FISHERIES REPORT
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WARMWATER STREAM FISHERIES REPORT
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Cover: A new addition to Tennessee's fish fauna, the **Laurel Dace** ***(Phoxinus saylori)***, inhabits small woodland streams flowing through the Walden Ridge region of the Cumberland Plateau (photo by Carl Williams).

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INTRODUCTION

The fish fauna of Tennessee is the most diverse in the United States, with approximately 297 species of native fish and about 26 to 29 introduced species (Etnier and Starnes 1993). Region IV has 7,837 km of streams that total approximately 5,711 ha in 21 east Tennessee counties. There are approximately 1,287 km classified as coldwater streams. Streams in Region IV, except for a few in Anderson, Campbell, and Claiborne counties (Cumberland River System streams) are in the Ridge and Valley and Blue Ridge physiographic provinces of the upper Tennessee River drainage basin. The main river systems in the region are the Clinch, Powell, Little Tennessee, mainstream Tennessee River, French Broad, Nolichucky and Holston.

Streams and rivers across the state are of considerable value as they provide a variety of recreational opportunities. These include fishing, canoeing, swimming, and other riverine activities that are unmatched by other aquatic environments. Streams and rivers are also utilized as water sources both commercially and domestically. The management and protection of this resource is recognized by Tennessee Wildlife Resources Agency (TWRA) and has been put forth in the Strategic Plan (TWRA 2000) as a primary goal.

This is the fourteenth annual report on stream fishery data collection in TWRA's Region IV. The main purpose of this project is to collect baseline information on game and non-game fish and macroinvertebrate populations in the region. This baseline data is necessary to update and expand our Tennessee Aquatic Database System (TADS) and aid in the management of fisheries resources in the region.

Efforts to survey the region’s streams have led to many cooperative efforts with other state and federal agencies. These have included the Tennessee Department of Environment and Conservation (TDEC), Tennessee Valley Authority (TVA), U.S. Forest Service (USFS), Oak Ridge National Laboratory (ORNL), and the National Park Service (NPS).

The information gathered for this project is presented in this report as river and stream accounts. These accounts include an introduction describing the general characteristics of the survey site, a study area and methods section summarizing site location and sampling procedures, a results section outlining the findings of the survey(s), and a discussion section, which allows us to summarize our field observations and make management recommendations.

METHODS

The streams to be sampled and the methods required are outlined in TWRA field request No. 00-4. A total of 6 streams were sampled and are included in this report. Stream surveys were conducted from July to October 2000. Seventy (1 IBI and 69 CPUE) fish samples and one benthic sample were collected.

SAMPLE SITE SELECTION

Index of Biotic Integrity (IBI) sample sites were selected that would give the broadest picture of impacts to the watershed. We typically located our sample site in close proximity to the mouth of a stream to maximize resident species collection. However, we positioned survey sites far enough upstream to decrease the probability of collecting transient species. Large river sampling sites (Holston, South Fork Holston, French Broad, Pigeon, and Little Pigeon rivers) were selected based on the length of the river and available access points. Typically we selected sample areas in these rivers that represented the best available habitat for any given reach being surveyed. Sampling locations were delineated in the field on 7.5 minute topographical maps and then digitally re-created using a commercially available software package.

WATERSHED ANALYSIS

Watershed size and/or stream order has historically been used to create relationships for determining maximum expected species richness for IBI analysis. This has been accomplished by plotting species richness for a number of sites against watershed areas and/or stream orders (Fausch et al. 1984). We chose to use watershed area (kilometer^2) to develop our relationships as this variable has been shown to be a more reliable variable for predicting maximum species richness. Watershed areas **(the area upstream of the survey site)** were determined from USGS 1:24,000 scale maps.

FISH COLLECTIONS

Fish data were collected by employing a slightly modified (Saylor and Alstedt 1990) Index of Biological Integrity (Karr et al. 1986). Fish were collected with standard electrofishing (backpack) and seining techniques. A 3 x 1.3 meter seine was used to make hauls in shallow pool and run areas. Riffle and deeper run habitats were sampled with a seine in conjunction with a backpack electrofishing unit (100-600 VAC). An area approximately the length of the seine^2 (i.e., 3 meter x 3 meter) was electrofished in a downstream direction. A person with a dipnet assisted the person electrofishing in collecting those fish, which did not freely drift into the seine. Timed (5-min duration) backpack electrofishing runs were used to sample shoreline habitats. In both cases (seining or shocking) an estimate of area (meter^2) covered on each pass was calculated. Fish collections were made in all habitat types within the selected survey reach. Collections were made repeatedly for each habitat type until no new species was collected for three consecutive samples for each habitat type. All fish collected from each sample were enumerated and in the case of game fish, lengths and weights obtained. Anomalies (e.g., parasites, deformities, eroded fins, lesions, or tumors) were noted along with occurrences of hybridization. After processing, the captured fish were either held in captivity or released into the stream where they could not be recaptured.

Catch-per-unit-effort samples (CPUE) were conducted in five rivers during 2000. Timed boat electrofishing runs were made in pool and shallower habitat where navigable. Efforts were made to sample the highest quality habitat in each sample site and include representation of all habitat types typical to the reaches surveyed. Total electrofishing time was calculated and was used to determine our catch-effort estimates (fish/hour).

Generally, fish were identified in the field and released. Problematic specimens were preserved in 10% formalin and later identified in the lab or taken to Dr. David A. Etnier at the University of Tennessee Knoxville (UTK). Most of the preserved fish collected in the 2000 samples were catalogued into our reference collection or deposited in the University of Tennessee Research Collection of Fishes. Common and scientific names of fishes used in this report are after Robins et al. (1991) and Etnier and Starnes (1993).

AGE and GROWTH

In order to address management questions pertaining to the age and growth characteristics of stream dwelling smallmouth bass (*Micropterus dolomieu*), spotted bass (*M. punctulatus*), largemouth bass (*M. salmoides*) and rock bass (*Ambloplites rupestris*) populations, statewide collection of otolith samples was initiated in 1995 by regional stream crews. Otoliths were extracted from black bass and rock bass for age and growth analysis. Efforts were made to collect a representative sample of all age classes of black bass and rock bass in each river.

BENTHIC COLLECTIONS

Qualitative benthic samples were collected from each IBI fish sample site. These were taken with aquatic insect nets, by rock turning, and by selected pickings from as many types of habitat as possible within the sample area. Taxa richness and relative abundance are the primary considerations of this type of sampling. Taxa richness reflects the health of the benthic community and biological impairment is reflected in the absence of pollution sensitive taxa such as Ephemeroptera, Plecoptera, and Trichoptera (EPT).

Large particles and debris were picked from the samples and discarded in the field. The remaining sample was preserved in 50% isopropanol and later sorted in the laboratory. Organisms were enumerated and attempts were made to identify specimens to species level when possible. Many were identified to genus, and most were at least identified to family. Dr. David A. Etnier (UTK), examined problematic specimens and either made the determination or confirmed our identifications. Comparisons with identified specimens in our aquatic invertebrate collection were also useful in making determinations. For the most part, nomenclature of aquatic insects used in this report follows Brigham et al. (1982) and Louton (1982). Names of stoneflies

(Plecoptera) are after Stewart and Stark (1988) and caddisflies are after Etnier et al. (1998), from which many of the determinations were made. Benthic results are presented in tabular form with each stream account.

WATER QUALITY MEASUREMENTS

Basic water quality data were taken at most sites in conjunction with the fishery and benthic samples. The samples included dissolved oxygen (DO), temperature, pH, and conductivity. Data were taken from midstream and mid-depth at each site, using a YSI model 58 DO meter and a YSI model 33 S-C-T meter. Scientific Products™ pH indicator strips were used to measure pH. Stream velocities were measured with a Marsh-McBirney Model 201D current meter. The Robins-Crawford "rapid crude" technique (as described by Orth 1983) was used to estimate flows. Water quality parameters were recorded on physicochemical data forms and are included with each stream account.

DATA ANALYSIS

Twelve metrics described by Karr et al. (1986) were used to determine an IBI score for each stream surveyed. These metrics were designed to reflect fish community health from a variety of perspectives (Karr et al. 1986). Given that IBI metrics were developed for the midwestern United States, many state and federal agencies have modified the original twelve metrics to accommodate regional differences. Such modifications have been developed for Tennessee primarily through the efforts of the TVA and Tennessee Tech University. In developing our scoring criteria for the twelve metrics we reviewed pertinent literature [North American Atlas of Fishes (Lee et al. 1980), The Fishes of Tennessee (Etnier and Starnes 1993), various TWRA Annual Reports and unpublished data] to establish historical and more recent accounts of fishes expected to occur in the drainages we sampled. Scoring criteria for the twelve metrics were modified according to watershed size. Watersheds draining less than 13 kilometer^2 were assigned different scoring criteria than those draining greater areas. This was done to accommodate the inherent problems associated with small stream samples (e.g., lower catch rates and species richness). Young-of-the-year fish and non-native species were excluded from the IBI calculations. After calculating a final score, an integrity class was assigned to the stream reach based on that score. The classes used follow those described by Karr et al. (1986) and are as follows:

Total IBI score (sum of the 12 metric ratings)	**Integrity Class**	**Attributes**
58-60	Excellent	Comparable to the best situations without human disturbance; all regionally expected species for the

		habitat and stream size, including the most intolerant forms, are present with a full array if size classes; balanced trophic structure.
48-52	Good	Species richness somewhat below expectation, especially due to the loss of the most intolerant forms; some species are present with less than optimal abundance or size distributions; trophic structure shows some signs of stress.
40-44	Fair	Signs of additional deterioration include loss of intolerant forms, fewer species, highly skewed trophic structure (e.g., increasing frequency of omnivores and green sunfish or other tolerant species); older age classes of top predators may be rare.
28-34	Poor	Dominated by omnivores, tolerant forms, and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; hybrids

		and diseased fish often present.
12-22	Very poor	Few fish present, mostly introduced or tolerant forms; hybrids common; disease, parasites fin damage, and other anomalies regular.
	No fish	Repeated sampling finds no fish.

Catch per unit effort analysis was performed on the five large rivers sampled during 2000. Total time spent electrofishing at each site was used to calculate the CPUE estimates for each species collected. Length categorization analysis (Gabelhouse 1984) was used to calculate Proportional Stock Density (PSD) and Relative Stock Density (RSD) for black bass and rock bass populations sampled during 2000. Annual mortality rates for black bass and rock bass were estimated (when the data met the criteria) according to the procedures described by Van Den Avyle (1993).

Benthic data collected for the 2000 surveys were subjected to a biotic index that rates stream condition based on the overall taxa tolerance values and the number of Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa present. The North Carolina Division of Environmental Management (NCDEM) has developed a bioclassification index and associated criteria for the southeastern United States (Lenat 1993) . This technique rates water quality according to scores derived from taxa tolerance values and EPT taxa richness values. The final derivation of the water quality classification is based on the combination of scores generated from the two indices. The criteria used to generate the biotic index values and EPT values are as follows:

Score	Biotic Index Values	EPT Values
5 (Excellent)	< 5.14	> 33
4.6	5.14-5.18	32-33
4.4	5.19-5.23	30-31
4 (Good)	5.24-5.73	26-29
3.6	5.74-5.78	24-25
3.4	5.79-5.83	22-23
3	5.84-6.43	18-21
2.6	6.44-6.48	16-17
2.4	6.49-6.53	14-15
2	6.54-7.43	10-13
1.6	7.44-7.48	8-9
1.4	7.49-7.53	6-7
1 (Poor)	> 7.53	0-5

The overall result is an index of water quality that is designed to give a general state of pollution regardless of the source (Lenat 1993). Taxa tolerance rankings were based on those given by NCDEM (1995) with minor modifications for taxa, which did not have assigned tolerance values.

RIVER and STREAM ACCOUNTS

Holston River

Introduction

The Holston River represents a valuable recreational resource to the state as it provides water based recreation to several communities, towns, and cities along its course. It is also an important source of drinking water for many populations between Kingsport and Knoxville. Through history, the Holston River, has been subjected to many man-induced alterations including channelization, damming, and pollution. Two dams regulate most of the flow outside of tributaries that enter the river above and below these dams. Fort Patrick Henry Dam located on the South Fork Holston River near Kingsport controls the river between Boone Reservoir and Cherokee Reservoir. Releases from Fort Patrick Henry coincide with lake level management activities and the need for cooling water at the TVA John Sevier steam plant near Rogersville. With the completion of Cherokee Dam in 1941, much of the free flowing characteristics of the river basin within Tennessee were eliminated. Although a "controlled" river, the Holston still boasts a fairly diverse fish assemblage and is home to at least two threatened species (spotfin chub *Cyrpinella monacha* and snail darter *Percina tanasi*) and thirteen species of freshwater mussels (Ahlstedt 1986).

Our 2000 surveys focused on characterizing black bass and rock bass population dynamics and developing a fish species list for TADS. Historical surveys have been conducted on the river by various agencies, with the majority of these focusing on community assessment.

Study Area and Methods

The Holston River originates near Kingsport with the confluence of the North Fork Holston and South Fork Holston rivers. These rivers along with the Middle Fork all originate in Virginia. The Holston flows in a southwesterly direction before combining with the French Broad River to form the headwaters of the Tennessee River. The river has a drainage area of approximately 9,780 km^2 at its confluence with the French Broad River. In Tennessee, approximately 184 kilometers of the Holston River flows through the Ridge and Valley ecological province before joining the French Broad River near Knoxville. Public access along the river is primarily private, however, there are some "pull-outs" along public roads paralleling the river. The TWRA manages three public access areas along the river, which include boat ramps near Hunt Creek, the community of Surgoinsville, and Nance Ferry downstream of Cherokee Dam. TVA maintains access below John Sevier Steam Plant and immediately below Cherokee Dam. The cities of Church Hill and Kingsport both have public ramps at their city parks.

Between July 24 and August 3, 2000, we conducted 28 fish surveys between Kingsport and Knoxville (Figure 1). Because this river is a tailwater, habitat availability fluctuates with

Figure 1. Site locations for samples conducted on the upper (A) and lower (B) Holston River during 2000.

Figure 1 (A)

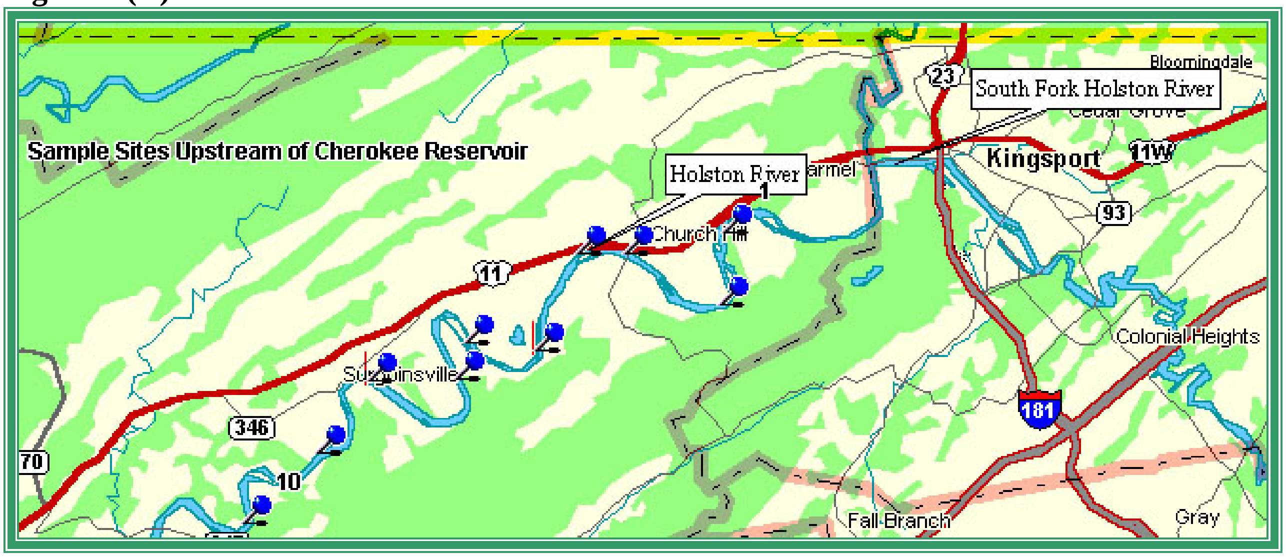
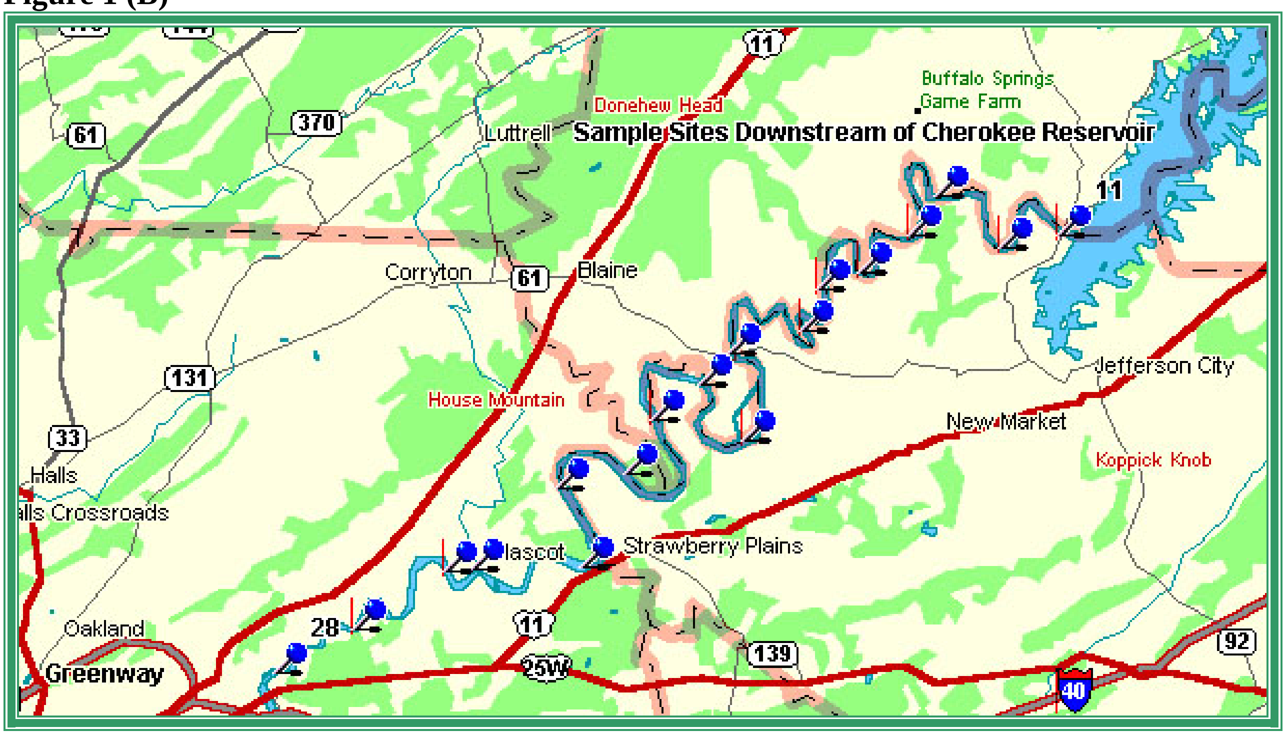


Figure 1 (B)



water releases. However, in our survey sites, the habitat consisted primarily of wooded shorelines with interspersed rock outcroppings. Submerged woody debri was scarce in most of our sample areas. The river substrate was predominately bedrock and boulder with some cobble in the riffle areas. Star grass and river weed were prolific in the section of river above the John Sevier Stream Plant, but were virtually non-existent below Cherokee Dam. Measured channel widths ranged from 56 to 169 m, while site lengths fell between 125 and 1108 m (Table 1).

Water temperatures ranged from 21.5 to 25 C upstream of Cherokee Reservoir and 16 to 22.5 C downstream of Cherokee Reservoir. Conductivity varied from 265 to 320 μs/cm (Table 1). There were no noticeable differences in conductivity for samples taken upstream of and downstream of Cherokee Reservoir.

Table 1. Physiochemical and site location data for samples conducted on Holston River during 2000.

