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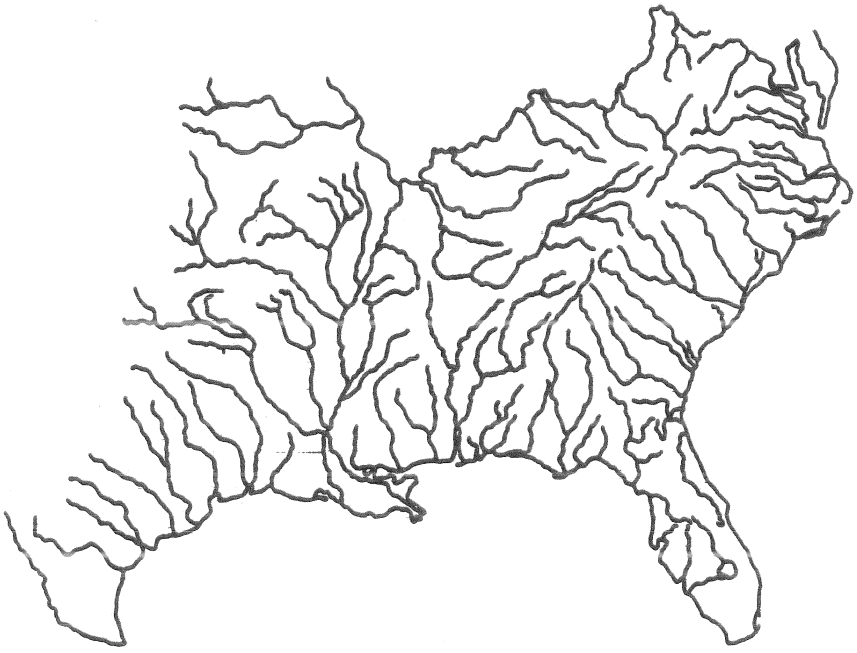

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Longitudinal Succession of Fishes in the Dan River in Virginia and North Carolina (Blue Ridge/Piedmont Provinces)

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ABSTRACT

Sixty-eight species and 46,460 individuals of fishes in 11 families were taken in 298 collections made from 1968-2000 in the Dan River, located in the Blue Ridge and Piedmont provinces in Virginia and North Carolina, and these serve as the material for this study of fish longitudinal distribution. Most common was the Cyprinidae with 21 species and 29,254 specimens taken, followed by Centrarchidae (12; 4617), Percidae (7; 3429), Ictaluridae (9; 3072), and Catostomidae (11; 3029). Six additional families included eight species that comprised 6.6% (3059 specimens) of all individuals collected. Twelve additional species not collected in this study are known to occur in the Dan River or Kerr Reservoir. The river is located in four physiographic-province subdivisions: Uplands, Blue Ridge Escarpment, Inner Piedmont, and Fault Basin; the Escarpment showed a pronounced division into an Upper- and a Lower-Gorge. Analyses of the longitudinal distribution of fishes in the Dan River revealed that the most diverse river region (with 86.8% of the species) was the downstream-most (Fault Basin), the least diverse (with 25.0% of the species) was the headwaters (Uplands); the other regions fell on this trend-line. Two major fish associations were noted: one cluster contained three groups of species related by distribution and abundance in the upper reach of the river, and another cluster contained six groupings that were prevalent in the middle and lower reaches. A number of species recorded in the upper reach of the river dropped out downstream, where they were replaced by a larger number of other species. Most fishes were widely distributed in the river, but several, especially *Exoglossum maxillingua, Thoburnia hamiltoni,* and *Cottus caeruleomentum*, were restricted. The first capture of *Rhinichthys cataractae* in the Dan River is reported here.

INTRODUCTION

Changes in abundance and/or composition (addition of species, replacement of species, or both) of fish species in streams between headwaters and lower reaches is known as longitudinal succession. In North America, a number of authors [e.g., Harrel et al. (1967) in Oklahoma, Jenkins and Freeman (1972) in Virginia, Matthews (1986) in Arkansas] have reported a gradual addition of species downstream. Burton and Odum (1945), however, reported that longitudinal succession in mountain streams in Virginia was characterized by a replacement, rather than by an addition, of species, but their sampling methods were critiqued by Lachner and Jenkins (1971), Matthews (1986), and Jenkins and Burkhead (1994). Maurakis et al. (1987) also noted a replacement of species downstream in steeper-gradient streams of the upper Rappahannock River (Blue Ridge Province) in Virginia, as well as in the lower (Coastal Plain) extreme of this river. Cicerello and Butler (1985) observed an addition of species in the middle section of a tributary of the Cumberland River and a replacement of species in the lower section. Balon and Stewart (1983) noted that distributions of fishes in a river system in Africa occurred in distinct headwaters, foothills, floodplain, and river mouth zones, with some fading into, and overlapping of, ichthyofaunas of adjacent zones.

Stream order has been used more often in North America than any other variable to study the longitudinal distribution of fishes, with the following hypothesis: if assemblages of fishes correspond to stream order, or to pronounced changes in stream size or geomorphology, marked qualitative and/or quantitative changes in the fish fauna should occur at discrete locations between stream headwaters and lower reaches (Matthews, 1986). However, from the results of a study of 23 small streams in the eastern and central United States, Matthews (1986) concluded that differences in microhabitats, rather than of stream order, influenced fish longitudinal succession. In sum, it appears that longitudinal succession is complicated and can be evidenced in a number of ways, and that it depends on the stream or stream type and no doubt on other variables.

Here we examine the relationship of the distribution of fishes to river kilometer locations and to habitat in the Dan River of Virginia and North Carolina, based on data collected by us in a river survey from 1992 to 1998 and by others from 1968 to 2000. We studied the Dan River because it is relatively pristine in the upper reaches, is of moderate size, is ichthyologically rich, contains one Virginia-listed threatened and three North Carolina-listed endangered and two of-special-concern fish species (Rohde et al., 1998), and the ichthyofauna of this river in its entirety has not been studied previously. This study of the Dan River continues the work on the distribution and status of the fishes of this region by Rohde and Arndt (1991, 1994) and Rohde et al. (1998).

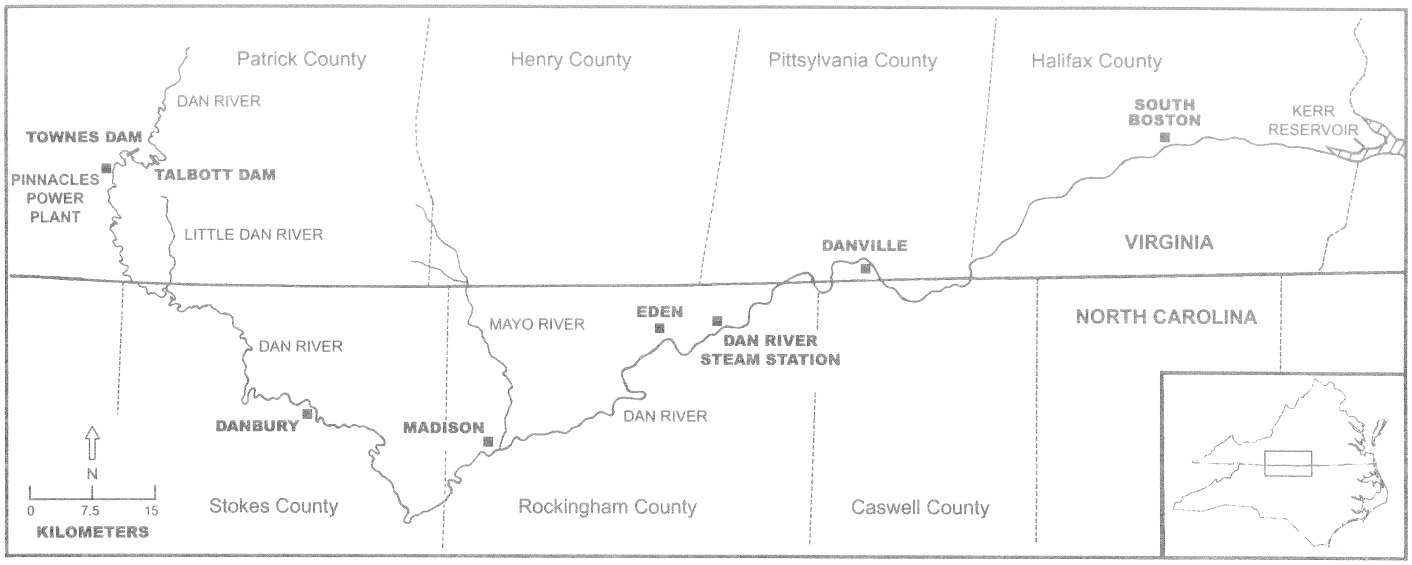

Figure 1. The Dan River in Virginia and North Carolina, showing locations mentioned in the text.

LOCATION OF THE DAN RIVER

The Dan River is located in the Blue Ridge/Piedmont provinces of Virginia and North Carolina (Fig. 1). It originates in Patrick County, VA, and flows south for some 60 river kilometers (rkm) before it crosses into NC in northwestern Stokes County. It then flows to the southeast across most of Stokes County, turns sharply to the northeast, and crosses most of Rockingham County in NC. After a run of 120 rkm it enters VA in southern Pittsylvania County, and after a short run in this state it reenters NC, flows east and north and then quickly reenters VA in Halifax County, and ends, finally, in Kerr Reservoir, created by a dam on the Roanoke (Staunton) River. The Dan River from its origin to its junction with the Roanoke River at Kerr Reservoir is 320 rkm long, and it drains some 6,600 km^2. The Roanoke River discharges into Albemarle Sound on the Atlantic Coastal Plain of northeastern NC.

METHODS

We used data from 298 collections made at 42 sites (Fig. 2) from 1968-2000, as follows: 32 collections made at 23 sites by Rohde and Arndt during 1992-98; 120 collections made by the VA Department of Game and Inland Fisheries (VDGIF) in 1992-1998; three by Paul L. Angermeier of Virginia Polytechnic Institute and State University (VPI) in 1989-1990; one by the NC

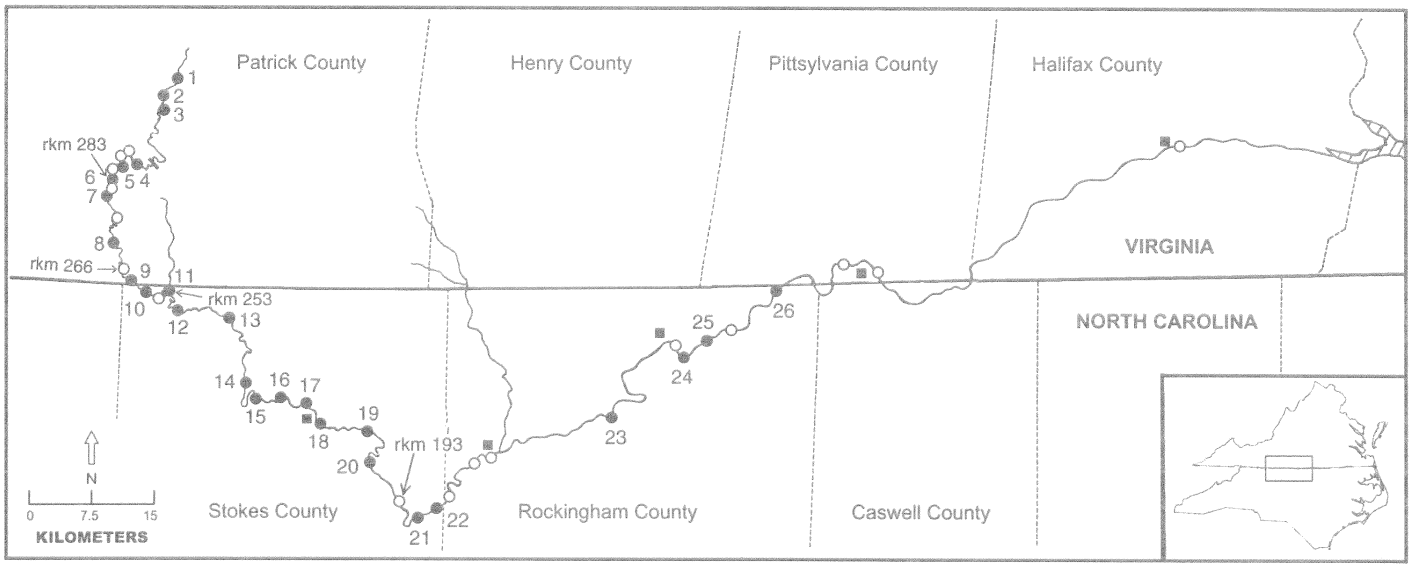

Figure 2. The Dan River showing sites sampled: a numbered black dot indicates a site used in similarity analyses, an open circle indicates an additional site sampled.

Wildlife Resources Commission (NCWRC) in 1990; 126 by biologists of the Duke Power Company (DPC) during 1977-2000; 13 by Edward F. Menhinick of the University of North Carolina-Charlotte from 1968-85; and three by the North Carolina Division of Environmental Management in 1986. Additional collections have been made in Virginia and these records have been plotted by Jenkins and Burkhead (1994).

We made 23 of our collections with a Coffelt BP-6 backpack electroshocker and seine (3.0 or 4.6 m in length, 1.2 m deep, 0.64 cm mesh) into which the shocked fishes drifted or swam. At each site, we electrofished from bank to bank and along river sections from 43 to 213 m (mean 122 m) long. Total sampling time per site per visit ranged from 50 to 190 min (mean 110.2 min), and continued until we believed that sampling had been comprehensive in all microhabitats and until no additional species was collected. We made nine of our collections with only a seine (3.0 to 6.1 m long, 1.2 m deep, 0.64 cm mesh). We sampled only during normal low-water conditions from Jul-Sep, and in Nov. Most fishes were preserved in 10% formalin and later identified and counted. We deposited preserved specimens in the North Carolina State Museum of Natural Sciences in Raleigh. Scientific names follow Robins et al. (1991), except for *Moxostoma collapsum* (Jenkins and Burkhead, 1994), *Cottus caeruleomentum* (Kinziger et al., 2000), and *Percina nevisense* (Goodin et al., 1998). All collections made by others were made with a backpack shocker, except those made by VPI biologists who used a boat electroshocker, from Jun-Nov.

Collections were made from near the headwaters at rkm 317 downstream to rkm 23; only three sites were sampled in the lower 98 rkm of the river from Danville, VA to Kerr Reservoir. All sites were chosen on the basis of ease of access (bridge crossings or boat ramps). Overall, from 1 to 36 collections were made at a given site. We used U. S. Geological Survey 15-min topographic maps and a map tracer to determine mean gradient and river kilometer locations.

To determine longitudinal distribution of species we used data from all collections made by electroshocker, boat electroshocker, and seine, at sites located from rkm 23 to rkm 317. For analysis of similarity of fishes, we used data only from sites sampled with a backpack electroshocker and only where a similar effort had been expended. These data were obtained from one collection each from 26 sites located from rkm 120 to rkm 317 (Fig. 2). We used Morisita's index with Horn's modification (Horn, 1966) and the Community Analyses System 4.2 software (Bloom, 1992) to determine faunal similarities between sites and to determine the locations of faunal breaks. A value of 1.00 in this index indicates that all elements are present in the same numbers in two compared areas. Matthews (1986) considered a value in this index of less than 0.5 to indicate a break in the distribution of the fauna.

Seventeen sites (Table 1) were scored on 1, 2 Aug and 2 Oct 1998 during low water conditions for eight physicochemical characteristics: water temperature, dissolved oxygen concentration, conductivity, pH, river width, river depth, current speed, and substrate composition (percent of sand, gravel, rubble, and boulder/bedrock). Temperature, dissolved oxygen, conductivity, and pH were measured once per site. Stream width was measured at each site along three transects usually located from 10 to 20 m apart. Depth, current, and substrate measurements were made along each transect at 2-m intervals.

Table 1. Physicochemical values recorded at 17 Dan River sites on 1-2 Aug and 2 Oct 1998. Depths and widths that varied are given as mean and range. Cond =conductivity in microohms; DO=dissolved oxygen.

