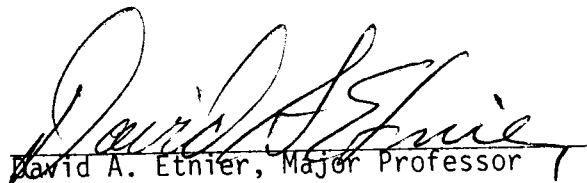
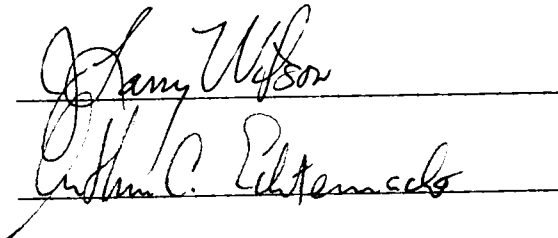
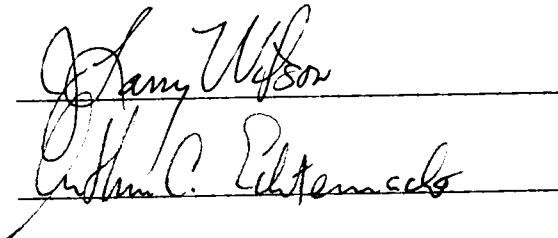


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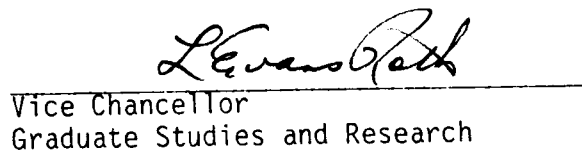
I am submitting herewith a thesis written by Andrew Glen Haines entitled "A Study of the Fishes of Lookout and South Chickamauga Creek Systems in Tennessee and Georgia." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Ecology.


David A. Ethier, Major Professor

We have read this thesis
and recommend its acceptance:

Accepted for the Council:


Vice Chancellor
Graduate Studies and Research

A STUDY OF THE FISHES OF LOOKOUT AND SOUTH CHICKAMAUGA CREEK
SYSTEMS IN TENNESSEE AND GEORGIA

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Andrew Glen Haines

June 1982

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ABSTRACT

This thesis reports the results of an ichthyofaunal survey of Lookout and South Chickamauga creek systems in Alabama, Georgia, and Tennessee, conducted between October, 1979 and November, 1980. A total of 98 collections are included, 62 made by the author and 36 by other investigators. Collections were made using 3 X 1.5 m and 6 X 3 m small-mesh minnow seines. A total of 85 species are reported from both creeks combined, including 12 species which are very rare or were considered to be extirpated from either or both creek systems. Included in this thesis is an annotated list of species collected during this and earlier surveys, with notes on their habitat and distribution both within each creek system and in comparison with each other. A description of the study area and collection sites is included. Collections of Ichthyomyzon bdellium, I. greeleyi, Hybopsis storeriana, Notropis chrosomus, N. lirus, N. telescopus, Pimephales promelas, Catostomus commersoni, Perca flavescens, Percina sciera, and P. tanasi contribute new distributional records for these species in the Tennessee River drainage of northeast Georgia.

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I. INTRODUCTION

This paper reports the findings of an ichthyofaunal study of the Lookout and South Chickamauga creek systems in Alabama, Georgia, and Tennessee. The purpose was to determine the distribution and species diversity of fishes within both creek systems and to locate populations of certain species considered to be in need of protection. The study was based primarily on specimens taken in 62 collections made between October, 1979 and November, 1980. Data from 15 collections in the University of Alabama Ichthyological Collection (UAIC), 10 University of Georgia collections (UGIC), 9 Tennessee Valley Authority collections (TVA), and 2 Georgia Department of Transportation collections made prior to or during the study were also included.

Available information concerning the fishes of Lookout Creek and South Chickamauga Creek was found to be inadequate, since most survey work was conducted in the late 1800's and early 1900's. At present, there is no published work on the fishes of either creek system. It appeared that most of the streams in both creek systems had remained uncollected until this survey, especially the main-stream portions. The primary reason for this lack of collections may lie in the fact that South Chickamauga Creek was a severely polluted stream in the past and many investigators felt that this stream was of little interest and essentially devoid of any important fishes. The lack of collections in Lookout Creek is hard to understand, since it contains a diverse fish fauna and is in a relatively undisturbed condition. The majority of collections in this portion

of the Tennessee River system have been concentrated on streams in northern Alabama and streams draining the south central portion of Tennessee, overlooking this southeastern tributary.

Included in this paper is an annotated list of fish species collected during this and earlier surveys, with notes on the habitat and distribution of the more important fishes, both within each creek system and in comparison with each other.

This study was planned as part of an ichthyofaunal survey of streams of the Gulf Coastal and Tennessee River drainages in northeastern and north-central Georgia, sponsored by the United States Fish and Wildlife Service, Office of Endangered Species. Preliminary results of this study were reported by Etnier et al. (1981).

II. DESCRIPTION OF THE STUDY AREA

Lookout Creek and South Chickamauga Creek Watersheds

The area drained by Lookout and South Chickamauga creeks is located in southeastern Tennessee, northwestern Georgia, and a small portion of extreme northeastern Alabama (Figure 1). The South Chickamauga Creek watershed drains an area of approximately 428 square miles (1108 km^2) in parts of Hamilton County, Tennessee, and Catoosa, Whitfield, and Walker counties in northwestern Georgia (Thomson *et al.*, 1956). South Chickamauga Creek flows northeast some 55 miles (88 km) from its headwaters in Walker, Whitfield, and Catoosa counties, Georgia, entering the Tennessee River (Nickajack Reservoir) at river kilometer 753.3 in downtown Chattanooga, Tennessee. Lookout Creek watershed comprises an area approximately 175 square miles (453 km^2), draining parts of Hamilton County, Tennessee, Dade County, Georgia, and DeKalb County, Alabama. Lookout Creek flows northeastward some 40 miles (64.4 km) from its headwaters in DeKalb County, Alabama, entering the Tennessee River (Nickajack Reservoir) at river kilometer 739.8 in Hamilton County, Tennessee.

Physiography and Geology

Physiographically, Lookout and South Chickamauga creek systems are located in two of the major provinces of the eastern United States, the Cumberland Plateau in the Appalachian Plateau Physiographic Province and the Ridge and Valley Physiographic Province (Fenneman,

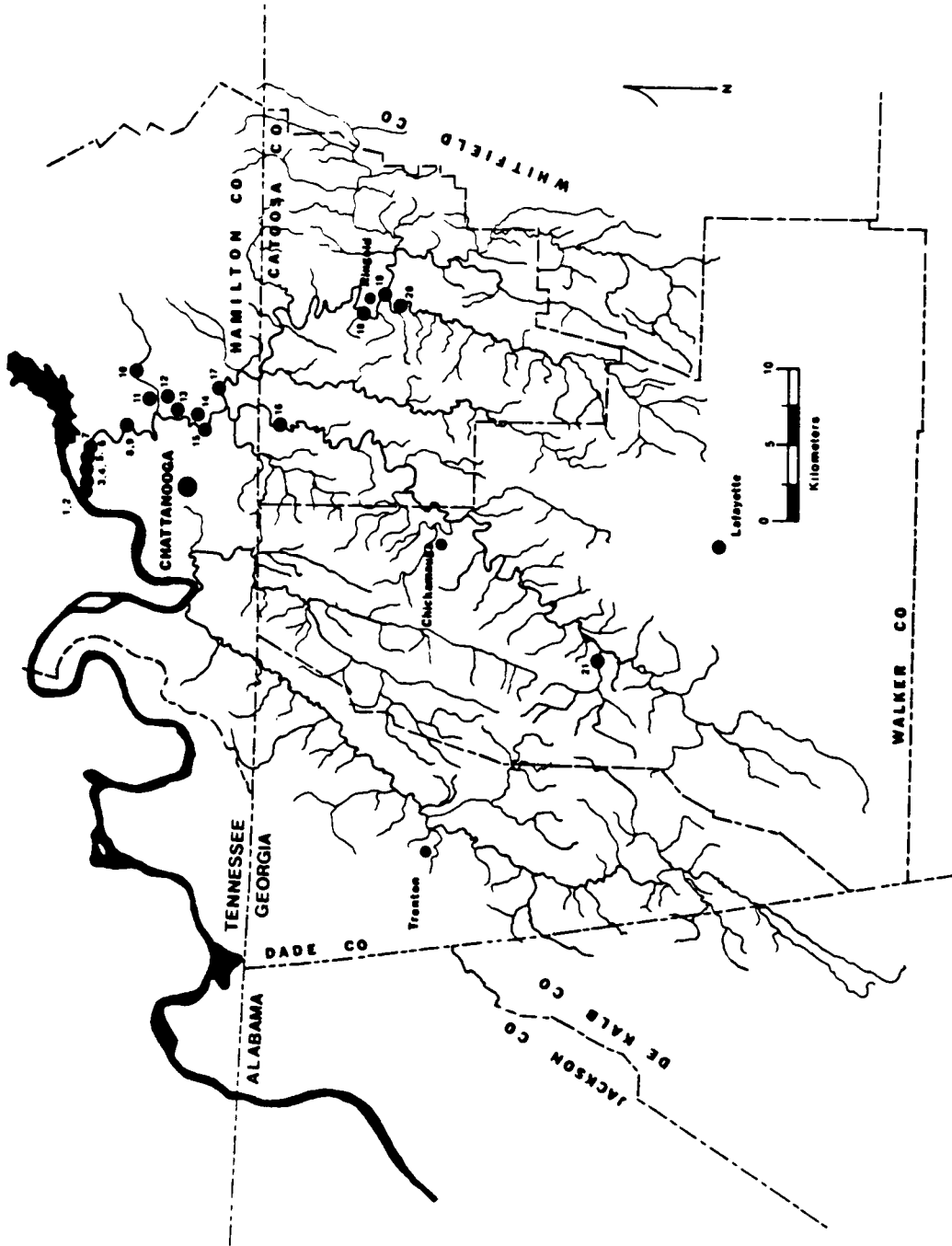


Figure 1. Locations of wastewater sources listed in Appendix A.

1938). The eastern portion of the South Chickamauga Creek system drains the Ridge and Valley Physiographic Province, with the western tributaries of South Chickamauga Creek and all of Lookout Creek draining the Cumberland Plateau.

All of Catoosa and Whitfield counties in Georgia and the eastern portions of Walker County, Georgia, and Hamilton County, Tennessee, lie within the Ridge and Valley Physiographic Province. This area is drained by South Chickamauga Creek and its middle and eastern tributaries. The average width of this southern portion of the Ridge and Valley is 40 miles (64 km), with the Blue Ridge Physiographic Province to the east and the Cumberland Plateau to the west (Fenneman, 1938). This province consists of alternating ridges and valleys oriented in a northeast-southwest direction.

Rocks of the Ridge and Valley are mainly Ordovician and Silurian in age, comprised of the Knox Dolomite, Chickamauga Limestone and Shale, and Red Mountain Sandstone, which is closely associated with the Fort Payne Chert of Mississippian age (Spencer, 1893). There are great differences in hardness of these rocks that have resulted in the conspicuous ridge and valley topography seen today. Limestones and shales are generally eroded away most rapidly, with cemented siliceous sandstones and conglomerates being more resistant. Streams within this physiographic province follow belts of the least resistant rocks (limestones and shales of the Chickamauga Supergroup, Knox Group, and Conasauga Group), crossing the ridge forming hard rock belts through water gaps (Luther et al., 1979; Spencer, 1893). The most prominent water gap is that of South Chickamauga Creek,

which separates Taylor's Ridge and Whiteoak Mountain at Ringgold, Georgia.

Taylor's Ridge is the most conspicuous ridge in this portion of the Ridge and Valley Physiographic Province and is part of a mountain belt that extends southwest to Rome, Georgia. It is the highest ridge between the Blue Ridge Physiographic Province to the east and the Cumberland Plateau to the west (Atwood, 1940). West of Taylor's Ridge, there are numerous low parallel ridges that extend to the base of the Cumberland Plateau and are composed of Knox Dolomite. There are numerous springs associated with this rock formation, several of which are large enough to provide water for municipalities (i.e. Chickamauga Spring, Walker County, Georgia, and Yates Spring, Catoosa County, Georgia).

The Cumberland Plateau portion of the study area occupies the western portion of Walker County, all of Dade County, and the northern portion of DeKalb County in Georgia, and the western portion of Hamilton County, Tennessee. The Cumberland Plateau in this region is made up of several flat-topped plateau-like mountains (Lookout Mountain, Pigeon Mountain, and Sand Mountain), which are dissected remnants of the Great Appalachian Plateau that extends almost unbroken from southern New York to central Alabama (Fenneman, 1938). The plateau is underlain by flat to gently dipping beds of rock and coal seams. Limestones, shales, and conglomerates of Mississippian age lie under the lower slopes which are capped by resistant sandstones, shales, and conglomerates of early Pennsylvanian age. These resistant rocks have protected the top of the plateau from erosion and give it

a characteristic flat-topped profile (Spencer, 1893; Luther et al., 1979). Many caverns, some of which are quite extensive, occur in the Mountain Limestone at the bases of Lookout, Pigeon, and Sand Mountains. Coal seams of Carboniferous age are found in horizontal beds in association with the Raccoon Mountain Formation (sandstone, siltstone, and shale) (Luther et al., 1979).

Lookout Creek is located in an anticlinal valley which separates Lookout Mountain from Sand Mountain to the east. This valley is oriented in a northeast direction and is much sharper and narrower than the valleys east of Lookout Mountain (Fenneman, 1938). It is bounded by escarpments made steep by the easier weathering of weaker rocks that lie below the sandstone rock cover. The present valley lies approximately 275 to 305 m below the top of Lookout and Sand mountains. Lookout Creek valley is traversed by a number of parallel ridges in a similar repetition, but on a smaller scale, to the topography east of Lookout Mountain in the Ridge and Valley Physiographic Province, being composed of Chickamauga Limestone and Shales and the Red Mountain Sandstone (Atwood, 1940).

Topography

Topographic relief of the study area is quite extreme, with elevations ranging from 193 m at the mouths of Lookout and South Chickamauga creeks to over 610 m at the top of Lookout, Pigeon, and Sand mountains. The highest point in elevation is located atop Lookout Mountain at High Point, 735 m above sea level. Total relief is 541 m.

Climate

The climate of the Lookout and South Chickamauga area is temperate but humid, with hot summers and cool winters. Annual precipitation averages about 127 to 132 cm per year, being fairly well distributed throughout the year, except for drier late summer and early fall months (Thomson et al., 1956). Temperatures range during mid-winter from an average daily minimum near 0°C to an average daily maximum of about 10°C. During mid-summer, temperatures range from an average daily minimum near 22°C to an average daily maximum near 32°C (Luther et al., 1979). Such climatic conditions are very conducive to chemical weathering.

Aquatic Habitats and Stream Quality

It was apparent from the beginning of the study that both streams differed substantially in water quality, though habitat and stream type were similar. The lower portion of South Chickamauga Creek and its major tributary, West Chickamauga Creek, were severely affected by both domestic and industrial effluents as well as siltation from non-point sources. Lookout Creek was virtually unaffected by point source effluents, with only minor impacts of non-point sources evident. South Chickamauga Creek has had a history of water quality problems as well as flood problems in the last 40 to 50 years that has not been as severe in extirpating the fish fauna as once thought. The seasonal floods that characterize South Chickamauga Creek may be

a factor involved in reducing the effects of certain types of pollutants during certain times of the year.

The South Chickamauga Creek system consists of several tributary streams. The largest tributary is West Chickamauga Creek, draining the west and southwest portions of the watershed. Little Chickamauga, East Chickamauga, and Tiger creeks drain the south, southeast, and eastern portions of the watershed. Water quality and aquatic habitats for each stream will be discussed separately.

West Chickamauga Creek flows northeast through Walker County, Georgia, joining South Chickamauga Creek at river kilometer 20.9. The tributaries above Kensington, Georgia, drain the western portion of Lookout Mountain and the eastern portion of Pigeon Mountain, forming a deep valley. The three major tributaries are Mill, Mud, and Hogjowl creeks. All three are small, spring-fed, riffle-pool streams averaging 2 to 3 m in width. Water depth ranged from 10 cm in riffles to 1 m in pools. No aquatic vegetation was observed in these streams; however, collections were made in early spring before the emergence of most aquatic plants. Stream gradient was moderate. Water quality was good in all three streams due to the forested watershed, the influence of springs, and the lack of intensive agricultural practices.

Below the confluence of Mud and Hogjowl creeks, West Chickamauga Creek increased in width, averaging 8 to 10 m. Water depth ranged from 20 cm in riffles to 1 to 2 m in pools. Substrates consisted of sand, small to medium gravel, and cobble in riffle areas and sand,

silt, and detritus in pools. Water quality was good in this section downstream to Kensington, Georgia.

Water quality in West Chickamauga Creek decreased from Kensington, Georgia, downstream to the confluence with South Chickamauga Creek. This was due to a Barwick Corporation chemical plant located at Kensington, Georgia, and to several other point and non-point sources located at Chickamauga and Fort Oglethorpe, Georgia, which are shown in Figure 1 (page 4). Stream width averaged 10 to 12 m in the upper portion and 20 to 25 m in the lower portion. Substrates in riffle areas consisted of sand, medium gravel, and cobble, with sand, silt, and mud in pools. Siltation was visible in both riffles and pools throughout this section. Water willow (Justicia) growths occurred along riffle margins and in shallow riffles. Water quality problems were visible at all stations sampled in this portion of West Chickamauga Creek, as indicated by sewage odor, turbidity, blue-green algal growths, and low fish abundance.

South Chickamauga Creek is formed by three tributaries which join at Ringgold, Georgia; Tiger Creek, East Chickamauga Creek, and Little Chickamauga Creek.

Tiger Creek is a spring-fed Order 4 stream. Stream width ranged from 1 to 2 m in the upper section to 8 to 10 m in the lower section. Riffle areas had substrates consisting of sand, small gravel, cobble, and bedrock. Pool substrates were primarily sand, silt, and detritus. Stream gradient was moderate throughout the entire stream. Water depth ranged from 10 cm in riffle areas to a maximum of 1.5 m in pools. Water willow occurred in shallow riffles and along the

margins of deeper riffles in the lower section. Watercress (Nasturtium) growths occurred in several springs and spring runs in the upper section.

