 | 0 |
| <u>Elliptio dilatata</u> | 6 | 5 | 4 | 5 |
| <u>Epioblasma brevidens</u> * | 13 | 10 | 13 | 13 |
| <u>Epioblasma capsaeformis</u> * | 17 | 17 | 0 | 0 |
| <u>Epioblasma triquetra</u> | 24 | 8 | 10 | 15 |
| <u>Fusconaia barnesiana</u> * | 10 | 14 | 0 | 8 |
| <u>Fusconaia cuneolus</u> ** | 0 | 17 | 0 | 0 |
| <u>Fusconaia cor</u> ** | 20 | 0 | 16 | 19 |
| <u>Fusconaia subrotunda</u> | 4 | 4 | 5 | 3 |
| <u>Lampsilis fasciola</u> | 9 | 6 | 7 | 9 |
| <u>Lampsilis ovata</u> | 8 | 10 | 11 | 13 |
| <u>Lasmigona costata</u> | 7 | 8 | 16 | 11 |
| <u>Leptodea fragilis</u> | 20 | 0 | 0 | 0 |
| <u>Lexingtonia dolabelloides</u> ** | 0 | 0 | 0 | 19 |
| <u>Ligumia recta</u> | 25 | 22 | 14 | 17 |
| <u>Medionidus conradicus</u> * | 3 | 3 | 3 | 4 |
| <u>Plethobasus cyphus</u> | 16 | 17 | 16 | 17 |
| <u>Pleurobema oviforme</u> * | 22 | 0 | 16 | 0 |
| <u>Potamilus alatus</u> | 11 | 12 | 0 | 0 |
| <u>Ptychobranthus fasciolaris</u> | 13 | 7 | 9 | 15 |
| <u>Ptychobranthus subtentum</u> * | 11 | 22 | 0 | 0 |
| <u>Quadrula cylindrica</u> | 25 | 0 | 16 | 0 |
| <u>Quadrula intermedia</u> ** | 22 | 17 | 11 | 19 |
| <u>Quadrula sparsa</u> ** | 25 | 0 | 0 | 19 |
| <u>Villosa iris</u> | 25 | 0 | 16 | 9 |
| <u>Villosa vanuxemensis</u> * | 18 | 0 | 0 | 0 |

79: Quantitative data, App. B, Table 1, TVA 1988

83: Quantitative data, App. B, Table 2, TVA 1988

88: Quantitative data, App. B, Table 3, TVA 1988

890: Quantitative data, YMA 1989 and 1990

*Cumberlandian species

+Endangered species

Table A3. Frequency data of Powell River quantitative mussel surveys. Frequency numbers are based on number of occurrences per survey for each specific location.

| | TVA | | | YMA |
|------------------------------------|-----|----|----|-----|
| | 79 | 83 | 88 | 890 |
| <u>Actinonaias ligamentina</u> | 14 | 10 | 10 | 8 |
| <u>Actinonaias pectorosa</u> * | 12 | 12 | 13 | 8 |
| <u>Alasmidonta marginata</u> | 1 | 0 | 0 | 0 |
| <u>Amblema plicata</u> | 8 | 1 | 6 | 6 |
| <u>Cyclonaias tuberculata</u> | 7 | 2 | 5 | 7 |
| <u>Dromus dromas</u> *+ | 2 | 4 | 1 | 4 |
| <u>Elliptio crassidens</u> | 4 | 3 | 1 | 0 |
| <u>Elliptio dilatata</u> | 8 | 8 | 9 | 8 |
| <u>Epioblasma brevidens</u> * | 4 | 3 | 3 | 4 |
| <u>Epioblasma capsaeformis</u> * | 3 | 1 | 0 | 0 |
| <u>Epioblasma triquetra</u> | 2 | 3 | 5 | 2 |
| <u>Fusconaia barnesiana</u> * | 4 | 3 | 0 | 2 |
| <u>Fusconaia cuneolus</u> *+ | 0 | 2 | 0 | 0 |
| <u>Fusconaia cor</u> *+ | 4 | 0 | 1 | 1 |
| <u>Fusconaia subrotunda</u> | 9 | 8 | 9 | 5 |
| <u>Lampsilis fasciola</u> | 8 | 7 | 6 | 6 |
| <u>Lampsilis ovata</u> | 9 | 4 | 3 | 4 |
| <u>Lasmigona costata</u> | 8 | 4 | 1 | 4 |
| <u>Leptodea fragilis</u> | 4 | 0 | 0 | 0 |
| <u>Lexingtonia dolabelloides</u> * | 0 | 0 | 0 | 1 |
| <u>Ligumia recta</u> | 1 | 1 | 1 | 2 |
| <u>Medionidus conradicus</u> * | 10 | 9 | 12 | 7 |
| <u>Plethobasus cyphus</u> | 6 | 2 | 1 | 2 |
| <u>Pleurobema oviforme</u> * | 2 | 0 | 1 | 0 |
| <u>Potamilus alatus</u> | 7 | 2 | 0 | 0 |
| <u>Ptychobranhus fasciolaris</u> | 8 | 8 | 5 | 3 |
| <u>Ptychobranhus subtentum</u> * | 5 | 1 | 0 | 0 |
| <u>Quadrula cylindrica</u> | 1 | 0 | 1 | 0 |
| <u>Quadrula intermedia</u> *+ | 2 | 2 | 1 | 1 |
| <u>Quadrula sparsa</u> *+ | 1 | 0 | 0 | 1 |
| <u>Villosa iris</u> | 1 | 0 | 1 | 5 |
| <u>Villosa vanuxemensis</u> * | 1 | 0 | 0 | 0 |

79: Quantitative data, App. B, Table 1, TVA 1988

83: Quantitative data, App. B, Table 2, TVA 1988

88: Quantitative data, App. B, Table 3, TVA 1988

890: Quantitative data, YMA 1989 and 1990

*Cumberlandian species

+Endangered species

Table A4. Rank order of frequency data of Powell River mussel surveys. Numbers are based on data shown in Table A3.