Rkm	Date 1998	T (°C)	DO (ppm)	Cond	pH	Mean Width(m) (range)	Mean Depth(cm) (range)	Mean Current (m/sec)	Substrate (%) sand	gravel	rubble	boulder
313	1 Aug	19	5.4	37	8.4	6.3(5-8)	26.4 (10-54)	0.12 (0.009-0.39)	18.8	37.5	31.2	12.5
312	1Aug	17.9	7.5	38	7.8	7.3 (6-9)	24 (9-44)	0.17 (0.003-0.50)	29.4	35.3	35.3	0
285	1 Aug	19.6	7.9	42	7.7	7.7(6-9)	22.3 (7-46)	0.19 (0.02-0.37)	5.6	55.5	22.2	16.7
282	1 Aug	20.2	7.2	42	7.5	11	40.8 (16-64)	0.3 (0.04-0.79)	0	23.8	52.4	23.8
280	1 Aug	21	8.1	42	7.4	15	28.8 (15-44)	0.37 (0.14-0.89)	0	33.3	57.1	9.5
270	1 Aug	21.7	8	42	7.5	18	25.7 (10-42)	0.42 (0.17-0.72)	23.8	47.6	28.6	0
261	1 Aug	22.6	7.3	44	7.5	12 (11.5-12.5)	44.8 (17-87)	0.37 (0.006-0.76)	14.3	42.8	42.8	0
249	1 Aug	23.4	7.5	43	7.5	20.7 (14-24)	34.6 (12-50)	0.38 (0.08-0.9)	19	47.6	23.8	9.5
240	1 Aug	25.2	7.7	45	8.1	26	30.6 (10-55)	0.39 (0.05-0.78)	9.5	42.8	33.3	14.3
217	2 Oct	20	---	---	7.7	32 (30-33)	27.3 (12-56)	0.39 (0.1-0.68)	6	36	46	12
214	2 Aug	22.2	7.6	48	7.4	31	30.9 (8-54)	0.61 (0.04-1.42)	12.8	51.1	21.3	14.9
207	2 Oct	18.5	---	---	7.8	49	34.3 (11-79)	0.27 (0.006-0.92)	16.1	37.5	23.2	23.2
199	2 Aug	23.4	7.2	51	7.5	50	40.5 (10-100)	0.44 (0.02-1.43)	14.8	51.8	18.5	14.8
193	2 Aug	24	6.3	51	7.4	29	53.6 (14-84)	0.38 (0.3-0.53)	64	36	0	0
174	2 Oct	21	---	---	7.3	27	72.4 (26-140)	0.3 (0-0.53)	15.2	54.5	21.2	9.1
170	2 Oct	20	---	---	7.6	31	54.4 (23-97)	0.34 (0.01-0.54)	83.3	14.3	2.4	0
156	2 Oct	20	---	---	7.3	53	77.8 (33-130)	0.14 (0.006-0.29)	60	20	4	16

Substrate types present were categorized as: sand (particles <0.3 cm in diameter); gravel (0.3-8.0 cm); rubble (8.0-30.0 cm); and boulder/bedrock (>30.0 cm). Width, depth, and current are summarized as averages of all measurements taken on the three transects at each individual site. Substrate types are presented as percentages combined for all sites in a given geologic section.

RESULTS AND DISCUSSION

Description of Study Area

The Dan River originates at an elevation of 939 m in the Uplands of the Blue Ridge Province, upstream of the Blue Ridge Escarpment crest (Hack, 1982). The river runs for 8 rkm in these Blue Ridge Uplands at a relatively steep gradient (11 m/rkm) before it enters a 46 rkm-long gorge it has cut through the Escarpment. The gorge is divisible into an upper gorge (rkm 312-284) ca. 250 m wide and a lower gorge (rkm 283-266) ca. 730 m wide. The river in the upper gorge is narrow and convoluted and has a steeper gradient (13 m/rkm) than in the Uplands, a result of cutting through the weaker rocks of the Blue Ridge Escarpment. The river in the lower gorge is less convoluted.

In the upper portion of the gorge are two man-made impoundments, completed for the Pinnacles Hydroelectric Project (owned by the City of Danville, VA) in 1938 by construction of Talbott Dam and, some 9 rkm downstream, Townes Dam. The Project has been in operation since about 1940 (Burkhead and Jenkins, 1991). All river discharge from Townes Dam has historically been diverted through a viaduct to a powerhouse at rkm 283. River flow below the powerhouse fluctuates widely. Because of this water diversion, the 5 rkm from Townes Dam to the powerhouse has usually been dewatered, except for limited natural flow from local tributaries and springs. To safeguard the biota in this reach, however, the City of Danville agreed in 1994 to maintain a minimum flow of 6 ft^3/sec. The impoundments have been stocked with game fishes over the years, but records are lacking.

Below the gorge the river meanders 71 rkm to the southeast through the Inner Piedmont Province, a region comprised of metamorphosed sedimentary and volcanic rocks of Upper Precambrian to Lower Paleozoic age (Gair and Slack, 1979). At rkm 190, it curves sharply to the northeast; this is ca. 6 rkm downstream of its entry to the Dan River-Danville Basin, a fault basin of soft sedimentary rocks of Upper Triassic age (Thayer, 1970). These rocks have been eroded more than have the adjacent harder crystalline rocks, and this has resulted in a lowland in the Piedmont Province (Thayer, 1970). From this basin to Kerr Reservoir the river traverses a gently rolling topography of Piedmont sands and silts. The river is in a generally forested watershed, although some land is in pasture, hayfields, and, especially further downstream, more actively-cultivated cropland. In 1728, the river near the Halifax-Pittsylvania County line was described by William Byrd, a surveyor, as "a charming river" and "exceedingly beautiful" with crystal clear water (Ausband, 1991). Today, the middle and lower Dan River is turbid for much of the year and Jenkins and Burkhead (1994) noted that it sometimes appears to be plowable. Six obvious barriers to fish movements are present in this section: four dams within the Danville city limits effectively block upstream migration of fishes from Kerr Reservoir, a fifth dam is located upstream at the Duke Power Steam Electric Station at Eden, NC, and a sixth dam is located further upstream in Madison, NC.

River Sections

Uplands (rkm 320-312) (two sites measured, rkm 313, 312)–Mean gradient of these 8 rkm was ca. 11 m/rkm (Fig. 3). Current averaged 0.17 m/sec (SD 0.11); mean width averaged

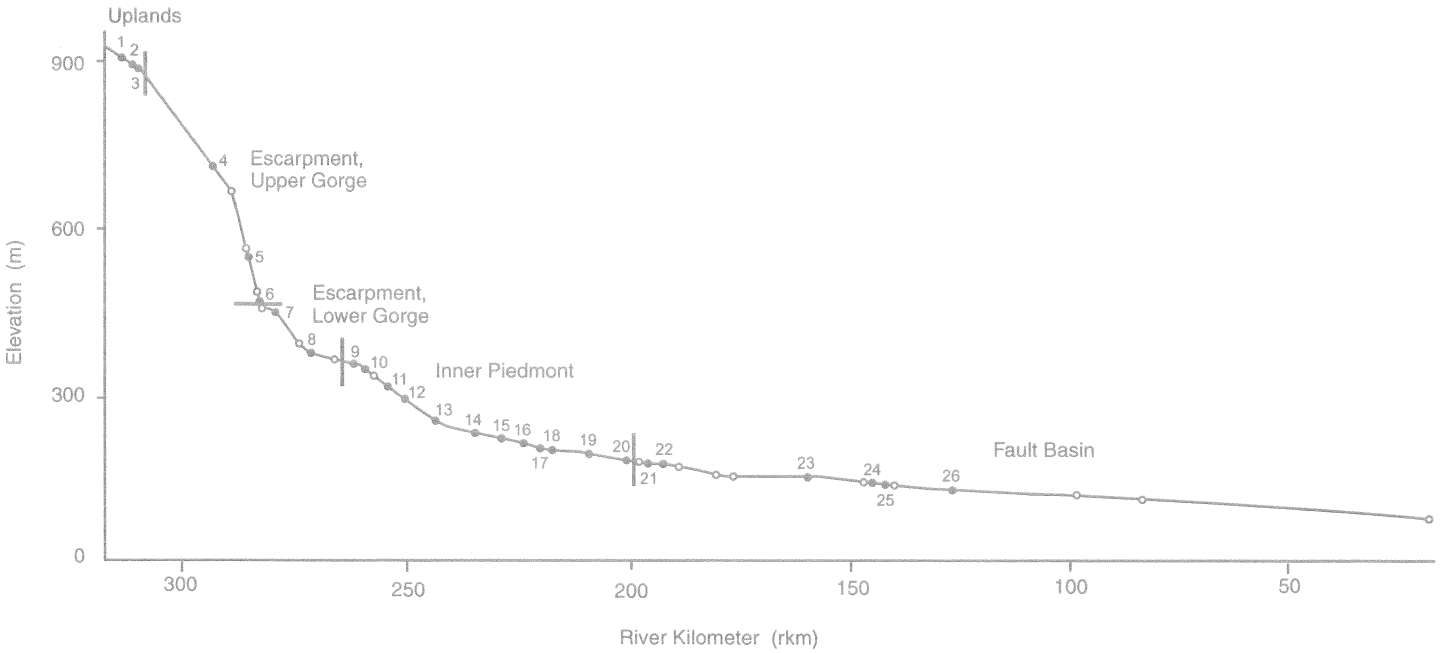

Figure 3. Gradient profile (highly exaggerated) of the Dan River. Sampled sites as defined in Fig. 2.

6.8 m (SD 1.47); average depth was 25.2 cm (SD 13.53); substrate was gravel (36.4%), rubble (33.3%), sand (24.2%) in pools, and some boulders (6.1%); and river-edge habitat was mixed pasture and hardwood forest (Table 1).

Escarpment (rkm 312-266) (four sites measured, rkm 285, 282, 280, 270)–The Escarpment is subdivisible into two distinct sections based on geomorphology: an upper section from rkm 312 to rkm 284 which is narrow and convoluted (hereafter, Upper Gorge), and a lower section from rkm 283 to rkm 266 which is wider and less convoluted (Lower Gorge). Mean gradient in the Upper Gorge was 13 m/rkm. At the Upper Gorge site (rkm 285), river width was 7.7 m (SD 1.53), depth 22.3 cm (SD 10.25), current 0.19 m/sec (SD 0.12), and the substrate was of gravel (55.5%), rubble (22.2%), boulders (16.7%), and sand (5.6%). In the Lower Gorge, mean gradient was ca. 5 m/rkm, mean width 14.7 m (SD 3.04), mean depth 31.8 cm (SD 11.86), with a substrate of rubble (46.0%), gravel (34.9%), with many boulders (11.1%), and occasional sand (7.9%), and mean current during low water levels was 0.38 m/sec (SD 0.19). Riparian habitat was primarily mature hardwood forest.

Inner Piedmont (rkm 265-197) (seven sites measured, rkm 261, 249, 240, 217, 214, 207, 199)–Gradient in this reach averaged ca. 2 m/rkm. Current averaged 0.40 m/sec (SD 0.29), width 30.8 m (SD 13.38), depth 32.6 cm (SD 15.90), with a substrate of gravel (43.9%), rubble (29.5%), sand (12.7%), boulders (11.5%), and outcrops of bedrock (2.4%). The water became increasingly more turbid downstream (personal observations). Riverside habitat was mixed farmland and hardwood forest.

Fault Basin (rkm 196-0) (four sites measured, rkm 193, 174, 170, 156)–Gradient averaged ca. 0.6 m/rkm. Current averaged 0.29 m/sec (SD 0.14), width 49.4 m (SD 19.76), depth 63.4 cm (SD 24.64), and a substrate primarily of sand (57.2%) and gravel (30.6%), with rubble (7.2%), boulders (3.2%), and bedrock (1.6%). The water was usually turbid (personal observations). River-edge habitat bordered a wide floodplain on which was present mixed farmland and mature deciduous forest.

Species Occurrence and Abundance

Sampling by us and others yielded 46,460 fish specimens of 68 species recorded from rkm 23 to 317 (Table 2).

Twenty-one species of cyprinids comprised 30.9% of the 68 species and 63.0% (29,254 individuals) of the total specimens (Table 2). The six most abundant cyprinids (and comprising a total of at least 75% of all members of this family recorded) in decreasing order of abundance were *Clinostomus funduloides* (8509 specimens), *Nocomis leptocephalus* (4848), *Luxilus cerasinus* (2905), *Cyprinella analostana* (2560), *Notropis chiliticus* (2504), and *Lythrurus ardens* (2143). Twelve species of centrarchids comprised 17.6% of the total species and 9.9% (4617 specimens) of the total specimens; most abundant were *Lepomis auritus* (2936 specimens) and *Lepomis macrochirus* (873). Seven species of percids were recorded and comprised 10.3% of the total species and contained 7.4% (3429 specimens) of all individuals taken; the most abundant percids were *Percina roanoka* (1439 specimens) and *Etheostoma flabellare* (1260). Nine species of ictalurids comprised 16.2% of the total species and 6.6% (3072 specimens) of the total specimens; the most abundant were *Noturus insignis* (1977 specimens) and *Ameiurus brunneus* (688). Eleven species of catostomids comprised 16.2% of the total fish species and 6.5% (3029 specimens) of the total specimens taken. *Moxostoma erythrurum* (1407 specimens), *Catostomus commersoni* (423), *Scartomyzon cervinus* (295), and *Moxostoma pappillosum* (281) were the most abundant suckers. The remainder of the fish species collected included eight species in six families, and these comprised 6.6% (3059 specimens) of all individuals taken.

Additional Fishes Known from the Dan River

Twelve additional species, not collected in our study, have been reported from the Dan River or Kerr Reservoir by Jenkins and Burkhead (1994) or in personal communications. Four, *Dorosoma petenense, Alosa aestivalis*, *Morone americana*, and *Aplodinotus grunniens*, are known only from Kerr Reservoir but potentially could move into the Dan River (Jenkins and Burkhead, 1994; Dan Wilson, VDGIF, pers. comm. 2001). Four others, *Alosa pseudoharengus*, *Erimyzon oblongus*, *Ameiurus nebulosus*, and *Esox niger*, are known from a few records from the lower Dan River and Kerr Reservoir (Jenkins and Burkhead, 1994). One record of *Pimephales notatus* taken in the Dan River in 1951 (Jenkins and Burkhead, 1994) represents an apparently unsuccessful introduction since none has been taken recently. One specimen of *Ictalurus furcatus* was taken and released at rkm 249 on 23 September 1988 (Charles Smith, Guilford College, pers. comm., 1994) and two specimens of *Pylodictis olivaris* were captured at rkm 68 near Milton, Caswell County, NC in 1993 (Brad Hammers, NCWRC, pers. comm., 1997). A reproducing population of *Morone saxatilis* occurs in Kerr Reservoir and some regularly migrate upstream as far as a dam in Danville (Jenkins and Burkhead, 1994).

Longitudinal Succession

The occurrence of a longitudinal succession of fishes is evident and is described in the accounts of the following river sections. Fishes which we believe to have been introduced into the upstream reservoirs and to have escaped into flowing portions of the river in the Upper Gorge are not considered in this section.

Section rkm 317-312: Uplands

Seventeen species were collected at three sites between rkm 317-312 in the headwaters above the Blue Ridge Escarpment crest (Table 3). Of these, all (three) species of salmonids taken, namely *Oncorhynchus mykiss* (3 specimens taken), *Salmo trutta* (11), and *Salvelinus fontinalis* (3), have been introduced. *Salvelinus fontinalis* may be native to the upper Dan River (Jenkins and Burkhead, 1994), but if so, this population has no doubt been genetically swamped by introduced individuals. One specimen of *Lepomis auritus* was taken here.

Most abundant here, and comprising a combined total of at least 75% of the total specimens taken, were *Clinostomus funduloides* (1947 specimens; mean number/collection = 389.4), *Luxilus cerasinus* (653; 130.4), and *Nocomis leptocephalus* (189; 37.8). Mean catch (= mean number per collection) of the other 10 species taken here ranged from 0.2 to 32.2 (Table 4).

Table 2. Phylogenetic list of fishes captured in the Dan River, 1968-2000, and number of each taken.

