12-1976

The Distribution of Fishes in the Little Tennessee River System

James McKee Winfield Jr.
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To the Graduate Council:

I am submitting herewith a thesis written by James McKee Winfield Jr. entitled "The Distribution of Fishes in the Little Tennessee River System." I have examined the final electronic 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 Animal Science.

David A. Etnier, Major Professor

We have read this thesis and recommend its acceptance:

Nathan Helms, Peter Wehner

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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and recommend its acceptance:

Accepted for the Council:

Vice Chancellor
Graduate Studies and Research

THE DISTRIBUTION OF FISHES IN THE LITTLE TENNESSEE RIVER SYSTEM

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

James McKee Winfield, Jr.

December 1976

ACKNOWLEDGMENTS

My thanks to Dr. David Etnier, teacher, consultant, editor, and friend, to Nathan Helms, Peter Wehner, and Frank Oakberg, themselves always, and especially to Kaye who made it all happen with her patience and help.

ABSTRACT

This paper is the product of a study of the ichthyofaunal distribution within the Little Tennessee River. This system is a major tributary to the Tennessee River.

A total of 212 collections are included in this paper. Of this total, 67 were made by the author. The remainder of the collections were made by various agencies and individuals. Of the total number of collections made by the author, approximately half were done using diving gear and employing sight identification. The remaining collections were accomplished with the aid of seines.

Included in this paper is a list of the species of fish which inhabit the river system with a description of habitat preferences and distributions within the system.

Also included is a discussion of the various ichthyofaunal units which exist in the system and the species which characterize each unit. The effects of alteration of the river system by man as shown by broken distributional patterns and species diversity are discussed.

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CHAPTER I

INTRODUCTION

The information found in this paper concerns the ichthyofaunal composition of the Little Tennessee River. There are several reasons this particular river system was chosen. Preliminary studies revealed that the river had been collected infrequently in its lower reaches. This area extends from the North Carolina--Tennessee line to the Little Tennessee River's confluence with the Tennessee River and contains a large portion of the river system. The upper portion had been studied previously by various persons and agencies at different times. I considered it necessary to consolidate all the available data into one paper. By including my own observations it is hoped that a better understanding of the river will result. Secondly, this river system was chosen because of its relationship with other systems in East Tennessee that have already been studied. It was felt that the addition of this survey would fill a gap in the overall study of the headwaters of the Tennessee River. River systems to the south and to the north have, in the past, been more closely observed. Thirdly, there is the distinct possibility that the Little Tennessee River may become impounded in the near future. Construction of the dam would result in the destruction of suitable habitat for many of the fishes found in the river and in the streams that flow into it. Most heavily

affected would be the darters (Percidae) and the minnows (Cyprinidae), some of which are rare or endemic.

Included in this paper are collections made by the author and by other individuals the author contacted. Collection reports include collection location, dates, collectors, fish collected and their numbers. A discussion of the species distribution within the system is included for some species.

I. The River

The Little Tennessee River is composed of numerous streams and rivers which flow through portions of three states. Its drainage basin lies in parts of southeastern Tennessee, southwestern North Carolina, and northwestern Georgia. Nearly two-thirds of the system is located in North Carolina. In Georgia less than 100 square miles is drained by the river's headwaters. The entire watershed covers approximately 2600 square miles. Good agricultural land is scarce except in the lower portion of the river. Most of the drainage area is covered with natural vegetation. The Little Tennessee River system is composed of the Little Tennessee River with its headwaters in Georgia, five smaller rivers and numerous creeks and streams. In Tennessee Tellico River, Abrams Creek, and Citico Creek are the main tributaries to the river. Four rivers flow into the river in North Carolina. These are the Cheoah, Nantahala, Oconaluftee, and Tuckaseegee rivers. The Little Tennessee

River empties into the Tennessee River near Loudon, Tennessee.

Tellico River, the longest tributary to the Little Tennessee in Tennessee, drains most of the northern part of Cherokee National Forest. The upper and lower portions of the river are distinctly different. The upper portion is clear, clean, and basically unaffected by man. Most of the original fish fauna still remains. The upper Tellico River is characterized by fast flowing water with long riffle areas and small pools. The bottom is composed of moderate to large size boulders. This area is frequently stocked with trout and provides some of the best trout fishing water in the state. The lower portion of the river has been greatly altered by agricultural activities and construction resulting from the proposed dam on the Little Tennessee. Both have resulted in increased turbidity and disruption of bottom conditions.

Abrams Creek is another major tributary to the Little Tennessee in Tennessee. The Great Smoky Mountains National Park is, in part, drained by this system. In the past this stream has yielded some fish of great significance taxonomically. In 1957 Abrams Creek was reclaimed. All "rough fish" were eliminated and an intensive stocking program was begun. The area still contains some of its original fish fauna, but several species have apparently been extirpated. Abrams Creek is a scenic stream running cold and clear through the

Great Smoky Mountains. Its headwaters originate in the Cades Cove area. The stream is characterized by moderately fast currents, in a long series of riffles and pools emptying into Chilhowee Reservoir. The stream has great fishing potential with the upper portion trout water and the lower portion well populated with smallmouth bass and some trout.

The third major tributary in Tennessee is Citico Creek. This stream drains the northern portion of Cherokee National Forest. It is almost totally unaltered from its headwaters to its mouth. Geographically it is very similar to Abrams Creek, both being in heavily forested areas. The stream is characterized by pools and riffles with a substrate of rocks and gravel. The current is moderate to fast. This stream is important as a breeding ground for trout which travel up it each year in late winter. The upper reaches of the stream offer good quality trout fishing.

There are four rivers which empty into the Little Tennessee in North Carolina. One of these is Cheoah River. It has its origin in the far western corner of the state. Santeetlah Reservoir, formed by numerous creeks and streams, is located in the headwaters of this river. Out of it flows Cheoah River. The river empties into the Little Tennessee below the Cheoah Dam at Tapoco. It is characterized by moderately fast flowing water with substrates ranging from medium size boulders to gravel and sand.

Another major contributor of water to the Little Tennessee in North Carolina is the Nantahala River. It originates very close to the North Carolina--Georgia state line and flows north into Nantahala Reservoir. Upon leaving this lake it again flows north and its lower reaches are impounded by Fontana Reservoir. The Nantahala is one of the most beautiful rivers in the system. The lower portion of the river traverses some of the most rugged terrain in the basin. It is less affected by man, due, in part, to the establishment of Nantahala National Forest. It is a fast flowing river, periodically stocked with trout, with a rock and gravel substrate.

The Oconaluftee River drains the most northern portion of the system. It flows southwest out of the higher mountains and enters the Tuckaseegee River east of Bryson City, North Carolina. Most of its watershed is in the Cherokee Indian Reservation. Through good management procedures this river has been developed into an excellent trout fishery. As a result of stocking programs managed by the Cherokees, excellent catches of both brook and rainbow trout are taken each year, offering additional income to many Indians in the area. The river is typical of high elevation rivers, fast flowing with many riffles and pools and rock and gravel substrates.

Draining the most eastern portion of the river system is the Tuckaseegee River. Longest tributary to the Little

Tennessee in North Carolina, this river flows north from its headwaters through an area of high population density. Combining with the Oconaluftee River it empties into Fontana Reservoir. Pollution is a major problem in this river. Scott Creek in Jackson County, a tributary to the Tuckaseegee, has the highest concentration of pollutants in the basin. Receiving large quantities of domestic and pulp mill waste, this stream is devoid of dissolved oxygen at most times of the year (Messer and Ratledge 1963). The entire lower portion of the Tuckaseegee is affected by the high levels of pollutants found in this creek. As a result the river below Scott Creek is dark brown in color. "Soap suds," one characteristic of polluted waters, can be seen frequently on the river. These conditions prevail from Scott Creek downstream to the mouth of the river in Fontana Reservoir. In 1959, as a result of poor water quality, a large fish kill occured in the section of the river between Scott Creek and the Jackson--Swain County line. A reduction in the number of original fish species has resulted (Messer and Ratledge 1963).

Slickrook Creek is the most unaffected tributary in the system. A stream of great beauty, Slickrook flows along the North Carolina--Tennessee state line. This stream originates in the northern part of Cherokee National Forest, joining with the Little Tennessee at Calderwood Lake. It is basically unaltered and may contain most of its original fish fauna.

Slickrock has a wide range of montane pool and riffle habitats. Also found on the creek are several high falls. These falls form a barrier to fish migration and restrict the distribution of fish in the stream. Substrates are rock and gravel. The creek has good populations of trout but is not heavily fished due to its inaccessability.

The mainstream Little Tennessee River has its headwaters in the far southern corner of the river system in Rabun County, Georgia. It flows north through the basin into Fontana Reservoir and then turns west into Tennessee. In Tennessee there are two reservoirs, Chilhowee and Calderwood, and approximately 35 miles of free-flowing water. It empties into the Tennessee River near Loudon, Tennessee. The upper and lower sections of the river are very different in terms of water quality. From Fontana Reservoir upstream, the Little Tennessee is highly polluted. Both industrial and domestic waste are emptied into the river. The Franklin area has been a major source of this pollution (Messer and Ratledge 1963). Also, industrial waste is emptied into the river in the Georgia portion of the system. As a result only remnants of the original fish fauna may remain. From Fontana Reservoir downstream water quality improves. The Tennessee portion of the river is clear and clean. The river and reservoirs offer some of the best trout fishing water found in eastern United States. Fluctuating water levels, due to varying dam discharge,

characterize the lower part of the river. The bottom is composed of moderate size rocks and bedrock shelves. During periods of low discharge riffles are frequently seen along the river. Pollution in certain areas of the basin poses a definite danger to populations of fish present. Only the lower section is free of pollution. Higher quality water is due to a low population density in the area and to the presence of surrounding parks and forests. The upper Little Tennessee system is highly polluted, with mining, industrial, and domestic waste the major sources of this pollution. Many of the towns and villages located within the basin discharge untreated waste products directly into the river and into its tributaries. The result has been the alteration or destruction of some of the more interesting parts of the river in terms of fauna. High levels of turbidity and siltation have resulted (Messer and Ratledge 1963).

II. COLLECTING SITES, MATERIALS, AND METHODS

A total of 212 collections are included in this paper. Appendix A contains these collections. Of this total, 67 were made by the author during the study period which extended from March, 1972 to October, 1972. Also included are 63 collections made by the North Carolina Wildlife Resource Commission in 1963 and 23 Tennessee Valley Authority collections made in 1969. Both series of collections were made in the

upper portion of the river in North Carolina and Georgia. The additional 59 collections were made by various persons and agencies. Most collections were made where roads allowed easy access to the water.

The tributary streams and rivers were the most frequent collection sites. The lower portion of the river was not sampled frequently by the author because of unusually high levels of water during the study period. Collection data for this section of the river was supplied by the Tennessee Valley Authority and the Tennessee Game and Fish Commission. Boles (1968) also supplied information concerning the fish found in the lower river. In 1973, 1974, and 1975 this section of the river was thoroughly examined by students of the University of Tennessee and the Tennessee Valley Authority. This survey was generated by the discovery of a new species, Percina tanasi, by Dr. David Etnier of the University. Included in this paper are the collections of that survey.

In some streams several collections were made in one particular site. Abrams Creek was sampled this way in two locations. This was done with the hope of finding some of this streams rarer fish, particularly the madtoms, Noturus baileyi and Noturus flavus. Some streams were collected at several sites with the hope of observing the different species of fish found in various parts of the stream. Collections were made from the river's confluence with the Tennessee

River upstream to its headwaters. As a result Percina aurantica was observed in both Tellico River and Citico Creek. Also found in Tellico River was the darter, Percina burtoni. The distribution of the undescribed shiner Notropis sp. (cf. N. spectrunculus) in Citico Creek was also studied using this procedure.

In making the collections no particular type of habitat was stressed. This procedure reduced the possibility of emphasizing any particular group of fish. When snorkel diving was employed, notes were taken as to which fish were located in each part of a site.

The equipment used in the collections included seines of various sizes and snorkel diving gear. Ten-and twenty-foot small-mesh seines were found to be very useful within this river system. The ten-foot seine was most frequently used in collecting the tributaries of the river. A bag seine was used when conditions allowed in the mainstream and in the larger pools of the tributaries.

Sodium cyanide was also employed but only when it appeared that nothing else would work. My reluctance to use this chemical was due to the large trout populations found within the system. It was feared that its use would directly or indirectly result in the death of other fish also. The procedure employed in using this chemical was as follows. Tablets of sodium cyanide were placed at the heads of the riffles by

one member of the collecting team. Other members were involved in setting up seines and in manning dip nets. As many specimens of non-game fish were collected as possible. Game fish were recorded and returned to the water. All retained specimens were preserved in ten-percent formalin upon capture. All pertinent information was printed on a card and placed in the container housing the specimens. Sodium cyanide was used most frequently in attempting to capture the more elusive fish, particularly the madtoms. This chemical allowed the collection of habitats unsuited for other procedures.

Snorkel diving was the most frequently used method of examining the fish populations found in the system. The necessary equipment consists of a diving mask, snorkel, and diving fins. A wet suit provided protection from cold water in the headwater streams and in dam tailwaters. Water depth and clarity were the major limiting factors for this method. It was found that observing the bottom dwelling fish was very difficult. Sculpins and madtoms were seldom seen using this method. Snorkel diving was used most frequently because it allows the diver to note not only the species within an area but also their location in that area. It also allows a more accurate means of determining the abundance of each species. Also the natural flow of events within the stream was not disrupted.

With the assistance of Dr. D. A. Etnier, I identified

all specimens I obtained. All other collections were identified by the collectors. Literature used in the identifications included Eddy (1969), Etnier (1967), Jenkins (1970), Moore (1968), and Miller (1968).

Abbrevations used in this paper are as follows: U. T. L. T.--University of Tennessee Little Tennessee collections, N. C. W. R. C.--North Carolina Wildlife Resource Commission, B. S. F. W.--Bureau of Sport Fisheries and Wildlife, T. V. A.--Tennessee Valley Authority.

CHAPTER II

AN ANNOTATED LIST OF THE FISH SPECIES IN THE SYSTEM

Family Petromyzontidae

Ichthyomyzon bdellium (Jordan)--Ohio lamprey. Two specimens of the Ohio lamprey were collected in the lower portion of the river, one from the area around Rose Island and the other from the Davis Island area. I. bdellium prefers larger rivers with riffles and channels. Within the Little Tennessee, Chilhowee Dam serves as the major restricting factor in its distribution. It is very doubtful that it occurs in the higher elevations of the system.