| | TVA | | | YMA |
|------------------------------------|-----|----|----|-----|
| | 79 | 83 | 88 | 890 |
| <u>Actinonaias ligamentina</u> | 1 | 2 | 3 | 1 |
| <u>Actinonaias pectorosa</u> * | 2 | 1 | 1 | 1 |
| <u>Alasmidonta marginata</u> | 25 | 0 | 0 | 0 |
| <u>Amblema plicata</u> | 6 | 20 | 7 | 1 |
| <u>Cyclonaias tuberculata</u> | 11 | 15 | 7 | 5 |
| <u>Dromus dromas</u> ** | 21 | 8 | 14 | 10 |
| <u>Elliptio crassidens</u> | 16 | 11 | 14 | 0 |
| <u>Elliptio dilatata</u> | 6 | 4 | 4 | 1 |
| <u>Epioblasma brevidens</u> * | 15 | 11 | 11 | 10 |
| <u>Epioblasma capsaeformis</u> * | 20 | 20 | 0 | 0 |
| <u>Epioblasma triquetra</u> | 21 | 11 | 7 | 15 |
| <u>Fusconaia barnesiana</u> * | 15 | 11 | 0 | 15 |
| <u>Fusconaia cuneolus</u> ** | 0 | 15 | 0 | 0 |
| <u>Fusconaia cor</u> ** | 16 | 0 | 14 | 19 |
| <u>Fusconaia subrotunda</u> | 4 | 4 | 4 | 8 |
| <u>Lampsilis fasciola</u> | 6 | 7 | 6 | 7 |
| <u>Lampsilis ovata</u> | 8 | 8 | 11 | 10 |
| <u>Lasmigona costata</u> | 6 | 8 | 14 | 10 |
| <u>Leptodea fragilis</u> | 16 | 0 | 0 | 0 |
| <u>Lexingtonia dolabelloides</u> * | 0 | 0 | 0 | 19 |
| <u>Ligumia recta</u> | 25 | 20 | 14 | 15 |
| <u>Medionidus conradicus</u> * | 3 | 3 | 2 | 5 |
| <u>Plethobasus cyphus</u> | 13 | 15 | 14 | 15 |
| <u>Pleurobema oviforme</u> * | 21 | 0 | 14 | 0 |
| <u>Potamilus alatus</u> | 11 | 15 | 0 | 0 |
| <u>Ptychobranchus fasciolaris</u> | 6 | 4 | 7 | 14 |
| <u>Ptychobranchus subtentum</u> * | 14 | 20 | 0 | 0 |
| <u>Quadrula cylindrica</u> | 25 | 0 | 14 | 0 |
| <u>Quadrula intermedia</u> ** | 21 | 15 | 14 | 19 |
| <u>Quadrula sparsa</u> ** | 25 | 0 | 0 | 19 |
| <u>Villosa iris</u> | 25 | 0 | 14 | 8 |
| <u>Villosa vanuxemensis</u> * | 25 | 0 | 0 | 0 |

79: Quantitative data, App. B, Table 1, TVA 1988

83: Quantitative data, App. B, Table 2, TVA 1988

88: Quantitative data, App. B, Table 3, TVA 1988

890: Quantitative data, YMA 1989 and 1990

*Cumberlandian species

+Endangered species

APPENDIX B

Abundance and Frequency Data of Mussels from
TVA and YMA Clinch River Surveys

Table B1. Abundance data of Clinch River Quantitative mussel surveys. Numbers are totals per survey, regardless of area sampled or specific location.

| | TVA | | | YMA |
|------------------------------------|-----|----|-----|-----|
| | 79 | 83 | 88 | 890 |
| <u>Actinonaias ligamentina</u> | 307 | 19 | 141 | 656 |
| <u>Actinonaias pectorosa</u> * | 136 | 25 | 111 | 227 |
| <u>Alasmidonta marginata</u> | 0 | 0 | 1 | 4 |
| <u>Amblema plicata</u> | 25 | 2 | 11 | 33 |
| <u>Cumberlandia monodonta</u> | 8 | 0 | 1 | 0 |
| <u>Cyclonaias tuberculata</u> | 35 | 2 | 18 | 19 |
| <u>Cyprogenia stegaria</u> ** | 3 | 0 | 2 | 1 |
| <u>Dromus dromas</u> ** | 1 | 0 | 1 | 6 |
| <u>Elliptio crassidens</u> | 0 | 0 | 0 | 1 |
| <u>Elliptio dilatata</u> | 102 | 1 | 70 | 58 |
| <u>Epioblasma brevidens</u> * | 3 | 0 | 5 | 8 |
| <u>Epioblasma capsaeformis</u> * | 26 | 1 | 1 | 12 |
| <u>Epioblasma triquetra</u> | 4 | 0 | 0 | 0 |
| <u>Fusconaia barnesiana</u> * | 36 | 1 | 2 | 39 |
| <u>Fusconaia cuneolus</u> ** | 20 | 0 | 8 | 18 |
| <u>Fusconaia cor</u> ** | 5 | 3 | 0 | 2 |
| <u>Fusconaia flava</u> | 0 | 0 | 0 | 2 |
| <u>Fusconaia subrotunda</u> | 58 | 10 | 30 | 87 |
| <u>Hemistena lata</u> + | 5 | 0 | 2 | 2 |
| <u>Lampsilis fasciola</u> | 6 | 3 | 4 | 49 |
| <u>Lampsilis ovata</u> | 19 | 1 | 8 | 9 |
| <u>Lasmigona costata</u> | 63 | 1 | 24 | 46 |
| <u>Lemiox rimosus</u> ** | 1 | 0 | 2 | 3 |
| <u>Leptodea fragilis</u> | 1 | 0 | 2 | 0 |
| <u>Lexingtonia dolabelloides</u> * | 0 | 0 | 1 | 8 |
| <u>Ligumia recta</u> | 4 | 0 | 1 | 1 |
| <u>Medionidus conradicus</u> * | 46 | 0 | 54 | 192 |
| <u>Plethobasus cyphus</u> | 1 | 0 | 2 | 4 |
| <u>Pleurobema cordatum</u> | 1 | 0 | 0 | 0 |
| <u>Pleurobema oviforme</u> * | 4 | 0 | 1 | 5 |
| <u>Potamilus alatus</u> | 4 | 1 | 1 | 3 |
| <u>Ptychobranthus fasciolaris</u> | 12 | 7 | 11 | 39 |
| <u>Ptychobranthus subtentum</u> * | 76 | 0 | 47 | 104 |
| <u>Quadrula cylindrica</u> | 15 | 0 | 0 | 0 |
| <u>Quadrula pustulosa</u> | 3 | 0 | 3 | 5 |
| <u>Strophitus undulatus</u> | 0 | 0 | 0 | 1 |
| <u>Truncilla truncata</u> | 4 | 0 | 0 | 1 |
| <u>Villosa iris</u> | 9 | 0 | 17 | 34 |
| <u>Villosa perpurpurea</u> * | 1 | 0 | 0 | 0 |

79: Quantitative data, App. C, Table 1, TVA 1988

83: Quantitative data, App. C, Table 2, TVA 1988

88: Quantitative data, App. C, Table 3, TVA 1988

890: Quantitative data, YMA 1989 and 1990

*Cumberlandian species

+Endangered species

Table B2. Rank order of abundance data from Clinch River quantitative mussel surveys. Numbers are based on data shown in Table B1.