Taxon	Total	% of Total
Lepisosteidae		<0.1
Lepisosteus osseus	2	
Clupeidae		0.3
Dorosoma cepedianum	145	
Cyprinidae		63.0
Campostoma anomalum	188	
Carassius auratus	4	
Clinostomus funduloides	8509	
Cyprinella analostana	2560	
Cyprinella lutrensis	13	
Cyprinus carpio	100	
Exoglossum maxillingua	245	
Luxilus albeolus	1154	
Luxilus cerasinus	2905	
Lythrurus ardens	2143	
Nocomis leptocephalus	4848	
Nocomis raneyi	873	
Notemigonus crysoleucas	77	
Notropis amoenus	159	
Notropis chiliticus	2504	
Notropis hudsonius	287	
Notropis procne	76	
Phoxinus oreas	1890	
Rhinichthys atratulus	357	
Rhinichthys cataractae	1	
Semotilus atromaculatus	361	
Catostomidae		6.5
Carpiodes cyprinus	41	
Catostomus commersoni	423	
Hypentelium nigricans	150	
Hypentelium roanokense	233	
Moxostoma collapsum	132	
Moxostoma erythrurum	1407	
Moxostoma macrolepidotum	21	
Moxostoma pappillosum	281	
Scartomyzon ariommus	40	
Scartomyzon cervinus	295	
Thoburnia hamiltoni	6	
Ictaluridae		6.6
Ameiurus brunneus	688	
Ameiurus catus	30	
Ameiurus melas	4	
Ameiurus natalis	2	
Ameiurus nebulosus	23	
Ameiurus platycephalus	183	
Ictalurus punctatus	145	
Noturus gilberti	20	
Noturus insignis	1977	
Esocidae		<0.1
Esox americanus	2	
Salmonidae		3.4
Oncorhynchus mykiss	435	
Salmo trutta	1005	
Salvelinus fontinalis	154	
Poeciliidae		<0.1
Gambusia holbrooki	3	
Cottidae		2.8
Cottus caeruleomentum	1313	
Centrarchidae		9.9
Ambloplites cavifrons	6	
Ambloplites rupestris	3	
Lepomis auritus	2936	
Lepomis cyanellus	139	
Lepomis gibbosus	30	
Lepomis gulosus	8	
Lepomis macrochirus	873	
Lepomis microlophus	130	
Micropterus dolomieu	21	
Micropterus salmoides	363	
Pomoxis annularis	19	
Pomoxis nigromaculatus	89	
Percidae		7.4
Etheostoma flabellare	1260	
Etheostoma nigrum	33	
Etheostoma podostemone	590	
Etheostoma vitreum	53	
Percina nevisense	53	
Percina roanoka	1439	
Stizostedion vitreum	1	
Number of species	68	
Number of specimens	46,460	

Table 3. Fish species, and number of each, taken at sampling sites on the Dan River, 1968-2000, excluding fishes stocked in the reservoirs. Data taken from sites in bold type were used for similarity analyses. Lines separate fishes in each river section. Table 3 continued on next page.

	Uplands			Upper Gorge					Lower Gorge					
Species rkm:	**317**	**313**	**312**	**297**	290	287	**286**	284	**283**	282	**280**	274	**270**	266
Clinostomus funduloides	335	1314	298	436	82	1200	1926	2273	6	30	7	358	122	55
Luxilus cerasinus	19	542	92	4	29	165	175	586	1	9	16	76	89	37
Nocomis leptocephalus	49	112	28	238	164	717	916	611	18	34	23	37	52	30
Phoxinus oreas	1	58	29	201	1	319	654	538	1	8		21	2	23
Rhinichthys atratulus	1	7	1	153	32	68	28	50	4	8	2	1	1	1
Semotilus atromaculatus	11	30	14	2		84	140	50				3	1	19
Catostomus commersoni	4	19	8	70	5	74	81	78	1	2	1		2	5
Salvelinus fontinalis	1	1	1	132	10	2		6	1					
Salmo trutta	3	5	3	440	202	122	73	139	3	2	2	1	3	
Campostoma anomalum		8			1		1							1
Notropis chiliticus		51	52				11	596	2	19	24	62	50	59
Hypentelium nigricans		2				3	1	7	5	1	4		4	
Hypentelium roanokense		24	11			5	7	32				6	11	26
Noturus insignis		8	6	1	89	298	194	129	2		1		11	
Oncorhynchus mykiss		3		227	180			14	3		1	1		
Lepomis auritus		1						7						
Etheostoma flabellare		149	12	62	129	115	79	115	6	3	23	22	128	1
Thoburnia hamiltoni					1			2	2		1			
Ambloplites cavifrons					1			1						
Etheostoma podostemone					16			19			1	1	4	
Cyprinella analostana						1								
Rhinichthys cataractae						1								
Scartomyzon cervinus						1	3	59	26	1	10	3	13	2
Exoglossum maxillingua							3	172	4		1	9	22	6
Luxilus albeolus								1		3		1	4	4
Noturus gilberti								1					5	4
Cottus caeruleomentum								222	205	16	184	156	437	1
Percina roanoka											2	4	24	2
Lythrurus ardens													17	2
Etheostoma nigrum													1	15
Nocomis raneyi														
Notropis procne														
Micropterus dolomieu														
Etheostoma vitreum														
Percina nevisense														
Ameiurus melas														
Ameiurus platycephalus														
Moxostoma erythrurum														
Micropterus salmoides														
Scartomyzon ariommus														
Moxostoma pappillosum														
Ameiurus brunneus														
Notropis amoenus														
Cyprinus carpio														
Carassius auratus														
Cyprinella lutrensis														
Carpiodes cyprinus														
Moxostoma collapsum														
Ameiurus catus														
Ameiurus nebulosus														
Ictalurus punctatus														
Esox americanus														
Lepomis cyanellus														
Lepomis gibbosus														
Lepomis macrochirus														
Lepomis microlophus														
Pomoxis annularis														
Pomoxis nigromaculatus														
Gambusia holbrooki														
Notemigonus crysoleucas														
Ameiurus natalis														
Notropis hudsonius														
Lepomis gulosus														
Moxostoma macrolepidotum														
Ambloplites rupestris														
Dorosoma cepedianum														
Lepisosteus osseus														
Stizostedion vitreum														
Number of specimens	424	2334	555	1966	942	3175	4292	5708	290	136	303	762	1003	293
Number of species	9	17	13	12	15	16	16	24	17	13	17	17	22	19
Number of collections	1	2	2	9	7	32	36	36	1	1	1	2	2	1

Table 3. Continued.

		Inner Piedmont													Fault Basin														
Species	rkm:	**261**	**259**	257	**253**	**249**	**240**	**231**	**224**	**221**	**217**	**214**	**207**	**199**	193	**190**	**186**	183	174	170	**156**	139	**138**	**135**	131	**120**	98	84	23	Total
Clinostomus funduloides		5	20	7		1	6	26	1			1																		8509
Luxilus cerasinus		10	460	77	39	40	166	23	3	12	2	115	6	17	38	3	36					2	3	5	3	5				2905
Nocomis leptocephalus		88	153	132	117	76	207	129	16	190	50	253	70	33	52	7	22	2	1	10	6	8	17	89	19	72				4848
Phoxinus oreas			24	4				1				3										1	1							1890
Rhinichthys atratulus																														357
Semotilus atromaculatus			2	4																			1							361
Catostomus commersoni		9	4	7		2	1			1	1	1			1				4			3	5	26	6	2				423
Salvelinus fontinalis																														154
Salmo trutta			2	1	2																			1		1				1005
Campostoma anomalum		2	5	5		24	29	1	1	28	11	11	2	56							1			1						188
Notropis chiliticus		23	105	182	125	57	102	141	25	69	12	210	78	138	102	27	176	2					4							2504
Hypentelium nigricans		1	6	7			1	3	1			3	2	10	26	1	13		4		1	1	3	23	7	10				150
Hypentelium roanokense		12	30	12	7	2	6	4	5	7	13	2	5	1	2									2	1					233
Noturus insignis		16	100	57	33	41	143	73	152	206	70	159	73	78	16		9		1	1	1	1	3	5						1977
Oncorhynchus mykiss			4		2																									435
Lepomis auritus				1	2	6	4	4	8	27	5	30		9	110	8	4	1	158	6	13	764	754	405	372	210	4	13	10	2936
Etheostoma flabellare		52	121	75	19	8	31	3	19	34	4	29	4		2	2	10	1			1			1						1260
Thoburnia hamiltoni																														6
Ambloplites cavifrons																						1	2	1						6
Etheostoma podostemone		8	37	42	4	36	36	33	60	70	28	92	30	11	39	1	13	2			2			5						590
Cyprinella analostana			8			24	16	119	7	28	6	97	2	4	354	37	385	3	3	61	61	171	279	545	237	98	2	10	2	2560
Rhinichthys cataractae																														1
Scartomyzon cervinus		1	16	45	7	14	19	4	13	1	3	21	1	14	2							1	4	11						295
Exoglossum maxillingua		1	16	6		3	2																							245
Luxilus albeolus			50	57		12	3	6	14	16		32	20	25	50	1	67		9	1	46	143	220	256	78	35				1154
Noturus gilberti			5	3	1							1																		20
Cottus caeruleomentum		38	40	9	5																									1313
Percina roanoke		4	41	24	22	41	92	125	163	194	88	295	114	126	10		41							26		1				1439
Lythrurus ardens		47	649	161	31	167	122	96	6	95	2	126	2		76	11	77	19			38	158	165	17	35	24				2143
Etheostoma nigrum			10	5																			1		1					33
Nocomis raneyi			9	4		7	12	1	41	3	2	23		9	75	16	96		7		6	27	52	379	69	31		4		873
Notropis procne			22	4																	5	4	10	24	3	4				76
Micropterus dolomieu			1	1								2					1				1		4	7	3			1		21
Etheostoma vitreum			16	19	4	2	1	5		4		1												1						53
Percina nevisense			7				1	10		5		10			6							1		11	1	1				53
Ameiurus melas				1															2				1							4
Ameiurus platycephalus				2		1	2		2	28		19		8	22	1			10		2	27	22	16	8	13				183
Moxostoma erythrurum						1		1	1	1	4	23			47		5		134	1		267	377	272	188	78	5	2		1407
Micropterus salmoides						1			1			1			8				20		1	57	102	64	80	21	3	3	1	363
Scartomyzon ariommus							3	1	7	1	7	8	4	1										8						40
Moxostoma pappillosum										24		16		3	56		10		25	1	17	6	22	59	2	36	1	3		281
Ameiurus brunneus										1	5	5	12	27	27		4	2	13		1	61	129	172	24	180	3	22		688
Notropis amoenus											1						1					74	38	4	7	34				159
Cyprinus carpio												1							6			20	14	7	23	19		3	7	100
Carassius auratus															2									1		1				4
Cyprinella lutrensis															2				4			3	1			3				13
Carpiodes cyprinus															1		1		1			8	2	12	2	3		8	3	41
Moxostoma collapsum															27							3	12	62	8	6		5	9	132
Ameiurus catus															1							10	6	1				9	3	30
Ameiurus nebulosus															5				2			7	3	4		1	1			23
Ictalurus punctatus															9				10			47	44	10	2	11		4	8	145
Esox americanus															1								1							2
Lepomis cyanellus															3				1	1		37	66	8	3	20				139
Lepomis gibbosus															1				2			9	9		5	3	1			30
Lepomis macrochirus															3	4			14			188	290	98	163	86	7	2	18	873
Lepomis microlophus															1							38	48	15	25	3				130
Pomoxis annularis															3				4			4	3	2	2			1		19
Pomoxis nigromaculatus															1							11	30	15	27	1		4		89
Gambusia holbrooki																		2								1				3
Notemigonus crysoleucas																			2			4	26	6	1	38				77
Ameiurus natalis																				1					1					2
Notropis hudsonius																					1	48	34	143	25	33		3		287
Lepomis gulosus																						3	4		1					8
Moxostoma macrolepidotum																							5					11	5	21
Ambloplites rupestris																							2	1						3
Dorosoma cepedianum																								38	22	5	12	66	2	145
Lepisosteus osseus																									1				1	2
Stizostedion vitreum																												1		1
Number of specimens		317	1963	954	420	566	1005	809	546	1045	314	1590	425	570	1181	119	971	34	437	83	204	2218	2819	2859	1455	1090	39	175	69	46460
Number of species		16	29	29	16	22	23	22	21	23	19	30	16	18	36	13	19	9	24	9	18	37	44	45	36	34	10	20	12	68
Number of collections		1	7	2	1	2	3	3	1	2	1	6	1	2	10	1	3	1	8	1	3	19	30	22	18	14	1	1	1	298

Table 4. Relative abundance (number of specimens/number of collections) of fishes taken in this Dan River study,1968-2000, for each individual river region. Values for species that in total comprise the top 75% most-abundant species/region are identified in bold type.

Species	Uplands	Upper Gorge	Lower Gorge	Pied-mont	Fault Basin
Campostoma anomalum	1.60	0.02	0.12	5.47	0.02
Clinostomus funduloides	**389.40**	**49.31**	**72.25**	2.09	
Luxilus cerasinus	**130.40**	7.99	**28.50**	**30.31**	0.71
Nocomis leptocephalus	**37.80**	**22.05**	**24.25**	**47.31**	2.29
Notropis chiliticus	20.60	5.06	**27.00**	**39.59**	2.34
Phoxinus oreas	17.60	**14.28**	6.88	1.00	0.02
Rhinichthys atratulus	1.80	2.76	2.12		
Semotilus atromaculatus	11.00	2.30	2.88	0.19	0.01
Catostomus commersoni	6.20	2.57	1.38	0.81	0.35
Hypentelium nigricans	0.40	0.09	1.75	1.06	0.67
Hypentelium roanokense	7.00	0.37	5.38	3.31	0.04
Noturus insignis	2.80	5.92	1.75	**37.53**	0.28
Oncorhynchus mykiss	0.60	3.51	0.62	0.19	
Salvelinus fontinalis	0.60	1.25	0.12		
Salmo trutta	2.20	**8.13**	1.38	0.16	0.02
Lepomis auritus	0.20	0.06		3.00	**21.29**
Etheostoma flabellare	32.20	4.17	22.88	12.47	0.13
Cyprinella analostana		0.01		9.72	**16.90**
Exoglossum maxillingua		1.46	5.25	0.88	
Luxilus albeolus		0.01	1.50	7.34	**6.81**
Rhinichthys cataractae		0.01			
Scartomyzon cervinus		0.52	6.88	4.97	0.13
Thoburnia hamiltoni		0.02	0.38		
Noturus gilberti		0.01	1.12	0.31	
Cottus caeruleomentum		1.85	**124.88**	2.88	
Ambloplites cavifrons		0.02			0.03
Etheostoma podostemone		0.29	0.75	**15.22**	0.47
Lythrurus ardens			2.38	**47.00**	4.66
Etheostoma nigrum			2.00	0.47	0.02
Percina roanoka			4.00	**41.53**	0.59
Cyprinus carpio				0.03	0.74
Nocomis raneyi				3.47	5.73
Notropis amoenus				0.03	1.19
Notropis procne				0.81	0.38
Moxostoma erythrurum				0.97	**10.34**
Moxostoma pappillosum				1.34	1.79
Scartomyzon ariommus				1.00	0.06
Ameiurus brunneus				1.56	4.80
Ameiurus melas				0.03	0.02
Ameiurus platycephalus				1.94	0.91
Micropterus salmoides				0.09	2.71
Micropterus dolomieu				0.12	0.13
Etheostoma vitreum				1.62	0.01
Percina nevisense				1.03	0.10
Lepisosteus osseus					0.02
Dorosoma cepedianum					1.09
Carassius auratus					0.03
Cyprinella lutrensis					0.10
Notemigonus crysoleucas					0.58
Notropis hudsonius					2.16
Carpiodes cyprinus					0.31
Moxostoma collapsum					0.99
Moxostoma macrolepidotum					0.16
Ameiurus catus					0.22
Ameiurus natalis					0.02
Ameiurus nebulosus					0.17
Ictalurus punctatus					1.09
Esox americanus					0.02
Gambusia holbrooki					0.02
Ambloplites rupestris					0.02
Lepomis cyanellus					1.04
Lepomis gibbosus					0.22
Lepomis gulosus					0.06
Lepomis macrochirus					**6.56**
Lepomis microlophus					0.98
Pomoxis annularis					0.14
Pomoxis nigromaculatus					0.67
Stizostedion vitreum					0.01
Number of species	17	27	26	39	59
Number of specimens	3313	16,083	2787	10,524	13,753
Number of collections	5	120	8	32	133

Thirteen of the 14 native species taken here, as well as the (introduced) salmonids, are all fishes typically found in headwaters. The exception is *Lepomis auritus*, which, while it is native in the lower river, has been introduced into this upper reach. All fishes except *Campostoma anomalum* and *L. auritus* generally occurred throughout the Upper Gorge downstream as far as rkm 284.

