

FINAL REPORT

Status of Fish and Mollusc Populations of the Clinch River

St. Paul, Virginia, 1973

INTRODUCTION

Periodic flooding of the Clinch River poses a continuing threat to industries and residences along the banks of the river at St. Paul, Virginia. To protect these properties, it has been decided to rechannel a portion of the river to divert it away from the west side of St. Paul. In addition, a portion of alternate highway 58 and a small residential section of St. Paul located along the banks of the river are to be relocated. These actions will eliminate a large bend of the Clinch River about $1\frac{1}{2}$ miles long and channelize or otherwise disturb an additional large downstream area of the stream and its tributaries below St. Paul.

As a result of these pending actions the Tennessee Valley Authority is presently studying the potential environmental impact of the project on the biota of the Clinch River in the vicinity of St. Paul. This survey is an integral part of that study and is designed to estimate the present species composition and abundance of fish and mollusc populations of the Clinch River and its tributaries between river miles 248 and 258.

The Clinch River is a headwater tributary of the Tennessee River located in the southwestern region of Virginia. The Clinch drains 1,260 square miles of land in Virginia and flows for a distance of 148 river miles before it enters Tennessee. Average discharge for the Clinch at

Speers Ferry, Virginia from 1920 to 1960 was 1,578 cfs with extreme flows of 45,300 cfs in January, 1957, and 42 cfs in September, 1939 (Cairns et al. 1971). Studies of the Clinch River (1964 through 1969) by Virginia Commission of Game and Inland Fisheries and State Water Control Board personnel indicate the Clinch River is a relatively clean and productive river with the exception of small sections downstream from Tazewell and Carbo, Virginia. Production of fish and invertebrates in these areas, although substantial, appeared to be repressed by the presence of industrial and domestic pollutants (Wollitz, 1967 and 1968). Major sources of pollution in the study area are from industry, (a steam-electric plant at Carbo, Virginia), mining, and from domestic sewage, primarily St. Paul.

The aquatic fauna of the study area has been subjected to two recent chemical kills. The first kill occurred in June, 1967, when a dike on a fly ash holding pond collapsed at Appalachian Power Company's 700 megawatt steam power generating plant near Carbo, Virginia about 10 miles above the study area. Within less than an hour 400 acre feet of caustic alkaline (pH 12.00 - 12.08) slurry of fly ash and water poured into the Clinch River. The caustic slug equalled 40% of the daily flow of the Clinch at that time (Cairns et al. 1971). It was estimated that 73% of the fish and virtually all of the mollusc stocks were eliminated from the present study area. Virginia Commission of Game and Inland Fisheries and State Water Control Board personnel found that: 1) fish species near St. Paul had been reduced from 16 to 10, 2) index catches of fishes were reduced 79% in numbers and 72% in weight from pre-kill data, 3) all bottom dwelling invertebrates appeared to be completely eliminated from the first 3 or 4 miles below the spill and drastically reduced over the next 77 miles; mollusc species were virtually eliminated

between Carbo and St. Paul, Virginia, a distance of about 13 river miles. Subsequent studies found that with the exception of the molluscs, invertebrate populations were reestablished within 3 months, and fish populations within 26 months. Reestablishment of fish populations was aided by restocking of several thousand fish including 4 new species. Other adjustments in fish stocks included shifts in numerical importance of most species present.

In June, 1970, an undetermined amount of sulphuric acid was released from the Appalachian Power Company plant at Carbo, Virginia. This release resulted in a kill of about 5,300 fish. It was estimated that stream organisms were affected for a distance of about 13 river miles from Carbo to St. Paul, Virginia. Recovery was apparently rapid for all faunal groups except mollusca (Cairns et al. 1971).

The objective of this study is to assess the present qualitative and to the extent possible, the quantitative status of fish and mollusc stocks in the study area, i.e. between river miles 248 and 258 on the Clinch River and its tributaries in Southwestern Virginia.