| | TVA | | | YMA |
|------------------------------------|-----|----|----|-----|
| | 79 | 83 | 88 | 890 |
| <u>Actinonaias ligamentina</u> | 1 | 2 | 1 | 1 |
| <u>Actinonaias pectorosa</u> * | 2 | 1 | 2 | 2 |
| <u>Alasmidonta marginata</u> | 0 | 0 | 23 | 22 |
| <u>Amblema plicata</u> | 11 | 7 | 9 | 12 |
| <u>Cumberlandia monodonta</u> | 17 | 0 | 23 | 0 |
| <u>Cyclonaias tuberculata</u> | 9 | 7 | 7 | 13 |
| <u>Cyprogenia stegaria</u> + | 25 | 0 | 17 | 29 |
| <u>Dromus dromas</u> ** | 28 | 0 | 23 | 19 |
| <u>Elliptio crassidens</u> | 0 | 0 | 0 | 29 |
| <u>Elliptio dilatata</u> | 3 | 9 | 11 | 6 |
| <u>Epioblasma brevidens</u> * | 25 | 0 | 14 | 17 |
| <u>Epioblasma capsaeformis</u> * | 10 | 9 | 23 | 15 |
| <u>Epioblasma triquetra</u> | 20 | 0 | 0 | 0 |
| <u>Fusconaia barnesiana</u> * | 8 | 9 | 17 | 9 |
| <u>Fusconaia cuneolus</u> ** | 12 | 0 | 12 | 14 |
| <u>Fusconaia cor</u> ** | 19 | 5 | 0 | 26 |
| <u>Fusconaia flava</u> | 0 | 0 | 0 | 26 |
| <u>Fusconaia subrotunda</u> | 6 | 3 | 5 | 5 |
| <u>Hemistena lata</u> + | 19 | 0 | 17 | 26 |
| <u>Lampsilis fasciola</u> | 18 | 5 | 15 | 7 |
| <u>Lampsilis ovata</u> | 13 | 9 | 12 | 16 |
| <u>Lasmigona costata</u> | 5 | 9 | 6 | 8 |
| <u>Lemiox rimosus</u> ** | 28 | 0 | 17 | 24 |
| <u>Leptodea fragilis</u> | 28 | 0 | 17 | 0 |
| <u>Lexingtonia dolabelloides</u> * | 0 | 0 | 23 | 17 |
| <u>Ligumia recta</u> | 20 | 0 | 23 | 29 |
| <u>Medionidus conradicus</u> * | 7 | 0 | 3 | 3 |
| <u>Plethobasus cyphus</u> | 28 | 0 | 17 | 22 |
| <u>Pleurobema cordatum</u> | 28 | 0 | 0 | 0 |
| <u>Pleurobema oviforme</u> * | 20 | 0 | 23 | 20 |
| <u>Potamilus alatus</u> | 20 | 9 | 23 | 24 |
| <u>Ptychobranchus fasciolaris</u> | 15 | 4 | 9 | 9 |
| <u>Ptychobranchus subtentum</u> * | 4 | 0 | 4 | 4 |
| <u>Quadrula cylindrica</u> | 14 | 0 | 0 | 0 |
| <u>Quadrula pustulosa</u> | 25 | 0 | 16 | 20 |
| <u>Strophitus undulatus</u> | 0 | 0 | 0 | 29 |
| <u>Truncilla truncata</u> | 20 | 0 | 0 | 29 |
| <u>Villosa iris</u> | 16 | 0 | 8 | 11 |
| <u>Villosa perpurpurea</u> * | 28 | 0 | 0 | 0 |

79: Quantitative data, App. C, Table 1, TVA 1988

83: Quantitative data, App. C, Table 2, TVA 1988

88: Quantitative data, App. C, Table 3, TVA 1988

890: Quantitative data, YMA 1989 and 1990

*Cumberlandian species

+Endangered species

Table B3. Frequency data of Clinch River quantitative mussel surveys. Frequency numbers are based on number of occurrences per survey for each specific location.

| | <u>TVA</u> | | | <u>YMA</u> |
|------------------------------------|------------|-----------|-----------|------------|
| | <u>79</u> | <u>83</u> | <u>88</u> | <u>890</u> |
| <u>Actinonaias ligamentina</u> | 10 | 1 | 9 | 10 |
| <u>Actinonaias pectorosa</u> * | 10 | 1 | 9 | 10 |
| <u>Alasmidonta marginata</u> | 0 | 0 | 1 | 3 |
| <u>Amblema plicata</u> | 6 | 1 | 6 | 5 |
| <u>Cumberlandia monodonta</u> | 1 | 0 | 1 | 0 |
| <u>Cyclonaias tuberculata</u> | 8 | 1 | 7 | 5 |
| <u>Cyprogenia stegaria</u> + | 3 | 0 | 2 | 1 |
| <u>Dromus dromas</u> ** | 1 | 0 | 1 | 3 |
| <u>Elliptio crassidens</u> | 0 | 0 | 0 | 1 |
| <u>Elliptio dilatata</u> | 8 | 1 | 6 | 9 |
| <u>Epioblasma brevidens</u> * | 3 | 0 | 3 | 5 |
| <u>Epioblasma capsaeformis</u> * | 5 | 1 | 1 | 3 |
| <u>Epioblasma triquetra</u> | 5 | 0 | 0 | 0 |
| <u>Fusconaia barnesiana</u> * | 8 | 1 | 1 | 7 |
| <u>Fusconaia cuneolus</u> ** | 6 | 0 | 4 | 6 |
| <u>Fusconaia cor</u> ** | 2 | 1 | 0 | 1 |
| <u>Fusconaia flava</u> | 0 | 0 | 0 | 1 |
| <u>Fusconaia subrotunda</u> | 9 | 1 | 7 | 5 |
| <u>Hemistena lata</u> + | 4 | 0 | 1 | 2 |
| <u>Lampsilis fasciola</u> | 4 | 1 | 2 | 9 |
| <u>Lampsilis ovata</u> | 7 | 1 | 6 | 5 |
| <u>Lasmigona costata</u> | 9 | 1 | 8 | 9 |
| <u>Lemiox rimosus</u> ** | 1 | 0 | 2 | 2 |
| <u>Leptodea fragilis</u> | 1 | 0 | 2 | 0 |
| <u>Lexingtonia dolabelloides</u> * | 0 | 0 | 1 | 2 |
| <u>Ligumia recta</u> | 3 | 0 | 1 | 1 |
| <u>Medionidus conradicus</u> * | 6 | 0 | 5 | 5 |
| <u>Plethobasus cyphyus</u> | 1 | 0 | 2 | 2 |
| <u>Pleurobema cordatum</u> | 1 | 0 | 0 | 0 |
| <u>Pleurobema oviforme</u> * | 2 | 0 | 1 | 2 |
| <u>Potamilus alatus</u> | 3 | 1 | 1 | 1 |
| <u>Ptychobranchus fasciolaris</u> | 7 | 1 | 5 | 9 |
| <u>Ptychobranchus subtentum</u> * | 10 | 0 | 7 | 5 |
| <u>Quadrula cylindrica</u> | 3 | 0 | 0 | 0 |
| <u>Quadrula pustulosa</u> | 2 | 0 | 1 | 5 |
| <u>Strophitus undulatus</u> | 0 | 0 | 0 | 1 |
| <u>Truncilla truncata</u> | 3 | 0 | 0 | 1 |
| <u>Villosa iris</u> | 2 | 0 | 3 | 5 |
| <u>Villosa perpurpurea</u> * | 1 | 0 | 0 | 0 |

79: Quantitative data, App. C, Table 1, TVA 1988

83: Quantitative data, App. C, Table 2, TVA 1988

88: Quantitative data, App. C, Table 3, TVA 1988

890: Quantitative data, YMA 1989 and 1990

*Cumberlandian species

+Endangered species

Table B4. Rank order of frequency data from Clinch River quantitative mussel surveys. Numbers are based on data shown in Table B3.