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420000601	1	Hawkins	Church Hill 188SW	136.3	363126N	824054W	127	1108	21.5	290	0.9
420000602	2	Hawkins	Lovelace 189NW	134.1	362955N	824053W	123	596	22	285	0.9
420000603	3	Hawkins	Church Hill 188SW	131.5	363110N	824323W	111	375	23	280	0.9
420000604	4	Hawkins	Church Hill 188SW	130.1	363100N	824323W	164.5	468	23	285	0.9
420000605	5	Hawkins	Stony Point 180NE	127.5	362854N	824545W	145	576	24	265	0.9
420000606	6	Hawkins	Stony Point 180NE	125.5	362901N	824733W	80	678	22.5	275	0.5
420000607	7	Hawkins	Stony Point 180NE	122.6	362815N	824748W	169	429	22.5	275	0.5
420000608	8	Hawkins	Stony Point 180NE	118.8	362818N	825018W	139	419	25	280	0.9
420000609	9	Hawkins	Stony Point 180NE	115.8	362640N	825132W	117	427	25	320	0.9
420000610	10	Hawkins	Burem 180NW	112.7	362509N	825328W	122.5	424	25	290	0.9
420000611	11	Grainger/Jefferson	Joppa 155NE	52	361004N	833015W	134.5	625	16	270	2
420000612	12	Grainger/Jefferson	Joppa 155NE	49.5	360945N	833142W	111.5	533	17	270	2
420000613	13	Grainger/Jefferson	Joppa 155NE	47	361046N	833118W	100	568	17	270	2
420000614	14	Grainger/Jefferson	Joppa 155NE	46	361000N	833354W	113.5	1024	19	280	2
420000615	15	Grainger/Jefferson	Joppa 155NE	41.8	360916N	833516W	98	522	20	280	2+
420000616	16	Grainger/Jefferson	Joppa 155NE	38.8	360859N	833606W	134.5	468	20	285	2+
420000617	17	Grainger/Jefferson	Joppa 155NE	37.5	360809N	833637W	68	125	19	280	2+
420000618	18	Grainger/Jefferson	Luttrell 155NW	33.1	360740N	833819W	115	210	21	285	2+
420000619	19	Grainger/Jefferson	Mascot 155SW	31	360559N	833751W	56	377	21	300	2+

Table 1. Continued on next page

Table 1. Continued

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420000620	20	Grainger/Jefferson	Mascot 155SW	28	360707N	833905W	137.5	654	21.5	300	2+
420000621	21	Grainger/Jefferson	Mascot 155SW	25.5	360624N	834014W	124.5	554	22.5	290	2+
420000622	22	Jefferson/Knox	Mascot 155SW	22	360519N	834058W	140.5	428	19	285	N/A
420000623	23	Jefferson/Knox	Mascot 155SW	19.7	360503N	834226W	144	554	20	295	2+
420000624	24	Knox	Mascot 155SW	17	360325N	834200W	107.5	443	21	290	2+
420000625	25	Knox	Mascot 155SW	14	360324N	834442W	74.5	337	22	310	2+
420000626	26	Knox	John Sevier 146SE	11.4	360324N	834441W	107.5	589	22	300	2+
420000627	27	Knox	John Sevier 146SE	9	360214N	834734W	80	404	22	295	2+
420000628	28	Knox	John Sevier 146SE	6.2	360122N	834932W	117.5	440	21	295	2+

Fish were collected by boat electrofishing in accordance with the standard large river sampling protocols (TWRA 1998). Fixed-boom electrodes were used to transfer 4-5 amps DC at all sites. This current setting was determined effective in narcotizing all target species (black bass and rock bass). With the exception of black bass, all fish collected were returned to the river. Additionally, efforts were made to identify non-target species encountered at each survey site. All sites were sampled during daylight hours and had survey durations ranging from 900 to 1448 seconds. Catch-per-unit-effort (CPUE) values were calculated for each target species at each site. Length categorization indices were calculated for target species following Gabelhouse (1984).

Results

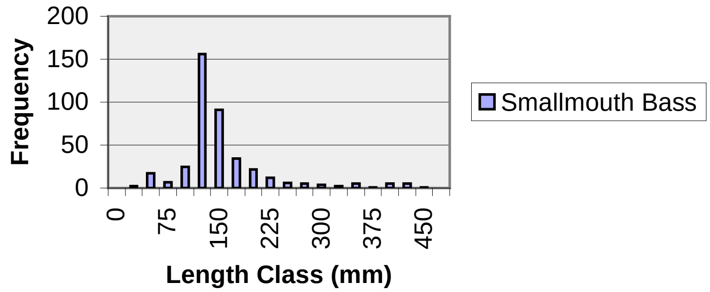
CPUE estimates for smallmouth bass averaged 52.9/hour (SD 34.3), while the spotted bass and largemouth bass estimates were 8.2/hour (SD 12.9) and 4.7/hour (SD 6.5), respectively (Table 2). There was a general trend of increasing catch rate for smallmouth bass for samples downstream of Cherokee Reservoir (sites 11-28) (Table 2). Largemouth and spotted bass appeared to be most abundant in the lower reaches of the river. Rock bass CPUE was highest in the downstream sample sites (downstream of Cherokee Reservoir) and averaged 25.0/hour (SD 38.9). The highest catch rate for this species was recorded at site 17 (188.4/hour), which was 653% above the 28 site average.

Table 2. Catch per unit effort and length-categorization indices of target species collected at twenty-eight sites on the Holston River during 2000.

Site Code	Smallmouth Bass CPUE	Spotted Bass CPUE	Largemouth Bass CPUE	Rock Bass CPUE
420000601	59.7	0	5.0	9.9
420000602	41.8	0	0	38.3
420000603	55.9	0	4.0	23.9
420000604	31.1	0	0	11.7
420000605	43.8	0	4.0	4.0
420000606	35.9	0	0	3.6
420000607	23.8	4.0	4.0	59.5
420000608	63.2	0	2.9	11.5
420000609	7.8	0	0	0
420000610	15.9	0	11.9	8.0
420000611	7.8	7.8	19.5	0
420000612	55.9	0	0	0
420000613	27.9	0	0	11.9
420000614	11.9	0	0	0
420000615	95.6	0	0	15.9
420000616	131.7	0	0	4.0
420000617	102.1	0	0	188.4
420000618	39.8	4.0	27.8	63.6
420000619	51.8	47.8	8.0	83.7
420000620	78.5	15.7	7.9	3.9
420000621	59.9	16.0	8.0	4.0
420000622	79.8	4.0	4.0	0
420000623	119.2	15.9	4.0	39.7
420000624	103.4	31.8	0	51.7
420000625	23.9	20.0	8.0	8.0
420000626	66.1	11.7	0	11.7
420000627	11.9	11.9	7.9	19.8
420000628	35.8	39.7	4.0	23.8
MEAN	**52.9**	**8.2**	**4.7**	**25.0**
STD. DEV.	**34.3**	**12.9**	**6.5**	**38.9**
	Length-Categorization Analysis	**Length-Categorization Analysis**	**Length-Categorization Analysis**	**Length-Categorization Analysis**
	PSD = 28.3	PSD = 66.7	PSD = 52.6	PSD = 28.2
	RSD-Preferred = 18.5	RSD-Preferred = 33.3	RSD-Preferred = 15.8	RSD-Preferred = 8.7
	RSD-Memorable = 4.3	RSD-Memorable = 0	RSD-Memorable = 0	RSD-Memorable = 0
	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0

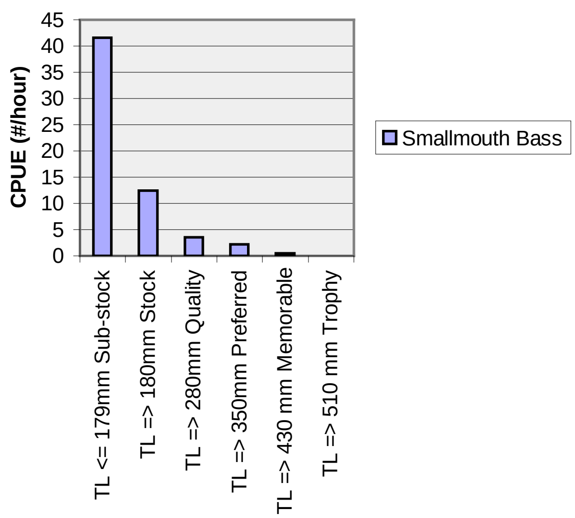
The majority of the smallmouth bass collected from the Holston River during 2000 fell within the 100 mm to 225 mm length range (Figure 2). Our data indicated that bass less than 100 mm, were not completely vulnerable to the sampling gear. Length categorization analysis

Figure 2. Length frequency distribution for smallmouth bass collected from the Holston River during 2000.



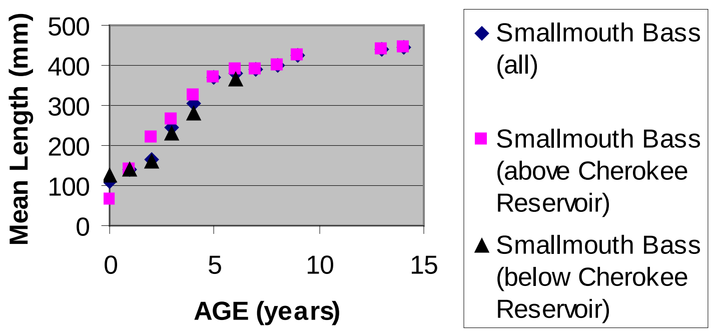
indicated the Relative Stock Density (RSD) for preferred smallmouth bass (TL ≥ 350 mm) was 18.5. RSD for memorable (TL ≥ 430 mm) and trophy (TL ≥ 510 mm) size bass were 4.3 and 0, respectively. The PSD of smallmouth bass (ratio of quality size bass to stock size bass) was 28.3. Catch per unit effort estimates by RSD category indicated smallmouth bass had the highest catch rates of any of the black bass species collected for the category RSD-Q and above. The catch of sub-stock smallmouth was quite high which indicated good recruitment (Figure 3). Overall, growth rates for smallmouth in the whole system were very similar to values reported for the statewide average for age groups represented in the 2000 sample (Figure 4).

Figure 3. Relative stock density (RSD) catch per unit effort by category for smallmouth bass collected from the Holston River during 2000.



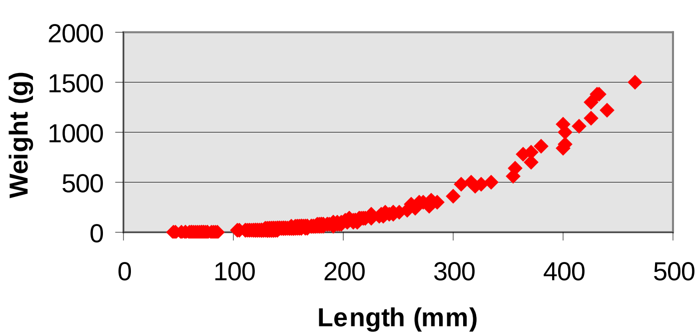
However, upon closer examination of the data for smallmouth upstream and downstream of Cherokee Reservoir it is apparent that there is a significant discrepancy in size and age structure (Figure 4). The population upstream of Cherokee Reservoir exhibits characteristics similar to those surveyed in other rivers of east Tennessee (Carter et al. 1999,2000). The population structure of smallmouth bass below the reservoir is characterized by slower growth and truncated age structure. This type of age and size distribution has not been observed in any other Tennessee river surveyed to date.

Figure 4. Mean length at age for smallmouth bass collected from the Holston River (all), above, and below Cherokee Reservoir during 2000.



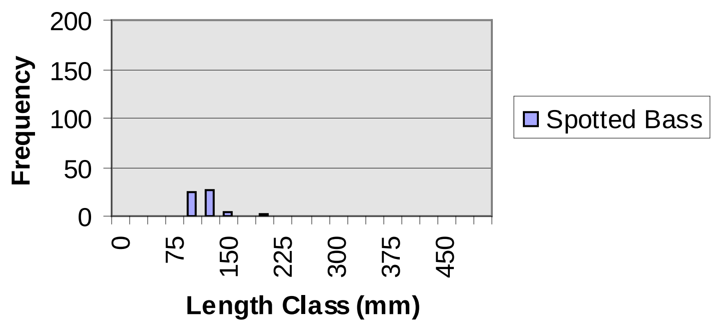
Linear and curvilinear length-weight regression analysis indicated steady growth through the 500 mm length range and yielded a length-weight equation of –5.3 + 3.2x (Figure 5) for the overall population. Growth for bass downstream of Cherokee Reservoir was substantially slower than those upstream of the reservoir. Overall, growth statistics (Von Bertalanffy, 1938) calculated for the total population predicted a maximum length of 499.5 mm (19.6 in), for the bass population upstream of Cherokee Reservoir the value was slightly lower (457.6 mm, 18 in). Because of the relative absence of older age groups in the bass population downstream of the reservoir, no meaningful predictions on maximum length could be generated. Overall, the annual mortality rate for smallmouth bass ages 2-4 in the Holston River was 76%.

Figure 5. Curvilinear length-weight relationships for smallmouth bass collected from the Holston River during 2000.



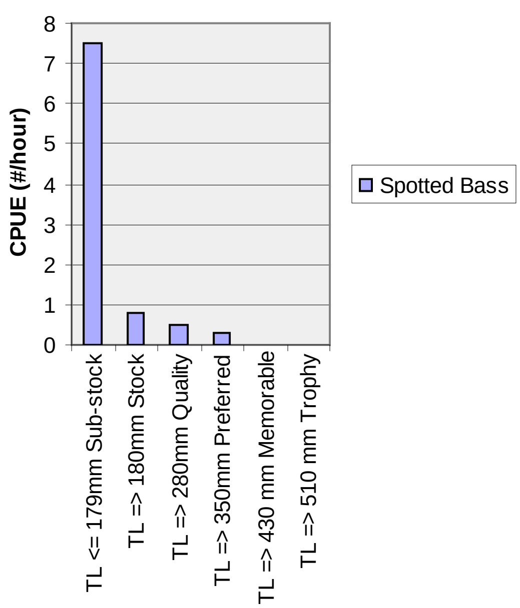
The majority of spotted bass collected from the Holston River during 2000 fell within the 100 to 175 mm length range (Figure 6). Our data indicated that fish less than 100 mm, were for the most part, not effectively sampled. Length categorization analysis indicated the RSD

Figure 6. Length frequency distribution for spotted bass collected from the Holston River during 2000.



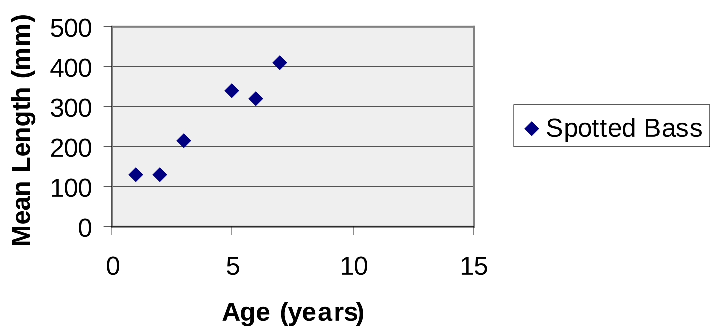
for preferred spotted bass (TL ≥ 350 mm) was 33.3. RSD for memorable (TL ≥ 430 mm) and trophy (TL ≥ 510 mm) size bass was 0. The PSD of spotted bass was 66.7. Catch per unit effort estimates by RSD category revealed very few spotted bass above the RSD-S category, indicating a relative lack of larger fish available to anglers (Figure 7). Additionally, the catch rate for sub-stock spotted was fairly good relative to the other categories, however, recruitment into the larger size classes was poor.

Figure 7. Relative stock density (RSD) catch per unit effort by category for spotted bass collected from the Holston River during 2000.



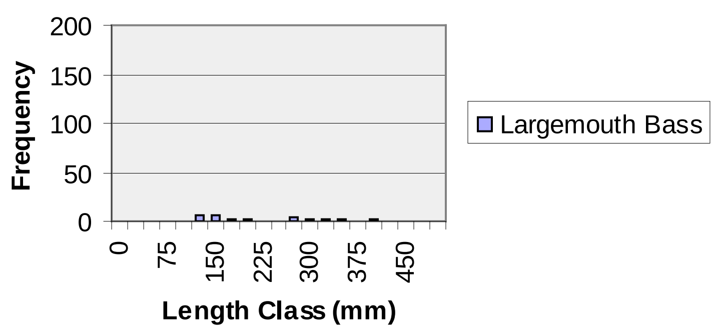
Due to the sporadic and unpredictable collection of riverine spotted bass, characterization of age and growth dynamics for this species is less than optimal. The sample of spotted bass collected from the Holston in 2000, was no different than most of the previous samples collected in east Tennessee (exception Nolichucky River). Age and growth structure of Holston River spotted bass was similar to other east Tennessee populations for the ages represented (Figure 8). Because of the limited data available for spotted bass from the Holston River, no meaningful results could be generated for mortality or potential population growth.

Figure 8. Mean length at age for spotted bass collected from the Holston River during 2000.



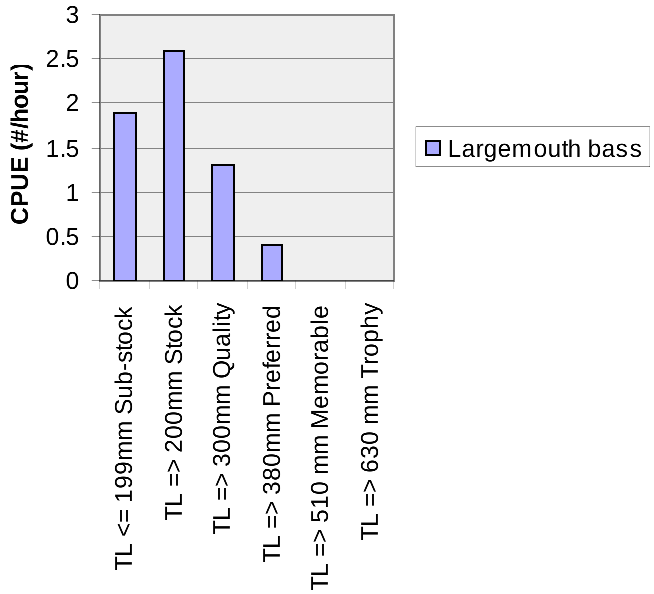
Largemouth bass collected during 2000 fell within the 125 to 200 mm length range (Figure 9). Length categorization analysis indicated the RSD for preferred largemouth bass

Figure 9. Length frequency distribution for largemouth bass collected from the Holston River during 2000.



(TL ≥ 380 mm) was 15.8. RSD for memorable (TL ≥ 510 mm) and trophy (TL ≥ 630 mm) size largemouth bass was 0. The PSD of largemouth bass was 52.6. The catch rate for largemouth bass in RSD-Q and above were very similar to the values observed for spotted bass (Figure 10). Poor recruitment was also evident by the relative lack of sub-stock largemouth bass; however, survival was good based on recruitment into the larger size categories.

Figure 10. Relative stock density (RSD) catch per unit effort by category for largemouth bass collected from the Holston River during 2000.

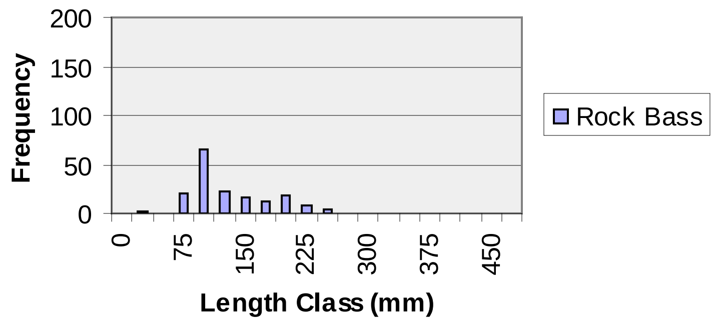


Age and growth determination for largemouth bass in the Holston River was based on 36 individuals from our 28 sample sites. Like, spotted bass the small sample size hinders any strong conclusions regarding growth characteristics of the population. Figure 11 below depicts mean length at age for largemouth bass collected from the Holston River during 2000. The majority of the population we were able to sample consisted of 1 and 2 year old fish (67%).

Figure 11. Mean length at age for largemouth bass collected from the Holston River during 2000.

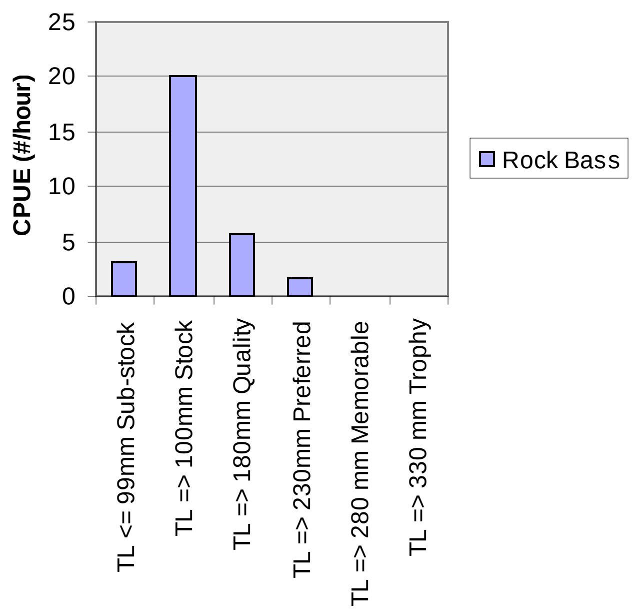
Individuals in the 100 to 150 mm range represented the majority of rock bass in our sample (Figure 12). Length categorization analysis indicated the RSD for preferred rock bass

Figure 12. Length frequency distribution for rock bass collected from the Holston River during 2000.



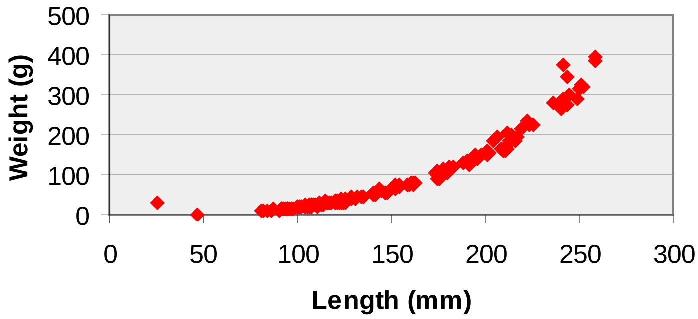
(TL ≥ 230 mm) was 8.7. RSD for memorable (TL ≥ 280 mm) and trophy (TL ≥ 330 mm) size rock bass was 0. The PSD of rock bass was 28.2. Catch per unit effort estimates by RSD category indicated the majority of our catch was stock size fish with few quality size rock bass represented in the sample (Figure 13). The sub-stock catch of rock bass was low, but probably does not indicate poor recruitment due to the fact that sampling efficiency is usually lower with this size group.

