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The fishes of the Conasauga River in Tennessee

Robert Allen Stiles

To the Graduate Council:

I am submitting herewith a thesis written by Robert Allen Stiles entitled "The fishes of the Conasauga River in Tennessee." 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 Zoology.

David A. Etnier, Major Professor

We have read this thesis and recommend its acceptance:

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

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

May 20, 1968

To the Graduate Council:

I am submitting herewith a thesis written by Robert Allen Stiles entitled "The Fishes of the Conasauga River in Tennessee." I recommend that it be accepted for fifteen quarter hours credit in partial fulfillment of the requirements for the degree Master of Science, with a major in Zoology.

David A. Etnier
Major Professor

We have read this thesis and recommend its acceptance:

Accepted for the Council:

Hilton A. Smith
Vice President for
Graduate Studies and Research

THE FISHES OF THE CONASAUGA RIVER IN TENNESSEE

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

Robert Allen Stiles

June 1968

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Finally I must express my indebtedness to my wife, Linda, for her assistance and encouragement during the preparation of this thesis.

ABSTRACT

This thesis reports the results of a survey of the fishes of the Tennessee portion of the Conasauga River. This river is unique in that it is the only part of the Alabama River drainage to flow through Tennessee.

The survey was carried out between the autumn of 1965 and the spring of 1968. Collecting was done with fifteen-foot minnow seines and a sixty-foot bag seine.

This thesis contains descriptions and ecological notes on the fishes taken during the survey. Because of the survey, nineteen species are added to the list of fishes occuring in Tennessee.

The evidence for and against a past connection or major stream piracy between the Alabama and Tennessee River systems is examined. It is concluded that the dissimilarity between the ichthyofauna of the two systems argues for a long history of mutual isolation except for the minor capture of headwater streams. It is pointed out that further research into this question needs to be carried out by zoologists and geologists.

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CHAPTER I

INTRODUCTION

The major purpose of this paper is to report the results of a survey of the smaller fishes of the Conasauga River in Tennessee.

The Conasauga River is unique among Tennessee waters in that it is the only stream in the state that is not part of the vast Mississippi River drainage. Instead, the Conasauga is the northernmost stream in the Alabama River portion of the Mobile Bay drainage. It was felt that this river might contain fish not reported before from the state. A survey was conducted between the autumn of 1965 and the spring of 1968. This report includes the fishes collected in that survey with descriptions of the more interesting species.

I. THE RIVER

The Conasauga River arises in the mountains of northern Georgia. It has its beginnings in the streams draining the northern slopes of Cohutta Mountain in Murray and Fannin Counties, Georgia. Cohutta Mountain rises to an elevation of approximately 3,500 feet above mean sea level. From its beginning the river flows north for about ten miles, entering the state of Tennessee in Polk County approximately four and three-fourths miles east of Tennga, Georgia.

As it crosses the Tennessee-Georgia state line at an elevation of 956 feet, the Conasauga River joins with another river, the Jacks, which also arises in Northern Georgia. The Jacks River has its

headwaters in the mountains to the east of Cohutta Mountain and flows to the northwest to its confluence with the Conasauga.

On entering Tennessee, the Conasauga River curves to the west, dipping back into Georgia about one and three-fourths miles west of its entrance into Tennessee. It then re-enters Tennessee and continues in a generally westward direction, finally bending sharply to the south and entering Georgia for the last time at a point about seven miles to the west of where it first entered Tennessee.

The Conasauga River continues southward through Georgia until it joins with the Coosawattee River near the town of Calhoun. The river formed by the junction of the Conasauga and Coosawattee Rivers is the Oostanaula which continues southward, joining the Etowah near Rome, Georgia, to become the Coosa River. The Coosa and the Tallapoosa Rivers form the Alabama River which flows into the Gulf of Mexico by way of Mobile Bay.

At the point where the Jacks and Conasauga Rivers enter Tennessee and join together, both can be characterized as swift, cold, mountain streams. At their confluence, the Jacks River is approximately fifty feet wide and the Conasauga River a little smaller. The stream varies from riffles two or three feet deep to pools six feet deep. The water is clear, cold and rather swift. The stream bottom is largely rough and rocky.

For three or four miles after its confluence with the Jacks River, the Conasauga River continues to drop rather abruptly from an elevation of approximately 956 feet to an elevation of approximately 800 feet.

This stretch is characterized by rapids, deep pools and bed rock riffles. Once it reaches the 800 foot level the stream begins to broaden. The remaining six miles of stream within Tennessee are characterized by pools six to ten feet deep, shallow gravel bottom stretches, and riffles. At the point where the Conasauga River leaves Tennessee for the last time, it is approximately 100 feet wide. The water continues to be clear, cool, and the current varies from moderate to swift. The elevation is approximately 750 feet above mean sea level at this point.

II. COLLECTING SITES AND METHODS

Thirteen collections were taken from the river from October 28, 1965, to March 3, 1968. The sites of these collections and the species and numbers of fish taken are listed in the Appendix of this paper. In addition, numerous collections were made in Georgia for comparative purposes.

Collections were taken in three major areas of the river in Tennessee. Four of the collections were taken in the upper stretch of the river. One of these collections was made at the confluence of the Jacks and Conasauga rivers. One was taken approximately one-fourth mile downstream from that point, and the third was taken from Sheads Creek, a tributary of the Jacks River. A fourth collection was made in a small mountain tributary stream of the Conasauga River.

The second group of six collections was made in an area from approximately two miles upstream to two miles downstream of the point where U. S. Highway 411 crosses the Conasauga River in Polk County,

Tennessee. Elevations here range from 800 feet at the farthest point upstream to approximately 760 feet at the farthest point downstream.

Finally, three collections were taken at the point where the Conasauga River flows from Tennessee into Georgia near the line between Bradley and Polk Counties, Tennessee.

The bulk of the collecting was done with a fifteen-foot minnow seine. A sixty-foot bag seine was also used. However, it was impossible to use the bag seine in the upper reaches of the river due to the rough and rocky nature of the bottom.

Minnow and bag seines were used because the emphasis in our collecting was on the smaller fishes inhabiting the stream. It was felt that the cyprinids, catostomids, the genera Percina and Etheostoma (Percidae), and other smaller fishes of the river were more likely to yield species that had not been reported previously from Tennessee. The larger fishes such as the larger Ictaluridae have already been reported from other waters of the state. The game species present a further problem in that many of them are introduced fishes, having been stocked in the river by the game and fish commissions of Georgia and Tennessee.

This paper lists the species collected in the survey, with descriptions of the more interesting forms. The counts and measurements used in the descriptions follow the procedures set forth by Hubbs and Lagler (1947). The scientific and common names used follow Bailey, et al. (1960), except for a few recent changes in nomenclature.

The following abbreviations are used in this paper: U. T. C. means the University of Tennessee's Conasauga Collection. U. T. denotes the University of Tennessee's Catalogue collection.

CHAPTER II

DESCRIPTIONS OF THE FISH

I. FAMILY PETROMYZONTIDAE

Least brook lamprey--Lampetra aepyptera (Abbott). Six specimens of Lampetra aepyptera were collected in Minnewauga Creek, a tributary of the Conasauga River in Polk County, Tennessee.

Lampetra aepyptera can be distinguished from Entosphenus lamottei (Le Sueur) which occurs in the other drainages of Tennessee on the basis of the number of myomeres between the most posterior gill cleft and the anus. L. lamottei has over sixty while L. aepyptera has less than sixty.

II. FAMILY CATOSTOMIDAE

Alabama hogsucker--Hypentelium etowanum (Jordan). H. etowanum is the most prevalent catostomid in the river and one of the most prevalent fish in the river. It is found throughout the Conasauga drainage in Tennessee, being abundant not only in the main streams, but in the tributary streams as well.