Ichthyomyzon castaneus Girard--Chestnut lamprey. Etnier (1970) recorded one specimen of this parasitic lamprey from Calloway Island. Mainly an inhabitant of larger streams and rivers, it occurs in the lower portion of the mainstream Little Tennessee River. It is very doubtful that it occurs with any regularity in the upper sections of the system.

Ichthyomyzon greeleyi Hubbs and Trautmen--Allegheny brook lamprey. Raney (1952) recorded Ichthyomyzon hubbsi from the Little Tennessee River and Oconaluftee River in North Carolina. Vladykov (1973) had indicated that I. hubbsi is a junior synonym of I. greeleyi (Pers. Comm. David Etnier). The collections indicated that I. greeleyi prefers the larger streams in the headwater area.

Lampetra lamottei (Lesueur)--Eastern brook lamprey. This non-parasitic species is the most abundant lamprey in the system. It is found most frequently in the lower portion of the river and occurs in larger numbers there during the spring. Due to its habitat preference it is doubtful that it occurs in the upper portion of the system.

Family Polyodontidae

Polyodon spathula (Walbaum)--Paddlefish. The existence of the paddlefish within the system was verified by the collection of 25 specimens of the species by a T. V. A. field team. The collection was made around the coffer dam at the Tellico Dam site (Pers. Comm. Doug Harned). P. spathula is restricted to the slower, warmer waters of the lower Little Tennessee River.

Family Acipenseridae

Acipenser fulvescens Rafinesque--Lake sturgeon. No written collection records for A. fulvescens for this river system were found by the author. Verification of its existence in the lower Little Tennessee River is provided by the capture of several specimens by commercial fishermen (Pers. Comm. Price Wilkins). Etnier (1976) suggests that a reproducing population of the species may exist in this area. It is very doubtful that the species occurs above the first dam, Chilhowee.

Family Amiidae

Amia calva Linnaeus--Bowfin. One specimen of the bowfin was collected from Fontana Reservoir by Louder and Baker (1968). This fish was probably mistakenly introduced into the reservoir during stocking procedures. This species occurs in sluggish rivers and lakes in lowland areas and is not usually found in the cold waters of the mountains. I found it interesting that the specimen collected was an adult. This fact poses questions as to its origin and to its ability to adapt to an unfamiliar habitat.

Family Lepisosteidae

Lepisosteus osseus (Linnaeus)--Longnose gar. This is the only gar found in the system. An inhabitant of big rivers, its range in the system extends only a short distance upstream from its confluence with the Little Tennessee River. In this area large populations are frequently found.

Family Clupeidae

Alosa chrysochloris (Rafinesque)--Skipjack herring. All records for the skipjack herring in this system come from the main channel of the river in Tennessee. Their existence in the North Carolina and Georgia drainage area is doubtful.

Dorosoma cepedianum (Lesueur)--Gizzard shad. The gizzard shad is frequently found in the main channel of the Little Tennessee River, its reservoirs and larger tributaries in

Tennessee. It also occurs in the reservoirs in North Carolina.

Dorosoma petenense (Gunther)--Threadfin shad. Menhiniok (1976) lists three collection sites for the threadfin shad in North Carolina. All three collections were made in the reservoirs of the system. I feel that the presence of these fish is the product of introduction by the state of North Carolina. In addition, the species was introduced into Chilhowee Reservoir by Tennessee Game and Fish personnel. Attempts to collect the species the following year were unsuccessful (Pers. Comm. Bill Seawell).

Family Hiodontidae

Hiodon tergisus Lesueur--Mooneye. Good populations of mooneye are found in the lower main channel of the Little Tennessee River. Large numbers are observed each spring as "runs" in the river. It is very doubtful that they occur in the North Carolina or Georgia drainage areas since they prefer larger, slower rivers.

Family Salmonidae

Salmo gairdneri Richardson--Rainbow trout. S. gairdneri is the most frequently seen trout in the system. Its range extends over most of the drainage area in suitable habitats. Due to the fact that the rainbow trout is one of the principal game fish in the system, most specimens were released

when caught. In most cases the presence of this fish is the result of introduction by game and fish personnel in their stocking programs.

Salmo trutta Linnaeus--Brown trout. This European introduction is most often seen in the main channel of the Little Tennessee River in Tennessee and in the upper tributaries in North Carolina. It is frequently employed in stocking programs within the system. Citico Creek serves as a breeding area for natural reproduction of S. trutta during late winter--early spring.

Salvelinus fontinalis (Mitchill)--Brook trout. S. fontinalis is frequently found in the cold, clear waters of headwater streams. Good populations occur in the upper reaches of Citico Creek and Tellico River in Tennessee. The main channel of the Little Tennessee River in Tennessee has also been stocked with "brookies." Many of the tributaries in North Carolina have good S. fontinalis populations. I also observed some S. fontinalis in reservoirs in North Carolina.

Oncorhynchus nerka (Walbaum)--Sockeye salmon. Menhinick (1976) records two collections of Oncorhynchus nerka from Nantahala River and its reservoir. These collections of Pacific salmon were certainly from stocking operations conducted by North Carolina Fish and Game personnel.

Family Esocidae

Esox masquinongy Mitchill--Muskellunge. Menhinick, Burton,

and Bailey (1972) reported that E. masquinongy exist in Cheoah and Fontana Reservoirs as an introduced species. Capable of living in reservoirs and rivers this species has also been found occasionally existing in the Little Tennessee River itself in North Carolina. It is very doubtful that it presently inhabits the Tennessee portion of the river system. A dentary bone found in Monroe County, Tennessee and dated 1800 indicates that the species was native to the system (Pers. Comm. Art Bogan).

Family Cyprinidae

Campostoma anomalum (Rafinesque)--Stoneroller. This species was the most frequently collected one in the system. It is found from the lowland streams into the higher elevations, primarily in tributary streams.

Clinostomus funduloides Girard--Rosyside dace. An inhabitant of cold, clear, clean water this fish is found only in headwater areas. In these areas good populations are frequently observed. Deubler (1955) states that a new subspecies of Clinostomus funduloides exists in the upper elevations of this system and that in the extreme headwaters intergrades of the new subspecies and C. funduloides funduloides occur.

Carassius auratus (Linnaeus)--Goldfish. An Asiatic introduction, goldfish were observed in Abrams Creek by Lennon (1960). Also Menhinick (1976) lists three records for the

species from the reservoirs and rivers of the system in North Carolina.

Cyprinus carpio Linnaeus--European carp. Introduced from Asia, the carp is frequently seen in the warmer waters of the system, usually in the lower main channel of the river and in the reservoirs.

Hybopsis aestivalis (Girard)--Speckled chub. H. aestivalis is restricted to the very lowest portion of the Little Tennessee River in Tennessee. The species does not occur in large numbers or in great frequency. The habitat preference for H. aestivalis is one of lower elevation rivers with a bottom of rubble or sand. The occurrence of H. aestivalis above Chilhowee Dam is doubtful.

Hybopsis amblops (Rafinesque)--Bigeye chub. All of my records for this species came from the Tennessee portion of the system. An inhabitant of moderate to large sized streams, it was frequently seen in the lower tributaries. Good populations of H. amblops were observed around the mouths of the creeks. In addition, Menhinick, Burton and Bailey (1972) extend the range of the species to include the Little Tennessee River in North Carolina.

Hybopsis insignis Hubbs and Crowe--Blotched chub. Two collections of H. insignis from lower Citico Creek in Monroe County, Tennessee are available. An inhabitant of moderate sized tributaries, this species is rarely seen in the system.

Hybopsis monacha (Cope)--Spotfin chub. H. monacha has been collected from five locations within this river system. The University of Michigan Museum of Zoology has one specimen from Nolan Creek, Swain County, North Carolina, and two specimens from Citico Creek. In addition, Carl Hubbs in 1939 recorded 39 specimens from Abrams Creek. This record is included in Appendix A. T. V. A. collection records also show 17 specimens of the species from the Little Tennessee River in Macon County, North Carolina. Only the T. V. A. record was collected in recent times. These records show that the species may have been distributed widely in the past but presently are restricted to the streams and rivers of the higher elevations.

Nocomis micropogon (Cope)--River chub. N. micropogon is found throughout the river system. This species is found in riffles, runs and pools of clear, clean streams with a gravel or rock bottom. It is frequently seen with Notropis coccogenis.

Notemigonus crysoleucas (Mitchill)--Golden shiner. Menhinick (1976) recorded three collection locations for Notemigonus crysoleucas. All three collections were qualified as being questionable. Included in Appendix A is one collection of the species made by T. V. A. from the Little Tennessee River in Macon County, North Carolina. I feel these specimens were the result of introduction by fishermen or game management personnel.

Notropis coccogenis (Cope)--Warpaint shiner. The warpaint shiner is one of the most abundant cyprinids in the system. It is found in a wide range of habitats from slower, gravel-bottomed lowland streams to headwater tributaries throughout the system. Siltation restricts their distribution in lower areas. Best populations are found in moderate to large sized tributaries with swift flowing water and a gravel or rock bottom.

Notropis cornutus chrysocephalus (Rafinesque)--Striped shiner. This fish is found only in the lowland areas of the system in Tennessee. It is an inhabitant of slow moving pool areas of moderate sized streams.

Notropis galacturus (Cope)--Whitetail shiner. The whitetail shiner was found in all the major portions of the system. It was collected in small numbers in many of the moderate to large sized tributaries in North Carolina and Tennessee. I also observed N. galacturus in Chilhowee Reservoir.

Notropis leuciodus (Cope)--Tennessee shiner. This small cyprinid inhabits tributaries with fast flowing water and a bottom of gravel or rock. I frequently observed schools of the fish below riffles. It is found throughout the system. I believe that the fish identified as Notropis boops by Ratledge, Carnes, and Collins (1966) were N. leuciodus.

Notropis photogenis (Cope)--Silver shiner. N. photogenis is an inhabitant of large rivers with fast flowing water. It

is more abundant in the upper portion of the system than in the lower. Records for this species also exist for Citico Creek, Abrams Creek and the mainstream at Davis Island. Dahlberg and Scott (1971) extend the range of this species into Georgia. Individuals tend to gather in the quieter water behind large boulders.

Notropis rubellus (Agassiz)--Rosyface shiner. Menhinick, Burton and Bailey (1972) list N. rubellus as rare in this system. All records for it are from the upper Little Tennessee River in North Carolina. The species prefers the fast, clear, deep running water of larger rivers.

Notropis rubricroceus (Cope)--Saffron shiner. Outten (1958) states that this shiner lives in the middle to upper levels of small to moderate mountain streams which have clear water and moderate current. Two records for the species are known from this system; one from Swain County, North Carolina, and the other from Turkey Creek, a tributary to the Tellico River in Monroe County, Tennessee. This record agrees with Outten's description. The existence of isolated populations of this species presented questions I have been unable to solve.

Notropis sp. (cf. N. spectrunculus). All specimens of this species come from the lower levels of Citico Creek. This fish is most frequently found in the transition zone between riffle and pool. There was a general increase in the number of specimens per collection toward the mouth of the creek.

Notropis spectrunculus (Cope)--Mirror Shiner. N. spectrunculus is an inhabitant of clear, fast flowing water, usually in higher elevations. All specimens collected within the system come from the upper portion of the Little Tennessee River in North Carolina. Dahlberg and Scott (1971) also list the species as being present in the Georgia sector of the system.

Notropis spilopterus (Cope)--Spotfin shiner. This species was found very rarely within the system. Records for it come from Abrams Creek and the lower section of the Little Tennessee River. N. spilopterus prefers larger streams and rivers which have slow moving current. I feel that the existence of this species in the lower reservoirs is probable although no records exist at present.

Notropis telescopus (Cope)--Telescope shiner. The telescope shiner was frequently observed in the lower portion of the system, less frequently in the higher. It was observed in the larger streams also. As for habitat preference this species was most frequently observed in fast flowing, clear water around riffle areas. In most cases the bottom was gravel and rock. Lennon (1960) listed N. ariommus from this system, but these specimens were probably N. telescopus.

Notropis volucellus (Cope)--Mimic shiner. Only one record for this species is recorded and it is very questionable. Carl Hubbs reported N. volucellus from near Abrams Falls on Abrams Creek in 1931. It seems likely that this record was

based on either N. spectrunculus or its undescribed ally.

Phenacobius crassilabrum Minckley and Craddock--Fatlips minnow. Five collections of P. crassilabrum are known from this system. Dahlberg and Scott (1971) list two collections of the species from Betty Creek in Rabun County, Georgia. The other three collections are from Graham and Macon counties in North Carolina. This rather rarely found species is an inhabitant of small, high elevation streams. It was reported by Lennon (1960) as P. catostomus.

Phenacobius uranops Cope--Stargazing minnow. A rare species in the system that is found in riffle areas in moderate to large sized streams and the main channel over boulders and gravel substrates. Five collections of the species have been made, all from the Tennessee portion of the system. The related P. crassilabrum inhabits the North Carolina and Georgia portions of the system, while P. uranops appears to be restricted to the Tennessee drainage area.

Phoxinus oreas ssp.--Mountain redbellied dace. Three collection records are available, one each from Tabcat Creek, Four-Mile Creek, and Caney Creek. At present the specimens are being described by Wayne Starnes, University of Tennessee, and Robert Jenkins of Roanoke College as a new subspecies.

Pimephales notatus (Rafinesque)--Bluntnose minnow. This species is most frequently found in slow moving rivers and streams in lowland areas. T. V. A. lists three collections

of the species from creeks and streams in North Carolina. I feel compelled to include these records although their validity is extremely doubtful. The specimens were unavailable for examination.

Rhinichthys atratulus (Hermann)--Blacknose dace. A common inhabitant within the system, this species prefers smaller tributaries. It is also found with some regularity in the larger streams and main channel.

Rhinichthys cataractae (Valenciennes)--Longnose dace. R. cataractae was frequently collected with R. atratulus. Found in small to moderate size streams, this species is seldomly seen in the larger rivers.