Section rkm 297-284: Gorge, Upper

All 17 species recorded in the headwaters on the Uplands were found in the Upper Gorge, including the dewatered portion, as well as an additional 10 species (Table 3).

Clinostomus funduloides was the most abundant species (5917 specimens; mean catch 49.31) here, followed by *Nocomis leptocephalus* (2646; 22.05) and *Phoxinus oreas* (1713; 14.28) (Table 4). The three salmonid species mentioned previously were most abundant (1547 specimens total) in the constricted portion of the river located between rkm 297-284. *Exoglossum maxillingua* and *Cottus caeruleomentum* were restricted to that reach of river between rkm 286 and 240. The first record of *Rhinichthys cataractae* in the Dan River was taken at rkm 287.

Section rkm 283-266: Gorge, Lower

First recorded at rkm 280 was *Percina roanoka* (2 specimens). Its appearance coincided with a decrease in river gradient below the Pinnacles Power Plant. *Salvelinus fontinalis* and *Thoburnia hamiltoni* were not collected below rkm 283 and rkm 280, respectively (Table 3).

Most abundant in this section were *Cottus caeruleomentum* (999 specimens; mean catch 124.88), *Clinostomus funduloides* (578; 72.25), *Luxilus cerasinus* (228; 28.50), *Notropis chiliticus* (216; 27.00), and *Nocomis leptocephalus* (194; 24.25) (Table 3, 4).

Section rkm 261-253: Inner Piedmont, Upper

Just below the VA/NC border and downstream of the gorge we recorded an additional seven species: *Nocomis raneyi* (9 specimens taken), *Notropis procne* (22), *Micropterus dolomieu* (1), *Etheostoma vitreum* (16), *Percina nevisense* (7), *Ameiurus melas* (1), and *A. platycephalus* (2) (Table 3).

Most abundant throughout rkm 261-253 were four cyprinids: *Lythrurus ardens* (888 specimens; mean catch 80.73), *Luxilus cerasinus* (586; 53.27), *Nocomis leptocephalus* (490; 44.54), and *Notropis chiliticus* (435; 39.54) (Table 3, 4). *Etheostoma flabellare* (267 specimens; 24.27) and *Noturus insignis* (206; 18.73) were also abundant.

Section rkm 249-199: Inner Piedmont, Lower

Seven species were added between rkm 249 and 199: *Micropterus salmoides* (3 specimens taken), *Moxostoma erythrurum* (31), *Scartomyzon ariommus* (32), *M. pappillosum* (43), *Ameiurus brunneus* (50), *Notropis amoenus* (1), and *Cyprinus carpio* (1) (Table 3). Seven species present upstream from rkm 261 to 253 were absent here.

Most abundant in this section were *Percina roanoka* (1238 specimens; mean catch 58.95), *Nocomis leptocephalus* (1024; 48.76), *Noturus insignis* (995; 47.38), *Notropis chiliticus* (832; 39.62), *Lythrurus ardens* (616; 29.33), and *Etheostoma podostemone* (396; 18.86) (Table 3, 4).

Rkm 193: Fault Basin, Upper Site

Fourteen species were first recorded at rkm 193: six centrarchids [*Lepomis cyanellus* (3 specimens), *L. gibbosus* (1), *L. macrochirus* (3), *L. microlophus* (1), *Pomoxis annularis* (3), *P. nigromaculatus* (1)], three ictalurids [*Ameiurus catus* (1), *A. nebulosus* (5), and *Ictalurus punctatus* (9)], and five others, namely *Esox americanus* (1), *Carassius auratus* (2), *Cyprinella lutrensis* (2), *Carpiodes cyprinus* (1), and *Moxostoma collapsum* (27) (Table 3). All 14 species are typical of slower waters and of sand/silt/mud substrates.

Most abundant here were *Cyprinella analostana* (354 specimens), *Lepomis auritus* (110), and *Notropis chiliticus* (102) (Table 3).

Section rkm 183-170: Fault Basin

Three species were first collected in this section: *Gambusia holbrooki* (2 specimens) at rkm 183, *Notemigonus crysoleucas* (2) at rkm 174, and *Ameiurus natalis* (1) at rkm 170 (Table 3).

Most abundant in this section were *Lepomis auritus* (165 specimens) and *Moxostoma erythrurum* (135) (Table 3).

Section rkm 156-135: Fault Basin

Five species were first collected here: *Notropis hudsonius* (1 specimen) at rkm 156, *Lepomis gulosus* (3) at rkm 139, *Moxostoma macrolepidotum* (5) and *Ambloplites rupestris* (2) at rkm 138, and *Dorosoma cepedianum* (38) at rkm 135 (Table 3). The only other records of *Ambloplites cavifrons* (4 specimens) from outside the Upper Gorge were taken from rkm 139 to 135. Seven species recorded upstream in the Fault Basin were not taken below this section.

Most abundant in this section were *Lepomis auritus* (1936 specimens), *Cyprinella analostana* (1056), *Moxostoma erythrurum* (916), *Luxilus albeolus* (665), *Lepomis macrochirus* (576), and *Ameiurus brunneus* (363)(Table 3).

Rkm 120: Fault Basin

Thirty-six of the 59 species collected at, or upstream of, rkm 120 in the Fault Basin were not collected farther downriver (Table 3). This is probably an artifact of sampling, since fishes downstream of rkm 120 were collected only with a boat electroshocker. No species was taken only at rkm 120. Most abundant at rkm 120 were *Lepomis auritus* (210 specimens) and *Ameiurus brunneus* (180 specimens) (Table 3).

Rkm 84 and 23: Fault Basin

Stizostedion vitreum (1 specimen) was taken only at rkm 84 (Table 3). Most abundant at rkm 84 were *Dorosoma cepedianum* (66 specimens) and *Ameiurus brunneus* (22). Most abundant at rkm 23 were *Lepomis macrochirus* (18 specimens) and *L. auritus* (10).

Rkm 193-23: Fault Basin, All Sites Summarized

Lepomis auritus (2832 specimens; 21.29 mean catch) and *Cyprinella analostana* (2248; 16.90) were the most abundant species taken throughout the Fault Basin (Table 3, 4). Other important Fault Basin species included *Moxostoma erythrurum* (1376; 10.34), *Luxilus albeolus* (906; 6.81), *Lepomis macrochirus* (873; 6.56), *Nocomis raneyi* (762; 5.73), *Ameiurus brunneus* (638; 4.80), and *Lythrurus ardens* (620; 4.66). All these species were also abundant in other sections of the river.

Of the 24 species found only in the Fault Basin (15 sites, 133 collections) (Table 3, 4), seven species, *Dorosoma cepedianum, Notropis hudsonius, Moxostoma collapsum, Ictalurus punctatus, Lepomis cyanellus, L. macrochirus,* and *L. microlophus,* were represented by more than 100 specimens each. Of the remaining 17 species that first occurred from rkm 193 (start of the Dan River-Danville Basin) and downstream, taken were three species (*Lepisosteus osseus, Esox americanus, Stizostedion vitreum*) that were represented by only one or two specimens of each, and four species (*Carassius auratus, Gambusia holbrooki, Ameiurus natalis, Ambloplites rupestris*) that were represented by a total of only 11 specimens and that were taken at only two sites each (Table 3). The remaining 10 species occurred intermittently throughout the 170 rkm reach from rkm 193 to rkm 23 of the Triassic Basin section of the river (Table 3).

Faunal Groupings

Based on our analysis, we identified three distinct faunal breaks, thus four fish groupings (Fig. 4). The first faunal break, with a similarity index value of 0.30, occurred between rkm 286 and 283 and was located between sites 5 and 6 in the narrow Upper Gorge (Fig. 5). The river at this point changed from a coldwater to a coolwater stream. This thermal change may explain this break. No reproducing trout have been found, by us and by pertinent state fisheries biologists, in the river below rkm 283. The second faunal break, with a similarity index value of 0.23, occurred between rkm 270 and 261, just below the gorge. The third faunal break, with a similarity index value of <0.10, occurred between rkm 199 and 193. This corresponded to the break between that section of river over the Upper Precambrian-Paleozoic rocks at rkm 199 and that section over the rocks of the Upper Triassic found at rkm 193 and downstream.

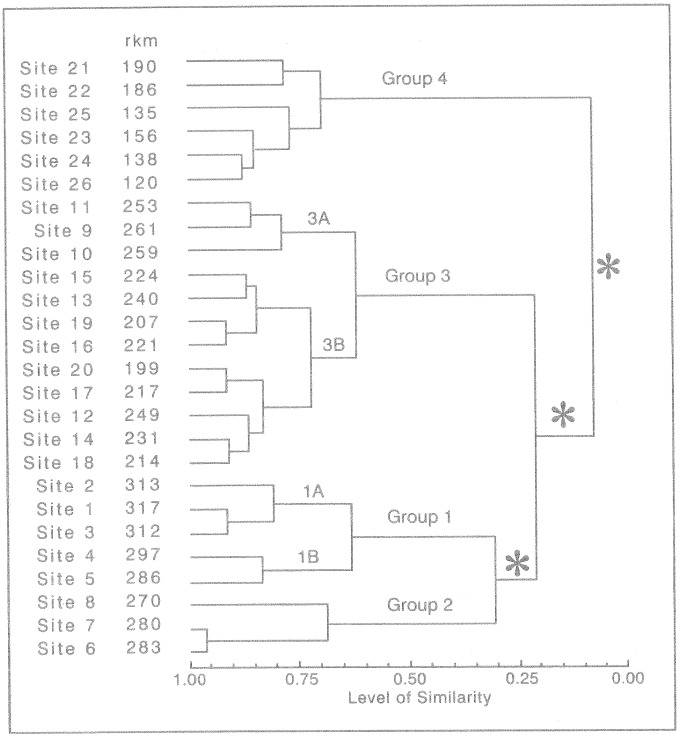

Figure 4. Dendrogram of groupings of fishes in the Dan River by sampling sites as based on Horn's modification of Morisita's Index. Faunal breaks are indicated by an asterisk.

The fishes in Group 1, which consists of 19 species, were found at sites 1 to 5 (Fig. 4, Table 3). This group comprised the assemblage found on the Uplands above the Escarpment crest at sites 1 to 3 (at rkm 317 to 312), and in the constricted portion of the Upper Gorge at sites 4 and 5 (at rkm 297 and 286).

Two subgroups, with a similarity index value of 0.63 to each other, were evident in Group 1. These corresponded well to the two conspicuous geomorphic units sampled: subgroup 1A, with 17 species, occurred above the gorge at three sites; and subgroup 1B, with 18 species, occurred in the Upper Gorge at two sites.

The fish assemblage in Group 2, of 25 species, was found at sites 6 to 8 in the Lower Gorge from immediately downstream of the Pinnacles Power Plant, from rkm 283 to rkm 270. Replacement of species was evident between those found in Group 1 and those found in the next section of river, in Group 2. Of the 19 species in Group 1, two dropped out (temporarily) and were replaced by eight additional species in Group 2 (Table 3).

Group 3, of 38 species, occurred from below the gorge and downstream for the next 62 rkm, at sites 9 to 20 (from rkm 261 to 199). Notable when moving from Group 2 to Group 3 was the loss of three species (*Rhinichthys atratulus, Thoburnia hamiltoni, Salvelinus fontinalis*) and an addition of 15 species (including two from Group 1), primarily of openwater cyprinids, catostomids, ictalurids, and piscivorous centrarchids.

Identified in Group 3 were two subgroups, with a similarity index value of 0.60 (Fig. 4). Subgroup 3A consisted of 30 species that were found at three sites, from rkm 261 to 253. Subgroup 3B consisted of 32 species that were found at nine sites in 50 kilometers of river from rkm 249 to 199. The primary physical differences which may account for the separation here were river width (wider in the lower reach), slower current, and substrate (more bedrock/boulders in the lower reach).

Group 4, of 56 species, occurred in the lowermost portion of the study area, from rkm 190 to 120 (Fig. 5). Over five times as many species (21) were added here, particularly of ictalurids and centrarchids, than were lost (4).

A dendrogram based on species similarities rather than on site similarities shows two clusters (I, II) and their contained groupings (Fig. 6). Cluster I contains three groups of species (Ia, Ib, Ic) related by distribution and abundance and are dominant in the upper reach of the river, and these are discussed here. The distributions of *Cottus caeruleomentum* and *Exoglossum maxillingua* (0.53 similarity) were previously mentioned as being highly restricted. The taxa in group Ib (*Clinostomus funduloides - Phoxinus oreas - Semotilus atromaculatus - Catostomus commersoni - Rhinichthys atratulus*) represent those species that are the most common in the headwaters (0.48). Two salmonids (*Salmo trutta - Oncorhynchus mykiss*) comprise group Ic (0.73), and these were most abundant in the Upper Gorge.

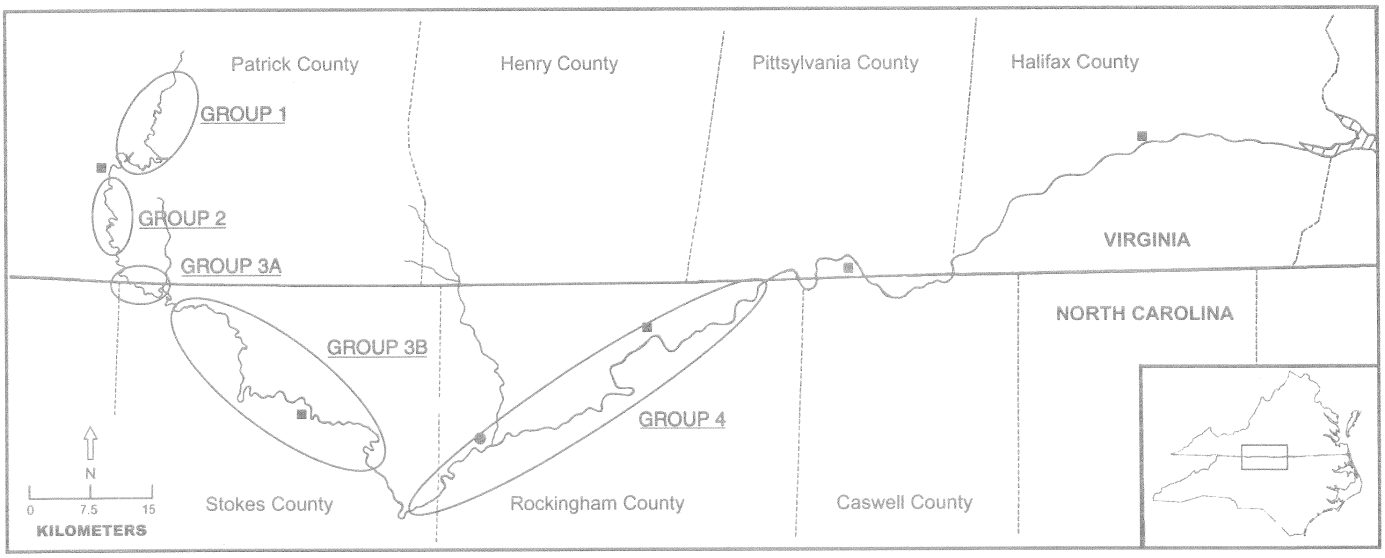

Figure 5. Fish groupings in the Dan River as based on Horn's modification of Morisita's Index.

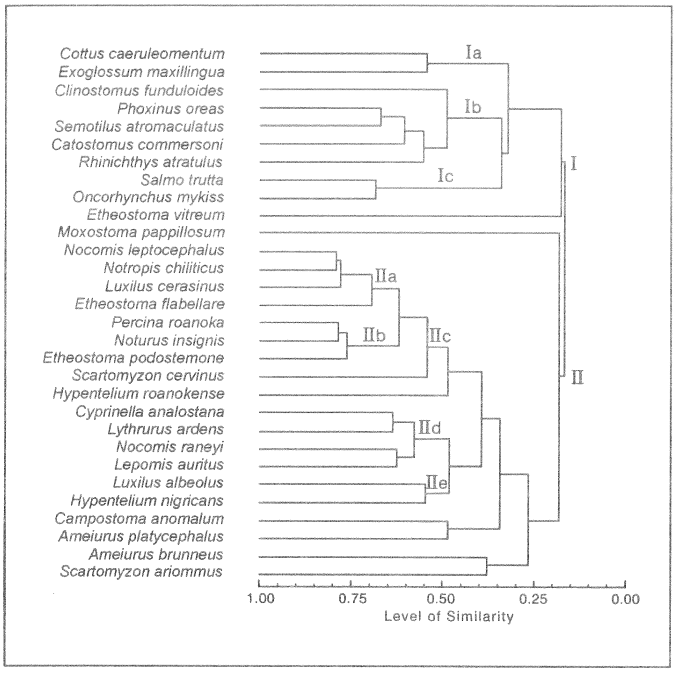

Figure 6. Dendrogram of selected fishes groupings in the Dan River as based on Horns' modification of Morisita's Index.