H. etowanum is very similar to the other hogsucker in Tennessee, H. nigricans. Moore (1968) mentions some differences in coloration; but they have not proved very useful for the fishes collected in Tennessee.

The major difference between the two species appears to be the

number of dorsal fin rays. H. etowanum usually possesses ten rays in the dorsal fin, while H. nigricans has eleven.

Dr. John S. Ramsey (Cooperative Fishery Unit, Auburn University, personal communication, 1968) also notes a difference in the interorbital region. He says:

> In nigricans of all but the smallest size, there is a raised supraorbital rim, and the interorbital region generally is concave. In etowanum, the supraorbital rim is not elevated much except in the very largest specimens, and the interorbital area is flat or slightly convex.

Redhorses--Genus Moxostoma. Two species of Moxostoma have been collected from the stream. They are the black redhorse [Moxostoma duqeusni (Le Sueur)] and the golden redhorse [Moxostoma erythrurum Rafinesque)]. Only one specimen of each was taken. A single adult M. duquesnei was taken in U. T. C. collection one and a young M. erythrurum was taken in U. T. C. collection ten. Both the collecting sites are in the lower reaches of the stream in Tennessee. Collecting done in this survey was restricted to the shallower pools and riffles. Redhorses are generally inhabitants of the deeper pools, therefore their abundance in our samples is probably not a true indication of their abundance in the stream.

For descriptions of the two species collected one may refer to Moore (1968), Eddy (1957), and Robins and Raney (1956).

III. FAMILY CYPRINIDAE

Stoneroller--Campostoma anomalum (Rafinesque). The stoneroller is one of the most common cyprinids in the stream. It is found in the

entire portion of the river in Tennessee. For descriptions of this fish and discussions of its geographical variations see Ross (1952).

Blacknose dace--Rhinichthys atratulus (Hermann). Two specimens of this species were collected in a small tributary stream of the drainage in Tennessee. Occasional specimens may wander into the main stream. This species was not collected from headwater streams of the drainage in Georgia but it is probably present in some of them.

Riffle minnow--Phenacobius catostomus Jordan. Two specimens of this species have been taken in the Conasauga in Tennessee. One adult was taken in U. T. C. collection one and the other, a juvenile, was taken in U. T. C. collection four.

P. catostomus was previously reported from some of the headwater streams of the Tennessee River System. Minckley and Craddock (1962) have noted that it was recorded:

> . . . by Hubbs (1939) and by Lennon (1960) in mimeographed lists of the fishes of the Tennessee River System and of Great Smokey Mountains National Park respectively, by Lennon and Parker (1957) and others in their statements of the range of P. catostomus that included the Tennessee River system.

Minckley and Craddock (1962), however, have shown that specimens which were reported from the Tennessee River System as P. catostomus represented a new species which they described as P. crassilabrum. Thus, the above mentioned two specimens appear to be the only two specimens of P. catostomus collected from the waters of the state.

P. catostomus is readily distinguished from P. uranops, the most abundant Phenacobius in East Tennessee, on the basis of coloration and number of scales in the lateral line.

P. catostomus has a broader lateral band than does P. uranops and tends to have a broader caudal spot. Both species have a wide light band above the dark lateral band and then a dark dorsal area. However, the dorsal area in P. catostomus is usually darker than that of P. uranops.

P. catostomus also averages more scales in the lateral line. Specimens of P. uranops housed in the University of Tennessee collection do not usually have more than 55 or 56 scales in the lateral line. The two P. catostomus have more than 60 scales in the lateral line. Minckley and Craddock (1962) found a range 59-69 scales in the lateral line for P. catostomus with a mean of 63.8. They found a range of 52-61 scales in the lateral line for P. uranops with a mean of 55.4. P. crassilabrum averaged between the two but closer to P. catostomus. The range for P. crassilabrum was 56-68 with a mean of 60.1.

Minckley and Craddock (1962) point out differences in the color patterns of P. catostomus and P. crassilabrum. They assert that:

> The color pattern of P. catostomus is strikingly different from that of P. crassilabrum in that it is basically black and silvery, rather than brown. The dorsolateral area is separated into two regions, one light band above a silvery lateral band, and a darker region that covers the upper fourth of the body. This is often so intense that the mid-dorsal stripe is totally masked. The scale pockets of the light dorsolateral area in P. catostomus are blackened on their margins, having the appearance of longitudinal dark lines that are separated by the alignment of the relatively unpigmented centers of the pockets. The faintly serrate margins of the lateral band, which result from pigments extending along the myosepta in crassilabrum, are absent in P. catostomus. (p. 373).

Creek chub--Semotilus atromaculatus (Mitchill). This very widespread and well known fish is perhaps the most abundant cyprinid in the

small mountain brooks and tributary streams of the Conasauga in Georgia and Tennessee. It may occur accidentally in the main stream.

Silverstripe shiner--Notropis stilbius (Jordan). This large and striking shiner is moderately abundant in the lower stretches of the Conasauga. An inhabitant of deeper and quieter water, it was not found in the upper stretches of the river.

N. stilbius is unique among the Notropis of the river in having a variable pharyngeal tooth count. Several keys such as Eddy (1957) follow Jordan and Everman (1896) in listing the dentition of this species as 2, 4-4, 1; however, the majority of these specimens show a dentition of 2, 4-4, 2. Many do have a tooth count of 1, 4-4, 2 or 2, 4-4, 1 and some have a count of 1, 4-4, 1. However, as noted by Etnier (unpublished manuscript, 1967), most of the specimens have two teeth in the outer row of at least one arch. (One aberrant specimen possessed a dentition of 2, 4-4, 3).

The anal fin ray count is ten to eleven. The diameter of the eye is longer than snout length and the mouth is large and decidedly oblique.

In coloration, N. stilbius possesses a well defined caudal spot which is continuous anteriad with a dark lateral band. Anterior to the dorsal fin, the lateral band remains dark along the lateral myotome separation but becomes diffuse ventral to this. In the anterior portion of the body where the lateral line is most ventrally curved there is a separation between the ventral edge of the lateral band and the lateral line. This space is crossed by some melanophores edging the scales of the region, giving a serrated effect to the anterior, ventral border of

the lateral band. The pored scales of the lateral line are distinctly edged by melanophores. There is a narrow, pale stripe bordering the dorsal edge of the lateral band. Laterally and dorsally the scale margins are outlined with melanophores. A narrow predorsal streak is present. This continues through the base of the dorsal fin to become a post dorsal streak which ends at the anterior dorsal insertion of the caudal fin.

In life this fish well mirrors its common name of silverstriped shiner, for its lateral band and sides are a brilliant silver.

Mountain shiner--Notropis lirus (Jordan). Only two specimens of this small and slender Notropis have been taken in this survey.

N. lirus has a 2, 4-4, 2 pharyngeal tooth count and shows ten to eleven anal fin rays. According to Eddy (1957), maximum length for this species is two and one-fourth inches.

The two specimens from the Conasauga River show a narrow and rather poorly defined caudal spot. Specimens from the Little River of the Tennessee drainage (U. T. 44.18) show a more well defined caudal spot. Specimens from elsewhere in the Tennessee drainage (U. T. 44.94 and U. T. 121.44) show little if any indication of a caudal spot.

The caudal spot is continuous with a dark lateral band. This lateral band is confined anteriorly between the lateral myotome separation and the lateral line. The pored scales of the lateral line are not outlined with melanophores. One of the diagnostic features of this fish is the fact that the lateral band continues anteriorly through the eye and onto the snout.