Figure 13. Relative stock density (RSD) catch per unit effort by category for rock bass collected from the Holston River during 2000.



Curvilinear and linear length-weight analysis indicated progressive growth through the represented length classes and yielded a length-weight equation of - 4.79 + 2.7x (Figure 14).

Figure 14. Curvilinear length-weight relationship for rock bass collected from the Holston River during 2000.



Because of our confidence in determining age and growth characteristics (based on previous samples) for rock bass in east Tennessee we did not collect any otolith samples from rock bass in 2000. Therefore, no mortality or potential population growth statistics could be calculated. Age and growth and mortality of rock bass in the Holston River are assumed to be similar to those reported for other east Tennessee populations (Carter et al. 1999, 2000).

Several other species were collected or observed (48) during our survey of the Holston River. One species (spotfin chub) collected in the 2000 sample is listed by the U.S. Fish and Wildlife Service as threatened. A list of species occurrence by site can be found in Table 3.

Table 3. Distribution of fish species collected from the Holston River during 2000.

Holston River Mile	136	134	131	130	127	125	123	119	116	113	52	49	47	46	42	39	37	33	31	28	25	22	19	17	14	11	9	6
Site Code	420000601	420000602	420000603	420000604	420000605	420000606	420000607	420000608	420000609	420000610	420000611	420000612	420000613	420000614	420000615	420000616	420000617	420000618	420000619	420000620	420000621	420000622	420000623	420000624	420000625	420000626	420000627	420000628
Species																												
Catostomidae																												
Black buffalo											*		*	*			*			*								
Black redhorse	*	*	*	*		*		*	*																			
Golden redhorse	*		*	*	*	*	*		*	*									*	*		*	*		*		*	*

Table 3. Continued on next page

Table 3. Continued

Holston River Mile	136	134	131	130	127	125	123	119	116	113	52	49	47	46	42	39	37	33	31	28	25	22	19	17	14	11	9	6
Site Code	4200000601	4200000602	4200000603	4200000604	4200000605	4200000606	4200000607	4200000608	4200000609	4200000610	4200000611	4200000612	4200000613	4200000614	4200000615	4200000616	4200000617	4200000618	4200000619	4200000620	4200000621	4200000622	4200000623	4200000624	4200000625	4200000626	4200000627	4200000628
Species																												
Smallmouth buffalo											*	*				*	*			*						*		
Northern hog sucker	*	*	*	*	*	*	*					*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*
River carpsucker		*		*		*			*		*																	
Quillback											*																	
Silver redhorse											*	*		*				*		*			*	*	*	*		*
Centrarchidae																												
Black crappie											*						*	*										
Bluegill	*		*		*		*		*	*	*	*				*		*	*		*	*		*	*		*	*
Green sunfish								*		*																		
Largemouth bass	*		*		*		*	*		*	*	*						*	*	*	*	*	*		*		*	*
Redbreast sunfish	*	*	*	*	*	*	*	*	*	*					*		*		*	*		*	*		*	*	*	*
Redear sunfish							*		*	*								*	*									
Rock bass	*	*	*	*	*	*	*	*		*			*		*	*	*	*	*	*	*		*	*	*	*	*	*
Smallmouth bass	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Spotted bass							*				*							*	*	*	*	*	*	*	*	*	*	*
Warmouth										*																		
White crappie																								*				
Clupeidae																												
Gizzard shad	*	*			*		*		*	*		*	*	*	*	*			*	*				*	*	*		*
Cottidae																												
Banded sculpin																*												
Cyprinidae																												
Bigeye chub				*																								
Bluntnose minnow		*																			*							
Carp	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Mimic shiner			*	*		*																						
River chub	*		*			*	*	*													*			*				
Rosyface shiner	*																											
Silver shiner		*																										
Spotfin chub							*																					
Spotfin shiner	*		*	*		*	*	*		*		*	*	*	*	*			*		*	*	*	*	*	*		*
Stoneroller	*	*	*	*	*								*	*		*		*										*

Table 3. Continued on next page

Table 3. Continued

Holston River Mile	136	134	131	130	127	125	123	119	116	113	52	49	47	46	42	39	37	33	31	28	25	22	19	17	14	11	9	6
Site Code	420000601	420000602	420000603	420000604	420000605	420000606	420000607	420000608	420000609	420000610	420000611	420000612	420000613	420000614	420000615	420000616	420000617	420000618	420000619	420000620	420000621	420000622	420000623	420000624	420000625	420000626	420000627	420000628
Species																												
Streamline chub	*					*		*																				
Striped shiner		*						*																				
Telescope shiner	*	*	*	*	*	*		*																				
Tennessee shiner							*																					
Warpaint shiner	*			*	*		*	*													*							
Whitetail shiner	*	*			*		*	*																				
Ictaluridae																												
Channel catfish										*	*			*		*			*	*	*	*	*	*	*			*
Yellow bullhead	*	*					*																					
Lepisosteidae																												
Longnose gar											*			*	*											*		
Moronidae																												
Striped bass											*				*		*											
Percidae																												
Greenside darter	*			*			*									*	*				*	*	*	*				
Logperch																	*		*			*	*	*		*	*	*
Redline darter							*																					
Sauger																						*	*					
Snubnose darter																	*			*						*		
Salmonidae																												
Rainbow trout													*	*														
Sciaenidae																												
Drum											*		*	*	*	*	*	*		*	*	*	*	*	*	*	*	*

Discussion

The Holston River has had a long history of degradation and misuse. Because of the hydropower facilities established on the river much of its free flowing characteristics have been lost, altering the aquatic community and its inhabitants. Mitigation efforts have been conducted in order to establish or re-establish certain suitable species in portions of the river, particularly downstream of Cherokee Reservoir. Between 1997 and 1999, 11,816, 30 to 75 mm smallmouth bass were stocked into the tailwater downstream of Cherokee Dam, in an attempt to bolster the existing population. A put-and-take rainbow trout (*Oncorhynchus mykiss*) fishery was established in the Cherokee tailwater and has become quite popular with local anglers. One threatened species, the snail darter, has been successfully re-introduced into the tailwater near Knoxville and there has been discussion of re-introducing selected mussel species into the river.

Efforts made by the Tennessee Valley Authority to improve water quality downstream of Cherokee Dam have for the most part been responsible for the observed improvements below the dam. Dissolved oxygen management in the forbay of Cherokee Lake has drastically improved the D.O. levels in the tailwater resulting in restoration projects that would have historically not been considered.

During the past five years there has been growing concern about the decline in the rock bass fishery in that portion of the river between the North Fork Holston and John Sevier Steam Plant. Our observations led us to conclude that much of the habitat in this portion of the river was not suitable for rock bass due the proliferation of aquatic vegetation, particularly river weed and star grass. Much of what would be considered suitable habitat has been "choked" out by extensive mats of vegetation, which in many cases, spans the entire width of the river channel. Where rock bass were collected in good numbers, there was a dominance of rocky habitat and an absence of aquatic vegetation. Based on conversations with local residents and TWRA personnel, this increase in aquatic vegetation has only occurred in the last few years. It is hard to speculate the reasons for the "perceived" increases, but it could be related to minimum flow regimes, nutrient loading or a combination. The occurrence of this aquatic vegetation has undoubtedly affected some species (and angling opportunities) and warrants further investigation.

The disparity in the age and growth of the smallmouth bass populations upstream and downstream of Cherokee Reservoir is of interest and can possibly be explained by the differences in average water temperature between the two reaches. Both reaches experience coldwater releases from dams, however, the upper reach receives significant warmwater input from the North Fork Holston River and potentially from the Eastman Chemical Plant. The portion of the Holston below Cherokee Dam does not have a tributary comparable to the North Fork, thus water temperatures would potentially remain depressed. This could be a factor in the observed decrease in growth rates for smallmouth bass downstream of Cherokee Dam and the stunted age structure. Minimum flow regimes downstream of Cherokee Dam may play a variable role (based on annual precipitation) in regulating this population.

Management Recommendations

1. Continue the rainbow trout put-and-take program.

2. Investigate the role of minimum flow regimes on aquatic vegetation abundance and bass population regulation.

3. All fingerling smallmouth bass stocked into the tailwater should be marked with oxytetracycline (OTC) to enable cohort evaluation.

4. Begin a comparison study of smallmouth bass population dynamics in various tailwaters that would include the Holston River.

5. Initiate an angler use and harvest survey.

6. Develop a fishery management plan for the river.

7. Include the section of river below Cherokee Dam in the annual trout tailwater surveys.

South Fork Holston River

Introduction

The South Fork Holston River originates in Widener Valley of southwest Virginia, flowing into Tennessee to form South Holston Reservoir. At this point the river loses its free flowing characteristics being controlled by South Holston Dam, Boone Dam, and Ft. Patrick Henry Dam before joining the North Fork Holston River near Kingsport. The South Fork Holston River in Tennessee is probably best known for the trout tailwater fishery that has been established below South Holston Dam. This resource has received nationwide recognition and is arguably the best trout tailwater in Tennessee. Our focus in evaluating the South Fork Holston River was confined to the reach of river downstream Ft. Patrick Henry Dam. This section of river has received little attention and is of interest to the agency due to the annual stockings of rainbow and brown trout. The tailwater receives about 10,000 rainbow trout and 3,000 brown trout (*Salmo trutta*) each year between the dam and Kingsport. We were also interested in assessing the black bass/rock bass fishery and developing a species list for TADS.

Study Area and Methods

The South Fork Holston River has a drainage area of 5,304 km^2 at its confluence with the North Fork near Kingsport. In Tennessee, the South Fork (South Holston Reservoir) skirts the Blue Ridge ecoregion and enters the Ridge and Valley ecoregion downstream of South Holston Dam. Access to Ft. Patrick Henry tailwater is limited in the upper reach. There is a primitive boat launch under the John B. Dennis Bridge that allows a limited number of anglers to access the river by boat. There is walk-in access just downstream of the dam on both sides of the river channel. The city of Kingsport has developed a greenway park from the Eastman Chemical property downstream to the North Fork Holston River. This provides several walk-in access points to the river and one developed boat ramp. Most of this portion of the river flows through urban and industrial settings with little of the natural riparian zone unimpacted.

On July 19, 2000 we sampled six sites between Ft. Patrick Henry Dam and the North Fork Holston River (Figure 15). Due to the fluctuation of flow in the river, habitat availability varies. The shoreline habitat consisted primarily of grass with short woodlots interspersed along the length of the river. Submerged woody debris was scarce in most of our sample areas. The river substrate was predominately bedrock and boulder with some cobble in the riffle areas. Measured channel widths ranged from 42 to 88.5 m, while site lengths fell between 208 and 1027 m (Table 4). Water temperatures ranged from 17 to 22 C. Conductivity varied from 185 to 240 μs/cm (Table 4). There was a noticeable increase in conductivity and temperature once we moved downstream of the Eastman Chemical Plant. Effluent from discharge pipes within the plant in all likelihood is responsible for the elevated values.

Figure 15. Site locations for samples conducted on the South Fork Holston River during 2000.

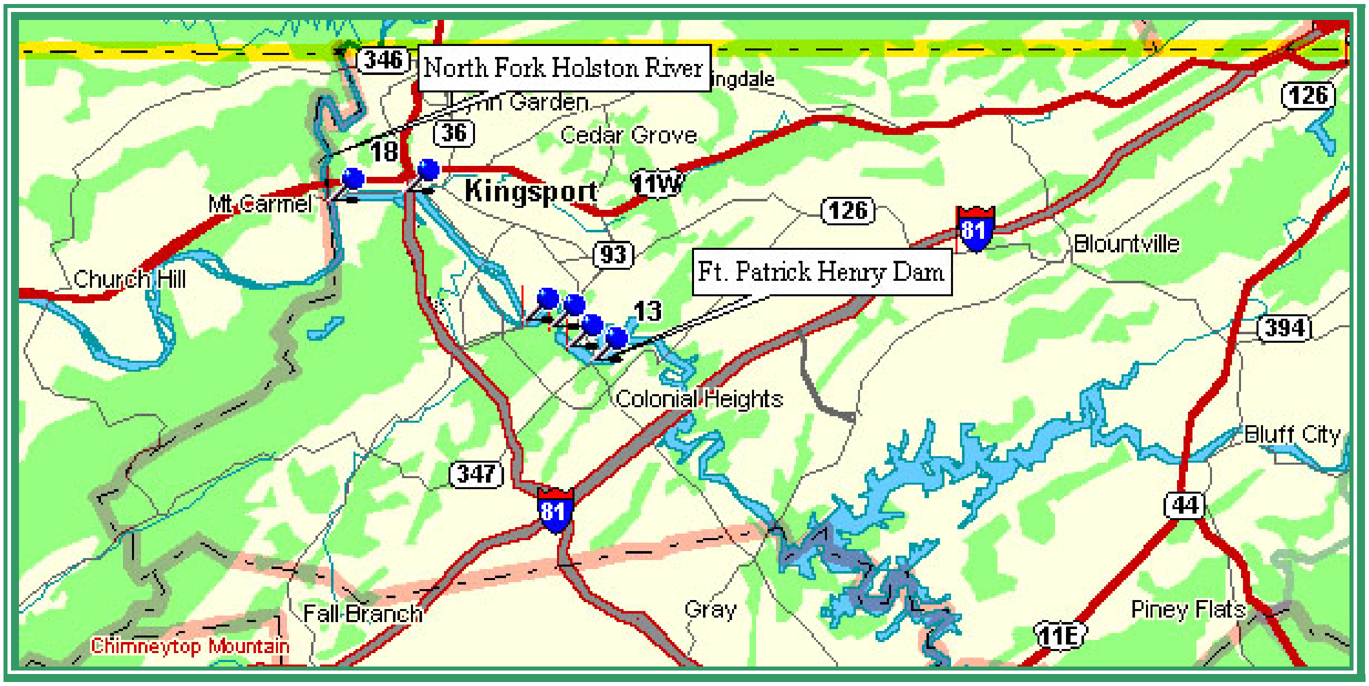


Table 4. Physiochemical and site location data for samples conducted on the South Fork Holston River during 2000.

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420000213	13	Sullivan	Kingsport 188SE	8	362953N	823033W	43	385	17	185	0.9
420000214	14	Sullivan	Kingsport 188SE	7.8	363014N	823110W	42.3	560	17	185	N/A
420000215	15	Sullivan	Kingsport 188SE	6.7	363034N	823130W	66.5	832	17	185	0.9
420000216	16	Sullivan	Kingsport 188SE	5.7	363041N	823213W	79	1027	17	185	0.9
420000217	17	Sullivan	Kingsport 188SE	1.2	363303N	823458W	60.6	639	22	240	0.9
420000218	18	Sullivan	Kingsport 188SE	0	363251N	823643W	88.5	208	22	240	N/A

Fish were collected by boat electrofishing in accordance with the standard large river sampling protocols (TWRA 1998). Fixed-boom electrodes were used to transfer 4-5 amps DC at all sites. This current setting was determined effective in narcotizing all target species (trout, black bass and rock bass). With exception of black bass, all fish collected were returned to the river. Additionally, efforts were made to identify non-target species encountered at each survey site. All sites were sampled during daylight hours and had survey durations ranging from 594 to

916 seconds. Catch-per-unit-effort (CPUE) values were calculated for each target species at each site. Length categorization indices were calculated for target species following Gabelhouse (1984).

Results

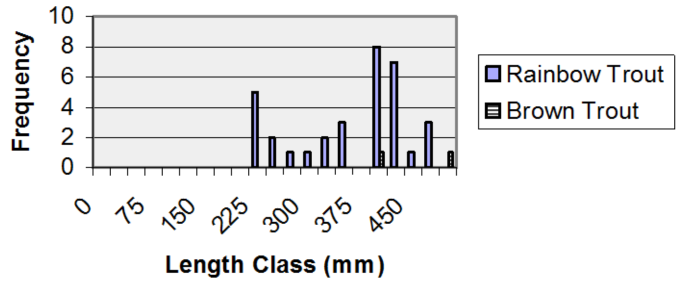
CPUE estimates for rainbow trout averaged 24.4/hour (SD 36.7), while the mean brown trout estimate was 1.3/hour (SD 3.3). Smallmouth and spotted bass estimates were 9.3/hour (SD 18.9) and 0.7/hour (SD 1.6), respectively (Table 5). Surprisingly, the mean catch of largemouth bass was quite high (5.3/hour, SD 9.5). Rock bass CPUE was highest at the most downstream site (18) and averaged 9.3/hour (SD 19.1). There was a definite demarcation in the catch of black bass and rock bass above and below the Eastman Plant. These species were most prevalent in sites 17 and 18, which were below the plant. At these two sites, water temperature had risen by five degrees, which appeared to have a significant affect on their occurrence.

Table 5. Catch per unit effort and length categorization indices of target species collected at six sites on the South Fork Holston River during 2000.

Site Code	Rainbow Trout CPUE	Brown Trout CPUE	Smallmouth Bass CPUE	Spotted Bass CPUE	Largemouth Bass CPUE	Rock Bass CPUE
420000213	42.4	0	0	0	0	0
420000214	92.0	8.0	0	0	0	0
420000215	4.0	0	0	0	0	0
420000216	4.0	0	4.0	0	0	0
420000217	3.9	0	3.9	3.9	23.6	7.9
420000218	0	0	47.7	0	8.0	47.7
MEAN	**24.4**	**1.3**	**9.3**	**0.7**	**5.3**	**9.3**
STD. DEV.	**36.7**	**3.3**	**18.9**	**1.6**	**9.5**	**19.1**
	Length-Categorization Analysis	**Length-Categorization Analysis**	**Length-Categorization Analysis**	**Length-Categorization Analysis**	**Length-Categorization Analysis**	**Length-Categorization Analysis**
	PSD = 57.6	PSD = 100	PSD = 100	PSD = N/A	PSD = 0	PSD = 54.5
	RSD-Preferred = 9.1	RSD-Preferred = 100	RSD-Preferred = 100	RSD-Preferred = N/A	RSD-Preferred = 0	RSD-Preferred = 0
	RSD-Memorable = 0	RSD-Memorable = 0	RSD-Memorable = 100	RSD-Memorable = N/A	RSD-Memorable = 0	RSD-Memorable = 0
	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = N/A	RSD-Trophy = 0	RSD-Trophy = 0

The majority of the rainbow trout collected from the South Fork fell within the 350 and 475 mm size class (Figure 16). The few brown trout that were collected were between 400 and 500 mm (Figure 16).

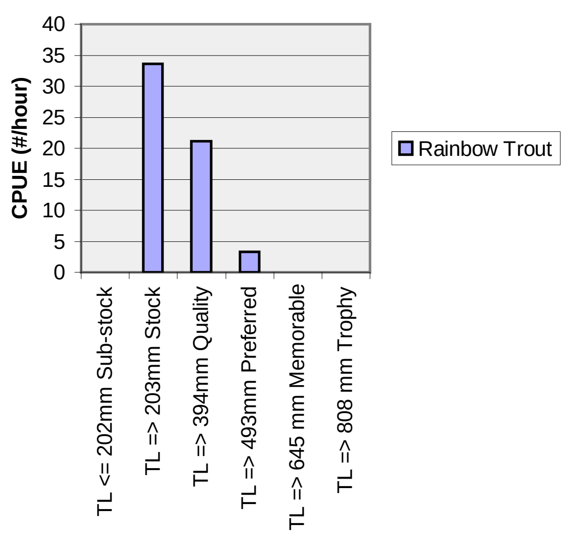
Figure 16. Length frequency distribution for trout collected from the South Fork Holston River during 2000.



All trout collected were in excellent shape and appeared to be growing extremely well. They appeared to be holdover fish that had become more or less naturalized as all of the characteristics associated with a freshly stocked hatchery fish were gone. The limited access to this portion of the river is believed to be the reason for the high abundance of quality trout.

Length categorization analysis indicated the RSD for preferred rainbow trout (TL $\geq$ 493 mm) was 9.1. RSD for memorable (TL $\geq$ 645 mm) and trophy (TL $\geq$ 808 mm) size rainbow trout was 0. Although no rainbow trout in the memorable and trophy size category, it is highly likely that they exist in this tailwater. A few rainbow trout, large enough to enter at least the memorable category were observed but not collected. The PSD of rainbow trout was 57.6. Catch per unit effort estimates by RSD category indicated all of our catch was stock size fish and above. There was a substantial number of quality trout and a few preferred rainbow trout represented in the sample (Figure 17). No sub-stock rainbow trout were collected, this was expected as reproduction probably does not occur in this tailwater and stocked trout exceed this length category.

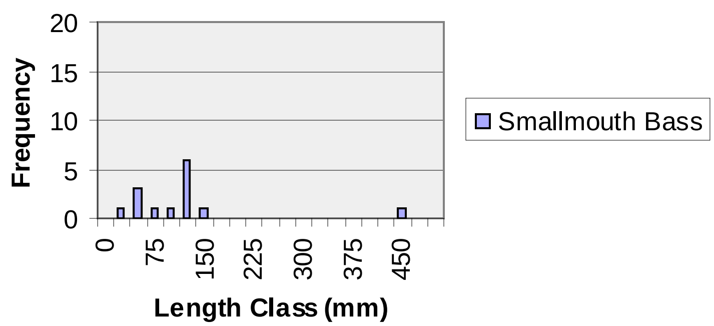
Figure 17. Relative stock density (RSD) catch per unit effort by category for rainbow trout collected from the South Fork Holston River during 2000.



Length categorization analysis indicated the RSD for preferred brown trout (TL ≥ 445 mm) was 100. RSD for memorable (TL ≥ 584 mm) and trophy (TL ≥ 762 mm) size brown trout was 0. Only two brown trout were collected, both in the preferred category. Although no brown trout in the memorable and trophy size category were collected, it is highly likely that they do occur although recruitment of this species into the fishery seems negligible. The PSD of brown trout was 100.