East Chickamauga Creek, an Order 5 stream in the lower section, was similar to Tiger Creek in stream habitats; however, the watershed was larger than that of Tiger Creek which resulted in more extensive pools in the lower section. Stream gradient was moderate in the headwaters and low in the lower section. Pool and riffle substrates were similar to Tiger Creek. Some siltation was visible in the lower section, due to agricultural practices and to clearing of land for development.

Little Chickamauga Creek, an Order 4 stream, was similar in size and water quality to East Chickamauga Creek. Stream width ranged from 2 to 3 m in the upper portion to 10 to 12 m near Ringgold, Georgia. Pool and riffle substrates were similar to Tiger and East Chickamauga creeks. Stream gradient was moderate. Water willow growths occurred in and along the margins of riffle areas, primarily in the lower section. Water quality was similar to East Chickamauga Creek, with some siltation visible below river kilometer 17.7. An industrial facility, Dixie Yarns, Inc., located at river kilometer 2.4, was a point source of wastewater into Little Chickamauga Creek. Another industrial facility, Salem Carpet Mills, Inc., located adjacent to Dixie Yarns, Inc. discharged both process and sanitary wastes into Little Chickamauga Creek at river kilometer 2.3. The locations of both facilities is shown on Figure 1 (page 4). A description of the wastes discharged is listed in Appendix A (Vincent, 1979).

Below the confluence of the three tributaries at Ringgold, Georgia, South Chickamauga Creek was a medium-sized river (Order 5). Stream width averaged 30 to 40 m in this section downstream to river kilometer 20.9. Stream gradient was moderate. Riffle areas, some of which were quite extensive, occurred at 0.4 to 0.8 km intervals. Substrates in shallow riffle areas consisted of silt, sand, and small to medium gravel, with silt, sand, medium gravel, and boulders in deeper riffles. Pool substrates consisted of sand, silt, and mud, with some detritus and downed trees. Water depth ranged from 10 to 30 cm in riffles to 2 to 3 m in the deeper pools. Extensive growths of water willow and water weed (Podostemum) occurred throughout this section. Several extensive bedrock riffles were located between river kilometer 41.8 and 37.0.

Water quality from Ringgold, Georgia, downstream was degraded due to effluents from several industries and a municipal sewage treatment plant located at Ringgold. The location of these point sources are shown on Figure 1 (page 4). The effects of pollution were less visible below river kilometer 45.0, with a subsequent increase in the diversity and abundance of the fish fauna. Non-point siltation was visible at all stations sampled in this section.

West Chickamauga Creek joins South Chickamauga Creek at river kilometer 20.9, making it an Order 6 stream. From this point downstream to the embayment of Nickajack Reservoir, stream size increased, averaging 50 to 60 m in width. Stream gradient was moderate throughout this section. Between river kilometer 20.1 and 11.2 there were extensive flood control improvements, consisting of levees and pumping

stations, along with some stream channel modifications. Water quality in this section was severely impacted by numerous point and non-point sources, which are listed in Appendix A. The location of point source discharges into South Chickamauga Creek are shown on Figure 1 (page 4) (Vincent, 1979).

Lookout Creek flows northeast through Dade County, Georgia, draining the northwestern portion of Lookout Mountain and the northeastern portion of Sand Mountain. It was an Order 5 riffle-pool stream with good water quality. Most of the low order tributary streams were spring fed. However, some of the eastern tributaries draining off Lookout Mountain were dry during the summer months.

The section of Lookout Creek above Trenton, Georgia, was pristine in comparison to South Chickamauga Creek. It is classified as an Order 4 stream. There were no signs of either point or non-point source pollution, which was indicated by water quality, habitat conditions, and the abundance and diversity of fishes. Stream width ranged from 5 to 10 m near the Alabama state line to 10 to 15 m at Trenton, Georgia. Gradient was moderate throughout this section. Water depth ranged from 10 cm in riffles to a maximum of 2 m in pools. Riffle substrates typical of this section, as well as the section below Trenton, consisted of sand, fine gravel, and cobble, with bedrock and boulders in several of the larger riffle areas. Riffles were located at approximately 0.8 km intervals, with long, steep-banked pools between. Pool substrates consisted of sand, silt, and detritus, with snags and downed trees common. Several logjams were observed in this section that

completely blocked the stream channel. Growths of water willow and water weed were common in shallow riffles.

The section of Lookout Creek below Trenton, Georgia, was similar to the upper section in substrate types, stream gradient, and water quality; however, riffle areas were less common. Stream width averaged 15 to 20 m, and depth ranged from 10 cm in riffles to a maximum of 3 m in pools. There were numerous logjams present throughout this section. Water willow and water weed growths were common in shallow riffles. Trenton, Georgia, wastewater treatment plant, located at river kilometer 30.6, discharged sanitary wastewater into Lookout Creek. There were no water quality problems resulting from this treatment facility.

III. COLLECTION SITES

Data

Collection sites in the Lookout Creek system are numbered consecutively, beginning at the mouth (Figure 2). Collection sites in the South Chickamauga Creek system are also numbered consecutively from the mouth (Figure 2) but due to the dendritic drainage pattern in the upper portion of the system the eastern tributaries have lower site numbers than the western tributaries.

Collection sites in the upper portion of Lookout Creek in DeKalb County, Alabama, are located with respect to township (T), range (R), and section (Sec), as determined from United States Geologic Survey topographic maps, scale 1:24,000. Due to the absence of townships, range, and section lines in both Tennessee and Georgia, collection sites are described from the nearest town, highway crossing, intersection, or other prominent landmarks.

Elevations for each collection site were taken from United States Geologic Survey topographic maps, scale 1:24,000, to the nearest contour. The contour intervals were located every 20 feet (6 m) with supplementary contours at 10 feet (3 m) in areas of low relief.

The following data are listed for each collection site if available: site number, name of stream; stream location with respect to towns, highways, and other landmarks; section; township; range; stream kilometer; county; state; elevation; water clarity; water temperature in degrees celsius; air temperature in degrees celsius;

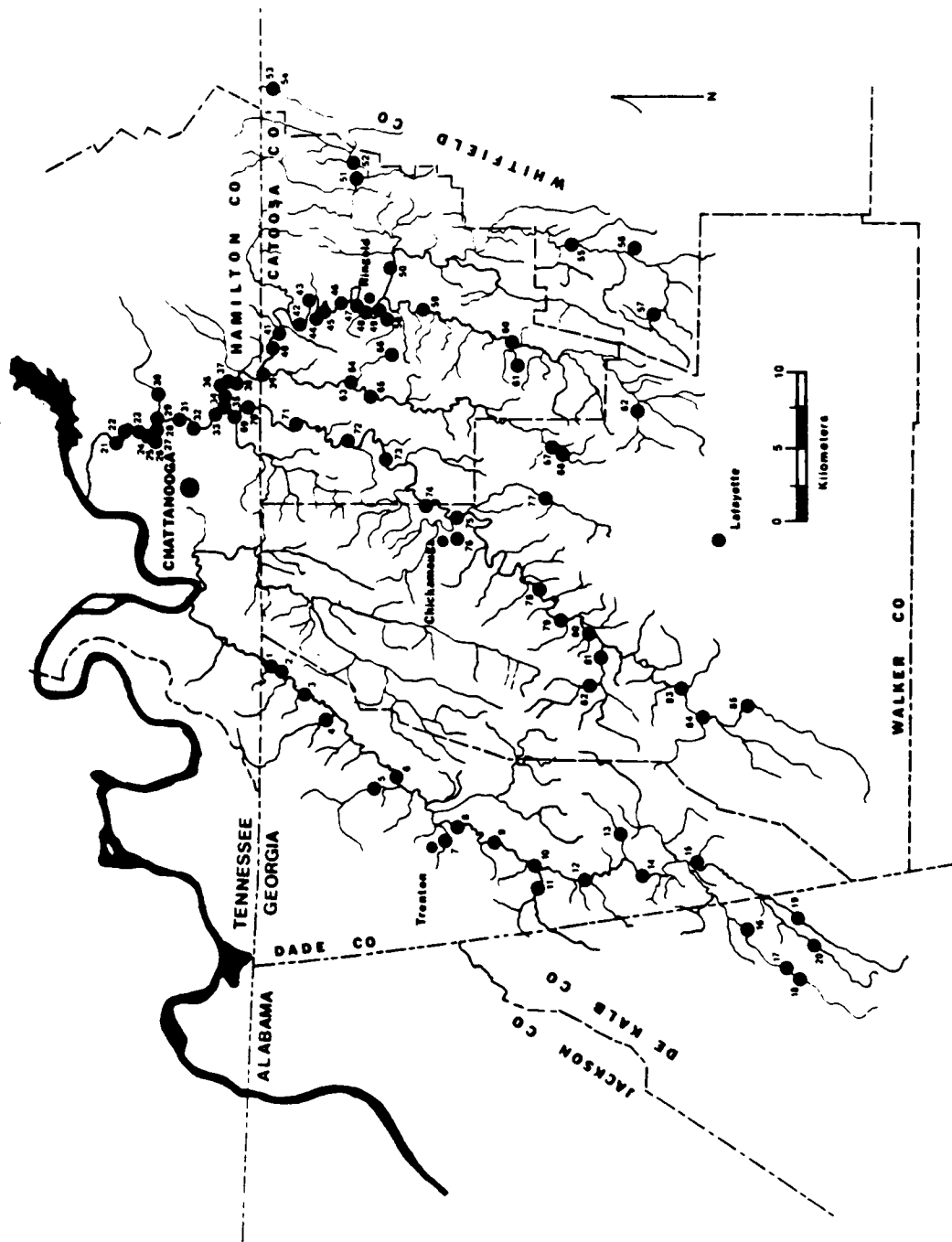


Figure 2. Map of collection sites in Lookout Creek and South Chickamauga creek systems.

current; substrate description; depth; width; date of collection; collection number; stream order; and a list of species collected at each site. The species collected at each site are numbered according to the number assigned to them in the annotated list of species. Abbreviations used in the site descriptions are as follows: AGH, Andrew Glen Haines; JLH, John L. Harris; UAIC, University of Alabama Ichthyological Collection; UGIC, University of Georgia Ichthyological Collection; and TVA, Tennessee Valley Authority. All collections were made using 3 m X 1.5 m and 6 m X 3 m small-mesh minnow swines, unless stated otherwise in the site description.

All streams within both creek systems were classified according to Horton's (1945) stream classification system as modified by Strahler (1957). Streams were ranked by using accurate United States Geologic Survey topographic maps made from aerial photographs, scale 1:24,000. Extreme unbranched headwater streams, whether intermittent or permanent, are ranked as Order 1. The union of two Order 1 streams forms an Order 2 stream. Where two Order 2 streams join, an Order 3 stream is formed, etc. Whenever two streams of the same order join, they form a stream of the next highest order. The rank of a stream was not increased by the entrance of another stream of lower order. All springs and spring runs are ranked as Order 1 streams, although they may not fit the classification system perfectly because of a large subterranean drainage area. This stream classification system is based on stream branching and not on physico-chemical or biological characteristics.

Site Descriptions¹

1. Lookout Creek 1.1 km SE of L & N R. R. overpass over US Hwy 11, off road that turns east just S of overpass, Dade Co., GA. Elev. 195 m; water clear; current moderate to swift; substrate small gravel, sand, mud; depth to 2 m; width to 15 m. 1 November 1980. AGH 80-68. Order 5.

Species: 10, 13, 17, 23, 24, 28, 39, 55, 56, 59, 60, 62, 68, 76, 77, 81, 85.

2. Lookout Creek 0.6 km NE of Wildwood, Dade Co., GA. Elev. 197 m; water slightly turbid; current moderate; substrate gravel, sand, silt, detritus; depth to 1 m; width to 18 m. 16 June 1981. AGH 81-18. Order 5.

Species: 10, 13, 17, 23, 24, 26, 29, 37, 39, 47, 55, 59, 62, 63, 68, 71, 76, 77, 80, 81, 85.

3. Lookout Creek 1.9 km SE of Wildwood, below mill dam, Dade Co., GA. Elev. 198 m; water slightly turbid; current moderate to swift; substrate gravel, sand, silt, detritus; depth to 1.5 m; width to 23 m. 16 June 1981. AGH 81-19. Order 5.

Species: 10, 13, 17, 23, 24, 31, 39, 47, 55, 59, 62, 63, 68, 75, 76, 77, 79, 80, 84, 85.

4. Pope Creek on US Hwy 11 NE of Trenton, Dade Co., GA. Elev. 209 m; water clear; current moderate to swift; substrate gravel, rock;

¹See pp. 35-64 for identities of numbered species.

depth to 1 m; width to 4.5 m. 25 July 1964. UAIC 1333. Order 3.
Species: 10, 72, 74, 76, 77, 85.

5. Squirrel Town Creek 5.6 km NE of Trenton, Dade Co., GA.
Elev. 210 m; water clear; current swift; substrate gravel, rock;
depth to 1.5 m; width to 6 m. 5 May 1963, UAIC 997. 22 July 1965,
UAIC 1658. Order 3.
Species: 10, 19, 36, 39, 72, 75, 76, 77, 85.

6. Lookout Creek at Co. rd. 201 Xing, Dade Co., GA. Elev.
204 m; water clear; current moderate to swift; substrate gravel, sand,
silt; depth to 1.5 m; width to 15 m. 10 May 1980. AGH 80-14.
Order 5.
Species: 26, 58, 75, 76, 77, 80, 81, 85.

7. Small creek tributary to Lookout Creek behind Dade County
High School, Trenton, Dade Co., GA. Elev. 229 m; water clear; current
swift; substrate gravel, rock, sand; depth to 1 m; width to 4.5 m.
4 May 1963. UAIC 999. Order 2.
Species: 10, 36, 37, 74, 77, 85.

8. Lookout Creek below Sitton Mill dam, Dade Co., GA. Elev.
210 m; water clear; current moderate to swift; substrate gravel,
boulder, sand, detritus; depth to 1 m; width to 12 m. 29 September
1965, UAIC 1690. 1 November 1980, AGH 80-69. Order 4.
Species: 2, 6, 10, 11, 17, 19, 20, 21, 23, 24, 25, 26, 28, 29, 33,
39, 41, 42, 43, 46, 47, 50, 53, 55, 58, 59, 60, 62, 63, 64, 65, 67,
68, 69, 70, 71, 72, 74, 75, 76, 77, 80, 81, 84, 85.

9. Lookout Creek 2.4 km upstream from GA Hwy 143 Xing, Dade
Co., GA. Elev. 213 m; water clear; water temp. 24.4°C; current

moderate to swift; substrate bedrock, cobble, gravel, sand; depth to 1 m; width to 9 m. 20 August 1980. AGH 80-64. Order 4.

Species: 10, 17, 19, 23, 24, 25, 26, 29, 34, 39, 43, 58, 59, 62, 67, 68, 71, 75, 76, 77, 80, 85.

10. Lookout Creek approximately 4.8 km SW of Trenton, Dade Co., GA. Elev. 218 m; water clear; water temp. 24.4°C; air temp. 26.7°C; current moderate to swift; substrate gravel, cobble, sand; depth to 1.5 m; width to 9 m. 19 August 1980. AGH 80-63. Order 4.

Species: 10, 17, 19, 23, 24, 26, 29, 39, 43, 59, 63, 68, 71, 72, 75, 76, 77, 85.

11. Crayfish Creek on US Hwy 11, 4.8 km SW of Trenton, Dade Co., GA. Elev. 232 m; water clear; current swift; substrate gravel, rock, sand; depth to 1.5 m; width to 4.5 m. 5 May 1963. UAIC 998. Order 3.

Species: 10, 23, 35, 36, 39, 62, 74, 77, 85.

12. Lookout Creek approximately 8.8 km SW of Trenton, Dade Co., GA. Elev. 226 m; water slightly turbid; water temp. 22.8°C; air temp. 26.7°C; current moderate to swift; substrate gravel, boulder, sand; depth to 1.5 m; width to 9 m. 19 August 1980. AGH 80-62. Order 4.

Species: 10, 17, 19, 23, 24, 25, 26, 29, 36, 39, 42, 58, 59, 60, 62, 65, 68, 71, 72, 75, 76, 77, 85.

13. Hurricane Creek at Co. rd 125 Xing, approximately 11.6 km S of Trenton, Dade Co., GA. Elev. 244 m; water clear; water temp. 22.2°C; air temp. 35°C; current slow; substrate gravel, sand; depth

to 1 m; width to 3 m. 19 July 1980. AGH 80-45. Order 2.

Species: 10, 24, 36, 37, 38, 62, 74, 77, 85.

14. Lookout Creek under R. R. bridge, 1.6 km SE of Rising Fawn, Dade Co., GA. Elev. 232 m. 29 November 1959. UGIC 689a (rotenone sample). Order 4.

Species: 19, 24, 41, 43, 58, 59, 60, 61, 62, 63, 64, 65, 67, 69, 85.

15. Lookout Creek at Co. rd. 129 Xing, approximately 16.9 km S of Trenton, Dade Co., GA. Elev. 242 m; water slightly turbid; water temp. 25.6°C; air temp. 30°C; current slow to moderate; substrate gravel, sand, silt; depth to 1.5 m; width to 9 m. 19 July 1980. AGH 80-44. Order 3.

Species: 10, 19, 23, 24, 25, 29, 39, 42, 53, 58, 59, 62, 65, 67, 69, 71, 75, 76, 77, 80, 85.

16. Dry Creek on US Hwy 11, approximately 4.8 km from the AL-GA state line, DeKalb Co., AL. Elev. 268 m; water clear; current moderate to swift; substrate gravel, rock, mud; depth to 1 m; width to 6 m. 10 November 1963. UAIC 1072. Order 4.

Species: 10, 17, 24, 39, 62, 63, 75, 76, 77, 85.

17. Unnamed spring at Rodgers on US Hwy 11, Sec 28, T 4 S, R 10 E, DeKalb Co., AL. Elev. 280 m; water clear; water temp. 14.4°C; current swift, substrate gravel; depth to 30 cm; width to 45 cm. 19 August 1964. UAIC 1393. Order 1.

Species: 10, 36, 37, 77, 85.

18. Unnamed spring on W side of US Hwy 11, Sec 5, T 5 S, R 10 E, DeKalb Co., AL. Elev. 299 m; water clear; current moderate

to swift; substrate sand, gravel; depth to 60 cm; width to 3.5 m.

