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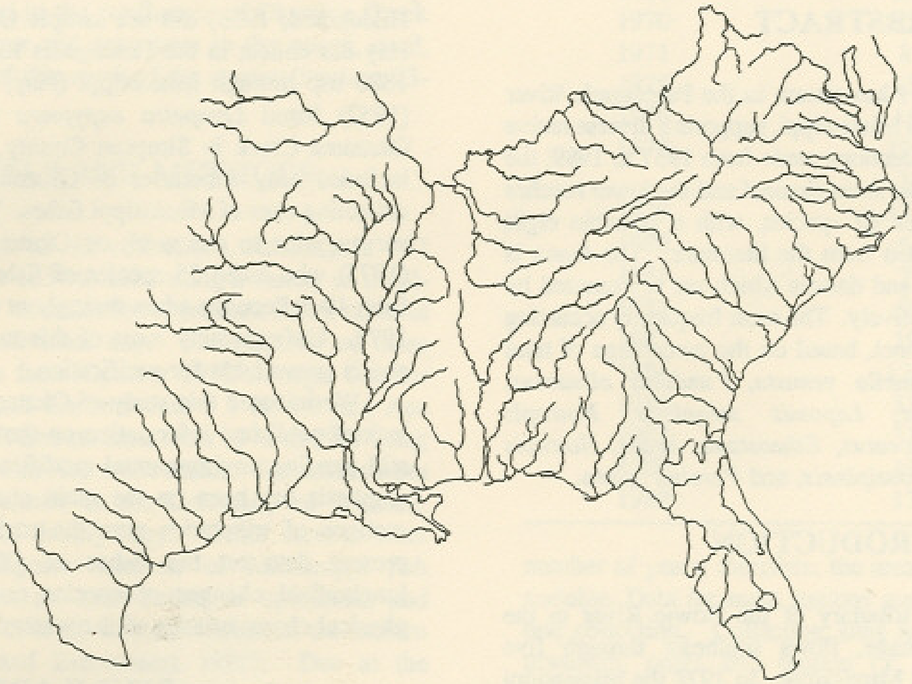

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FISHES OF OKATOMA CREEK, A FREE-FLOWING STREAM IN SOUTH-CENTRAL MISSISSIPPI

STEPHEN T. ROSS
Department of Biological Sciences
University of Southern Mississippi
Hattiesburg, MS 39406-5018

DAVID C. HEINS
Department of Ecology, Evolution, and Organismal Biology
Tulane University
New Orleans, LA 70118

JOHN W. BURRIS
Mississippi Department of Wildlife Fisheries and Parks
P.O. Box 451
Jackson, MS 39205

ABSTRACT

Okatoma Creek, a 71 km stream in the Pascagoula River Drainage of south-central Mississippi, supports a diverse native fish fauna. Based on collections made from 1937 to 1989, the known ichthyofauna of the main channel and the lower reaches of its tributaries includes 62 species, with a possible eight additional species reported from the literature. The fauna is dominated by cyprinids and darters which are represented by 16 and 13 species, respectively. The most frequently occurring species in the main channel, based on the percentage of total species lots, are *Cyprinella venusta, Fundulus olivaceus, Luxilus chrysocephalus, Lepomis megalotis, Notropis volucellus, Notropis buccatus, Etheostoma beani, Notropis longirostris, Lythrurus roseipinnis,* and *Percina sciera.*

INTRODUCTION

Okatoma Creek, a tributary of the Bowie River in the Pascagoula River Drainage, flows southeast through five counties in south-central Mississippi. In 1978 the Mississippi Heritage Conservation and Recreation Service declared Okatoma Creek to be a Class A stream suitable for inclusion under the Federal Wild and Scenic Rivers Act of 1968; however, the actual incorporation has not yet taken place.

The stream is largely unaltered throughout its length and is free from impoundments on the main channel. However, one plan (Soil Conservation Service, 1974) projects an impoundment on the upper reaches of the stream about 3.2 km north of state highway 28 east of Magee, Mississippi. This plan also includes desnagging between Seminary and Collins, Mississippi, and some channelization work (enlarging and shaping of the channel) near Magee. In addition, fourteen flood retarding devices would be built at various points throughout the drainage.

There is little published information on the fishes of the Okatoma Creek system. Early collectors in Mississippi (Hay, 1881; 1883; Evermann, 1899; Hildebrand and Towers, 1928; Hildebrand, 1933) did not sample Okatoma Creek, although Hay did collect in the Pascagoula River Drainage during his 1880 trip through Mississippi (Hay, 1881). Although Cook (1952) listed *Lampetra aepyptera* from a 'backwater' of Okatoma Creek in Simpson County, she later (Cook, 1959) included only tributaries of Okatoma Creek in her list of collecting sites of Mississippi fishes. The most comprehensive survey prior to our work on Okatoma Creek was by Teels (1975) who listed 55 species of fishes, which were obtained from 10 collections taken throughout the drainage in 1968 and 1975. Unfortunately most of this material was not archived and is unavailable for verification.

We initiated this study of Okatoma Creek because of the lack of published information on the fishes and the proposed, still pending environmental modifications to the creek. Our emphasis has been on the main channel, and on the lower sections of tributaries near the main channel. Herein we present data on the fishes of Okatoma Creek, and on longitudinal changes of species composition as related to physical characteristics of the watershed.

STUDY AREA

Okatoma Creek drains an area of 751.2 km^2 (U.S. Geological Survey, 1977) located in the Pine Hills physiographic region of the East Gulf Coastal Plain province (Cross et al., 1974). The watershed varies from 8 to 16 km in width and is about 106 km long (Rich, 1968). Okatoma Creek itself is approximately 71 km long, with numerous meanders among small rolling hills. The headwaters of Okatoma Creek are Dry Creek and Haw Branch, located in Simpson County north of Magee. Okatoma Creek ends at its confluence with Bowie Creek northwest of Hattiesburg. Average discharge (based on 25 measurements from 1980-1988) at the state highway 590 bridge near the town of Seminary was 6 m^3/s, with a minimum flow of 1.9 and a maximum of 45.6 m^3/s (USGS 1980-1988).

The stream bed near the headwaters cuts the sand and

gravel of the Plio-Pleistocene? Citronelle Formation. Southward from Collins, the eroded Miocene Catahoula sandstone forms waterfalls and hard, erosion-pocketed bottoms providing a sharp contrast to the stream bed of the upper reaches. The lower reaches are in the Miocene Hattiesburg-Pascagoula formations and have many sand and gravel riffles.

For purposes of data analysis we recognize three sections of the main channel, based on the three geologic formations through which it flows:

1) Citronelle Formation--This formation extends from the headwaters to just north of Seminary and contributes to the sand, gravel, and clay substrata of the stream bed in this area (Stations 1-13).

2) Catahoula Formation--The stream flows through the sandstone erosional features of this formation between Seminary and Sanford (Stations 14-22).

3) Hattiesburg-Pascagoula Formations--These formations extend from Sanford to the confluence of Okatoma Creek with the Bowie River and contribute to the gravel, sand, and clay substrata of this reach of the stream (Stations 23-34).