METHODS

Past research has shown that estimates of fish and invertebrate standing crops can vary seasonally, tending to be lower during colder months. This may be due in part to varying availability of different species to various types of capture gear due to life cycle stage, partial or complete dormancy, seasonal shifts in niche occupancy, and the tendency of some species to enter the substrate when water temperatures

drop below 40 to 42 F. For these reasons we decided that electro-fishing would probably yield the least biased estimate of fish stocks during the winter sampling period.

TRIBUTARY SAMPLING:

Twelve tributaries enter the Clinch River between miles 248 and 258. Of these 6 are dry part of each year and 5 receive some form of industrial and or domestic pollution. Sampling stations along the Clinch River and tributaries are illustrated in appendix figure 1.

1. Fish sampling: A 100 yard representative section of stream was selected along each tributary. Sections selected included both pool and riffle areas. Each section was thoroughly covered during two or three passes with a portable, gasoline powered electro-fishing apparatus. Voltage was varied to maintain a constant output of 2.5 amps. A constant effort was maintained to collect the maximum number of fish during each pass.

Fish population densities per 100 yard sample section were estimated by the DeLury depletion method. A second section of stream was sampled on each tributary in an attempt to collect representatives of all species present. All fish collected were identified, counts made by species and recorded by tributary and sampling station.

Description of tributaries and sampling stations:

- (A) Unnamed: River mile 248.15, right bank

Station 1

Location: 0.1 miles from mouth.

Condition: Small stream draining area that has been strip mined. Bottom covered with brown precipitate (probably

iron). No fish or invertebrates.

(B) Russell Creek: River mile 248.9, right bank

Station 1

Location: From mouth of stream to foot of impassable falls (about 40 yards).

Condition: Stream is clear with gravel and boulder bottom, but drains an upstream area that has been strip mined. Good population of small fishes.

Station 2

Location: above mining road bridge; 0.85 miles from mouth.

Condition: Stream has recently been altered by strip mine operation. Pollution is severe and several feet of sludge covered the stream bottom. Few fishes.

Station 3

Location: just off Rt. 655; 3.0 miles from mouth; 0.7 miles above Rt. 58.

Condition: Stream flows through a strip mine waste. The stream is heavily polluted with several feet of sludge on the bottom. Fish were scarce.

Station 4 (Meade Creek)

Location: a tributary to Russell Creek just above Rt. 58.

Site is located above small bridge; 10.2 miles from confluence.

Condition: stream flows through a strip mine area.

It is polluted but has gravel bottom rather than silt.

- (C) Unnamed: River mile 253.7, right bank

Station (intermittent stream)

- (D) Robinette: River mile 253.9, right bank

Station 1

Location: just off Rt. 58 above railroad bridge; 0.15 miles from mouth.

Condition: stream has a low flow and does not appear polluted. Fish density decreased, however, as we moved upstream.

- (E) Unnamed: River mile 254.05, right bank

Station (intermittent stream)

- (F) Lick Creek: River mile 255.7, right bank

Station 1

Location: from Rt. 628 bridge upstream; 0.13 miles from mouth.

Condition: stream is polluted, probably from more than one source. Debris is common and the substrate covered by fine silt. Fish populations were low.

Station 2

Location: Above and below the first railroad bridge above Hamlin; 3.4 miles above mouth.

Condition: similar to those at Station 1.

Station 3 (Honey Branch)

Location: a tributary to Lick Creek at Morefield. Site located at first bridge on Rt. 628; 0.55 miles above confluence.

Condition: water is clear and appears relatively free of pollution. Siltation is minor. Many small fish present.

(G) Unnamed: River mile 249.5, left bank

Station (intermittent stream)

(H) Unnamed: River mile 249.85, left bank

Station 1

Location: just above railroad bridge; 0.1 mile from mouth.

Condition: the stream flows underground above the sampling station and very little resurfaces. The water is clear and appears free of pollution. Fish are fairly abundant.

(I) Castle Run: River mile 252.5, left bank

Station I

Location: just below the mining operations; 0.30 mile above mouth.

Condition: stream is slightly discolored and extensively covered with crushed rock. Fish are fairly abundant.

(J) Unnamed: River mile 255.0, left bank

Station (intermittent stream)

(K) Unnamed: River mile 256.95, left bank

Station 1

Location: just above the road culvert; 100 yards from mouth.