10 April 1964. UAIC 1257. Order 1.

Species: 10, 36, 37, 60, 85.

19. Morgan Spring, Sec 26, T 4 S, R 10 E, DeKalb Co., AL.
Elev. 271 m; water clear; water temp. 14.4°C; current moderate to swift; substrate gravel, sand; depth to 45 cm; width to 2 m. 19 August 1964. UAIC 1392. Order 1.

Species: 10, 24, 36, 37, 38, 39, 74, 77, 85.

20. Gifford Spring, Sec 8, T 5 S, R 10 E, DeKalb Co., AL.
Elev. 293 m; water clear; water temp. 15°C; current slow to swift; substrate gravel; depth to 30 cm; width to 1 m. 19 August 1964. UAIC 1394. Order 1.

Species: 36, 37, 77, 85.

21. South Chickamauga Creek, river kilometer 6.4 to 6.9, Hamilton Co., TN. Elev. 195 m. 5-14 November 1980. TVA Personnel. Order 6.

Species: 10, 17, 21, 28, 30, 62, 64, 68, 76, 78, 80, 85.

22. South Chickamauga Creek, river kilometer 7.4 to 8.0, Hamilton Co., TN. Elev. 196 m. 5-14 November 1980. TVA Personnel. Order 6.

Species: 10, 13, 17, 21, 28, 31, 32, 39, 62, 63, 64, 68, 76, 78, 80, 85.

23. South Chickamauga Creek, river kilometer 9.5, Hamilton Co., TN. Elev. 197 m. 5-14 November 1980. TVA Personnel. Order 6.
Species: 10, 17, 21, 28, 32, 76, 80, 82.

24. South Chickamauga Creek, river kilometer 9.8 to 10.3, Hamilton Co., TN. Elev. 197 m. 5-14 November 1980. TVA Personnel. Order 6.

Species: 16, 17, 21, 28, 32, 62, 78, 80.

25. South Chickamauga Creek at river kilometer 10.3, Hamilton Co., TN. Elev. 197 m. 5-14 November 1980. TVA Personnel. Order 6. Species: 10, 17, 28, 32, 35, 68, 78, 80, 85.

26. South Chickamauga Creek, river kilometer 10.3 to 11.3, Hamilton Co., TN. Elev. 198 m. 5-14 November 1980. TVA Personnel. Order 6.

Species: 17, 21, 28, 68, 80, 85.

27. South Chickamauga Creek at river kilometer 11.9, Hamilton Co., TN. Elev. 198 m. 5-14 November 1980. TVA Personnel. Order 6. Species: 10, 17, 21, 28, 32, 47, 68, 76, 77, 78, 82, 83, 85.

28. South Chickamauga Creek at river kilometer 13.3, Hamilton Co., TN. Elev. 199 m. 5-14 November 1980. TVA Personnel. Order 6. Species: 17, 21, 28, 37, 42, 47, 55, 62, 68, 76, 78, 80, 82, 85.

29. South Chickamauga Creek at river kilometer 13.9. Hamilton Co., TN. Elev. 199 m. 5-14 November 1980. TVA Personnel. Order 6. Species: 10, 17, 21, 28, 31, 32, 39, 59, 68, 71, 77, 78, 80, 81, 85.

30. Friar Branch at Shallowford Rd. Xing, Hamilton Co., TN. Elev. 203 m; water clear; water temp. 20°C; air temp. 29.4°C; current slow to moderate; substrate sand, silt, gravel; depth to 1 m; width to 6 m. 12 July 1981. AGH 81-20. Order 4.

Species: 6, 10, 24, 33, 39, 46, 55, 59, 60, 69, 72, 77, 85.

31. South Chickamauga Creek, river kilometer 16.7 to 16.9, Hamilton Co., TN. Elev. 200 m. 5-14 November 1980. TVA Personnel. Order 6.
Species: 10, 28, 32, 35, 78, 85.

32. South Chickamauga Creek, river kilometer 16.9 to 19.3, Hamilton Co., TN. Elev. 200 m. 5-14 November 1980. TVA Personnel. Order 6.
Species: 13, 21, 28, 48, 56, 64, 78, 80, 85.

33. South Chickamauga Creek at river kilometer 20.4, Hamilton Co., TN. Elev. 200 m; water clear; current moderate to swift; substrate gravel, sand, cobble, boulder; depth to 1 m; width to 45 m. 1 November 1980, AGH 80-72. 22 November 1980, AGH 80-82. Order 6.
Species: 6, 10, 17, 28, 39, 48, 50, 55, 58, 60, 62, 64, 68, 69, 71, 76, 77, 78, 82, 85.

34. South Chickamauga Creek, river kilometer 19.3 to 20.9, Hamilton Co., TN. Elev. 201 m. 5-14 November 1980. TVA Personnel. Order 6.
Species: 6, 10, 13, 17, 28, 31, 32, 35, 39, 42, 43, 48, 55, 56, 57, 62, 68, 69, 71, 76, 77, 78, 80, 81, 82, 85.

35. South Chickamauga Creek, river kilometer 20.9 to 21.4, Hamilton Co., TN. Elev. 201 m. 5-14 November 1980. TVA Personnel. Order 5.
Species: 6, 17, 28, 32, 39, 48, 75, 76, 77, 78, 81, 85.

36. South Chickamauga Creek, river kilometer 23.6 to 24.3, Hamilton Co., TN. Elev. 202 m. 5-14 November 1980. TVA Personnel.

Order 5.

Species: 10, 17, 21, 28, 32, 64, 71, 76, 77, 78, 80, 85.

37. South Chickamauga Creek at river kilometer 24.8, Hamilton Co., TN. Elev. 203 m. 5-14 November 1980. TVA Personnel. Order 5.

Species: 10, 17, 32, 39, 48, 71, 76, 77, 78, 80, 85.

38. South Chickamauga Creek at Elise Chapin Wildlife Sanctuary, Hamilton Co., TN. Elev. 204 m; water clear; water temp. 15.5°C; air temp. 12.8°C; current moderate to swift; substrate gravel, sand, silt, detritus; depth to 1 m; width to 27 m. 22 November 1980. AGH 80-81.

Order 5.

Species: 10, 17, 24, 28, 39, 48, 55, 58, 59, 60, 62, 64, 68, 71, 72, 76, 77, 78, 85.

39. South Chickamauga Creek, river kilometer 27.8 to 29.3, Hamilton Co., TN. Elev. 207 m. 5-14 November 1980. TVA Personnel.

Order 5.

Species: 10, 13, 17, 19, 21, 23, 24, 32, 39, 48, 55, 67, 68, 71, 72, 75, 76, 77, 78, 80, 82, 85.

40. South Chickamauga Creek at and below mill dam at Graysville, Catoosa Co., GA. Elev. 209 m; water slightly turbid; current moderate to swift; substrate gravel, cobble, boulder, sand; depth to 2 m; width to 30 m. 4 April 1953, UGIC 281. 28 September 1968, UGIC 1175. 8 August 1980, AGH 80-59. 4 October 1980, AGH 80-65.

Order 5.

Species: 10, 13, 17, 20, 23, 24, 26, 32, 39, 42, 53, 55, 56, 58, 59, 60, 61, 62, 64, 67, 68, 69, 70, 71, 72, 73, 75, 76, 77, 78, 80, 81, 82, 84, 85.

41. South Chickamauga Creek at river kilometer 33.3, Catoosa Co., GA. Elev. 210 m. 5-14 November 1980. TVA Personnel. Order 5. Species: 6, 10, 13, 17, 23, 24, 30, 39, 55, 71, 72, 75, 76, 77, 78, 85.

42. South Chickamauga Creek at river kilometer 38.5, Catoosa Co., GA. Elev. 213 m. 5-14 November 1980. TVA Personnel. Order 5. Species: 10, 13, 17, 23, 24, 27, 39, 69, 71, 72, 76, 77, 78, 85.

43. South Chickamauga Creek at river kilometer 39.7, Catoosa Co., GA. Elev. 213 m; water turbid; water temp. 26.1°C; air temp. 23.9°C; current swift; substrate bedrock, gravel, cobble, sand; depth to 2 m; width to 30 m. 27 July 1980. AGH 80-56. Order 5. Species: 10, 13, 19, 20, 23, 24, 37, 39, 42, 58, 59, 63, 67, 69, 71, 76, 77, 85.

44. South Chickamauga Creek at river kilometer 40.5, Catoosa Co., GA. Elev. 215 m; water turbid; water temp. 26.1°C; air temp. 23.9°C; current moderate to swift; substrate bedrock, gravel, cobble, sand; depth to 1.5 m; width to 30 m. 27 July 1980. AGH 80-55. Order 5.

Species: 10, 13, 17, 23, 24, 58, 59, 72, 76, 77, 78, 81, 85.

45. South Chickamauga Creek at river kilometer 40.9, Catoosa Co., GA. Elev. 216 m; water turbid; current moderate; substrate bedrock, gravel, sand; depth to 1 m; width to 26 m. 26-27 July 1980. AGH 80-54 (experimental mesh gill net sample). Order 5. Species: 6, 39, 42, 58, 59, 66.

46. South Chickamauga Creek at river kilometer 43.4; Catoosa Co., GA. Elev. 218 m; water turbid; water temp. 25.6°C; air temp. 31.1°C; current moderate to swift; substrate gravel, boulder, sand; depth to 1 m; width to 25 m. 26 July 1980. AGH 80-53. Order 5.

Species: 10, 23, 24, 32, 33, 37, 55, 58, 59, 67, 69, 71, 75, 76, 77, 80, 81, 85.

47. South Chickamauga Creek at river kilometer 48.3, Catoosa Co., GA. Elev. 223 m; water turbid; water temp. 23.9°C; air temp. 25.6°C; current moderate; substrate gravel, cobble, boulder, sand; depth to 1 m; width to 23 m. 26 July 1980. AGH-80-52. Order 5. Species: 10, 13, 19, 23, 24, 26, 32, 39, 55, 58, 59, 60, 62, 68, 69, 71, 72, 76, 77, 78, 80, 81, 85.

48. South Chickamauga Creek at US Hwy 41 Xing in Ringgold, Catoosa Co., GA. Elev. 224 m. 28 September 1968. UGIC 1176. Order 5.

Species: 10, 17, 19, 23, 55, 58, 65, 71, 76, 77, 85.

49. South Chickamauga Creek at GA St Hwy 151 Xing in Ringgold, Catoosa Co., GA. Elev. 226 m; water slightly turbid; water temp. 25.6°C; air temp. 32.2°C; current slow to moderate; substrate gravel, sand, silt, mud; depth to 1 m; width to 25 m. 19 July 1980. AGH 80-47. Order 5.

Species: 10, 19, 23, 24, 32, 53, 55, 59, 67, 69, 71, 75, 76, 77, 80, 85.

50. South Chickamauga Creek at L & N R. R. Xing, 1.6 km SE of Ringgold, Catoosa Co., GA. Elev. 229 m; water slightly turbid; water temp. 12.8°C; air temp. 15.6°C; current slow to moderate; substrate gravel, boulder, sand; depth to 1 m; width to 15 m. 4 October 1980. AGH 80-66. Order 5.

Species: 10, 13, 19, 23, 24, 39, 55, 58, 59, 62, 71, 75, 76, 77, 78, 85.

51. Tiger Creek at Co. rd. 385 Xing in Keith, Catoosa Co., GA. Elev. 242 m; water clear; water temp. 19.4°C; air temp. 33.3°C; current moderate to swift; substrate bedrock, gravel, boulder, sand; depth to 1 m; width to 9 m. 8 August 1980, AGH 80-57. 18 August 1980, AGH 80-61. Order 4.

Species: 9, 10, 12, 37, 39, 55, 71, 72, 76, 77, 85.

52. Tiger Creek at ford on gravel road 0.3 km NW of Co. rd. 213, at Smith Chapel, Catoosa Co., GA. Elev. 250 m; water clear; water temp. 17.8°C; air temp. 30°C; current slow to moderate; substrate gravel, cobble, bedrock, sand, detritus; depth to 1 m; width to 9 m. 18 August 1980. AGH 80-60. Order 3.

Species: 36, 37, 39, 55, 59, 60, 61, 62, 71, 72, 77, 85.

53. Bridges Spring, 1.8 km W of Cohutta, Whitfield Co., GA. Elev. 268 m; water clear; current very slow to none; substrate sand, mud; depth to 1 m; width to 12 m. 4 March 1966. UAIC 1872. Order 1.

Species: 12.

54. Bridges Spring run at tar road, approximately 2.1 km W of Cohutta, Whitfield Co., GA. Elev. 268 m; water milky; current slow; substrate marl, gravel; depth to 60 cm; width to 3 m. 4 October 1980. AGH 80-67a. Order 2.

Species: 10, 12, 24, 33, 36, 55, 59, 60, 62, 77.

55. East Chickamauga Creek at confluence with Hopkins Creek at Co. rd. 326 Xing, Whitfield Co., GA. Elev. 249 m; water clear; current moderate; substrate gravel, sand, silt; depth to 1.5 m; width to 12 m. 10 May 1980. AGH 80-11. Order 4.

Species: 10, 13, 24, 27, 39, 62, 71, 72, 75, 76, 77, 85.

56. Freeman Spring at Co. rd. 331, Whitfield Co., GA. Elev. 262 m; water clear; water temp. 15°C; air temp. 30°C; current slow to moderate; substrate gravel, sand, silt; depth to 1 m; width to 4.5 m. 8 August 1980. AGH 80-58. Order 1.

Species: 36, 37, 53, 62, 72, 77, 85.

57. East Chickamauga Creek 0.3 km W of Co. rd. 336 Xing, along Co. rd. 338, Whitfield Co., GA. Elev. 274 m; water clear; water temp. 16.7°C; air temp. 26.7°C; current moderate; substrate gravel, bedrock; depth to 60 cm; width to 6 m. 10 May 1980. AGH 80-12. Order 4.

Species: 10, 24, 39, 59, 67, 72, 75, 76, 77, 85.

58. Tributary to South Chickamauga Creek at GA St Hwy 2 Xing in Ringgold, Catoosa Co., GA. Elev. 235 m. 1 October 1966. UGIC 1003. Order 3.

Species: 10, 20, 23, 24, 30, 39, 58, 62, 69.

59. Little Chickamauga Creek at Co. rd. 179 Xing, Catoosa Co., GA. Elev. 235 m; water slightly turbid; current moderate; substrate gravel, cobble, sand; depth to 1.5 m; width to 12 m. 26 October 1979, JLH 79-60. 19 April 1980, AGH 80-10. Order 4.

Species: 1, 10, 13, 19, 23, 24, 37, 39, 43, 53, 55, 59, 60, 62, 71, 72, 75, 76, 77, 80, 81, 85.

60. Little Chickamauga Creek at Co. rd 189 Xing, Catoosa Co., GA. Elev. 242 m; water turbid; water temp. 23.3°C; air temp. 32.2°C; current slow to moderate; substrate gravel, sand, mud, detritus; depth to 1.5 m; width to 8 m. 25 July 1980. AGH 80-49. Order 4.

Species: 10, 19, 24, 39, 53, 55, 59, 60, 62, 71, 77, 81, 85.

61. Yates Spring at Catoosa Co. water treatment plant, outside of fence, Catoosa Co., GA. Elev. 244 m; water clear; water temp.

14.4°C; air temp. 28.9°C; current slow to moderate; substrate silt, sand, detritus; depth to 1 m; width to 9 m. 25 July 1980. AGH 80-48. Order 1.

Species: 38, 55, 60, 85.

62. Tributary to Little Chickamauga Creek at GA St Hwy 95, Walker Co., GA. Elev. 270 m. 13 April 1960. UGIC 785. Order 3. Species: 10, 33, 37, 53, 59, 72, 77.

63. Peavine Creek at confluence with Ellis spring branch, at Co. rd. 2 Xing, Catoosa Co., GA. Elev. 216 m; water turbid; water temp. 23.9°C; air temp. 29.4°C; current slow to moderate; substrate gravel, sand, silt; depth to 1.5 m; width to 6 m. 25 July 1980. AGH 80-51. Order 4.

Species: 10, 17, 23, 39, 55, 60, 62, 71, 76, 77, 85.

64. Ellis Spring branch at confluence with Peavine Creek at Co. rd. 2 Xing, Catoosa Co., GA. Elev. 216 m; water clear; water temp. 18.3°C; air temp. 29.5°C; current slow to moderate; substrate gravel, sand; depth to 60 cm; width to 3 m. 25 July 1980. AGH 80-51. Order 3.

Species: 10, 36, 76, 77, 85.

65. Peavine Creek at GA St Hwy 2 Xing, Catoosa Co., GA. Elev. 216 m; water turbid; current slow to moderate; substrate temporary fill from bridge construction, silt, boulders; depth to 1.5 m; width to 8 m. 19 April 1980. AGH 80-9. Order 4.

Species: 10, 17, 39, 62, 85.

66. Ellis Spring at Co. rd. 382, approximately 5.3 km WNW of Ringgold, Catoosa Co., GA. Elev. 238 m; water clear; water temp.

14.4°C; air temp. 29.4°C; current moderate; substrate gravel, sand; depth to 45 cm; width to 2 m. 25 July 1980. AGH 80-50. Order 1.
Species: 36, 60.

67. Peavine Creek 3.2 km ESE of Rock Spring, Walker Co., GA. Elev. 249 m. 14 April 1960. UGIC 789. Order 2.
Species: 10, 37, 71, 72, 75, 76, 77, 85.

68. Peavine Creek at GA St Hwy 143, 3.9 km SSE Rock Spring, Walker Co., GA. Elev. 256 m. 14 April 1960. UGIC 790. Order 2.
Species: 59, 62, 65, 77, 85.

69. West Chickamauga Creek, river kilometer 0.0 to 2.1, Hamilton Co., TN. Elev. 201 m. 5-14 November 1980. TVA Personnel. Order 5.
Species: 6, 10, 17, 32, 39, 62, 78, 85.

70. West Chickamauga Creek at river kilometer 3.2, Hamilton Co., TN. Elev. 203 m. 5-14 November 1980. TVA Personnel. Order 5.
Species: 13, 17, 78, 85.