MATERIALS AND METHODS

This study is based on 95 collections, resulting in 997 species lots, made from 1937 to 1989 using a variety of small-mesh seines (Table 1). A collection represents fishes taken at a single site on an individual day. The majority of these collections were taken from October 1978 through October 1979 by DCH, JWB and students with a 3 m, 4.8 mm Ace mesh seine, and by STR and students from 1975 to 1989 using 6.1 m and 3.05 m, 3.1 mm Ace mesh seines. Specimens from these collections are stored in the University of Southern Mississippi Museum of Ichthyology. Other records were obtained from a computer database of Mississippi fish distributions built from an examination of specimens and museum records from over 30 fish collections in the eastern United States (Ross and Brenneman, 1991). Due to the potentially different methods and biases of the various collectors, data are treated qualitatively. Similarities between physiographic regions were determined by the Jaccard coefficient, which is based on presence/absence data (Ludwig and Reynolds, 1988).

Names of fishes follow Robins et al. (1991), with some exceptions. Based on studies by Simons (1991; in press), we place *Ammocrypta beani* and *A. vivax* in *Etheostoma*. In addition, we recognized the families Fundulidae, following Parenti (1981), and Elassomatidae, following Branson and Moore (1962) and Rohde and Arndt (1987).

COLLECTING LOCALITIES

Data are based on 35 general collecting stations along the main channel, and on 12 stations along the tributaries (Fig. 1). Collections were made by numerous investigators over a number of years; therefore, the area sampled per collection is variable. Data for most stations are composites of more than one collection. Collecting sites are identified generally by township, range and section (T, R, sec.), and to within approximately 200-400 m by universal transverse Mercator coordinates (North-South coordinates = utmy; East-West coordinates = utmx). Localities that were only given as township, range and section were arbitrarily placed midway along the channel for that section. Numbers after each collecting station description correspond to species as shown on Table 2.

Table 1. A chronology of fish collections in Okatoma Creek and its tributaries. Specimens are housed at the University of Southern Mississippi Museum of Ichthyology (USM) unless otherwise indicated. Museum acronyms follow Levinton et al. (1985) and Levinton and Gibbs (1988).

year	number of lots	museum
1937	1	MMNS
1947	1	MMNS
1949	7	CU
1962	17	MMNS
	1	SLU
1963	2	MMNS
1964	1	MMNS
	2	TU
1968	28	TU
1970	25	TU
1971	8	MMNS
1975	13	
1976	15	
1978	186	
	1	UM
1979	431	
1980	6	
1981	2	
1982	9	
1983	19	
1984	121	
1986	33	
1987	31	
1988	19	
1989	17	

Main Channel, Okatoma Creek

Station 1. [Haw Branch] at unnamed road 0.50-0.75 mile S state hwy. 540 about 1 mile SW Martinville (T2N, R5E, sec. 35)(utmx= 238900; utmy= 3539400). 12 species: 5, 9, 14, 16, 17, 35, 36, 39, 40, 41, 43, 47.

Station 2. [Haw Branch] at state hwy. 541 (T1N, R5E, sec. 2)(utmx= 240300; utmy= 3539000). 13 species: 4, 5, 9, 14, 17, 20, 33, 36, 40, 41, 43, 45, 47.

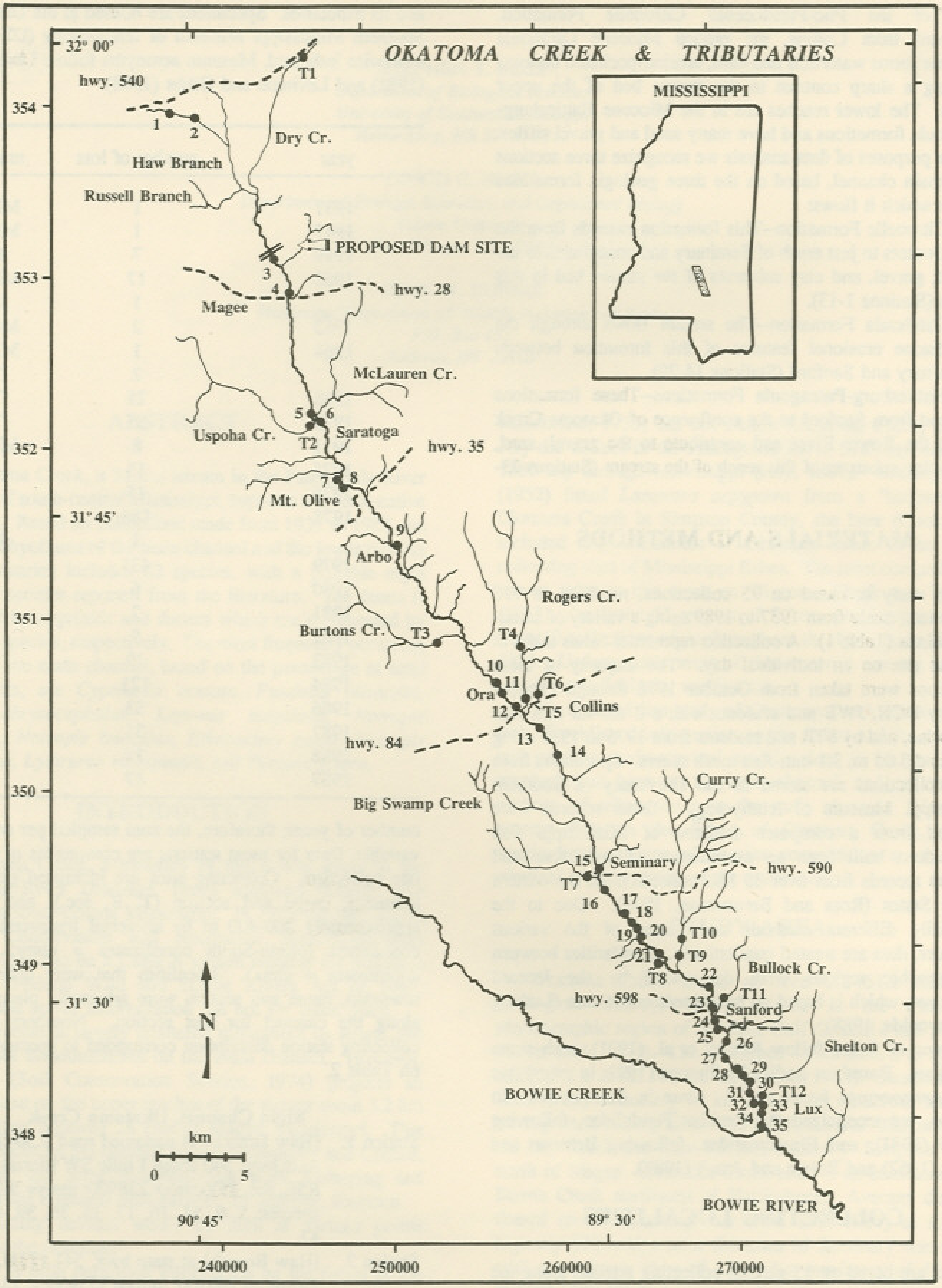

Figure 1. A map of the Okatoma Creek, Mississippi, watershed showing collecting stations. Mercator coordinates are indicated by the outward facing tick marks; latitude and longitude by the inner facing marks. Vertical Mercator coordinates are x 10,000.

Station 3. At unnamed road about 2 miles ENE of Magee (T1N, R6E, sec. 32)(utmx= 244700; utmy= 3530600). 21 species: 3, 4, 5, 8, 9, 12, 14, 15, 17, 31, 35, 36, 37, 39, 40, 41, 43, 45, 47, 56, 58.