Condition: water is clear and appears to be relatively unpolluted. Very few fish were present above a small cascade.

(L) Big Spring Creek: River mile 257.0, left bank

Station 1

Location: 0.2 miles above mouth

Condition: stream appears relatively unpolluted with a healthy fish population. A forty foot waterfall isolates the stream above the first quarter mile.

2. Mollusc Sampling:

Sampling for molluscs was done at the same stations as sampling for fishes. Molluscs were sampled with a D-net with an 18 inch base and a 1 mm mesh net. The equipment sampled a 1.5 square foot area of stream bottom. Samples were stratified over riffle and pool areas. Twelve samples were taken from each sample station (6 samples per strata). Confidence limits at the 95% level were calculated for the mean number of molluscs per sample per station.

RIVER SAMPLING:

Fourteen stations along the Clinch River between miles 248 and 258 were sampled for fish and mollusc species (appendix figure 1).

1. Fish sampling: At each sampling station along the river an attempt was made to collect fish from all possible habitats. A boat mounted generator was used to sample the deeper areas of the river. The shallow areas were covered with a portable Georater generator mounted in an 8 foot pram and pulled behind the shocking crew. In the deeper areas the best catches were obtained by intermittent operation of the generator on the boat shocker. A sample entailed 30 minutes of shocking time over the deeper water with

the shocking boat, and a single complete pass over the shallow areas with the Georater. Fish captured were identified and recorded by species and number. Species captured during the present study were compared to recent lists of species compiled by other studies in the area.

2. Mollusc sampling: Sampling for molluscs was done over the same sections of river as fish sampling (appendix figure 1). Sampling was stratified over pool and riffle areas when both habitats were present in the sample section. Twelve 1.5 square foot samples were taken at each station. Samples were taken to a depth of 6 inches where possible.

RESULTS

TRIBUTARY SAMPLES

Seven of the 12 tributaries sampled along the Clinch River between river miles 248 and 258 contained populations of fish. Three of these appear to receive some form of industrial or domestic pollution (appendix tables 1 and 2).

1. Fish samples: Appendix table 2 lists numbers, and species of fish by tributary, and estimated abundance of fish by sample section. Population estimates were made only on permanent tributaries.

Tributaries D and H, though intermittent, contained fish that probably move seasonally into the tributaries from the main river. Population estimates were not made for test sections on these streams.

Cottid species are not included in the population estimates listed in table 2. Shortly after sampling began, erratic catches of cottid species indicated that this group was not being captured in

proportion to their abundance. Catch figures for cottids were, therefore, subtracted from the catches before population estimates were made.

The population estimate for Russell Creek is for the entire section of the tributary from an impassable falls downstream (about 40 yards). Fish species from stations upstream from the falls, however, are included in table 2.

2. Mollusc samples:

Molluscs were captured in only 3 of the 12 tributaries in the study area (table 3). Of these, 3 genera of snails and 1 genus of limpet were found to be present in the tributaries. Freshwater clams or mussels were not captured in any of the tributary samples.

Estimates of population densities ($p \leq .05$) were made by sample station.

RIVER SAMPLES:

Water quality data was collected from selected stations along the Clinch River (table 4).

1. Fish samples:

Species, numbers and relative abundance of species by station and capture method are listed in table 5. Because different collection methods were used for pool and riffle stations, comparisons of catches should be made only within strata, and used only as rough estimates.

Of the 39 species captured, 15 were taken only from riffle areas, 9 exclusively from pools, and 14 from both habitats (table 5).

2. Mollusc samples:

Molluscs were captured at only 4 of the river sampling sections, and appeared to be uniformly low in abundance (table 6). Both snails and

clams appeared to prefer a riffle habitat, possibly due to differences in substrate materials between riffles and pools.