| | TVA | | | YMA |
|------------------------------------|-----|----|----|-----|
| | 79 | 83 | 88 | 890 |
| <u>Actinonaias ligamentina</u> | 1 | 1 | 1 | 1 |
| <u>Actinonaias pectorosa</u> * | 1 | 1 | 1 | 1 |
| <u>Alasmidonta marginata</u> | 0 | 0 | 1 | 18 |
| <u>Amblema plicata</u> | 11 | 1 | 7 | 9 |
| <u>Cumberlandia monodonta</u> | 28 | 0 | 20 | 0 |
| <u>Cyclonaias tuberculata</u> | 6 | 1 | 4 | 9 |
| <u>Cyprogenia stegaria</u> + | 18 | 0 | 15 | 26 |
| <u>Dromus dromas</u> ** | 28 | 0 | 20 | 18 |
| <u>Elliptio crassidens</u> | 0 | 0 | 0 | 26 |
| <u>Elliptio dilatata</u> | 6 | 1 | 7 | 3 |
| <u>Epioblasma brevidens</u> * | 18 | 0 | 13 | 9 |
| <u>Epioblasma capsaeformis</u> * | 14 | 1 | 20 | 18 |
| <u>Epioblasma triquetra</u> | 14 | 0 | 0 | 0 |
| <u>Fusconaia barnesiana</u> * | 6 | 1 | 20 | 7 |
| <u>Fusconaia cuneolus</u> ** | 12 | 0 | 12 | 8 |
| <u>Fusconaia cor</u> ** | 24 | 1 | 0 | 26 |
| <u>Fusconaia flava</u> | 0 | 0 | 0 | 26 |
| <u>Fusconaia subrotunda</u> | 4 | 1 | 4 | 9 |
| <u>Hemistena lata</u> + | 16 | 0 | 20 | 21 |
| <u>Lampsilis fasciola</u> | 16 | 1 | 15 | 3 |
| <u>Lampsilis ovata</u> | 9 | 1 | 7 | 9 |
| <u>Lasnigona costata</u> | 4 | 1 | 3 | 3 |
| <u>Lemiox rimosus</u> ** | 28 | 0 | 15 | 21 |
| <u>Leptodea fragilis</u> | 28 | 0 | 15 | 0 |
| <u>Lexingtonia dolabelloides</u> * | 0 | 0 | 20 | 21 |
| <u>Ligumia recta</u> | 18 | 0 | 20 | 26 |
| <u>Medionidus conradicus</u> * | 12 | 0 | 10 | 9 |
| <u>Plethobasus cyphyus</u> | 28 | 0 | 15 | 21 |
| <u>Pleurobema cordatum</u> | 28 | 0 | 0 | 0 |
| <u>Pleurobema oviforme</u> * | 24 | 0 | 20 | 21 |
| <u>Potamilus alatus</u> | 18 | 1 | 20 | 26 |
| <u>Ptychobranhus fasciolaris</u> | 9 | 1 | 10 | 3 |
| <u>Ptychobranhus subtentum</u> * | 1 | 0 | 4 | 9 |
| <u>Quadrula cylindrica</u> | 18 | 0 | 0 | 0 |
| <u>Quadrula pustulosa</u> | 24 | 0 | 20 | 9 |
| <u>Strophitus undulatus</u> | 0 | 0 | 0 | 26 |
| <u>Truncilla truncata</u> | 18 | 0 | 0 | 26 |
| <u>Villosa iris</u> | 24 | 0 | 13 | 9 |
| <u>Villosa perpurpurea</u> * | 28 | 0 | 0 | 0 |

79: Quantitative data, App. C, Table 1, TVA 1988

83: Quantitative data, App. C, Table 2, TVA 1988

88: Quantitative data, App. C, Table 3, TVA 1988

890: Quantitative data, YMA 1989 and 1990

*Cumberlandian species

+Endangered species

APPENDIX C

Abundance and Frequency Data of Mussels from
TVA and YMA Duck River Surveys

Table C1. Abundance data of Duck River mussel surveys. Numbers are totals per survey, regardless of area sampled or specific location.

| | TVA | | | | YMA |
|------------------------------------|-----|-----|-----|-----|-----|
| | 79B | 79C | 88A | 88B | 890 |
| <u>Actinonaias ligamentina</u> | 1 | 3 | 1 | 1 | 1 |
| <u>Actinonaias pectorosa</u> * | 1 | 1 | 3 | 7 | 1 |
| <u>Amblema plicata</u> | 55 | 34 | 51 | 290 | 211 |
| <u>Anadonta grandis</u> | 0 | 0 | 0 | 10 | 3 |
| <u>Arcidens confragosus</u> | 0 | 0 | 0 | 0 | 1 |
| <u>Cyclonaias tuberculata</u> | 497 | 123 | 147 | 611 | 383 |
| <u>Elliptio dilatata</u> | 37 | 24 | 67 | 160 | 146 |
| <u>Epioblasma capsaeformis</u> * | 0 | 1 | 2 | 0 | 3 |
| <u>Fusconaia barnesiana</u> * | 14 | 7 | 5 | 7 | 4 |
| <u>Fusconaia ebena</u> | 0 | 0 | 0 | 0 | 1 |
| <u>Lampsilis fasciola</u> | 19 | 5 | 40 | 174 | 36 |
| <u>Lampsilis cardium</u> | 0 | 0 | 0 | 0 | 6 |
| <u>Lampsilis ovata</u> | 5 | 4 | 4 | 44 | 17 |
| <u>Lampsilis teres</u> | 0 | 0 | 0 | 0 | 1 |
| <u>Lasmigona complanata</u> | 1 | 0 | 0 | 3 | 2 |
| <u>Lasmigona costata</u> | 19 | 9 | 11 | 18 | 27 |
| <u>Lemiox rimosus</u> ** | 69 | 42 | 44 | 33 | 47 |
| <u>Leptodea fragilis</u> | 1 | 1 | 11 | 18 | 24 |
| <u>Lexingtonia dolabelloides</u> * | 120 | 46 | 25 | 71 | 32 |
| <u>Medionidus conradicus</u> * | 20 | 14 | 38 | 161 | 2 |
| <u>Megalonaias nervosa</u> | 5 | 38 | 20 | 484 | 29 |
| <u>Obliquaria reflexa</u> | 385 | 2 | 16 | 57 | 41 |
| <u>Obovaria subrotunda</u> | 21 | 6 | 0 | 1 | 2 |
| <u>Pleurobema cordatum</u> | 18 | 8 | 0 | 0 | 0 |
| <u>Pleurobema oviforme</u> * | 20 | 5 | 0 | 1 | 7 |
| <u>Pleurobema rubrum</u> | 1 | 0 | 1 | 4 | 0 |
| <u>Potamilus alatus</u> | 7 | 3 | 11 | 69 | 23 |
| <u>Ptychobranthus fasciolaris</u> | 4 | 0 | 0 | 5 | 0 |
| <u>Quadrula cylindrica</u> | 22 | 1 | 2 | 18 | 5 |
| <u>Quadrula intermedia</u> ** | 6 | 0 | 1 | 2 | 0 |
| <u>Quadrula pustulosa</u> | 112 | 66 | 62 | 174 | 144 |
| <u>Quadrula quadrula</u> | 1 | 0 | 0 | 29 | 15 |
| <u>Toxolasma lividus</u> * | 1 | 1 | 0 | 5 | 1 |
| <u>Tritogonia verrucosa</u> | 7 | 2 | 12 | 58 | 31 |
| <u>Truncilla donaciformis</u> | 0 | 0 | 0 | 1 | 6 |
| <u>Truncilla truncata</u> | 1 | 9 | 81 | 44 | 153 |
| <u>Villosa iris</u> | 2 | 0 | 1 | 8 | 2 |
| <u>Villosa taeniata</u> | 0 | 0 | 0 | 0 | 4 |
| <u>Villosa vanuxemensis</u> * | 0 | 0 | 2 | 15 | 2 |

79B: Qualitative data, Table 16, TVA 1986

79C: Quantitative data, Table 17, TVA 1986

88A: Quantitative data, App. A, Table 2, TVA 1988

88B: Qualitative data, App. A, Table 1, TVA 1988

890: Quantitative data, YMA 1989 and 1990

*Cumberlandian species

+Endangered species

Table C2. Rank order of abundance data from Duck River mussel surveys. Numbers are based on data shown in Table C1.