Station 4. At state hwy. 28 bridge about 1.75 mile E of Magee (T10N, R6E, sec. 3)(utmx= 245400; utmy= 3528500). 22 species: 3, 4, 5, 14, 15, 16, 17, 27, 30, 35, 36, 37, 39, 40, 41, 43, 45, 47, 54, 56, 58, 59.

Station 5. At railroad bridge about 3/4mi. NNE of Saratoga; T10N, R17W, sec. 26)(utmx= 247000; utmy= 3521500). 16 species: 3, 4, 5, 11, 14, 15, 16, 27, 35, 43, 49, 51, 54, 56, 58, 59.

Station 6. Along E bank opposite mouth of Uspoha Creek (T10N, R17W, sec. 26) (utmx= 246800; utmy= 3521350). 13 species: 3, 4, 5, 15, 23, 32, 35, 36, 37, 43, 46, 56, 58.

Station 7. Vicinity of unnamed road about 0.5 mi N of Mount Olive (T9N, R17W, sec. 12)(utmx= 248200; utmy= 3517700). 12 species: 3, 4, 5, 12, 14, 15, 16, 35, 36, 43, 54, 56.

Station 8. At Mt. Olive (T9N, R17W, sec. 12)(utmx= 248300; utmy= 3517500). 1 species: 11.

Station 9. At unnamed road about 0.7 mile NE of Arbo (T9N, R16W, sec. 20)(utmx= 251400; utmy= 3513800). 32 species: 3, 4, 5, 11, 12, 13, 15, 16, 17, 21, 22, 26, 28, 30, 34, 35, 36, 37, 39, 41, 43, 44, 45, 46, 47, 50, 52, 54, 55, 56, 58, 59.

Station 10. At unnamed road 0.5-0.7 mi ENE of Ora (T8N, R16W, sec. 13)(utmx= 256700; utmy= 3505600). 20 species: 3, 4, 5, 8, 12, 13, 15, 16, 22, 26, 35, 36, 41, 43, 46, 50, 52, 55, 56, 58.

Station 11. 1 mi. N of Collins, just S of Ora (T8N, R16W, sec. 13)(utmx= 257000; utmy= 3505300). 12 species: 3, 13, 20, 22, 25, 30, 31, 35, 40, 43, 46, 50.

Station 12. At hwy. 84 bridge NE Collins (T8N, R15W, sec. 19)(utmx= 258000; utmy= 3503000). 28 species: 3, 4, 5, 12, 14, 15, 16, 17, 18, 22, 23, 27, 30, 32, 35, 36, 37, 38, 39, 41, 43, 45, 47, 49, 53, 55, 58, 59.

Station 13. 1 mi. S of Collins (T8N, R15W, sec. 19)(utmx= 259400; utmy= 3503000). 1 species: 4.

Station 14. At unnamed road 0.25 mi W of Kola (T8N, R15W, sec. 29)(utmx= 260300: utmy= 3501500). 16 species: 3, 5, 12, 13, 15, 21, 26, 35, 41, 43, 46, 50, 52, 55, 56, 59.

Station 15. Vicinity of state hwy. 590, W of Seminary (T7N, R15W,sec. 21) (utmx= 262400; utmy= 3494400). 13 species: 3, 4, 5, 15, 18, 21, 35, 43, 50, 52, 54, 56, 59.

Station 16. About 0.5mi. below state hwy.590, 0.4 air-miles SSW of Seminary (T7N, R15W, sec.22)(utmx= 262600; utmy= 3493400). 4 species: 1, 8, 35, 52.

Station 17. About 1.7 air-miles SSE of Seminary (T7N, R15W, sec. 27)(utmx= 263800; utmy= 3491800). 9 species: 3, 4, 27, 35, 36, 37, 39, 43, 52.

Station 18. About 2.0 air mi. SSE of Seminary (T7N, R15W, sec. 26)(utmx= 264400; utmy= 3491600). 22 species: 3, 4, 5, 7, 12, 13, 14, 15, 16, 18, 23, 26, 35, 36, 41, 43, 46, 50, 52, 54, 56, 59.

Station 19. About 2.6-2.8 air-miles SSE of Seminary; (T7N, R15W, sec. 35)(utmx= 264600 utmy= 3491000). 14 species: 3, 4, 5, 11, 12, 15, 26, 28, 35, 38, 46, 52, 58, 59.

Station 20. Above confluence of Neely Branch (T7N, R15W, sec. 35)(utmx= 264900; utmy= 3490800). 1 species: 7.

Station 21. N of Sanford at Fairchilds landing (T6N, R15W, sec. 1)(utmx= 265800; utmy= 3489600). 22 species: 3, 4, 5, 8, 11, 12, 13, 14, 15, 16, 18, 23, 28, 35, 36, 43, 50, 52, 54, 56, 58, 59.

Station 22. About 0.75 air-mile NE of Sanford (T6N, R14W, sec. 7). (utmx= 268750; utmy= 3487500). 13 species: 3, 11, 12, 13, 15, 16, 18, 39, 43, 46, 47, 50, 59.

Station 23. At state hwy. 598 about 0.8 km WNW of Sanford (T6N, R14W, secs. 17 and 18)(utmx= 268900; utmy= 3486300). 29 species: 3, 4, 5, 7, 8, 11, 12, 13, 14, 15, 16, 18, 25, 27, 28, 35, 36, 38, 39, 41, 43, 44, 45, 46, 49, 50, 56, 58, 59.

Station 24. About .54 km below hwy. 598 bridge, S of Sanford (T6N, R14W, sec. 20)(utmx= 269000; utmy= 3485800). 3 species: 52, 58, 59.

Station 25. 0.8-1.0 km below hwy. 598 bridge, S of Sanford (T6N, R14W, sec. 17)(utmx= 269100; utmy= 3485500). 17 species: 3, 4, 5, 11, 12, 13, 15, 16, 21, 35, 43, 46, 50, 52, 54, 58, 59.

Station 26. About 1.2 air-miles S of Sanford (T6N, R14W, sec. 20)(utmx= 269700 ; utmy= 3484500). 32 species: 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 16, 18, 21, 23, 26, 35, 36, 38, 39, 43, 46, 48, 50, 52, 54, 55, 56, 58, 59, 60, 62.

Station 27. 2.1 km downstream from hwy. 598 bridge (T6N, R14W, sec. 20)(utmx= 269500; utmy= 3484000). 12 species: 3, 5, 7, 12, 13, 15, 18, 43, 50, 52, 56, 58.

Station 28. About 2.2 air miles SSE of Sanford, 1.4 miles NW Lux (T6N, R14W, sec. 29)(utmx= 270400; utmy= 3482900). 18 species: 3, 4, 8, 12, 13, 15, 16, 18, 21, 35, 41, 43, 46, 47, 50, 54, 58, 59.

Station 29. About 1 mile upstream from bridge near Lux (T6N, R14W, sec. 28)(utmx= 270800; utmy= 3482500). 24 species: 3, 4, 6, 7, 11, 12, 13, 14, 15, 16, 17, 18, 21, 23, 35, 37; 41, 43, 46, 47, 50, 52, 59, 61.

Station 30. 4.4 km downstream from hwy. 598 bridge; 1.4 km upstream from bridge near Lux (T6N, R14W, sec. 28) (utmx= 270800; utmy= 3482300). 13 species: 3, 4, 5, 7, 8, 12, 13, 15, 21, 35, 39, 50, 54.