DISCUSSION

Winter sampling problems have quite likely affected estimates of fish abundance in the Clinch River and estimates of mollusc abundance in the river and tributaries. There is evidence that fishes and invertebrates move into and out of the substrate with changes in temperature during winter months. These movements would have the greatest affect on estimates of abundance of molluscs because of their slow response time. Catches of fish in deeper areas of the River indicated a clumped distribution, and were highly variable in abundance. For these reasons estimates of fish abundance seemed futile and were not attempted in the main river. Previous studies by Cairns et al. (1971) and Wollitz (1972) found that following the chemical kills of 1967 and 1970, fish abundance was back within the normal range within 26 months, but that mollusc populations remained low. Our studies corroborate their findings.

Estimates of species composition over the study area appear good. I could not locate any previous species lists for the tributaries in the study area. However, for the Clinch River near St. Paul, Wollitz (1972) lists 16 species of fish prior to the 1967 fish kill and 10 species in 1969. Our study identified 39 species of fish from the main river and 28 species from tributaries. Two recent thesis studies on the Clinch River, one on fish and one on invertebrates, are now in their final stages. The data from these studies were not available to us for comparison.

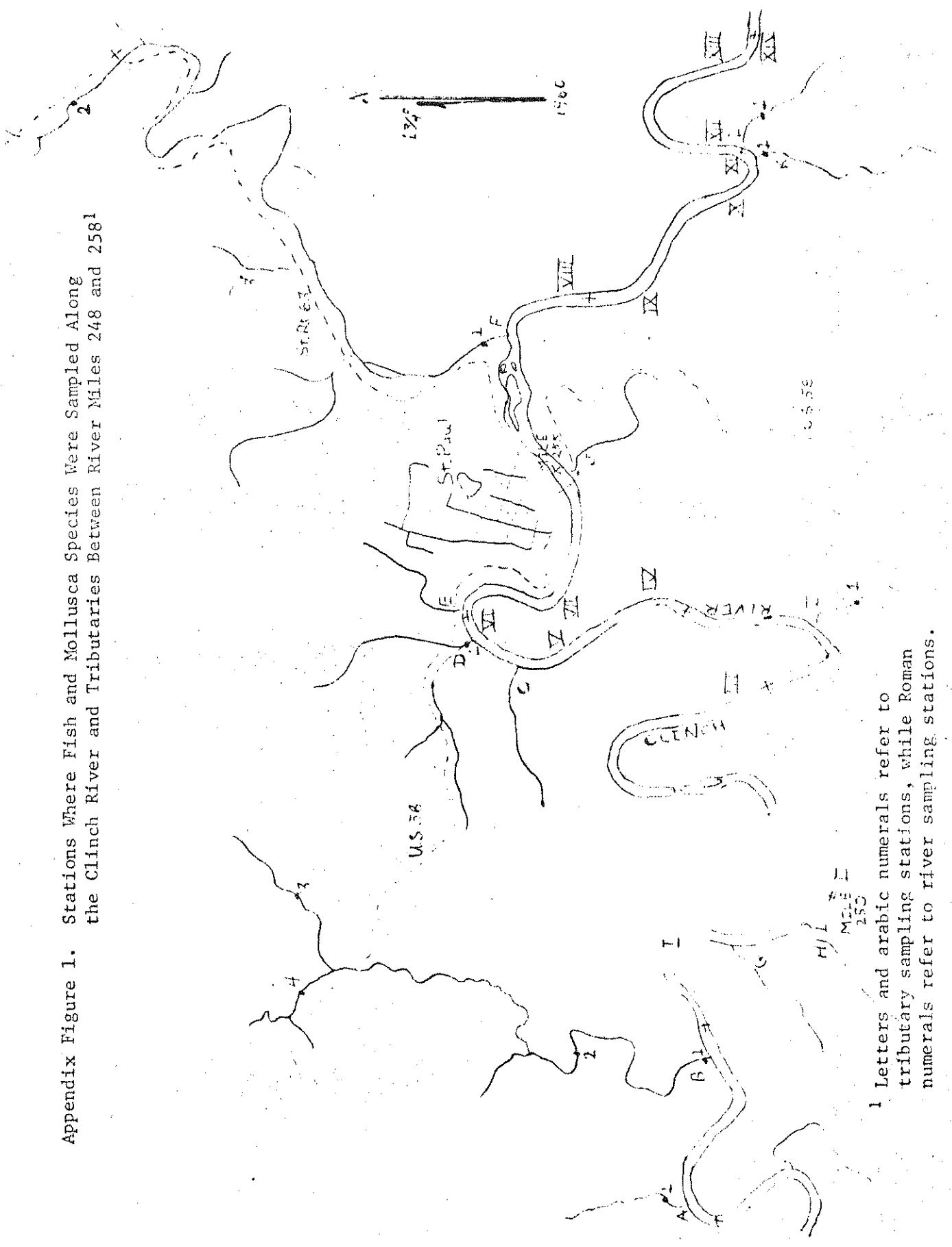
Four species of rare and endangered fish (Polydon spathula, Ethostoma cinereum, E. tippecanoe and Percina macrocephala) are listed from the Clinch River. None of these were present in our samples. The possibility exists, however, that they may be present in the study area.