71. West Chickamauga Creek at GA St Hwy 146 Xing, Catoosa Co., GA. Elev. 204 m; water slightly turbid; water temp. 15.6°C; air temp. 12.8°C; current slow to moderate; substrate bedrock, boulder, gravel, sand; depth to 1 m; width to 27 m. 4 October 1980, AGH 80-67b. 5-14 November 1980, TVA Personnel. Order 5.
Species: 10, 17, 25, 28, 32, 42, 55, 56, 59, 60, 62, 64, 76, 78, 85.

72. West Chickamauga Creek at Battlefield Parkway Xing, Catoosa Co., GA. Elev. 207 m. August 1978. GA Dept. of Trans. Order 5.
Species: 41, 45, 58, 59, 60, 61, 62, 63.

73. West Chickamauga Creek at Alexander Bridge, river kilometer 23.6, Catoosa Co., GA. Elev. 210 m. August 1978. GA Dept. of Trans. Order 5.
Species: 81.

74. West Chickamauga Creek at Lee and Gordon Mill, Walker Co., GA. Elev. 213 m; water turbid; water temp. 10°C; air temp. 10°C; current slow to moderate; substrate gravel, bedrock, sand; depth to 1 m; width to 22 m. 5-14 November 1980, TVA Personnel. 22 November 1980, AGH 80-83. Order 5.
Species: 10, 17, 24, 55, 60, 62, 69, 76, 85.

75. West Chickamauga Creek at GA St Hwy 434 Xing, Walker Co., GA. Elev. 218 m; water clear; current moderate; substrate gravel, sand, silt; depth to 1.5 m; width to 15 m. 10 May 1980. AGH 80-13. Order 5.
Species: 10, 19, 25, 33, 55, 59, 60, 62, 76, 77, 81, 85.

76. Crawfish Spring at GA St Hwy 341 in Chickamauga, Walker Co., GA. Elev. 220 m; water clear; water temp. 14.4°C; air temp. 21.1°C; current slow to none; substrate sand, silt, detritus; depth to 1 m; width to 30 m. 26 December 1965, UAIC 1819. 19 April 1980, AGH 80-8. Order 1.
Species: 39, 60, 85.

77. Crawfish Creek 11.7 km N of Lafayette, Walker Co., GA. Elev. 242 m. 14 May 1960. UGIC 788. Order 3.
Species: 36, 59, 72, 76, 77, 85.

78. West Chickamauga Creek at GA St Hwy 341 Xing, Walker Co., GA. Elev. 230 m; water slightly turbid; water temp. 25.6°C; air temp.

32.2°C; current slow to moderate; substrate bedrock, gravel, sand, silt, mud; depth to 1 m; width to 12 m. 19 July 1980. AGH 80-46.

Order 5.

Species: 10, 23, 24, 29, 55, 59, 60, 62, 69, 85.

79. West Chickamauga Creek on GA St Hwy 143 E of Jct. with GA St Hwy 193 and 143, Walker Co., GA. Elev. 232 m; water clear; water temp. 4.4°C; air temp. 7.2°C; current moderate to swift, substrate gravel, sand; depth to 1 m; width to 10 m. 26 December 1965. UAIC 1821. Order 5.

Species: 3, 10, 24, 25, 39, 43, 67, 71, 72, 74, 75, 76, 85.

80. West Chickamauga Creek at Hall Mill Dam, Walker Co., GA. Elev. 238 m; water slightly turbid; water temp. 10°C; air temp. 10°C; current slow to moderate; substrate boulder, gravel, sand, silt; depth to 1.5 m; width to 22 m. 22 November 1980. AGH 80-84. Order 5. Species: 52, 60, 62.

81. Mill Creek at Co. rd. S1355 in Kensington, Walker Co., GA. Elev. 245 m; water clear; water temp. 8.3°C; air temp. 10°C; current slow to moderate; substrate gravel, sand, silt; depth to 1 m; width to 7 m. 22 November 1970. AGH 80-85. Order 4. Species: 3, 13, 19, 23, 24, 25, 39, 58, 59, 60, 62, 64, 72, 75, 76, 77, 85.

82. Mill Creek at GA St Hwy 193, approximately 1.6 km S of Jct. with GA St Hwy 341, Walker Co., GA. Elev. 262 m; water slightly turbid; current moderate; substrate sand, fine gravel; depth to 1.5 m; width to 12 m. 7 October 1979. JLH 79-52. Order 3.

Species: 10, 22, 24, 25, 27, 29, 39, 43, 52, 55, 59, 60, 62, 64, 71, 72, 75, 76, 77, 81, 85.

83. West Chickamauga Creek at Co. rd. 107 Xing, 4.2 km SW of Davis Crossroads, Walker Co., GA. Elev. 249 m; water clear; current moderate; substrate bedrock, gravel; depth to 1.5 m; width to 9 m.

19 April 1980. AGH 80-5. Order 4.

Species: 3, 10, 19, 23, 24, 25, 29, 59, 60, 62, 64, 69, 72, 75, 76, 77, 85.

84. Mud Creek at Co. rd. 101 Xing, approximately 10.4 km W of Lafayette, Walker Co., GA. Elev. 255 m; water clear; current swift; substrate gravel, boulder; depth to 1.5 m; width to 9 m. 19 April 1980. AGH 80-7. Order 4.

Species: 9, 10, 19, 23, 24, 25, 29, 33, 37, 52, 53, 59, 60, 62, 64, 72, 75, 76, 77, 85.

85. Hogjowl Creek along Co. rd. S1763, just downstream from Xing, Walker Co., GA. Elev. 268 m; water clear; current moderate to swift; substrate bedrock, gravel; depth to 1 m; width to 9 m; 19 April 1980. AGH 80-6. Order 3.

Species: 10, 19, 23, 24, 25, 29, 39, 69, 76, 77, 85.

IV. ANNOTATED SPECIES LIST

The following annotated list is a compilation of the species of fishes collected from Lookout Creek and South Chickamauga Creek systems during the study, including those species that have been reported from these creek systems in earlier stream surveys. Both scientific and common names of families, genera, and species follow those set forth in Robins et al. (1980).

Early papers on the fishes from the study area were written about collections from South Chickamauga Creek and West Chickamauga Creek. The first paper on the fishes of South Chickamauga Creek was published by Jordan and Brayton in 1878. They listed 11 species collected from South Chickamauga Creek at Ringgold, Georgia, and included the following: Hiodon tergisus Lesueur (as Hyodon selenops), Notropis lirus (Jordan), Hybopsis monacha (Cope) (as Ceratichtyhs monachus), Phenacobius uranops Cope, Pimephales notatus (Rafinesque) (as Hyborhynchus notatus), Lagochila lacera Jordan and Brayton (as Quassilabia lacera), Moxostoma duquesnei (Lesueur) (as Myxostoma macrolepidotum duquesnei), Etheostoma blennioides Rafinesque (as Diplesium blennioides), Etheostoma jessiae (Jordan and Brayton) (as Poecilichthys jessiae), Percina maculata (Girard) (as Alvordius maculatus), and Cottus sp. (as Potamocottus meridionalis). Evermann and Hildebrand (1914) reported the following fishes from West Chickamauga Creek at Lee and Gordon's Mill, Walker County, Georgia: Campostoma anomalum (Rafinesque), Hybopsis insignis Hubbs and Crowe,

(as Hybopsis dissimilis), Hybopsis amblops (Rafinesque), Nocomis micropogon (Cope) (as Hybopsis kentuckiensis), Notropis coccogenis (Cope), Notropis chrysocephalus (Rafinesque) (as Notropis cornutus), Notropis galacturus (Cope), Phenacobius uranops Cope, Pimephales notatus (Rafinesque), Pimephales vigilax (Baird and Girard) (as Cliola vigilax), Hypentelium nigricans (Lesueur) (as Catostomus nigricans), Moxostoma erythrurum (Rafinesque) (as Moxostoma aureolum), Ictalurus punctatus (Rafinesque), Noturus flavipinnis Taylor (as Noturus miurus Jordan), Lepomis megalotis (Rafinesque), Micropterus dolomieu Lacépède, Micropterus salmoides (Lacépède), Etheostoma blennioides Rafinesque (as Diplesium blennioides), Etheostoma zonale (Cope), and Cottus sp. (as Cottus ictalops). Their record of Notropis stilbius (Jordan) is most likely a misidentification, since no other records of this Alabama River system endemic exist from South Chickamauga Creek (Dahlberg and Scott, 1971; Lee et al., 1980).

Recent records of fish occurring in Lookout and South Chickamauga creek systems are found in Dahlberg and Scott (1971) and Seehorn (1975). Additional records include those from the Georgia Department of Transportation and the Tennessee Valley Authority (TVA). Collection records from the University of Georgia were obtained from Dr. Byron J. Freeman and from the University of Alabama Ichthyological Collection from Dr. Herbert T. Boschung. Lists of species collected by TVA and Timmons (1975b) from Nickajack Reservoir and included in Appendix B and Appendix C.

Included in the species accounts for each species are the scientific name, author of the original description, and common name.

Some indication is given of the abundance and distribution of each species within both creek systems, as well as a description of habitat.

A summary of the species collected from both the Lookout and South Chickamauga creek systems along with a list of the collection sites where each species was collected is included in Appendix D. After each collection site number is the number of individuals of that species collected at that site.

Petromyzontidae

1. Ichthyomyzon bdellium (Jordan). Ohio lamprey.

Two specimes of this parasitic lamprey were collected from Little Chickamauga Creek during the study. Both specimens were ammocoetes measuring 160 mm and 127 mm in total length with 56 and 55 trunk myomeres, respectively. The habitat of Ichthyomyzon bdellium is medium to large river during the adult stage and smaller rivers and creeks during the spawning, ammocoetes, and transforming periods of the life cycle (Hubbs and Trautman, 1937).

2. Ichthyomyzon castaneus Girard. Chestnut lamprey.

One specimen 135 mm in total length was collected from Lookout Creek below Sitton Mill dam in a backwater area 3 feet (1 m) in depth in sand and detritus. This species is parasitic in the adult stage of its life cycle. Timmons (1975b) reported collecting the chestnut lamprey from Nickajack Reservoir.

3. Ichthyomyzon greeleyi Hubbs and Trautman. Allegheny brook lamprey.

Five specimens of this non-parasitic lamprey were collected from the upper portion of West Chickamuga Creek. This species closely resembles Ichthyomyzon bdellium, but differs by having a higher trunk myomere count. Ichthyomyzon greeleyi occurs chiefly in creeks, avoiding small brooks as well as rivers (Hubbs and Trautman, 1937).

Lepisosteidae

No specimens of gar were collected during the study, although gar were observed swimming along the margins of several pools in both Lookout and South Chickamauga creeks.

4. Lepisosteus oculatus (Winchell). Spotted gar.

Spotted gar were reported from Nickajack Reservoir by Timmons (1975b) and presumably occur in both Lookout and South Chickamauga creek systems. It was also reported from a TVA cove rotenone survey of Nickajack Reservoir (TVA, 1972).

5. Lepisosteus osseus (Linnaeus). Longnose gar.

Longnose gar have been collected from Nickajack Reservoir, as reported by Timmons (1975b) and TVA (1972).

Clupeidae

6. Dorosoma cepedianum (Lesueur). Gizzard shad.

The gizzard shad was collected from pool and backwater areas of higher order streams in both Lookout and South Chickamauga creek systems. It apparently avoids streams with very high gradient and those streams lacking large permanent pools (Pflieger, 1975). It

was reported to be one of the most abundant species collected from Nickajack Reservoir (Timmons, 1975b; TVA, 1972).

7. Dorosoma petenense (Gunther). Threadfin shad.

Threadfin shad were not collected from either creek system during the study. It was reported from Nickajack Reservoir by Timmons (1975b) and TVA (1972), although not as common as the gizzard shad. Their habitat is similar to that for Dorosoma cepedianum except that the threadfin shad does not enter creeks as readily as gizzard shad.

Hiodontidae

8. Hiodon tergisus Lesueur. Mooneye.

No specimens of mooneye were collected during the study. It has been reported from Nickajack Reservoir (Timmons, 1975b; TVA, 1972), although it is uncommon. Mooneye larva were collected by TVA in the lower portion of South Chickamauga Creek in Chattanooga. This species inhabits the open waters of reservoirs and the larger pools of streams. Mooneye may migrate into Lookout and South Chickamauga creek systems to spawn.

Salmonidae

9. Salmo gairderi Richardson. Rainbow trout.

Rainbow trout are stocked in several tributaries to South Chickamauga Creek and West Chickamauga Creek. These streams are spring fed and have temperatures low enough to sustain trout fishery. Local fishermen reported catching rainbow trout from both Peavine

Creek and Little Chickamauga Creek, although none were collected from either of these streams during the study.

Cyprinidae

10. Campostoma anomalum (Rafinesque). Stoneroller.

Stonerollers were the most common cyrinid collected from both Lookout and South Chickamauga creek systems during the study. They were widely distributed and common in streams of all orders, from small headwater creeks to large streams. Specimens were collected over gravel and rubble substrates in riffles with moderate to swift currents and in rocky pools adjacent to riffles.

11. Cyprinus carpio Linnaeus. Carp.

Native to Asia, carp are now widely distributed throughout the United States as a result of widespread introductions that began in the late 1800's. No carp were collected during the study but they are reported to be common in Nickajack Reservoir (Timmons, 1975b; TVA, 1972). Seehorn (1975) reported carp from the Chattahoochee National Forest which is drained by streams in the South Chickamauga Creek system. One specimen of Cyprinus carpio was collected from Lookout Creek in 1959 during a rotenone survey. Carp presumably occur in both creek systems, though none were collected because of difficulties in sampling their preferred habitat of large, deep pools.

12. Hemitremia flammea (Jordan and Gilbert). Flame chub.

The flame chub was collected from only two sites in the Tiger Creek watershed during the study. This species is restricted to springs and spring runs in the Tennessee River drainage and small

portions of the Cumberland River and Mobile Basin drainages. In Georgia it is considered to be a threatened species, and it has been considered as a species of special concern throughout its range (Helfman and Freeman, 1979). The only previous records from Georgia consist of an early record from the now severely polluted West Chickamauga Creek near Chickamauga, Georgia, and a recent record from Bridges Spring, Whitfield County, Georgia. During the study, what appears to be a thriving population of Hemitremia flammea was found at Bridges Spring and one specimen was collected from Tiger Creek (collection site #51) that may represent a downstream migrant from the nearby spring population.

13. Hybopsis amblops (Rafinesque). Bigeye chub.

The bigeye chub was collected from medium to large streams (orders 4-6) in both Lookout and South Chickamauga creek systems. It was uncommon to common in quiet areas near riffles over sand, gravel, and rock substrates and near the base of riffles in slow to moderate current.

14. Hybopsis insignis Hubbs and Crowe. Blotched chub.

This species was not collected during the study, although it was reported from West Chickamauga Creek at Lee and Gordon's Mill by Evermann and Hildebrand (1914). They listed a collection of Hybopsis dissimilis from West Chickamauga Creek that is probably Hybopsis insignis which was described by Hubbs and Crowe (1956). Seehorn (1975) reported that Hybopsis insignis probably occurs in the Chattahoochee National Forest within the South Chickamauga Creek system. This species has apparently been extirpated from the South

Chickamauga Creek system as a result of siltation and water pollution in West Chickamauga Creek. The blotched chub inhabits large, high gradient streams with a continuous flow of clear water and clean gravel or rocky substrates, which is no longer typical of West Chickamauga Creek.

15. Hybopsis monacha (Cope). Spotfin chub.

The spotfin chub was not collected during the study and has not been collected from South Chickamauga Creek since the late 1800's record from Ringgold, Georgia (Jordan and Brayton, 1878). This inhabitant of large streams and rivers is apparently disappearing from the Tennessee River fauna and is currently listed as threatened by the United States Fish and Wildlife Service. It has apparently been extirpated from South Chickamauga Creek due to water pollution and siltation at and below Ringgold, Georgia.

16. Hybopsis storeriana (Kirtland). Silver chub.

TVA personnel collected the silver chub from South Chickamauga Creek between river kilometer 9.8 and 10.3 during November 1980. An additional specimen was collected from Nickajack Reservoir by Timmons (1975b). This is a species of large, sluggish rivers and it is widespread in the main channel of the Tennessee River. It apparently enters the sluggish portions of larger tributaries to the Tennessee River, which is characteristic of the lower sections of both Lookout and South Chickamauga creeks (Etnier, 1976a).

17. Nocomis micropogon (Cope). River chub.

The river chub was common and widely distributed in medium sized streams in both creek systems. It was collected in swift current

over gravel and rocky substrates. Additional specimens were collected from pool areas below riffles in slow to moderate current. In both creek systems, the river chub is an inhabitant of the higher order streams (orders 4-6).

18. Notemigonus crysoleucas (Mitchill). Golden shiner.

No specimens of the golden shiner were collected during the study, although Seehorn (1975) reported it from South Chickamauga Creek within the Chattahoochee National Forest. It has also been reported from Nickajack Reservoir by Timmons (1975b) and TVA (1972). The golden shiner is a popular baitfish and may be established in both creek systems.

19. Notropis ardens (Cope). Rosefin shiner.

The rosefin shiner was common at several localities in both creek systems. It occurs sympatically with the closely related Notropis lirus in South Chickamauga Creek. Specimens were collected in small creeks (Order 3) to medium sized streams (orders 4 and 5) with moderate currents and gravel to rocky substrates.

20. Notropis ariommus (Cope). Popeye shiner.

The popeye shiner was collected at two localities in South Chickamauga Creek (collection sites 40 and 43). Two earlier records (Dahlberg and Scott, 1971) are from Lookout Creek above Trenton, Georgia (collection site 8) and a tributary to South Chickamauga Creek at Ringgold, Georgia (collection site 58). This species is found in relatively clear, flowing waters in large creeks and small rivers and is closely associated with gravel substrates (Gilbert, 1969). Prior to this study, the popeye shiner was considered to be extirpated

from the state of Georgia (Helfman and Freeman, 1979). There is apparently a breeding population of N. ariommus in South Chickamauga Creek, although pollution and siltation problems persist in the area downstream from Ringgold, Georgia.

21. Notropis atherinoides Rafinesque. Emerald shiner.

The emerald shiner was collected from several localities in the lower portion of South Chickamauga Creek by TVA personnel during November, 1980. One earlier record is from Lookout Creek above Trenton, Georgia. It has been reported from Nickajack Reservoir (Timmons, 1975b). This pelagic species is an inhabitant of the open channels of large, permanently flowing streams having moderate or low gradients. They tolerate a wide range of turbidity and substrate types (Pflieger, 1975), and are widespread in local reservoirs.