Station 31. 5.3 km downstream from hwy. 598 bridge; 0.7 km upstream from bridge near Lux (T6N, R14W, Sec. 33)(utmx= 271000; utmy= 3481500). 16 species:

3, 4, 5, 7, 8, 12, 13, 15, 16, 35, 43, 46, 47, 50, 52, 54.

Station 32. Vicinity of bridge crossing near Lux (T6N, R14W, sec. 33)(utmx= 271500; utmy= 3481000). 28 species: 3, 4, 5, 7, 8, 10, 11, 12, 13, 15, 16, 18, 21, 28, 29, 35, 36, 38, 39, 41, 43, 46, 47, 50, 52, 54, 58, 59.

Station 33. About 1 stream mile above unnamed road WSW Lux (T6N, R14W, sec. 33)(utmx= 271600; utmy= 3480800). 16 species: 3, 4, 8, 12, 13, 15, 18, 35, 38, 39, 50, 52, 54, 55, 58, 59.

Station 34. Vicinity of unnamed road about .5 mile WSW Lux (T6N, R14W, sec. 33)(utmx= 271600; utmy= 3480600). 18 species: 3, 7, 8, 12, 13, 15, 16, 17, 18, 19, 21, 26, 35, 36, 41, 43, 46, 50.

Station 35. At confluence with Bowie River (T5N, R14W, sec. 4)(utmx= 271500; utmy= 3479500). 2 species: 16, 39.

Tributaries

Station T1. Unnamed tributary to Dry Creek, 5 mi. ENE of Martinville at state hwy. 540 (T2N, R6E, sec. 21)(utmx= 266600; utmy= 3542600). 11 species: 9, 17, 24, 32, 35, 36, 39, 40, 41, 43, 47.

Station T2. Uspoha Creek, between mouth of creek and railroad crossing, 3/8mi NNE of Saratoga (T10N, R6E, sec. 26) (utmx= 246550; utmy = 3521200). 24 species: 1, 3, 4, 5, 8, 11, 12, 14, 15, 16, 20, 21, 23, 27, 28, 31, 35, 38, 43, 50, 52, 55, 56, 58.

Station T3. Burtons Creek, 3 miles N of Collins at state hwy. 49 (T8N, R16W, sec. 3)(utmx= 253500; utmy= 3508200). 5 species: 2, 21, 22, 23, 46.

Station T4. Rogers Creek, 2.9 miles N of Collins (T8N, R15W, sec. 7)(utmx= 258400; utmy= 3507800). 6 species: 1, 4, 5, 11, 35, 55.

Station T5. Rogers Creek, near Collins (T8N, R15W, sec. 18)(utmx= 258300; utmy= 3504500). 1 species: 14.

Station T6. Unnamed tributary to Okatoma Creek, 1.7 miles E of Collins (T8N, R15W, sec. 18)(utmx= 259500; utmy= 3505000). 7 species: 4, 8, 11, 35, 43, 53, 55.

Station T7. Big Swamp Creek, locality estimated at state hwy. 49 (T7N, R15W, sec. 21)(utmx= 261300; utmy= 3494700). 1 species: 50.

Station T8. Unnamed tributary to Okatoma Creek near Station 20 (T6N, R15W, sec. 1)(utmx= 265700; utmy= 3489500). 3 species: 8, 11, 52.

Station T9. Curry Creek, vicinity of railroad bridge north of Sanford (T6N, R15W, sec. 1)(utmx= 267000; utmy= 3489500). 27 species: 3, 4, 5, 7, 8, 11, 12, 13, 16, 18, 20, 21, 28, 29, 35, 36, 38, 39, 42, 46, 50, 52, 53, 54, 55, 57, 58.

Station T10. Curry Creek, off dirt road ca. 3.5 miles N Sanford (T7N, R15W, sec. 36)(utmx= 267300; utmy= 3490500). 21 species: 3, 4, 5, 8, 11, 12, 13, 16, 28, 35, 36, 39, 41, 43, 46, 47, 50, 54, 55, 56, 58.

Station T11. Bullock Creek, at railroad bridge ca. 1 mile NNE of Sanford (T6N, R14W, sec. 8)(utmx= 269400; utmy= 3487000). 7 species: 8, 11, 12, 21, 28, 35, 52.

Station T12. Shelton Creek, at mouth (T6N, R14W, sec. 33)(utmx= 271400; utmy= 3481200). 7 species: 3, 13, 39, 40, 41, 43, 44.

RESULTS AND DISCUSSION

Sixty-two species of fishes were collected from Okatoma Creek and its tributaries; 58 were taken from the main channel and 45 from the tributaries (Table 2). Teels (1975) previously reported 55 species from 10 localities in Okatoma Creek and its tributaries. We did not collect 12 of the species reported by Teels (1975), including *Dorosoma cepedianum*, *Alosa chrysochloris*, *Pimephales notatus*, *Hybognathus nuchalis*, *Ictiobus bubalus*, *Moxostoma erythrurum*, *Pylodictus olivaris*, *Noturus funebris*, *Etheostoma proeliare*, *Etheostoma nigrum*, *Etheostoma whipplei*, and *Mugil cephalus*. Five of these species (*D. cepedianum*, *A. chrysochloris*, *H. nuchalis*, *P. olivaris*, and *M. cephalus*) have been collected downstream of Okatoma Creek in the Leaf River (Ross et al., 1990). In addition, *I. bubalus* is documented from the Bowie River (just downstream of Okatoma Creek), and *N. funebris* and *E. proeliare* are reported from the Leaf River (Ross and Brenneman, 1991). Consequently, these eight species likely are valid records for Okatoma Creek.

Reports for the other four species (Teels, 1975) are not supported by more recent information and are of doubtful validity. *Etheostoma whipplei* has been reported previously from the Pascagoula River Drainage in the headwaters of the Chickasawhay River and from the Leaf River (Retzer et al., 1986). Based on examination of museum material, Ross and Brenneman (1991) list four occurrences in the upper Chickasawhay River. Extensive recent field work in the mid- to lower-reaches of the Leaf River has not yielded *E. whipplei* (Ross et al., 1989; 1990). Thus, we believe that *E. whipplei* is an unlikely inhabitant of Okatoma Creek and that fish identified by Teels (1975) as *E. whipplei* were probably *E. swaini*, a species which has been collected in Okatoma Creek. Three other unconfirmed species reported by Teels (1975), *P. notatus*, *M. erythrurum* and *E. nigrum*, are not documented by museum specimens from the Pascagoula River Drainage (Ross and Brenneman, 1991) and their presence in Okatoma Creek is unlikely. Thus, based on comparison of our data with Teels (1975), the fish fauna of Okatoma Creek and its tributaries may include at least 70 species.

Overall, the fauna (Table 2) is dominated by cyprinids (16 species), darters (13 species) and centrarchids (11 species). Within the main channel, the ten most frequently occurring species (based on the percentage of total lots) are *Cyprinella venusta* (7.1%), *Fundulus olivaceus* (5.6%), *Luxilus chrysocephalus* (5.5%), *Lepomis megalotis* (5.0%), *Notropis*

Table 2. Fishes of the Okatoma Creek watershed. The numbers under the position heading correspond to: 1- Citronelle Formation; 2- Catahoula Formation; 3- Pascagoula-Hattiesburg Formation.