Semotilus atromaculatus (Mitchill)--Creek chub. This species is well distributed throughout the system in small to moderate sized streams. In the larger rivers it is less abundant. It is usually found in small numbers except in areas where the stream has been disturbed and there large populations are frequently found.

Family Catostomidae

Catostomus commersoni (Lacepede)--White sucker. Most frequently found in the lowland areas of the system but also found with some frequency in the basin area of North Carolina. Sometimes found in large concentrations, this fish prefers pool areas of deep, slow-moving stretches of moderate size streams.

Cycleptus elongatus (Lesueur)--Blue sucker. All specimens of this species come from the main channel of the Little Tennessee River in Tennessee. This rare sucker inhabits pool areas below large riffles in the main channel.

Hypentelium nigricans (Lesueur)--Northern hogsucker. One of the most frequently seen fish in the system, it is found in all types of habitats. Frequently seen resting on the bottom in runs, it is also found in pool areas. H. nigricans is distributed all over the system except in areas of heavy siltation.

Ictiobus bubalus (Rafinesque)--Smallmouth buffalo. An inhabitant of larger rivers, all records for I. bubalus come from the main channel of the Little Tennessee River in Tennessee. Its occurrence in North Carolina and Georgia is doubtful.

Moxostoma anisurum (Rafinesque)--Silver redhorse. Jenkins (1970) lists M. anisurum as rare in the Little Tennessee River system. Menhinick (1976) recorded one collection of the species from Fontana Reservoir in North Carolina. It is an inhabitant of large tributaries and main channels of the system. One record for the main channel at Rose Island exists.

Moxostoma carinatum (Cope)--River redhorse. Adults of this species are most frequently found in the main channel of the river and in the lower portions of its main tributaries. Records exist from both North Carolina and Tennessee. Juveniles

were found to inhabit some of the upper portions of the main tributaries, particularly Citico and Abrams creeks.

Moxostoma duquesnii (Lesueur)--Black redhorse. Juveniles of M. duquesnii are inhabitants of moderate to small sized streams with clear, fast flowing water. They prefer a clean bottom of gravel or rock. The species is also found with some frequency around mouths to larger rivers and reservoirs of the system. Dahlberg and Scott (1971) indicated that it is found in the headwaters of the Little Tennessee River in Georgia.

Moxostoma erythrurum (Rafinesque)--Golden shiner. M. erythrurum is frequently found with M. duquesnii since the two have similar habitat preferences.

Moxostoma macrolepidotum breviceps (Cope)--Shorthead redhorse. Jenkins (1970) listed M. m. breviceps as rare in the Little Tennessee River system. All records are from the main channel of the river and from mainstream reservoirs which indicates a preference for larger bodies of water. Menhinick (1976) records four collections of the species from the rivers and reservoirs of the system in North Carolina.

Family Ictaluridae

Ictalurus furcatus (Lesueur)--Blue catfish. I found one decomposing specimen of the blue catfish in Indian Boundary Lake, Monroe County, Tennessee. This specimen was probably

introduced into the lake during stocking operations by Tennessee Game and Fish. It may occur also in the lower mainstream.

Ictalurus natalis (Lesueur)--Yellow bullhead. This species was collected in two instances, one from Tabcat Creek, Monroe County, Tennessee, and the other from the mainstream Little Tennessee River in Monroe County, Tennessee.

Ictalurus punctatus (Rafinesque)--Channel catfish. This fish was found only in the mainstream river and reservoirs. It was most frequently found in large still-water areas with a rock and gravel bottom.

Noturus baileyi Taylor--Smoky madtom. Five specimens for this species exist. All were taken during stream reclamation in 1957. The collection was made in the lower portion of Abrams Creek, Great Smoky Mountains National Park and comprised the types for the species. Although I made numerous collections of the area, no additional specimens were taken due, as Taylor (1969) suggests, to the secretive nature of madtoms. It is possible that N. baileyi is extinct.

Noturus eleutherus Jordan--Mountain madtom. N. eleutherus was collected on three occasions from this river system. Two collections were made from the lower mainstream Little Tennessee River and one was made from the lower Tellico River. This secretive madtom prefers a bottom of rubble with numerous crevices. The distribution of the species is restricted to

the lower elevations of the system.

Noturus flavus Rafinesque--Stonecat. N. flavus was collected along with N. baileyi in the 1957 collection of Abrams Creek. Again I was unable to supply additional specimens. Comiskey (1970) stated the species is most frequently observed in large streams along the edge of shallow riffles.

Pylodictis olivaris (Rafinesque)--Flathead catfish. The flathead catfish is found only in large bodies of water, specifically the main channel and reservoirs, of this river system. Three records exist for it. One from Fontana Reservoir, one from the lower Little Tennessee River, and one from Tellico River. Deep pools of water are frequently the preferred habitat for this species.

Family Cyprinodontidae

Fundulus catenatus (Storer)--Northern studfish. Good populations of this fish were found to inhabit the lower end of this system. The confluence of major tributaries and the main channel are also preferred habitat by this species. Comiskey (1970) noted that F. catenatus was frequently collected in areas of maximum sunlight.

Family Poecilidae

Gambusia affinis (Baird and Girard)--Mosquitofish. This species is most frequently found in the lower portion of the river, where good populations exist. I feel that it may also

occur in the mainstream reservoirs farther upstream.

Family Atherinidae

Labidesthes sicculus (Cope)--Brook silverside. All collection records for the brook silverside are in locations from Chilhowee Reservoir downstream. This species prefers large bodies of water with considerable depth.

Family Percichthyidae

Morone chrysops (Rafinesque)--White bass. One specimen of this species was collected in Fontana Reservoir. The preferred habitat of the white bass within this river system is large reservoirs. It may also occur in some abundance during certain times of the year in the larger rivers of the system.

Family Centrarchidae

Ambloplites rupestris (Rafinesque)--Rock bass. Good populations of this species exist in most tributaries and rivers within the system. The population density is lowest for the rock bass in the lower portion of the river. It has been observed in varied habitats, from pool to riffle and river to reservoir.

Lepomis auritus (Linnaeus)--Redbreast sunfish. This species of sunfish was found to be distributed throughout the system with the exception of smaller streams in the highest elevations. In most observations the number of specimens was

small. A majority of the collections recorded are from larger rivers and reservoirs. This information indicated a preferred habitat of larger bodies of water for the species.

Lepomis cyanellus Rafinesque--Green sunfish. The green sunfish was observed in small numbers in varied portions of the system. It exists throughout the system but is seldom seen in large numbers. An exception is Indian Boundary Reservoir where a large population exists, possible as a result of introduction.

Lepomis gulosus (Cuvier)--Warmouth. I observed the warmouth in Chilhowee Reservoir and collected one specimen from Baker's Creek, Blount County, Tennessee. I feel that this species is restricted to the lowlands and the reservoirs of the system.

Lepomis macrochirus Rafinesque--Bluegill. This species was observed throughout the river system. In terms of preferred habitat in a free-flowing river or stream, L. macrochirus inhabit the calmer areas of pools. It was seldom observed in the rapid flowing areas of running water. When observed in this habitat, it was found in the slower pool areas behind large boulders.

Lepomis megalotis (Rafinesque)--Longear sunfish. Two collections for this species are recorded. Carl Hubbs identified five specimens from Abrams Creek in 1937. One additional specimen was collected from the Little Tennessee River at Rose Island by the Bureau of Sport Fisheries and Wildlife

in 1964. I feel that this is an uncommon fish within the system.

Micropterus dolomieui Lacepede--Smallmouth bass. The smallmouth bass is found frequently in a range of habitats from moderate sized streams to reservoirs. In some streams, in particular Abrams Creek, high population densities were observed. This species prefers the fast flowing riffle areas of a stream but was also observed in pool areas. It prefers a bottom covered with rocks and boulders. Stomach analysis showed a direct relationship between food preference and bottom type.

Micropterus punctulatus (Rafinesque)--Spotted bass. This uncommon bass inhabits the lower portion of the Little Tennessee River. As the population density of the smallmouth bass decreases downstream, the numbers of spotted bass increased. Water temperature, turbidity, and current speed are apparently the controlling factors in this relationship.

Micropterus salmoides (Lacepede)--Largemouth bass. The largemouth bass inhabits the larger rivers and reservoirs of the system. I feel that most specimens observed, excluding those in the lower portion of the system, were the result of stocking procedures carried out by state agencies.

Pomoxis annularis Rafinesque--White crappie. Good populations of this species occur in the larger reservoirs of the system. It is also found in some abundance in the lower

portion of the mainstream river.

Pomoxis nigromaculatus (Lesueur)--Black crappie. Within this river the distributions of P. annularis and P. nigromaculatus are very similar.

Family Percidae

Etheostoma blennioides Rafinesque--Greenside darter. Two distinct subspecies of E. blennioides exist within the Little Tennessee River. They are E. b. newmanii and E. b. gutselli. E. b. newmanii inhabits the streams and rivers of that portion of the system found in Tennessee. It was found to exist in varying habitats from moderate size, clean, free flowing streams to the more sluggish main tributaries. This habitat preference reflects also a wide range of bottom preferences for the species. E. b. gutselli is found exclusively in the upper areas of the system. Where water conditions permit, this subspecies prefers a bottom of gravel, rock, and boulders. It is much more restricted in its range of habitat than is E. b. newmanii, being confined to streams with higher gradients and lower turbidity. This species is discussed further in the next chapter.

Etheostoma chlorobranchium Zorach--Greenfin darter. Within this river system the greenfin darter was found to inhabit moderate size feeder streams and smaller rivers. Present in waters of higher elevation, this species prefers fast flowing, clear, clean water with a bottom of gravel, rock and boulders.

It was found in associations with two similar darters, E. rufilineatum and E. maculatum. The highest observed population density occurred in Abrams Creek. The range of this particular species extends into the headwater region.

Etheostoma (Catonotus) sp.--Duskytail darter. Only one record for E. (Catonotus) exists for this river system (Appendix A). Carl Hubbs in 1936 collected two specimens of the species from the lower portion of Abrams Creek. Due to a 1957 stream reclamation project it is doubtful that the species still occurs in this stream.

Etheostoma flabellare Rafinesque--Fantail darter. All records for this species come from the upper tributaries of Abrams Creek. Anthony Creek in the Great Smoky Mountains National Park has the highest concentration of specimens in the area. As for bottom type preference, this species is most frequently found in small riffle areas with a substrate of sand and gravel and pool areas with moderate current.

Etheostoma maculatum Kirtland--Spotted darter. Zorach and Raney (1967) list seven collections for the spotted darter from the system. Five of those collections came from the Little Tennessee River in North Carolina and two collections from Abrams Creek. I made one additional observation in Abrams Creek. Four collections by T. V. A. are recorded from the Tuckaseegee and Little Tennessee Rivers. This species prefers swift riffles of moderate to large streams with a gravel,

rock and boulder substrate. The distribution of the species within the system is very similar to that of E. chlorobranchium.

Etheostoma rufilineatum (Cope)--Redline darter. This darter is the most abundant percid found in the river system in Tennessee. The population density of E. rufilineatum decreases after crossing the state line into North Carolina. Good populations were observed in Tellico River, Abrams Creek, and Citico Creek. In North Carolina the only good population of this species is most frequently seen in small to moderate size, free-flowing, clear, clean streams with a bottom type of rock, boulder and gravel. Within the streams themselves, the species is most abundant in riffle areas and runs.

Etheostoma simoterum (Cope)--Tennessee snubnose darter. All collections made, and records found, for this species occur in Tennessee. I was unable to find any evidence of E. simoterum's presence in North Carolina or Georgia. In regards to abundance, the larger populations observed occurred in the small to moderate sized tributaries in the lower portion of the system. Population density decreased upstream into the headwaters. The species prefers moderate current and a sand and gravel bottom. It is also found in pool areas with a substrate of sand, gravel and rock.

Etheostoma jessiae (Jordan and Brayton)--Blueside darter. The blueside darter is also restricted to the Tennessee portion

of the system. It occurs only in the lower tributaries of the system in areas of slow to moderate current and sand and gravel bottom. In larger tributaries it is more abundant near the stream's confluence with the main river.

Etheostoma swannanoa Jordan and Evermann--Swannanoa darter. Three collections for this species are recorded. All three were made in North Carolina, one in Slickrock Creek and two in Big Santeetlah Creek. This uncommon species inhabits higher elevation streams.

Etheostoma zonale (Cope)--Banded darter. E. zonale was found frequently scattered throughout the system. It was observed in moderate to large streams and rivers. This species prefers riffle areas with rapid current. It also shows some preference for areas along banks where vegetation and debris are present.

Percina aurantiaca (Cope)--Tangerine darter. This species was collected from two tributaries to the Little Tennessee River in Tennessee, Citico Creek and Tellico River. It was also collected from the Tuckaseegee River and Big Santeetlah Creek in North Carolina. By far the largest populations exist in Tellico River where the fish was observed in a range of habitats from higher elevation, clear, clean and fast flowing water to the more sluggish, murkier water near the river's union with the mainstream. In the middle and upper portion of this river large populations were observed. Most specimens

were observed in riffle areas.

Percina burtoni Fowler--Blotchside logperch. P. burtoni is one of the rarer fish of this particular river system, occurring only in the middle portion of the Tellico River and in the main lower channel. Due to the evasive nature of the species no collections of this fish were made. All identification was made visually. This darter was found inhabiting the pools below larger riffles. It prefers moderate current with a bottom of sand, gravel and rock.

Percina caprodes (Rafinesque)--Logperch. All available records and collections for this species are from the lower half of the river system. It inhabits the main river, reservoirs and the larger tributaries, and is seldom seen in small streams or creeks.

Percina evides (Jordan and Copeland)--Gilt darter. Denoncourt (1969) lists the subspecies found to inhabit the Little Tennessee River system as P. evides striolacauda. This species is most frequently found in moderate to large sized streams in areas of loose gravel and rubble. Its range within the system extends through North Carolina and Tennessee into Georgia (Dahlberg, 1971).

Percina sciera (Swain)--Dusky darter. The dusky darter, an uncommon percid in the system, was collected in six locations. It was collected from Notchy Creek, a lowland tributary to the Little Tennessee River which is relatively small

in size with a bottom of sand and debris, and from the Tellico and lower Little Tennessee rivers. The specimens from Notchy Creek were collected from a pool area, scattered with limbs and branches of surrounding trees.