22. Notropis chrosomus (Jordan). Rainbow shiner.

One individual of this species (UT 44.1921) was collected in Mill Creek (collection site 82) and represents the first record of N. chrosomus from the Tennessee River drainage. The rainbow shiner is endemic to the Mobile Bay drainage and inhabits small, clear, spring-fed streams (Swift, 1970). This record is likely the result of an introduction, since other Mobile Bay endemics were not collected in Mill Creek, although it is possible that it may have entered this creek from an underground source emerging from the base of Lookout Mountain as a spring.

23. Notropis coccogenis (Cope). Warpaint shiner.

The warpaint shiner was common and widely distributed in small creeks to medium sized streams in both Lookout and South Chickamauga

creek systems. This species is confined to the upper portion of the Tennessee River system, inhabiting riffles and pools of clear, cool streams with gravel and rocky substrates. They were collected in streams of orders 3-5.

24. Notropis chrysocephalus chrysocephalus (Rafinesque).

Striped shiner.

The striped shiner was the second most common cyprinid collected during the study, inhabiting streams ranging in size from small head-water creeks to small rivers (orders 1-5). It was abundant in pools and riffles with gravel, sand, and rocky substrates in slow to moderate current.

25. Notropis galacturus (Cope). Whitetail shiner.

The whitetail shiner was common in the Order 3 and 4 portion of Lookout Creek. They were common only in the upper portion of West Chickamauga Creek in the South Chickamauga Creek system. Specimens were collected in riffles and pools with moderate current over sand, gravel, and rocky substrates.

26. Notropis leuciodus (Cope). Tennessee shiner.

The Tennessee shiner was only collected in Lookout Creek (orders 4 and 5), where it was common in riffles and pools in moderate current over sand and gravel substrates. One earlier record (UGIC 1175) is from South Chickamauga Creek at Graysville, Georgia (collection site 40), and is the only record for N. leuciodus from this creek system.

27. Notropis lirus (Jordan). Mountain shiner.

The mountain shiner was collected at four localities in the South Chickamauga Creek system. Prior to this record, N. lirus was not known to occur in the Tennessee River system in Georgia. This species was uncommon, and as is rather typical throughout its range, localities were widely scattered. Two of the localities were small, clear, spring-fed streams (collection sites 55 and 82) with sand, gravel, and boulder substrates. The other two localities were in South Chickamauga Creek proper, with similar habitat, where it occurred sympatrically with Notropis ardens.

28. Notropis spilopterus (Cope). Spotfin shiner.

The spotfin shiner was common in the lower portions of both Lookout and South Chickamauga creek systems (orders 4-6). Specimens were collected in pools and backwater areas adjacent to riffles with sand, silt, and gravel substrates. It has also been reported from Nickajack Reservoir (Timmons, 1975b).

29. Notropis telescopus (Cope). Telescope shiner.

The telescope shiner was common and widely distributed in Lookout Creek and in West Chickamauga Creek. These represent the first north central Georgia records of this species outside of the Toccoa and Hiawassee river systems (Dahlberg and Scott, 1971). Specimens were collected near riffles over sand, gravel, and rocky substrates in moderate current of orders 3-5 streams.

30. Notropis volucellus (Cope). Mimic shiner.

The mimic shiner was collected by TVA personnel at two localities (collection sites 21 and 41) in the lower portion of South

Chickamauga Creek (orders 5 and 6). One earlier record (UGIC 1003) was from a tributary to South Chickamauga Creek at Ringgold, Georgia. Timmons (1975b) reported the mimic shiner from Nickajack Reservoir.

31. Notropis whipplei (Girard). Steelcolor shiner.

The steelcolor shiner was collected by TVA personnel at four localities in South Chickamauga Creek (Order 6). Timmons (1975b) reported collecting N. whipplei from Nickajack Reservoir in association with N. spilopterus. This species is often found near rocky or gravel riffles in moderate or swift current.

32. Phenacobius uranops Cope. Stargazing minnow.

The stargazing minnow was only collected from South Chickamauga Creek downstream from Ringgold, Georgia, to river kilometer 7.4. These represent the first records of P. uranops from Georgia since an 1893 collection from South Chickamauga Creek (Evermann and Hildebrand, 1914). It was rare in riffle areas with swift currents, over gravel to rocky substrates.

33. Pimephales notatus (Rafinesque). Bluntnose minnow.

Pimephales notatus were widely distributed and uncommon in the South Chickamauga Creek system. One earlier record (UGIC 689) was from Lookout Creek (collection site 8), although no specimens were collected from this creek system during the study. Jordan and Brayton (1878) reported P. notatus from South Chickamauga Creek at Ringgold, Georgia. Specimens were collected in streams ranging in size from spring runs (Order 2) to large streams (Order 5). This species is common in a wide range of habitats, usually more numerous

in quiet pools and backwater areas of medium sized to moderately large streams (Pflieger, 1975).

34. Pimephales promelas Rafinesque. Fathead minnow.

The fathead minnow was collected at only one locality in Lookout Creek (collection site 9). Timmons (1975b) reported collecting P. promelas from Nickajack Reservoir. This species is one of the most commonly used baitfish and is common in a wide range of habitats, from ponds to flowing streams (Pflieger, 1975).

35. Pimephales vigilax (Baird and Girard). Bullhead minnow.

The bullhead minnow was collected from the lower portion of South Chickamauga Creek by TVA personnel from river kilometer 10.3 to 20.9. One earlier record was from Lookout Creek (collection site 11), although none were collected from this creek during the study. It has also been reported from Nickajack Reservoir, where it was common in backwaters with silty bottoms. This species is one of the dominant small forage species in Tennessee River reservoirs and in the slow moving portions of the large rivers in Tennessee (Etnier, 1976a).

36. Rhinichthys atratulus (Hermann). Blacknose dace.

The blacknose dace was common in small headwater streams, springs, and spring runs in both creek systems (orders 1-3). This species is typically found in small, usually cool, gravelly, rocky streams of moderate to high gradient, occurring mainly in pools and slow runs. Rhinichthys atratulus was often collected with Semotilus atromaculatus.

37. Semotilus atromaculatus (Mitchill). Creek chub.

The creek chub was common in streams ranging from small headwater creeks to medium sized streams in both Lookout Creek and South Chickamauga Creek, but was most abundant in the smaller, higher gradient streams. Specimens collected in larger streams may represent downstream migrants, since this species is usually an inhabitant of low-order streams.

Catostomidae

38. Catostomus commersoni (Lacépède). White sucker.

The white sucker was collected at only two localities (collection sites 13 and 61), being restricted to springs and small headwater creeks. One earlier record (UAIC 1392) was from Morgan Spring (collection site 19), a tributary to Lookout Creek.

39. Hypentelium nigricans (Lesueur). Northern hog sucker.

The northern hog sucker was the most common and widely distributed catostomid collected in both creek systems. They inhabited streams ranging from springs (Order 1) and small headwater creeks to large streams (orders 5 and 6). Specimens were collected from riffles with moderate to swift current over gravel and rocky substrates.

40. Lagochila lacera Jordan and Brayton. Harelip sucker.

The original description of the harelip sucker was based on specimens collected from South Chickamauga Creek near Ringgold, Georgia (Jordan and Brayton, 1877). It has not been collected since 1893 and is presumably extinct. The harelip sucker was once

widely distributed, being known from about 20 localities in eight states, inhabiting generally clear streams with clean, relatively silt-free substrates. Destruction of habitat and increased turbidity resulting from widespread environmental changes at the turn of the century probably contributed to the demise of this species (Trautman, 1981).

41. Minytrema melanops (Rafinesque). Spotted sucker.

No specimens of the spotted sucker were collected during the study, although it was reported from both Lookout Creek and West Chickamauga Creek in three earlier collections (UGIC 689 and 689a, GA Dept. of Trans.). It was reported to be abundant in Nickajack Reservoir by Timmons (1975a).

42. Moxostoma duquesnei (Lesueur). Black redhorse.

The black redhorse was the most common redhorse collected during the study, being taken at nine collection sites and in both creek systems. This is the first record of M. duquesnei since Jordan and Brayton (1878) collected it from South Chickamauga Creek at Ringgold, Georgia. Specimens were collected in medium to large streams (orders 3-6) from riffles and shallow pools in moderate current.

43. Moxostoma erythrurum (Rafinesque). Golden redhorse.

The golden redhorse was collected at eight collection sites during the study, being more common in Lookout Creek than the black redhorse, M. duquesnei. The habitat requirements of the golden redhorse are similar to those for the black redhorse, except that the golden redhorse prefers slightly warmer water, less current, and is more tolerant of turbidity (Pflieger, 1975).

Ictaluridae

44. Ictalurus furcatus (Lesueur). Blue catfish.

Fishermen reported catching blue catfish from South Chickamauga Creek at Graysville, Georgia, although none were collected from either creek system during the study. Populations of this large catfish persist in the main channel of the Tennessee River and the French Broad River, from Douglas Reservoir downstream to Kentucky Lake (Etnier, 1976b). This large river species may inhabit the lower portion of both creek systems where suitable habitat is available.

45. Ictalurus melas (Rafinesque). Black bullhead.

No specimens of the black bullhead were collected during the study, although it was collected by the Georgia Department of Transportation from West Chickamauga Creek in 1978 (collection site 72). This species is more common in streams of middle and west Tennessee (Etnier, 1976b). Black bullheads have also been collected from Nickajack Reservoir (Timmons, 1975b).

46. Ictalurus natalis (Lesueur). Yellow bullhead.

The yellow bullhead was collected at only one locality (collection site 30) during the study and was recently reported from below Bridges Spring, Whitfield County, Georgia (Pers. comm. B. J. Freeman, 1981). One earlier record was from Lookout Creek at Sitton Mill Dam, Dade County, Georgia. Yellow bullheads have also been collected from Nickajack Reservoir (Timmons, 1975b; TVA, 1972). This species inhabits a wide variety of habitats, from small streams to main channel reservoirs.

47. Ictalurus punctatus (Rafinesque). Channel catfish.

Channel catfish were collected at several localities in the lower portion of both Lookout and South Chickamauga creek systems. This is the most common and widely distributed catfish in Tennessee, inhabiting a wide range of streams, from turbid, slow moving lowland streams to clear, high gradient upland streams (Etnier, 1976b). They are common in Nickajack Reservoir (Timmons, 1975b; TVA, 1972).

48. Noturus eleutherus Jordan. Mountain madtom.

The mountain madtom was collected from several localities in South Chickamauga Creek. Taylor (1969) reported one specimen (USNM 161724) from Chickamauga Creek, but otherwise these are the only recent records for N. eleutherus from the state of Georgia. As is typical for the species, collections were made over shallow gravel riffles with some organic detritus in a moderate to swift current. It is important to note that N. eleutherus has been able to survive in the lower portion of South Chickamauga Creek that has historically been plagued with water pollution problems and fish kills. Georgia status for this species had been "undetermined" (Helfman and Freeman, 1979), apparently due to the possibility that it no longer occurred in Georgia. This collection and the lack of records from elsewhere in Georgia suggest that protected status is appropriate in Georgia.

49. Noturus flavipinnis Taylor. Yellowfin madtom.

No specimens of the yellowfin madtom were collected during the study. It has not been collected from West Chickamauga Creek since the 1893 record from Lee and Gordon's Mill (Evermann and Hildebrand, 1914), and has apparently been extirpated from the South Chickamauga

Creek system. A survey of West Chickamauga Creek at Lee and Gordon's Mill resulted in a collection of only three fish species, with evidence of severe water pollution visible.

50. Pylodictis olivaris (Rafinesque). Flathead catfish.

One specimen of P. olivaris was collected from South Chickamauga Creek (collection site 33) during the study. One earlier record is from Lookout Creek at Sitton Mill Dam, Dade County, Georgia. Fishermen reported catching flathead catfish from South Chickamauga Creek above Graysville, Georgia. Flathead catfish inhabit large rivers and reservoirs.

Amblyopsidae

51. Typlichthys subterraneus Girard. Southern cavefish.

The southern cavefish was not collected during the study, but was reported in 1969 from Twin Snakes Cave, Dade County, Georgia, in the Lookout Creek watershed (Dahlberg and Scott, 1971). No caves were surveyed, although collections were made from several springs emerging from caves. Woods and Inger (1958) give the range of the southern cavefish from the limestone region of northeastern Oklahoma through southern Missouri and northern Arkansas to central Kentucky and Tennessee and into northern Alabama. This record extends the distribution of the southern cavefish into northwestern Georgia.

Cyprinodontidae

52. Fundulus catenatus (Storer). Northern studfish.

Fundulus catenatus were collected at three localities in the upper portion of West Chickamauga Creek (collection sites 80, 82, and 84). The only previous record was from West Chickamauga Creek at the junction of Hwy 143 and Hwy 341, Walker County, Georgia (Thomerson, 1969). It is possible that the entire Georgia range of the northern studfish is confined to West Chickamauga Creek. Specimens were collected along the margins of pools and riffles where there was little current.

53. Fundulus olivaceus (Storer). Blackspotted topminnow.

The blackspotted topminnow was widely distributed in medium to large streams in South Chickamauga Creek system, but was usually uncommon. It was collected from two localities in Lookout Creek (collection sites 8 and 15). Specimens were collected in backwater areas and along the margins of pools.

54. Fundulus stellifer (Jordan). Southern studfish.

Thomerson (1969) reported one specimen of F. stellifer from West Chickamauga Creek, Walker County, Georgia. This represents the only record of this Alabama River endemic within the Tennessee River drainage. This record is significant since it was from the range of F. catenatus and a specimen of F. catenatus was taken along with F. stellifer in this collection. Lack of additional specimens from more recent collections suggests that this record resulted from an

accidental introduction, possibly bait release, that did not result in an established population.

Poeciliidae

55. Gambusia affinis (Baird and Girard). Mosquitofish.

The mosquitofish was one of the most common and widely distributed fish collected during the study, inhabiting quiet pools of small to large streams (orders 1-6).

Atherinidae

56. Labidesthes sicculus (Cope). Brook silverside.

Brook silversides were common at several large stream localities in both creek systems, where they were collected from quiet pools with mud and detritus substrates. It is a common forage fish in Nickajack Reservoir (Timmons, 1975b).

Percichthyidae

57. Morone chrysops (Rafinesque). White bass.

White bass were collected by TVA personnel at one locality in South Chickamauga Creek (collection site 34). This species is a common gamefish in Nickajack Reservoir (Timmons, 1975b; TVA, 1972).

Centrarchidae

58. Ambloplites rupestris (Rafinesque). Rockbass.

Rockbass were common and widespread in small to large streams of both creek systems. They were usually collected in slow moving

water of stream margins around boulders, submerged logs, and growths of Justicia over bottoms of gravel and rubble.

59. Lepomis auritus (Linnaeus). Redbreast sunfish.

The redbreast sunfish was common and widely distributed in streams of all orders, ranging from small headwater creeks to large streams. Collections of L. auritus were made in rocky pools around cover.

60. Lepomis cyaneus Rafinesque. Green sunfish.

The green sunfish was common in streams ranging from springs and small headwater creeks to large streams. This sunfish can tolerate a wide range of environmental conditions, such as dissolved oxygen, turbidity, temperature, and stream flow, as exhibited by its presence in small streams that often dry up during the summer (Pflieger, 1975).

61. Lepomis gulosus (Cuvier). Warmouth.

Warmouth were collected at three localities in the South Chickamauga Creek system (collection sites 40, 52, and 72). One earlier record (UGIC 689a) was from Lookout Creek (collection site 14). Specimens were taken in quiet pools and backwaters of medium to large streams (orders 3-5), usually near some type of cover (i.e. boulders, logs, and undercut banks).

62. Lepomis macrochirus Rafinesque. Bluegill.

Generally distributed throughout both Lookout and South Chickamauga creek systems in small to large streams (orders 1-6), bluegill were collected at more localities and in greater numbers than any other centrarchid.

63. Lepomis megalotis (Rafinesque). Longear sunfish.

Longear sunfish were collected at nine localities during the study, being more common in Lookout Creek than in South Chickamauga Creek. Specimens were taken from rocky pools and backwaters of medium to large streams.

64. Lepomis microlophus (Gunther). Redear sunfish.

Redear sunfish were widespread in both creek systems, though never common, inhabiting areas ranging from small creeks to large streams. They were usually collected along the margins of pools near cover and aquatic vegetation, as well as in backwater areas.

65. Lepomis punctatus (Valenciennes). Spotted sunfish.

Spotted sunfish, typically a lowland species, were collected at three localities in Lookout Creek (collection sites 8, 12, and 15). Several earlier records (UGIC 689a, 1176, and 790) were from Lookout Creek (collection site 14) and South Chickamauga Creek (collection sites 48 and 68). It was collected from quiet pools near rocks and submerged logs and in backwater areas with growths of water willow (Justicia).

66. Micropterus coosae Hubbs and Bailey. Redeye bass.

This bass is an endemic of the Mobile Basin drainage, and Tennessee drainage records are almost certainly the result of earlier introductions. One specimen of Micropterus coosae was collected in South Chickamauga Creek from a shallow pool with a bedrock and gravel substrate. It seems likely that the redeye bass is widespread and firmly established in the South Chickamauga Creek system, even though only one specimen was collected.

67. Micropterus dolomieu Lacépède. Smallmouth bass.

Although not collected as frequently as Micropterus punctulatus or Micropterus salmoides, smallmouth bass were common in medium to large streams in both Lookout and South Chickamauga creek systems. Specimens were collected in pools near riffles over gravel and rubble substrates, usually near some type of cover such as boulders, logs, or water willow.

68. Micropterus punctulatus (Rafinesque). Spotted bass.

Spotted bass were common and widespread in medium to large streams (orders 3-6) in both creek systems. They usually inhabit flowing waters that are warmer and slightly more turbid than those inhabited by the smallmouth bass.

69. Micropterus salmoides (Lacépède). Largemouth bass.

Largemouth bass were common in medium to large streams of both creek systems, preferring quiet pools with no noticeable current and abundant cover. They are more characteristic of lentic habitats than of streams, being replaced by one of the other black basses in streams with high gradients and continuous strong flow.