The Clinch River in the vicinity of St. Paul, Virginia, although degraded by various forms of pollution, still supports a viable fishery and has a potential for improvement if deemed desirable by the public.

LITERATURE CITED

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Appendix Figure 1. Stations Where Fish and Mollusca Species Were Sampled Along the Clinch River and Tributaries Between River Miles 248 and 258¹



¹ Letters and arabic numerals refer to tributary sampling stations, while Roman numerals refer to river sampling stations.

Appendix Table 1. Physical Characteristics of Tributaries to the Clinch River Between River Miles 248 and 258 Near St. Paul, Virginia¹

Source	Tributary and Sampling Station											
	(A) Unnamed	(B) Russell	Meade Fork	Robins- ette(D)	(F) Lick Creek	(H) Unnamed	Castle Run(I)	(K) Unnamed	Big (L) Springs			
	1	2	3	4	1	1	1	1	1	1		
Air Temp. (°F)	-	40°	45°	50°	41°	35°	35°	39°	45°	48°	42°	
Water Temp (°F)	-	44°	47°	45°	45°	36°	36°	40°	54°	53°	54°	
D. O. (ppm)	10.0	10.8	12.8	11.0	12.6	12.3	12.8	12.0	9.8	10.0	11.0	8.0
pH	6.8	7.6	7.8	7.5	8.1	8.1	8.3	7.7	7.6	7.8	7.9	8.3
Average depth (ft)	0.3	1.0	1.0	0.5	0.40	1.5	1.0	0.75	0.30	1.0	0.30	1.0
Average width (ft)	3	12	8	8	6	12	12	10	4	10	4	10
Domestic Pollution	-	-	-	-	X	X	X	-	-	-	-	-
Industrial ² Pollution	X	X	X	X	-	X	X	-	-	-	-	-

¹ Four unnamed tributaries in the area were dry and not sampled.

² Includes pollution from mining activities.

Table 2. Fish Species and Estimated Abundance in Tributaries of the Clinch River Between River Miles 248 and 258, St. Paul, Virginia, 1973.

Species ³	Stations ¹										L	
	1	2	3	4	D	F	H	I	K			
Centrarchidae												
Ambloplites rupestris					1			1				11
Lepomis auritus												1
Lepomis macrochirus							1					
Catostomidae												
Catostomus commersoni					1							8
Hypentelium nigricans	1				6		4	1	1			1
Moxostoma erythrurum												1
Moxostoma macrolepidotum												3
Moxostoma duquesnei	1						1			1	2	
Cyprinidae												
Campostoma anomalum	55	1	14	5	8	112	5	61	18	141	14	345
Hybopsis amblops								1				
Hybopsis insignis												
Nocomis micropogon			1							1		
Notropis cornutus	51				1			3	6	37		70
Notropis coccogenis	7					2			1	3		28
Notropis galacturus	4					1			1	3		10
Notropis leuciodus									7	3		7
Notropis spilopterus									1			3
Notropis volucellus									1			
Notropis ariommus												2
Notropis telescopus												5
Pimephales notatus	1							1	4	1		1
Pimephales promelas	7	6	7									
Rhinichthys atratulus	63		10	30	41	4	27	31	11	5	7	41
Semotilus atromaculatus	14		8					2			7	2

Table 2. (continued).