Family and Species		Main Channel[1] Position	Main Channel[1] Lots N (%)	Tributaries Lots N (%)	Total Lots N (%)
Petromyzontidae					
1	*Ichthyomyzon gagei*	2	1 (.12)	2 (1.23)	3 (.30)
Anguillidae					
2	*Anguilla rostrata*	-	--	1 (.61)	1 (.10)
Cyprinidae					
3	*Cyprinella venusta*	1,2,3	59 (7.07)	5 (3.07)	64 (6.42)
4	*Luxilus chrysocephalus*	1,2,3	46 (5.52)	12 (7.36)	58 (5.82)
5	*Lythrurus roseipinnis*	1,2,3	34 (4.08)	8 (4.91)	42 (4.21)
6	*Macrhybopsis aestivalis*	3	3 (.36)	--	3 (.30)
7	*Macrhybopsis storeriana*	2,3	13 (1.56)	1 (.61)	14 (1.40)
8	*Nocomis leptocephalus*	1,2,3	19 (2.28)	9 (5.52)	28 (2.81)
9	*Notemigonus crysoleucas*	1	3(.36)	1 (.61)	4 (.40)
10	*Notropis atherinoides*	3	1 (.12)	--	1 (.10)
11	*Notropis baileyi*	1,2,3	15 (1.80)	12 (7.36)	27 (2.71)
12	*Notropis buccatus*	1,2,3	38 (4.58)	5 (3.07)	43 (4.31)
13	*Notropis longirostris*	1,2,3	35 (4.20)	5 (3.07)	40 (4.01)
14	*Notropis texanus*	1,2,3	13 (1.56)	3 (1.84)	16 (1.60)
15	*Notropis volucellus*	1,2,3	39 (4.68)	3 (1.84)	42 (4.21)
16	*Notropis winchelli*	1,2,3	25 (3.00)	3 (1.84)	28 (2.81)
17	*Opsopoeodus emiliae*	1,3	10 (1.20)	1 (.61)	11 (1.10)
18	*Pimephales vigilax*	1,2,3	20 (2.40)	1 (.61)	21 (2.11)
Catostomidae					
19	*Carpiodes cyprinus*	3	1 (.12)	--	1 (.10)
20	*Erimyzon tenuis*	1	3 (.36)	2 (1.23)	5 (.50)
21	*Hypentelium nigricans*	1,2,3	16 (1.92)	4 (2.45)	20 (2.01)
22	*Minytrema melanops*	1	8 (.96)	1 (.61)	9 (.90)
23	*Moxostoma poecilurum*	1,2,3	6 (.72)	2 (1.23)	8 (.80)
Ictaluridae					
24	*Ameiurus melas*	-	--	1 (.61)	1 (.10)
25	*Ameiurus natalis*	1,2	2 (.24)	--	2 (.20)
26	*Ictalurus punctatus*	1,2,3	7 (.84)	--	7 (.70)
27	*Noturus gyrinus*	1,2	5 (.60)	1 (.61)	6 (.60)
28	*Noturus leptacanthus*	1,2,3	7 (.84)	7 (4.29)	14 (1.40)
29	*Noturus nocturnus*	3	1 (.12)	1 (.61)	2 (.20)
Esocidae					
30	*Esox americanus*	1	4 (.48)	--	4 (.40)
31	*Esox niger*	1	2 (.24)	1 (.61)	3 (.30)
Aphredoderidae					
32	*Aphredoderus sayanus*	1	2 (.24)	1 (.61)	3 (.30)
Fundulidae					
33	*Fundulus notatus*	1	1 (.12)	--	1 (.10)
34	*Fundulus notti*	1	1 (.12)	--	1 (.10)
35	*Fundulus olivaceus*	1,2,3	47 (5.64)	9 (5.52)	56 (5.62)
Poeciliidae					
36	*Gambusia affinis*	1,2,3	26 (3.12)	4 (2.45)	30 (3.01)
Atherinidae					
37	*Labidesthes sicculus*	1,2,3	7 (.84)	--	7 (.70)
Centrarchidae					
38	*Ambloplites ariommus*	1,2,3	8 (.96)	2 (1.23)	10 (1.00)
39	*Lepomis cyanellus*	1,2,3	17 (2.04)	4 (2.45)	21 (2.11)
40	*Lepomis gulosus*	1	5 (.60)	2 (1.23)	7 (.70)
41	*Lepomis macrochirus*	1,2,3	18 (2.16)	3(1.84)	21 (2.11)
42	*Lepomis marginatus*	-	--	1 (.61)	1 (.10)
43	*Lepomis megalotis*	1,2,3	42 (5.04)	5 (3.07)	47 (4.71)

Table 2. Continued.

Family and Species		Position	Main Channel[1] Lots N (%)	Tributaries Lots N (%)	Total Lots N (%)
44	*Lepomis microlophus*	1,2	2 (.24)	1 (.61)	3 (.30)
45	*Lepomis punctatus*	1,2	6 (.72)	--	6 (.60)
46	*Micropterus punctulatus*	1,2,3	31 (3.72)	4 (2.45)	35 (3.51)
47	*Micropterus salmoides*	1,2,3	12 (1.44)	2 (1.23)	14 (1.40)
48	*Pomoxis annularis*	3	1 (.12)	--	1 (.10)
Elassomatidae					
49	*Elassoma zonatum*	1,2	3 (.36)	--	3 (.30)
Percidae					
50	*Etheostoma beani*	1,2,3	38 (4.56)	6 (3.68)	44 (4.41)
51	*Etheostoma histrio*	1	1 (.12)	--	1 (.10)
52	*Etheostoma lynceum*	1,2,3	25 (3.00)	6 (3.68)	31 (3.11)
53	*Etheostoma parvipinne*	1	1 (.12)	2 (1.23)	3 (.30)
54	*Etheostoma stigmaeum*	1,2,3	20 (2.40)	3 (1.84)	23 (2.31)
55	*Etheostoma swaini*	1,3	8 (.96)	6 (3.68)	14 (1.40)
56	*Etheostoma vivax*	1,2,3	14 (1.68)	3 (1.84)	17 (1.71)
57	*Percina lenticula*		--	1 (.61)	1 (.10)
58	*Percina nigrofasciata*	1,2,3	26 (3.12)	6 (3.68)	32 (3.21)
59	*Percina sciera*	1,2,3	33 (3.96)	--	33 (3.31)
60	*Percina vigil*	3	1 (.12)	--	1 (.10)
61	*Percina* sp., gulf logperch	3	1 (.12)	--	1 (.10)
62	*Percina* sp., Pearl River channel darter	3	1 (.12)	--	1 (.10)
totals			834	163	997

[1] main channel includes sites in Haw Creek

volucellus (4.7%), *Notropis buccatus* (4.6%), *Etheostoma beani* (4.6%), *Notropis longirostris* (4.2%), *Lythrurus roseipinnis* (4.1%), and *Percina sciera* (4.0%).

The three regions of the main channel are similar in species composition, with the highest similarities between adjoining regions ($J_{1,2}$= .70; $J_{1,3}$= .56; $J_{2,3}$= .66). The fauna of the Catahoula formation is slightly more similar to that of the upstream Citronelle, than to the downstream Hattiesburg-Pascagoula formation.

Eleven species were taken at one to four stations (usually in low numbers) only within the Citronelle Formation. *Notemigonus crysoleucas, Erimyzon tenuis, Minytrema melanops, Esox americanus, E. niger, Aphredoderus sayanus, Fundulus notatus, F. notti, Lepomis gulosus, Etheostoma histrio*, and *E. parvipinne* comprised this group. Although *Ichthyomyzon gagei* was found in the main channel only within the reaches of the Catahoula Formation, it was taken from tributaries flowing over the Citronelle formation. Eight species, *Macrhybopsis aestivalis, Notropis atherinoides, Carpiodes cyprinus, Noturus nocturnus, Pomoxis annularis, Percina* sp., cf. *copelandi, P.* sp., cf. *caprodes*, and *Percina vigil*, were each taken only at one or two stations in the Pascagoula and Hattiesburg formations; they generally were caught in small numbers. Most other species were collected from two to three of the major physiographic subdivisions of the stream.