Cluster II contains five species groups, IIa to IIe (similarity index >0.5). Highly similar were fishes that were abundant and widespread in the river below the gorge downstream to the Triassic Basin. This includes two highly related groups: IIa) *Nocomis leptocephalus - Notropis chiliticus - Luxilus cerasinus - Etheostoma flabellare* (0.72 similarity) and IIb) *Percina roanoka - Noturus insignis - Etheostoma podostemone* (0.75). These two groups are strongly related to each other (0.60). Group IIc includes these two groups (a,b) and also includes *Scartomyzon cervinus* (0.55 similarity). Also similar (0.56) is group IId *(Cyprinella analostana - Lythrurus ardens - Nocomis raneyi - Lepomis auritus)* which is abundant in the deeper waters of the runs. This latter group is also related (0.47) to the *Luxilus albeolus - Hypentelium nigricans* group IIe (0.53) (Fig. 6) found in the more shallow portions of runs.

CONCLUSIONS

The Dan River supports a diverse and abundant fish fauna, and 80 species are known to occur or potentially could occur. This diversity is due, in part, to the high water quality present in the upper part of the river, consistent stream flow, and extensive habitat diversity throughout. Initially, at its origin on the Blue Ridge Uplands, the river is narrow and shallow, with a slow current. In the gorge, due to an increase in gradient, the current speed increases. Below the gorge, the gradient decreases but fast-current areas are frequent as the river traverses constrictions in the crystalline rocks of the Inner Piedmont; the river substrate there is composed primarily of rubble and gravel. The lowermost reach of river passes through the Fault Basin where river width and depth increase, the current slows slightly, and the substrate consists primarily of sand with gravel. All of these factors, and a general increase in water temperature, are possible major determinants of Dan River fish distribution. Local habitat heterogeneity may explain some of the disjunct fish distributions noted in the Dan River.

From the headwaters, where 17 species were taken, fish diversity increased steadily downstream to just below the VA-NC border (at rkm 261) where a group of five species was first taken, to comprise a total of 35 species collected in that reach of river approximately upstream of the VA-NC border. The reason for this pronounced increase of five species may be that the upstream-most deep run (>1 m depth) of the river is located here and that species often found in such habitat, e.g., *Nocomis raneyi*, *Notropis procne,* and *Micropterus dolomieu*, were first found here.

Species were added gradually, and others dropped out, as the river ran through the rest of the Upper Precambrian/Lower Paleozoic rocks area, for a total of 39 species that occurred in this mid-river reach (from rkm 259 to 199).

A major faunal break then occurred in the river as it entered the Dan River-Danville (Triassic) Basin. Fourteen species first occurred here, we presume primarily because of a change in substrate from gravel-rubble to primarily sand, from a faster to a slower current, and possibly because of an increase in water depth and a tolerance to increased turbidity.

Nine species that were found upstream in the Upper Precambrian/Lower Paleozoic region (from rkm 317 to 199) were absent from downstream in the Triassic Basin (from rkm 193 to 23) (Table 3). Eight other species were present in very low numbers and were taken at only one or two sites, mostly below a dam located at rkm 135 where, according to David Coughlan (DPC, 2001, pers. comm.), the "swift current had created an oasis of gravel, rock, and cobble habitat" in an area of otherwise sand substrate.

Most (47) of the 68 species that we recorded in this survey were widely distributed in the river (some conspicuous examples are *Luxilus cerasinus, Nocomis leptocephalus, Catostomus commersoni,* and *Noturus insignis*), or widely distributed throughout a particular geologic section (particularly *Cyprinella analostana, Moxostoma erythrurum, Lepomis auritus* throughout the Fault Basin, and *Percina roanoka* throughout the Inner Piedmont).

The distribution of *Exoglossum maxillingua, Thoburnia hamiltoni,* and *Cottus caeruleomentum* was limited, and each was restricted to 56 rkm or less of the upper river. Their occurrence there ranged from abundant (*C. caeruleomentum*) to rare (*T. hamiltoni)*, and all were apparently restricted to some specific and as yet unidentified bottom type, water temperature, and/or flow regime. These restrictors likely are suitable spawning substrate for the sculpin and very high water quality for the sucker. The distributions of some fishes (e.g., *Notropis procne, Scartomyzon ariommus, S. cervinus, Ambloplites cavifrons, Micropterus dolomieu, Etheostoma nigrum,* and *E. vitreum*) are less easily characterized since each has a major gap in occurrence in the Dan River. Some of the more rarely-captured species, such as *Lepisosteus osseus, Esox americanus, Carassius auratus, Ameiurus melas, A. natalis, Gambusia holbrooki,* and *Stizostedion vitreum*, were found at only one to three widely-spaced sites. Their low rates of occurrence and localized distributions presumably are a result of a lack of

habitat. Our analysis of the distribution of fishes in the Dan River support the hypothesis of Matthews (1986) that differences in microhabitats, rather than of stream order, influence and complicate longitudinal succession.

ACKNOWLEGMENTS

For assistance in field work we thank students from The Richard Stockton College of New Jersey (TRSCNJ) and colleagues from the University of North Carolina at Wilmington, too numerous to list here, although M.L. Moser of the latter deserves special mention. The Graphics Production Department of TRSCNJ helped to prepare the figures. We thank R.E. Jenkins, D.J. Coughlan, and an anonymous reviewer for their helpful comments. This research was supported in part by a grant from the North Carolina Wildlife Resources Commission, Nongame and Endangered Wildlife Program, and by travel funds and vehicles support provided by faculty committees and the administration of TRSCNJ. These surveys were conducted under North Carolina Wildlife Resources Scientific Collecting Permit Number 39 and Permit Number SCP9652 issued by the Virginia Department of Game and Inland Fisheries.

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MINUTES

Business Meeting
26th Annual Meeting
Southeastern Fishes Council

The 2000 meeting of the Southeastern Fishes Council (SFC) was called to order by Chair Steve Ross at 5:32 PM on 15 April 1999. The meeting was held in Plaza Room B of the Marriot Hotel and Convention Center in Chattanooga, Tennessee in conjunction with the Association of Southeastern Biologists (ASB). Executive Committee members attending were Stephen T. Ross (Chair), Gerald R. Dinkins (Secretary), Mary Freeman (Chair-elect), and Peggy Shute (Treasurer).

SECRETARY'S REPORT

Minutes from the 1999 SFC business meeting held in Wilmington, North Carolina were distributed and were reviewed by attendees. A motion was made to accept the minutes as written, and was carried by voice vote.

TREASURER'S REPORT

Peggy Shute provided a summary of the treasurer's report, and noted that it will be revised to reflect $76 found in SFC button vest (proceeds from sale of SFC buttons at 1999 meeting). A motion was made to accept the treasurer's report as printed, and was carried by voice vote.

COMMITTEE REPORTS

Technical Advisory Committee

Mel Warren, co-chair of the Technical Advisory Committee, provided a status report of his committee's review of the diversity, distribution, and conservation status of the native freshwater fishes of the southern United States. Mel noted that the manuscript has been submitted to Fisheries, the monthly membership magazine of the American Fisheries Society.

Resolutions Committee

Steve Ross noted that the committee has been forwarded for consideration a resolution regarding the Needmore Tract, a large piece of land in western North Carolina bordering the Little Tennessee River just upstream of the Fontana impoundment. The resolution, drafted by the Little Tennessee River Watershed Association, urges Nantahala Power and Light to take measures to protect the biological resources on the entire Needmore Tract.

Steve Walsh provided an update on the resolutions regarding the Rodman Dam removal and the Ichetucknee River. The Rodman resolution was sent to Florida Governor Jeb Bush, urging him to support removal of the Rodman (=Kirkpatrick) dam on the Oklawaha River. The Ichetucknee resolution was also sent to Governor Bush, and stated the Council's opposition to the construction of cement plant about three miles from the Ichetucknee State Park and very near the type locality (and only known population) of the federally threatened Squirrel Chimney Cave Shrimp.

OLD BUSINESS

Several matters pertaining to old business were briefly discussed, including:

- Current status of listing the Alabama sturgeon as federally protected;
- Recent conference, held in Chattanooga, on southeast imperiled fishes initiative;
- Timeliness of having SFC play a larger role in conservation issues;
- Availability on U.S Fish and Wildlife Service's webpage, of report on Southeast Imperiled Fish Strategy document, authored by Dick Biggins;
- SFC being placed on Tennessee Department of Conservation mailing list for notification of application wanting to alter headwater streams.
- Status of SFC's southeastern imperiled fishes initiative, and meeting of a Southeastern Imperiled Fishes Working Group, to be held in Chattanooga in October 2000.

Chairman Ross described ongoing efforts within SFC to establish a system by which individuals or agencies could be recognized for their work in conserving southeastern fishes. As yet, this has not been finalized, but the Council is closer to bringing to the membership for vote a way to acknowledge conservation efforts.

The final matter of old business brought to the floor of the business meeting pertained to a proposal, initially brought in front of the Council during the 1999 SFC meeting in Wilmington, NC, to change the annual meeting venue of SFC from it's traditional arrangement with the Association of Southeastern Biologists (ASB), to the annual midyear meeting of the Southeastern Division of the American Fisheries Society (SDAFS). As a result of the discussion in Wilmington, the members in attendance decided that a list of the pros and cons of this suggested change should be drafted, and, if such a change met the approval of the governing board of the SDAFS and the SFC Executive Committee, that the entire SFC membership would be allowed to vote on a possible change in venue by a mail-in ballot. A list of pros and cons was mailed to the membership in December 1999. Votes were collected by the Secretary via mail and email and brought to the meeting in Chattanooga. Chairman Ross invited those in attendance who had not yet voted to cast their ballot as he opened the floor for further discussion. Most in attendance expressed their view regarding this matter. Chairman Ross then closed the floor, and announced the results of the vote: 33 had cast their ballot in favor of changing the venue, and 33 opposed the change. Based on these results, Chairman Ross announced that SFC will meet with ASB in New Orleans in 2001, and in the future will consider alternating between meeting with ASB (in years when the American Society of Ichthyologists and Herpetologists does not meet in the southeast) and the Southern Division of the

American Fisheries Society (SDAFS). SFC will pursue cosponsoring another symposium at a future mid-year meeting of the SDAFS, similar to the one held in Savannah, Georgia in February 2000.

NEW BUSINESS

Chairman Ross reported that the SFC website is currently handled by George Burgess at the University of Florida's Museum of Natural History. Steve expressed his desire for more information to be posted, and for more people to be involved with posting information.

REGIONAL REPORT

Regional reports were not presented. Attendees were referred to the SFC webpage where the reports have been posted.

After accepting a motion to adjourn, Chairman Ross closed the meeting at 6:32 PM.

Respectfully submitted,
Gerald R. Dinkins, Secretary

Southeastern Fishes Council Treasurer's Report, March 2000

Checking Account Balance, 21 March 2000		$2,977.48
Dues and Contributions, 12 April 1999 through 21 March 2000:		
1998 dues	$80.00	
1999 dues	$1,360.00	
2000 dues	$440.00	
2001 dues	$60.00	
Contributions	$72.00	
TOTAL:		$2,032.00
Expenditures, 12 April 1999 through 21 March 2000:		
Proceedings # 39, printing cost	$751.96	
Proceedings # 39, postage	$113.95	
TN Secretary of State (annual report)	$20.00	
Meeting venue survey copying & postage	$93.95	
1999-edition Buttons	$222.00	
Returned check & fee	$25.00	
TOTAL:		$1,226.86
Checking Account Balance as of 21 March 2000:		$3,782.62
2000 dues received, not yet deposited		$100.00
Paine Webber Cash Fund as of 31 December 1998:		$3,067.76
Reported Fund, 31 December 1997	$2,929.45	
Earned interest and adjustments, 1998	$138.31	
Total Assets		$6,950.38

Notes:
Membership on 21 March 2000 is as follows:
Paid only through 1997 (not renewed): 9 individuals (also, Arkansas Game & Fish Commission; MS State Univ.)
Paid through 1998: 17 individuals or institutions (also, Univ. Illinois; Zoological Record)
Paid through 1999: 101
Paid through 2000: 19
Paid through 2001 & lifetime members: 6

Respectfully submitted,
Peggy W. Shute

Regional SFC Reports

REGION I - Northeast

That well-known deviant and voyeur, Bob Jenkins (Roanoke College), has been spending all of his free time in the past two springs observing sucker sex. In fact, he has been so consumed with it that I have little to report on his activities this past year. Hopefully, by next year he will have tired of it and be ready to enlighten us all.

Mike Pinder (Virginia Game and Inland Fisheries) reports that since 1998, his department's Wildlife Diversity Division has been developing techniques to propagate mussels for eventual release into the upper Tennessee River. The cultivation facility is located on the South Fork Holston River near Marion, VA. Presently, they are holding over 22 species (307 individuals). Fourteen have successfully spawned in hatchery raceways with low mortality for most species. In June biologists will survey a potential release site on the Clinch River. The wavyrayed lampmussel (*Lampsilis fasciola*) and the oyster mussel (*Epioblasma capsaeformis*) will be the first artificially propagated species released at this study site.

Eugene Murakis (Science Museum of Virginia) has been spending a considerable amount of time (4 year grant) studying freshwater fishes of Greece which is slightly outside the purview of SEFC but he still has managed to continue his work on southeastern fishes. In press is a comparison of spawning and non-spawning substrates in nests of *Nocomis* and *Exoglossum*. Along with Ray Katula and Bill Roston, he has submitted a manuscript on spawning in *Hemitremia flammea* and with a student (Will Gretes, Univ. Richmond) is completing a comparisons of myomere counts among larval *H. flammea* and populations of *Semotilus*. Finally, he is wrapping up nest attractant studies and spawning of *Nocomis effusus*.

Wayne Starnes (North Carolina State Museum of Natural Sciences) took the plunge off the cliff again and got married in January. According to various sources, he is still happily married. Congratulations, Wayne. The past two springs, he joined up with several agencies, including Carolina Power and Light Co., Duke Power Co., NC Wildlife Resources Commission, SC Department of Natural Resources, US Fish and Wildlife Service, NC State University and others in a massive electroshocking survey of the Pee Dee river in NC and NC in search of further specimens of the robust and undescribed

"Carolina" redhorses. The effort in 2000 yielded only the second documented specimen of the robust redhorse from the Pee Dee basin since it's description by Cope in 1870. The "Carolina" redhorse, under study and description by Jenkins and Starnes, is known in the Pee Dee from but five specimens, the last collected in 1994. These are clearly two of the rarest fishes in the Pee Dee and probably have been largely extirpated from that river by a combination of predation by *Pylodictis olivaris* and other factors. The only currently strong population of the "Carolina" redhorse resides in the lower Deep River portion of the Cape Fear basin. It appears to be on the verge of extinction from the remainder of that basin. Surveys are being spearheaded by CP&L in conjunction with re-licensing of dams on the Pee Dee. This year's effort will be expanded upstream to include reaches of the river below Tillary reservoir in addition to revisiting reaches sampled last year from below Blewett Falls Lake, NC to Cheraw, SC. After four long days on the Pee Dee in April 2001with a mega-flotilla (9) of shocking boats, one 12 lb running ripe female robust redhorse was dip-netted by Wayne in a shoal area above Mill Creek. They worked the area from Blewett Falls to Cheraw and also between Tillary and Blewett. That is one rare fish. Additionally, another nuptial male "Carolina" redhorse was taken at High Falls in late April 2001.

The NCSM data base is now fully developed and operational (thanks to Gabriella Hogue and Jonathan Raine). Data entry of locality records is proceeding at a good clip with about 2500 records, most with GIS data, entered. These records support probably 15,000 or more lots and cataloging is complete on several hundred of these (only 80,000 more to go!). NCSM, in conjunction with researchers at the NCSU Vet School, is in the process of setting up a lab to conduct molecular investigations aimed at the systematics and conservation of fishes and mollusks. Morgan Raley, currently with the NCSM fishes unit, will be moving down the street to begin these tasks in June.