Species ³	R ²				Stations ¹					
	1	2	3	4	D	F	H	I	K	L
Percidae										
Etheostoma blennioides					1			1		12
Etheostoma simoterum					1			5		2
Etheostoma zonale					1	1	3	1	1	1
Cottidae ⁴										
Cottidae caroliniae					32			68	23	99
TOTALS	204	7	32	43	51	161	104	271	53	652
Population estimates ⁴	315					358	113	217	31	596
Confidence limits	± 53					?	± 38	± 18	± 1	± 6

1 All other tributaries were either dry or no fish were captured in the sampling sections.

2 Stations 2, 3 and 4 are above an impassable falls.

3 The identification of a few species have not yet been verified. A revised table will be submitted when this has been done.

4 Sculpins not included in population estimates.

Table 3. Total molluscs captured listed by genera, station and estimated abundance ($p < .05$) per 1.5 square foot sample in tributaries of the Clinch River (miles 248 - 258), St. Paul, Virginia, 1973

Genus	Station ¹				Total Count
	B3	F2	K1	L1	
(Limpet)					
Ferrissia sp.	--	4	--	--	4
(Snails)					
Physa sp.	6	--	--	--	6
Goniobasis sp.	--	--	92	8	100
Spirodon sp.	--	--	4 ²	--	4
Estimated abundance and confidence	$.5 \pm .43$	$.33 \pm .31$	7.67 ± 1.33	$.67 \pm .41$	

¹ No molluscs were captured at other stations

² Confidence limits were the same as those calculated for Ferrissia.

Table 4. Water Quality Analyses at Selected Stations on the Clinch River (miles 248 - 258), St. Paul, Virginia, 1973¹

Stations	Temp. (C)	Total Hardness ppm CaCO ₃	Total Alkalinity ppm CaCO ₃	pH	DO
III	11.5	180	140	8.1	10.2
IV	11.5	150	110	7.9	10.2
VII	11.5	174	110	8.1	10.2
VIII	11.5	-	130	8.1	10.0
X	11.5	180	128	8.1	10.0
XIV	11.5	160	125	8.1	10.2

¹ Water level about 4 feet above normal.

Table 5. Fish species and Relative Abundance in the Clinch River (miles 248 - 258), St. Paul, Virginia, 1973¹

Species	(Riffler)						(Pools)								
	I	IV	V	VII	XI	TOTALS	II	III	VI	VII	IX	X	XII	XIV	TOTALS
(Catostomidae)															
Catostomus comersoni	-	-	-	2	1	3	-	-	-	-	-	-	-	-	-
Hypentelium nigricans	3	12	7	1	7	30	1	2	3	6	-	4	1	-	17
Moxostoma carinatum	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2
Moxostoma erythrurum & duquesnei (breviceps)	-	-	-	4	6	10	4	-	6	2	-	-	1	-	14
Moxostoma macrolepidotum	-	-	-	-	-	-	5	1	4	4	17	23	1	-	62
(Centrarchidae)															
Ambloplites rupestris	-	-	-	2	-	2	-	1	-	1	1	-	-	-	3
Lepomis auritus	-	-	-	14	-	14	-	-	-	-	-	-	-	-	-
Lepomis macrochirus	-	-	-	1	6	7	-	-	-	-	1	-	-	-	1
Lepomis megalotis	-	-	-	13	7	20	-	-	-	-	1	-	1	1	3
Lepomis punctatus	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
Micropterus dolomieu	-	-	-	4	1	5	-	-	-	-	-	-	-	1	1
Micropterus punctulatus	-	-	-	1	1	2	-	-	-	-	-	-	1	-	1
Micropterus salmoides	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2
Pomoxis nigromaculatus	-	-	-	-	3	3	-	-	1	1	1	-	-	-	3
(Clupeidae)															
Dorosoma cepedianum	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
(Cottidae)															
Cottus caroliniae	-	-	-	1	4	5	-	-	-	-	-	-	-	-	-
(Cyprinidae)															
Camptostoma anomalum	-	-	-	13	4	17	-	-	-	-	-	-	7	-	7
Cyprinus carpio	-	-	-	-	2	2	-	1	1	20	1	-	1	1	25
Hypopsis insignis	5	3	18	1	-	27	-	-	-	-	1	-	-	-	1
Notropis microgogon	-	1	1	32	-	34	-	-	-	-	1	-	-	-	1
Notropis telescopus	-	-	-	-	-	-	-	-	-	20	-	-	-	-	20

Table 5. (continued).