Among the more common species taken from three physiographic subdivisions, *Notropis buccatus* was more abundant in the lower reaches of Okatoma Creek. Other species which were more common in the lower sections were *Notropis longirostris* and *Cyprinella venusta*. Although *Etheostoma beani* and *Etheostoma vivax* were collected throughout much of the stream, *E. vivax* was more common in the admixed sand and gravel areas of the Citronelle and Catahoula formations, while *E. beani* was more common in the sandy substrata of the Hattiesburg-Pascagoula formations and the lower portion of the Citronelle Formation.

The Okatoma Creek system has a relatively diverse ichthyofauna. Of the 86 total species reported for the Pascagoula River Drainage (Swift et al., 1986), at least 67% inhabit reaches of the Okatoma Creek and its tributaries. Okatoma Creek supports a greater diversity of fishes than many other stream systems of comparable drainage area flowing into the northern Gulf of Mexico, except for the streams in the Tombigbee River Drainage (Table 3). Bayou Sara, which flows into the Mississippi River also has a somewhat larger fauna. The diverse fish assemblage of Okatoma Creek is due at least in part to the habitat diversity resulting from the varied physiographic features of the stream.

Alterations to the stream, such as channelization and desnagging, which reduce this habitat diversity or change the physical conditions of the remaining habitats may be expected to result in a reduction of the size and diversity of the species assemblage of fishes. Moreover, many of the channel modifications were proposed for the upper section of Okatoma Creek, which flows over the Citronelle Formation and supports

Table 3. Fish species diversity (freshwater and anadromous forms) for stream systems of the southeastern coastal plain of Mississippi, Alabama , and Louisiana, arranged by drainage area. Terminology for basin and drainages follows Ross and Brenneman (1991), as modified from Jenkins et al. 1971.

Stream	Basin	Drainage	Drainage Area (km^2)	Species	Reference
Bull Mountain Creek	Gulf of Mexico	Tombigbee River	347	79	Pierson and Schultz (1984)
Bayou Sara	Mississippi River	Lower Miss. River S	493	80	Grady et al. (1983)
Okatoma Creek	Gulf of Mexico	Pascagoula River	751	62 (+8)	present study
Sucarnoochee River	Gulf of Mexico	Tombigbee River	1567	101	Hubbard et al. (1991)
Biloxi Bay system	Gulf of Mexico	Coastal Rivers	1760	39	Caldwell (1966)
Bay St. Louis system	Gulf of Mexico	Coastal Rivers	2046	43	Caldwell (1966)
Escatawpa River	Gulf of Mexico	Pascagoula River	2650	51	Beckham (1977)
Noxubee River	Gulf of Mexico	Tombigbee River	2953	93	Hubbard (1987)

a rich and somewhat different fish fauna than the lower sections. Thus, potential losses to biodiversity may be particularly great if the proposed stream alterations are completed.

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Note added in proof:

Based on a recent re-examination of mosquitofish by STR, it is apparent that both *Gambusia affinis* and *G. holbrooki*, as well as intergrades between the two forms, occur in the Pascagoula River Drainage including Okatoma Creek. In Okatoma Creek there is apparently not a longitudinal pattern to their distribution; frequencies of each form are: *G. affinis* - 41%; *G. holbrooki* - 31%, and intergrades - 28% (N=75).

REIDENTIFICATION OF WILLIAM BARTRAM'S SAVANNAH RIVER *AMBLOPLITES*, WITH EARLY EVIDENCE FOR A TENNESSEE-SAVANNAH FAUNAL EXCHANGE

ROBERT C. CASHNER
Department of Biological Sciences
University of New Orleans
New Orleans, LA 70148

TIM M. BERRA
Department of Zoology
The Ohio State University
Mansfield, OH 44906

DONALD G. CLOUTMAN
Duke Power Company
13339 Hagers Ferry Road
Huntersville, NC 28078

The illustrations of artist naturalists from the late 18th to early 19th centuries have been successfully used to identify species extant today (Pietsch, 1984; Berra, 1989; Randall and Wheeler, 1991). Since diagnostic characters are not always depicted accurately, in some cases identifications are limited to genera or families. Such works still have scientific merit, however, because the drawings can frequently be associated with living species, as well as providing insights into past scientific endeavors (Pietsch, 1984; Randall and Wheeler, 1991).

Berra (1989) presented the contributions to ichthyology by William Bartram (1739-1823), the first American-born artist/naturalist. These consisted of six drawings of different fish species made from Bartram's travels in the southeastern United States from 1773-1776. Berra (1989), following Harper (1958), used the morphological features presented in the illustrations and Bartram's own written accounts to determine each species represented. Among Bartram's works are five drawings of members of the family Centrarchidae, four of which (all from the St. Johns River, FL) are easily referable to the genus *Lepomis* by virtue of the presence of an emarginate caudal fin, rounded operculum, and three spines in the anal fin. The illustrations also show character states for pectoral fin shape, opercular flap length and border, mouth gape, and pigmentation typical of *L. auritus*, *L. gulosus*, *L. macrochirus mystacalis*, and *L. microlophus*. The fifth centrarchid drawing which was not as well executed as the others (Fig. 1) was identified by Berra (1989) as a member of the rock bass genus *Ambloplites* based on the five anal-fin spines depicted in the illustration. He tentatively identified it as representing the shadow bass, *A. ariommus*.

It is our purpose to provide information and data that support the conclusion that William Bartram's first ichthyological illustration was indeed an *Ambloplites*, but that the species represented is more likely the rock bass, *A. rupestris*, rather than the shadow bass, *A. ariommus*. We document the occurrence of *A. rupestris* in the Savannah River drainage today through literature and museum records and discuss the zoogeographic implications of Bartram's find.

Some colleagues (e.g., R.E. Jenkins, in litt.) have questioned the identification of Bartram's work as an *Ambloplites* because the illustration does not depict the proper relationships of certain features (such as the large mouth, well developed supramaxilla, large eye, and body pigment pattern) characteristic of the genus, and also because *Ambloplites* was not reported from the Savannah River by Dahlberg and Scott (1971), Swift et al. (1986), or Cashner (1980). Menhinick (1991), however, showed a Savannah record of *A. rupestris*. Although there is a slight possibility that Bartram based his initial fish drawing on some non-centrarchid percoid, the locality he provided makes this unlikely. Bartram (in Harper, 1943; in Berra, 1989) initially described the site as "... Savanah River near Tugilo Georgia [sic]." At the end of his annotation on the fish, Bartram added, "He is an Inhabitant of the Province of Georgia, in Savanah River high up in the country near the mouth of Tugilo River [sic]." Although, we cannot find "Tugilo River" or "Tugilo, GA, on any Georgia road map or topographic map of the region, we think it is reasonable to assume that Bartram was referring to the Tugaloo River, a southeasterly-flowing tributary to the upper Savannah River near the GA, NC, and SC borders. If the specimen did indeed

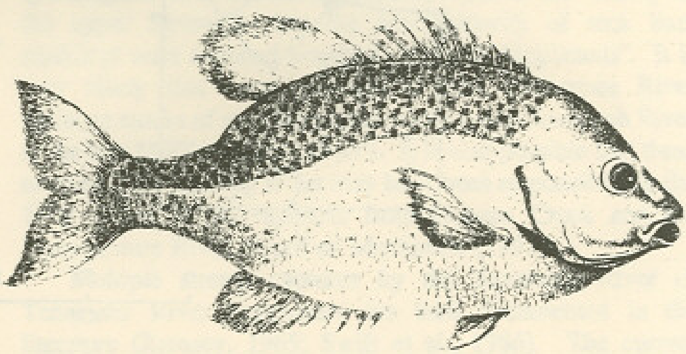

Figure 1. Bartram's illustration of *Ambloplites rupestris*.