70. Pomoxis nigromaculatus (Lesueur). Black crappie.

The abundance and distribution of the black crappie within both creek systems is probably greater than that indicated by the collections. Black crappie were only collected at two localities, one in Lookout Creek and one in South Chickamauga Creek. Principal habitat requirements of the black crappie are clear water, absence of noticeable current, and abundant cover in the form of submerged timber or aquatic

vegetation. The black crappie is less tolerant of turbidity and siltation than the more adaptable white crappie, Pomoxis annularis.

Percidae

71. Etheostoma blennioides newmani Rafinesque. Greenside darter.

There are three nominal subspecies of the greenside darter recognized by Miller (1968). Etheostoma blennioides newmani is the form in the entire Cumberland River drainage and in most of the Tennessee River drainage, with E. b. gutselli in the upper Pigeon and Little Tennessee river systems. The greenside darter was one of the most abundant and widespread species of darters collected from both creek systems. Specimens were collected in deep, swift riffles and runs over gravel, rock, and cobble substrates in streams ranging from small creeks to large streams, where they were frequently common.

72. Etheostoma caeruleum Storer. Rainbow darter.

Etheostoma caeruleum was common and widespread in moderate to swift currents over gravel substrates in streams ranging in size from small creeks to large streams (orders 2-5) in both creek systems. It was most often taken from the swifter riffles.

73. Etheostoma cinereum Storer. Ashy darter.

This interesting species was not collected during the study, and has not been reported since a 1953 record from South Chickamauga Creek at Graysville, Georgia (Dalhberg and Scott, 1971). Considerable effort was exerted to collect E. cinereum at this locality, but none were collected. The ashy darter prefers large streams and rivers

where it is usually found near boulders and gravel with a moderate to sluggish current, which is characteristic of the locality in South Chickamauga Creek at Graysville. It may be that the ashy darter has been extirpated from South Chickamauga Creek.

74. Etheostoma duryi Henshall. Blackside snubnose darter.

Etheostoma duryi was collected at only one locality (collection site 13) in the Lookout Creek system during the study. Several earlier records reported E. duryi from both Lookout Creek (collection sites 4, 7, 1, 11, and 19) and from West Chickamauga Creek (collection site 79). They inhabited small to large streams (orders 1-5) primarily in the Lookout Creek system. Etheostoma duryi is sympatric with the closely related E. simoterum in both Lookout Creek and West Chickamauga Creek.

75. Etheostoma jessiae (Jordan and Brayton). Blueside darter.

The original description of E. jessiae was based on specimens collected from South Chickamauga Creek at Ringgold, Georgia (Jordan and Brayton, 1878). Streams inhabited by E. jessiae ranged in size from small creeks to large streams (orders 2-5). It was most common in shallow pools and riffles with a slow to moderate current over sand and gravel substrates.

76. Etheostoma rufilineatum (Cope). Redline darter.

Redline darters were the most common and widespread darter collected during the study. They were usually very abundant in swift, shallow riffles with rock and gravel substrates. Specimens were collected from small creeks to the main stream portions of both creek systems (orders 2-6).

77. Etheostoma simoterum (Cope). Tennessee snubnose darter.

Etheostoma simoterum was the most common darter in small creeks and streams of both creek systems. This species inhabited shallow pools adjacent to riffles and along the margins of riffles in shallow water over sand and gravel substrates.

78. Etheostoma zonale (Cope). Banded darter.

The banded darter was most common in the larger stream portion of South Chickamauga Creek (orders 5 and 6), being absent from Lookout Creek. This species was collected from swift riffles with gravel substrates, often in thick growths of water weed.

79. Perca flavescens (Mitchill). Yellow perch.

One specimen of P. flavescens was collected from Lookout Creek (collection site 3) in a swift riffle with a gravel substrate. The yellow perch, not considered to be native to the Tennessee River system, was probably introduced into the Hiawassee River and is now present in Chickamauga and Nickajack reservoirs (Timmons, 1975a).

80. Percina caprodes (Rafinesque). Logperch.

Three distinct forms of P. caprodes occur in Tennessee, two of which occur in the Conasauga River of the Mobile Basin drainage.

Percina c. caprodes occurs throughout the Tennessee River system as well as the Cumberland River, Barren River, and main channel of the Mississippi River (Etnier, 1978). Individuals were collected in the deeper and more sluggish portions of riffles and in shallow, gravel-bottomed pools with a slow to moderate current. They were most common in the main stream portion and larger tributaries of both creek systems.

81. Percina sciera (Swain). Dusky darter.

Percina sciera was widespread in the main stream portions of both creek systems, as well as the larger tributaries. They were collected from shallow pools and deeper runs and riffles with rock and gravel substrates. This is the first record of P. sciera from the Tennessee River system in Georgia, as well as from both creek systems.

82. Percina tanasi Etnier. Snail darter.

Six specimens of P. tanasi were collected in South Chickamauga Creek (collection site 33) on November 1, 1980. TVA biologists surveyed South Chickamauga Creek subsequent to the initial discovery and established the presence of snail darters from river kilometer 9.5 upstream to river kilometer 31.0 in Catoosa County, Georgia. A total of 38 specimens representing three age classes were collected during this survey. Prior to this discovery, the snail darter was known only from transplanted individuals in the lower Holston, Elk, and Nolichucky rivers; a potentially established transplant population in the lower Hiawassee River; and specimens that continue to appear below both Tellico and Fort Loudon dams. Subsequent surveys have located additional populations in Big Sewee Creek and Sequatchie River, Tennessee, and Paint Rock River, Alabama, as well as in the main channel of the Tennessee River adjacent to the mouths of South Chickamauga Creek, Sewee Creek, and Sequatchie River. The original specimens collected from South Chickamauga Creek were taken over sand and gravel substrates in depths of about 80 cm. This locality has abundant areas with broad, shallow gravel shoals and, in spite of the smaller size

and evidence of considerable siltation, is similar to shoal areas formerly occupied by P. tanasi in the lower Little Tennessee River.

83. Sizostedion canadense (Smith). Sauger.

TVA biologists surveying South Chickamauga Creek reported collecting sauger at collection site 27 in the lower portion of South Chickamauga Creek, although no other records exist for this species in either creek system. Sauger are reported to be uncommon in Nickajack Reservoir (Timmons, 1975b). It is possible that sauger from Nickajack Reservoir enter both creeks during late winter spawning runs.

Sciaenidae

84. Aplodinotus grunniens Rafinesque. Freshwater drum.

Freshwater drum were taken from the large stream portion of both Lookout and South Chickamauga Creeks. Specimens were collected from silt, sand, and gravel-bottom pools with only a slight current. They are reported to be abundant in Nickajack Reservoir (Timmons, 1975b).

Cottidae

85. Cottus carolinae Gill. Banded sculpin.

Banded sculpins were common and widespread in streams of all sizes in both creek systems. Specimens were taken in springs and spring runs and small to large streams, usually in clear, moderate to swift flowing riffles over rock and gravel substrates.

Additional species known from Nickajack Reservoir and likely to occur occasionally in or near the mouths of the two creek systems

include: Lepisosteus platostomus (shortnose gar), Anguilla rostrata (American eel), Alosa chrysochloris (skipjack herring), Carpiodes carpio (river carpsucker), Carpiodes cyprinus (quillback), Ictiobus bubalus (smallmouth buffalo), Ictiobus cyprinellus (bigmouth buffalo), Ictiobus niger (black buffalo), Morone mississippiensis (yellow bass), and Pomoxis annularis (white crappie).

V. DISCUSSION AND CONCLUSIONS

The fish fauna of Lookout and South Chickamauga creek systems comprise 14 families, 33 genera, and 85 species, which includes 12 species that are very rare or are considered to be extirpated from either or both creek systems. A total of 55 species were collected from Lookout Creek and 71 species from South Chickamauga Creek system. An additional 20 species were reported from Nickajack Reservoir by Timmons (1975b) and TVA (1972), some of which may migrate up from the Tennessee River into suitable habitat in both creek systems. Most of these reservoir-associated species are more typical of large-river habitat though, which is rare in both creek systems. A total of 92 collections from 85 collection sites are reported from both creek systems combined, with 23 collections from Lookout Creek system and 69 collections from South Chickamauga Creek system. The distribution of sampling stations and number of fish species per stream order for both creek systems is listed in Table 1.

Both creeks were faunistically similar, sharing 51 species, although Lookout Creek was smaller in drainage area than South Chickamauga Creek. The similarity in fish fauna of both creek systems can be illustrated by using Long's formula (1963) for average faunal resemblance.

$$\text{Average Faunal Resemblance} = \frac{C (N_1 + N_2)}{2 N_1 N_2}$$

Where C = number of species common to or shared by the two creek faunas, N_1 = number of species in Lookout Creek fauna, and N_2 = number

Table 2. Distribution of sampling stations and fish species per stream order in the Lookout Creek and South Chickamauga creek systems.

Stream Order	No. of Samples	No. of Streams Sampled	Minimum No. of Species	Maximum No. of Species	Mean No. of Species
<u>Lookout Creek</u>					
1	4	4	5	8	5.5
2	2	2	6	9	7.5
3	4	4	6	22	11.2
4	9	2	10	49	19.0
5	4	1	8	29	16.5
<u>South Chickamauga Creek</u>					
1	5	5	1	11	3.4
2	3	3	5	16	7.7
3	6	6	5	32	8.3
4	11	8	5	37	14.1
5	31	2	3	53	12.8
6	13	1	6	36	12.5

of species in South Chickamauga Creek fauna. Using this formula, a value of 0.82 was obtained. The similarity becomes readily apparent when compared with a perfect resemblance value of 1.00. The reason for a lower than perfect resemblance value between the two creek faunas is primarily in the smaller size of the Lookout Creek watershed and a reduction in water volume and large-stream habitat. This resulted in the absence of certain large-stream inhabiting fishes such as Hiodon tergisus, Hybopsis storeriana, Notropis lirus, N. volucellus, Phenacobius uranops, Ictalurus furcatus, Noturus eleutherus, Morone chrysops, Etheostoma zonale, and Percina tanasi. Several additional species which were present in the South Chickamauga Creek fauna but absent from Lookout Creek are Ichthyomyzon bdellium, I. greeleyi, Salmo gairdneri, Hemitremia flammea, Notropis chrosomus, and Micropterus coosae.

Although both creek systems share similar fish fauna, water quality differed substantially. South Chickamauga Creek below Ringgold, Georgia, was severely impacted by industrial and municipal wastes. This was due primarily to numerous industries and wastewater treatment plants located on or adjacent to South Chickamauga Creek in Ringgold, Georgia, Fort Oglethorpe, Georgia, and Chattanooga, Tennessee. Non-point source siltation from road construction, land clearing for subdivisions, and from poor agricultural practices was also evident. On the other hand, Lookout Creek was not impacted by industrial or municipal wastes since it was located in a more rural area away from the industrial facilities near Chattanooga, Tennessee.

Several tributary streams in the South Chickamauga Creek system are also impacted at present as indicated by a low diversity of fish species. Fish collections in West Chickamauga Creek below Kensington, Georgia, Peavine Creek, and Friar Branch indicated that these streams have suffered from domestic and industrial wastes as well as from siltation. Comparison of the fish fauna in these tributaries with those in unpolluted tributaries (i.e. upper West Chickamauga Creek, Tiger Creek, Little Chickamauga Creek, and Mill Creek) indicated that the species present were those not sensitive to pollution (i.e. Dorosoma cepedianum, Campostoma anomalum, Notropis chrysocephalus, Gambusia affinis, Lepomis macrochirus, and Micropterus salmoides).

Species richness in the middle section of South Chickamauga Creek between Ringgold, Georgia, and the mouth of West Chickamauga Creek (river kilometer 21.0) was greater than that below river kilometer 21.0. Siltation was also progressively greater at stations below river kilometer 30.0. Historic fish collection records from South Chickamauga Creek (Jordan and Brayton, 1878; Evermann and Hildebrand, 1914) indicate that the creek once supported a more complex fish community than it does at present. The harelip sucker (Lagochila lacera), spotfin chub (Hybopsis monacha), blotched chub (H. insignis), and yellowfin madtom (Noturus flavipinnis), now presumed extirpated in this creek system, were once collected from South Chickamauga Creek. Siltation and pollution may have brought about the loss of these sensitive species as well as reduced the abundance and diversity of the fish fauna of South Chickamauga Creek, because of the loss of suitable breeding and feeding habitat.

The presence of several threatened or endangered species in South Chickamauga Creek indicates that past pollution problems were not as severe as once thought. The discovery of a population of the snail darter, Percina tanasi, was very significant, both zoogeographically as well as for the future status of this endangered species. Prior to this discovery, the only known naturally occurring population existed in the lower 24 km of the Little Tennessee River and a small portion of the Tennessee River in upper Watts Bar Reservoir. This population in the Little Tennessee River is now considered to be extirpated due to the closing of Tellico Dam in November, 1979, which impounded the entire breeding habitat of Percina tanasi in the Little Tennessee River. Several transplants have been attempted in the lower Hiwassee River, Elk River, Nolichucky River, and Holston River. Subsequent to the discovery of Percina tanasi in South Chickamauga Creek, additional populations were discovered in Big Sewee Creek (Rhea County, Tennessee), Sequatchie River (Marion County, Tennessee), and Paint Rock River in northern Alabama. At present, these recent discoveries are thought to represent natural populations and are probably not the result of transplant operations conducted by TVA and United States Fish and Wildlife Service biologists.

The recent discoveries have extended the natural range of Percina tanasi by 322 km, from the Little Tennessee River downstream to northern Alabama. When first discovered in the Little Tennessee River, the snail darter was thought to inhabit only the main stream portion of the Tennessee River and the lower reaches of major tributaries. It was not thought to be an inhabitant of smaller rivers and creeks that

were direct tributaries to the Tennessee River. The recent discoveries were made in smaller streams which have similar habitat to that in the lower Little Tennessee River, including sand-gravel shoal areas used by Percina tanasi for feeding and reproduction. However, due to past water quality and siltation problems in South Chickamauga Creek, populations of the snail darter's primary food, aquatic gastropods (Anculosa sp., Ferrissia sp., Pleurocera sp., and Physa sp.), were virtually absent from shoal areas inhabited by P. tanasi. Gastropods were more abundant in South Chickamauga Creek above Graysville, Georgia, though never in high densities. Other macroinvertebrates utilized by P. tanasi were present in low numbers and included caddisfly larvae, aquatic beetle larvae, chironomid larvae, and other dipteran larvae. An analysis of stomach contents of 10 P. tanasi from South Chickamauga Creek indicated that there was a shift in the diet from gastropods to other macroinvertebrate food items, which included larvae of caddisflies, chironomids, and other dipterans.

The fish assemblage of the lower portion of South Chickamauga Creek was comparable to that found in the lower Little Tennessee River prior to impoundment (Starnes, 1977; Hickman and Fitz, 1978). Fifteen species were taken along with P. tanasi from sand-gravel shoal areas, although several of these were absent at some of the localities. Fish species associated with P. tanasi in South Chickamauga Creek included the following: Campostoma anomalum, Hybopsis amblops, H. storeriana, Nocomis micropogon, Phenacobius uranops, Hypentelium nigricans, Noturus eleutherus, Etheostoma blennioides, E. jessiae, E. rufilineatum, E. simoterum, E. zonale, Percina caprodes, P. sciera, and Cottus

carolinae. Several species associated with P. tanasi in the lower Little Tennessee River, but absent from South Chickamauga Creek, included P. evides, P. shumardi, and Cottus bairdi.

It is important to note that the future status of the snail darter, currently listed as endangered by the United States Fish and Wildlife Service, must await further studies on these recently discovered populations. It is highly probable that the snail darter is doing well in these streams and that sometime in the near future the status of P. tanasi will be reduced from endangered to threatened.

Only one record existed of the mountain madtom, Noturus eleutherus, in the South Chickamauga Creek system before this study (Taylor, 1969). Helfman and Freeman (1979) considered it to be extirpated from Georgia. Specimens were collected from shallow gravel riffles near detritus at several localities below Graysville, Georgia, downstream to river kilometer 16.9. This represents the only known population of N. eleutherus in the state of Georgia. Protective status may be necessary if water quality in this section of South Chickamauga Creek should decline, even though the mountain madtom is common in other parts of its range. At present, this population appears to be in no immediate danger.

Another rare species collected in South Chickamauga Creek was the popeye shiner, Notropis ariommus. Prior to this study, the popeye shiner was thought to be extirpated from the state of Georgia (Helfman and Freeman, 1979). One earlier record (UGIC 689) was from Lookout Creek above Trenton, Georgia, however none were collected there during this study. Specimens were collected between river kilometers 39.7

and 30.7 in shallow sand- and gravel-bottom pools. This species is peripheral in Georgia, with its major distribution in the Tennessee and Ohio river drainage. Its restriction to medium to large streams with clear flowing waters over clean gravel substrates probably accounts for its spotty occurrence. Extirpation from many localities where it was formerly present should be taken into consideration in determining the status of the popeye shiner in the state of Georgia.

Two other species considered to be rare or unusual in the state of Georgia by the Fernbank Conference (Helfman and Freeman, 1979) are apparently peripheral in Georgia and are in no need of protection. The northern studfish, Fundulus catenatus, was collected at several localities in the upper portion of West Chickamauga Creek, where it was uncommon. The blueside darter, Etheostoma jessiae, was common and widespread at localities in both Lookout and South Chickamauga creeks. Both species are common in other parts of their range and therefore protective status is not necessary at present; however, this may change if water quality should deteriorate in the future.

Two species, Hemitremia flammea and Rhinichthys atratulus, were found to be associated with springs in the study area, but not restricted to them. One population of flame chub, H. flammea, was located in Bridges Spring, Whitfield County, Georgia, and at present is the only known population of H. flammea remaining in the state of Georgia. Populations of R. atratulus were more common and widespread throughout both creek systems. This represents the first record of R. atratulus from Lookout Creek. Specimens of both species were collected from relatively undisturbed cold spring-fed streams. Damming and alteration

of springs as well as the stocking of game fishes into springs has resulted in increased habitat destruction that undoubtedly eliminated populations of H. flammea and R. atratulus from springs in both creek systems. Some type of protection is warranted for the Bridges Spring population of flame chub, since populations are declining throughout its range in Tennessee and Alabama.