N. lirus shows its close relationship with N. ardens (Cope) and N. umbratilis (Girard) in having a concentration of melanophores around the anterior base of the dorsal fin. However, unlike N. ardens and N. umbratilis, this concentration of pigment does not usually form a spot on the anterior portion of the dorsal fin itself.

Coosa shiner--Notropis xaenocephalus (Jordan). One of the more common Notropis in the Conasauga River, this species is found throughout the drainage in Tennessee.

It has a dentition of 2, 4-4, 2 and an anal fin ray count of seven. Occasional specimens may show eight anal fin rays.

The rays of the dorsal and caudal fins are lightly outlined with melanophores, but the anal fin is almost clear. Suttkus and Raney (1955) note a narrow dark border on the last anal ray but in most of our specimens the last anal ray has only a few scattered melanophores. There are usually a few scattered melanophores on the other rays of the anal fin. The base of the anal fin is surrounded by melanophores which extend posteriorly as a postanal stripe.

There is a prominent, rounded caudal spot which is continuous with a dark lateral band. The former is set off by being somewhat darker in intensity than the latter. The lateral band becomes diffuse anterior to the middle of the dorsal fin.

The anterior portion of the lateral line is outlined by melanophores. Below the anterior lateral line for a distance of about one scale row there are melanophores which form lines or chevrons. These lines are found in the center of the scales instead of outlining their

margins, a condition unique among the Notropis taken in this survey.

Dorsal to the lateral band is a pale stripe which widens posteriad. A narrow predorsal stripe is present which is widest just posterior to the nape and just anterior to the dorsal fin. The widening of the stripe at the anterior insertion of the dorsal fin forms a rather conspicuous spot at this point. In some specimens there may be a very faint postdorsal stripe.

Rainbow shiner--Notropis chrosomus (Jordan). This small and colorful shiner is apparently a rare species in the Tennessee portion of the stream. Two specimens were taken in U. T. C. collection four.

N. chrosomus has a pharyngeal tooth count of 2, 4-4, 2, and eight anal fin rays. The fish has a dark lateral band which lessens in intensity anteriad. Both the ventral and the dorsal margins of the band are well differentiated throughout. The band widens on the posterior half of the caudal peduncle to form a narrow caudal spot. A conspicuous dark bar runs along the shoulder from the lateral band to the pectoral fin base. Dorsal to the lateral band there is a wide, pale stripe which extends from the base of the caudal fin anteriad across the dorsal part of the operculum to the posterior dorsal edge of the orbit. The well defined dark edges of the scales dorsal to this pale stripe do not cross it.

In life the pink or red color of this pale stripe readily distinguishes this shiner from any other in the drainage. A faint predorsal streak exists, but the postdorsal streak is absent. There is a concentration of dark pigment which borders the anterior two thirds of the

base of the dorsal fin. Males in life, may show red bars on the anal, dorsal and caudal fin.

Burrhead shiner--Notropis asperifrons Suttkus and Raney. Only four specimens of this fish have been taken in the Tennessee portion of the Conasauga. These were taken in Minnewauga Creek, a tributary of the river at an elevation of 800 feet. The stream at the point where these specimens were taken was approximately fifteen feet wide and four feet deep. It formed a clear pool with a sandy bottom. N. asperifrons seems to inhabit small clear streams with a rubble, bed rock, or sand bottom and is probably limited to tributary streams in the Tennessee portion of the river.

Suttkus and Raney (1955) report that N. asperifrons has a quite variable pharyngeal tooth count. However the basic count, as in N. xaenocephalus and N. chrosomus is 2, 4-4, 2.

N. asperifrons is readily distinguishable from N. xaenocephalus on the basis of body shape and the lack of a predorsal streak. N. asperifrons is a more elongate fish than N. xaenocephalus. N. xaenocephalus has, as previously mentioned, a well defined predorsal streak. N. asperifrons on the other hand shows generally no predorsal streak though there may be the slightest trace of one in some specimens. N. asperifrons also lacks a postdorsal streak but there may be a slight concentration of pigment on the back forming a small spot at the base of the last two or three dorsal fin rays.

N. chrosomus, like N. xaenocephalus, has a predorsal streak and is a heavier bodied shiner than N. asperifrons. N. chrosomus can further

be distinguished from N. asperifrons by the number of anal fin rays. N. asperifrons, like N. xaenocephalus, usually has seven anal fin rays while N. chrosomus usually possesses eight.

Blacktail shiner--Notropis venustus (Girard). This is the largest Notropis in the river, reaching a length of five to six inches according to Eddy (1957). Abundant in the larger pools in the lower stretch of the river in Tennessee, it does not appear to be present in the higher elevations.

Eddy (1957), following Jordan and Everman (1896), gives the dentition as 4-4. However, all specimens collected from the Conasauga show a pharyngeal tooth count of 1, 4-4, 1. Actually Jordan called this a separate species, Notropis stignaturis Jordan (Jordan and Everman, 1896) and listed the dentition of N. stignaturis as 1, 4-4, 1.

This species is marked by a very large, conspicuous, jet black caudal spot which is wider than the diameter of the eye. Pigment from this spot extends for a short distance onto the middle five or six rays of the caudal fin. This caudal spot is connected anteriad with a lateral band, which is very narrow just anterior to the caudal spot, widens slightly over the anal fin base, and then narrows again. It fades completely anterior to the dorsal fin.

Breeding males sometimes have a concentration of pigment on the side just anterior to the lateral band which forms a large, ovoid lateral blotch.

There is no light stripe dorsal to the lateral band and the scales both above and below the lateral myotome separation are strongly outlined with melanophores.

The dorsal fin rays are outlined with pigment which tends to form a diffuse spot on the posterior portion of the fin. In some specimens the dorsal fin membranes are a pale, milky white at their base.

The caudal fin rays are also outlined with melanophores while the anal, pelvic, and pectoral fins are a pale white. All the fins tend to be clear at their tips.

Breeding males show a profusion of fine nuptial tubercles on the mandible, premaxillary, snout, occiput, and posteriad on the nape to the anterior base of the dorsal fin.

Alabama shiner--Notropis callistius (Jordan). One of the larger and more prevalent Notropis in the stream, it has a pharyngeal tooth count of 1, 4-4, 1, and eight anal fin rays.

Like N. venustus, N. callistius shows a large quadrate caudal spot which is larger than the eye. It differs from N. venustus in that the caudal spot of N. callistius does not extend onto the rays of the caudal fin.

The fish has a faint, dusky lateral band which is very diffuse and may be completely obliterated in breeding males. The lateral band and caudal spot are almost disconnected, being joined across the narrow part of the caudal peduncle by only a thin dark line along the lateral myotome separation.

Dorsal to the lateral band, juveniles and older females may show a rather narrow, pale stripe that is crossed by the dark scale margins. This too, may be obscured in breeding males.

The fish has a broad predorsal stripe which continues through

the dorsal fin to form a postdorsal stripe which terminates midway on the caudal peduncle.

The dorsal fin rays are outlined with melanophores except for the tip of the fin which is white. In breeding males the membranes between the fin rays are heavily pigmented, forming a wide, dark streak between the white tip and a light area at the base of the fin. The rays of the caudal fin are outlined with melanophores and both caudal and dorsal fins show a reddish color in life. The pelvic, pectoral, and anal fins are a milky white with some fin rays being outlined by pigment.

N. callistus has a rather fleshy snout which slightly overhangs a horizontal mouth.

Breeding males bear four distinct rows of large nuptial tubercles on the snout, head, and nape. One of the rows may continue on the mid-dorsal line posteriorly as far as the anterior insertion of the dorsal fin.

Tricolor shiner--Notropis trichroistius (Jordan and Gilbert). This is the most prevalent Notropis in the Tennessee portion of the Conasauga River.