| | TVA | | | | YMA |
|------------------------------------|-----|-----|-----|-----|-----|
| | 79B | 79C | 88A | 88B | 890 |
| <u>Actinonaias ligamentina</u> | 23 | 18 | 21 | 29 | 30 |
| <u>Actinonaias pectorosa</u> * | 23 | 22 | 17 | 22 | 30 |
| <u>Amblema plicata</u> | 6 | 6 | 5 | 3 | 2 |
| <u>Anadonta grandis</u> | 0 | 0 | 0 | 20 | 23 |
| <u>Arcidens confragosus</u> | 0 | 0 | 0 | 0 | 30 |
| <u>Cyclonaias tuberculata</u> | 1 | 1 | 1 | 1 | 1 |
| <u>Elliptio dilatata</u> | 7 | 7 | 3 | 7 | 4 |
| <u>Epioblasma capsaeformis</u> * | 0 | 22 | 19 | 0 | 23 |
| <u>Fusconaia barnesiana</u> * | 15 | 11 | 16 | 22 | 21 |
| <u>Fusconaia ebena</u> | 0 | 0 | 0 | 0 | 30 |
| <u>Lampsilis cardium</u> | 0 | 0 | 0 | 0 | 18 |
| <u>Lampsilis fasciola</u> | 12 | 14 | 7 | 4 | 8 |
| <u>Lampsilis ovata</u> | 19 | 16 | 17 | 12 | 15 |
| <u>Lampsilis teres</u> | 0 | 0 | 0 | 0 | 30 |
| <u>Lasmigona complanata</u> | 23 | 0 | 0 | 27 | 25 |
| <u>Lasmigona costata</u> | 12 | 9 | 13 | 14 | 12 |
| <u>Lemiox rimosus</u> ** | 5 | 4 | 6 | 15 | 6 |
| <u>Leptodea fragilis</u> | 23 | 22 | 13 | 17 | 13 |
| <u>Lexingtonia dolabelloides</u> * | 3 | 3 | 9 | 8 | 9 |
| <u>Medionidus conradicus</u> * | 10 | 8 | 8 | 6 | 25 |
| <u>Megalonaias nervosa</u> | 19 | 5 | 10 | 2 | 11 |
| <u>Obliquaria reflexa</u> | 2 | 20 | 11 | 11 | 7 |
| <u>Obovaria subrotunda</u> | 9 | 13 | 0 | 29 | 25 |
| <u>Pleurobema cordatum</u> | 14 | 10 | 0 | 0 | 0 |
| <u>Pleurobema oviforme</u> * | 10 | 14 | 0 | 29 | 17 |
| <u>Pleurobema rubrum</u> | 23 | 0 | 21 | 26 | 0 |
| <u>Potamilus alatus</u> | 16 | 18 | 13 | 9 | 14 |
| <u>Ptychobranchus fasciolaris</u> | 21 | 0 | 0 | 24 | 0 |
| <u>Quadrula cylindrica</u> | 8 | 22 | 19 | 17 | 20 |
| <u>Quadrula intermedia</u> ** | 18 | 0 | 24 | 28 | 0 |
| <u>Quadrula pustulosa</u> | 4 | 2 | 4 | 4 | 5 |
| <u>Quadrula quadrula</u> | 23 | 0 | 0 | 16 | 16 |
| <u>Toxolasma lividus</u> * | 23 | 22 | 0 | 24 | 30 |
| <u>Tritogonia verrucosa</u> | 16 | 20 | 12 | 10 | 10 |
| <u>Truncilla donaciformis</u> | 0 | 0 | 0 | 29 | 18 |
| <u>Truncilla truncata</u> | 23 | 9 | 2 | 12 | 3 |
| <u>Villosa iris</u> | 22 | 0 | 21 | 21 | 25 |
| <u>Villosa taeniata</u> | 0 | 0 | 0 | 0 | 21 |
| <u>Villosa vanuxemensis</u> * | 0 | 0 | 19 | 19 | 25 |

79B: Based on qualitative data, Table 16, TVA 1986

79C: Based on quantitative data, Table 17, TVA 1986

88A: Based on quantitative data, App. A, Table 2, TVA 1988

88B: Based on qualitative data, App. A, Table 1, TVA 1988

890: Quantitative data, YMA 1989 and 1990

*Cumberlandian species

+Endangered species

Table C3. Frequency data of Duck River mussel surveys. Frequency numbers are based on number of occurrences per survey for each specific location.

| | TVA | | | | | | YMA |
|------------------------------------|-----|-----|-----|-----|-----|-----|-----|
| | 79A | 79B | 79C | 88A | 88B | 88C | 890 |
| <u>Actinonaias ligamentina</u> | 2 | 1 | 1 | 1 | 1 | 2 | 1 |
| <u>Actinonaias pectorosa</u> * | 3 | 1 | 1 | 2 | 6 | 5 | 1 |
| <u>Amblema plicata</u> | 9 | 26 | 7 | 5 | 29 | 9 | 11 |
| <u>Anadonta grandis</u> | 0 | 0 | 0 | 0 | 3 | 3 | 1 |
| <u>Arcidens confragosus</u> | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| <u>Cyclonaias tuberculata</u> | 8 | 45 | 15 | 12 | 53 | 9 | 12 |
| <u>Elliptio dilatata</u> | 7 | 19 | 12 | 9 | 35 | 8 | 8 |
| <u>Epioblasma capsaeformis</u> * | | 0 | 1 | 1 | 0 | | 2 |
| <u>Fusconaia barnesiana</u> * | 5 | 10 | 4 | 4 | 7 | 7 | 2 |
| <u>Fusconaia ebena</u> | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| <u>Lampsilis cardium</u> | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| <u>Lampsilis fasciola</u> | 7 | 14 | 4 | 13 | 44 | 9 | 10 |
| <u>Lampsilis ovata</u> | 5 | 5 | 3 | 2 | 18 | 7 | 10 |
| <u>Lampsilis teres</u> | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| <u>Lasmigona complanata</u> | 1 | 1 | 0 | 0 | 2 | 1 | 2 |
| <u>Lasmigona costata</u> | 5 | 9 | 4 | 4 | 22 | 7 | 7 |
| <u>Lemiox rimosus</u> ** | 8 | 28 | 10 | 6 | 14 | 6 | 4 |
| <u>Leptodea fragilis</u> | 2 | 1 | 1 | 7 | 10 | 9 | 9 |
| <u>Lexingtonia dolabelloides</u> * | 8 | 33 | 14 | 5 | 27 | 9 | 9 |
| <u>Medionidus conradicus</u> * | 5 | 10 | 6 | 3 | 20 | 4 | 2 |
| <u>Megalonaias nervosa</u> | 9 | 41 | 11 | 6 | 46 | 9 | 9 |
| <u>Obliquaria reflexa</u> | 6 | 6 | 1 | 6 | 10 | 5 | 10 |
| <u>Obovaria subrotunda</u> | 4 | 14 | 5 | 0 | 1 | 1 | 1 |
| <u>Pleurobema cordatum</u> | 6 | 13 | 7 | 0 | 0 | 0 | 0 |
| <u>Pleurobema oviforme</u> * | 7 | 14 | 4 | 0 | 0 | 1 | 4 |
| <u>Pleurobema rubrum</u> | 1 | 1 | 0 | 1 | 3 | 3 | 0 |
| <u>Potamilus alatus</u> | 6 | 7 | 2 | 5 | 30 | 9 | 8 |
| <u>Ptychobranchus fasciolaris</u> | 3 | 4 | 0 | 0 | 4 | 3 | 0 |
| <u>Quadrula cylindrica</u> | 4 | 10 | 1 | 1 | 13 | 6 | 2 |
| <u>Quadrula intermedia</u> ** | 2 | 3 | 0 | 1 | 1 | 1 | 0 |
| <u>Quadrula pustulosa</u> | 9 | 40 | 15 | 8 | 37 | 9 | 11 |
| <u>Quadrula quadrula</u> | 1 | 1 | 0 | 0 | 4 | 2 | 3 |
| <u>Toxolasma lividus</u> * | 1 | 1 | 1 | 0 | 4 | 2 | 1 |
| <u>Tritogonia verrucosa</u> | 4 | 5 | 1 | 5 | 17 | 5 | 7 |
| <u>Truncilla donaciformis</u> | 0 | 0 | 0 | 0 | 1 | 1 | 3 |
| <u>Truncilla truncata</u> | 2 | 1 | 1 | 8 | 17 | 7 | 7 |
| <u>Villosa iris</u> | 1 | 2 | 0 | 1 | 5 | 4 | 1 |
| <u>Villosa taeniata</u> | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| <u>Villosa vanuxemensis</u> * | 1 | 0 | 0 | 2 | 9 | 6 | 1 |