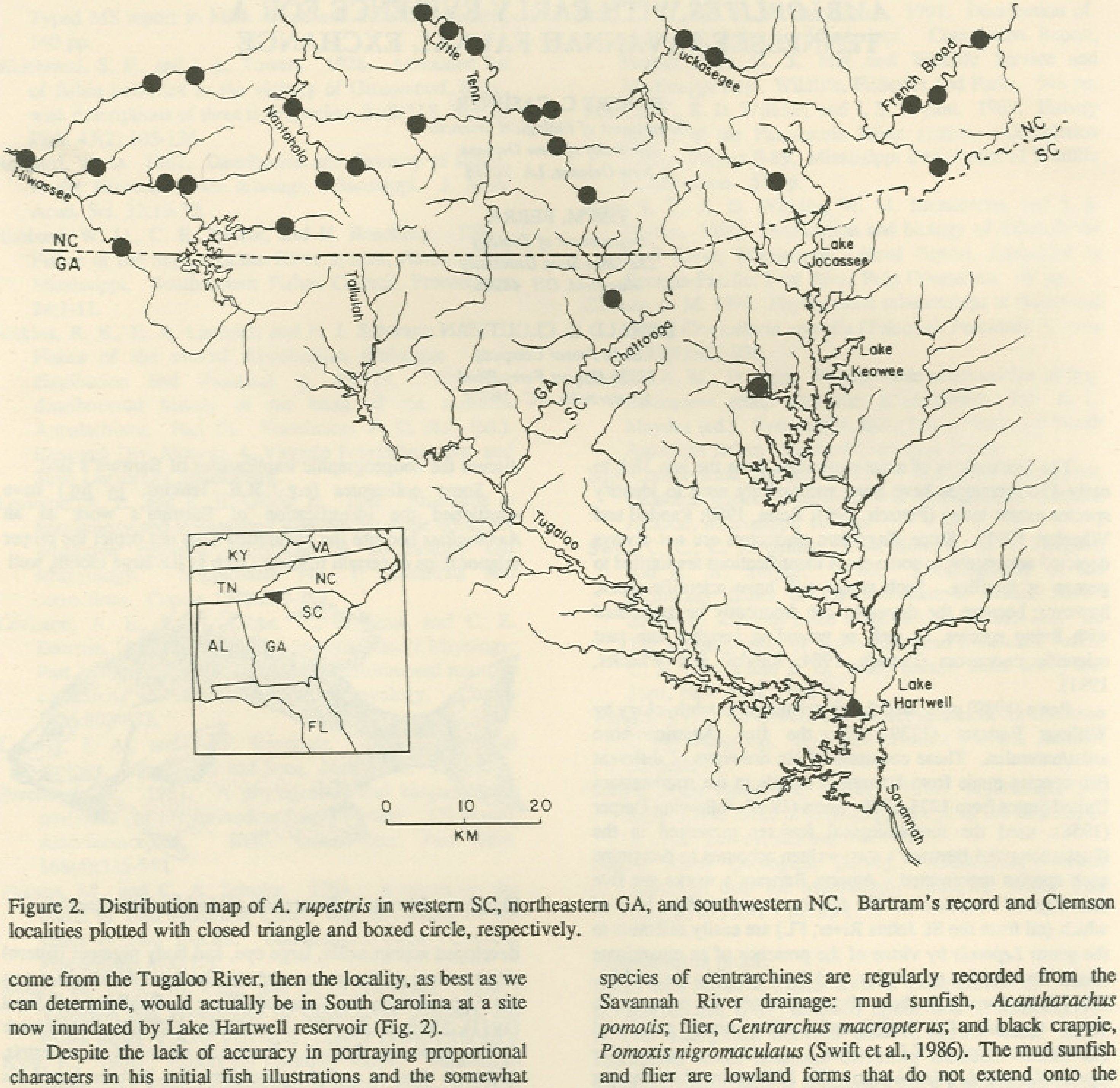

Figure 2. Distribution map of *A. rupestris* in western SC, northeastern GA, and southwestern NC. Bartram's record and Clemson localities plotted with closed triangle and boxed circle, respectively.

come from the Tugaloo River, then the locality, as best as we can determine, would actually be in South Carolina at a site now inundated by Lake Hartwell reservoir (Fig. 2).

Despite the lack of accuracy in portraying proportional characters in his initial fish illustrations and the somewhat atypical descriptions in his account (e.g., "...Fins & Tail black, except those placed on the fore part of his Body which are red or orange color [sic]."), we feel that Bartram was most likely depicting an *Ambloplites*. The primary reason for our conclusion is that Bartram displayed correct dorsal and anal spinous ray counts for all his lepomine subjects. All four illustrations of *Lepomis* are shown with the typical ten dorsal and three anal spines. The putative *Ambloplites* specimen illustrated in Berra (1989:221) has ten dorsal and five anal spines. The anal spine count serves to eliminate any other non-centrarchid percoids (e.g., *Morone*), and places the species represented in the centrarchid subfamily Centrarchinae. Three species of centrarchines are regularly recorded from the Savannah River drainage: mud sunfish, *Acantharachus pomotis*; flier, *Centrarchus macropterus*; and black crappie, *Pomoxis nigromaculatus* (Swift et al., 1986). The mud sunfish and flier are lowland forms that do not extend onto the piedmont and montaine provinces. The black crappie, which may occur farther up the Savannah drainage, has only seven or eight dorsal spines and a more posteriorly placed dorsal fin than the specimen in Bartram's drawing. The general body shape, median fin placement, and spine number are most characteristic of *Ambloplites*.

The determination of the species in Bartram's *Ambloplites* drawing is more difficult to resolve than the generic designation. Berra's (1989) identification as *A. ariommus* was based primarily on his understanding that the geographic range of the shadow bass encompassed all drainages in the southeastern United States. In fact, the shadow bass is

distributed only along the Gulf Slope drainages east of the Mississippi River and is not known to occur in any Atlantic Slope drainage (Cashner, 1980; Page and Burr, 1991). Berra also based his species identification on the proportional measurements he obtained directly from Bartram's drawing, noting that the body depth was greater than the range given for *A. rupestris* (Cashner, 1974). Body depth, as expressed in thousandths of standard length, is usually 415-435 in *A. rupestris* and 445-460 in *A. ariommus* (Cashner, 1974). Although, the Bartram illustration of *Ambloplites* has a body depth/SL of 450, his lack of precision in the portrayal of other morphometric characters reduces the diagnostic value of this character.