N. trichroistius is readily distinguished from its most closely allied species in the stream, N. callistius and N. caeruleus, on the basis of the number of scales anterior to the dorsal fin base, number of anal fin rays, and coloration. Both N. callistius and N. caeruleus have eight (occasionally nine) anal fin rays. N. trichroistius has nine. N. trichroistius also has sixteen to nineteen scale rows anterior to the dorsal fin base; N. callistius and N. caeruleus seldom show more than fifteen.

N. trichroistius shows a conspicuous caudal spot that is seldom as wide as the diameter of the eye. Anteriad the caudal spot is continuous with a dark lateral band. The lateral band is narrow just anterior to the caudal spot, widens until it reaches a point even with the origin of the dorsal fin, and then narrows rapidly to become a thin line of pigment along the lateral myotome separation anterior to the dorsal fin insertion.

Dorsal to the lateral band there is a pale, light stripe which is crossed by the dark margins of the scales.

The dorsal fin bears a dusky band on its basal portion. This band is widest at the anterior edge of the fin and narrows as it proceeds porteriorly. The posterior rays of the dorsal fin also bear a concentration of dark pigment along their length which forms a black blotch.

The caudal fin rays are outlined with melanophores and in life the caudal and dorsal fins bear a reddish color. The pectoral, pelvic, and anal fins are a milky white. A distinguishing characteristic of this fish is that in some live and most freshly preserved specimens the pelvic, pectoral, and anal fins bear a stripe on the anterior edge of the fin which may vary in color from reddish orange to yellow.

Blue shiner--Notropis caeruleus (Jordan). Perhaps the most handsome cyprinid in the stream, this shiner is found in moderate numbers throughout the river in Tennessee.

As has been mentioned previously, N. caeruleus has eight anal fin rays and fifteen or less scale rows anterior to the dorsal fin. The dentition is 1, 4-4, 1.

The fish has a narrow caudal spot which is continuous with a dark lateral band. Both are almost the same intensity. The band is almost the same width throughout but narrows slightly from the midpoint of the dorsal fin anteriad and continues across the operculum to the tip of the snout and mandible. Above the lateral band is a pale stripe which also continues onto the snout.

The dorsal and caudal fin rays are outlined with melanophores. While the posterior rays of the dorsal fin of some specimens may show a slight intensification of pigment, the dorsal blotch is very indistinct.

The anal, pectoral, and pelvic fins are white in preserved specimens. Etnier (1957, unpublished manuscript) notes that in fresh specimens the anal and pelvic fins tend to be a pale yellow color. Breeding males show fine nuptial tubercles on the head, snout, and around the curve of the upper jaw.

Notropis chrysocephalus (Rafinesque). This common and widespread fish is found in small numbers in some of the quieter waters and tributaries in the lower part of the drainage in Tennessee. For a detailed discussion of N. chrysocephalus and the closely related N. cornutus, see Gilbert (1961).

IV. FAMILY ICTALURIDAE

Speckled madtom--Noturus leptacanthus Jordan. N. leptacanthus is a slender madtom with a small, narrow head. Eddy (1957) distinguishes it from all other members of the genus except N. gyrinus by the fact that the posterior edge of the pectoral spine in these two species is not barbed.

The fish is a rather mottled yellowish brown. There is a great deal of bluish black on the head and dorsal regions of the body. The posterior part of the body may bear bluish black specks. The ventral surface anterior to the pelvic fins is white, flecked with brown spots. The fins are a mottled, yellowish brown with white tips. This coloration distinguishes N. leptacanthus from N. gyrinus which is a rather uniform brown or gray fish. N. gyrinus is also a more robust bodied madtom. Five of these fish were taken in one collection (U. T. C. one). This may not give a true indication of their abundance in the stream.

V. FAMILY CYPRINODONTIDAE

Southern studfish--Fundulus stellifer (Jordan). This fish is abundant in small, quiet backwaters out of the main channel of the river in its lower reaches.

Specimens were taken in clear, shallow water less than three feet deep, over sandy bottoms. At the site of U. T. C. collection five fairly large concentrations of the fish were observed at the edge of weed beds in shallow water.

In life, F. stillifer shows a bluish coloration above, with silvery white below.

The fish superficially resembles the allied species, F. catenatus, of the Tennessee and Cumberland watersheds. Closer examination reveals several differences in coloration. Like F. catenatus, F. stillifer bears small dots or spots along its side which are brown in preserved specimens. In F. catenatus these dots form lines which run

longitudinally along the dorsal and lateral areas of the body. In F. stillifer the dots are scattered over the back and sides but do not form rows or lines. Males of both species may have the caudal fin edged with a black band. In F. stillifer the dorsal fin may also be so edged.

VI. FAMILY POECILIIDAE

Mosquitofish--Gambusia affinis (Baird and Girard). This common and widespread fish is occasionally found in the main portion of the stream and is probably present in most sluggish backwaters in the survey area.

VII. FAMILY CENTRARCHIDAE

Redeye bass--Micropterus coosae Hubbs and Bailey. A larger fish of the family Centrarchidae, M. coosae is found in several other streams in the state of Tennessee because of introductions by the Tennessee Game and Fish Commission. The Conasauga is the only stream in the state in which it occurs naturally.

The fish is quite abundant throughout the entire river. M. coosae is strikingly colored. In life it is usually a dark olivacious or olive green above, streaked with blue. The throat and breast may be blue and the soft dorsal and caudal fin are red.

Along the sides are a series of lateral blotches. These are usually quadrate and have light centers. In fingerlings the anterior blotches may be obscured; however, the blotches on the caudal peduncle are usually visible.

The young of M. coosae often show a small caudal spot which usually disappears in older specimens. As Hubbs and Bailey (1940) note:

> the sub-terminal black band across the caudal lobes, so prominent in the young of the other species in the genus, is very indistinct in the young of coosae.

The scales in the ventrolateral region bear dark spots in more mature specimens and these tend to form longitudinal streaks. There are two streaks on the cheek, which run posteriorly from the anterior edge of the maxilla to the posterior edge of the cheek. The fish also shows a large, dark spot on the posterior tip of the operculum.

M. coosae is a stout fish with a robust caudal peduncle. Anglers who regularly fish the river in Tennessee have reported taking specimens up to two pounds. However, a recent world record from Georgia topped six pounds.

Spotted bass--Micropterus punctulatus (Rafinesque). This species of Micropterus has been collected from the lower stretch of the river in Tennessee.

M. punctulatus is readily distinguishable from M. coosae by general body configuration and color. M. punctulatus from the Conasauga are slim in appearance with a narrow caudal peduncle.

Like M. coosae, M. punctulatus bears a series of ovoid or quadrate blotches along the side. In M. punctulatus these blotches are usually not light in the center, as in M. coosae, and the anterior ones do not become obscured in adults. M. punctulatus also has a dark caudal spot which is quite distinct even in the adult.

In young M. punctulatus there is a well differentiated

subterminal caudal band. As noted previously this band is very indistinct in young coosae.

M. punctulatus is generally olivacious above and light colored below. As in M. coosae the scales in the ventrolateral region of the body bear dark spots which form longitudinal streaks on the body.

Hubbs and Bailey (1940) note that M. punctulatus henshalli, the subspecies of spotted bass found in the Alabama drainage, and M. coosae overlap in their range but that M. coosae appears to be more of an upland form. Our collections in the Conasauga tend to bear this out. M. punctulatus has been collected only from the lower stretch of the river where it leaves Tennessee. M. coosae, however, has been found further up the drainage in Tennessee and Georgia.