79A: Qualitative & quantitative data, App. A, Table 4, TVA 1988

79B: Qualitative data, Table 16, TVA 1986

79C: Quantitative data, Table 17, TVA 1986

88A: Quantitative data, App. A, Table 2, TVA 1988

88B: Qualitative data, App. A, Table 1, TVA 1988

88C: Qualitative & quantitative data, App. A, Table 4, TVA 1988

890: Quantitative data, YMA 1989 and 1990

*Cumberlandian species

+Endangered species

Table C4. Rank order of frequency data from Duck River mussel surveys. Numbers are based on data shown in Table C3.

| | TVA | | | | | | YMA |
|------------------------------------|-----|-----|-----|-----|-----|-----|-----|
| | 79A | 79B | 79C | 88A | 88B | 88C | 890 |
| <u>Actinonaias ligamentina</u> | 22 | 23 | 18 | 20 | 28 | 25 | 25 |
| <u>Actinonaias pectorosa</u> * | 20 | 23 | 18 | 17 | 20 | 17 | 25 |
| <u>Amblema plicata</u> | 1 | 6 | 7 | 10 | 7 | 1 | 2 |
| <u>Lampsilis cardium</u> | 0 | 0 | 0 | 0 | 0 | 0 | 18 |
| <u>Arcidens confragosus</u> | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| <u>Cyclonaias tuberculata</u> | 4 | 1 | 1 | 2 | 1 | 1 | 1 |
| <u>Elliptio dilatata</u> | 7 | 7 | 4 | 3 | 5 | 9 | 10 |
| <u>Epioblasma capsaeformis</u> * | | 0 | 18 | 20 | | | 18 |
| <u>Fusconaia barnesiana</u> * | 13 | 13 | 11 | 14 | 18 | 10 | 18 |
| <u>Fusconaia ebena</u> | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| <u>Lampsilis cardium</u> | 0 | 0 | 0 | 0 | 0 | 0 | 18 |
| <u>Lampsilis fasciola</u> | 7 | 8 | 11 | 1 | 3 | 1 | 4 |
| <u>Lampsilis ovata</u> | 13 | 18 | 15 | 17 | 11 | 10 | 4 |
| <u>Lampsilis teres</u> | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| <u>Lasmigona complanata</u> | 26 | 23 | 0 | 0 | 27 | 28 | 18 |
| <u>Lasmigona costata</u> | 13 | 15 | 11 | 14 | 9 | 10 | 12 |
| <u>Lemiox rimosus</u> ** | 4 | 5 | 6 | 7 | 13 | 14 | 14 |
| <u>Leptodea fragilis</u> | 22 | 23 | 18 | 6 | 15 | 1 | 7 |
| <u>Lexingtonia dolabelloides</u> * | 4 | 4 | 3 | 10 | 8 | 1 | 7 |
| <u>Medionidus conradicus</u> * | 13 | 13 | 9 | 9 | 10 | 20 | 18 |
| <u>Megalonaias nervosa</u> | 1 | 2 | 5 | 7 | 2 | 1 | 7 |
| <u>Obliquaria reflexa</u> | 10 | 17 | 18 | 7 | 15 | 17 | 4 |
| <u>Obovaria subrotunda</u> | 17 | 8 | 10 | 0 | 28 | 28 | 25 |
| <u>Pleurobema cordatum</u> | 10 | 12 | 7 | 0 | 0 | 0 | 0 |
| <u>Pleurobema oviforme</u> * | 7 | 8 | 11 | 0 | 28 | 28 | 14 |
| <u>Pleurobema rubrum</u> | 26 | 23 | 0 | 20 | 25 | 22 | 0 |
| <u>Potamilus alatus</u> | 10 | 16 | 16 | 10 | 6 | 1 | 10 |
| <u>Ptychobranthus fasciolaris</u> | 20 | 20 | 0 | 0 | 22 | 22 | 0 |
| <u>Quadrula cylindrica</u> | 17 | 12 | 18 | 20 | 14 | 14 | 18 |
| <u>Quadrula intermedia</u> ** | 22 | 21 | 0 | 20 | 28 | 28 | 0 |
| <u>Quadrula pustulosa</u> | 1 | 3 | 1 | 4 | 4 | 1 | 2 |
| <u>Quadrula quadrula</u> | 26 | 23 | 0 | 0 | 22 | 25 | 16 |
| <u>Toxolasma lividus</u> * | 26 | 23 | 18 | 0 | 22 | 25 | 25 |
| <u>Tritogonia verrucosa</u> | 17 | 18 | 18 | 10 | 18 | 17 | 12 |
| <u>Truncilla truncata</u> | 22 | 23 | 18 | 4 | 12 | 10 | 12 |
| <u>Villosa iris</u> | 26 | 22 | 0 | 20 | 21 | 20 | 25 |
| <u>Villosa taeniata</u> | 0 | 0 | 0 | 0 | 0 | 0 | 18 |
| <u>Villosa vanuxemensis</u> * | 26 | 0 | 0 | 17 | 17 | 14 | 25 |

79A: Qualitative & quantitative data, App. A, Table 4, TVA 1988

79B: Qualitative data, Table 16, TVA 1986

79C: Quantitative data, Table 17, TVA 1986

88A: Quantitative data, App. A, Table 2, TVA 1988

88B: Qualitative data, App. A, Table 1, TVA 1988

88C: Qualitative & quantitative data, App. A, Table 4, TVA 1988

890: Quantitative data, YMA 1989 and 1990

*Cumberlandian species

+Endangered species

APPENDIX D

Number of Mussels Collected During YMA Stream Surveys

Table D1. Number of Mussels Collected During YMA Powell River Quantitative Sampling, 1989 and 1990.