The scarcity of black bass and rock bass upstream of the Eastman Chemical Plant is presumably related entirely to the low temperatures observed in this reach. Once we moved downstream of the plant we began encountering all species of black bass and rock bass and observed a 5 degree (C) temperature increase at our sampling stations. The length distribution of smallmouth bass was predominantly comprised of individuals in the 50 to 125 mm size range. One bass in the 450 mm class was collected (Figure 18).

Figure 18. Length frequency distribution for smallmouth bass collected from the South Fork Holston River during 2000.



Length categorization analysis indicated the Relative Stock Density (RSD) for preferred smallmouth bass (TL ≥ 350 mm) was 100. RSD for memorable (TL ≥ 430 mm) and trophy (TL ≥ 510 mm) size bass were 100 and 0, respectively. The PSD of smallmouth bass (ratio of quality size bass to stock size bass) was 100. The catch of sub-stock smallmouth was quite high, comprising 92% or our catch (Figure 19). However, based on our overall sample it does not appear that these fish are recruiting into the fishery in this portion of the river. Perhaps this reach of the river is a transition zone where the density and recruitment of warmwater species is depressed as the transition from coldwater to warmwater habitat occurs. Overall, growth rates for the 14 smallmouth bass collected in the South Fork were similar to those values observed for similar age groups within the drainage (Figure 20). Because of the low sample size, no mortality or maximum population growth statistics were calculated.

Figure 19. Relative stock density (RSD) catch per unit effort by category for smallmouth bass collected from the South Fork Holston River during 2000.

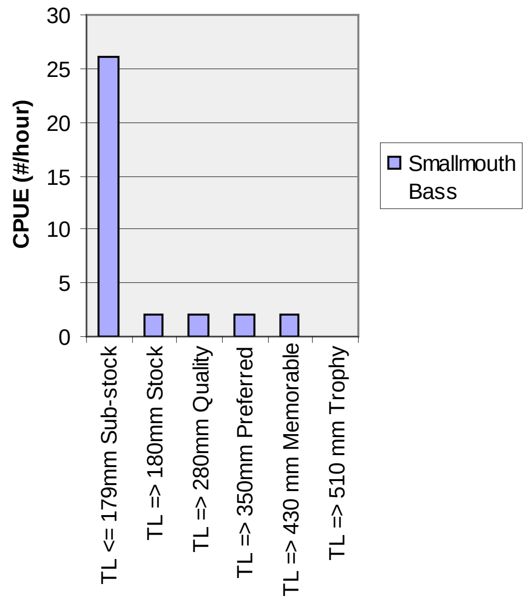
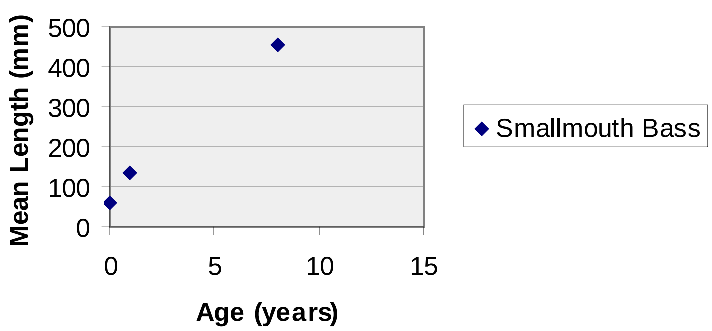
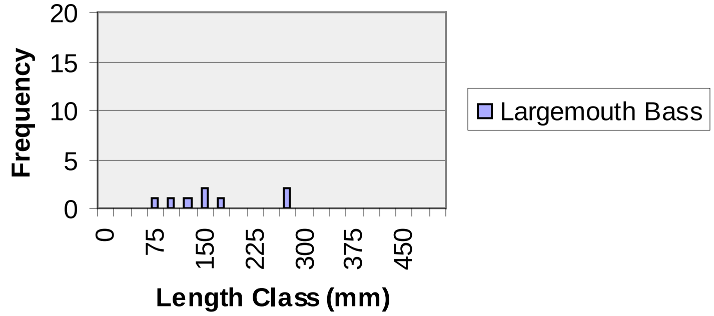


Figure 20. Mean length at age for smallmouth bass collected from the South Fork Holston River during 2000.



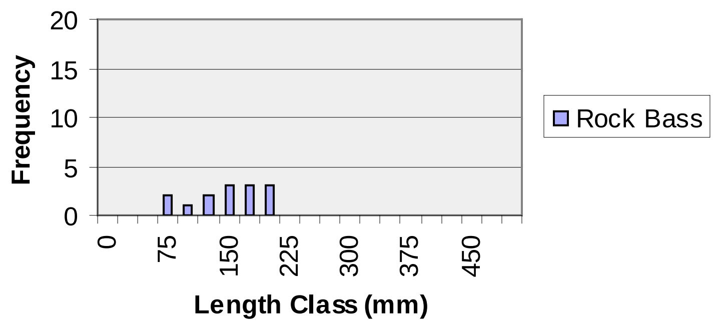
The occurrence of spotted bass in South Fork was insignificant. Only one spotted bass (150 mm length class) was collected. Because of their relatively low numbers, no population statistics were calculated. Eight largemouth bass were collected at sites 17 (6) and 18 (2). The majority of these bass were confined to the 75 to 175mm length groups (Figure 21). Length categorization analysis for largemouth bass was calculated, however because no quality size bass were collected the PSD and RSD values for this species was 0. The catch of sub-stock largemouth was quite high, comprising 75% or our catch. However, recruitment of these fish is negligible.

Figure 21. Length frequency distribution for largemouth bass collected from the South Fork Holston River during 2000.



Thirteen rock bass were collected at the two downstream sites (17 and 18). The majority of these were collected in site 18 along an extensive rip-rap bank just upstream from the North Fork Holston River. The size distribution was fairly typical of other riverine populations with the bulk of the fish falling in the 75 to 175mm length range (Figure 22). PSD for this population was 54.5. The value for preferred, memorable and trophy rock bass was 0. Sub-stock catch of rock bass was low, only 2 (15%) of the fish were in this size category. Like other samples

Figure 22. Length frequency distribution for rock bass collected from the South Fork Holston River during 2000.



collected in 2000, no otoliths were taken from rock bass in the South Fork. It is assumed that growth characteristics are similar to other east Tennessee populations.

Several other species were collected or observed (26) during our survey of the South Fork Holston River. As mentioned before, the species richness increased dramatically downstream of the Eastman Chemical Plant as water temperature increased. A list of species occurrence by site can be found in Table 6.

Table 6. Distribution of fish species collected from the South Fork Holston River during 2000.

South Fork Holston River Mile	8	7.8	6.7	5.7	1.2	0
Site Code	420000213	420000214	420000215	420000216	420000217	420000218
Species						
Catostomidae						
Black redhorse	*	*	*		*	*
Golden redhorse					*	
Northern hog sucker		*		*	*	*
River carpsucker					*	
White sucker			*	*		
Centrarchidae						
Bluegill					*	
Green sunfish					*	
Largemouth bass					*	*
Redbreast sunfish					*	*
Rock bass					*	*
Smallmouth bass				*	*	*
Spotted bass					*	
Clupeidae						
Gizzard shad					*	*
Cottidae						
Banded sculpin		*				
Cyprinidae						
Carp					*	
Mimic shiner	*					
River chub						*
Spotfin shiner						*
Stoneroller			*	*		
Telescope shiner				*		
Warpaint shiner				*		
Ictaluridae						
Yellow bullhead						*
Percidae						
Greenside darter					*	*
Snubnose darter						*
Salmonidae						
Brown trout		*				
Rainbow trout	*	*	*	*	*	

Discussion

Much of the South Fork Holston River downstream of Ft. Patrick Henry Dam has been altered by channelization, riparian zone destruction, and pollution. All of these factors, along with regulated flows, have influenced the fish community that we observed during our survey of the river. The first 2 miles of the river, downstream of Ft. Patrick Henry Dam, offers excellent opportunities to catch quality rainbow trout and to a lesser extent brown trout. The health of the sport fishery outside the one provided by trout is negligible. There are opportunities to catch black bass and rock bass in the lower reaches of the river, however, the densities are at levels that would discourage most anglers.

Overall, this reach of the South Fork Holston exemplifies the negative impacts that man can have on a river. Within its short 8 mile journey from Ft. Patrick Henry Dam it has been cooled down, channelized, warmed up, denuded of most of the riparian vegetation, and serves as a receptacle for numerous waste water discharges.

Management Recommendations

1. Continue stocking catchable rainbow and brown trout at the present rate. Evaluate the potential of a consistent fingerling trout stocking program.

2. Develop a fishery management plan for this river.

3. Include the portion of river between Ft. Patrick Henry Dam and the John B. Dennis bridge in the annual trout tailwater sampling scheme.

French Broad River

Introduction

Like many of the larger rivers in east Tennessee, the French Broad has a long history of pollution related problems stemming from industry, urbanization, and agricultural activities within the watershed. Ichthyological studies within the watershed date back to the mid to late 1800's when Cope and Jordan made some of the first collections in the river (Harned 1979). The most recent fisheries collection by the TWRA was conducted in 1990 near river mile 78 (Bivens and Williams 1991). Harned (1979) probably conducted the most comprehensive survey of the river and watershed tributaries to date. One hundred seventeen sample stations were surveyed on the mainstem French Broad and four of its tributaries during the summer of 1977 (Harned 1979). Our interest in surveying the French Broad was the evaluate the sport fishery and develop a species list for the river from the North Carolina state line to its confluence with the Holston River near Knoxville.

Study Area and Methods

The French Broad River originates near Rosman, North Carolina and flows in a southwesterly direction before combining with the Holston River to form the Tennessee River. The French Broad has a drainage area of 13,177 km^2 and courses some 349 km from its headwaters to the confluence with Holston River (Harned 1979). The French Broad is located in the Blue Ridge physiographic province in North Carolina and a small portion of Tennessee (Cocke Co.). The river transitions into the Ridge and Valley physiographic province near Newport. There is one large reservoir located on the French Broad in Tennessee, Douglas Reservoir, located in Jefferson and Sevier counties. The reservoir impounds approximately 69 km of river channel and spreads out over 30,400 acres (Harned 1979). The elevational profile of the river is quite impressive with the steepest fall observed from Asheville, North Carolina to Newport, Tennessee. Within Tennessee, the river descends about 477 feet between the state line and Knoxville (Figure 23).

The river downstream of Douglas Dam is one of the few warmwater tailwaters in east Tennessee. It is managed under a minimum flow regime by the Tennessee Valley Authority (TVA) to provide recreational opportunities and to ensure that water quality remains at acceptable levels. Since the improvements in water quality below the dam, several restoration projects have been initiated. These include the introduction of the lake sturgeon and selected species of mollusks. The snail darter has in recent years, colonized the river from stockings made in the Holston River and has established a resident population. The snail darter is currently listed as threatened by the U.S. Fish and Wildlife Service.

Between August 7 and 17, 2000 we sampled twenty-four sites from the North Carolina state line to Knoxville (Figure 24). The tailwater section of the river was sampled between 7 and 10 August. Due to the fluctuation of flow in the river downstream of Douglas Dam, habitat availability varies. In both sections of the river (tailwater and free-flowing) the native riparian vegetation was for the most part intact. There seemed to be more agricultural development in the tailwater reach of the river due more suitable topography. Submerged woody debris was scarce in most of our sample areas. The river substrate was predominately bedrock and boulder with

Figure 23. Longitudinal profile of elevation along the French Broad River from Knoxville to the TN/NC state line.

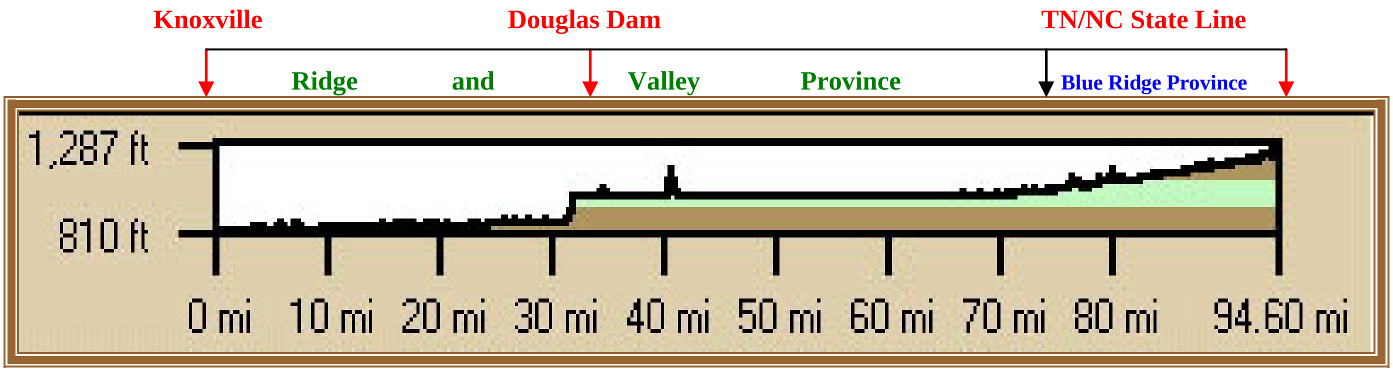


Figure 24. Site locations for samples conducted on the upper (A) and lower (B) French Broad River during 2000.

Figure 24 (A)

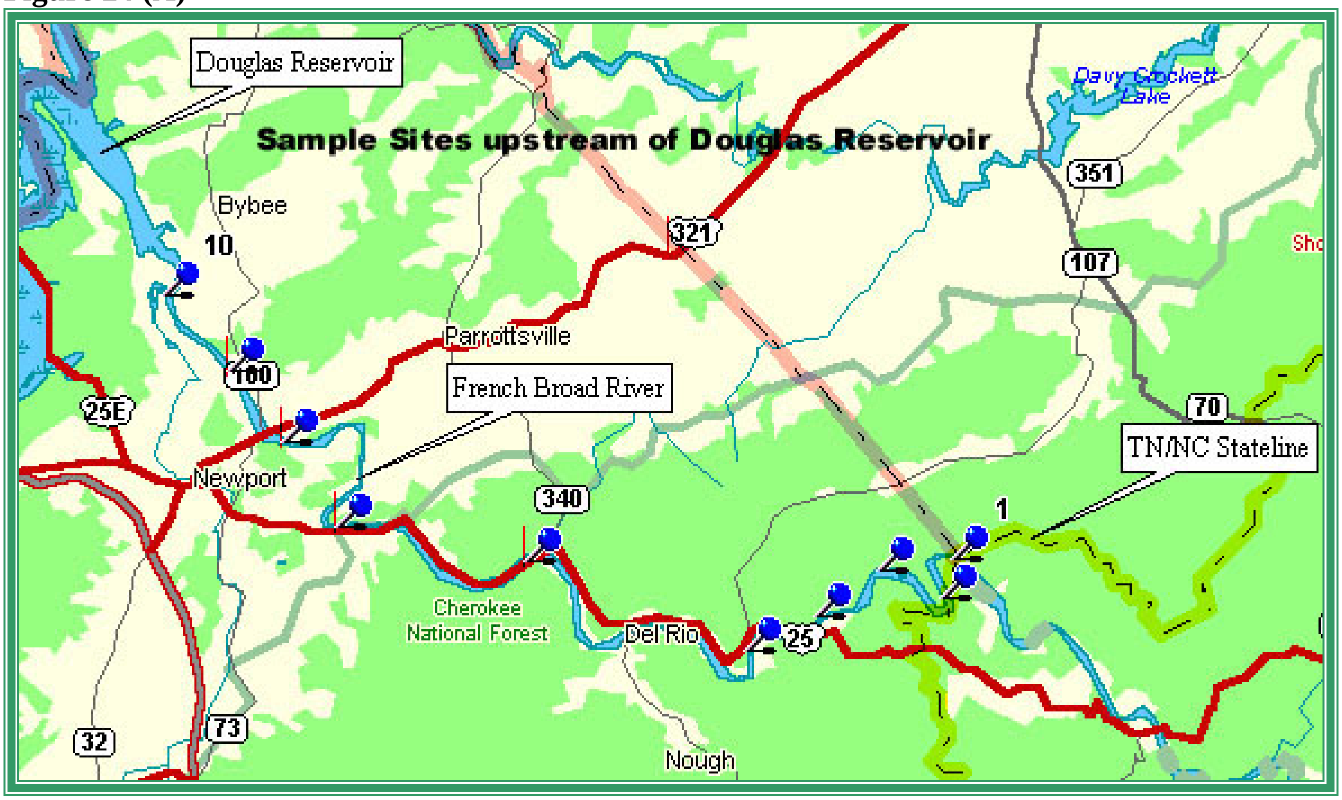
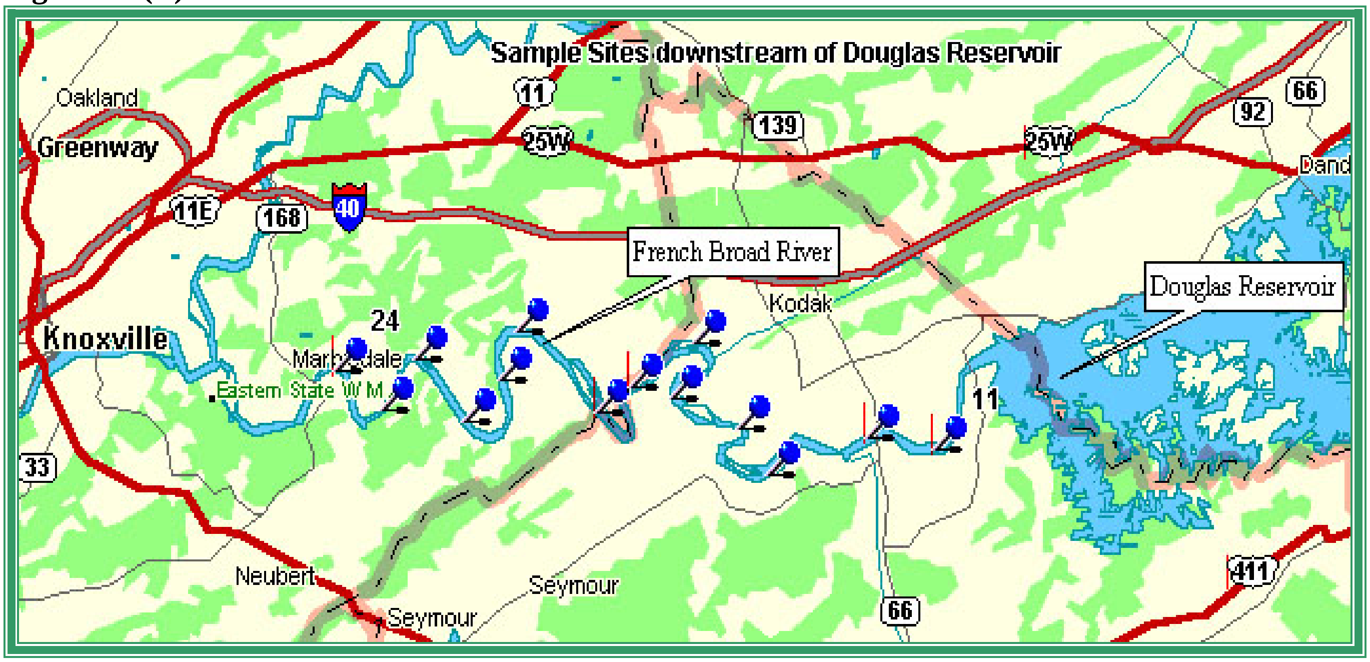


Figure 24 (B)



some cobble in the riffle areas. Measured channel widths ranged from 61 to 228 m, while site lengths fell between 230 and 655 m (Table 7). Water temperatures ranged from 22 to 30 C. Conductivity varied from 90 to 300 μs/cm (Table 7). The highest conductivity observed during our samples was at site 10, just downstream of the Pigeon River.

Table 7. Physiochemical and site location data for samples conducted on the French Broad River during 2000.