Percina shumardi (Girard)--River darter. P. shumardi is found exclusively in the lower elevations of the Little Tennessee River system. Two collection records exist for lower Little Tennessee. The species prefers larger bodies of running water with a gravel and rock bottom. It is very doubtful that the range of P. shumardi extends above Chilhowee Dam.

Percina squamata (Gilbert and Swain)--Olive darter. Dahlberg and Scott (1971) list one collection of this species from Rabun County, Georgia, Betty Creek system, 0.2 miles east of Dillard. Three collections from the Tuckaseegee River, made by T. V. A. are also recorded. The distribution of P. squamata is restricted to those areas in North Carolina and Georgia drained by the system.

Percina tanasi--Snail darter. P. tanasi, a new species, was discovered by Drs. David Etnier and Robert Stiles in the fall of 1973. The type specimens were collected from the Little Tennessee River at Coytee Springs, Loudon County, Tennessee. Etnier (1976) states that the species prefers gravel shoals in the lower 32 kilometers of the Little Tennessee River. Found in limited numbers, the species prefers the areas of

shoals with swiftest current.

Stizostedion canadense (Smith)--Sauger. All records for the sauger come from the lower mainstream river where fair populations exist. This fish prefers large flowing bodies of water with moderate depth.

Stizostedion vitreum (Mitchill)--Walleye. Good populations of walleye exist in the cold, clear water of the upper Little Tennessee River reservoirs. These bodies of water provide a preferred habitat for the species. Boles (1968) also includes one record of one specimen collected from the lower mainstream river.

Family Sciaenidae

Aplodinotus grunniens Rafinesque--Freshwater drum. The freshwater drum is found solely in the lower tributaries and mainstream of the Little Tennessee River. It inhabits sluggish, murky water with a mud, sand or gravel bottom.

Family Cottidae

Cottus bairdi Girard--Mottled sculpin. This sculpin is very abundant throughout the system. It has a wide range of habitat preference, from larger, lowland tributaries and mainstream to high elevation mountain streams. C. bairdi is most frequently found in the higher elevations.

Cottus carolinae (Gill)--Banded sculpin. This less abundant sculpin is scattered throughout the system. It was frequently collected with C. bairdi in both lowland and higher

elevation streams. The frequency of the species increases downstream with the highest concentrations occurring in the warmer lowland waters.

CHAPTER III

DISCUSSION AND CONCLUSIONS

Within the Little Tennessee River system many species, especially the cyprinids, are found dispersed throughout the system. A closer examination of the collection records for the area shows five more-or-less defined ichthyofaunal units. Each of the units is characterized by the presence of specific species which occur only within that unit, or by limited diversity within the unit. The units are as follows; the lower Little Tennessee River mainstream unit, the middle Little Tennessee River reservoirs, the Abrams Creek unit, the Citico Creek--Tellico River unit, and the Little Tennessee River basin in North Carolina. Abrams Creek is included as a unit although at present those species which differentiate it from other units may no longer exist within the system.

The lower 32 kilometers of the mainstream Little Tennessee River and its smaller feeder streams exhibit the greatest diversity in species within the river system. Collection records for 64 species of fish exist for this area of the system. Species which are restricted to this lower region include; Percina sciera, Percina shumardi, Hybopsis aestivalis, Cycleptus elongatus, Polyodon spathula, Lepisosteus osseus, and a newly described endemic darter Percina tanasi. I feel that the presence of the sturgeon, Acipenser fulvescens, within these waters is a real possibility, although no specimens are available at present.

At present the Tennessee Valley Authority proposes to impound most of the remaining free-flowing water between Chilhowee Dam and the confluence of the Little Tennessee and the Tennessee River. Although the lower Little Tennessee River mainstream can not be considered as a natural system in this area due to the altered river characteristics produced by the operation of Chilhowee Dam, completion of this project will eliminate the preferred habitat for those species restricted to the area proposed for impoundment. Particularly affected will be the darter, Percina tanasi; the sucker, Cycleptus elongatus and the sturgeon, Acipenser fulvescens. For C. elongatus and A. fulvescens the consequences of this proposed impoundment will be reduction of suitable habitat for two vanishing species. The consequences for Percina tanasi are even more severe. Etnier (1976) states that P. tanasi is restricted to the lower 32 kilometers of the mainstream Little Tennessee River. It prefers areas of swift current and a bottom of coarse gravel and sand interspersed with bedrock. The entire area where this species can, at present, be found will be innundated by the Tellico Project. Although extensive efforts have been made to locate other populations of this darter, to date it exists in no other locality than the lower Little Tennessee River. Impoundment of the area will drastically alter the habitat there and will result in the extinction of P. tanasi and also in the exclusion of numerous other species from the system.

The area from the upper reaches of Fontana Reservoir to the tailwaters of Chilhowee Dam composes the most complex of the ichthyofaunal units of the system. Unlike the other units of the system which are characterized by the uniqueness of the species found within the unit, the unit composed of middle reservoirs of the mainstream Little Tennessee River is delineated by the limited species diversity within the impounded water. Collections for the immediate tailwaters of Chilhowee Dam include 39 species of fish. In contrast, records for the reservoirs found in this unit record only 21 species. Attempts to increase this number have been made by several agencies. Seawell (Pers. Comm) stated that Dorosoma petenense had been introduced into Chilhowee Reservoir but that in the following year collectors were unable to obtain any specimens from the reservoir. Also kokanee salmon (Oncorhynchus nerka), smelt (Osmerus mordax), and a chub (Leucichthys sp.) were introduced into Calderwood Reservoir with no success (Pers. Comm. Price Wilkins). From this difference in numbers of species I feel that this area exercises great influence over the distribution of fishes within the entire system. The slow-moving, deep waters of the reservoirs and the physical structure of their dams serve as insurmountable barriers to many species. Also, due to the location of this group of reservoirs in the central section of the system, the unit isolates the other units from each other. The Little Tennessee River basin is

isolated from the lower Little Tennessee by the characteristics of the reservoir barrier. This isolation is also true of Abrams Creek. The effect of the barrier is least felt at the unions of the Citico Creek--Tellico River unit and the tailwaters of Chilhowee Dam. Here water characteristics are more similar. Even in this area thermal qualities and differences in habitat restrict the distribution of some fish. The distribution of Notropis sp. (cf. N. spectrunculus) shows this restriction clearly. This species was observed in some abundance throughout the lower elevations of Citico Creek. Water temperature in this area of the creek is characteristic of lower elevation streams. I made several dives in the much colder waters of the river below the mouth of Citico Creek in a futile attempt to locate specimens in the river. From this information I conclude that the drastic change in habitat has created a distributional barrier. This situation exemplifies the effects of man-made barriers within this unit. The construction of the series of dams which exist in this unit has resulted in the disruption of the natural elevational sequences in habitats and water conditions and has injected atypical habitats into the system. The result is a man-made isolation mechanism for the ichthyofaunal units and a restriction of the potential for distribution of the species of the system.

Abrams Creek comprises another ichthyofaunal unit of

great interest. Unfortunately, due to a stream reclamation project completed in 1957, much of its original fauna has been extirpated. Noturus baileyi Taylor, the smoky madtom, was described from the lower portion of the stream. The type series of five specimens taken in 1957 represents the only specimens known. Noturus flavus, unknown elsewhere in the system, was also included among specimens taken in the 1957 "rough fish" removal operation. Two darters of the subgenus Catonotus (Etheostoma flabellare and the undescribed dusky-tail darter) are also known from Abrams Creek, but do not occur elsewhere in the system. The spotfin chub, Hybopsis monacha, also occurred in Abrams Creek (39 specimens collected by C. L. Hubbs in 1937), but has not been taken there since the 1957 "rough fish" removal operation. The large number of specimens collected indicates that at the time of the collection this species was abundant in the system. I made numerous trips to various areas of Abrams Creek in an attempt to collect Noturus baileyi, Noturus flavus, Hybopsis monacha and Etheostoma (Catonotus) sp. These collection trips provided no new specimens of the species mentioned. I feel that the 1957 reclamation project resulted in the elimination of Noturus flavus and Etheostoma (Catonotus) sp. from the river system and in the case of Noturus baileyi, from existence.

Abrams Creek also provided some valuable information on

the distribution of the darter, Etheostoma blennioides. All collections of the greenside darter from Abrams Creek were of the subspecies Etheostoma blennioides newmannii. Also all specimens of Etheostoma blennioides downstream from Abrams Creek were of the subspecies newmannii. Collections made in Slickrock Creek, the next major tributary upstream, yielded specimens of Etheostoma blennioides gutselli. This subspecies of E. blennioides is characteristic of those specimens collected from the system above Slickrock Creek. The area between Abrams Creek and Slickrock Creek serves as the boundary for the range of these two subspecies. I was unable to find any sympatric area. The river between these two streams is presently impounded. These impounded waters serve as a barrier to any interchange between the two subspecies.

Citico Creek and Tellico River comprise the unit least affected by man. Much of the drainage area lies within Cherokee National Forest and has been little altered. In both streams wildlife management areas encompass the headwater areas. Interesting species which exist in this unit include Percina aurantiaca, Percina burtoni and Notropis sp. The undescribed Notropis was discussed in the section on the middle reservoirs and their effects. This species is restricted to lower Citico Creek. In addition, Hybopsis monacha is known to have existed in Citico Creek. It is doubtful that the species still occurs there. Intensive sampling of the

stream yielded no new specimens. It is quite likely that the H. monacha specimens represented strays from a population in the main river. Percina aurantiaca occurs in abundance in Tellico River and with less frequency in Citico Creek. I observed specimens of P. aurantiaca in the lower elevations of Tellico River but greater abundance occurs in the middle and upper reaches of the river. The species does occur outside of this unit but it was very rarely observed. Percina burtoni was observed on two occasions in Tellico River. This rare darter was neither collected nor observed in any other location in the system. Both Percina aurantiaca and P. burtoni are highly intolerant of changes in stream conditions. The nearly pristine waters of Tellico River and Citico Creek may provide these two species with the only suitable conditions for stable population.

The rivers and streams which drain the Little Tennessee basin in North Carolina comprise another ichthyofaunal unit within the system. Fontana Reservoir serves as a barrier to any further distribution of the species downstream. Species unique to this unit include Notropis spectrunculus, N. rubellus, Phenacobius crassilabrum, Percina squamata, Etheostoma swannanoa and Hybopsis monacha. Notropis spectrunculus is distributed throughout this unit from smaller streams to rivers. Records for Phenacobius crassilabrum and Notropis rubellus exist from the Little Tennessee and Tuckaseegee or Cheoah river drainage areas. Percina squamata and Etheostoma swannanoa

are restricted to the Tuckaseegee River and Slickrock Creek respectively. The discovery of Hybopsis monacha in good numbers from the Little Tennessee River is of special interest. Eager (1976) reports the collection by T. V. A. personnel of 17 specimens of the species from four collection sites along a 24 mile stretch of the river. This section of the river is between Fontana Reservoir and Franklin Dam. Records for Hybopsis monacha exist for Citico and Abrams Creeks but these collections were made before the series of reservoirs on the Little Tennessee River were constructed. I feel that prior to the construction of the series of dams on the river Hybopsis monacha was distributed throughout much of the system. Collection records for Abrams Creek during this time period indicate that good populations of the species existed there. Reservoir construction coupled with stream reclamation projects have resulted in a reduction in habitat for the species. I feel that the Little Tennessee population is a remnant of a much larger one. Should the effectiveness of sewage treatment for the town of Franklin, located above the area, decline; or increased siltation occur, this population would become endangered.

Glenville Lake and its tributaries provided some of the more interesting collections for the river system. Glenville Lake is a smaller impoundment on the West Fork of the Tuckaseegee. Menhinick (1976) reported three species of fish

from this area not collected elsewhere in the system; Nocomis leptocephalus, Notropis lutipinnis, and Osmerus mordax. Notropis rubricroceus, found rarely in the system, was also on record from this area. The existence of these fish in the Chattooga River provided a clue to understanding the situation in the area. A trip to the North Carolina State University's Department of Geosciences provided information as to the possibility of stream capture in the tributaries feeding Glenville Lake. An examination of maps of the area showed that Hurricane Creek, a tributary to Glenville Lake, was the key to the problem. Hurricane Lake, located on the creek, showed an elevation of 3800 feet. The elevation of the divide in this area is approximately 3900 feet. The headwaters of a stream feeding Cashiers Lake on the Chattooga River had an elevation of 3790 feet. The distance between the feeder stream to Cashiers Lake on the eastern side of the divide and Hurricane Lake on the western side is approximately one-half mile. This elevational difference and distance are characteristic of several locations in this area, each with Hurricane Creek on the western side of the divide and a tributary of Chattooga River on the eastern side. From this information I feel that stream capture here is a definite possibility and that if capture did occur it happened in recent times. The named fish have not expanded their range downstream into the Tuckaseegee. Confined to a limited area, eight miles in length, they are presently unable

to extend their range due to the construction of the Glenville Lake Dam. An earlier capture would have resulted in the distribution of these species in the Tuckaseegee River.

In conclusion the distribution of fishes within the Little Tennessee River System has been altered as a result of man's influence on the environment. The construction of reservoirs and reclamation of streams have resulted in reduced habitats and broken species dispersal patterns. In addition, as a result of the man-made disruptions, several species may no longer exist. If the proposed Tellico Project is completed several more may be doomed to extinction. Overall, the distribution of fishes in this system is, in part, a result of man's influence.

BIBLIOGRAPHY

BIBLIOGRAPHY

Boles, Hallet D. 1968. Little Tennessee River Investigation. Bureau of Sport Fisheries and Wildlife.

Comiskey, C. E. 1970. The Fishes of the Big South Fork of the Cumberland River System. Master's Thesis. University of Tennessee. 1970.

Deubler, E. E. 1955. A Taxonomic Study of the Cyprinid Fish in the Eastern United States. University Microfilms Publications. pp. 68-73.

Eager, R. 1976. Range Extension and Comments of the Spotfin chub, Hybopsis monacha, in the Little Tennessee River. An unpublished manuscript. T. V. A.

Eddy, S. 1969. How to Know the Freshwater Fishes. Wm. C. Brown Co., Dubuque, Iowa.

Etnier, D. A. 1967. University of Tennessee fish collections for 1967. Unpublished manuscript.