Four other very common species of Centrarchids were collected from the river. They were the longear sunfish [Lepomis megalotis (Rafinesque)], the bluegill [Lepomis macrochirus Rafinesque], the green sunfish [Lepomis cyanellus Rafinesque], and the rock bass [Ambloplites rupestris (Rafinesque)]. No attempt was made to fully sample the centrarchid population of the stream.

VIII. FAMILY PERCIDAE

Log perch--Percina caprodes (Rafinesque). This common species is found in the lower part of the stream in Tennessee but it does not appear to be very abundant. For descriptions see Moore (1968), Jordan and Evermann (1896).

Bronze darter--Percina palmaris (Bailey). The most abundant

member of this genus in the Tennessee portion of the Conasauga, P. palmaris has been collected throughout the entire study area. It is usually found behind large rocks in the deeper, faster portions of riffles.

In preservative the body coloration of this fish varies from shades of yellowish brown above to pale white or yellowish white below. Along the sides there is a series of eight to ten rectangular blotches. In large males the anterior blotches may join with the dorsal blotches. These lateral blotches are confluent along the midline of the body.

The only other darter taken in this survey with which P. palmaris might be confused is P. nigrofasciata. P. palmaris can be distinguished from P. nigrofasciata by differences in the dorsal blotches, gill membrane connection, shape of the lateral blotches, and number of scales in the lateral line.

Both P. nigrofasciata and P. palmaris have seven to nine dorsal blotches. On P. palmaris there are two blotches anterior to the spinious dorsal fin base. P. nigrofasciata has only one. P. nigrofasciata, like P. palmaris, has a series of large blotches along the sides. In P. nigrofasciata the anterior blotches are usually diamond-shaped and dorsoventrally elongated, while the posterior blotches are quadrate. In P. palmaris the anterior blotches are rectangular or quadrate. The two darters are further distinguishable by the fact that the gill membranes of P. nigrofasciata are slightly connected while in P. palmaris they are completely separated. Finally, there is some divergence between P. palmaris and P. nigrofasciata in the number of

scales in the lateral line. P. nigrofasciata from the Coosa drainage have from fifty-one to sixty-four lateral line scales with a mean of approximately fifty-eight or fifty-nine. P. palmaris has from fifty-seven to seventy-one scales in the lateral line with a mean of approximately sixty-three or sixty-four. Thus, there is overlap between the lateral line scale counts for the two species. But a series of P. nigrofasciata will, in general, show a mean number of lateral line scales below sixty while a series of P. palmaris will show a mean number above sixty.

For a more detailed description of P. palmaris see Bailey (1940) For a photograph of a large male of this species see Figure 1.

Blackbanded darter--Percina nigrofasciata (Agassiz). This fish is not as abundant as P. palmaris in the Tennessee portion of the Conasauga River but it was collected in moderate numbers throughout the study area. It appears to be more prevalent in the lower reaches of the stream in Tennessee. This is understandable since the Conasauga would represent the extreme northern limit of its range in the Alabama system.

For a comparison of P. palmaris and P. nigrofasciata see the preceding section of this paper. For a detailed description of this species and its various subspecies see Crawford (1956).

Percina frenigera Ramsey and Williams ms. This striking species is currently being described by Ramsey and Williams. Two adults and one juvenile have been taken from the Tennessee portion of the stream at the point of its confluence with the Jack's River. Eleven specimens have been collected from Minnewauga Creek, a tributary of the

FIGURE 1. Male Percina palmaris.

Conasauga in Tennessee. And one adult female was taken in Georgia approximately one mile upstream from the Tennessee line. According to Dr. John S. Ramsey (Cooperative Fishery Unit, Auburn University. personal communication, 1967) these are the only adults that have been collected outside of the Tallapoosa portion of the Alabama River System. Two juveniles have been collected from the remainder of the Alabama system.

All specimens were taken in clear water, two to three feet deep. Those taken in the Conasauga River itself were collected at the edge of the main current of the stream. Those taken in Minnewauga Creek were collected from shallow pools with a moderate current. In all cases the specimens were collected over sandy bottoms.

Dr. Ramsey (personal communication, 1968) has stated that the fish is taken in similar habitats in the Tallapoosa.

This Percina is readily distinguishable from all other members of the genus in the Alabama system on the basis of coloration. It bears a series of large, quadrate blotches on the side, which in the adult, join together to form a broad lateral band. This band, which is black in life, runs from the base of the caudal fin anteriorly across the dorsal edge of the operculum to the tip of the snout. The lateral bands are separated by the premaxillary frenum, but are joined by a band of pigment on the tip of the mandible.

Below the lateral band the body bears no melanophores except a few along the midventral line of the body. The melanophores on the fin rays tend to form three wavy lines on the caudal fin. There are two

indistinct spots at the dorsal and ventral base of the caudal fin. A middle spot is coalesced with the lateral band. As Dr. Ramsey notes, "this species is unique in Percina in having a low-dorsal count, with 10 rays modally." (personal communication, 1967).

For a photograph of this fish see Figure 2.

Greenbreast darter--Etheostoma jordani Gilbert. Etheostoma jordani, the most abundant darter in the Conasauga, is generally taken on shallow riffles in clear water.

In life the spinious dorsal, soft dorsal, and caudal fin bear a bright red stripe. These stripes turn white in preservative. On the spinious dorsal fin the red stripe is narrow at the edge of the fin. It is broader on the soft dorsal and caudal fin and is bordered at the edge of the fin by a narrow dark stripe.

In preserved specimens, the sides and back of the body are a light brown. Live fish may be dark brown, or almost black. Darkened scales on the sides tend to form small squares or dorsoventrally elongate blotches, especially along the lateral line. The humeral scales are enlarged, forming a dark humeral spot.

Eight dorsal blotches are present. The occiput, interorbital area, and snout are dark. The lower half of the cheeks, the throat, and breast tend to be blue or bluish gray, especially in fresh specimens.

Some of the scales along the body bear red or reddish orange melanophores which form red spots. These are especially prevalent on the anterior half of the body below the lateral line.

There is a dusky suborbital bar present. There is also a dark

FIGURE 2. Percina frenigera.

bar running anteriorly from midway of the cheek through the eye and onto the snout. It ends at the tip of the premaxilla. Four dark spots are located at the base of the caudal fin, the middle two being partially fused into one spot. Figure 3 is a photograph of a large male.

Coosa darter--Etheostoma coosae (Fowler). This is the second most abundant darter in the Conasauga in Tennessee. In the main stream it is usually found on shallow riffles. It is also found in tributaries to the main stream. In the smaller tributaries it may be the only darter present.

The fish is generally light tan or brown above and white below. Along its sides are five to eight "W" shaped blotches. The anterior blotches tend to break up into irregular lines. In mature males the posterior blotches may form large quadrate spots and in some cases may join with the dorsal blotches to form lines around the posterior part of the body (see Figure 4). In life the posterior blotches of mature males are a light green.

There are seven or eight well developed dorsal blotches. In mature males there is a narrow red stripe in the middle of the spinious and soft dorsal fins. The base and tips of the fin bear dark stripes.

A suborbital bar is present which tends to curve vertically and posteriorly. There is also a bar running from the anterior edge of the orbit to the tip of the snout. There is no continuation of this bar posteriorly except for a small dark spot at the ventral, posterior edge of the orbit.

In specimens from the Conasauga, the premaxillary (contrary to

FIGURE 3. Male Etheostoma jordani.

FIGURE 4. Male Etheostoma coosae.

Eddy, 1957) is protractile and the gill membranes are moderately connected.

Rock-darter--Etheostoma rupestre Gilbert and Swain. This darter is found in small numbers in the lower portion of the river. Four adults and three juveniles have been taken in Tennessee. E. rupestre is easily separated from any other Etheostoma in the Conasauga drainage by having six rather than seven or eight dorsal blotches.