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420000701	1	Cocke	Paint Rock 188SW	99.5	355638N	825355W	109	500	23	90	0.85
420000702	2	Cocke	Paint Rock 188SW	98.9	355556N	825405W	86	494	23	90	0.85
420000703	3	Cocke	Paint Rock 188SW	97.3	355628N	825540W	72	496	27	95	0.85
420000704	4	Cocke	Paint Rock 188SW	95.3	355537N	825703W	85.5	431	27	95	0.85
420000705	5	Cocke	Paint Rock 188SW	93.6	355503N	825839W	61	230	27	95	0.85
420000706	6	Cocke	Neddy Mountain 173NE	86.8	355503N	825839W	75	463	25.5	100	0.85

Table 7. Continued on next page

Table 7. Continued

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420000707	7	Cocke	Newport 173NW	82.2	355714N	830756W	84.5	186	30	120	0.85
420000708	8	Cocke	Nepwort 173NW	78.1	355714N	830755W	87.5	279	26	120	0.9
420000709	9	Cocke	Rankin 172SW	76	360004N	831022W	85.5	505	27.5	105	0.9
420000710	10	Cocke	Rankin 172SW	74	360122N	831148W	106	345	28	300	0.9
420000711	11	Sevier	Douglas Dam 156NE	29.8	355557N	833335W	136	517	22	130	1.4
420000712	12	Sevier	Douglas Dam 156NE	28.1	355611N	833511W	134.5	320	22	130	1.4
420000713	13	Sevier	Douglas Dam 156NE	25.5	355530N	833738W	196.5	462	22	130	1.4
420000714	14	Sevier	Boyds Creek 156NW	23.3	355622N	833818W	104.5	423	23	130	1.4
420000715	15	Sevier	Boyds Creek 156NW	21.5	355656N	833955W	143	655	23	130	1.4
420000716	16	Sevier	Boyds Creek 156NW	19.6	355753N	833921W	228	399	23	130	1.3
420000717	17	Sevier	Boyds Creek 156NW	17.8	355704N	834059W	135	326	23	130	1.3
420000718	18	Knox	Boyds Creek 156NW	15.5	355634N	834143W	195	616	23	130	1.3
420000719	19	Knox	Boyds Creek 156NW	13.5	355805N	834339W	140.5	605	23	130	1.3
420000720	20	Knox	Boyds Creek 156NW	11.8	355709N	834403W	179.5	427	22	135	2+
420000721	21	Knox	Boyds Creek 156NW	9.9	355626N	834456W	206	441	22	135	2+
420000722	22	Knox	Shooks Gap 147NE	8.2	355736N	834606W	170	610	24	140	2+
420000723	23	Knox	Shooks Gap 147NE	5.8	355637N	834655W	118.5	274	23	140	2+
420000724	24	Knox	Shooks Gap 147NE	4.8	355729N	834800W	129.5	346	24	140	2+

Fish were collected by boat electrofishing in accordance with the standard large river sampling protocols (TWRA 1998). Fixed-boom electrodes were used to transfer 4-5 amps DC at all sites. This current setting was determined effective in narcotizing all target species (black bass and rock bass). With the exception of black bass, all fish collected were returned to the river. Additionally, efforts were made to identify non-target species encountered at each survey site. All sites were sampled during daylight hours and had survey durations ranging from 900 to 4245 seconds. Catch-per-unit-effort (CPUE) values were calculated for each target species at each site. Length categorization indices were calculated for target species following Gabelhouse (1984).

Results

CPUE estimates for smallmouth bass averaged 11.9/hour (SD 13.0), while the mean spotted bass estimate was 13.1/hour (SD 15.6). Largemouth and rock bass estimates were 2.0/hour (SD 4.7) and 3.9/hour (SD 11.2), respectively (Table 8). Surprisingly, the mean catch of spotted bass was higher than any other black bass species collected. The catch of all target species was probably under represented at sites 14 through 19 due to high flows during our sampling efforts (2 generators). Rock bass were collected at only four of the 24 survey sites. These sites were all located downstream of Douglas Dam.

Table 8. Catch per unit effort and length categorization indices of target species collected at twenty-four sites on the French Broad River during 2000.

Site Code	Smallmouth Bass CPUE	Spotted Bass CPUE	Largemouth Bass CPUE	Rock Bass CPUE
420000701	18.1	6.0	0.0	0.0
420000702	31.8	0.0	0.0	0.0
420000703	39.5	0.0	0.0	0.0
420000704	27.9	0.0	0.0	0.0
420000705	39.5	19.8	0.0	0.0
420000706	18.7	12.7	0.0	0.0
420000707	15.6	11.7	0.0	0.0
420000708	23.9	8.0	0.0	0.0
420000709	19.3	3.9	0.0	0.0
420000710	3.9	7.9	11.8	0.0
420000711	0.0	4.0	19.9	0.0
420000712	0.0	12.0	4.0	0.0
420000713	11.7	3.9	0.0	0.0
420000714	0.0	4.0	0.0	0.0
420000715	0.0	0.0	0.0	0.0
420000716	0.0	4.0	0.0	0.0
420000717	0.0	4.0	4.0	0.0
420000718	0.0	4.0	0.0	0.0
420000719	0.0	8.0	0.0	0.0
420000720	12.0	48.0	4.0	40.0

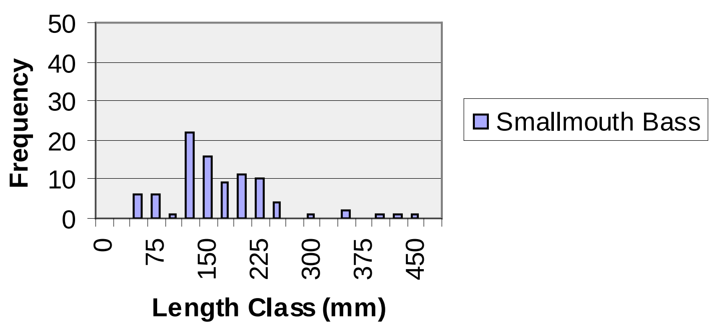
Table 8. Continued on next page

Table 8. Continued

Site Code	Smallmouth Bass CPUE	Spotted Bass CPUE	Largemouth Bass CPUE	Rock Bass CPUE
420000721	11.7	39.0	0.0	11.7
420000722	8.0	39.9	0.0	4.0
420000723	3.9	50.8	3.9	39.0
420000724	0.0	23.9	0.0	0.0
MEAN	**11.9**	**13.1**	**2.0**	**3.9**
STD. DEV.	**13.0**	**15.6**	**4.7**	**11.2**
	Length-Categorization Analysis	**Length-Categorization Analysis**	**Length-Categorization Analysis**	**Length-Categorization Analysis**
	PSD = 15.8	PSD = 21.6	PSD = 60	PSD = 29.2
	RSD-Preferred = 13.2	RSD-Preferred = 5.9	RSD-Preferred = 30	RSD-Preferred = 0
	RSD-Memorable = 5.3	RSD-Memorable = 0	RSD-Memorable = 10	RSD-Memorable = 0
	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0

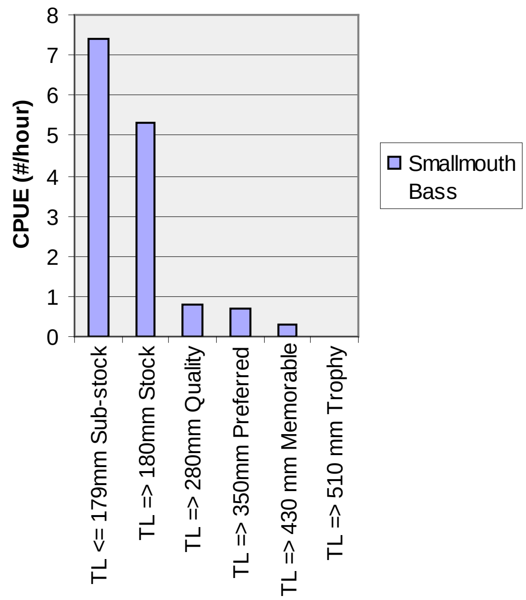
The length distribution of smallmouth bass was predominantly comprised of individuals in the 125 to 225 mm size range. Three bass over the 375 mm (15 in) were collected (Figure 25.)

Figure 25. Length frequency distribution for smallmouth bass collected from the French Broad River during 2000.



Length categorization analysis indicated the Relative Stock Density (RSD) for preferred smallmouth bass (TL $\geq$ 350 mm) was 13.2. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass were 5.3 and 0, respectively. The PSD of smallmouth bass (ratio of quality size bass to stock size bass) was 15.8. The catch of sub-stock smallmouth was relatively high, comprising 58% of our catch (Figure 26). However, based on our overall sample it does not appear that many fish are recruited into the quality and above categories. Based on our sampling efforts and visual observations, the section of river upstream of Douglas Reservoir provides the best smallmouth bass habitat.

Figure 26. Relative stock density (RSD) catch per unit effort by category for smallmouth bass collected from the French Broad River during 2000.

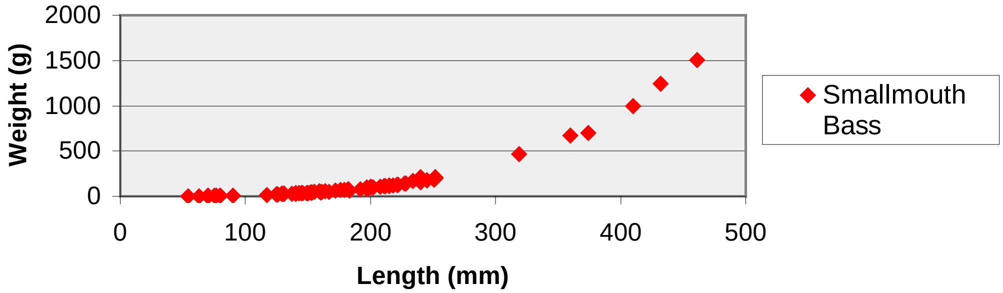


Overall, growth rates for the smallmouth bass collected from the French Broad were slightly higher than those values observed for similar age groups in other rivers throughout the region (Carter et al. 1999,2000) (Figure 27). Linear and curvilinear length-weight regression

Figure 27. Mean length at age for smallmouth bass collected from the French Broad River during 2000 (ages 3 and 4 actual value, only one fish in age group).

analysis indicated steady growth through the 500 mm length range and yielded a length-weight equation of –5.2 + 3.1x (Figure 28) for the overall population. The rate of growth for smallmouth in the French Broad appeared to be somewhat faster and maximum growth for the species was also higher. Overall, growth statistics (Von Bertalanffy, 1938) calculated for the total population predicted a maximum length of 707 mm (27.8 in), for the bass population in the French Broad River. The annual mortality rate for smallmouth bass could not be calculated.

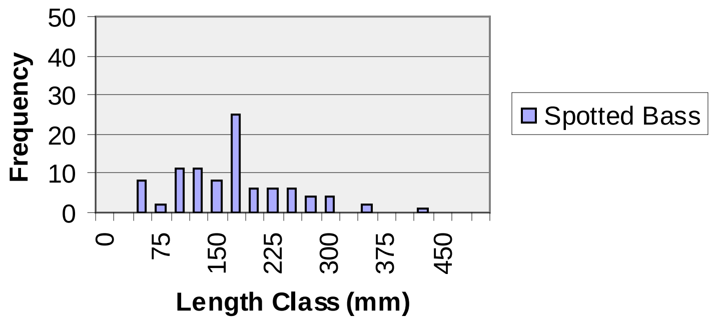
Figure 28. Curvilinear length-weight relationship for smallmouth bass collected from the French Broad River during 2000.



This was due to the absence of at least three ages classes that were vulnerable to the sampling gear, which had at least five individuals in the group.

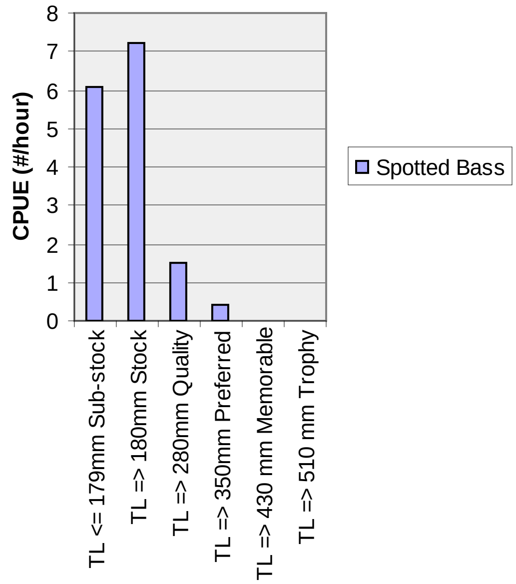
The majority of spotted bass collected from the French Broad River during 2000 fell within the 100 to 175 mm length range (Figure 29). Our data indicated that fish less than 100 mm, were for the most part, not effectively sampled. Length categorization analysis indicated

Figure 29. Length frequency distribution for spotted bass collected in the French Broad River during 2000.



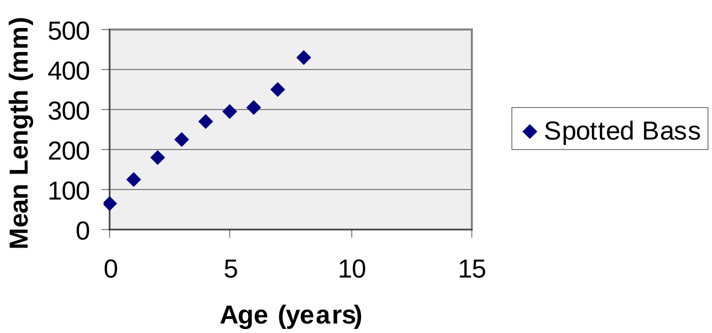
the RSD for preferred spotted bass (TL $\geq$ 350 mm) was 5.9. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass was 0. The PSD of spotted bass was 21.6. Catch per unit effort estimates by RSD category revealed very few spotted bass above the RSD-S category, indicating a relative lack of larger fish available to anglers (Figure 30). However, recruitment from the sub-stock to stock category was good. Within the RSD categories, only 15% of our catch was in quality or above size category.

Figure 30. Relative stock density (RSD) catch per unit effort by category for spotted bass collected from the French Broad River during 2000.



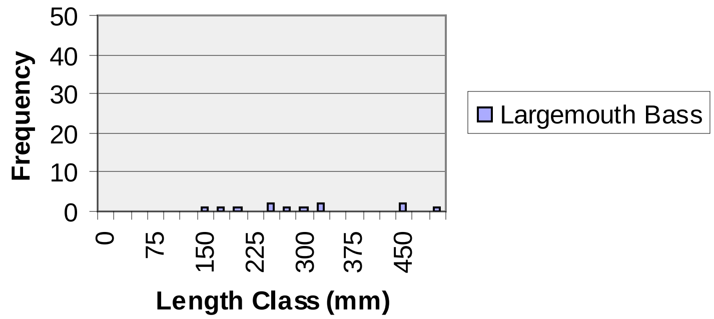
Due to the sporadic and unpredictable collection of riverine spotted bass, characterization of age and growth dynamics for this species is less than optimal. The sample of spotted bass collected from the French Broad, was no different than most of the previous samples collected in east Tennessee. Age and growth structure of the French Broad River spotted bass was similar to other east Tennessee populations for the ages represented (Figure 31). Overall, growth statistics (Von Bertalanffy, 1938) calculated for the total population predicted a maximum length of 581 mm (22.8 in), for the spotted bass population in the French Broad River. The annual mortality rate calculated for spotted bass ages 2-5 was 63%.

Figure 31. Mean length at age for spotted bass collected from the French Broad River during 2000.



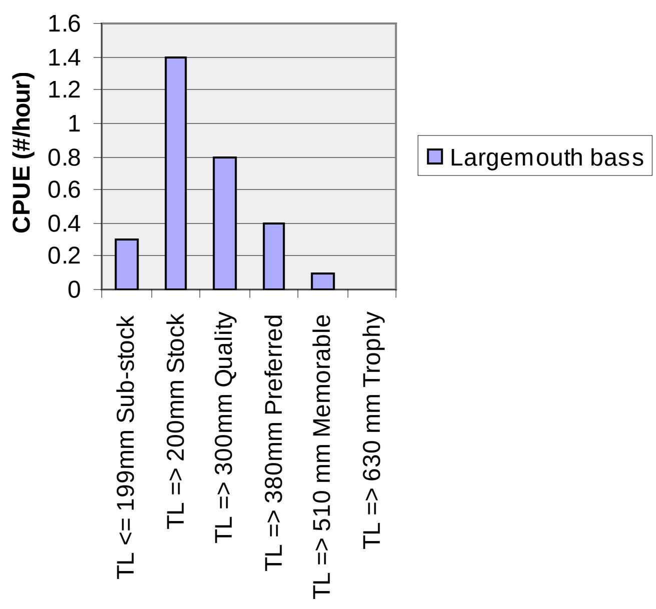
Most of the largemouth bass collected from the French Broad fell within the 250 to 325 mm length range (Figure 32). Length categorization analysis indicated the RSD for preferred

Figure 32. Length frequency distribution for largemouth bass collected from the French Broad River during 2000.



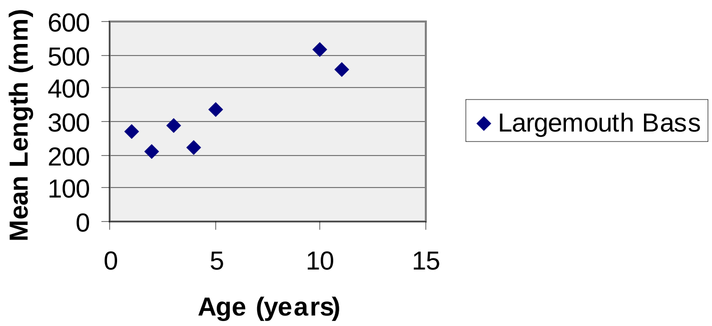
largemouth bass (TL ≥ 380 mm) was 30. RSD for memorable (TL ≥ 510 mm) and trophy (TL ≥ 630 mm) size largemouth bass was 10 and 0, respectively. The PSD of largemouth bass was 60. The highest catch rate by RSD category was for stock size largemouth bass. Although numbers were extremely low, recruitment into the preferred category and above was good (Figure 33).

Figure 33. Relative stock density (RSD) catch per unit effort by category for largemouth bass collected from the French Broad River during 2000.



Age and growth determination for largemouth bass in the French Broad River was based on 12 individuals from our 24 sample sites. Because of the small sample size, any strong conclusions regarding growth characteristics of the population are hindered. Figure 34, depicts mean length at age for largemouth bass collected in the French Broad River. The majority of the population we were able to sample consisted of 2 and 3 year old fish (50%). Due to the low numbers of fish collected in the sample and the distribution in sizes of what was collected, no accurate population growth or mortality statistics could be calculated.

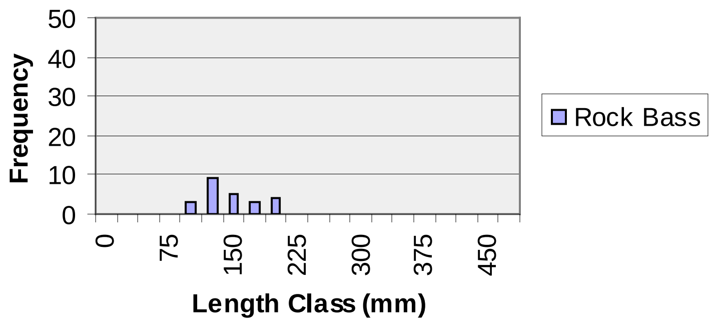
Figure 34. Mean length at age for largemouth bass collected from the French Broad River during 2000.



Probably the most perplexing occurrence (or lack of) we observed in our survey of the French Broad River was the relative absence of rock bass in the river. All of the rock bass that were collected in our surveys were collected downstream of Douglas Reservoir (sites 20-23). In what was considered the best available habitat (the reach above Douglas Reservoir), no rock bass were observed or collected. This is unusual because many of the tributaries within this reach of the French Broad have populations of rock bass.

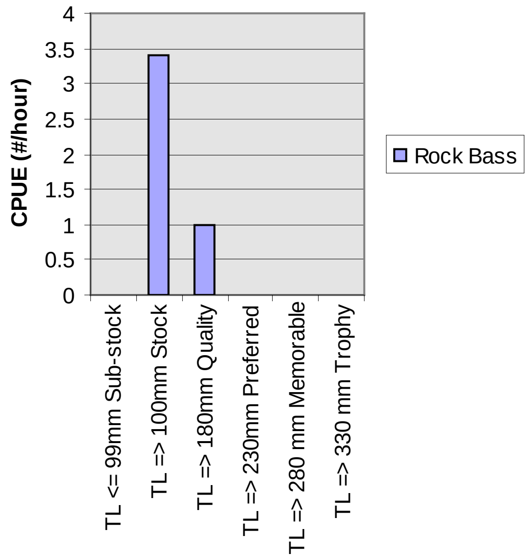
Thirty-one rock bass were collected at sites 20-23. The size distribution was fairly typical of other riverine populations with the bulk of the fish falling in the 75 to 175mm length range (Figure 35).

Figure 35. Length frequency distribution for rock bass collected from the French Broad River during 2000.



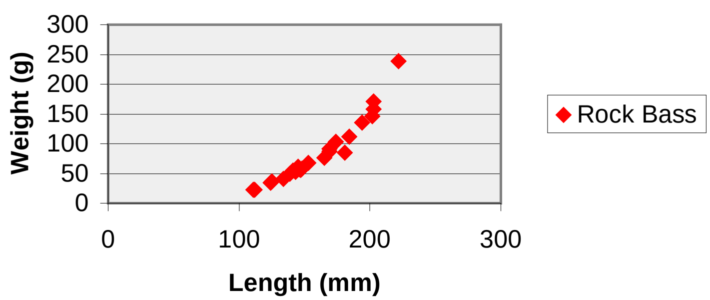
PSD for this population was 29.2. The value for preferred, memorable and trophy rock bass was 0. Sub-stock catch of rock bass was absent (Figure 36), however, this does not necessarily indicate the lack of reproduction. The vulnerability of these smaller fish to the electrofishing gear is considerably lower than larger size groups. Recruitment of rock bass into the stock and quality size was relatively good even though numbers were low. Curvilinear and linear length-

Figure 36. Relative stock density (RSD) catch per unit effort by category for rock bass collected in the French Broad River during 2000.



weight analysis indicated good growth for the represented length classes and yielded a length-weight equation of - 5.1 + 3.1x (Figure 37).