_____, 1970. University of Tennessee fish collections for 1970. Unpublished manuscript.

_____. 1972. Rare, Endangered or Otherwise Interesting Fish Species. Cherokee Division, Cherokee National Forest, University of Tennessee. Knoxville.

_____.1976. Percina (Imostoma) tanasi, a new percid fish from the Little Tennessee River, Tennessee. Proceedings of the Biological Society of Washington. Vo. 88, No. 411, pp. 469-488.

Dahlberg, M. D. and D. C. Scott. 1971. The Freshwater Fishes of Georgia. Bulletin--Georgia Academy of Science, Vol. 29. pp. 1-64.

Denoncourt, R. F. 1969. A Systematic Study of the Gilt darter, Percina evides. University Microfilms Publications. pp. 36-46.

Gilbert, C. R. 1969. Systematics and Distribution of the American Cyprinid Fishes, Notropis ariommus and Notropis telescopus. Copeia 1969. (3):474-492.

Jenkins, R. E. 1970. Systematic Studies of the Catostomid Fish Tribe Moxostomatin. Ph. D. Thesis. Cornell University. 1970. p. 799.

Lennon, R. E. 1960. Fishes of the Great Smoky Mountains National Park. Bureau of the Sport Fisheries and Wild-Life.

Louder, D. E. and W. D. Baker. 1968. Fontana Reservoir. Wildlife in North Carolina 32 (1:January):6-8

Minchley, W. L. and J. E. Craddick. 1962. A New species of Phenocobius (Cyprinidae) from the upper Tennessee River System. Copeia (2):369-377.

Menhinick, E. F., T. M. Burton, J. R. Bailey. 1972. An Annotated Checklist of the Freshwater Fishes of North Carolina.

_____. 1976. The Freshwater Fishes of North Carolina. Unpublished manuscript.

Messer, J. B. and H. M. Ratledge. 1963. Survey and Classification of the Little Tennessee River and Tributaries. North Carolina Wildlife Resources Commission final report. Project I-14-R.

Miller, R. V. 1968. A Systematic Study of the greenside darter, Etheostoma blennioides. Rafinesque (Pisces:Percides). Copeia 1968 (1):1-40.

Moore, G. A., W. F. Blair, A. P. Blair, P. Brodkorb, F. R. Cayle. 1968. Vertebrates of the United States. McGraw-Hill, Inc., New York. p. 616.

Outten, D. M. 1958. Life history of Notropis galacturus and rubricroceus. J. Elisha Mitchill Sci. Soc. 74:122-134.

Raney, E. C. 1952. A new lamprey, Ichthyomyzon hubbsi, from the upper Tennessee River System. Copeia (2):93-99.

Ratledge, H. M., W. C. Carnes, and E. D. Collins. 1966. Checklist of fishes collected from lotic waters in North Carolina. North Carolina Wildlife Resources Commission final report. Project F-14-R:1-13.

Taylor, W. R. 1969. A revision of the catfish genus Noturus Rafinesque, with an analysis of the higher groups in the Ictaluridae. U. S. Nat. Mus. Bull. 282:1-315.

Tennessee Valley Authority, 1969. Upper Little Tennessee River Drainage Basin. Division of Forestry, Fisheries and Wildlife.

Troutman, M. B. 1957. The Fishes of Ohio, with Illustrated Keys. Ohio State University Press, Columbus. p. 683.

Vladykov, V. D. 1973. North American Non-parasitic lampreys of the family Petromyzonidae must be Protected. Canadian Field-Naturalist 87:235-239.

Zorach, R. and E. C. Raney. 1967. Systematics of the percid fish, Etheostoma maculatum Kirkland, and the related species of the subgenus Nothonotus. Am. Midl. Nat. 77(2): 296-322.

APPENDIXES

APPENDIX A

Scientific Name

Petromyzontidae

Ichthyomyzon bdellium Jordan: 196(1), 197(1).
Lampetra lamottei (Lesueur): 12(29), 33(7), 197(2), 200(1).

Lepisosteidae
Lepisosteus osseus (Linnaeus): 17(3), 26(1), 157(105), 158(2), 206(2).

Clupeidae
Alosa chrysochloris (Rafinesque): 154(1), 156(2), 157(2), 196(3).
Dorosoma cepedianum (Lesueur): 16(2), 17(1), 18(126), 57(15), 69(25), 76(10), 156(1), 157(1), 196(7).

Hiodontidae
Hiodon tergisus Lesueur: 17(9), 18(41), 196(1), 207(1).

Salmonidae
Salmo gairdneri Richardson: 3(?), 7(2), 17(30), 18(51), 21(1), 23(3), 24(2), 34(26), 35(1), 36(1), 38(1), 50(1), 59(1), 78(6), 81(2), 82(6), 84(6), 92(1), 95(21), 96(14), 97(14), 99(2), 103(3), 104(6), 105(2), 106(1), 107(3), 108(2), 111(6), 112(27), 113(8), 120(2), 121(1), 123(3), 126(4), 129(8), 131(1), 132(15), 134(5), 136(6), 139(1), 144(6), 145(3), 149(4), 151(2), 152(2), 154(2), 156(1), 158(3), 159(?), 160(?), 161(?), 162(?), 167(?), 169(?), 171(?), 173(?), 174(?), 176(?), 178(10), 179(6), 181(2), 199(1), 201(5), 207(3).
Salmo trutta Linnaeus: 17(83), 18(40), 94(1), 95(1), 96(3), 102(8), 109(1), 111(1), 116(3), 130(11), 134(13), 135(36), 149(1), 150(4), 165(?), 170(?), 171(?), 172(?), 173(?), 175(?), 196(6), 201(11).
Salvelinus fontinalis (Mitchill): 80(1), 81(2), 96(1), 104(1), 130(2), 163(?), 164(?), 166(?), 167(?), 168(?).

Cyprinidae
Campostoma anomalum (Rafinesque): 1(?), 2(?), 3(?), 5(?), 8(50), 12(1), 13(1), 14(3), 19(8), 20(17), 21(46), 22(7), 23(1), 24(10), 25(54), 26(9), 28(1), 31(1), 32(5), 33(1), 34(16), 35(15), 36(5), 38(12), 39(3), 40(7), 41(25), 42(6), 44(2), 47(20), 48(6), 49(75), 51(10), 52(21), 53(3), 54(50), 55(10), 56(2), 58(50), 59(20), 61(31), 62(7), 63(20), 64(10), 65(8), 66(10), 67(40), 68(3), 69(9), 71(3), 72(3), 73(1), 75(22),

78(5), 82(3), 84(13), 85(10), 86(1), 88(2), 90(50), 91(6), 92(1), 93(1), 100(3), 102(2), 103(1), 108(1), 111(2), 115(25), 124(2), 128(1), 131(2), 134(65), 135 (133), 142(1), 144(1), 145(2), 169(?), 173(?), 175(?), 180(4), 185(2), 187(3), 189(2), 196(1), 199(2), 201(1), 204(8), 205(5), 206(5), 209(43), 211(8).

Clinostomus funduloides Girard: 3(?), 20(28), 21(17), 22(3), 25(6), 35(1), 36(3), 38(39), 39(26), 50(1), 78(3), 84(5), 91(17), 100(8), 108(10), 111(14), 124(22), 131(6), 134(67), 135(11), 144(41), 165(?), 172(?), 173(?), 175(?), 177(?).

Cyprinus carpio Linnaeus: 17(77), 18(36), 57(2), 76(1), 158(10), 206(1).

Hybopsis aestivalis (Girard): 193(2), 198(1), 200(1).

H. amblops (Rafinesque): 12(1), 13(57), 19(4), 26(36), 33(1), 46(9), 49(100), 55(1), 56(4), 58(20), 60(16), 62(6), 71(6), 74(1), 182(1), 185(2), 186(15), 187(2), 203(5), 205(1).

H. insignis Hubbs and Crowe: 14(1), 44(1).

H. monacha (Cope): 26(39), 208(1).

Nocomis micropogon (Cope): 12(1), 13(4), 14(1), 20(7), 21(1), 22(2), 24(12), 25(20), 26(9), 28(14), 30(5), 31(6), 32(5), 33(7), 34(29), 35(27), 40(3), 42(2), 45(4), 47(4), 49(12), 50(7), 51(3), 54(4), 55(8), 58(5), 61(10), 63(4), 64(3), 66(1), 79(7), 80(6), 81(25), 86(9), 88(7), 90(4), 93(8), 98(1), 101(11), 102(10), 109(9), 111(14), 120(1), 121(3), 122(2), 124(2), 134(83), 135(302), 141(1), 142(1), 146(10), 147(6), 148(1), 169(?), 171(?), 172(?), 173(?), 175(?), 177(?), 181(4), 184(7), 185(8), 186(4), 187(14), 192(2), 193(2), 196(20), 197(11), 199(4), 200(3), 201(5), 202(3), 203(1), 204(6), 205(3), 206(13), 207(21), 208(3), 209(89), 210(230), 211(27).

Notemigonus crysoleucas (Mitchill): 208(2).

Notropis atherinoides Rafinesque: 196(26).

N. coccogenis (Cope): 12(2), 13(10), 14(30), 19(9), 20(3), 24(19), 25(6), 28(2), 29(31), 30(10), 31(25), 32(28), 33(14), 34(19), 35(8), 38(18), 39(9), 40(4), 41(10), 42(21), 43(7), 44(2), 45(10), 46(2), 47(10), 48(3), 49(16), 50(8), 51(5), 54(4), 55(51), 56(11), 58(20), 59(10), 60(1), 62(7), 63(2), 64(5), 66(5), 67(10), 68(9), 70(8), 76(2), 79(14), 80(5), 86(15), 88(5), 90(4), 93(1), 94(1), 98(9), 101(14), 106(2), 115(7), 120(1), 121(31), 122(44), 124(8), 129(2), 134(2), 135 (43), 138(3), 141(1), 142(1), 147(36), 148(3), 169(?), 171(?), 172(?), 173(?), 175(?), 181(12), 182(7), 184(3), 185(4), 186(4), 187(46), 196(18), 197(14), 199(6), 200(1), 201(1), 202(1), 203(4), 204(16), 205(4), 208(5), 209(133), 210(50), 211(28).

N. cornutus chrysocephalus (Rafinesque): 8(13), 10(1), 12(1), 14(3), 26(3), 61(3), 70(5), 72(1), 75(1), 184(8), 185(14), 197(1).

N. galacturus (Cope): 9(13), 12(3), 13(5), 14(5), 15(13), 16(1), 19(27), 26(31), 30(24), 31(19), 32(14), 33(7), 34(4), 35(17), 39(2), 41(100), 43(1), 44(1), 45(2), 47(5), 48(3), 49(25), 50(9), 51(1), 52(1), 54(80), 55(3), 57(50), 58(35), 59(10), 60(11), 61(4), 64(5), 66(1), 68(13), 76(2), 80(100), 81(5), 86(9), 90(80), 102(3), 122(4), 147(2), 181(5), 182(3), 184(4), 186(2), 196(1), 203(3), 205(2), 209(35), 211(97).

N. leuciodus (Cope): 12(2), 13(50), 14(28), 20(16), 22(5), 24(15), 25(26), 26(4), 31(7), 32(1), 33(26), 34(40), 35(30), 36(6), 38(20), 39(4), 40(15), 41(50), 42(12), 43(5), 44(13), 45(16), 46(8), 47(35), 48(20), 49(50), 50(20), 51(20), 54(50), 55(25), 58(100), 59(50), 60(1), 61(73), 62(1), 63(50), 64(20), 66(20), 67(10), 76(15), 80(1), 86(31), 90(50), 93(11), 98(13), 101(11), 120(5), 121(6), 122(3), 124(10), 141(1), 142(4), 144(3), 147(21), 169(?), 172(?), 173(?), 177(?), 181(20), 182(12), 184(10), 185(49), 186(8), 187(45), 196(3), 197(6), 200(5), 203(1), 204(23), 205(2), 208(10), 209(4), 210(100), 211(6).

N. photogenis (Cope): 26(1), 31(1), 32(1), 33(11), 35(2), 86(1), 101(1), 121(14), 122(41), 147(2), 200(2), 208(5), 209(5), 211(37).

N. rubellus (Agassiz): 29(1), 86(5), 208(8).

N. rubricroceus (Cope): 68(6).

Notropis sp.: 12(20), 14(94), 44(4), 45(2), 46(5), 48(1), 55(7).

N. spectrunculus (Cope): 31(4), 32(65), 86(15), 93(1), 98(36), 101(3), 109(21), 111(3), 120(12), 121(79), 122(33), 128(2), 129(1), 146(17), 147(48), 209(354), 210(12), 211(41).

N. telescopus (Cope): 12(1), 13(18), 14(13), 19(10), 26(57), 32(5), 33(27), 35(14), 40(16), 41(20), 42(2), 43(16), 44(5), 45(21), 46(2), 47(10), 48(7), 49(5), 50(3), 51(5), 54(20), 55(1), 56(2), 58(10), 59(5), 60(15), 62(5), 63(10), 64(10), 68(2), 74(1), 86(63), 90(20), 115(1), 134(16), 135(117), 141(1), 142(1), 146(1), 185(2), 186(5), 202(1), 203(4), 204(17), 205(3), 208(5).

N. volucellus (Cope): 26(9).

Phenacobius crassilabrum Minckley and Craddock: 84(3), 86(10), 101(?), 208(3), 209(1), 212(1).

P. uranops Cope: 13(2), 26(10), 35(1), 193(1), 200(11).

Pimephales notatus (Rafinesque): 169(?), 171(?), 172(?).

Rhinichthys atratulus (Hermann): 1(?), 2(?), 3(?), 4(?), 5(?), 6(26), 8(27), 11(?), 20(12), 21(13), 22(12), 23(8), 24(10), 67(5), 71(2), 72(17), 73(8), 75(3), 78(8), 82(2), 84(6), 87(16), 89(22), 91(4), 92(21), 102(7), 104(3), 109(23), 110(8), 111(4), 112(11), 117(11), 128(16), 140(26), 149(8), 159(?), 160(?), 161(?), 164(?), 165(?), 166(?), 171(?), 178(8), 179(11), 182(7), 188(2), 189(4), 204(2), 205(1), 210(4), 211(9).