| SPECIES | RIVER MILE | | | | | | | | | |
|--------------------------------------|------------|-------|-------|--------|--------|--------|-------|--------|-------|-------|
| | 94.8 | 110.2 | 115.4 | 115.4b | 117.3a | 117.3b | 117.6 | 117.65 | 117.8 | 117.9 |
| <i>Actinonaias ligamentina</i> | 66 | 20 | 57 | 31 | 41 | 34 | 33 | 34 | 22 | 32 |
| <i>Actinonaias pectorosa</i> | 15 | 5 | 14 | 4 | 11 | 2 | 22 | 13 | 30 | 24 |
| <i>Amblema plicata</i> | 4 | 1 | 1 | 3 | 4 | 5 | 1 | 1 | 3 | 1 |
| <i>Cyclonaias tuberculata</i> | 3 | 1 | 3 | | 3 | 1 | 2 | 1 | | 1 |
| <i>Dromus dromas (E)</i> | 5 | 2 | | | | 1 | | | | 1 |
| <i>Elliptio dilatata</i> | 2 | 2 | 4 | 4 | 2 | 1 | 5 | 2 | 2 | 2 |
| <i>Epioblasma brevidens (C)</i> | 1 | | | | | | 2 | 1 | 2 | |
| <i>Epioblasma triquetra (C)</i> | 3 | | | | | | | | | |
| <i>Fusconaia barnesiana</i> | 9 | 3 | | | | | | | 1 | |
| <i>Fusconaia cor (E)</i> | | | | | 1 | | | | | |
| <i>Fusconaia subrotunda</i> | | | 11 | 5 | 17 | 15 | | 5 | 2 | 5 |
| <i>Lampsilis fasciola</i> | 1 | | 1 | 1 | 3 | 1 | 1 | | 1 | 2 |
| <i>Lampsilis ovata</i> | 1 | | | | 1 | 2 | 1 | | | 1 |
| <i>Lasmigona costata</i> | 2 | | 1 | | 1 | 4 | | 1 | | |
| <i>Lexingtonia dolabelloides (C)</i> | | | | | | 1 | | | | |
| <i>Ligumia recta</i> | 1 | | | | | | | | | 1 |
| <i>Medionidius conradicus</i> | 16 | 1 | 7 | 1 | 2 | 3 | 8 | 3 | | 4 |
| <i>Plethobasus cyphus</i> | 1 | | | | | | 1 | | | |
| <i>Ptychobranchus fasciolaris</i> | 2 | | | | | | 1 | 1 | | |
| <i>Quadrula intermedia (E)</i> | | 1 | | | | | | | | |
| <i>Quadrula sparsa (E)</i> | | | | | 1 | | | | | |
| <i>Villosa iris</i> | | | 5 | | 3 | | 1 | | 1 | 1 |
| TOTAL SPECIES | 16 | 9 | 10 | 7 | 15 | 12 | 12 | 10 | 9 | 12 |
| TOTAL MUSSELS | 132 | 36 | 104 | 49 | 90 | 70 | 78 | 62 | 64 | 75 |

E = Federally Listed Endangered C = Candidate for Federal List

Table D2. Number of Mussels Collected During YMA Clinch River Quantitative Sampling, 1989 and 1990.

| SPECIES | RIVER MILE | | | | | | | | | | | |
|--------------------------------------|------------|-------|-------|-------|-------|-------|-------|--------|--------|-------|--------|--------|
| | 183.5 | 189.3 | 189.6 | 192.4 | 213.1 | 223.3 | 226.4 | 226.7a | 226.7b | 236.3 | 270.9a | 270.9b |
| <i>Actinonaias ligamentina</i> | 270 | 80 | 33 | 58 | 28 | 34 | 17 | 71 | 41 | 2 | 13 | 9 |
| <i>Actinonaias pectorosa</i> | 66 | 41 | 9 | 18 | 6 | 8 | 1 | 15 | 17 | 1 | 27 | 18 |
| <i>Alasmodonta marginata</i> | | | 2 | | | | | | | 1 | 1 | |
| <i>Amblema plicata</i> | | 2 | 3 | | 4 | 4 | | 1 | 19 | | 4 | 2 |
| <i>Cyclonaias tuberculata</i> | | 5 | 6 | | 2 | 2 | | | 4 | | | |
| <i>Cyrogenia stegaria (E)</i> | | | | | 1 | | | | | | | |
| <i>Dromus dromas (E)</i> | 3 | 1 | 2 | | | | | | | | | |
| <i>Elliptio crassidens</i> | | | 1 | | | | | | | | | |
| <i>Elliptio dilatata</i> | 1 | 3 | 6 | 11 | 1 | 1 | 5 | 1 | 9 | | 16 | 4 |
| <i>Epioblasma brevidens (C)</i> | 2 | | 1 | 2 | 1 | | | 2 | | | | |
| <i>Epioblasma capsaeformis (C)</i> | 1 | | | 9 | | | | 2 | | | | |
| <i>Fusconia barnesiana</i> | 11 | 4 | 14 | 2 | | 1 | 1 | | | | 4 | 2 |
| <i>Fusconia cor (E)</i> | | | | | | | | | | | 2 | 1 |
| <i>Fusconia cuneolus (E)</i> | 2 | 1 | | 3 | 1 | | 8 | | | | 2 | 1 |
| <i>Fusconia flava</i> | | | 2 | | | | | | | | | |
| <i>Fusconia subrotunda</i> | | | | | 11 | 14 | 8 | 5 | 41 | | 4 | 4 |
| <i>Hemistena lata (E)</i> | 1 | 1 | | | | | | | | | | |
| <i>Lampsilis cardium</i> | | | | | 1 | | | | | | | |
| <i>Lampsilis fasciola</i> | 1 | 3 | 4 | 7 | 2 | 1 | 2 | 3 | 3 | | 17 | 6 |
| <i>Lampsilis ovata</i> | 3 | | | 2 | | | 1 | 1 | 1 | | 1 | 1 |
| <i>Lasmigona costata</i> | 10 | 1 | 4 | 5 | 3 | 3 | 1 | 6 | 12 | 1 | 3 | 1 |
| <i>Ligumia recta</i> | | | | | 1 | | | | | | | |
| <i>Lemiox rimosus (E)</i> | 1 | | | 2 | | | | | | | | |
| <i>Lexingtonia dolabelloides (C)</i> | | | 1 | | | | | | | | 6 | 1 |
| <i>Medionidus conradicus</i> | 26 | 32 | 47 | 83 | | | | | | | 4 | |
| <i>Pleurobema oviforme (C)</i> | | | 3 | | | | 2 | | | | | |
| <i>Pleurobema cyphus</i> | | | | | | 1 | | | | | | |
| <i>Potamilius alatus</i> | | | | | | | | 1 | 2 | | | |
| <i>Psychobranchus fasciolaris</i> | 2 | 4 | 5 | 4 | 1 | 3 | 1 | 7 | 1 | | 8 | 3 |
| <i>Psychobranchus subtentum</i> | 30 | 16 | 23 | 26 | | | | 1 | | | 5 | 4 |
| <i>Quadrula pustulosa</i> | | 1 | 1 | | 1 | | 1 | 1 | | | | |
| <i>Strophitus undulatus</i> | | | | 1 | | | | | | | | |
| <i>Truncilla truncata</i> | 1 | | | | | | | | | | | |
| <i>Villosa iris</i> | | 1 | 6 | 7 | | 1 | | 1 | 3 | | 12 | 4 |
| TOTAL SPECIES | 17 | 16 | 20 | 16 | 15 | 11 | 12 | 15 | 11 | 4 | 17 | 16 |
| TOTAL MUSSELS | 431 | 196 | 173 | 240 | 64 | 72 | 48 | 118 | 152 | 5 | 129 | 60 |