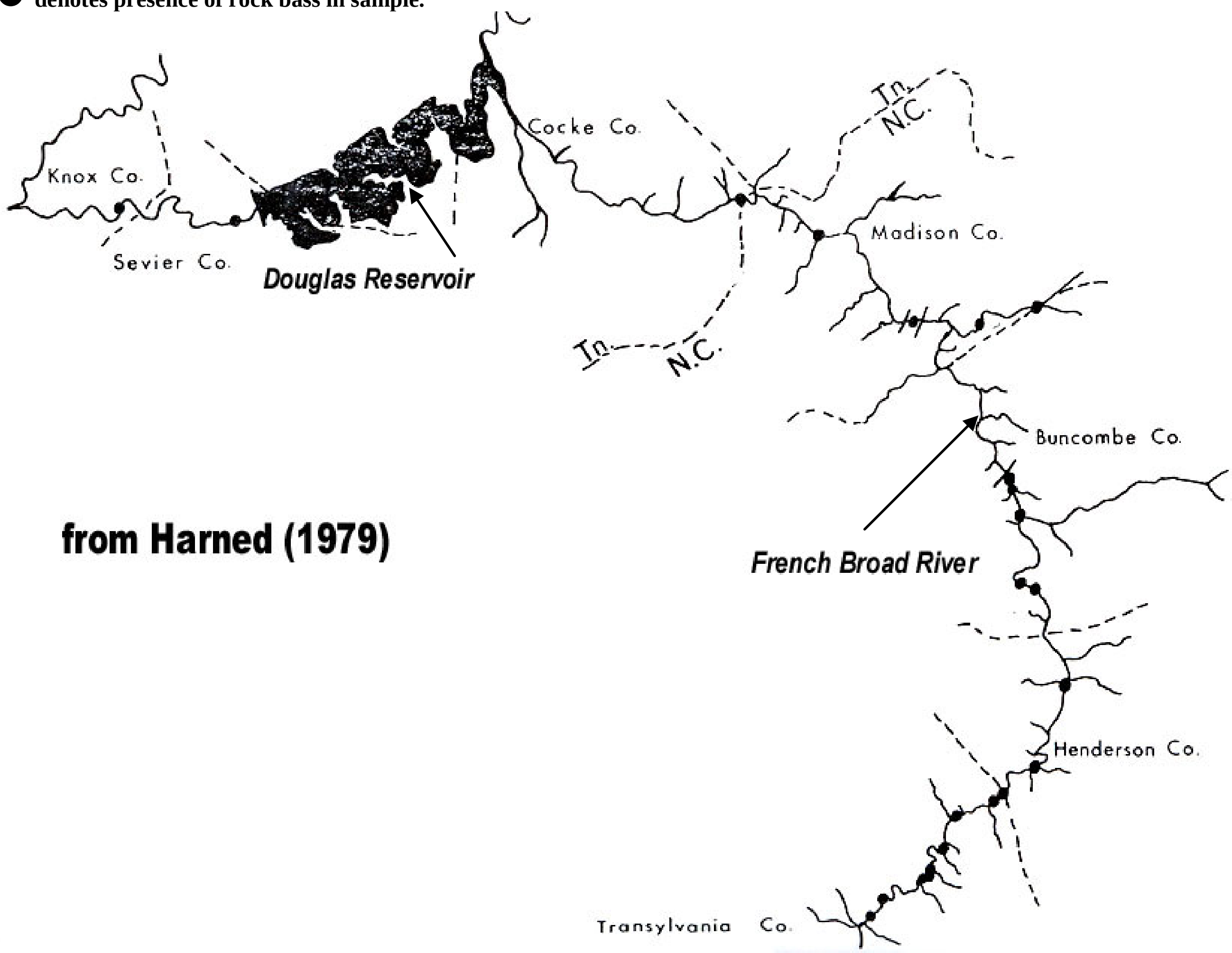
Figure 37. Curvilinear length-weight relationship for rock bass collected in the French Broad River during 2000.



As with the other populations sampled during 2000, no otoliths were taken from rock bass for age determination. The lack of rock bass upstream of Douglas Reservoir is currently not understood, Harned (1979) reported the collection of rock bass from all portions of the French Broad River, which included the reach above the reservoir. Harned's 1977 collections did illustrate that rock bass were more prevalent in the North Carolina portion of the river and progressively occurred more frequently in the headwaters of the river (Figure 38). Bivens and Williams (1991) did not report any rock bass from their collection at river mile 78 (Boyer Island) during 1990.

Figure 38. Occurrence of rock bass in the French Broad River during 1977 (illustration from Harned 1979).

● **denotes presence of rock bass in sample.**



Because of the French Broad's long history of pollution related problems (primarily sedimentation), perhaps rock bass have been eliminated from the portion of river upstream of Douglas Reservoir. Rock bass are considered to be an intolerant species and require fairly specific habitat requirements in order to sustain a viable population. Further investigation regarding the abundance of rock bass in the North Carolina portion of the river is warranted.

During our survey of the French Broad we encountered several other species that were recorded for TADS purposes. None of these species have been given any status designation by the USFWS or TWRA. A list of the species we collected can be found in Table 9.

Table 9. Distribution of fish species collected from the French Broad River during 2000.

French Broad River Mile	99	98	97	95	94	87	82	78	76	74	30	28	25	23	21	20	18	16	14	12	10	8	6	5
Site Code	4200007001	4200007002	4200007003	4200007004	4200007005	4200007006	4200007007	4200007008	4200007009	4200007010	4200007011	4200007012	4200007013	4200007014	4200007015	4200007016	4200007017	4200007018	4200007019	4200007020	4200007021	4200007022	4200007023	4200007024
Species																								
Catostomidae																								
Black buffalo														*					*					*
Black redhorse	*		*					*						*				*			*			
Golden redhorse	*		*	*	*	*				*	*	*	*	*	*	*	*	*	*	*	*		*	*
Smallmouth buffalo	*		*	*	*	*	*	*	*	*		*	*	*	*	*	*	*	*		*			
Northern hog sucker	*	*		*	*	*	*	*	*		*		*					*		*	*	*	*	
Quillback	*	*																						
River carpsucker		*																						
River redhorse	*		*				*		*	*			*		*			*			*	*		
Shorthead redhorse	*	*	*	*		*	*	*	*															
Silver redhorse			*						*	*														
Spotted sucker											*	*					*							*
Centrarchidae																								
Black crappie																		*						
Bluegill	*					*	*	*	*	*	*	*	*	*		*	*			*	*	*	*	*
Green sunfish					*	*																		
Largemouth bass										*	*	*					*		*	*			*	
Redbreast sunfish	*			*	*	*	*		*	*		*	*										*	
Rock bass																				*	*	*	*	
Smallmouth bass	*	*	*	*	*	*	*	*	*	*			*							*	*	*	*	
Spotted bass	*				*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	*	*	*
White crappie														*										
Clupeidae																								
Gizzard Shad	*		*	*		*			*	*		*		*	*	*	*	*	*		*	*	*	*
Cottidae																								
Banded sculpin			*																	*		*		
Cyprinidae																								
Bigeye chub				*	*						*													

Table 9. Continued on next page

Table 9. Continued

French Broad River Mile	99	98	97	95	94	87	82	78	76	74	30	28	25	23	21	20	18	16	14	12	10	8	6	5
Site Code	420000701	420000702	420000703	420000704	420000705	420000706	420000707	420000708	420000709	420000710	420000711	420000712	420000713	420000714	420000715	420000716	420000717	420000718	420000719	420000720	420000721	420000722	420000723	420000724
Species																								
Bluntnose minnow											*													
Carp	*			*			*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	*	*
River chub		*				*	*	*	*													*		
Rosyface shiner				*	*	*	*	*	*															
Silver shiner	*				*										*									
Spotfin shiner	*	*	*	*	*	*	*	*	*	*	*	*				*	*	*		*	*	*	*	*
Stoneroller											*											*		
Striped shiner											*													
Warpaint shiner																				*				
Whitetail shiner	*				*	*		*																
Hiodontidae																								
Mooneye	*		*													*								
Ictaluridae																								
Channel catfish	*	*	*	*	*	*	*	*	*	*			*					*			*	*		*
Flathead catfish	*	*					*	*	*															
Mountain madtom								*	*															
Yellow bullhead																				*				
Lepisosteidae																								
Longnose gar		*	*				*		*								*					*		*
Spotted gar													*						*					
Moronidae																								
White bass						*																		
Yellow bass												*										*		*
Percidae																								
Banded darter		*	*	*	*	*		*	*	*														
Dusky darter																				*				
Greenside darter																				*				
Logperch			*	*		*	*	*	*	*										*	*	*	*	
Redline darter		*							*													*		

Table 9. Continued on next page

Table 9. Continued

French Broad River Mile	99	98	97	95	94	87	82	78	76	74	30	28	25	23	21	20	18	16	14	12	10	8	6	5
Site Code	420000701	420000702	420000703	420000704	420000705	420000706	420000707	420000708	420000709	420000710	420000711	420000712	420000713	420000714	420000715	420000716	420000717	420000718	420000719	420000720	420000721	420000722	420000723	420000724
Species																								
Sauger											*							*			*			
Snubnose darter																				*		*		
Walleye				*		*		*		*														
Sciaenidae																								
Drum	*		*				*		*	*	*	*	*			*	*	*		*		*	*	*

Discussion

The French Broad River represents a valuable resource for the state. Although degraded over the years from residential, municipal, and agricultural growth, the river has seen improvement in water quality and maintains many of its scenic and natural characteristics. It supports and active whitewater rafting industry and is an important recreational resource for local residents. The fishery of the river is probably not the best within the region, but does provide adequate angling opportunities that deserve management consideration. Probably the most abundant species we encountered that would be sought by anglers is the channel catfish (*Ictalurus punctatus*). This species was abundant at the majority of our sites and most of the fish collected were of quality size. Water quality improvements to the tailwater section of the river by TVA have allowed for the recovery of selected species of fish and mussels. The snail darter, listed as threatened, is the most notable success story in the tailwater. Approximately 500 lake sturgeon were stocked into the tailwater in 2000 in hopes of recovering this species to some of its former range. Mussel reintroductions by the TWRA, U.S. Geological Survey, and Tennessee Tech University are underway.

The establishment of a musky fishery in the reach of river upstream of Douglas Reservoir could be worthwhile. The North Carolina Wildlife Resource Commission currently stocks 1,000 to 1,500 musky (Ohio Strain) in the French Broad River every other year (Scott Loftis, NCWRC, pers comm.). Harned (1979) documented musky at one of his sampling stations just upstream from the TN/NC line in Madison County. We did not encounter any musky in our surveys, however, the potential for them to occur in Tennessee is good.

Access along the river is somewhat limited, although a good portion of the upper reach of the river is located on U.S. Forest Service land. There is one developed access point upstream of Douglas Reservoir that is maintained by the USFS. Developed public access downstream of Douglas Reservoir is limited to ramps at Douglas Dam (TVA) and Highway 66 Bridge (TWRA) near Sevierville. There are a few primitive ramps and pull-outs along some of the roads paralleling the river above and below Douglas Reservoir.

Management Recommendations

1. Follow up with NCWRC regarding rock bass abundance in the North Carolina portion of the river (consider reintroducing this species in the Tennessee portion upstream of Douglas Reservoir).

2. Investigate the potential for developing a musky stocking program. Consult with NCWRC on their current program.

3. Develop a fishery management plan for the river.

4. Initiate an angler use survey on the river.

Little Pigeon River

Introduction

The Little Pigeon River has received national attention for some of the smallmouth bass the river produces. It has been featured on ESPN's "The Fishing Hole" and draws a fair amount of angling pressure during certain times of the year, particularly in the spring. Because of the value of this resource and its close proximity to the heavily developed towns of Sevierville and Pigeon Forge, we were interested in assessing the characteristics of the sport fish population and begin to develop some management strategies for the river. In 1997, the agency conducted a cooperative survey of the river at one location in (Bivens et al. 1998). This sample primarily focused on community assessment and identifying any trends that may indicate degradation to the river.

Recently, there have been inquiries from the public regarding a regulation that would protect smallmouth bass. We tried to design our survey in a manner that would maximize the collection of resident smallmouth bass as well as other sport species. Additionally, we developed a list of species encountered or collected during our survey of the river for inclusion into TADS. Limited surveys within the watershed have been conducted by TWRA. Peterson (1984) evaluated the fish community of the West Prong Little Pigeon. Bivens et al. (1997,1998) conducted IBI surveys on the West Prong Little Pigeon and the East Fork Little Pigeon.

Study Area and Methods

The Little Pigeon River flows in a northerly direction before emptying into the French Broad River near river mile 27. The river has a drainage area of approximately 987 km^2 at its confluence with the French Broad River. Public access along the river is primarily limited to bridge crossing and small “pull-outs” along roads paralleling the river. There are a few primitive launching areas for canoes or small boats. The lower portion of the Little Pigeon can be accessed via the French Broad River from the TWRA public ramp at the Hwy. 66 bridge.

On July 5, 2000, we conducted five fish surveys between Sevierville and the French Broad River (Figure 39). Measured channel widths ranged from 39.1 to 71.5 m, while site lengths fell between 440 and 1000 m (Table 10). Water temperatures ranged from 23.5 to 25 C and conductivity varied from 75 to 105 µs/cm (Table 10). The habitat in the upper reaches of the river (Sites 1-3) has all but been eliminated by channelization. Very little instream cover was available and almost all of the natural riparian vegetation removed. In the lower two sites (4 and 5), the river has retained much of its natural characteristics and available cover was more abundant.

Fish were collected by boat electrofishing in accordance with the standard large river sampling protocols (TWRA 1998). Fixed-boom electrodes were used to transfer 4-5 amps DC at all sites. This current setting was determined effective in narcotizing all target species (black bass and rock bass). With the exception of black bass, all fish collected were returned to the river. Additionally, efforts were made to identify non-target species encountered at each survey site. All sites were sampled during daylight hours and had survey durations ranging from 957 to

2032 seconds. Catch-per-unit-effort (CPUE) values were calculated for each target species at each site. Length categorization indices were calculated for target species following Gabelhouse (1984).

Figure 39. Site locations for samples conducted on the Little Pigeon River during 2000.

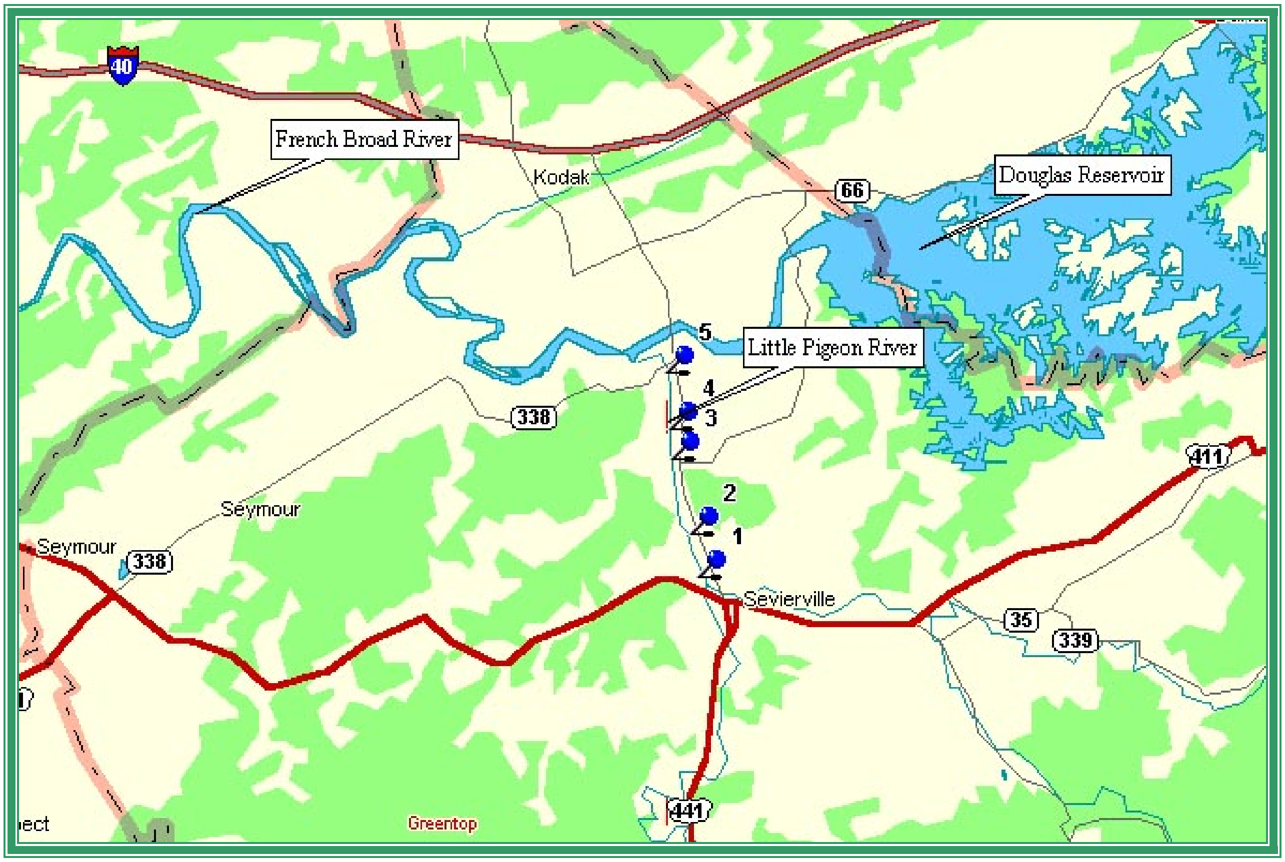


Table 10. Physiochemical and site location data for samples conducted on the Little Pigeon River during 2000.

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420000501	1	Sevier	Douglas Dam 156NE	5.0	355231N	833427W	71.5	561	23.5	75	1.5
420000502	2	Sevier	Douglas Dam 156NE	4.0	355306N	833438W	53.5	440	24	80	1.5
420000503	3	Sevier	Douglas Dam 156NE	2.9	355418N	833457W	47.6	1000	24	105	1.5
420000504	4	Sevier	Douglas Dam 156NE	2.0	355444N	833500W	39.1	850	25	100	1.5
420000505	5	Sevier	Douglas Dam 156NE	0.8	355537N	833503W	50.8	900	24.5	104	1.5

Results

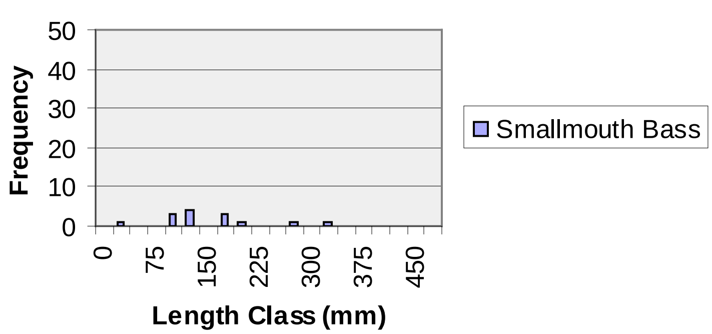
During our surveys, all target species were scarce. We collected 14 smallmouth bass, one rock bass, and four largemouth bass at all of our sites. No spotted bass were collected although they are known to occur here. CPUE estimates for smallmouth bass averaged 7.4/hour (SD 11.2), while the largemouth bass estimate was 3.3/hour (SD 5.1) (Table 11). We collected smallmouth and largemouth bass at only two of the five sites. Rock bass were collected at only the first site although habitat in the lower reaches of the river seemed suitable.

Table 11. Catch per unit effort and length categorization indices of target species collected at five sites on the Little Pigeon River during 2000.

Site Code	Smallmouth Bass CPUE	Spotted Bass CPUE	Largemouth Bass CPUE	Rock Bass CPUE
420000701	0.0	0.0	0.0	3.8
420000702	25.4	0.0	0.0	0.0
420000703	0.0	0.0	0.0	0.0
420000704	11.7	0.0	4.7	0.0
420000705	0.0	0.0	11.7	0.0
MEAN	**7.4**	**0.0**	**3.3**	**0.8**
STD. DEV.	**11.2**	**0.0**	**5.1**	**1.7**
	Smallmouth Bass Length-Categorization Analysis	**Spotted Bass Length-Categorization Analysis**	**Largemouth Bass Length-Categorization Analysis**	**Rock Bass Length-Categorization Analysis**
	PSD = 33.3	PSD = 0	PSD = 33.3	PSD = 0
	RSD-Preferred = 0	RSD-Preferred = 0	RSD-Preferred = 33.3	RSD-Preferred = 0
	RSD-Memorable = 0	RSD-Memorable = 0	RSD-Memorable = 0	RSD-Memorable = 0
	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0

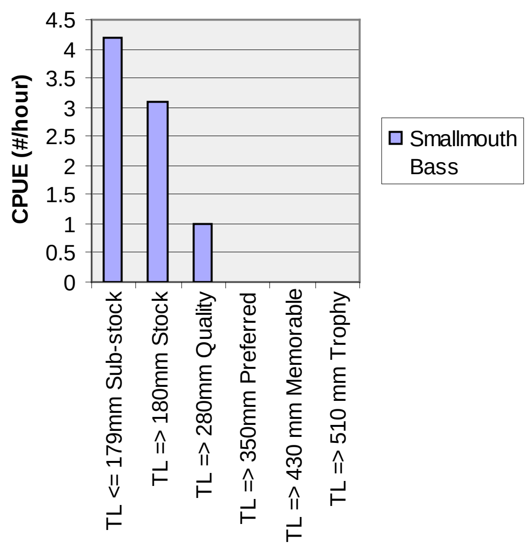
The length distribution of smallmouth bass was predominantly comprised of individuals in the 100 to 175mm size range. One bass over the 300 mm (12 in) was collected (Figure 40).

Figure 40. Length frequency distribution for smallmouth bass collected from the Little Pigeon River during 2000.