R. cataractae (Valenciennes): 20(2), 21(5), 22(2), 25(3), 36(3), 77(4), 84(10), 91(15), 92(21), 94(1), 100(4), 102(3), 104(7), 105(10), 106(12), 107(6), 108(2), 109 (2), 110(4), 111(12), 112(20), 114(1), 117(10), 120(5), 123(2), 124(2), 125(3), 127(7), 128(5), 131(1), 133(5), 134(21), 135(25), 136(13), 137(6), 139(11), 141(3), 142(4), 143(37), 144(1), 151(5), 160(?), 161(?), 168(?), 170(?), 171(?), 172(?), 173(?), 175(?), 179(4), 180(2), 181(6), 209(7).

Semotilus atromaculatus (Mitchill): 2(?), 5(?), 6(1), 19(5), 20(2), 21(27), 22(7), 32(4), 36(2), 53(8), 54(25), 56(1), 65(2), 72(1), 78(6), 83(2), 84(8), 85(2), 87(1), 89(1), 90(25), 120(17), 128(4), 131(1), 141(8), 142(1), 153(74), 182(19), 188(2), 189(5), 204(2), 211(3).

Catostomidae

Catostomus commersoni (Lacepede): 17(1), 18(2), 20(2), 21(15), 32(2), 87(23), 101(6), 121(1), 143(11), 146(2), 189(5), 211(54).

Cycleptus elongatus (Lesueur): 18(6), 156(9), 157(3).

Hypentelium nigricans (Lesueur): 1(?), 3(?), 10(1), 12(1), 13(2), 16(1), 17(11), 18(204), 19(3), 20(8), 21(7), 22(2), 24(6), 25(9), 26(4), 31(1), 32(19), 34(11), 35(1), 36(1), 38(7), 40(1), 41(6), 42(4), 45(1), 49(110), 52(3), 53(8), 54(6), 55(1), 56(1), 57(7), 59(10), 60(1), 61(10), 63(1), 64(1), 65(13), 66(4), 67(2), 68(2), 71(1), 72(1), 73(4), 75(2), 76(1), 78(2), 80(1), 84(3), 86(1), 87(7), 88(1), 90(6), 91(3), 98(7), 101(10), 106(1), 108(1), 109(13), 110(1), 115(9), 120(7), 121(1), 124(3), 128(1), 129(7), 134(13), 135(50), 138(1), 142(6), 144(1), 146(36), 148(1), 153(2), 155(5), 156(1), 160(?), 161(?), 169(?), 171(?), 172(?), 173(?), 175(?), 177(?), 178(3), 181(4), 182(8), 184(4), 185(1), 187(4), 192(1), 194(1), 196(9), 197(1), 198(1), 199(2), 200(2), 201(9), 202(3), 204(1), 205(2), 206(10), 207(1), 210(2), 211(185).

Ictiobus bubalus (Rafinesque): 17(15), 18(3), 154(2), 155(4), 156(3), 157(2), 158(39).

Moxostoma anisurum (Rafinesque): 196(2).

M. carinatum (Cope): 16(1), 18(1), 27(1), 29(1), 41(4), 47(5), 58(3), 59(8), 61(1), 196(5), 197(1), 198(1).

M. duquesnii (Lesueur): 16(11), 18(4), 26(1), 29(2), 31(3), 32(26), 33(2), 70(1), 184(1), 196(2), 201(1), 204(1), 209(1), 210(1), 211(17).

M. erythrurum (Rafinesque): 12(5), 16(1), 26(1), 27(3), 29 (18), 30(5), 32(1), 34(14), 49(3), 51(5), 58(5), 61(1), 62(1), 70(1), 74(3), 80(75), 182(6), 184(10), 186(2), 187(4), 196(19), 200(1), 202(2), 206(23), 208(5).

M. macrolepidotum breviceps (Cope): 17(3), 18(3), 27(1), 29(1), 196(1).

Ictaluridae
Ictalurus furcatus (Lesueur): 37(1).
I. natalis (Lesueur): 17(3), 19(1).
I. punctatus (Rafinesque): 16(3), 18(11), 30(1), 157(1), 196(4), 205(2).
Noturus eleutherus Jordan: 196(1), 197(1), 205(3).
Pylodictis olivaris (Rafinesque): 16(1), 18(1), 205(2).

Cyprinodontidae
Fundulus catenatus (Storer): 14(2), 26(6), 205(1), 206(1).

Poecilidae
Gambusia affinis (Baird and Girard): 19(1).

Atherinidae
Labidesthes sicculus (Cope): 9(1), 15(1), 182(2), 196(1), 199(2), 201(11), 206(2), 207(1).

Percichthyidae
Morone chrysops (Rafinesque): 16(1).

Centrarchidae
Ambloplites rupestris (Rafinesque): 17(16), 18(4), 19(1), 26(1), 31(1), 32(2), 34(1), 49(2), 52(2), 53(6), 58(1), 65(7), 71(1), 87(4), 109(1), 111(1), 135(1), 158(9), 187(2), 188(2), 201(6), 204(1), 205(2), 206(3), 207(1), 209(27), 210(1), 211(8).
Lepomis auritus (Linnaeus): 16(3), 17(30), 18(1), 49(4), 54(1), 57(10), 65(1), 69(1), 72(1), 74(1), 90(1), 158 (1), 165(?), 171(?), 196(1), 201(2), 210(1), 211(2).
L. cyanellus Rafinesque: 16(2), 17(1), 18(1), 37(4), 89(2), 196(2), 197(1), 205(1), 207(1).
L. gulosus (Cuvier): 87(6).
L. macrochirus Rafinesque: 6(3), 9(7), 10(1), 15(7), 16(1), 17(16), 18(1), 19(2), 26(7), 29(8), 30(1), 34(2), 37(80), 41(3), 49(2), 50(1), 57(25), 65(3), 69(2), 71(2), 78(1), 84(4), 87(15), 101(1), 109(3), 117(1), 158(34), 196(5), 197(3), 199(1), 201(2), 205(1), 206(10), 207(1), 209(2), 211(4).
L. megalotis (Rafinesque): 26(5), 158(1).
Micropterus dolomieui Lacepede: 16(1), 17(2), 18(1), 24(2), 26(2), 30(3), 34(20), 35(8), 36(3), 37(1), 38(1), 42(1), 47(1), 49(2), 50(3), 51(2), 54(3), 57(5), 58(1), 59(3), 62(1), 63(1), 65(1), 76(4), 80(5), 81(3), 86(1), 90(3), 135(80), 145(1), 158(2), 196(2), 201(3), 208(1), 209(2), 210(1).
M. punctulatus (Rafinesque): 17(1), 18(6), 158(9), 196(1), 206(9), 211(2).
M. salmoides (Lacepede): 7(1), 29(4), 32(1), 37(2), 49(50), 57(5), 58(1), 86(1).

Pomoxis annularis Rafinesque: 17(1), 206(1).
P. nigromaculatus (Lesueur): 17(1).

Percidae
Etheostoma blennioides Rafinesque: 12(1), 13(1), 14(1), 24 (16), 26(23), 32(1), 33(4), 40(3), 42(1), 43(2), 44(1), 45(1), 48(1), 54(8), 55(1), 58(2), 61(3), 64(10), 65(3), 79(1), 81(10), 88(1), 90(2), 93(1), 94(1), 187(2), 200 (1), 202(1), 205(2), 206(1), 207(1), 208(1), 209(4), 210(8), 212(4).
E. chlorobranchium Zorach: 24(11), 26(1), 31(1), 47(2), 51(1), 81(2), 93(1), 135(5), 148(1), 172(?), 199(1), 201(2), 204(5), 208(1), 212(6).
E. (Catonotus) sp. 26(2).
E. flabellare Rafinesque: 1(?), 21(6), 22(1).
E. jessiae (Jordan): 12(6), 14(1), 26(1), 33(13), 40(1), 42(1), 43(1), 49(1), 58(1).
E. maculatum Kirtland: 26(1), 208(13), 209(6), 210(7), 211(4).
E. rufilineatum (Cope): 12(1), 13(6), 14(15), 19(36), 26(21), 33(20), 34(35), 35(3), 36(2), 38(6), 40(48), 41(10), 42(54), 43(15), 44(66), 45(22), 46(8), 47(20), 48(28), 49(40), 50(35), 51(50), 54(50), 55(74), 56(4), 58(5), 60(4), 61(13), 63(3), 64(1), 79(4), 81(30), 90(50), 185(11), 186(2), 187(1), 192(1), 196(7), 197(1), 199(3), 202(1), 203(1), 205(7).
E. simoterum (Cope): 8(10), 10(7), 12(1), 13(1), 14(8), 19 (10), 20(3), 26(13), 33(8), 35(2), 40(1), 42(3), 44(2), 48(1), 49(50), 51(4), 52(2), 54(30), 55(7), 56(1), 58(5), 60(4), 61(9), 62(1), 69(18), 71(10), 72(15), 73(8), 75(8), 76(5), 87(2), 90(30), 185(4), 186(5), 187 (3), 188(2), 197(1), 201(7), 202(1), 203(10), 204(18), 205(10).
E. swannanoa Jordan and Brayton: 81(2), 134(7), 135(13).
E. zonale (Cope): 24(3), 26(6), 33(4), 34(2), 38(1), 58(1), 86(5), 187(1), 196(1), 197(1), 201(1), 203(5), 204(5), 205(2), 208(7), 209(2), 212(2).
Percina aurantiaca (Cope): 48(1), 58(10), 59(5), 63(4), 64(10), 76(3), 135(1), 211(1).
P. burtoni Fowler: 58(1), 64(1).
P. caprodes (Rafinesque): 9(1), 15(1), 17(6), 18(12), 41(1), 42(2), 43(2), 44(2), 45(2), 46(2), 48(1), 49(6), 54(2), 55(1), 69(7), 88(4), 185(1), 191(6), 192(14), 193(3), 194(1), 196(34), 197(2), 199(3), 200(1), 201(9), 202(24), 203(1), 205(6), 207(9).
P. evides (Jordan and Copeland): 12(3), 26(1), 31(1), 32(1), 33(2), 40(1), 42(1), 44(1), 54(11), 55(1), 58(15), 59(2), 64(7), 90(11), 101(2), 110(4), 148(2), 169(?), 185(6), 187(4), 191(2), 192(1), 193(6), 196(4), 197(3), 198(4), 200(18), 202(2), 206(1), 207(1), 208(16), 209(4), 210(1), 211(4), 212(4).

P. maculata (Girard): 86(1).
P. sciera (Swain): 74(6), 184(3), 187(2), 196(11), 197(3), 205(6),
P. shu rdi (Girard): 196(2), 197(1).
P. squamata (Gilbert and Swain): 209(3), 211(1), 212(1).
P. tanasi Etnier: 191(25), 192(8), 193(6), 194(3), 195(10), 198(5), 200(1), 202(30).
Stizostedion canadense (Smith): 17(3), 18(13), 26(1), 155(2), 196(2).

Sciaenidae
Aplodinotus grunniens Rafinesque: 17(18), 18(26), 155(3), 196(10).

Cottidae
Cottus bairdi Girard: 24(2), 35(3), 40(4), 54(1), 72(2), 73(8), 75(2), 77(13), 84(15), 86(4), 87(55), 88(42), 89(7), 90(1), 91(2), 92(5), 95(1), 96(5), 98(1), 99(5), 100(8), 103(8), 104(8), 106(4), 107(16), 108(1), 110(4), 111(2), 112(4), 115(2), 116(9), 117(11), 118(7), 120(3), 123(2), 127(13), 128(4), 132(7), 133(12), 137(66), 141 (3), 142(4), 144(26), 148(1), 150(29), 151(12), 152(6), 159(?), 160(?), 161(?), 169(?), 172(?), 173(?), 174(?), 177(?), 178(3), 179(6), 180(1), 181(1), 183(39), 184(2), 185(1), 186(2), 187(2), 196(6), 197(20), 199(48), 200(2), 201(146).
C. carolinae (Gill): 12(3), 13(1), 33(1), 69(2), 73(1), 77(1), 82(2), 89(1), 134(24), 135(12), 182(1), 182(4), 185(2), 191(2), 192(3), 193(12), 194(3), 195(3), 196 (39), 197(62), 198(11), 199(1), 200(1), 201(3), 202(9), 205(16), 206(12), 207(16), 210(14).

APPENDIX B

List of Locations Collected

1. Anthony Creek, at small bridge in Cades Cove, Great Smoky Mountains National Park, Blount Co., Tenn., March 22, 1962. R. Ross, J. Jenkins, G. Clemmer.

2. Anthony Creek in Cades Cove, Great Smoky Mountains National Park, Blount Co., Tenn., March 22, 1962. R. Jenkins, R. Ross, G. Clemmer.

3. Second tributary to Anthony Creek in Cades Cove, Great Smoky Mountains National Park, Blount Co., Tenn., March 22, 1962. R. Ross, R. Jenkins, G. Clemmer.

4. Tributary to Anthony Creek in Cades Cove, Great Smoky Mountains National Park, Blount Co., Tenn., March 22, 1962. R. Jenkins, R. Ross, G. Clemmer.

5. Tributary to Anthony Creek in Cades Cove, Great Smoky Mountains National Park, Blount Co., Tenn., March 22, 1962. R. Jenkins, R. Ross, G. Clemmer.

6. Tributary to Chilhowee Lake in Happy Valley, 4 miles west of Tallassee, Blount Co., Tenn., Sept. 7, 1961. J. S. Ramsey, W. P. Davis.

7. Chilhowee Lake, just above dam and Little Tennessee River, just below dam, Blount Co., Tenn., Sept. 7, 1961. J. S. Ramsey, W. P. Davis.

8. Stream entering Little Tennessee River from north at head of Calloway Island, Blount Co., Tenn., Jan. 1967. Etnier, Chue.

9. Chilhowee Reservoir, Monroe Co., Tenn., June 25, 1963. T. V. A.

10. Four-Mile Creek, at U. S. 129, Blount Co., Tenn., June 5, 1968. Bouchard.

11. Stream on U. S. 129, 1/2 mile east of junction of U. S. 129 and Tenn. 72, Monroe Co., Tenn., April 2, 1968. Bouchard.