One specimen of Notropis chrosomus, the rainbow shiner, was collected from Mill Creek in the upper West Chickamauga Creek watershed. The rainbow shiner is an Alabama River endemic and this represents the first record of its occurrence in the Tennessee River drainage in northern Georgia. The source of this introduction is at best speculative since no other Alabama River endemics were collected from this locality. This introduction is either the result of bait bucket introduction or possibly via a subterranean route from cave systems draining within Lookout Mountain. Several springs emerging at the base of Lookout Mountain form the source of Mill Creek. It is possible that during a period of high water, individuals of N. chrosomus were washed into a sinkhole on top of Lookout Mountain from a headwater tributary of the Little River, Alabama River system, later entering the Tennessee River system via springs draining into Mill Creek. This type of faunal transfer via cave systems has been speculated on before in the Big South Fork of the Cumberland River (Comiskey and Etnier, 1972) and in Wood Buffalo National Park, Canada (Nelson and Paetz, 1974).

The redeye bass, Micropterus coosae, was collected from a shallow pool at one locality in South Chickamauga Creek (river

kilometer 42.9). This represents the first record of the redeye bass from South Chickamauga Creek in Georgia. This species was probably introduced into South Chickamauga Creek since its range in Georgia is generally restricted to the upper Coosa River system, where it is endemic.

Several species of fish collected in the study area are the direct result of introduction by man. The rainbow trout, Salmo gairdneri, has been stocked by the Georgia Department of Natural Resources in several spring-fed streams in the South Chickamauga Creek system. The carp, Cyprinus carpio, was collected in an earlier survey of Lookout Creek and is probably present in South Chickamauga Creek, although no specimens were collected. One specimen of yellow perch, Perca flavescens, was collected from Lookout Creek, representing the first record from Lookout Creek.

Other noteworthy species reported from South Chickamauga Creek and/or Lookout Creek for the first time include: Ichthyomyzon bdellium, I. greeleyi, Hybopsis storeriana, Notropis lirus, N. telescopus, Pimephales promelas, Catostomus commersoni, and Percina sciera.

LITERATURE CITED

LITERATURE CITED

- Atwood, W. W. 1940. The Physiographic Provinces of North America. Ginn & Co., New York. pp. 107-143.
- Comiskey, C. E., and D. A. Etnier. 1972. Fishes of the Big South Fork of the Cumberland River. J. Tenn. Acad. Sci 47(4): 140-145.
- Dahlberg, M. D., and D. C. Scott. 1971. The freshwater fishes of Georgia. Bull. Ga. Acad. Sci. 29: 1-64.
- Etnier, D. A. 1976a. The Tennessee species of the family Cyprinidae. Unpublished Manuscript. pp. 1-28.
- Etnier, D. A. 1976b. Family Ictaluridae. Freshwater catfishes. Unpublished Manuscript. pp. 1-10.
- Etnier, D. A. 1978. The Tennessee species of the family Percidae. Unpublished Manuscript. pp. 1-29.
- Etnier, D. A., B. H. Bauer, and A. G. Haines. 1981. Fishes of the Gulf Coastal drainage of north Georgia (part 1), and fishes of South Chickamauga, Chattanooga, and Lookout creeks, north Georgia and Tennessee (part 2). Unpublished Manuscript. Part 2. pp. 1-97.
- Evermann, B. W. 1918. The fishes of Kentucky and Tennessee: A distributional catalogue of the known species. Bull. U. S. Bur. of Fish. 35: 295-368.
- Evermann, B. W., and S. F. Hildebrand. 1914. Notes on the fishes of east Tennessee. Bull. U. S. Bur. of Fish. 34: 431-452.
- Fenneman, N. M. 1938. Physiography of eastern United States. McGraw-Hill Book Co., New York. 714 pp.
- Gilbert, C. R. 1969. Systematics and distribution of the American Cyprinid fishes Notropis ariommus and Notropis telescopus. Copeia. 1969(3): 474-493.
- Helfman, G. S., and B. J. Freeman. 1979. The preliminary status of fishes of Georgia identified for consideration for protection at the 1974 Fernbank Conference. Unpublished Manuscript. Univ. of Ga. Mus. Nat. Hist. pp. 1-67.
- Hickman, G. D., and R. B. Fitz. 1978. A report on the ecology and conservation of the snail darter (Percina tanasi Etnier) 1975-1977. TVA Tech. Note No. B28. pp. 1-183.

- Horton, R. E. 1945. Erosional development of streams and their drainage basins; hydrophysical approach to quantitative morphology. *Bull. Geol. Soc. Am.* 56: 275-370.
- Hubbs, C. L., and W. R. Crowe. 1956. Preliminary analysis of the American cyprinid fishes, seven new, referred to the genus Hybopsis subgenus Erimystax. *Occ. Pap. Mus. Zool. Univ. Mich.* 578: 1-8.
- Hubbs, C. L., and M. B. Trautman. 1937. A revision of the lamprey genus Ichthyomyzon. *Misc. Publ. Mus. Zool. Univ. Mich.* 35: 1-109.
- Jordan, D. S., and A. W. Brayton. 1877. On Lagochila, a new genus of catostomid fish. *Proc. Acad. Nat. Sci. Phila.* 29: 280-283.
- Jordan, D. S., and A. W. Brayton. 1878. Contributions to North American ichthyology. Based primarily on the collections of the U. S. National Museum. III. A. On the distribution of the fishes of the Allegheny region of South Carolina, Georgia, and Tennessee, with descriptions of new and little known species. *Bull. U. S. Nat. Mus.* 12: 1-95.
- Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. 1980 et seq. Atlas of North American freshwater fishes. *N. C. State Mus. Nat. Hist., Raleigh.* i-x + 854 pp.
- Long, C. A. 1963. Mathematical formulas expressing faunal resemblance. *Trans. Kansas Acad. Sci.* 66(1): 138-140.
- Luther, E. T., R. L. Wilson, P. D. Sitterly, A. P. Avel, G. S. Hartman, S. W. Maher, and A. R. Leamon. 1979. Geology of Hamilton County, Tennessee. *Tenn. Div. Geol. Bull. No.* 79: 1-128.
- Miller, R. V. 1968. A systematic study of the greenside darter, Etheostoma blennioides Rafinesque (Pisces: Percidae). *Copeia.* 1968(1): 1-40.
- Nelson, J. S., and M. J. Paetz. 1974. Evidence for underground movement of fishes in Wood Buffalo National Park, Canada, with notes on recent collections in the park. *Can. Field Natur.* 88(2): 157-162.
- Pflieger, W. L. 1975. The fishes of Missouri. *Mo. Dept. Conser.* 343 pp.

- Robins, C. R., R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea, and W. B. Scott. 1980. A list of common and scientific names of fishes from the United States and Canada. Am. Fish. Soc. Sp. Publ. #12: 1-174.
- Seehorn, M. E. 1975. Fishes of southeastern national forests. U. S. Forest Service Publication. Atlanta, Georgia. pp. 1-26.
- Spencer, J. W. 1893. The Paleozoic group. The geology of ten counties of northwestern Georgia. Geol. Surv. of Georgia. pp. 1-406.
- Starnes, W. C. 1977. Ecological study of the snail darter in the Little Tennessee River. Ph.D. Dissertation. Univ. of Tenn., Knoxville. 143 pp.
- Strahler, A. N. 1957. Quantitative analysis of watershed geomorphology. Trans. Am. Geophys. Union. 38: 913-920.
- Swift, C. C. 1970. A review of the eastern North American cyprinid fishes of the Notropis texanus species group (subgenus Alburnops), with a definition of the subgenus Hydrophlox, and materials for a revision of the subgenus Alburnops. Ph.D. Dissertation. Florida State Univ. 476 pp.
- Taylor, W. R. 1969. A revision of the catfish genus Noturus Rafinesque with an analysis of higher groups in the Ictaluridae. Bull. U. S. Nat. Mus. 282: 1-307.
- Tennessee Valley Authority. 1972. Fish inventory data. Nickajack Reservoir. TVA Div. of Forestry, Fish., and Wildl. Devel. Norris, Tennessee. pp. 1-15.
- Thomerson, J. E. 1969. Variation and relationship of the studfishes, Fundulus catenatus and Fundulus stellifer (Cyprinodontidae, Pisces). Tulane Stud. Zool. 16(1): 1-21.
- Thomson, M. T., S. M. Herrick, and E. Brown. 1956. The availability and use of water in Georgia. State Div. of Cons. Dept. of Mines, Mining, and Geology. Bull. No. 65: 1-329.
- Timmons, T. J. 1975a. Range extension of the yellow perch, Perca flavescens (Mitchill), in Tennessee. J. Tenn. Acad. Sci. 1(3): 101-102.
- Timmons, T. J. 1975b. Fishes of Nickajack Reservoir, Tennessee, before the Raccoon Mountain pumped storage plant. Unpublished Ms. Thesis. Tenn. Tech. Univ. pp. 1-73.

- Trautman, M. B. 1981. The Fishes of Ohio. Ohio St. Univ. Press.
782 pp.
- Vincent, J. R. 1979. A summary of toxic substances information for the Chattanooga metropolitan area Tennessee-Georgia. EPA-330-1-79-006. Environmental Protection Agency, Office of Enforcement. Denver, Colorado. pp. 89-125.
- Woods, L. P., and R. F. Inger. 1957. The cave, spring, and swamp, fishes of the family Amblyopsidae of central and eastern United States. Am. Midl. Natur. 58(1): 232-256.

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APPENDICES

APPENDIX A

SOURCES OF WASTEWATER INTO SOUTH CHICKAMAUGA CREEK (VINCENT, 1979)

<u>Location (river kilometers)</u>	<u>Source</u>	<u>Wastes Discharged</u>
1. South Chickamauga Creek 0.32 km	Desoto, Inc. Manufacturer of light fixtures and fireplace furnishings.	Welding cooling water, may contain heavy metals; Cr, Cu, Ni, and Zn.
2. South Chickamauga Creek 0.32 km	Foam Fabricating, Inc. Manufactures polyurethane foam	Process wastewater, may contain hydrocarbons, some possibly toxic.
3. South Chickamauga Creek 0.8 km	Alco Chemical. Produces rubber processing and water treatment chemicals	Overflow from holding tanks may contain dibutylamine, acrylic acid, zinc, carbon disulfide and other organic compounds.
4. South Chickamauga Creek 1.3 km	Mueller Co. Foundry	Sanitary and industrial wastewater. Surface runoff from solid waste disposal may contain heavy metals and oil.
5. South Chickamauga Creek 1.9 km	W. R. Grace. Rare earth chemicals plant	Process, cooling and sanitary wastewaters, may contain caustic soda, trisodium phosphates, chlorides, fluorides, and radium.
6. South Chickamauga Creek 2.4 km	Hawthorne Street Landfill	Leachate from dump may contain toxic and radioactive wastes.

<u>Location (river kilometers)</u>	<u>Source</u>	<u>Wastes Discharged</u>
7. South Chickamauga Creek 2.7 km	Southern Centrifugal, Inc. Manufactures bronze bearings and machine parts.	Cooling water and surface runoff may contain heavy metals.
8. South Chickamauga Creek 8.2 km	Fibron, Inc. Fibrillated yarn plant.	Cooling water, no information on toxic substances.
9. South Chickamauga Creek 8.5 km	Stainless Metal Products. Manufactures metal display racks.	Plating waste and rinse water may contain high levels of hexavalent chromium and nickel.
10. Friar Branch 3.7 km	C. F. Industries, Inc. Fertilizer plant.	Treated process wastewater containing ammonia and chromium. Non-process cooling water.
11. Friar Branch Tributary	Colonial Pipeline Terminal: American Oil Co., Cities Service, Inc., Colonial Pipe- line, Exxon, Benton Oil Co., Chevron Oil Co., Shell Oil Co., and Southern Oil Co.	Surface runoff, spills and decant water, containing phenols and other petroleum products.
12. Friar Branch 0.8 km	GAF Corporation. Latex and textile chemical plant.	Process wastes containing ammonia, styrene and low levels of Cr, Cu, Pb, and Zn.
13. South Chickamauga Creek 13.7 km	Vulcan Materials. Quarry and sand plant.	Wash water and quarry drainage.
14. South Chickamauga Creek 16.9 km	Lutex Chemical Corp. Textile chemicals plant.	Process wastewater discharged via Brainerd WWTP, contains naphtha- lene, biphenyl and other toxic substances. Cooling water dis- charge, contains 34 organic

<u>Location (river kilometers)</u>	<u>Source</u>	<u>Wastes Discharged</u>
15. South Chickamauga Creek 17.4 km	Brainerd waste water treatment plant. In 1978 this plant was organically overloaded with occasional bypass of untreated wastewater directly into South Chickamauga Creek.	compounds, 8 of which are on the toxic substance list: chloroform, toluene methylene chloride, naphthalene, 1,2,4-trimethylbenzene, m-, o-, and p-xylene. Sanitary and industrial wastewater, average discharge of 19,000m ³ /day, designed capacity of 13,000m ³ /day. Industrial wastes alone exceed plant design capacity.
16. West Chickamauga Creek 7.7 km	Fort Oglethorpe waste water treatment plant (to be abandoned).	Sanitary and industrial wastes, average discharge of 7,570m ³ /day.
17. South Chickamauga Creek 23.3 km	East Ridge waste water treatment plant	Sanitary wastes, average discharge of 19,000m ³ /day.
18. South Chickamauga Creek 50.4 km	Ringgold waste water treatment plant	Sanitary and industrial wastes, average discharge of 600m ³ /day.
19. South Chickamauga Creek 52.4 km	Sweetwater Carpet Corp. Rug and carpet manufacturer.	Cooling water discharged directly into South Chickamauga Creek. Latex and sanitary wastes discharged to Ringgold waste water treatment plant, contains zinc and styrene.
20. Little Chickamauga Creek 2.4 km	Dixie Yarns, Inc. Carpet and yarn manufacturer.	Sanitary, process, and cooling wastewaters, containing Cr and other wastes.

<u>Location (river kilometers)</u>	<u>Source</u>	<u>Wastes Discharged</u>
Little Chickamauga Creek 2.4 km	Salem Carpet Mills. Carpet manufacturer.	Process and sanitary waste- waters.
21. West Chickamauga Creek 64.4 km	Barwick Chemical Corporation.	Unknown.

APPENDIX B

A LIST OF FISHES COLLECTED FROM NICKAJACK RESERVOIR (TVA, 1972)

Lepisosteidae--gars

Lepisosteus osseus (Linnaeus). Longnose gar.
Lepisosteus platostomus Rafinesque. Shortnose gar.

Clupeidae--herrings

Alosa chrysochloris (Rafinesque). Skipjack herring.
Dorosoma cepedianum (Lesueur). Gizzard shad.
Dorosoma petenense (Gunther). Threadfin shad.

Hiodontidae--mooneyes

Hiodon tergisus Lesueur. Mooneye.

Cyprinidae--minnows

Cyprinus carpio Linnaeus. Carp.
Hybopsis storeriana (Kirtland). Silver chub.
Notemigonus crysoleucas (Mitchill). Golden shiner.
Notropis atherinoides Rafinesque. Emerald shiner.
Notropis galacturus (Cope). Whitetail shiner.
Notropis whipplei (Girard). Steelcolor shiner.
Pimephales notatus (Rafinesque). Bluntnose minnow.

Catostomidae--suckers

Ictiobus bubalus (Rafinesque). Smallmouth buffalo.
Minytrema melanops (Rafinesque). Spotted sucker.
Moxostoma erythrurum (Rafinesque). Golden redhorse.

Ictaluridae--freshwater catfish

Ictalurus natalis (Lesueur). Yellow bullhead.
Ictalurus nebulosus (Lesueur). Brown bullhead.
Ictalurus punctatus (Rafinesque). Channel catfish.
Pylodictis olivaris (Rafinesque). Flathead catfish.

Atherinidae--silversides

Labidesthes sicculus (Cope). Brook silverside.

Percichthyidae--temperate basses

Morone chrysops (Rafinesque). White bass.

Morone mississippiensis Jordan and Eigemann. Yellow bass.

Centrarchidae--sunfishes

Ambloplites rupestris (Rafinesque). Rockbass.

Lepomis auritus (Linnaeus). Redbreast sunfish.

Lepomis cyanellus Rafinesque. Green sunfish

Lepomis humilis (Girard). Orangespotted sunfish.

Lepomis macrochirus Rafinesque. Bluegill.

Lepomis megalotis (Rafinesque). Longear sunfish.

Lepomis microlophus (Gunther). Redear sunfish.

Micropterus salmoides (Lacépède). Largemouth bass.

Pomoxis annularis Rafinesque. White crappie.

Pomoxis nigromaculatus (Lesueur). Black crappie.

Percidae--perches

Perca flavescens (Mitchill). Yellow perch.

Percina caprodes (Rafinesque). Logperch.

Sciaenidae--drum

Aplodinotus grunniens Rafinesque. Freshwater drum.

APPENDIX C

A LIST OF FISHES REPORTED FROM NICKAJACK RESERVOIR BY TIMMONS (1975)

Petromyzontidae--lampreys

Ichthyomyzon castaneus Girard. Chestnut lamprey.

Lepisosteidae--gars

Lepisosteus oculatus (Winchell). Spotted gar.

Lepisosteus osseus (Linnaeus). Longnose gar.

Amiidae--bowfin

Amia calva Linnaeus. Bowfin.

Anguillidae--freshwater eels

Anguilla rostrata (Lesueur). American eel.

Clupeidae--herrings

Alosa chrysochloris (Rafinesque). Skipjack herring.

Dorosoma cepedianum (Lesueur). Gizzard shad.

Dorosoma petenense (Gunther). Threadfin shad.

Hiodontidae--mooneyes

Hiodon tergisus Lesueur. Mooneye.

Cyprinidae--minnows

Cyprinus carpio Linnaeus. Carp.

Hybopsis storeriana (Kirtland). Silver chub.

Notemigonus crysoleucas (Mitchill). Golden shiner.

Notropis atherinoides Rafinesque. Emerald shiner.

Notropis spilopterus (Cope). Spotfin shiner.

Notropis volucellus (Cope). Mimic shiner.

Notropis whipplei (Girard). Steelcolor chiner.

Pimephales notatus (Rafinesque). Bluntnose minnow.

Pimephales promelas Rafinesque. Fathead minnow.

Pimephales vigilax (Baird and Girard). Bullhead minnow.