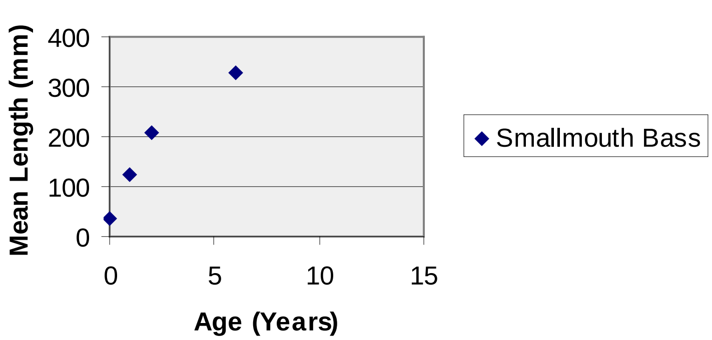
Length categorization analysis indicated the Relative Stock Density (RSD) for preferred smallmouth bass (TL $\geq$ 350 mm) was 0. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass was also 0. The PSD of smallmouth bass (ratio of quality size bass to stock size bass) was 33.3. The catch of sub-stock smallmouth was relatively high, comprising 57% of our catch (Figure 41). However, based on our overall sample it does not appear that many fish are recruited into the quality and above categories. Because of the relative lack of habitat in the Little Pigeon River, it is believed that the resident population of smallmouth bass is comprised of few and small fish.

Figure 41. Relative stock density (RSD) catch per unit effort by category for smallmouth bass collected from the Little Pigeon River during 2000.



Overall, growth rates for the few smallmouth bass collected in the Little Pigeon were similar to those values observed for same age groups in other rivers throughout the region (Carter et al. 1999,2000) (Figure 42). The annual mortality rate and maximum growth statistics

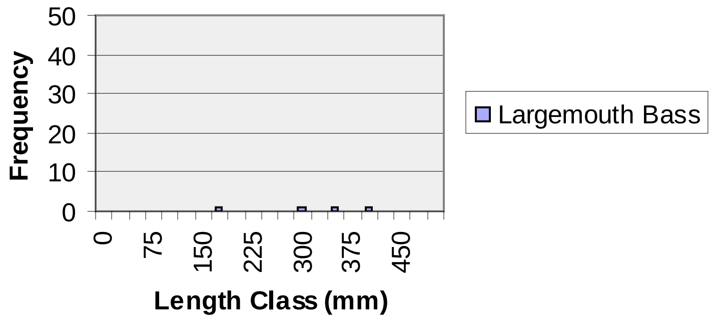
Figure 42. Mean length at age for smallmouth bass collected from the Little Pigeon River during 2000 (ages 0 and 6 actual value, only one fish in age group).



for smallmouth bass could not be calculated. This was due to the low number of individuals (14) collected in our sample.

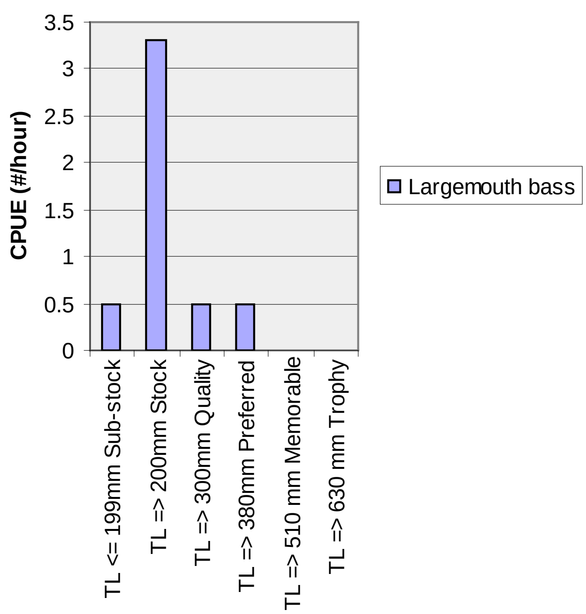
The four largemouth bass collected in the Little Pigeon were scattered between 175mm and 400 mm (Figure 43). Length categorization analysis indicated the RSD for preferred

Figure 43. Length frequency distribution for largemouth bass collected from the Little Pigeon River during 2000.



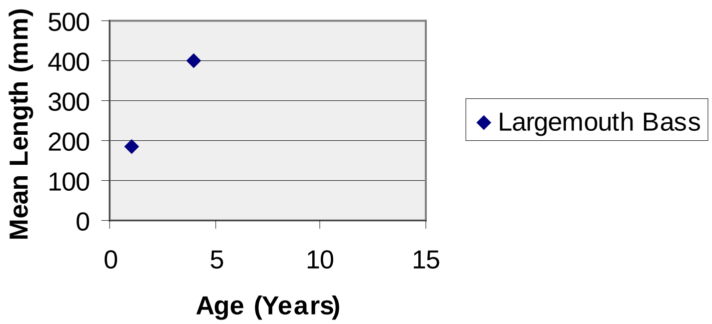
largemouth bass (TL ≥ 380 mm) was 33.3. RSD for memorable (TL ≥ 510 mm) and trophy (TL ≥ 630 mm) size largemouth bass was 0. The PSD of largemouth bass was 33.3. The highest catch rate by RSD category was for stock size largemouth bass. (Figure 44). Recruitment of larger bass into the fishery was extremely low.

Figure 44. Relative stock density (RSD) catch per unit effort by category for largemouth bass collected from the Little Pigeon River during 2000.



Age and growth determination for largemouth bass in the river was based on two individuals from our five sample sites. Because of the small sample size, any strong conclusions regarding growth characteristics of the population are hindered. Figure 45 depicts mean length at age for largemouth bass collected in the Little Pigeon River. Due to the low numbers of fish collected in the sample and the distribution in sizes, no accurate population growth or mortality statistics could be calculated.

Figure 45. Mean length at age for largemouth bass collected from the Little Pigeon River during 2000 (ages 1 and 3 actual value, only one fish in age group).



Only one 92 mm rock bass was collected during our samples. Although habitat seemed to improve downstream, rock bass remained absent from our collections. Rock bass are fairly habitat specific and are relatively intolerant to habitat degradation. Because of the low number collected in our survey no further analysis pertaining to this species will be presented.

Collected species not discussed in the results section can be found below in Table 12. None of the species collected were listed by the TWRA of the U.S. Fish and Wildlife Service.

Table 12. Distribution of fishes collected from the Little Pigeon River during 2000.

Little Pigeon River Mile	5	4	2.9	2	0.8
Site Code	420000501	420000502	420000503	420000504	420000505
Species					
Atherinidae					
Brook silverside					*
Catostomidae					
Black redhorse	*	*	*	*	*
Golden redhorse	*	*	*	*	*
Highfin carpsucker	*		*		

Table 12. Continued on next page

Table 12. Continued.

Little Pigeon River Mile	5	4	2.9	2	0.8
Site Code	420000501	420000502	420000503	420000504	420000505
Species					
Northern hog sucker	*	*	*	*	
Quillback	*				
River redhorse	*			*	
Shorthead redhorse		*		*	*
Smallmouth buffalo	*	*	*	*	*
Centrarchidae					
Bluegill		*	*	*	*
Largemouth bass				*	*
Redbreast sunfish	*	*	*	*	*
Rock bass	*				
Smallmouth bass	*	*	*	*	
Clupeidae					
Gizzard shad	*	*	*	*	*
Cottidae					
Banded sculpin	*				
Cyprinidae					
Bigeye chub	*				
Carp	*	*	*	*	*
Rosyface shiner		*			
Silver shiner	*	*	*	*	
Spotfin shiner	*		*	*	
Stargazing minnow		*			
Whitetail shiner	*	*	*	*	
Ictaluridae					
Channel catfish		*		*	
Flathead catfish			*	*	
Yellow bullhead			*		
Lepisosteidae					
Longnose gar	*	*	*	*	*
Spotted gar				*	
Moronidae					
White bass	*			*	
Percidae					
Blueside darter	*				
Gilt darter	*	*			
Greenside darter	*			*	
Logperch	*	*	*	*	
Snubnose darter	*				
Petromyzontidae					
Lamprey sp.		*			
Sciaenidae					
Drum	*	*	*	*	*

Discussion

The Little Pigeon River, although severely altered over the years, is a valuable resource to the state and to the cities of Sevierville and Pigeon Forge. The smallmouth bass fishery in this river seems to be seasonal and is most popular during the spring when larger bass apparently move in from the French Broad River to spawn. We have not documented this occurrence, however, it does occur according to local anglers. We are planning a return trip to the river this spring (April or May) to try and evaluate the spawning runs of smallmouth bass into the Little Pigeon River. Documentation of this event is of particular importance to the Agency, as protective regulations may be in order if it is found that the spawning run is significant and that angling is having an adverse effect on the population.

Management Recommendations

1. Investigate the spawning run of smallmouth bass from the French Broad River. Evaluate the significance of the resource and any potential threats to its viability.

2. Design habitat improvements that may bolster the carrying capacity of sport fishes in the river.

3. Continue to monitor the sport fishery in this river on a rotational basis. If public concern regarding the fate of the fishery becomes heightened, consider implementing an annual sampling schedule.

4. Develop a management plan for the river.

Pigeon River

Introduction

The Pigeon River has had a long history of pollution problems, stemming primarily from the 80 plus-year discharge of wastewater from the Champion Paper Mill in Canton, North Carolina. This discharge has undoubtedly had a profound effect on the recreational use of the river and after the discovery of elevated dioxin levels in the 1980's raised concerns about public health (TDEC 1996). Although the river has received increased attention in recent years, the recreational use of the river has not developed its full potential. In terms of the fishery, consumption of all fish was prohibited up until 1996 when the ordinance was downgraded, limiting consumption of carp *(Cyprinus carpio*), catfish (*Ictalurus punctatus*), and redbreast sunfish (*Lepomis auritus*) (TDEC 1996). Despite the continued posting of consumption advisories, the river draws a substantial amount of angling pressure. Since 1988, cooperative Index of Biotic Integrity samples have been conducted at two localities near river mile 8.2 (Tannery Island) and river mile 16.6 (Denton).

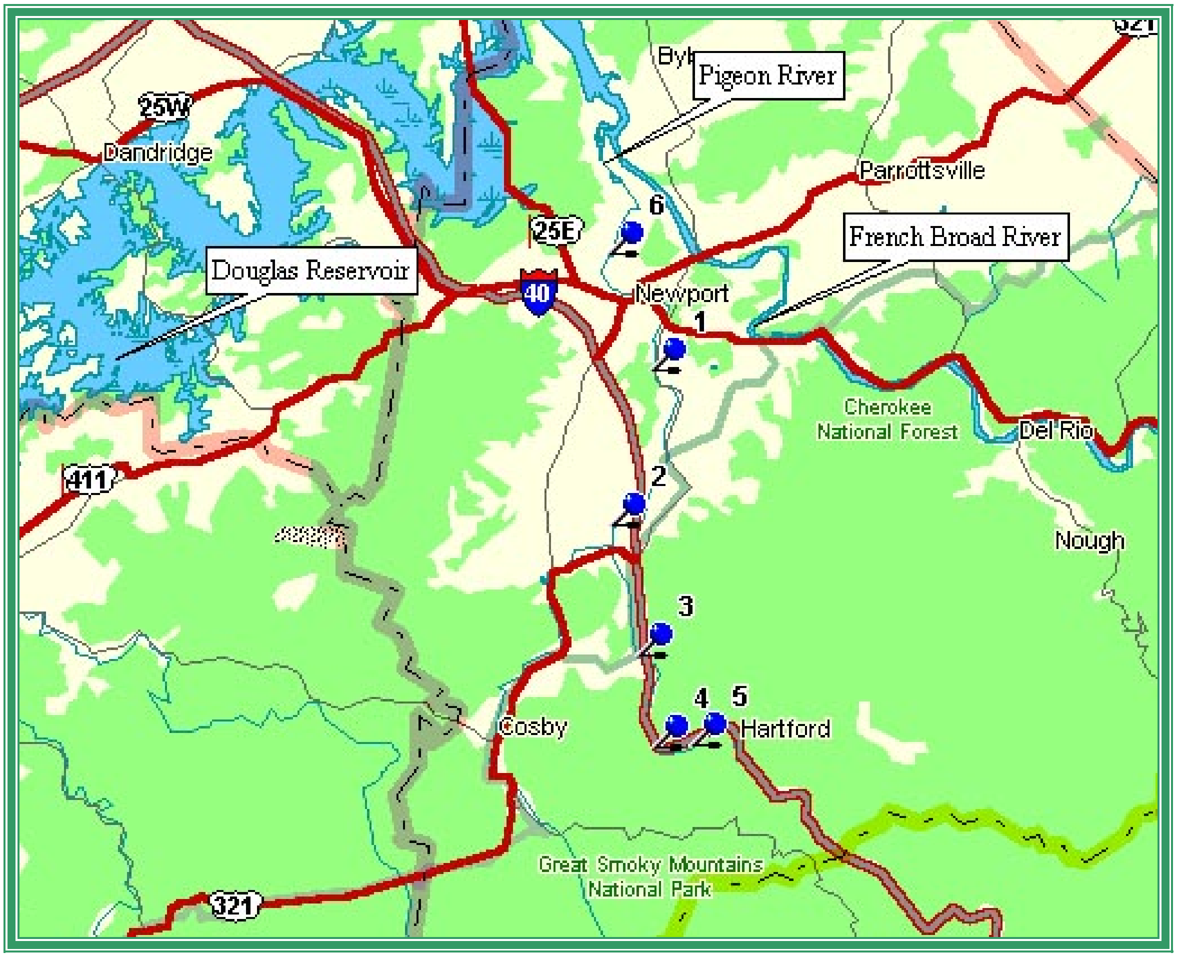
Our 2000 surveys focused on continuing our collection of catch effort data for black bass and rock bass. Catch effort data along with otolith samples from rock bass and black bass were collected from three sites in 1997 (Bivens et al. 1998) and five sites in 1998 (Carter et al. 1999). During 1998, a 508 mm minimum (20-inch) length limit on smallmouth bass with a one fish possession limit was passed by the Tennessee Wildlife Resources Commission (TWRC). This regulation was implemented on March 1, 1999.

Study Area and Methods

The Pigeon River originates in North Carolina and flows in a northwesterly direction before emptying into the French Broad River near river mile 73.8. The river has a drainage area of approximately 1,784 km^2 at its confluence with the French Broad River. In Tennessee, approximately 35 kilometers of the Pigeon River flows through mountainous terrain with interspersed communities and small farms before joining the French Broad River near Newport. Public access along the river is primarily limited to bridge crossing and small "pull-outs" along roads paralleling the river. There are a few primitive launching areas for canoes or small boats.

Between June 21 and July 13, 2000, we conducted six fish surveys between Newport and the community of Hartford (Figure 46). Because this portion of the river is a tailwater, habitat availability fluctuates with water releases. However, in our survey sites during low flow, the habitat consisted primarily of wooded shorelines with interspersed rock outcroppings. Submerged woody debris was fairly common in most of our sample areas. The river substrate was predominately boulder/cobble in riffle areas and bedrock with interspersed boulder/cobble

Figure 46. Site locations for samples conducted on the Pigeon River during 2000.



in the pool habitat. Measured channel widths ranged from 35.3 to 64.3 m, while site lengths fell between 80 and 869 m (Table 13). Water temperatures ranged from 22 to 25 C and conductivity varied from 170 to 200 μs/cm (Table 13).

Table 13. Physiochemical and site location data for samples conducted on the Pigeon River during 2000.

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420000401	1	Cocke	Newport 173NW	8.1	355633N	831043W	53.6	392	N/A	N/A	0.9
420000402	2	Cocke	Newport 173NW	13	355322N	831147W	64.3	869	25	190	N/A
420000403	3	Cocke	Hartford 173SW	16.6	355039N	831104W	N/A	414	N/A	N/A	0.9
420000404	4	Cocke	Hartford 173SW	19	354847N	831041W	35.3	80	24	180	0.9
420000405	5	Cocke	Hartford 173SW	20.5	354849N	830945W	47.3	839	22	170	0.9
420000406	6	Cocke	Hartford 173SW	3.6	355857N	831156W	54	193	25	200	N/A

Fish were collected by boat electrofishing in accordance with the standard large river sampling protocols (TWRA 1998). Fixed-boom electrodes were used to transfer 4-5 amps DC at all sites. This current setting was determined effective in narcotizing all target species (black bass and rock bass). All fish collected were returned to the river. Additionally, efforts were made to identify non-target species encountered at each survey site. All sites were sampled during daylight hours and had survey durations ranging from 1000 to 8033 seconds. Catch-per-unit-effort (CPUE) values were calculated for each target species at each site. Length categorization indices were calculated for target species following Gabelhouse (1984).

Results

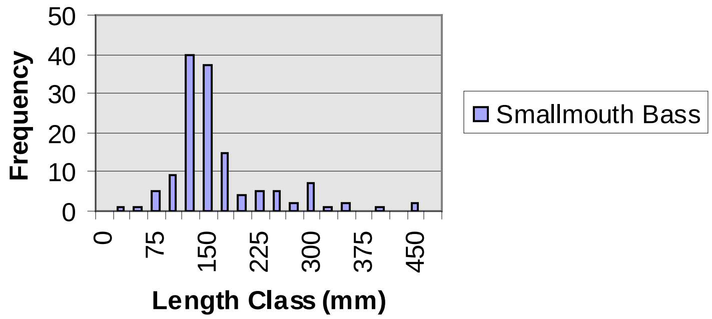
During our surveys, smallmouth bass and rock bass were collected from all the sample sites. The collection of spotted bass and largemouth bass was more sporadic. Smallmouth bass was the most abundant black bass species at any of the survey sites. CPUE estimates for this species averaged 30.9/hour (SD 36.2), while the spotted bass and largemouth bass estimates were 1.0/hour (SD 0.9) and 5.1/hour (SD 5.9), respectively (Table 14). There was a general trend of increasing catch rates for smallmouth bass in the intermediate reaches (sites 3-5) of the river (Table 14). Rock bass CPUE was highest between sample sites 2 and 5, averaging 12.5/hour (SD 6.3). The highest catch rate for this species was recorded at site 3 (19.7/hour), which also had the highest value in 1999.

Table 14. Catch per unit effort and length categorization indices of target species collected at six sites on the Pigeon River during 2000.

Site Code	Smallmouth Bass CPUE	Spotted Bass CPUE	Largemouth Bass CPUE	Rock Bass CPUE
420000401	3.8	1.1	2.7	4.9
420000402	17.9	0.0	13.0	13.8
420000403	14.3	1.8	0.4	19.7
420000404	97.2	0.0	0.0	14.4
420000405	47.7	1.0	12.2	17.2
420000406	4.7	2.4	2.4	4.7
MEAN	**30.9**	**1.0**	**5.1**	**12.5**
STD. DEV.	**36.2**	**0.9**	**5.9**	**6.3**
	Smallmouth Bass Length-Categorization Analysis	**Spotted Bass Length-Categorization Analysis**	**Largemouth Bass Length-Categorization Analysis**	**Rock Bass Length-Categorization Analysis**
	PSD = 33.3	PSD = 60	PSD = 58.6	PSD = 22.2
	RSD-Preferred = 12.8	RSD-Preferred = 20	RSD-Preferred = 0	RSD-Preferred = 0
	RSD-Memorable = 5.1	RSD-Memorable = 0	RSD-Memorable = 0	RSD-Memorable = 0
	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0

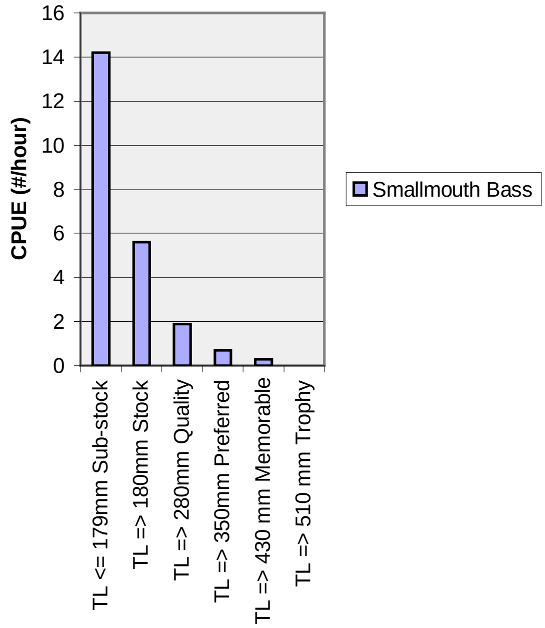
The majority of the smallmouth bass collected from the Pigeon River during 2000 fell within the 75 to 200 mm length range (Figure 47). Our data indicated that bass less than 75 mm, were not completely vulnerable to the sampling gear. Length categorization analysis indicated

Figure 47. Length frequency distribution for smallmouth bass collected from the Pigeon River during 2000.



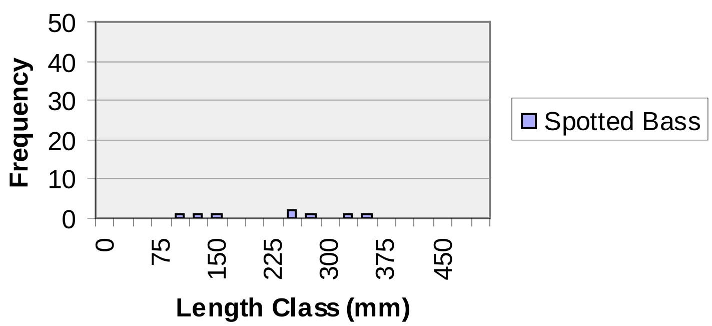
the Relative Stock Density (RSD) for preferred smallmouth bass (TL $\geq$ 350 mm) was 12.8. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass were 5.1 and 0, respectively. The PSD of smallmouth bass (ratio of quality size bass to stock size bass) was 33.3. Catch per unit effort estimates by RSD category indicated smallmouth bass had the highest catch rates of any of the black bass species collected for the category RSD-Q and above (Figure 48) although the values were not high. The catch of sub-stock smallmouth was quite high which indicated good recruitment (Figure 48). Linear and curvilinear length-weight regression analysis has been calculated for previous (Carter et al. 1999) years data and is assumed to be similar for the 2000 data. No age and growth data was collected from this population in 2000, age and growth characteristics for smallmouth bass in the Pigeon River are well documented from recent surveys (Carter et al. 1999, 2000).