12. Citico Creek, 1 mile above mouth, Monroe Co., Tenn., April 3, 1969. Starnes, Stiles, Etnier.

13. Tellico River, just above Tellico Plains, Monroe Co., Tenn., Nov. 13, 1965. Etnier, Stiles.

14. Lower Citico Creek, Monroe Co., Tenn., Nov. 13, 1965. Etnier, Stiles.

15. Chilhowee Reservoir, Monroe Co., Tenn., June 25, 1963. Det. Etnier, 1968.

16. Fontana Reservoir, above Almond Boat Dock, Graham Co., N. C. Sept. 13, 1962. Det. Etnier, 1968.

17. Little Tennessee River, above Bacon Ferry, Monroe Co., Tenn., Aug. 29-30, 1964. T. G. and F.

18. Little Tennessee River, above Calloway Island, Monroe Co., Tenn., Aug. 29-30, 1964. T. G. and F.

19. Tabcat Creek, tributary to Chilhowee Reservoir (Near Abrams Creek), Monroe Co., Tenn., June 14, 1968. C. Gilbert, D. Etnier, W. Seaman.

20. Abrams Creek, just below mouth of Cove Creek, at head of Abrams Creek Gorge, Great Smoky Mountains National Park, Blount Co., Tenn., Sept. 2, 1937. C. Hubbs.

21. Anthony Creek, Abrams Creek System, Blount Co., Tenn., Sept. 2, 1937. C. Hubbs.

22. Forge Creek (Mill Creek), tributary of Abrams Creek, Great Smoky Mountains National Park, Blount Co., Tenn., Sept. 2, 1937. C. Hubbs.

23. Anthony Creek, tributary to Abrams Creek, east end of Cades Cove, Great Smoky Mountains National Park, Blount Co., Tenn., Sept. 2, 1937. C. Hubbs.

24. Abrams Creek, just below Abrams Falls, Great Smoky Mountains National Park, Blount Co., Tenn., Sept. 3, 1937. C. Hubbs.

25. Abrams Creek above falls, Great Smoky Mountains National Park, Blount Co., Tenn., Sept. 3, 1937. C. Hubbs.

26. Abrams Creek, 1 mile above mouth to Little Tennessee River, Blount Co., Tenn., Sept. 6, 1937. C. Hubbs.

27. Little Tennessee River, below Calderwood Dam, Blount Co., Tenn., Sept. 6, 1937. C. Hubbs.

28. Twenty-Mile Creek, just above mouth in Cheoah Lake, Swain Co., N. C., Sept. 7, 1937. C. Hubbs.

29. Flooded mouth of Twenty-Mile Creek, in Cheoah Lake, Swain Co., N. C., Sept. 7, 1937. C. Hubbs.

30. Little Tennessee River, 1 mile below Bushell, Swain Co., N. C., Sept. 7, 1937. C. Hubbs.

31. Forney Creek, at mouth into Tuckaseegee River, Swain Co., N. C., Sept. 8, 1937. C. Hubbs.

32. Deep Creek, tributary to Tuckaseegee River, near Bryson City, Swain Co., N. C., Sept. 8, 1937. C. Hubbs.

33. Tellico River, at Tellico Plains, Monroe Co., Tenn., March 21, 1972. F. Oakberg, C. Soulor, J. Winfield, D. Etnier. Det. Winfield.

34. Abrams Creek, junction of Mill Creek, Monroe Co., Tenn., June 7, 1972. P. Wehner, J. Winfield.

35. Citico Creek, at Crane Island Bridge, Monroe Co., Tenn., June 18, 1972. J. Winfield, P. Wehner, N. Wehner.

36. Citico Creek, .15 miles below Double Camp Campground, Monroe Co., Tenn., June 18, 1972. J. Winfield, P. Wehner, N. Wehner.

37. Indian Boundary Lark, at Donnelly Creek, Monroe Co., Tenn., June 18, 1972. J. Winfield, P. Wehner, N. Wehner.

38. Citico Creek, .3 miles above Double Camp Campground, Monroe Co., Tenn., June 17, 1972. J. Winfield, P. Wehner.

39. Citico Creek, .7 miles above Double Camp Campground, Monroe Co., Tenn., June 17, 1972. J. Winfield, P. Wehner.

40. Citico Creek, at mouth of Young Branch, Monroe Co., Tenn., June 27, 1972. J. Winfield, P. Wehner.

41. Citico Creek, at and below spillway above Broken Arrow Resort, Monroe Co., Tenn., June 27, 1972. J. Winfield.

42. Citico Creek, 1.5 miles above Broken Arrow Resort, Monroe Co., Tenn., June 17, 1972. J. Winfield.

43. Citico Creek, twenty yards below mouth of Caney Creek, Monroe Co., Tenn., June 17, 1972. J. Winfield.

44. Citico Creek, 1 mile below Broken Arrow Resort, Monroe Co., Tenn., July 10, 1972. J. Winfield.

45. Citico Creek, 1/2 mile above Broken Arrow Resort, Monroe Co., Tenn., July 10, 1972. J. Winfield.

46. Citico Creek, at Citico Beach, Monroe Co., Tenn., July 10, 1972. J. Winfield.

47. Abrams Creek, at ranger station, Blount Co., Tenn., July 15, 1972. J. Winfield.

48. Citico Creek, 1 mile below Broken Arrow Resort, Monroe Co., Tenn., July 10, 1972. J. Winfield.

49. Tabcat Creek, at and around moutn to Chilhowee Reservoir, Blount Co., Tenn., July 19, 1972. J. Winfield.

50. Upper Abrams Creek, 1 mile above ranger station, Blount Co., Tenn., July 14, 1972. J. Winfield, P. Wehner.

51. Upper Abrams Creek, one hundred yards above Abrams Creek Campground, Blount Co., Tenn., July 13, 1972. J. Winfield.

52. Mill Branch, 1 mile above mouth to Chilhowee Lake, Blount Co., Tenn., July 13, 1972. J. Winfield.

53. Mill Branch, at Happy Valley, Blount Co., Tenn., July 13, 1972. J. Winfield.

54. Citico Creek, .75 miles above Broken Arrow Resort, at and around mouth of small unnamed creek, Monroe Co., Tenn., July 26, 1972. Starnes, Dickinson, Winfield, Etnier.

55. Lower Citico Creek, .75 miles above mouth of Little Tennessee River, Monroe Co., Tenn., July 26, 1972. Starnes, Dickinson, Winfield, Etnier.

56. Tabcat Creek, fifty yards from mouth to Chilhowee Lake, Blount Co., Tenn., Aug. 17, 1972. J. Winfield, N. Helms.

57. Chilhowee Lake, ten yards below culvert at Abrams Creek Cove, Blount Co,, Tenn., Aug. 17, 1972. J. Winfield, N. Helms.

58. Tellico River, at Quarry Creek, Monroe Co., Tenn., Aug. 18, 1972. J. Winfield, N. Helms.

59. Tellico River, at and around mouth of Lyons Creek, Monroe Co., Tenn., Aug. 18, 1972. J. Winfield, N. Helms.

60. Cane Creek, 1 mile southwest of Belltown, Monroe Co., Tenn., Aug. 20, 1972. J. Winfield, N. Helms.

61. Ballplay Creek, 1 mile morth of Tariffville, Monroe Co., Tenn., Aug. 20, 1972. J. Winfield, N. Helms.

62. Lyons Creek, at Tellico River, Monroe Co., Tenn., Aug. 20, 1972. J. Winfield, N. Helms.

63. Tellico River, at Oosterneck Creek, Monroe Co., Tenn., Aug. 24, 1972. J. Winfield, N. Helms.

64. Tellico River, one hundred yards upstream from Buck Branch, Monroe Co., Tenn., Aug. 24, 1972. J. Winfield, N. Helms.

65. Coker Creek, at Tenn. Hy. 326, Monroe Co., Tenn., Aug. 20, 1972. J. Winfield, N. Helms.

66. Bald River, at Bald River Falls, Monroe Co., Tenn., Aug. 20, 1972. J. Winfield, N. Helms.

67. Bald River, twenty yards above Bald River Falls, Monroe Co., Tenn., Aug. 20, 1972. J. Winfield, N. Helms.

68. Turkey Creek, at Tellico River, Monroe Co., Tenn., Aug. 20, 1972. J. Winfield, N. Helms.

69. Four-Mile Creek, fifty yards from mouth of Little Tennessee River, Monroe Co., Tenn., Aug. 23, 1972. J. Winfield, N. Helms.

70. Nine-Mile Creek, at Tenn. Hy. 129, Blount Co., Tenn., Aug. 23, 1972. J. Winfield, N. Helms.

71. Four-Mile Creek, at Tenn. Hy. 129, Blount Co., Tenn., Aug. 23, 1972. J. Winfield, N. Helms.

72. Bat Creek, at Co. rd. 2509, Monroe Co., Tenn., Aug. 23, 1972. J. Winfield, N. Helms.

73. Fork Creek, at Co. rd. 2509, Monroe Co., Tenn., Aug. 23, 1972. J. Winfield, N. Helms.

74. Notchy Creek, at Co. rd. 2568, Monroe Co., Tenn., Aug. 23, 1972. J. Winfield, N. Helms.

75. Island Creek, at Tenn. Hy. 72, Monroe Co., Tenn., Aug. 23, 1972. J. Winfield, N. Helms.

76. Tellico River, second bridge below Co. rd. 2415 bridge, Monroe Co., Tenn., Sept. 14, 1972. J. Winfield, F. Oakberg.

77. Sweetwater Creek, 1 mile southeast of Milltown, Graham Co., N. C., Sept. 7, 1972. J. Winfield, N. Helms.

78. Wolf Creek, at N. C. Hy. 28, Graham Co., N. C., Sept. 7, 1972. J. Winfield, N. Helms.

79. Cheoah River, 5 miles upstream from Tapoco, Graham Co., N. C., Sept. 7, 1972. J. Winfield, N. Helms.

80. Lower Slickrock Creek, near mouth to Cheoah Reservoir, Swain Co., N. C., Sept. 10, 1972. J. Winfield, N. Helms.

81. Slickrock Creek, at lower falls, Monroe Co., Tenn., Sept. 10, 1972. J. Winfield, N. Helms.

82. Sawyer Creek, at N. C. Hy. 28, Graham Co., N. C., Sept. 11, 1972. J. Winfield, N. Helms.

83. Small stream by Tapoco Lodge, at mouth to Cheoah River, Graham Co., N. C., Sept. 10, 1972. J. Winfield, N. Helms.

84. Long Creek, 1 mile south of Milltown, Graham Co., N. C., Sept. 10, 1972. J. Winfield, N. Helms.

85. Little Buffalo Creek, near mouth to Santeetlah Reservoir, Swain Co., N. C., Sept. 10, 1972. J. Winfield, N. Helms.

86. Little Tennessee River, NNW of Franklin, N. C. on N. C. Hy. 28, Macon Co., N. C., April 19, 1967. R. W. Yerger, C. Gilbert, C. Swift.

87. Baker's Creek, at Benfield, Blount Co., Tenn., Sept. 20, 1972. J. Winfield, B. Henson.

88. Baker's Creek, at first bridge above mouth to Little Tennessee River, Blount Co., Tenn., Sept. 20, 1972. J. Winfield, B. Henson.

89. First creek below Davis Ferry, on north bank, Loudon Co., Tenn., July 26, 1972. J. Winfield, B. Henson.

90. Citico Creek, 2 miles above Broken Arrow Resort, Monroe Co., Tenn., July 26, 1972. Starnes, Dickinson, Winfield, Etnier.

91. Alarka Creek, 2 miles east of Alarka School, Graham Co., N. C., June 23, 1961. N. C. W. R. C.

92. Barker's Creek, at Rockdale Church, Jackson Co., N. C., July 17, 1961. N. C. W. R. C.

93. Big Snowbird Creek, 1.8 miles above Little Snowbird Creek, Graham Co., N. C., June 20, 1961. N. C. W. R. C.

94. Big Snowbird Creek, approx. 7 miles above mouth of Little Snowbird Creek, Graham Co., N. C., June 30, 1961. N. C. W. R. C.

95. Buck Creek, picnic area next to U. S. Hy. 64, Macon Co., N. C., June 30, 1961. N. C. W. R. C.

96. Upper Buck Creek, approx. 1/2 mile above U. S. Hy. 64, Macon Co., N. C., Aug. 12, 1961. N. C. W. R. C.

97. Buff Creek, last upstream crossing, Jackson Co., N. C., July 14, 1961. N. C. W. R. C.

98. Burningtown Creek, second bridge above junction of State rds. 1372 and 1392, Macon Co., N. C., July 10, 1961. N. C. W. R. C.

99. At culvert, Macon Co., N. C., July 6, 1961. N. C. W. R. C.

100. Caney Fork, at Sugar Creek Road bridge, Jackson Co., N. C., July 21, 1961. N. C. W. R. C.

101. Cartoogechaye Creek, at 441 Highway bridge, Macon Co., N. C., July 31, 1961. N. C. W. R. C.

102. Cedar Creek, first bridge above Glenville Reservoir, Jackson Co., N. C., June 20, 1961. N. C. W. R. C.

103. Choga Creek, second bridge above Nantahala Lake, Macon Co., N. C., June 27, 1961. N. C. W. R. C.

104. Connelly Creek, at Chestnut Grove Road, Swain Co., N. C., June 23, 1961. N. C. W. R. C.

105. Cooper Creek, 1/4 mile below park line, Swain Co., N. C., June 23, 1961. N. C. W. R. C.

106. Cowee Creek No. 1, at confluence of Caler Fork, Macon Co., N. C., July 11, 1961. N. C. W. R. C.

107. Cowee Creek No. 2, culvert of state rd. 1347, near U. S. Forest Service property, Macon Co., N. C., July 11, 1961. N. C. W. R. C.