E = Federally Listed Endangered C = Candidate for Federal List

Table D3. Number of Mussels Collected During YMA Elk River Quantitative Sampling, 1990.

| SPECIES | RIVER MILE |
|------------------------------|------------|
| | 109.7 |
| <i>Actinonaias pectorosa</i> | 5 |
| <i>Elliptio dilatata</i> | 1 |
| <i>Fusconaia barnesiana</i> | 1 |
| <i>Fusconaia cor (E)</i> | 1 |
| TOTAL SPECIES | 4 |
| TOTAL MUSSELS | 8 |

E = Federally Listed Endangered

Table D4. Number of Mussels Collected During YMA North Fork Holston River Quantitative Sampling, 1990.

| SPECIES | RIVER MILE | | | | |
|--------------------------------------|------------|------|------|------|------|
| | 53.2 | 56.4 | 60.7 | 85.6 | 91.5 |
| <i>Actinonaias pectorosa</i> | | | | 9 | 3 |
| <i>Fusconaia barnesiana</i> | | | 1 | 1 | 4 |
| <i>Fusconaia cor (E)</i> | | | | 4 | 3 |
| <i>Lampsilis fasciola</i> | 7 | 10 | 9 | 1 | 4 |
| <i>Lampsilis ovata</i> | 1 | | | | |
| <i>Lexingtonia dolabelloides (C)</i> | | | | 19 | 17 |
| <i>Medionidius conradicus</i> | | | 1 | 12 | 31 |
| <i>Pleurobema oviforme (C)</i> | | | | | 14 |
| <i>Ptychobranchus fasciolaris</i> | | | | 16 | 3 |
| <i>Ptychobranchus subtentum</i> | | | | 1 | |
| <i>Villosa nebulosa</i> | 5 | 5 | | 5 | 56 |
| <i>Villosa vanuxemensis</i> | 2 | 6 | 2 | | 42 |
| TOTAL SPECIES | 4 | 3 | 2 | 5 | 10 |
| TOTAL MUSSELS | 15 | 21 | 11 | 8 | 177 |

E = Federally Listed Endangered C = Candidate for Federal List

Table D5. Number of Mussels Collected During YMA Duck River Quantitative Sampling, 1989 and 1990.

| SPECIES | RIVER MILE | | | | | | | | | | | | | |
|--------------------------------------|------------|--------|-------|-------|-------|--------|-------|--------|-------|--------|--------|--------|--------|--|
| | 133.4a | 133.4b | 133.6 | 133.8 | 151.9 | *156.1 | 156.2 | *159.5 | 172.0 | 179.1a | 179.1b | 179.2a | 179.2b | |
| <i>Actinonaias ligamentina</i> | | | | | | | | | | 1 | | | | |
| <i>Actinonaias pectorosa</i> | | | | | | | | | | 1 | | | | |
| <i>Ambelena plicata</i> | 25 | 8 | 22 | 8 | 1 | 1 | 1 | 1 | 1 | 40 | 34 | 38 | 33 | |
| <i>Anodonta grandis</i> | 1 | | | | | | | | | | 3 | | | |
| <i>Arcidens confragosus</i> | | | | | | | | | | | | | | |
| <i>Cyclonaias tuberculata</i> | 36 | 14 | 32 | 1 | 6 | 1 | 5 | 1 | 8 | 68 | 70 | 100 | 42 | |
| <i>Elliptio dilatata</i> | | | | | 27 | 2 | 5 | 1 | 11 | 17 | 30 | 13 | 41 | |
| <i>Epioblasma capsaeformis (C)</i> | | | | | | | | | | | | | | |
| <i>Fusconaias barnesiana</i> | | | | | | | | | | 3 | 1 | | | |
| <i>Fusconaias ebena</i> | | | 1 | | | | | | | | | | | |
| <i>Lampsilis cardium</i> | | | | | | | 1 | | | | | | 5 | |
| <i>Lampsilis fasciola</i> | 2 | 1 | | | 4 | 3 | 7 | 1 | 4 | 3 | 4 | 3 | 5 | |
| <i>Lampsilis ovata</i> | 2 | | 1 | | 3 | 1 | 3 | | 1 | 3 | 1 | | 1 | |
| <i>Lampsilis teres</i> | | | 1 | | | | | | | | | | | |
| <i>Lasnigona complanata</i> | 1 | | 1 | | | | | | | | | | | |
| <i>Lasnigona costata</i> | | 1 | | | | | 2 | | 2 | 8 | 4 | 3 | 7 | |
| <i>Leptodea fragilis</i> | 6 | | 2 | 2 | 1 | | 1 | | | 4 | 3 | 1 | 4 | |
| <i>Lemiox rimosus (E)</i> | | | | | | | | | | 17 | 23 | 5 | 2 | |
| <i>Lexingtonia dolabelloides (C)</i> | | | 2 | | 1 | 1 | 1 | 1 | 2 | 10 | 9 | 5 | 1 | |
| <i>Medionidus contrarius</i> | | | | | | 1 | | | 1 | | | | | |
| <i>Megalonaias nervosa</i> | 3 | 1 | 3 | | | | 2 | | 4 | 3 | 6 | 2 | 5 | |
| <i>Obiquaria reflexa</i> | 4 | 3 | 8 | 8 | 1 | 1 | | | | 4 | 7 | 2 | 3 | |
| <i>Obovaria subrotunda</i> | | | | | | | | | | 2 | | | | |
| <i>Pleurobema oviforme (C)</i> | | | | | 1 | | | | 1 | 2 | 1 | 3 | | |
| <i>Pseudis striata</i> | | | | 7 | 7 | 1 | | | | 4 | 1 | 1 | 4 | |
| <i>Quadrula cylindrica (C)</i> | | | | | | 1 | 4 | | | | | | | |
| <i>Quadrula pustulosa</i> | 15 | 5 | 16 | | 3 | 1 | 1 | | 4 | 26 | 27 | 33 | 13 | |
| <i>Quadrula quadrula</i> | 9 | 2 | 4 | | | | | | | | | | | |
| <i>Toxolasma lividus (C)</i> | | | | | | | | | | | | 1 | | |
| <i>Tritogonia verrucosa</i> | 4 | 2 | | 1 | | 1 | | | | 4 | 9 | 7 | 7 | |
| <i>Truncilla donaciformis</i> | | | 1 | 1 | | | | | | | | | | |
| <i>Truncilla truncata</i> | | | 1 | 1 | 2 | | | | 41 | 41 | 29 | 55 | 24 | |
| <i>Villosa iris</i> | | | | | | | | | | | 2 | | | |
| <i>Villosa taeniata</i> | | | | | | | | | | | 3 | 1 | | |
| <i>Villosa vanuxemensis</i> | | | | | | | | | | | 2 | | | |
| TOTAL SPECIES | 12 | 9 | 14 | 8 | 12 | 13 | 10 | 2 | 11 | 20 | 22 | 17 | 16 | |
| TOTAL MUSSELS | 108 | 37 | 95 | 24 | 57 | 16 | 31 | 2 | 39 | 261 | 272 | 273 | 197 | |

E = Federally Listed Endangered C = Candidate for Federal List

* Half Site (= 40 quadrats)