Species	(Rifles)											(Pools)				TOTALS
	I	IV	V	VII	XI	TOTALS	II	III	VI	VII	IX	X	XII	XIII	XIV	
<i>Notropis cornutus</i>	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-
<i>Notropis coccogenis</i>	-	-	-	5	-	5	-	-	-	-	-	-	-	-	-	-
<i>Notropis galacturus</i>	-	-	-	6	-	6	-	-	-	-	-	-	-	-	-	-
<i>Notropis leuciodus</i>	7	2	-	12	2	23	-	-	-	-	-	-	1	-	-	1
<i>Notropis rubellus</i>	-	-	-	6	-	6	-	-	-	-	-	-	-	-	-	-
<i>Notropis spilopterus</i>	-	-	-	7	-	7	-	-	-	-	-	-	-	-	-	-
<i>Notropis photogenis</i>	-	-	-	-	-	-	-	1	3	-	-	-	-	-	-	4
<i>Phenacobius uranops</i>	2	1	10	-	-	13	-	-	-	-	-	-	-	-	-	-
<i>Pimephales notatus</i>	-	-	-	13	8	21	-	-	-	-	-	-	1	-	-	1
<i>Rhinichthys atratulus</i> (Esocidae)	-	-	-	-	7	7	-	-	-	-	-	-	-	-	-	-
<i>Esox masquinongy</i> (Ictaluridae)	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
<i>Ictalurus punctatus</i> (Percidae)	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
<i>Etheostoma blennioides</i>	2	-	-	2	-	4	-	-	-	-	-	-	-	-	-	-
<i>Etheostoma rufilineatum</i>	-	-	1	1	-	2	-	-	-	-	-	-	-	-	-	-
<i>Etheostoma simoterum</i>	1	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-
<i>Etheostoma zonale</i>	4	1	2	6	-	13	-	-	-	-	-	-	-	-	-	-
<i>Percina caprodes</i>	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
TOTALS	25	20	39	149	59	292	10	6	19	56	27	27	14	3	11	173

Table 6. Estimated Mean Abundance ($p \leq .05$) of Mollusca Species per 1.5 Square Root Sample from the Clinch River (miles 248 - 258) St. Paul, Virginia, 1973

A. By rifle and pool habitat and combined samples:		Rifles	Pools	Combined	
(Snails)	Species				
	Spirodon subglobosa (form 1)	.056±.054	--	.021±.029	
	Spirodon subglobosa (form 2)	.028±.056	--	.010±.021	
	Spirodon subglobosa (form 3)	2.750±2.352	.017±.033	1.042±.915	
	Goniobasis simplex	.167±.127	.033±.047	.083±.054	
(Clams)					
	Actinonaias carinata	.028±.056	--	.010±.021	
	Truncilla sp.	.028±.056	--	.010±.021	
	Carunculina sp.	.028±.056	--	.010±.021	
	Spherium sp.	.028±.056	--	.010±.021	
B. By sampling station: ¹		I	V	VI	VIII
(Snails)	Species				
	Spirodon subglobosa (form 1)	--	.167±.247	--	--
	Spirodon subglobosa (form 2)	--	--	--	.083±.183
	Spirodon subglobosa (form 3)	.083±.183	--	.167±.247	8.083±6.754
	Goniobasis simplex	.167±.247	.333±.316	.083±.183	.083±.183
(Clams)					
	Actinonaias carinata	--	.083±.183	--	--
	Truncilla sp.	.083±.183	--	--	--
	Carunculina sp.	--	.083±.183	--	--
	Spherium sp.	--	.083±.183	--	--

¹ All other stations had 0 catches.