Fritz Rohde (NC Marine Fisheries), Rudy Arndt (Richard Stockton College), Jeff Foltz (Clemson University), and Joe Quattro (Univ. South Carolina) are still slowly working away on their SC fishes project. Foltz is currently computerizing all of the Clemson and Rohde and Arndt locality records.

The SC DNR research lab at Eastover is involved in three diversity/distribution studies. Jim Long is surveying fishes in rice fields in the lower Cooper River, Leo Rose is inventorying fishes in the Congaree Swamp National Monument, and Jason Bettinger is sampling the Broad River from above Columbia, SC to the NC/SC border.

Fritz Rohde

REGION II - Southeast

Conservation Notes

In Chattanooga last January (2001), a new conservation entity committed to halting the accelerated decline of imperiled southeastern freshwater fishes was quietly formed. The meeting was the second of two intense workshops hosted by the U.S. Fish and Wildlife Service with the explicit goal of conserving and recovering southeastern imperiled fishes. The 60+ attendees, representing the business sector, conservation groups, governments (state and federal agencies), and academia participated in both workshops. The first workshop (held in October 1999) produced a remarkable consensus plan (*see below). Participants in the January meeting focused on implementing the plan and unanimously agreed to create a new (as of yet unnamed) conservation entity. A volunteer Steering Committee was formed and charged with creating a new, non-profit organization, obtaining initial funding, identifying a director, and coining an appropriate name. Wendy Smith, World Wildlife Fund, was nominated as is the committee chair based on her experience with successful conservation groups. Wendy may be contacted at: southernrivers@worldnet.att.net. Other Steering Committee members are: George Benz (Tennessee Aquarium), Kelly Bibb (U.S. Fish and Wildlife Service), Dick Biggins (USFWS), Jeff Duncan (National Park Service), Mark Hughes (International Paper), Rick Mayden (St. Louis University), Stephen Ross (University of Southern Mississippi), Bobby Reed (Louisiana Department of Wildlife and Fisheries), David Sligh (American Rivers), Brian Wagner (Arkansas Fish and Game Commission), Stephen Walsh (USGS), and Chris Williams (World Wildlife Fund).

The new organization differs from the Southeastern Fishes Council in that it focuses on implementing and pursuing conservation actions and ultimately recovery. The group will be modeled after non-profit conservation groups such as WWF or TNC. The SFC formally offered to serve as a host for the new group. It was determined, however, that the new group would likely function better as an independent entity, but would clearly benefit from strong ties to professional, academic societies such as the SFC, American Fisheries Society, and the American Society of Ichthyologists and Herpetologists. Members of the SFC will continue to make significant contributions to the new group. A name for the group, the "Southeastern Fish Conservancy," abbreviated SEFC, is hereby tendered for consideration.

The portent of this group and its future importance to conservation are evidenced by the affiliations of steering committee members: state governments, federal government, academia, conservation groups, and the private sector. The success of the group absolutely depends on its egalitarian composition. Additional members of the business community are welcome (and needed), as well as members of county commissions and city councils. Altogether strange bedfellows indeed, but like politics, many important conservation decisions and actions are local. The latter point is emphasized when considering the future environmental impacts of southeastern metropolises such as Atlanta. Northward growth of metropolitan Atlanta already impinges the upper Coosa Rivers system, and could engulf it in 50 years. Indeed, the fringes of Atlanta and Chattanooga may coalesce in the heart of persisting diversity and remarkable endemism. Beyond obvious, potentially negative effects of urbanization, e.g., loss of arable land, water supply impoundments, polluted runoff, etc., loom fundamental transformations of the landscape, a process governed by local zoning decisions.

Resolving conservation conflicts at local levels is the critical

basis underlying successes of many river conservation groups. Modern conservation and recovery efforts must shun the largely ineffective adversarial approach. Contemporary conservation requires diverse partners vested in the mutual belief that aquatic biodiversity can be preserved amongst burgeoning urbanism. Moreover, it is need right now. Fortunately, at the heart of every conservation enterprise are the insuperable, wide-eyed faithful with "can do" attitudes and specifically, the ethical grit to make a difference.

The consensus document: "Strategic Plan for the Conservation and Recovery of Southeastern Imperiled Fishes" may be viewed at this website: http://www.sherpaguides.com/southeast/aquatic_fauna/strategy/index.html.

The Georgia Department of Natural Resources has produced an outstanding videotape on the conservation and recovery efforts underway for the robust redhorse. The video presents a balanced, informative narrative covering the rediscovery of the species to current recovery efforts for this impressive sucker. Emphasis is placed on the cooperative nature of activities between the federal government, states, and the private sector under the aegis of the Robust Redhorse Conservation Committee (RRCC). The USFWS agreed not to list the species *if* the members of the RRCC engaged in significant, cooperative efforts to conserve and recover the species. Although these conservation efforts are "outside" the authority of the Endangered Species Act, the point is made that without the ESA, cooperators would not have been motivated to undertake conservation activities. The robust redhorse story is a model of modern conservation cooperation, and the videotape merits accolades for clearly telling the story. Gary Mefee, Managing Editor for the journal *Conservation Biology*, recently reviewed the videotape and gave it high marks for quality and content. The tape is certainly worth viewing, especially the scenes of explosive spawning bouts in gravel shallows. As Mefee exclaimed: "It is really a big sucker!" Katheryn Kohm, the editor of the relatively new journal, *Conservation Biology in Practice*, an offshoot of *CB* dedicated to "bridging the gap between conservation science, practice, and policy," is interested in the case of the robust redhorse and the work of the RRCC. The robust redhorse was considered likely extirpated in the Peedee River until its recent capture. Although Cope described it from the Peedee River, the only other "recent" material was from the 1960s, exact site unknown. Additional information and links are found at: http://www.robustredhorse.com/.

Affecting Alabama, Georgia, and Florida, the Tri-State Water Project at times seems lukewarm or is a topic of heated concern. The project proposes interbasin transfer of water from the Apalachicola, Chattahoochee, and Flint rivers (ACF) to the Alabama, Coosa, and Tallapoosa rivers (ACT), to ensure the future water supply for Atlanta (and some other unclear benefits). The concern of the downstream states, Alabama and Florida, are whether enough water will remain to support natural resources and future growth demands. The agreements, or Tri-State compacts, are supposed establish mutually-agreed water allocation formulas, a goal that seems elusive. Among the three states, the city-state of Atlanta appears to be the winner, having insured its future water supply. It is evident that we do not really understand the breadth or severity of potential biological impacts. One strategy is to request the maximum flows possible for river sections that harbor listed species. However, this allocation will result in low system variability. How that will affect the long-term fitness of biota is unknown. Of all the considerations in the Tri-State compact, biological issues appear to have received the least attention. Most recently, Floridians have expressed concern regarding dewatering of the ACF and the resulting effects on Apalachicola Bay relative to the harvestable resources (primarily oysters, shrimp, crabs, and stripped mullet). Perhaps humans would ultimately benefit the most from allocations that promoted the greatest protection of biodiversity (seeing how we don't understand it all yet).

Research Notes

Chris Skelton, Georgia Natural Heritage Program, recently published his dissertation in Copeia, (2001, Number 1: p.118-128.) in which he describes the Walden Ridge endemic, *Phoxinus saylori*, a patronym honoring Charlie Saylor, a TVA biologist, who was among the first to collect the species. Having just earned his PhD, Chris eclipsed Sutt in publishing his dissertation by 50.5 years, a record that can only be broken by Reeve Bailey. By virtue of the extraordinarily restricted range, *P. saylori* bears monitoring relative to population changes. Chris is the first aquatic zoologist to join the heritage program in Georgia.

Mary and Bud Freeman continue their Freemanesque-pace in working on Georgia fishes, including a recent marathon effort to finish the description of the Halloween darter. After photographing Halloween darters last spring, I was impressed with its resemblance to *P. palmaris* (but not *evides*), a point Mary has made for some time. The Halloween darter is endemic to the Apalachicola, Chattahoochee, and Flint rivers in Alabama, Georgia, and Florida.

Sutt (Royal D. Suttkus) and Scott (Maurice) Mettee published description of a new minnow with a limited distribution in the Choctawhatchee and Pea rivers, *Notropis (Pteronotropis) merlini*, with a diagnosis of the *N. hypselopterus*-complex: *N. euryzonus, N. grandipinnis, N. hypselopterus, and N. merlini* (Geological Survey of Alabama Bulletin 170, 2001). The monograph treats Gulf slope *N. hypselopterus*, sans peninsular Florida and southeast Atlantic slope, and constitutes publication of a portion of Sutt's 1951 dissertation. Considerable information is treated, including an entwined taxonomic history and synonymy, resurrection of *P. grandipinnis* (Jordan), and usual morphological diagnosis and description, distribution, and zoogeography. The authors present argument for retaining subgeneric status of *Pteronotropis*. Unfortunately, gratis reprints were few and are exhausted; cost of the bulletin is exorbitant ($9 or $11?)—bad news for students.

Dennis Haney and colleagues, Furman College, South Carolina, reports they are conducting an interdisciplinary examination of the Enoree and Saluda River watersheds. The goal is to examine the interrelationships between land use, water chemistry and hydrology, and the biota of the streams. The ultimate goal is to provide baseline data in these drainages. In the Enoree and Saluda rivers, over 160 sites have been sampled in the past two years, with some interesting findings, including the discovery that the northern hog sucker, *Hypentelium*

nigricans is established in the Saluda

Jan Hoover reports the Fish Team at the Waterways Experiment Station (WES) in Vicksburg, Mississippi, which studies the effects of flood control, navigation, and habitat restoration projects on fish communities, was active in Region II. Full-time team members include Jack Killgore, Jan Hoover, Phil Kirk, Steven George, and Bradley Lewis. Adjunct members are Mississippi commercial fisherman Bill Lancaster, Tennessee Valley Authority (retired) larval fish taxonomist Bobby Wallus, and University of Louisiana professor emeritus Neil Douglas. Last summer, WES team members and Angie Haggard (now an instructor at Guilford Technical Community College in Jamestown, North Carolina) studied swimming performance of hatchery-reared juvenile Florida gar (*Lepisosteus platyrhincus*) in a laboratory swim tunnel. The 45-60 mm TL gar were weak (and sometimes erratic) swimmers, but sustained prolonged and burst speeds were measured, and a model of swimming endurance is in the works. The shortnose sturgeon (*Acipenser brevirostrum*), is being studied at Fort Stewart, Georgia. Pectoral spines collected by contractors are sectioned and read at WES and a model is under development for Army management of the Ogeeche River population. Other military work in this region consists of the final analyses of faunal survey data collected at Fort Gordon, Georgia. Fishes were collected by seine, and larval and juvenile fishes and invertebrates were collected in floating light-traps. The objective is to characterize quantitative relationships between aquatic animals and habitat features in this portion of the Savannah River.

The USGS group in Gainesville has had an active year. Leo Nico is involved in multiple studies of nonindigenous fishes: 1) Genetic characterization of multiple Asian swamp eel introductions (with Tim Collins and Joel Trexler of Florida International University). 2) Evaluation of ecosystem level effects and control methods for Asian swamp eels (with Bill Loftus and John Curnutt of USGS). 3) The influence of hydrology on life-history parameters of common freshwater fishes from south Florida (with Bill Loftus and Jeff Herod of USGS). 4) Reproduction of Asian swamp eels (Family: Synbranchidae, Genus: *Monopterus*): Relationships between blood steroid levels, gonad condition, and reproductive phrenology in introduced populations (with Tim Gross and Jeff Herod of USGS). 5) Risk assessment of introduced black carp (*Mylopharyngodon piceus*) and Asian swamp eel (genus: *Monopterus*) (with Jim Williams and Jeff Herod of USGS). He also is working with others in documenting the distribution and ecology of other nonindigenous fishes found in Florida and other parts of the US (particular focus is on cichlids and South American catfishes).

It was recently determined that Gainesville, Florida is the capital of senescing ichthyologists. At this writing, there are 10 in this area, yielding an unheard of ratio of 1 per 20,000 ordinary people. If you are an ichthyologist and thinking about retiring, DON'T COME HERE. We don't need you. The police already watch us; our phones are tapped; we are followed; 68% have unusual feelings about minnows and clupeids. Most recently, the AARC revoked Carter Gilbert's and Walt Courtney's cards for getting "butt naked" on a roadside after collecting. Notice: this facility will not lend waders anymore to elder ichthyologists or out-of-towners.

Howard Jelks and Frank Jordan (Loyola University of New Orleans) continue their visual survey monitoring program of the endangered *Etheostoma okaloosae*, now in its sixth year. They have included additional sites, some of which correspond to the recently initiated monitoring of immature aquatic insects. This summer they plan to compare quantitative seining with visual survey techniques. A sediment study conducted by Howard and myself (effects on suspended sediment on the reproductive successes of tricolor shiners, *C. trichroistia*) will appear in the September issue of Transactions of the American Fisheries Society. Carter Gilbert and Jim Williams continue the long term Florida fish book project. Steve Walsh and I are assisting Jim in completing the descriptions of the *Percina* sp. cf. *macrocephala* forms in the Coosa, Tallapoosa, and Black Warrior river systems. Additionally, Steve has received funding to survey for peripheral fishes (to Florida) in the Escambia River. Jim and Carter recently began revision of the *Audubon Field Guide to the Fishes*; this version omits marine mammals, which were curiously included in the first edition. However, why not have guides to the Mice and Minnows of Alabama, or darters, Dace, and Dugongs of Illinois? Steve Walsh, Howard Jelks, Jim Williams are among those spearheading a Suwannee River initiative, an effort to establish baseline data on one of the few un-impounded, large southeastern rivers. Given the increased interest in interbasin transfer as a solution to cities that have surpassed their immediate resources, the Suwannee River will only increase in attractiveness. Tampa has already considered such transfers.

We were fortunate to get USGS Species At Risk funding and support from the USFWS for survey work in the upper Coosa during summer 2000 for the study of putatively imperiled fishes. We made 148 focused collections in the area; these data should provide a comprehensive distributional snapshot of the study area. We discovered the introduced population of red shiners, *Cyprinella lutrensis*, in the upper Coosa River system has significantly spread since its discovery in the Etowah River in 1993. The insidious minnow had caused a hybrid swarm with the indigenous blacktail shiner, *C. venusta stigmatura*. Morphological investigation is underway of that hybrid and behavioral research (interactions among spawning adults) has been funded by the U.S. Fish and Wildlife Service. Most recently, Ryan Evans discovered *C. lutrensis* in Rock Creek (a Holly Creek tributary), the only remaining Conasauga River tributary still supporting a population of the threatened blue shiner, *C. caerulea*. More monitoring work will occur this summer for this nefarious exotic. There is legitimate concern it may threaten the largest population of blue shiners.

Note: I have endeavored to increase the contact list in Region II; anyone wishing to report research or conservation activities, or to have their name included on my email list, please contact me at noel_burkhead@usgs.gov.

Noel Burkhead

REGION III - North-Central

Status surveys and other interesting finds

As we have reported previously, the French Broad river, below Douglas Dam has shown improvement in the fish community in recent years. Fishes like tangerine and bluebreast darters (*Percina aurantiaca*, and *Etheostoma camurum*) were collected there for the first time in 1999, and other fishes known from that stretch of river have become more abundant, including blue suckers (*Cycleptus elongatus*) and snail darters (*Percina tanasi*). Also, Jim Layzer (Tennessee Cooperative Fisheries Research Unit, formerly listed as Tennessee Tech) reported that he has a graduate student doing a larval survey of this stretch of the French Broad River.

In summer 2000, biologists from the Southeast Aquatic Research Center (SARI), TVA, Tennessee Wildlife Resources Agency (TWRA), U.S. Fish & Wildlife Service (FWS), and the Tennessee Cooperative Fisheries Research Unit again stocked lake sturgeon in the French Broad River below Douglas dam. Follow-up surveys in this stretch of river have resulted in the observation or collection of four individuals in tailwater samples.