The number of spines depicted in the dorsal and anal fins, (10 and 5, respectively), is one less than the counts usually reported for each of the four species of *Ambloplites*. Although both values are variants that have been recorded for all *Ambloplites*, the lower counts are more frequently seen in *A. rupestris* than in the other species. For example, out of 650 specimens of *A. rupestris* examined, 8.1% had 10 dorsal spines and 9.2% had 5 anal spines; by contrast, only 3.4% of 442 *A. ariommus* had 10 dorsal spines and <1.0% had 5 anal spines (Cashner, 1974).

The most useful non-meristic trait in identifying *Ambloplites* species is color pattern of the lateral surface (Fig. 3). Shadow bass have four to five irregular blotches that extend from the dorsal fin base to the pelvic and anal fins, whereas rock bass have rows of spots. The pattern above the lateral line is clearly discernable in Bartram's *Ambloplites* (Fig. 1). Although the dorsolateral surface is darkly shaded, six rows of dark spots are nevertheless apparent. Dark spots also appear below the lateral line, but are more scattered and not organized into rows. This condition is not uncommon in specimens of *A. rupestris*.

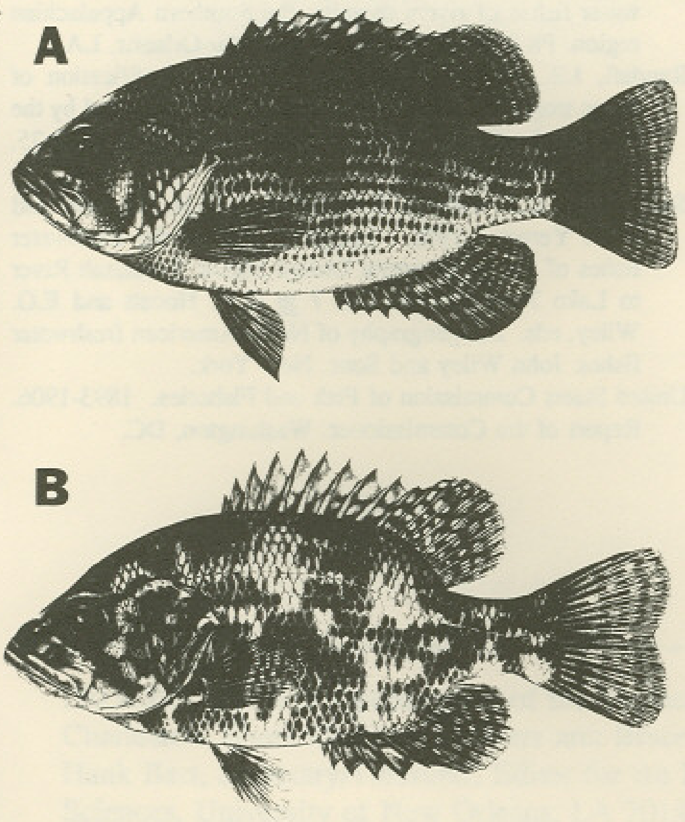

Figure 3. A. *Ambloplites rupestris* and B. *A. ariommus*.

As previously noted, rock bass have not been reported from the upper Savannah River drainage in any publication on state or regional ichthyofaunas, except for the recent record shown by Menhinick (1991). We report here on the collection of two specimens of *A. rupestris* from Oconee Creek, Oconee Co., SC, (Fig. 2) on 28 July 1982, by Melvin Cobb. The specimens which are currently in the teaching collection of Jeff Foltz, Clemson University, measure 75.0 mm and 131.1 mm SL, and have body depth/SL values of 400 and 393, respectively. Each has XI-11 dorsal fin elements, VI-10 anal fin elements, 22 breast scale rows, and a lateral pattern dominated by rows of spots. Although supporting our contention, confirmation of the presence of *A. rupestris* in the upper Savannah today does not conclusively prove that the species was present during Bartram's time. From the 1890's to the early 1900's, over 13,000 hatchery raised rock bass were distributed in GA and SC (U.S. Commission of Fish and Fisheries, 1893-1906). Some of the specified localities were in the Alabama and Apalachicola river drainages. A few (e.g., Washington, GA, and Allendale, SC) were in the vicinity of the upper Savannah, but the vast majority of rock bass stockings were reported simply as going to "applicants". It is very likely that some transplants from Tennessee River drainage stocks of rock bass reached the upper Savannah River in the late 1890's or early 1900's. It is also possible that these or some later stocking effort may have been responsible for the 1982 record of *A. rupestris* from Oconee Creek and the Horsepasture River record of Menhinick (1991).

Multiple stream captures by the Savannah River of Tennessee River headwaters are well documented in the literature (Ramsey, 1965; Swift et al., 1986). The current distribution of rock bass in streams of the Tennessee River drainage, in close proximity to the headwaters of the upper Savannah, suggests that it was susceptible to such capture (Fig. 2). There are a number of other Tennessee River drainage species that also occur in the Savannah, which supports the Tennessee stream capture hypothesis. These include: *Clinostomus funduloides*, *Cyprinella galactura*, *Luxilus coccogenis*, *Nocomis micropogon*, *Notropis leuciodus*, *N. rubricroceus*, *N. spectrunculus*, *Rhinichthys cataractae*, *Etheostoma zonale*, and *Cottus bairdi* (Deubler, 1955; Ramsey, 1965). If Bartram did indeed record the first specimen of *A. rupestris* from the Savannah River, he provided documentation of a stream capture event with the Tennessee River that occurred more than 200 years ago. The apparent scarcity of rock bass records in the upper Savannah River drainage may result from the presence of major impoundments which have caused habitat loss and consequent restriction of range in those areas. No data exist from pre-impoundment surveys to determine whether or not *A. rupestris* was more widespread in the Savannah River drainage than it is today.

The possibility that there was once a population of shadow

bass in the upper Savannah is unlikely, although it cannot be completely dismissed. The presence of *Luxilus zonistius*, *N. hypsilepis*, *Gambusia affinis*, and *Micropterus coosae* in the upper Savannah drainage are cited as evidence of an older connection with the Chattahoochee River system (Ramsey, 1965; Swift et al., 1986; Lydeard et al., 1991). The biological support for this connection may not be as strong as other lines of evidence. Both *G. holbrooki* and *G. affinis* are now known to occur in the upper Savannah. Their co-occurrence could be the result of stream capture between the Chattahoochee or Tennessee and the upper Savannah, but the introduction of *G. affinis* by federal or state agencies is also likely. The *N. hypsilepis* record from the upper Savannah is from habitat atypical for the species. The possibility of bait-bucket introduction cannot be completely dismissed (C. R. Gilbert, in. litt.). Finally, it has been suggested that the *Micropterus* in the Savannah commonly referred to as *M. coosae* may represent a distinct and undescribed form (C. R. Gilbert, in. litt.). *Ambloplites ariommus* is native to the Chattahoochee River system, but is primarily distributed below the Fall Line. Most of the current records for the species in the Chattahoochee system are from elevations of < 500 ft and all other populations of *A. ariommus* in Georgia inhabit areas that do not exceed that elevation. *Ambloplites ariommus* tends to be a lowland inhabitant, which argues against an upper Chattooga-Savannah transfer of this species. All records of *Ambloplites* in the Savannah, from Bartram's to Menhinick's are from elevations >1500 ft.

Without the specimen on which Bartram actually based his drawing, we cannot be absolutely certain whether it was *A. rupestris* or *A. ariommus*. However, circumstantial evidence, based on meristic characters, color pattern, habitat preference, geographic range, and prior drainage connections, strongly suggests that it was a rock bass.

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