Speckled darter--Etheostoma stigmaeum (Jordan). One specimen of this darter has been collected in Minnewauga Creek in the Tennessee portion of the drainage.

Etheostoma ditrema Ramsey and Suttkus. One specimen of this spring darter was taken in this survey. The specimen was collected in the outflow of a spring which drained into the main channel of the river. At the point where the fish was taken the outflow was approximately six feet wide and two feet deep. The fish was taken in aquatic vegetation, in clear water, over a silt bottom.

A lone specimen of an undescribed species of darter of the subgenus Ulocentra was collected in the Georgia portion of the Conasauga River one mile upstream from the Tennessee line. This fish may occur in very limited numbers in the Tennessee part of the stream. It resembles E. coosae but differs from the latter in having a shorter and broader suborbital bar. It also has "V" shaped blotches along its side, rather than the "W" shaped blotches found in E. coosae.

Dr. John S. Ramsey (Auburn University, personal communication, 1968) stated that the adult males of this fish possess a red band in

the anal fin, a characteristic lacking in E. coosae, and that the red band in the soft dorsal fin is much narrower than in E. coosae.

The specimen taken in this survey is currently on loan to Dr. Reeve M. Bailey of the University of Michigan, who is engaged in a revision of this subgenus.

IX. FAMILY COTTIDAE

Banded sculpin--Cottus carolinae (Gill). This widespread sculpin is quite common in the river. It is found both in the main stream and in the smaller tributaries.

CHAPTER III

CONCLUSIONS

On the basis of this survey it appears that the following species should be added to the list of fishes found in Tennessee: Hypentelium etowanum (Jordan), Phacobius catostomus Jordan, Notropis xaenocephalus (Jordan), Notropis asperifrons Suttkus and Raney, Notropis chrosomus (Jordan), Notropis stilbius (Jordan), Notropis callistius (Jordan), Notropis trichroistius (Jordan and Gilbert), Notropis caeruleus (Jordan), Noturus leptacanthus Jordan, Fundulus stellifer (Jordan), Percina nigrofasciata (Agassiz), Percina palmaris (Bailey), Percina frenigera Ramsey and Williams ms., Etheostoma jordani Gilbert, Etheostoma coosae (Fowler), Etheostoma rupestre Gilbert and Swain, Etheostoma ditrema Ramsey and Suttkus.

With either geological or zoological evidence, or a combination of the two, various authors have argued in favor of some type of past connection between the Tennessee and Alabama river systems. Hayes and Campbell (1894) advanced the theory of an Appalachian River that drained the southern Appalachian valley in the late Tertiary and occupied the sites of the upper Tennessee and Coosa Rivers. C. H. White (1904) took issue with them and, on the basis of geological evidence, argued instead that the upper Conasauga was at one time part of a complex of streams that flowed to the northwest across the area of the Cumberland Plateau. He stated that most of these streams, i.e., the

Doe-Watauga, Nolichucky, French Broad, Big and Little Pigeons, Little River, Little Tennessee, upper Tellico, Hiwassee, and Ocoee Rivers were captured by the developing Tennessee River but that the upper Conasauga River was captured by the Alabama River.

Satterfield (1961, unpublished Master's thesis, University of Georgia) notes that the northeastward barbed pattern of several streams in the Alabama system suggest capture from the Tennessee drainage. In order to buttress this thesis he cites similarities in ichthyofauna between the Alabama and Tennessee systems. For his data on the fishes of the two drainages he makes extensive use of the University of Georgia and Georgia State College fish collections plus the distribution records reported in Fowler (1945), Hubbs (1930) and Robins and Raney (1956).

The problem with Satterfield's work is that it contains several misidentifications which weaken his arguments. For example, he states:

> The large number of species of darters shared by the Tennessee and Alabama systems suggests extensive exchange of species between the system . . . (p. 28).

He lists five darters which he claims are common to the two systems. These are Etheostoma atripinne, Etheostoma simoterum, Etheostoma coosae, Percina maculata, and Percina caprodes.

On the basis of collections made not only in the Tennessee portion of the Conasauga River but in Georgia, too, it appears that E. atripinne and E. simoterum are not found in the Alabama system. Furthermore, there seem to be no confirmed records of E. coosae in the Tennessee and its presence there appears doubtful.

Satterfield also notes the presence of Hypentelium nigricans

in the Tennessee and Alabama systems. In actuality, the hogsucker of the Alabama is currently listed as a separate species, H. etowanum, and does show differences from H. nigricans of the Tennessee. In all fairness, however, it must be stated that the two are obviously closedly related and many ichthyologists, such as Dr. John S. Ramsey (Auburn University, personal communication, 1968), consider them to be subspecies.

Three other species whose distribution, Satterfield feels, indicates stream capture are Campostoma anomalum, Semotilus atromaculatus and Cottus carolinae (which he misidentifies as Cottus bairdi). Satterfield is forced to admit that the presence of S. atromaculatus in both the Alabama and the Tennessee systems may be due to only minor piracies of the smallest headwater streams. The same might be said of C. anomalum which is also found in headwater streams. It is further possible, as Satterfield admits, that fishermen using the two species for bait may have transported them from one drainage to another. C. carolinae is a very widespread species found in several river systems and its appearance in the Alabama does not seem to be predicated necessarily upon stream capture from the Tennessee.

There are various other problems with Satterfield's work but the above should indicate that the evidence for major stream piracy between the Alabama and Tennessee River systems is not as overwhelming as he would suggest.

Richards and Knapp (1964) and Suttkus and Ramsey (1967) are among those who have noted zoological evidence for a past connection or piracy between the Tennessee and Alabama systems. Richards and

Knapp (1964) point out that Percina lenticula (Richards and Knapp), an endemic species of darter from the Alabama, appears to be most closely related to Percina sciera (Swain), a Mississippi drainage fish. They have suggested that the ancestral stock of P. lenticula may have entered the Alabama by way of either stream piracy or some past connection between the Tennessee and the Alabama Rivers. But Richards and Knapp (1964) also admit that the ancestral stock of P. lenticula could have entered the Alabama system by way of eastward migration from the lower Mississippi drainage. In view of the fact that P. lenticula is a big river form, they seem to feel that this latter hypothesis is more tenable.

Suttkus and Ramsey (1967) in their description of Percina aurolineata, another endemic darter found above the fall line in the Alabama River system, note that it appears more closely related to P. sciera than to P. lenticula. Therefore they hypothesize that P. aurolineata may be derived from P. sciera stock that invaded the upper Alabama by way of a past connection with the Tennessee.

However, as in the case of P. lenticula, it is possible to argue that the ancestral stock of P. aurolineata may have entered the Alabama by way of eastward migration from the Mississippi. P. sciera is found in the Pearl and the Leaf Rivers which empty into the Gulf between the mouth of the Mississippi River and Mobile Bay. Furthermore, P. sciera has been collected from the Black Warrior and Tombigbee Rivers of the Mobile Bay system itself. It is possible that P. aurolineata evolved from P. sciera stock that migrated eastward from

the Mississippi drainage into the Alabama and became isolated above the fall line.

A comparison of the fishes taken in this survey with the fishes of the Tennessee system reveals more differences than similarities in the ichthyofauna.

When considering the fishes of the Conasauga River, there are three rather distinct groups. First are the fishes that are found in both the upper Alabama and upper Tennessee systems. Many of these are also found in the headwater streams of other river systems as well. This group includes Campostoma anomalum, Semotilus atromaculatus, Rhinchthys atratulus, and others. As has been mentioned previously these fish are often found in small tributary or headwater streams and may move from one drainage to another by way of minor stream captures.

The second group of fishes are those species that are endemic to the Alabama River system or to the Mobile Bay drainage.