Catostomidae--suckers

Carpiodes carpio (Rafinesque). River carpsucker.
Carpiodes cyprinus (Lesueur). Quillback.
Ictiobus bubalus (Rafinesque). Smallmouth buffalo.
Ictiobus cyprinellus (Valenciennes). Bigmouth buffalo.
Ictiobus niger (Rafinesque). Black buffalo.
Minytrema melanops (Rafinesque). Spotted sucker.
Moxostoma carinatum (Cope). River redhorse.
Moxostoma duquesnei (Lesueur). Black redhorse.
Moxostoma erythrurum (Rafinesque). Golden redhorse.
Moxostoma macrolepidotum (Lesueur). Shorthead redhorse.

Ictaluridae--freshwater catfish

Ictalurus furcatus (Lesueur). Blue catfish.
Ictalurus melas (Rafinesque). Black bullhead.
Ictalurus natalis (Lesueur). Yellow bullhead.
Ictalurus nebulosus (Lesueur). Brown bullhead.
Ictalurus punctatus (Rafinesque). Channel catfish.
Pyiodictis olivaris (Rafinesque). Flathead catfish.

Poeciliidae--livebearers

Gambusia affinis (Baird and Girard). Mosquitofish.

Atherinidae--silversides

Labidesthes sicculus (Cope). Brook silverside.

Percichthyidae--temperate basses

Morone chrysops (Rafinesque). White bass.
Morone mississippiensis Jordan and Eigenmann. Yellow bass.
Morone saxatilis (Walbaum). Striped bass.

Centrarchidae--sunfishes

Ambloplites rupestris (Rafinesque). Rockbass.
Lepomis auritus (Linnaeus). Redbreast sunfish.
Lepomis cyaneellus Rafinesque. Green sunfish.
Lepomis gulosus (Cuvier). Warmouth.
Lepomis humilis (Girard). Orangespotted sunfish.
Lepomis macrochirus Rafinesque. Bluegill.
Lepomis megalotis (Rafinesque). Longear sunfish.

Lepomis microlophus (Gunther). Redear sunfish.
Micropterus dolomieu Lacépède. Smallmouth bass.
Micropterus punctulatus (Rafinesque). Spotted bass.
Micropterus salmoides (Lacépède). Largemouth bass.
Pomoxis annularis Rafinesque. White crappie.
Pomoxis nigromaculatus (Lesueur). Black crappie.

Percidae--perches

Perca flavescens (Mitchill). Yellow crappie.
Percina caprodes (Rafinesque). Logperch.
Stizostedion canadense (Smith). Sauger.
Stizostedion vitreum (Mitchill). Walleye.

Sciaenidae--drum

Aplodinotus grunniens Rafinesque. Freshwater drum.

APPENDIX D

COLLECTION SUMMARY OF SPECIES COLLECTED FROM LOOKOUT AND SOUTH CHICKAMAUGA CREEK SYSTEMS

An X indicates the presence of at least one individual in a collection.

<u>Species</u>	<u>Collection Number and Number of Each Species Collected</u>
<u>Ichthyomyzon bdellium</u>	59-2
<u>Ichthyomyzon castaneus</u>	8-1
<u>Ichthyomyzon greeleyi</u>	79-1, 81-3, 83-1
<u>Dorosoma cepedianum</u>	8-1, 30-1, 33-1, 34-X, 40-X, 41-X, 45-10, 69-X
<u>Salmo gairdneri</u>	51-1, 84-2
<u>Campostoma anomalum</u>	1-10, 2-X, 3-X, 4-8, 5-12, 7-20, 8-52, 9-5, 10-24, 11-1, 12-68, 13-50, 15-22, 16-6, 17-6, 18-17, 19-1, 21-X, 22-X, 23-X, 25-X, 27-X, 29-X, 30-13, 31-X, 33-4, 34-X, 36-X, 37-X, 38-11, 39-X, 40-67, 41-X, 42-X, 43-87, 44-7, 46-38, 47-18, 48-1, 49-58, 50-10, 51-51, 52-2, 54-3, 55-3, 57-2, 58-1, 59-52, 60-8, 62-1, 63-5, 64-2, 65-1, 67-3, 69-X, 71-25, 74-X, 75-4, 78-16, 79-1, 82-5, 83-1, 84-8, 85-4
<u>Cyprinus carpio</u>	8-1
<u>Hemitremia flammea</u>	51-1, 53-5, 54-41
<u>Hybopsis amblops</u>	1-16, 2-X, 3-X, 8-3, 22-X, 32-X, 34-X, 39-X, 40-40, 41-X, 42-X, 43-6, 44-2, 47-1, 50-19, 55-7, 59-20, 70-X, 81-2
<u>Hybopsis storeriana</u>	24-X
<u>Nocomis micropogon</u>	1-31, 2-X, 3-X, 8-19, 9-10, 10-14, 12-1, 16-13, 21-X, 22-X, 23-X, 24-X, 25-X, 26-X, 27-X, 28-X, 29-X, 33-2,

<u>Nocomis micropogon</u> (con't)	34-X, 35-X, 36-X, 37-X, 38-9, 39-X, 40-47, 41-X, 42-X, 44-1, 48-1, 63-11, 65-2, 69-X, 70-X, 71-4, 74-X
<u>Notropis ardens</u>	5-4, 8-29, 9-20, 10-17, 12-1, 14-3, 15-37, 39-X, 43-4, 47-10, 48-9, 49-10, 50-86, 59-70, 60-1, 75-1, 81-24, 83-7, 84-40, 85-30
<u>Notropis ariommus</u>	8-1, 40-12, 43-2, 58-1
<u>Notropis atherinoides</u>	8-5, 21-X, 22-X, 23-X, 24-X, 26-X, 27-X, 28-X, 29-X, 32-X, 36-X, 39-X, 40-X
<u>Notropis chrosomus</u>	82-1
<u>Notropis coccogenis</u>	1-67, 2-X, 3-X, 8-71, 9-119, 10-97, 11-1, 12-95, 15-13, 39-X, 40-88, 41-X, 42-X, 43-54, 44-74, 46-11, 47-42, 48-5, 49-26, 50-10, 58-1, 59-8, 63-5, 78-1, 81-13, 83-4, 84-38, 85-45
<u>Notropis chrysocephalus</u> <u>chrysocephalus</u>	1-33, 2-X, 3-X, 8-156, 9-47, 10-104, 12-49, 13-26, 14-44, 15-130, 16-2, 19-3, 30-1, 38-23, 39-X, 40-108, 41-X, 42-X, 43-41, 44-28, 46-20, 47-40, 49-3, 50-5, 54-1, 55-1, 57-1, 58-17, 59-10, 60-5, 74-X, 78-6, 79-1, 81-17, 82-7, 83-6, 84-73, 85-19
<u>Notropis galacturus</u>	8-6, 9-14, 12-1, 15-10, 71-2, 75-7, 79-1, 81-3, 82-10, 83-6, 84-14, 85-2
<u>Notropis leuciodus</u>	2-X, 6-2, 8-104, 9-98, 10-38, 12-18, 40-1
<u>Notropis lirus</u>	42-X, 47-1, 55-1, 82-8
<u>Notropis spilopterus</u>	1-30, 8-6, 21-X, 22-X, 23-X, 24-X, 25-X, 26-X, 27-X, 28-X, 29-X, 31-X, 32-X, 33-138, 34-X, 35-X, 36-X, 38-2, 71-X
<u>Notropis telescopus</u>	2-X, 8-51, 9-12, 10-14, 12-99, 15-198, 78-1, 82-1, 83-3, 84-26, 85-3
<u>Notropis volucellus</u>	21-X, 41-X, 58-1

<u>Notropis whipplei</u>	3-X, 22-X, 29-X, 34-X
<u>Phenacobius uranops</u>	22-X, 23-X, 24-X, 25-X, 27-X, 29-X, 31-X, 34-X, 35-X, 36-X, 37-X, 39-X, 40-19, 46-1, 47-3, 49-2, 69-X, 71-X
<u>Pimephales notatus</u>	8-1, 30-1, 46-1, 54-37, 62-1, 75-1, 84-2
<u>Pimephales promelas</u>	9-1
<u>Pimephales vigilax</u>	11-1, 25-X, 28-X, 31-X, 34-X
<u>Rhinichthys atratulus</u>	5-2, 7-37, 11-3, 12-2, 13-17, 17-19, 18-18, 19-6, 20-16, 52-1, 54-5, 56-32, 64-1, 66-10, 77-11
<u>Semotilus atromaculatus</u>	2-X, 7-23, 13-2, 17-2, 18-1, 19-2, 20-1, 43-1, 46-1, 51-8, 52-9, 56-11, 59-3, 62-2, 67-1, 84-1
<u>Catostomus commersoni</u>	13-1, 19-1, 61-1
<u>Hypentelium nigricans</u>	1-2, 2-X, 3-X, 5-2, 8-17, 9-9, 10-10, 11-1, 12-5, 15-2, 16-3, 19-1, 22-X, 29-X, 30-1, 33-1, 34-X, 35-X, 37-X, 38-6, 39-X, 40-3, 41-X, 42-X, 43-1, 45-1, 47-1, 50-10, 51-3, 52-7, 55-5, 57-1, 58-1, 59-18, 60-3, 63-1, 65-1, 69-X, 76-3, 79-8, 81-5, 82-18, 85-1
<u>Minytrema melanops</u>	8-4, 14-5, 72-2
<u>Moxostoma anisurum</u>	40-1
<u>Moxostoma duquesnei</u>	8-1, 12-9, 15-17, 28-X, 34-X, 40-2, 43-1, 45-4, 71-1
<u>Moxostoma erythrurum</u>	8-10, 9-15, 10-4, 14-6, 34-X, 59-2, 79-1, 82-7
<u>Ictalurus melas</u>	72-1
<u>Ictalurus natalis</u>	8-1, 30-4
<u>Ictalurus punctatus</u>	2-X, 3-X, 8-1, 27-X, 28-X
<u>Noturus eleutherus</u>	32-X, 33-1, 34-X, 35-X, 37-X, 38-7, 39-X
<u>Pylodictis olivaris</u>	8-1, 33-1

<u>Fundulus catenatus</u>	80-1, 82-1, 84-2
<u>Fundulus olivaceus</u>	8-8, 15-2, 40-5, 49-1, 56-3, 59-2, 60-4, 62-5, 84-5
<u>Gambusia affinis</u>	1-1, 2-X, 3-X, 8-2, 28-X, 30-3, 33-20, 34-X, 38-7, 39-X, 40-44, 41-X, 46-5, 47-9, 48-11, 49-1, 50-3, 51-1, 52-2, 54-70, 59-10, 60-14, 61-10, 63-5, 71-1, 74-1, 75-1, 78-7, 82-9
<u>Labidesthes sicculus</u>	1-1, 32-X, 34-X, 40-46, 71-X
<u>Morone chrysops</u>	34-X
<u>Ambloplites rupestris</u>	6-1, 8-11, 9-2, 12-3, 14-2, 15-9, 33-1, 38-5, 40-29, 43-1, 44-1, 45-1, 46-4, 47-1, 48-5, 50-4, 58-9, 72-1, 81-7
<u>Lepomis auritus</u>	1-12, 2-X, 3-X, 8-26, 9-1, 10-2, 12-1, 14-13, 15-6, 30-2, 38-10, 40-10, 43-1, 44-1, 45-1, 46-2, 47-6, 49-4, 50-4, 52-5, 54-3, 57-5, 59-12, 60-4, 62-1, 68-1, 71-1, 72-5, 75-15, 77-4, 78-5, 81-1, 82-3, 83-5, 84-12
<u>Lepomis cyanellus</u>	1-1, 8-3, 12-2, 14-1, 18-4, 30-4, 33-2, 38-9, 40-6, 47-2, 52-1, 54-6, 59-17, 60-1, 61-11, 63-2, 66-2, 71-2, 72-2, 74-X, 75-1, 76-1, 78-4, 80-3, 81-2, 82-1, 83-8, 84-7
<u>Lepomis gulosus</u>	14-3, 40-2, 52-1, 72-2
<u>Lepomis macrochirus</u>	1-11, 2-X, 3-X, 8-6, 9-1, 11-3, 12-1, 13-4, 14-5, 15-1, 16-4, 21-X, 22-X, 24-X, 28-X, 33-2, 34-X, 38-5, 40-12, 47-2, 50-1, 52-6, 54-9, 55-4, 56-3, 58-7, 59-8, 60-6, 63-1, 65-1, 68-1, 69-X, 71-X, 72-2, 74-X, 75-6, 78-4, 80-3, 81-5, 82-15, 83-17, 84-22
<u>Lepomis megalotis</u>	2-X, 3-X, 8-19, 10-1, 14-34, 16-1, 22-X, 43-1, 72-5
<u>Lepomis microlophus</u>	8-7, 14-16, 21-X, 22-X, 29-X, 32-X, 33-1, 36-X, 38-1, 40-2, 71-1, 81-3, 82-2, 83-1, 84-1

<u>Lepomis punctatus</u>	8-8, 12-1, 14-2, 15-1, 48-2, 68-1
<u>Micropterus coosae</u>	45-1
<u>Micropterus dolomieu</u>	8-1, 9-1, 14-1, 15-4, 39-X, 40-2, 43-1, 46-1, 49-1, 57-1, 79-1
<u>Micropterus punctulatus</u>	1-4, 2-X, 3-X, 8-4, 9-3, 10-2, 12-1, 21-X, 22-X, 25-X, 26-X, 27-X, 28-X, 29-X, 33-1, 34-X, 38-1, 39-X, 40-19, 47-2
<u>Micropterus salmoides</u>	8-4, 14-2, 15-3, 30-1, 33-2, 34-X, 40-5, 42-X, 43-1, 46-2, 47-2, 49-2, 58-1, 74-1, 78-1, 83-2, 85-1
<u>Pomoxis nigromaculatus</u>	8-1, 40-4
<u>Etheostoma blennioides</u>	2-X, 8-9, 9-2, 10-7, 12-3, 15-4, 29-X, 33-2, 34-X, 35-X, 36-X, 37-X, 38-1, 39-X, 40-22, 41-X, 42-X, 43-4, 46-1, 47-14, 48-2, 50-6, 51-5, 52-3, 55-3, 59-12, 60-1, 63-1, 67-1, 79-59, 82-2
<u>Etheostoma caeruleum</u>	4-3, 5-6, 8-8, 10-2, 12-2, 30-2, 38-1, 39-X, 40-9, 41-X, 42-X, 44-1, 47-1, 49-6, 51-4, 52-3, 55-1, 57-6, 59-4, 62-4, 67-2, 77-2, 79-2, 81-5, 82-5, 83-2, 84-1
<u>Etheostoma cinereum</u>	40-1
<u>Etheostoma duryi</u>	4-3, 7-5, 8-1, 11-5, 13-2, 19-5, 79-27
<u>Etheostoma jessiae</u>	3-X, 5-4, 6-1, 8-12, 9-8, 10-5, 12-3, 15-2, 16-2, 39-X, 40-8, 41-X, 46-1, 49-1, 50-10, 55-1, 57-1, 59-17, 67-1, 79-17, 81-8, 82-20, 83-1, 84-1
<u>Etheostoma rufilineatum</u>	1-28, 2-X, 3-X, 4-6, 5-14, 6-3, 8-111, 9-20, 10-21, 12-41, 15-22, 16-17, 21-X, 22-X, 23-X, 27-X, 28-X, 33-10, 34-X, 35-X, 36-X, 37-X, 38-23, 39-X, 40-114, 41-X, 42-X, 43-1, 44-60, 46-17, 47-8, 48-3, 49-16, 50-20, 51-9, 55-9, 57-6, 59-23, 63-1, 64-1, 67-11, 71-1, 74-X, 75-7, 77-6, 79-57, 81-33, 82-21, 83-37, 84-22, 85-16

Etheostoma simoterum

1-20, 2-X, 3-X, 4-6, 5-26, 6-1,
7-3, 8-43, 9-22, 10-12, 11-3, 12-47,
13-7, 15-28, 16-9, 17-1, 19-1, 20-1,
27-X, 29-X, 30-52, 33-2, 34-X, 35-X,
36-X, 37-X, 38-10, 39-X, 40-103,
41-X, 42-X, 43-2, 44-14, 46-8, 47-18,
48-1, 49-20, 50-37, 51-10, 52-20,
54-8, 55-4, 56-11, 57-11, 59-87,
60-4, 62-3, 63-1, 64-1, 67-2, 68-2,
75-1, 77-14, 81-34, 82-37, 83-20,
84-9, 85-3

Etheostoma z. zonale

21-X, 22-X, 24-X, 25-X, 27-X, 28-X,
29-X, 31-X, 32-X, 33-9, 34-X, 36-X,
37-X, 38-10, 39-X, 40-49, 41-X,
42-X, 44-2, 47-3, 50-2, 69-X, 70-X,
71-X

Perca flavescens

3-1

Percina caprodes

2-X, 3-X, 6-1, 8-6, 9-3, 15-1, 21-X,
22-X, 23-X, 24-X, 25-X, 26-X, 28-X,
29-X, 32-X, 34-X, 36-X, 37-X, 39-X,
40-12, 46-2, 47-1, 49-1, 59-6

Percina sciera

1-5, 2-X, 6-1, 8-1, 29-X, 34-X,
35-X, 40-5, 44-1, 46-1, 47-2, 59-6,
60-1, 73-1, 75-1, 82-7

Percina tanasi

23-1, 27-6, 28-2, 33-6, 34-29, 39-2,
40-4

Stizostedion canadense

27-X

Aplodinotus grunniens

3-X, 8-1, 40-1

Cottus carolinae

1-12, 2-X, 3-X, 4-7, 5-8, 6-2, 7-10,
8-41, 9-3, 10-8, 11-3, 12-20, 13-2,
14-10, 15-1, 16-29, 17-5, 18-24,
19-3, 20-9, 21-X, 22-X, 25-X, 26-X,
27-X, 28-X, 29-X, 30-5, 31-X, 32-X,
33-15, 34-X, 35-X, 36-X, 37-X,
38-22, 39-X, 40-61, 41-X, 42-X,
43-7, 44-29, 46-9, 47-9, 48-3, 49-9,
50-3, 51-14, 52-15, 55-15, 56-12,
57-4, 59-15, 60-8, 61-39, 63-4,
64-2, 65-1, 67-8, 68-1, 69-X, 70-X,
71-16, 74-1, 75-3, 76-9, 77-19,
78-2, 79-8, 81-12, 82-11, 83-12,
84-11, 85-5

VITA

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