There are four other reports of sturgeon (none are well-documented) from Tennessee. TVA fisheries biologists recently heard reports of two possible lake sturgeon catches in the Tennessee system. Charlie Saylor heard reports that crappie fishermen, fishing with minnow-tipped jigs, caught a lake sturgeon in Norris Reservoir (Anderson Co., TN). The fish was released, but was reportedly three to four feet long, and ~50 pounds. Although it can't be verified, the size of this animal indicates it could have resulted from 1993 stockings TVA made in the Clinch River upstream of Norris Reservoir. Donnie Lowery, a TVA fishery biologist, also heard a report of a recent catch of "a big fish with barbels, that wasn't a catfish" from Nickajack Reservoir on the Tennessee system (Marion Co., TN). Also, Rick Bivens (TWRA) received a report that a fisherman caught and released a 14 inch sturgeon in upper Watts Bar Reservoir (near the I-75 bridge, Loudon Co., TN). It seems possible that some of the individuals stocked upstream of Fort Loudoun reservoir (beginning in 1999) could have moved this far downstream in the Tennessee system. Also, according to Rob Todd of the TWRA, Mr. Thomas Cunningham, a commercial fisherman, reported the recent catch of a 12-14 pound sturgeon in Old Hickory Reservoir on the Cumberland River (Wilson/Sumner counties). The fish was taken from a 3-inch-mesh gill net, and released alive. Since Etnier & Starnes list no pallid or shovelnose sturgeon in the Cumberland River, at least since the locks were put in place, this is likely to be a lake sturgeon. The last reports of lake sturgeon from the Cumberland system were two individuals collected in 1977 and 1978.

TVA crews continue to sample approximately 200 sites across the watershed, annually, which often results in interesting fish finds. For example, another interesting collection includes a report from Amy Wales of a blotchside logperch, *P. burtoni*, in little Buffalo River (Lewis Co., TN). TVA biologists again collected blue suckers *Cycleptus elongatus* in the Nolichucky River, while gathering information for an Environmental Impact Statement on ways to address the effects of accumulated sand and silt in Nolichucky Reservoir. The recent (summer 2000) TVA fish surveys basically confirmed the results of a TWRA survey in the Nolichucky River (Greene Co., TN) in 1999. At a TVA "fixed" IBI site on the Holston River upstream of Cherokee Reservoir (Surgoinsville, Hawkins Co., TN), Charlie Saylor reports regularly collecting one or two spotfin chubs, *Erimonax* (=*Cyprinella*) *monacha*. However, this year (2001) they found 16 juveniles, indicating continued improvement of this spotfin chub population.

Recent improvements in the water quality of the Pigeon River (French Broad watershed, Sevier Co., TN), prompted Tennessee Department of Environment & Conservation (TDEC) biologists (and many other cooperators) to begin a long-term project to restore native fishes to the Pigeon River. A committee of knowledgeable individuals (including Etnier, Saylor, etc. . .) put together a list of fishes known or likely to have inhabited the Pigeon River before they were extirpated by water quality problems related to paper company effluent upstream in NC. The committee decided to start with relatively common fishes that could be collected in large numbers elsewhere in the French Broad system. To date, several hundred elastomer-tagged adult blueside and gilt darters (*E. jessiae* and *Percina evides*) have been released at specific sites in the Pigeon River. University of Tennessee graduate students, and others will monitor the success of this project.

Once again, attempts by several survey crews (Univ. Alabama, Univ. of Tennessee, Conservation Fisheries, Inc., CFI) to find slender chubs (*Erimystax cahni*) at Frost Ford in the Clinch River, were unsuccessful. However, for the second consecutive year, two pygmy madtoms (*Noturus stanauli*) were collected there. These were kept live, and added to the captive population at CFI. Six pygmy madtoms that CFI had reared from a captive spawning of the pair collected in 2000 were released back into the Clinch River on that same date.

Tyler Sykes, of the Cookeville office of FWS, reported that Rick Mayden and his crew from the University of Alabama have been conducting a survey for the elusive "Chucky" madtom. This is another fish whose status is apparently extremely tenuous. Only one individual has been collected in the past several years, in spite of intensive surveys.

Tyler also reported that the FWS is supporting a graduate student from the Tennessee Cooperative Fisheries Research Unit (supervised by Jim Layzer) to perform a status survey of the bluemask darter [*E.* (*Doration*) sp.]. Presumably, this data will allow for an assessment of the current status of the species in comparison with data presented in Steve Layman's pre-listing surveys.

The creek didn't rise too much, and the Duckfest did take place, when on 3-4 June 2000, 32 biologists, representing at least ten different institutions or agencies converged on the lower end of the Duck River. They collected at least 78 species of fishes by various means. If you're interested in seeing how hard they worked, and exactly what species they collected, Jon Ambruster has created a nice website (http://george.cosam.auburn.edu:591/Duckfest/duckfest.html) containing information about this field trip.

Ben Keck, a U.T. graduate student is starting a project on the fishes of the Hatchie River system. He will be repeat surveying the sites that Wayne Starnes surveyed in the 1970's,

and adding some others.

The updated 2nd printing of the Fishes of Tennessee should be available by mid- or late summer. Etnier has permission from UT Press to reproduce the seven pages or so of addenda, and about four pages of corrections. He plans on having these printed for distribution (at cost—should be small).

Captive propagation, reintroduction, and other management activities

Pat Rakes and J. R. Shute (CFI) report that they still maintain captive populations of: *Erimonax monacha; Notropis mekistocholas; N. cahabae; Fundulus julisia; Noturus baileyi; N. flavipinnis; N. stanauli; N. stimosus* (Hatchie River form); *E. boehlkei; Etheostoma chienense; E. wapiti; E. percnurum; Percina copelandi*; *P. aurora*; and *P. aurolineata*. In addition to those reported previously, recent successful captive spawnings include *Noturus stanauli, N. bailey* and *N. stigmosus*.

As previously reported, spotfin chubs, and smoky and yellowfin madtoms (*Erimonax monacha, N. baileyi,* and *N. flavipinnis)*, were again captively propagated and reintroduced into Abrams Creek in the Great Smoky Mountains National Park, (Blount County, TN). No duskytail darters were stocked in 2000. Finally, reproduction was documented for all four of the reintroduced fishes in Abrams Creek, as several young-of-year spotfin chubs were observed, and individuals of all four reintroduced populations were observed on most monitoring surveys. Duskytail darters are regularly nesting in Abrams Creek and their numbers are increasing every year.

The status of *Fundulus julisia,* Barrens topminnow continues to be tenuous. In fact, for the second consecutive year (1999 and 2000) it became necessary to "rescue" Barrens topminnows remaining in the type locality pond (Summittville Mountain Spring, or as most folks know it, "Joe Banks' place", Coffee Co., TN) before the spring dried up. Topminnows were maintained at the CFI facility in Knoxville, and released back into the spring when water returned. Those released back into the spring in 2000 reproduced and all came through the winter of 2000-2001. Tyler Sykes, of the FWS, reports several activities that will hopefully improve the status of this fish. A "Barrens Topminnow Memorandum of Understanding" has been circulated among the organizations and agencies interested in the conservation of the species. It outlines recommendations of the Barrens Topminnow Working Group. One of these activities is a cooperative effort (FWS, TWRA, CFI, the Natural Resources Conservation Service, The Nature Conservancy, and the Tennessee Cooperative Fisheries Research Unit, and several private landowners) to establish about a half dozen refugia populations for the topminnows. When a suitable area has been created or enhanced, captively produced topminnows will be reintroduced. In conjunction with this, Jim Layzer's graduate student, Andrea Johnson, will help by monitoring the success of these reintroduction efforts. Another part of the working group's efforts will be public education. To help with this, Joe Tomelleri has recently finished a Barrens Topminnow illustrations (another one of his wonderful prints). Copies of this print will be provided to cooperating landowners.

J.R. Shute & Pat Rakes (CFI) released 290 captively propagated subadult and adult boulder darters, *Etheostoma wapiti*, at two sites on the Elk River (of the Tennessee system, Giles & Lincoln Cos., TN). While many of these were stocked at a site where a cooperative project (TWRA, FWS, TVA, CFI) had resulted in augmenting boulder habitat, the majority were stocked upstream of Harms Mill dam a few miles below Fayetteville, which J.R. and Pat had determined to be a significant barrier, after surveys in 1999. Before releasing the darters, Pat and J.R. snorkeled at the site of habitat augmentation (at the I-65 bridge, Giles Co., TN), and noted that the boulder darter population size has apparently increased here, probably as a result of the rocks that have been placed there the previous year. Tyler Sykes (FWS) reported that more of this habitat augmentation is planned for this summer (2001).

Tyler Sykes (FWS) reported that her office has a project to improve habitat in Bayou de Chien (Graves & Hickman Cos., KY), for relict darters (*E. chienense*). They are working with NRCS personnel and several landowners to implement agricultural Best Management Practices, and restore riparian vegetation.

As reported previously, there have been several proposals for reintroducing fish, snails, and mussels into appropriate habitats within the Tennessee system. Recently, (Federal Register 66:32250- 32264, June 14, 2001) the establishment of Nonessential Experimental Population Status was published for 16 freshwater mussels and one freshwater snail in the free-flowing reach of the Tennessee River below the Wilson Dam (Colbert and Lauderdale Cos., AL).

Also as we reported last year, spotfin chubs are one of four fish species proposed for reintroduction at several sites in the Tennessee system. However, to date, only one Nonessential Experimental Population status proposed rule has been published. This proposal (Federal Register 66:30853-30860, June 8, 2001) proposes to reintroduce duskytail darter, and smoky and yellowfin madtoms, in addition to the spotfin chub, into the Tellico River upstream of the Tellico Reservoir (Monroe Co., TN). Comments on this proposal are requested before August 7, 2001. If successful, these reintroductions could eventually lead to down-listing, or de-listing these fishes from the federal Endangered Species List.

Peggy W. Shute and David A. Etnier

REGION IV - South-Central

Mel Warren at the Southern Research Station, USDA Forest Service in Oxford, Mississippi reports that he, Andy Sheldon (visiting research scientist), and Wendell Haag have initiated a yearlong study examining the colonization by small-stream fishes of wood bundles placed in two channelized and two unchannelized streams in north Mississippi. They are examining colonization in mid-channel and near the bank with depth and flow as covariates. Susie Adams is leading a study of fish recolonization of first through third-order streams in north Mississippi that dried up during the 2000 drought. She is also examining longitudinal changes in growth and fecundity of certain groups of darters and minnows in the Sipsey Fork and

Brushy Creek in Bankhead National Forest, Alabama. Fish density and richness was much lower in spring 2001 than during 1994 sampling, possibly due to last summer's drought. Susie is also beginning a study with Steve Ross, University of Southern Mississippi, in examining the distribution and habitat use of *Acipenser oxyrinchus desotoi*, *Alosa alabamae*, and *Anguilla rostrata* in Black and Red creeks, De Soto National Forest, Mississippi. The Oxford crew is also conducting the third summer of fish and fish habitat surveys in Mississippi National Forests. To date, 148 sites have been sampled yielding about 110 species. On the mussel front, Wendell Haag is leading the third year of a study on the population size, age and size structure, size and age-specific fecundity, mortality, individual growth rates, and recruitment rate for about twelve species in the Sipsey River in Alabama, and the Little Tallahatchie and Buttahatchee rivers in Mississippi. The ultimate goal is to build population models that will evaluate how changes in these variables influence population growth rate and viability. Mel also reports that his group will be repeating a 1993 survey of mussel communities in Bankhead National Forest with a goal of deriving an accurate picture of the size structure of some populations. Research on Shoal Creek in Talladega National Forest, Alabama, will continue examining the headwater populations of mussels highly fragmented by a series of small dams, which includes two T & E species. Additional mussel studies include an attempt to identify fish hosts for several species from the Buttahatchee River, Mississippi. Along with Chuck Lydeard and Jen Buhay at the University of Alabama, the Oxford crew is continuing a study on patterns of host fish use and genetic variation across the range of *Villosa vanuxemensis*, *V. lienosa*, and *V. ortmanni*, which have shown some surprising patterns, especially in the upper Coosa River drainage. And finally, Andy Sheldon is finishing a yearlong comprehensive survey of stoneflies in two watersheds of the Ouachita Mountains at 38 stations. About 31 species have been identified; high species richness has been noted from seasonally dry streams, and several range extensions have been documented.

Jan Hoover reports that the Waterways Experiment Station (WES) Fish Team in Vicksburg, Mississippi continued field surveys of all three *Scaphirhynchus* species with varying degrees of success. Efforts to capture *S. suttkusi* for broodstock were part of a massive interagency effort. Despite setting numerous baited trotlines as well as one multi-organizational 24-hour fish-a-thon at the Claiborne Lock and Dam, none were collected. Sturgeon studies by WES in the lower Mississippi River were substantially more productive. From August to December 2000, hundreds of *S. platorynchus* were collected as well as six indisputable *S. albus*. For each sturgeon, data were recorded on geographic position, water quality, river morphometry, co-occurring fish species, and any morphological anomalies. To date, approximately 5% of shovelnose sturgeon collected exhibited some kind of deformity including missing tails, reduced pectoral fins, missing eyes, and curved spinal columns. One sturgeon was missing a rostrum. Numerous sturgeon were encircled by rubber bands, either around the rostrum or around the pectoral girdle, causing varying degrees of injury or debilitation. Other research by WES includes sampling streams of the Yazoo River system in Mississippi to determine long-term effects of dredging and weirs on fish assemblages.

Mark Peterson at the Gulf Coast Research Lab in Ocean Springs, Mississippi has co-authored four papers on marine and estuary fishes. These studies have examined laboratory and field growth responses of juvenile *Mugil* sp. and *Cynoscion arenarius*, respectively, using various ambient conditions, as well as the effects of habitat alterations on habitat use by early life history stages of fishes and crustaceans. Four other papers are in review on additional estuarine fishes and their habitat, reproductive biology, and status. Mark will graduate two masters students and his first Ph.D. student this year.

J.R. Shute reports that Conservation Fisheries (CFI) of Knoxville, Tennessee has been successfully spawning *Percina aurolineata* again this year; they have collected more eggs than ever before. Work still needs to be done on survivorship of the hatchlings, specifically getting the pelagic larvae to feed properly. Three *P. aurora* (a male and two females) were obtained from the crew at the University of Alabama, who collected these specimens this spring from the Leaf River. Although it appeared these darters were almost done with their spawning season, CFI managed to collect a few fertilized eggs and hatch them out. The information gained from this trio should help lay the groundwork for future spawning activities. Lastly, CFI has been successfully spawning *Etheostoma chienense* with relative ease. This species spawns under the surface of ceramic tiles in the tank, and the larvae are relatively easy to rear as they feed well on brine shrimp nauplii.

Scott Mettee of the Geologic Survey of Alabama reports that the second printing (3,000 copies) of Fishes of Alabama and the Mobile Basin, including several important corrections, is available from the publication sales office at the Survey. Scott and Royal Suttkus have released a Survey Bulletin examining four species of *Notropis* within the subgenus *Pteronotropis*, with comments on relationships, origins, and dispersion. Pat O'Neil and Tom Shepard published two Survey reports last year, one on water-quality assessment of the lower Cahaba River watershed and another on application of the index of biotic integrity for assessing biological condition of wadeable streams in the Black Warrior River system. Tom and Pat are completing reports on a water-quality study in Locust Fork and a land use/biomonitoring study in Mulberry Fork, both of which will be published by the Survey. They will initiate a study on the status of *Notropis cahabae*, *Etheostoma douglasi*, and *Percina brevicauda* in Locust Fork this summer. Stuart McGregor published one paper last year on recent mussel records from the North River system. He also has two papers in press, one on the mussel fauna of the Muscle Shoals area co-authored with Jeff Garner (ADCNR) and another on the mussels in the Cahaba River with Malcolm Pierson and Pat O'Neil. Stuart and Jeff are also conducting mussel surveys in the upper Tombigbee River proper and several of its major tributaries, and Stuart is continuing his Alabama cave shrimp monitoring project at Redstone Arsenal near Huntsville. The entire Survey crew will be involved in completing level 3 (IBI) fish bioassessments for TVA in north Alabama and will continue their biological sampling for EPA 319 projects in Lightwood Creek in south central Alabama and Choccolocco Creek in northeast Alabama. Finally, the sonic tracking work with *Cycleptus meridionalis*

continues to produce some interesting data on fish movements in the Alabama River. The project was expanded last year to include sonic tagging of a few *Moxostoma carinatum* and *Ictiobus bubalus*, and Scott will continue tagging these species this year, as well as *Polyodon spathula*. One unexpected opportunity this year was the tagging of the first *M. carinatum* (a 515 mm SL female) ever collected downstream of Claiborne Lock and Dam.