Finally, there are those species which are inhabitants of large rivers and streams and may be found in more than one of the southeastern drainages. Examples of these species are Percina nigrofasciata, Percina caprodes, Notropis venustus, etc. These species would appear to move from drainage to drainage largely by eastward or westward migration along the Gulf coast.

Minckley and Craddock (1962) lend some support to the theory of an ancient connection between the Alabama and Tennessee systems. They point out that Phenacobius crassilabrum of the upper Tennessee drainage appears to stand taxonomically between P. uranops of the Tennessee

drainage and P. catostomus of the Alabama. They argue that P. crassilabrum and P. catostomus are derived from a common ancestral stock that was present in a drainage system that was ancestral to both the Alabama and Tennessee systems.

If this ancestral system did exist it is rather strange that there is such little similarity between the ichthyofauna of the Alabama and Tennessee today. Certainly the dissimilarity between the two drainages argues for a long history of mutual isolation except for minor captures of the smaller headwater streams.

It would seem that further work concerning the relationship between the two drainages needs to be undertaken both by geologists and zoologists.

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APPENDIXES

APPENDIX A

U. T. COLLECTIONS IN THE TENNESSEE PORTION OF THE CONASAUGA

U. T. C. 1, Conasauga River at U. S. Hy. 411 bridge, Polk Co., Tenn. Oct. 28, 1965. D. A. and E. Etnier, R. A. and L. W. Stiles, D. Williams.

Notropis callistius (Jordan)	4
Notropis chrysocephalus (Rafinesque)	1
Notropis xaenocephalus (Jordan)	5
Notropis trichroistius (Jordan and Gilbert)	19
Noturus leptacanthus Jordan	5
Moxostoma duquesni (Le Sueur)	1
Phenacobius catostomus Jordan	1
Campostoma anomalum (Rafinesque)	1
Percina palmaris (Bailey)	13
Etheostoma jordani Gilbert	42
Etheostoma rupestre Gilbert and Swain	2

U. T. C. 2, Conasauga River, approx. 1/2 mi. downstream from its confluence with the Jacks. Polk Co., Tenn. June 14, 1966. D. A. and E. Etnier, R. A. Stiles, C. Amos, H. Mackey.

Notropis xaenocephalus (Jordan)	16
Notropis trichroistius (Jordan and Gilbert)	24
Notropis caeruleus (Jordan)	1
Notropis callistius (Jordan)	1
Campostoma anomalum (Rafinesque)	1
Hypentelium etowanum (Jordan)	7

Cottus carolinae (Gill) 2

Micropterus coosae Hubbs and Bailey 1

Percina nigrofasciata (Agassiz) 1

Percina palmaris (Bailey) 7

U. T. C. 3. Small mountain creek draining into Conasauga River. Polk Co., Tenn. June 24, 1966. D. A. and E. Etnier, R. A. Stiles, C. Amos, H. Mackey.

Rhinichthys atratulus (Hermann) 2

Semotilus atromaculatus (Mitchell) 4

U. T. C. 4. Conasauga River approx. 2 mi. east of U. S. Hy. 411, Polk Co., Tenn. June 24, 1966. D. A. and E. Etnier, C. Amos, H. Mackey.

Notropis stilbius (Jordan) 2

Notropis chrosomus (Jordan) 2

Notropis lirus (Jordan) 2

Notropis callistius (Jordan) 34

Notropis trichroistius (Jordan and Gilbert) 63

Notropis caeruleus (Jordan) 11

Notropis xaenocephalus (Jordan) 8

Phenacobius catostomus Jordan 1

Campostoma anomalum (Rafinesque) 2

Percina caprodes (Rafinesque) 1

Percina palmaris (Bailey) 5

Percina nigrofasciata (Agassiz) 1

Fundulus stellifer (Jordan) 3

Hypentelium etowanum (Jordan) 1

U. T. C. 5. Conasauga River at Tenn. Hy. 74 bridge. Tenn.-Ga. state line. Bradley Co., Tenn. July 24, 1966. R. A. and L. W. Stiles, D. Ingram.

Notropis lirus (Jordan)	3
Notropis xaenocephalus (Jordan)	2
Notropis trichroistius (Jordan and Gilbert)	15
Notropis callistius (Jordan)	5
Campostoma anomalum (Rafinesque)	28
Hypentelium etowanum (Jordan)	5
Phenacobius catostomus Jordan	1
Micropterus coosae Hubbs and Bailey	1
Ambloplites rupestris (Rafinesque)	1
Percina palmaris (Bailey)	1
Percina nigrofasciata (Agassiz)	1
Etheostoma jordani Gilbert	20
Etheostoma coosae (Fowler)	3
Etheostoma rupestre Gilbert and Swain	2
Cottus carolinae (Gill)	7
Moxostoma sp.	4

U. T. C. 6. Conasauga River approx. 2 mi. west of U. S. Hy. 411 Polk Co., Tenn. April 15, 1967. R. A. Stiles and H. Mackey.

Notropis xaenocephalus (Jordan)	1
Notropis trichroistius (Jordan and Gilbert)	3
Notropis callistius (Jordan)	1
Notropis caeruleus (Jordan)	1

Campostoma anomalum (Rafinesque) 1

Etheostoma jordani Gilbert 1

Cottus carolinae (Gill) 7

U. T. C. 7. Conasauga River at Tenn. Hy. 74 bridge, Tenn.-Ga. state line. Bradley Co., Tenn. April 15, 1967. R. A. Stiles and H. E. Mackey.

Notropis trichroistius (Jordan and Gilbert) 24

Notropis caeruleus (Jordan) 15

Notropis callistius (Jordan) 4

Campostoma anomalum (Rafinesque) 5

Fundulus stillifer (Jordan) 12

Gambusia affinis (Baird and Girard) 1

Etheostoma jordani Gilbert 6

U. T. C. 8. Conasauga River 1 mi. east of U. S. Hy. 411 Polk Co., Tenn. June 17, 1967. R. A. and L. W. Stiles.

Notropis trichroistius (Jordan and Gilbert) 76

Notropis caeruleus (Jordan) 20

Notropis callistius (Jordan) 12

Notropis venustus (Girard) 1

Campostoma anomalum (Rafinesque) 1

Hypentelium etowanum (Jordan) 1

Etheostoma coosae (Fowler) 1

Percina nigrofasciata (Agassiz) 1

U. T. C. 9. Sheads Cr., Conasauga River Drainage, 10½ mi. west of U. S. Hy. 411 on Forest Service Rd. 221, ½ mi. south of Ocoee W. M. A. Polk Co., Tenn., June 17, 1967. R. A. and L. W. Stiles.

Notropis trichroistius (Jordan and Gilbert)	108
Notropis xaenocephalus (Jordan)	19
Hypentelium etowanum (Jordan)	1
Etheostoma coosae (Fowler)	3
Micropterus coosae Hubbs and Bailey	1

U. T. C. 10. Conasauga River at Tenn. Hy. 74 bridge, Tenn.-Ga. state line. Polk Co., Tenn. June 22, 1967. D. A. and E. Etnier, R. A. Stiles, J. Elder.

Notropis venustus (Girard)	64
Notropis stilbius (Jordan)	18
Notropis callistius (Jordan)	6
Notropis caeruleus (Jordan)	13
Notropis chrysocephalus (Rafinesque)	1
Notropis trichroistius (Jordan and Gilbert)	33
Campostoma anomalum (Rafinesque)	14
Notropis xaenocephalus (Jordan)	4
Micropterus punctulatus (Rafinesque)	3
Lepomis megalotis (Rafinesque)	1
Moxostoma erythrurum (Rafinesque)	1
Moxostoma sp.	2
Percina caprodes (Rafinesque)	1
Percina nigrofasciata (Agassiz)	3

Cottus carolinae (Gill) 1

U. T. C. 11. Jack's River at its confluence with the Conasauga. Polk Co., Tenn., Nov. 17, 1967. D. A. Etnier, R. A. Stiles, J. Mackiewicz.