108. Coweeta Creek, just below junction of Bald Creek and Shope Creek, Macon Co., N. C., June 29, 1961. N. C. W. R. C.

109. Cullasaja River, at bridge at Turtle Pond Road, Macon Co., N. C., July 11, 1961. N. C. W. R. C.

110. Cullowhee Creek, at bridge at picnic area, Jackson Co., N. C., July 19, 1961. N. C. W. R. C.

111. Deep Creek, two hundred yards above Tuckaseegee River, Swain Co., N. C., June 28, 1961. N. C. W. R. C.

112. Dick's Creek, at bridge at church, Jackson Co., N. C., July 12, 1961. N. C. W. R. C.

113. Dick's Creek, first bridge above dam, Macon Co., N. C., June 27, 1961. N. C. W. R. C.

114. Ellijay Creek, eighth bridge on state rd. 1001, Macon Co., N. C., July 10, 1961. N. C. W. R. C.

115. Frank's Creek, one hundred yards above N. C. Hy. 129, Graham Co., N. C., June 14, 1961. N. C. W. R. C.

116. Glade Creek, lower crossing of U. S. Hy. 64, Macon Co., N. C., June 29, 1961. N. C. W. R. C.

117. Greens Creek, second bridge above N. C. Hy. 441, Jackson Co., N. C., July 12, 1961. N. C. W. R. C.

118. Jarrett Creek, bridge on Rainbow Springs Road, Macon Co., N. C., June 27, 1961. N. C. W. R. C.

119. Kertland Creek, at "Summer Place" sign, Swain Co., N. C., June 23, 1961. N. C. W. R. C.

120. Little Snowbird Creek, approx. 1 mile above mouth, Graham Co., N. C., June 19, 1961. N. C. W. R. C.

121. Little Tennessee River, first bridge on State rd. 1644, Macon Co., N. C., Aug. 17, 1961. N. C. W. R. C.

122. Little Tennessee River, three hundred yards above N. C. Hy. 28 bridge at Iotla, Macon Co., N. C., Aug. 17, 1961. N. C. W. R. C.

123. Long Creek, at Old Robbinsville Water Intake, Graham Co., N. C., June 15, 1961. N. C. W. R. C.

124. Middle Creek, crossing on Jeep Road, Macon Co., N. C., July 6, 1961. N. C. W. R. C.

125. Moses Creek, 1.9 miles above Caney Creek, Jackson Co., N. C., no date, N. C. W. R. C.

126. Mull Creek, second bridge above forks of road, Jackson Co., N. C., no date. N. C. W. R. C.

127. Nantahala River, one hundred yards below G. S. C. station, Macon Co., N. C., Aug. 18, 1961. N. C. W. R. C.

128. Nantahala River, upper gorge, Macon Co., N. C., June 21, 1961. N. C. W. R. C.

129. Nantahala River, gorge, Swain Co., N. C., Aug. 18, 1961. N. C. W. R. C.

130. Norton Creek, bridge crossing south of Norton, Jackson Co., N. C., July 20, 1961. N. C. W. R. C.

131. Panther Creek, 2.4 miles above N. C. Hy. 28, Graham Co., N. C., June 22, 1961. N. C. W. R. C.

132. Roaring Fork, first ford above Rainbow Springs Road, Macon Co., N. C., June 28, 1961. N. C. W. R. C.

133. Rough Fork, near confluence with Wayah Creek, Macon Co., N. C., July 6, 1961. N. C. W. R. C.

134. Big Santeetlah Creek, Stratton Cabin, Graham Co., N. C., Sept. 10, 1962. N. C. W. R. C.

135. Big Santeetlah Creek, high concrete bridge, Graham Co., N. C., Sept. 10, 1962. N. C. W. R. C.

136. Little Santeetlah Creek, picnic area, Graham Co., N. C., Aug. 23, 1962. N. C. W. R. C.

137. Savannah Creek, at Pumpkintown bridge, Jackson Co., N. C., July 13, 1961. N. C. W. R. C.

138. Sawyer Creek, .7 miles below N. C. Hy. 28, Graham Co., N. C., June 20, 1961. N. C. W. R. C.

139. Scott Creek, one hundred yards below U. S. Hy. 441 bridge, Jackson Co., N. C., July 14, 1961. N. C. W. R. C.

140. Sols Creek, crossing Forest Service rd. 96 bridge, Jackson Co., N. C., July 24, 1961. N. C. W. R. C.

141. Stecoah Creek, second bridge below N. C. Hy. 28. Graham Co., N. C., June 20, 1961. N. C. W. R. C.

142. Sweetwater Creek, bridge at Cheoah Community, Graham Co., N. C., June 14, 1961. N. C. W. R. C.

143. Tennessee Creek, first bridge above Tennessee Creek Reservoir, Jackson Co., N. C., July 24, 1961. N. C. W. R. C.

144. Tessentee Creek, Forest Service rd. 60 bridge, Macon Co., N. C., July 6, 1961. N. C. W. R. C.

145. Tribula Creek, 1 mile above Frank Creek, Graham Co., N. C., June 14, 1961. N. C. W. R. C.

146. East fork of Tuckaseegee River, at junction of east and west forks, Jackson Co., N. C., Aug. 16, 1961. N. C. W. R. C.

147. Tuckaseegee River, bridge at Webster, Jackson Co., N. C., Aug. 16, 1961. N. C. W. R. C.

148. West fork of Tuckaseegee River, between Glenville and Little Glenville Reservoir, Jackson Co., N. C., July 20, 1961. N. C. W. R. C.

149. Turtle Pond Creek, first bridge on Turtle Pond Road, Macon Co., N. C., July 10, 1961. N. C. W. R. C.

150. Wayah Creek, highway culvert, Macon Co., N. C., July 6, 1961. N. C. W. R. C.

151. West Buffalo Creek, two hundred yards below mouth of Squalla Creek, Graham Co., N. C., June 15, 1961. N. C. W. R. C.

152. Winespring Creek, two hundred yards above Nantahala Reservoir, Macon Co., N. C., June 27, 1961. N. C. W. R. C.

153. Yellow Creek, three hundred yards below first bridge, Graham Co., N. C., June 14, 1961. N. C. W. R. C.

154. Little Tennessee River, 1/4 mile below Chilhowee Dam, Blount Co., Tenn., May 23-24, 1964. B. S. F. W.

155. Little Tennessee River, at Tallasee, Blount Co., Tenn., May 23-24, 1964. B. S. F. W.

156. Little Tennessee River, at Bacon Ferry, Monroe Co., Tenn., May 23-24, 1964. B. S. F. W.

157. Little Tennessee River at Niles Ferry, Monroe Co., Tenn., May 23-24, 1964. B. S. F. W.

158. Little Tennessee River, at Rose Island, Monroe Co., Tenn., Aug. 29-30, 1964. B. S. F. W.

159. Scott Creek, near U. S. Hy. 194 bridge, Jackson Co., N. C., Oct. 1969. T. V. A.

160. Greens Creek, just above first bridge on State secondary rd. 1370, Jackson Co., N. C., Oct. 1969. T. V. A.

161. Cullowhee Creek, just above first bridge past Tilley Creek, Jackson Co., N. C., Oct. 1969. T. V. A.

162. Mull Creek, just below second bridge on State secondary rd. 1737, Jackson Co., N. C., Oct. 1969. T. V. A.

163. Rough Butt Creek, about two hundred yards below Wet Camp Gap Road crossing, Jackson Co., N. C., Oct. 1969. T. V. A.

164. Mill Creek, just above first bridge on State secondary rd. 1153, Jackson Co., N. C., Oct. 1969. T. V. A.

165. Knob Creek, just above confluence with Grassy Camp Creek, Jackson Co., N. C., Oct. 1969. T. V. A.

166. Robinson Creek, 1 mile beyond end of State secondary rd. 1128, Jackson Co., N. C., Oct. 1969. T. V. A.

167. Wolf Creek, at bridge on State secondary rd. 1757, Jackson Co., N. C., Oct. 1969. T. V. A.

168. Tanasee Creek, at bridge on State secondary rd. 1756, Jackson Co., N. C., Oct. 1969. T. V. A.

169. Burningtown Creek, just above State secondary rd. 1364, Graham Co., N. C., Oct. 1969. T. V. A.

170. Turtle Pond Creek, at first bridge on Turtle Pond Road, Macon Co., N. C., Oct. 1969. T. V. A.

171. Cullasaja River, behind island at Turtle Pond Road bridge, Macon Co., N. C., Oct. 1969. T. V. A.

172. Cartoogechaye Creek, behind Cartoogechaye Baptist Church, Macon Co., N. C., Oct. 1969. T. V. A.

173. Tessentee Creek, at confluence with Evans Creek, Macon Co., N. C., Oct. 1969. T. V. A.

174. Coweeta Creek, at U. S. Forest Service Experiment Station, Macon Co., N. C., Oct. 1969. T. V. A.

175. Betty Creek, at Patterson Gap Road bridge, Rabun Co., Ga., Oct. 1969. T. V. A.

176. Darnell Creek, .3 miles below confluence with Thomas Creek, Rabun Co., Ga., Oct. 1969. T. V. A.

177. Betty Creek, at Wolf Fork Road bridge, Rabun Co., Ga., Oct. 1969. T. V. A.

178. Cullowhee Creek, at Speedwell, Jackson Co., N. C., Oct. 2, 1972. J. Winfield, N. Helms.

179. Scott Creek, at Willets, Jackson Co., N. C., Oct. 2, 1972. J. Winfield, N. Helms.

180. Savannah Creek, at Greens Creek, Jackson Co., N. C., Oct. 2, 1972. J. Winfield, N. Helms.

181. Barker's Creek, at mouth to Tuckaseegee River, Jackson Co., N. C., Oct. 2, 1972. J. Winfield, N. Helms.

182. Little Tennessee River, at Davis Ferry, Loudon Co., Tenn., Sept. 20, 1972. J. Winfield, B. Hinson.

183. Baker Creek, at first bridge above mouth to Little Tennessee River, Blount Co., Tenn., Sept. 20, 1972. J. Winfield, B. Hinson.

184. Tellico River, at mouth of Notchy Creek, Monroe Co., Tenn., Sept. 14, 1972. Winfield, Oakberg.

185. Tellico River, at Co. rd. 2415, Monroe Co., Tenn., Sept. 14, 1972. Winfield, Oakberg.

186. Tellico River, at mouth of Ballplay Creek, Monroe Co., Tenn., Sept. 14, 1972. Winfield, Oakberg.

187. Tellico River, first bridge downstream from Co. rd. 2415, Monroe Co., Tenn., Sept. 14, 1972. Winfield, Oakberg.

188. Little Tennessee River, Little Four-Mile Creek, .1 mile south of Pumpkin Center, along U. S. Hy. 129, Monroe Co., Tenn., Dec. 5, 1975. Starnes.

189. Tributary to Four-Mile Creek, 1.3 miles south of Wellsville, Blount Co., Tenn., Dec. 6, 1975. Starnes.

190. Little Tennessee River, at Tollivar Island, Loudon Co., Tenn., May 8, 1975. Starnes.

191. Little Tennessee River, at Coytee Springs, Loudon Co., Tenn., April 23, 1975. Starnes.

192. Little Tennessee River, at Coytee Springs, Loudon Co., Tenn., Oct. 31, 1975. Starnes.

193. Little Tennessee River, at Coytee Springs, Loudon Co., Tenn., May 20, 1975. Starnes.

194. Little Tennessee River, at Coytee Springs, Loudon Co., Tenn., Aug. 2, 1975. Starnes.

195. Little Tennessee River, at Tollivar Island, Loudon Co., Tenn., Dec. 19, 1975. Starnes.

196. Little Tennessee River, at Rose Island, channel on south side of island, just above bridge into nursery, Sept. 30, 1974. Etnier.

197. Little Tennessee River, east side of Davis Island, river mile 14.8, Loudon Co., Tenn., Oct. 4, 1974. Etnier.

198. Little Tennessee River, at Coytee Springs, river mile 7, Loudon Co., Tenn., Oct. 4, 1974. Etnier.

199. Little Tennessee River, at Chilhowee Shoal, about 1 mile below Holt's Landing, Blount Co., Tenn., Sept. 30, 1974. T. V. A., Tenn. G. and F., U. T. Zoology.

200. Little Tennessee River, main channel side of Davis Island, about 3 river miles below U. S. Hy. 411, Loudon Co., Tenn., Oct. 4, 1974. T. V. A., Tenn. G. and F., U. T. Zoology.

201. Little Tennessee River, station one, south side of island about 1/4 mile below "Hoss" Holt's place, Blount Co., Tenn., Sept. 30, 1974. T. V. A., Tenn. G. and F., U. T. Zoology, Etnier.

202. Little Tennessee River, at Coytee Springs, about 7 river miles from mouth, Loudon Co., Tenn., Aug. 16, 1973. Etnier, Boronow, Corson, Clayton, Ingram, McDaniel, Richardson, Scott, Timmons, Waters. Low water.

203. Abrams Creek, at mouth of Bell Branch, Blount Co., Tenn., Aug. 9, 1971. Dickinson, Starnes, Winfield, Stiles, Etnier.

204. Little Tennessee River, at Coytee Springs, 1/4 mile below campground, Loudon Co., Tenn., Aug. 16, 1973. Etnier, Boronow, Corson, Clayton, Ingram, McDaniel, Richardson, Scott, Timmons, Waters. Low water.

205. Tellico River, just above new bridge, Monroe Co., Tenn., Sept. 30, 1973. Clark, Hughes, Dickinson, Etnier.

206. Little Tennessee River, at mile 18, Macon Co., Tenn., Sept. 30, 1964. Boles.

207. Little Tennessee River, at mile 23, Macon Co., Tenn., Sept. 30, 1964. Boles.

208. Little Tennessee River, at route 28 bridge, 1/4 mile south of Lotta, Macon Co., N. C., Nov. 6, 1975. Saylor, Eager, Hickman.

209. Tuckaseegee River, at Ferguson Field, Bryson City, Swain Co., N. C., Nov. 2, 1975. T. V. A.

210. Tuckaseegee River, below mouth of Caney Creek, Jackson Co., N. C., Nov. 2, 1975. T. V. A.

211. Tuckaseegee River, Dick's Creek, below Dillsboro, Jackson Co., N. C., Nov. 2, 1975. T. V. A.

212. Tuckaseegee River, below mouth of Caney Creek, Jackson Co., N. C., Nov. 2, 1975. T. V. A.

VITA

James McKee Winfield, Jr. was born in Charlotte, North Carolina on April 14, 1947. He attended elementary school in Charlotte and graduated from East Mecklenburg High School in June of 1965. In September of that year he enrolled at Furman University. He attended Furman for one year. Enrolling in the University of Tennessee at Knoxville in the summer of 1968, he graduated in the summer of 1970. In the fall of 1970 he entered graduate school at the University of Tennessee. In the spring of 1973 he left U. T. and for the next three years he was employed as a farm hand, surveyor and juvenile runaway specialist. He returned to U. T. in the fall of 1976.