Malcolm Pierson reports that Alabama Power Company is involved with divers using surface-supplied air to search for T & E mussels below all of the Coosa River hydro projects. These projects must be relicensed by 2007 if they are to continue operation. They are finding several species of mussels in these tailwater habitats, but to date, no T & E species have been observed. Malcolm also reports that Alabama Power has begun fish and mussel surveys in the original Coosa River channel below the Weiss diversion dam with assistance from the USGS Florida Caribbean Science Center and the Alabama Cooperative Fisheries and Wildlife Research Center. Preliminary reports should be available in late 2001.

Carl Couret of the USFWS in Daphne, Alabama reports that a collaborative effort between the his agency, World Wildlife Fund, Alabama Department of Conservation and Natural Resources, and the Corps of Engineers is underway to explore fish passage options at Claiborne Lock and Dam on the Alabama River. Options range from structural approaches (i.e., nature-like bypass channel, slotted/baffled "ladder", and fish lift) to more economic non-structural approaches (i.e., modified locking operations). Since these facilities are not passing a significant number of barges, Carl believes they could be operated to pass fish, at least during critical times of the year. A trial "passage" was recently performed, and gill netting of fishes leaving the upstream gates demonstrated low numbers of specimens but a respectable diversity. Species captured included typical big-river ichthyofauna, as well as two species of diadromous fishes, *Alosa alabamae* and *Morone saxatilis*. This trial operation demonstrated excellent potential for this project. Data on the movement of several fish species within the Alabama River are being gathered by the Geologic Survey of Alabama to assist in further development of this fish passage concept.

Frank Parauka of the U.S. Fish and Wildlife Service in Panama City, Florida reports that a survey of *Acipenser oxyrinchus desotoi* was conducted in the lower Choctawhatchee River during October and November 2000, to coincide with the species fall migration from freshwater to the marine environments. Sinking gill nets were set perpendicular to the riverbank and covered about 75 percent of the river. A total of 196 Gulf sturgeon were collected, weighed, measured, tagged (external Floy tags and injected PIT tags) and released. The fish ranged from 0.8 – 2.3 m total length and weighed from 2.2 – 66.7 kg. Sub adults (<18.1 kg) represented 38.8 percent of the sample and large fish (>45.4 kg) accounted for 11.7 percent of the catch. The two largest fish were equipped with external LTD (light, temperature, depth) archival tags, which are able to fix the location of the specimen by calculating the angle of the sun. The fish must be recaptured in order to retrieve the tag and download the information. Frank's office is also conducting a survey to determine the availability of Gulf sturgeon spawning habitat in Florida panhandle river systems. The objective is to create a map identifying sites that have characteristics (steep bluffs, limestone outcroppings, hard substrate, etc.) similar to previously documented Gulf sturgeon spawning sites. Frank also reports that a 17 minute video describing the life history and biology of the Gulf sturgeon, as well as the recovery efforts underway to restore the species to a level that would ultimately result in its delisting, was completed in 2000. The video was produced by Earthwave Productions in cooperation with the Fish and Wildlife and the US Army Corps of Engineers. Frank's office also coordinated the distribution of 2 million Phase I *Morone saxatilis* raised at Federal and State hatcheries in FL, GA, AL, MS and LA. The fish were stocked in river systems and impoundments throughout the southeast. In addition, over 100,000 Phase II (150 – 200 mm) specimens were stocked in the lower Apalachicola River. Lastly, Frank reports that his office and offices in Daphne, AL, and Baton Rouge, LA expended 65 field days in an effort to capture *Scaphirhynchus suttkusi* in the Alabama River. Ninety-five percent of the sampling effort in the Alabama River was between River Mile 39 and 65.5, with the remainder at River Mile 22. Baited trotlines and sinking gill nets were used to collect over 1,900 fish representing 25 different species, but no Alabama sturgeon were collected.

Carter Gilbert at the University of Florida in Gainesville reports that he and Rick Mayden, along with Steve Powers, are actively pursuing descriptions within the eastern *Macrhybopsis aestivalis* complex. Three of the four eastern species are new, and Carter has written a taxonomic key, diagnoses, and descriptions for all four species; Rick and Steve are working on genetics and statistical analyses of morphometric data. Carter has been receiving a number of old collections dating back to the 1870's and 1880's from Butler University that were discovered just a few years ago. Included are a number of O. P. Hay collections from Mississippi and Kansas, the results of which were summarized in three publications (two in Proc. USNM and one in Bull. U.S. Fish Commission) between 1881 and 1887. Also included are a few lots from west Florida (published by Hay in Proc. USNM in 1885). In addition, there are substantial remnants of a number of late-1870's Jordan collections from Georgia and South Carolina, mostly from the Saluda River near Greenville. A few types are present, including some previously thought to have been destroyed in the Indiana University fire of 1883. Also present are some lots received on exchange from the USNM; a few types are also present in these materials. Jordan started the collection during the couple of years he spent at Butler, and curation was later done by Hay. Carter is cataloguing these into the University of Florida collection. When he is done, Carter plans to publish this information along with the history of the Butler collection. Lastly, Carter and Jim Williams are revising the Audubon fish field guide, originally published about 20 years ago. Jim is handling the freshwater fishes and Carter is tackling the marine species; they should complete this project this summer.

Steve Walsh at the U.S. Geological Survey in Gainesville, Florida reports that he is continuing his involvement in a USGS National Water-Quality Assessment project to examine land-use patterns along a land-urban gradient in the Mobile Basin (Birmingham area) and the effects on water quality. Water

quality will be assessed with hydrology, hydrochemistry, and biological conditions (fishes, benthic invertebrates, algae, and habitat). This work is in conjunction with the Alabama office of the USGS Water Resources Division; Humbert Zappia is the collaborating biologist involved in this study. Steve has targeted 30 sites in the limestone/dolomitic portion of the Valley and Ridge province along a southwest to northeast swath of the Cahaba and middle/upper Coosa rivers that encompasses a broad gradient of varying levels of urbanization. All streams are first or second-order and were seriously affected by drought last year. Within Florida, Steve expects funding from the state for a one-year survey of the Escambia River for *Moxostoma carinatum*, *Crystallaria asprella*, and *Hybognathus hayi*. Due to these species limited ranges and low abundance, all are of special concern in the state.

At the University of Alabama, the big news is that Rick Mayden will be leaving later this summer to chair the Department of Biology at Saint Louis University and to assume an endowed chair research position. The opportunity to take a leadership role in a department and to move back to his home area was too good for Rick to pass up. I will be staying on as Collections Manager to continue the operations at UAIC until another Curator can be hired next year. Rick and Herb Boschung have secured the Smithsonian Press as a publisher for The Fishes of Alabama, and the project is nearing completion. Rick and his students and staff continue research on the systematics, conservation, and ecology of all three *Scaphirhynchus* species, *Notropis cahabae*, Catostomidae, several *Noturus* species, *Lepomis megalotis*, all Centrarchidae species, *Etheostoma ditrema*, snubnose darters, and several logperch species.

Bernie Kuhajda

REGION V - Northwest

Susan Rogers with Ecological Services Office (Conway, AR), U.S. Fish and Wildlife Service, reports that *Etheostoma moorei*, the yellow cheek darter, has been elevated to federal candidate species status, and it has been given a fairly high priority for listing. The species is endemic to the Little Red River (White River drainage), and its current distribution is restricted to four tributaries upstream of Greers Ferry Reservoir. Drought conditions over the past three years are thought to have reduced the available habitat for yellow cheeks to small sections of the four tributaries and population numbers are thought to have severely declined. Arkansas State University – Jonesboro faculty and graduate students are investigating reproductive biology and the feasibility of captive propagation.

Henry Robison at Southern Arkansas University, reports that he is conducting status reviews for *Notropis ortenbergeri* (Kiamichi shiner) and *Notropis perpallidus* (salt and pepper shiner) that are funded by the Ouachita National Forest. Also, a second edition of the Fishes of Oklahoma is underway, and a planned revision to the Fishes of Arkansas with Tom Buchanan will be underway soon.

Richard Standage, Forest Fisheries Biologist with Ouachita National Forest, reports that Arkansas and Oklahoma biologists are continuing annual monitoring of leopard darter (*Percina pantherina*) populations. Also, Edie Marsh-Matthews and colleagues, University of Oklahoma, have completed leopard darter movement studies in the Glover River, OK and in laboratory settings. Finally, Arkansas Tech University students and faculty are being funded by Ouachita National Forest to examine fish passage at Forest road crossings as a function of stream order.

John L. Harris

REGION VI - Southwest

Henry W. Robison, Southern Arkansas University, is currently conducting a study of the distribution and status of the peppered shiner (*Notropis perpallidus*), in Oklahoma and Arkansas for the Ouachita National Forest. In addition, Rob is finishing up a report to the Forest Service on the status and distribution of the Kiamichi shiner *(Notropis ortenburgeri*). Rudy Miller (retired from Oklahoma State University) and Rob are now busy at work on a revision of their "Fishes of Oklahoma" book which is hoped to be completed in two years. "The Fishes of Arkansas" is also about to under a revision for a second edition by Rob and Tom Buchanan (Westark College). Much summer field work is planned to re-photograph many of the species and to document some poorly collected areas of Arkansas.

The Waterways Experiment Station Fish Team has several ongoing projects in Lousiana and southern Arkansas. A study of fish-habitat relationships in the Red River, Louisiana, and the possible impacts of lock-and dams on fish communities, is nearing completion . Surveys of physical habitats and fish communities in the channel and floodplains of Bayou Meto are underway as part of an evaluation of the effects of water diversion in the Arkansas River system. Surveys of fishes and larval amphibians are also being conducted in small floodplain pools of the Ouachita River, Louisiana and Bayou Meto, Arkansas. On a recent field trip to Bayou Meto, young-of-year bowfin (*Amia calva*) were observed in an isolated floodplain puddle at the edge of a campground. As part of the ongoing effort by WES to document swimming performance of small, archaic fishes, a group was captured and taken to the laboratory as future participants in swim tunnel experiments.

Karen Kilpatrick, Natchitoches National Fish Hatchery, organized and breathed new life into the Pallid Sturgeon Lower Basin Work Group. A meeting held 20 March 2001 in Vicksburg, Mississippi was well-attended by individuals from the US Fish and Wildlife Service, US Army Corps of Engineers, Mississippi Museum of Natural Science, Arkansas Game and Fish Commission, and the Louisiana Department of Wildlife and Fisheries. Topics included the updated recovery plan, health issues and the possible threat of iridovirus, jeopardy opinions, and the activities of fish hatcheries. Bernie Kuhajda, University of Alabama, presented a lively and thorough synopsis of taxonomic and genetic issues surrounding identification of river

sturgeons. The latter part of the meeting was devoted to issue identification in which research and management priorities were identified and assigned to group participants. The priorities included: evaluation and refinement of techniques for practical and reliable identification of sturgeon (e.g., character indices); location of rearing grounds for young-of-year (e.g., by trawling for very small fish); quantification of habitats and periods of greater activity and abundance (e.g. surveys of populations and physical habitats); and outreach (i.e., creation of a list server).

Jan Hoover

NEWS and NOTES

David G. Lindquist (1946 - 2001)

Dr. David Gregory Lindquist, a long time member of the Southeastern Fishes Council, died at home on January 3, 2001 after a prolonged fight with cancer. Dave, a southern California native, received his Bachelor's degree from UCLA, his Master's degree from California State University at Hayward and Moss Landing Laboratories, and his Ph.D from The University of Arizona. He joined the faculty of the University of North Carolina at Wilmington in 1975. His contributions to the understanding of southeastern fishes are many and diverse.

At UNCW, in addition to being curator of fishes for a 35,000 lot fish collection used for research and reference, he taught popular (although demanding) classes on ichthyology and behavior of reef fishes. In addition to direct supervision of the many undergraduate and graduate students who were involved in his research, Lindquist was the Assistant Chair for graduate students which involved encouraging and mentoring many more.

He was principal investigator for one of the U.S. Fish & Wildlife Service's first Section 6, Endangered Species projects at Lake Waccamaw, NC, and continued his research career with many other grants. Because of his success in obtaining grants, he was inducted into the UNCW club that honors researchers bringing in more than a million dollars in funding. Some of these other research topics included: natural and artificial reefs off the North Carolina coast, the behavioral ecology of blennies in the Adriatic Sea, the effects of fertilizer run-off in coastal North Carolina environments, and tuna and mackerel off Cape Hatteras. He was author or co-author in more than 91 scientific publications and three books on the biology of fishes. During his career at UNCW, he was also a senior Fulbright Research Scholar to Austria.

Many of Lindquist's undergraduate students continued graduate studies in ichthyology. He encouraged them to attend scientific meetings where there are opportunities to meet the ichthyology "legends". Many of those students now have careers as university or government biologists, and also are productive Southeastern Fishes Council members.

J.R. and I personally benefited from Dave's love for fish and his enthusiasm to teach others what he knew. We were undergraduates in biology at UNCW, where most students were interested in marine life. When we showed some interest in freshwater fishes, he encouraged us to do an independent study project at nearby Lake Waccamaw, known for several endemic fishes. That encouragement sparked the lifelong interest for both of us and set the tone for the rest of our education and careers to follow. He also was determined to live life to the fullest extent possible. We witnessed this about a year before he died when he showed up at Lake Waccamaw with his waders and his bag seine ready to collect fishes like he had done years before! The courage he showed while battling cancer was an inspiration to those who knew him.

Peggy W. Shute

Southeastern Fishes Council
Proceedings

Information For Contributors

The primary purpose of the *Proceedings* is to publish peer-reviewed research papers and critical reviews of activities; regional reports and notes; and other pertinent information pertaining to the biology and conservation of southeastern fishes. The *Proceedings* is also an outlet for range extensions, distributions, and status papers, covering ecology and conservation ichthyology. Life history studies, faunal surveys, management issues, behavior, genetics and taxonomy of southeastern fishes are appropriate topics for papers in the *Proceedings*. Review papers or information on imperiled waters or fishes are particularly appropriate.

Manuscripts should be submitted in duplicate. A good guide for manuscript preparation is the Sixth Edition of the *CBE Style Manual* available form the Council of Biology Editors, One Illinois Center, Suite 200, 111 East Wacker Drive, Chicago, IL 60601-4298.

The entire manuscript including the Abstract (required for longer articles), Introduction, Methods, Results, Discussion, Acknowledgments, Literature Cited, Appendices, Tables, and Figure Legends must be double-spaced. The title, author's name and author's address (including fax number and email address for corresponding author) should be centered on the first page. Indicate a suggested running head of less than ten words at the bottom of the first page. An Abstract (if necessary) will be placed at the beginning of the text. Acknowledgments will be cited in the text immediately before the Literature Cited. All references cited in the paper will follow the standard format of using the last name of the author(s) followed by the year of publication of the paper. In the Literature Cited, the references will be alphabetical by the author's last name and chronological under a single authorship. Literature cited should be standardized and abbreviated, using the *World List of Aquatic Sciences And Fisheries Serial Titles* or guidelines in *CBE Manual for Authors, Editors, and Publishers 6th ed.* for journals not included in the *World List*.

Tables should be typed on a separate page, consecutively numbered and should have a short descriptive heading. Figures (to include maps, graphs, charts, drawings and photographs) should be consecutively numbered and if grouped as one figure each part block lettered in the lower left corner. Computer-generated graphics should be high quality prints; for drawings, high quality prints or photocopies are preferred to the original line art. Legends for figures must be on a separate sheet and each figure must be identified on the back. The desired location of each table or figure should be indicated in the margin of the manuscript. When possible, tables and figures will be reduced to one column width (3.5 in), so lettering on figures should be of appropriate size. Color figures can be printed at the author's expense.

Manuscripts will be subject to editing and will be reviewed by at least two anonymous persons knowledgeable in the subject matter. The edited manuscript and page proofs will be furnished to the author. Upon returning the reviewed and corrected manuscript to the editor, a PC disk copy of the final form of the text, tables and computer-generated graphics are also requested. Specific formatting information for the disk will be sent to the author with the edited manuscript. Reprints can be ordered at the time of printing, and will be supplied to the author at the cost of printing.

Regional reports, news notes and other short communications will also be edited and included when possible in the next number.

Only manuscripts from members of The Southeastern Fishes Council will be considered for publication. There is no charge for publishing in the *Proceedings*. All manuscripts and short communications should be sent to the editor:

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