Notropis trichroistius (Jordan and Gilbert) 53

Notropis xaenocephalus (Jordan) 11

Notropis callistius (Jordan) 7

Hypentelium etowanum (Jordan) 1

Percina frenigera Ramsey and Williams ms. 3

Percina palmaris (Bailey) 2

Etheostoma coosae (Fowler) 3

Etheostoma jordani Gilbert 5

Cottus carolinae (Gill) 2

U. T. C. 12. Minnewauga Cr., Conasauga Drainage. Polk Co., Tenn. Mar. 3, 1968. D. A. Etnier, R. A. Stiles, R. Bouchard, A. Gnilka.

Lampetra aepyptera (Abbott) 6

Campostoma anomalum (Rafinesque) 4

Semotilus atromaculatus (Mitchell) 2

Notropis chrosomus (Jordan) 1

Notropis stilbius (Jordan) 1

Notropis xaenocephalus (Jordan) 59

Notropis asperifrons Suttkus and Raney 4

Notropis trichroistius (Jordan and Gilbert) 420

Notropis caeruleus (Jordan) 17

Notropis callistius (Jordan) 34

Noturus leptacanthus Jordan 1

Micropterus coosae Hubbs and Bailey 1

Hypentelium etowanum (Jordan) 7

Percina frenigera Ramsey and Williams ms. 11

Percina palmaris (Bailey) 2

Percina nigrofasciata (Agassiz) 4

Etheostoma coosae (Fowler) 21

Etheostoma jordani Gilbert 4

Etheostoma stigmaeum (Jordan) 1

Cottus carolinae (Gill) 8

U. T. C. 13. Conasauga River 2 mi. west of U. S. Hy. 411 bridge Polk Co., Tenn. Mar. 3, 1968. D. A. Etnier, R. A. Stiles, R. Bouchard, A. Gnilka.

Lepomis cyanellus Rafinesque 30

Lepomis macrochirus Rafinesque 10

Notropis chrysocephalus (Rafinesque) 29

Campostoma anomalum (Rafinesque) 8

Semotilus atromaculatus (Mitchell) 2

Notropis xaenocephalus (Jordan) 15

Notropis venustus (Girard) 2

Notropis caeruleus (Jordan) 13

Notropis callistius (Jordan) 1

Fundulus stellifer (Jordan) 7

Etheostoma jordani Gilbert 17

Etheostoma rupestre Gilbert and Swain	3
Etheostoma coosae (Fowler)	20
Percina palmaris (Bailey)	1
Percina nigrofasciata (Agassiz)	1
Etheostoma ditrema Ramsey and Suttkus	1
Cottus carolinae (Gill)	1

APPENDIX B

The following map illustrates the sites of the collections taken for the survey. The numbers on the map correspond with the collections listed in Appendix A. (See page 44). For example number one on the map indicates the site of U. T. C. 1.

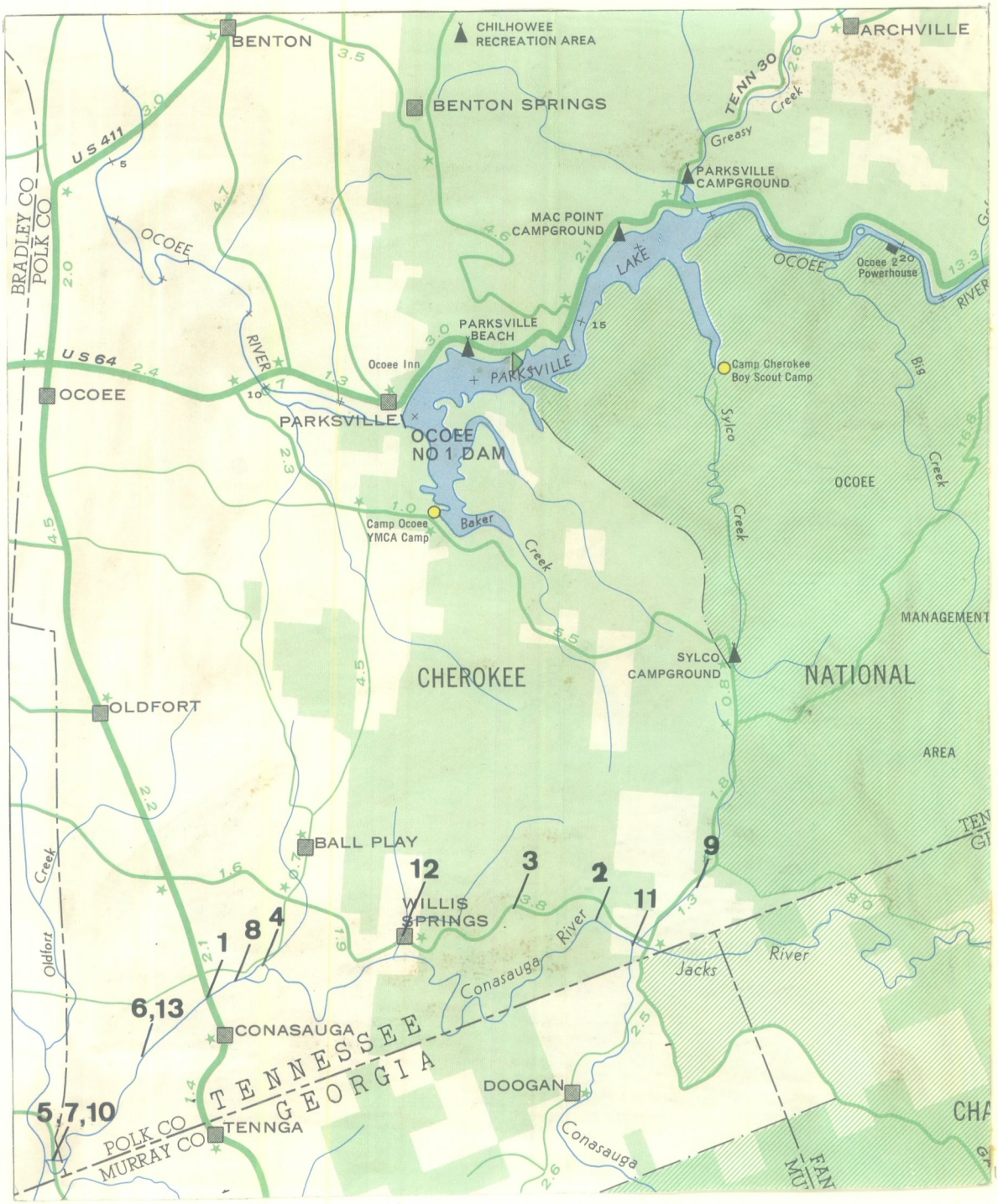

FIGURE 5. Tennessee portion of the Conasauga River.

VITA

Robert Allen Stiles was born January 9, 1935, in Maysville, Kentucky. He received his B. A. degree from Transylvania University, Lexington, Kentucky, in June, 1957. He entered Graduate School of the University of Tennessee in September, 1965. He served as a graduate assistant in the Department of Zoology for the school years 1966-67 amd 1967-68.

He is married to Linda Williams Stiles. Prior to entering this program he received a B. D. degree from the Divinity School of Venderbilt University in June, 1962, and did further graduate study in pastoral counseling at Vanderbilt University and the University of Chicago. During these graduate studies he received various scholarships including a Danforth Campus Internship and served as associate pastor or pastor of several churches.