Figure 48. Relative stock density (RSD) catch per unit effort by category for smallmouth bass collected from the Pigeon River during 2000.



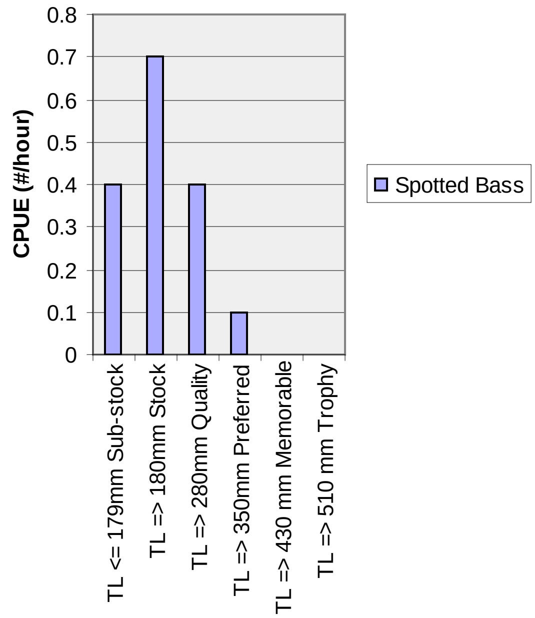
There were very few spotted bass collected from the Pigeon River in 2000. A total of eight spotted bass were collected in all of our samples. This was a 67% decrease in total catch from the previous year. Because there were so few spotted bass collected in the sample, no one size range dominated the length distribution (Figure 49). Length categorization analysis

Figure 49. Length frequency distribution for spotted bass collected from the Pigeon River during 2000.



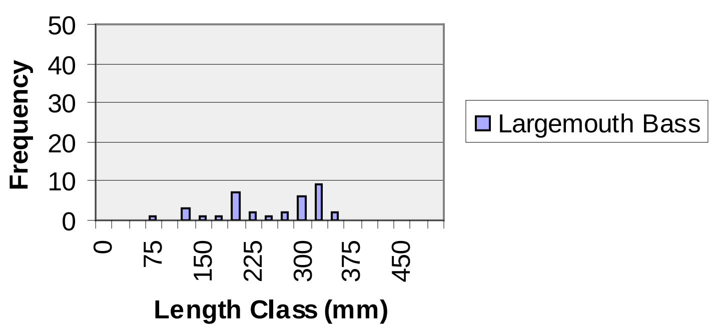
indicated the RSD for preferred spotted bass (TL $\geq$ 350 mm) was 20. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass was 0. The PSD of spotted bass was 60. Catch per unit effort estimates by RSD category revealed very few spotted bass above the RSD-Q category, indicating a relative lack of larger fish available to anglers (Figure 50). Additionally, the catch rate for sub-stock spotted bass was low indicating poor recruitment for 2000.

Figure 50. Relative stock density (RSD) catch per unit effort by category for spotted bass collected from the Pigeon River during 2000.



Most of the largemouth bass collected during 2000 fell within the 200 to 325 mm length range (Figure 51). Length categorization analysis indicated the RSD for preferred

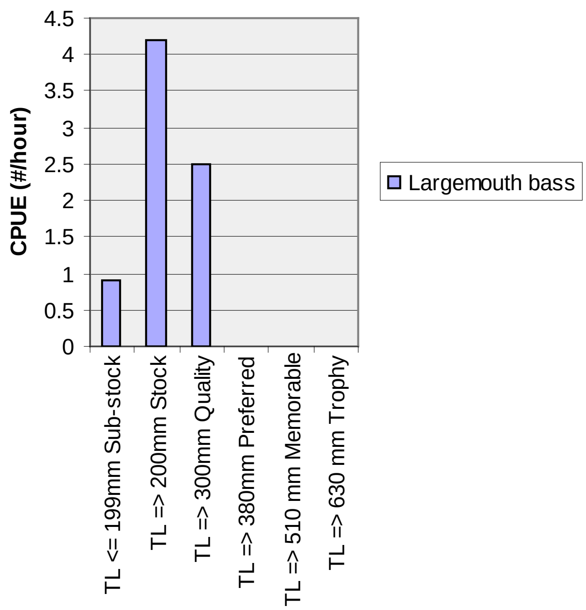
Figure 51. Length frequency distribution for largemouth bass collected from the Pigeon River during 2000.



largemouth bass (TL ≥ 380 mm) was 0. RSD for memorable (TL ≥ 510 mm) and trophy (TL ≥ 630 mm) size largemouth bass was also 0. The PSD of largemouth bass was 58.6. No largemouth bass above the RSD-Q category were collected (Figure 52). This was down from the

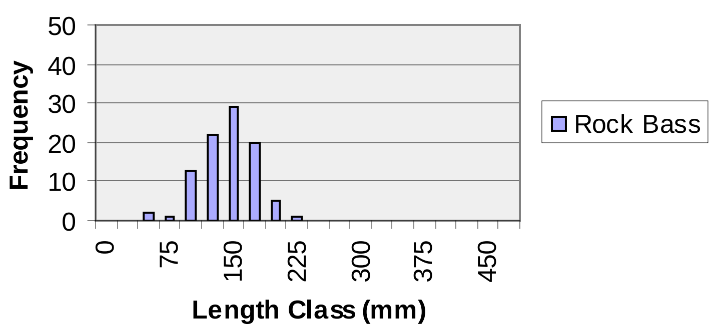
1999 sample where about 5% of our catch was in the preferred category. Poor recruitment was also evident by the relative lack of sub-stock largemouth bass.

Figure 52. Relative stock density (RSD) catch per unit effort by category for largemouth bass collected from the Pigeon River during 2000.



Individuals in the 100 to 175 mm range represented the majority of rock bass in our sample (Figure 53). Length categorization analysis indicated the RSD for preferred rock bass

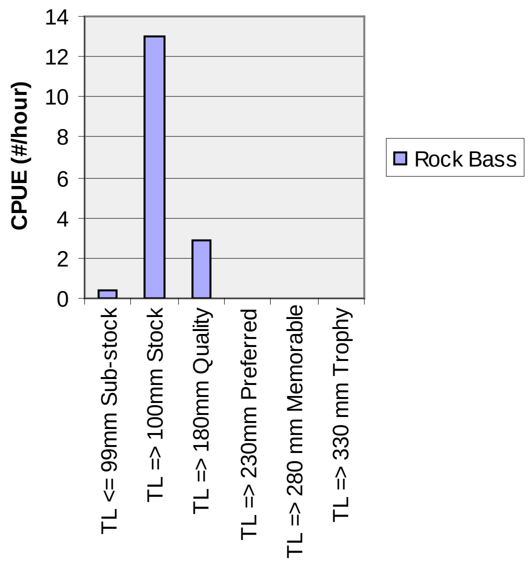
Figure 53. Length frequency distribution for rock bass collected in the Pigeon River during 2000.



(TL ≥ 230 mm) was 0. Likewise, RSD for memorable (TL ≥ 280 mm) and trophy (TL ≥ 330 mm) size rock bass was 0. The PSD of rock bass was 22.2. Catch per unit effort estimates by

RSD category indicated the majority of our catch was stock size fish with only 2.9% of the catch representing quality size fish (Figure 54). The sub-stock catch of rock bass was low, but probably does not indicate poor recruitment due to the fact that sampling efficiency is usually lower with this size group.

Figure 54. Relative stock density (RSD) catch per unit effort by category for rock bass collected in the Pigeon River during 2000.



Linear and curvilinear length-weight regression analysis has been calculated for previous (Carter et al. 1999) years data and is assumed to be similar for the 2000 data. No age and growth data was collected from this population in 2000, age and growth characteristics for rock bass in the Pigeon River are well documented from recent surveys (Carter et al. 1999, 2000).

Several other species were collected or observed (41) during our survey of the Pigeon River. None of the fish collected in the 2000 sample were listed by the U.S. Fish and Wildlife Service or the TWRA as threatened or endangered. One notable collection was that of the white catfish (*Ameiurus catus*), this represented the first collection of this species within the state. A list of species occurrence by site can be found in Table 15.

Table 15. Distribution of fishes collected in the Pigeon River during 2000 (list generated from boat sample only).

Pigeon River Mile	8.1	13	16.6	19	20.5	4.0
Sample Type	IBI/CPUE	CPUE	IBI/CPUE	CPUE	CPUE	CPUE
Site Code	420000401	420000402	420000403	420000404	420000405	420000406
Species						
Catostomidae						
Black buffalo	*	*			*	*
Black redhorse	*	*	*	*	*	*
Golden redhorse	*	*		*	*	*
Northern hog sucker	*	*	*	*	*	*
Quillback		*				
River carpsucker	*					
River redhorse	*					
Shorthead redhorse	*		*			*
Silver redhorse	*		*			
Smallmouth buffalo	*	*	*	*		*
White sucker					*	
Centrarchidae						
Black crappie	*	*			*	
Bluegill	*	*	*		*	*
Green sunfish		*	*			
Largemouth bass	*	*	*		*	*
Redbreast sunfish	*	*	*	*	*	*
Redear sunfish	*					
Rock bass	*	*	*	*	*	*
Smallmouth bass	*	*	*	*	*	*
Spotted bass	*		*		*	*
Clupeidae						
Gizzard shad	*	*	*	*	*	*
Cottidae						
Banded sculpin	*		*		*	
Cyprinidae						
Bigeye chub						*
Carp	*	*	*	*	*	*
Silver shiner				*		*
Spotfin shiner	*					
Stoneroller				*		
Telescope shiner				*	*	
Whitetail shiner			*	*	*	*
Ictaluridae						
Channel catfish	*	*				*
Flathead catfish	*					
White catfish					*	
Yellow bullhead			*		*	

Table 15. Continued on next page

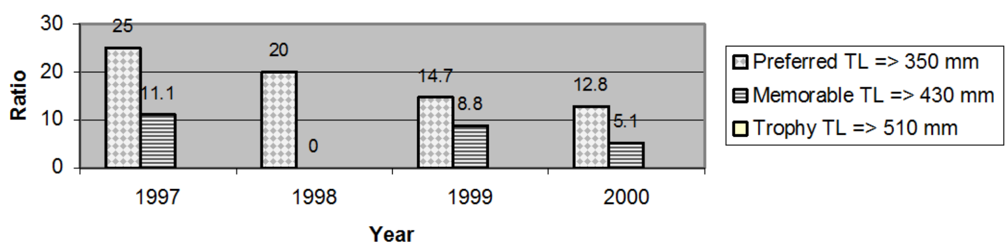
Table 15. Continued

Pigeon River Mile	8.1	13	16.6	19	20.5	3.6
Sample Type	IBI/CPUE	CPUE	IBI/CPUE	CPUE	CPUE	CPUE
Site Code	420000401	420000402	420000403	420000404	420000405	420000406
Species						
Lepisosteidae						
Spotted gar					*	
Moronidae						
White bass	*					
Percidae						
Logperch	*	*	*		*	*
Sauger			*			
Snubnose darter	*	*	*		*	
Walleye	*					*
Petromyzontidae						
Lamprey sp.	*	*				
Sciaenidae						
Drum	*	*				*

Discussion

The Pigeon River provides anglers with the opportunity to catch all species of black bass and also rock bass. Perhaps the greatest potential for elevating this river's "trophy" status lies in the smallmouth bass population. Given that a fair percentage of smallmouth bass are reaching the preferred category (average 15.8% between 1998-2000) and that these fish are growing slightly slower than the statewide average (Carter et al. 1999), there would appear to be potential for managing the smallmouth bass population in this river. With the implementation of the 20 inch length regulation during the 1999-2000 season, shifts in the smallmouth bass population structure may be forthcoming (higher densities of larger bass). We are currently tracking trends in this segment of the smallmouth bass population (Figure 55).

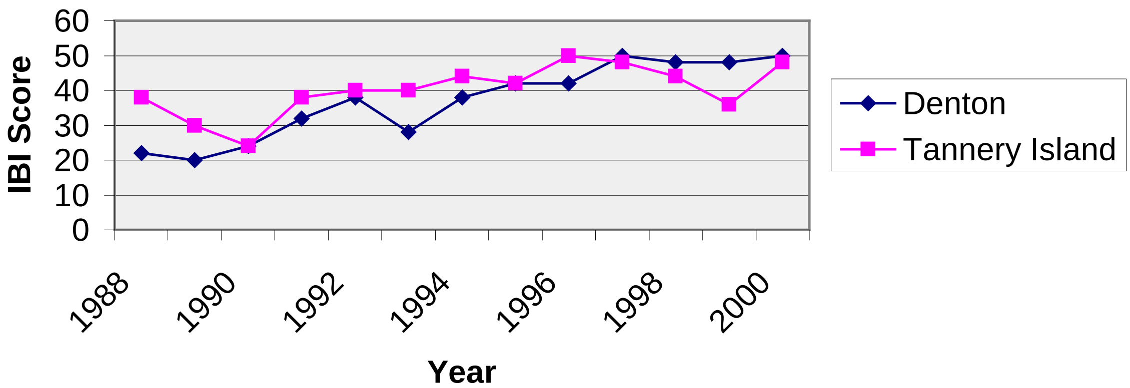
Figure 55. Trends in the ratio of preferred, memorable, and trophy smallmouth bass collected from the Pigeon River 1997-2000.



With the increase in recreational use on the river, it is important that angler use and harvest on the river be profiled. The Pigeon River is one potential candidate for a TWRA creel survey tentatively scheduled for the spring and summer of 2001. The collection of this type of data will aid in evaluating angler use of the resource and help in evaluating the current size and creel limit restrictions.

Over the last 13 years the IBI scores (TWRA and TVA data) at two stations on the Pigeon River have been steadily increasing (Figure 56).

Figure 56. Trends in Index of Biotic Integrity (IBI) at two stations on the Pigeon River (1988-2000).



This has primarily been the result of improved wastewater treatment at the Champion Paper Mill in Canton, North Carolina. The improved water quality has undoubtedly had an affect on the amount of recreation that is currently taking place, particularly whitewater rafting. It has also resulted in the return of a few species (e.g. *Notropis photogenis, Notropis telescopus*) previously not encountered in the annual surveys. The continuation of improvements to the water quality of the Pigeon River will in all likelihood have dramatic impacts on the use of the river in the future. Surveys on the Pigeon River will be conducted on an annual basis in order to assess any changes in the fishery that may result from the new regulation. Currently, there are tentative plans to re-introduce selected species of fish back into the river. A pilot project to re-introduce mussels is currently underway.

Management Recommendations

1. Implement an angler-use and harvest survey.

2. Continue monitoring the sport fish population, with detailed analysis focusing on the smallmouth bass fishery.

3. Continue the cooperative IBI surveys at the two established stations (Denton and Tannery Island).

4. Develop a management plan for the river.

Bennetts Fork

Introduction

Coal mining in Campbell and Claiborne counties of east Tennessee began in the early 1900's and peaked in the middle 1940's. Mining activities have continued to the present day, although the extensiveness of these activities has declined in recent years. As a result of these activities many of the streams in the Cumberland River watershed have suffered degradation from sedimentation and acid mine drainage.

We were interested in surveying Bennett Fork for three reasons. We wanted to assess the relative health of the stream based fish and benthic community, build a species list for TADS, and investigate the possible occurrence of the blackside dace.

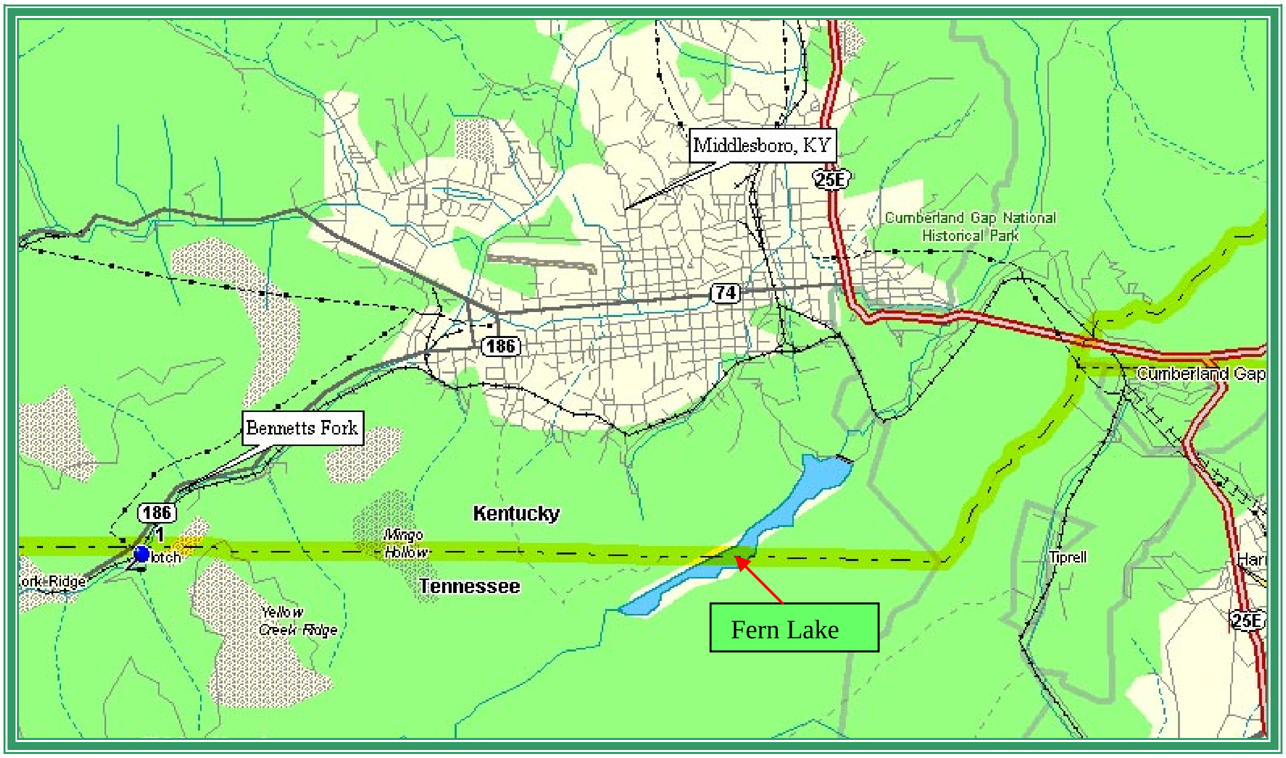
Bennetts Fork originates in Claiborne County, Tennessee. It flows in a northeasterly direction before joining Yellow Creek and emptying into the Cumberland River just north of Middlesboro, Kentucky. The majority of the watershed falls within Tennessee's boundary, which drains through steep forested terrain.

Study Area and Methods

Our survey of Bennetts Fork was conducted about 0.25 mi from the Tennessee/Kentucky stateline along route 132 (Figure 57). The stream flows through forested terrain with interspersed residential development in the low-lying areas. The majority of development within the watershed centers around the extraction of coal from surface mining operations. The watershed encompasses approximately 12.6 km^2 in Tennessee and is characterized by a second growth cove hardwood forest. The stream can best be described as moderately graded with riffle/run sequences as the dominant instream habitat component. There were very few pools in our sample reach (30%) and the development (area and depth) of these pools was somewhat limited. Instream cover was scarce and was limited to boulders and a few undercut banks. Woody debri within the stream was almost non-existent. The streambed was primarily composed of gravel and rubble in the pools and bedrock and rubble in the riffle areas. Coal fines were abundant in the substrate and served as a testament to the activities that were ongoing within the watershed. Basic water quality data collected at the site was within frequently observed ranges for this type of stream.

Our evaluation of the fish community was accomplished through an Index of Biotic Integrity (IBI) survey. Benthic organisms were collected with kick nets during a timed survey. Analysis of the fish and benthic samples followed procedures developed by Karr et al. (1986) and Lenat (1993).

Figure 57. Sample site location for the IBI survey conducted on Bennetts Fork.



Results

We collected a total of 438 fish comprising nine species during our IBI survey (Table 16). The only game species present was the redbreast sunfish (*Lepomis auritus*). The two most dominant species collected in our sample were the blacknose dace (*Rhinichthys atratulus*) and stoneroller (*Campostoma anomalum*). Together, these two species comprised 74% of the total number of fish in our sample. One darter species, the rainbow darter (*Etheostoma caeruleum*), was collected in low numbers. Probably the most interesting occurrence we had was the collection of a single specimen of the blackside dace (*Phoxinus cumberlandensis*). This federally threatened species is fairly common within the Cumberland drainage, but is confined in distribution to this drainage. The collection of this species from Bennetts Fork represents a new record for this stream.

Table 16. Fish species encountered in Bennetts Fork.

SPECIES	NUMBER COLLECTED
Blacknose dace	202
Blackside dace	1
Bluntnose minnow	1
Creek chub	97
Hybrid creek chub	1
Northern hog sucker	5

Table 16. Continued on next page

Table 16. Continued.

SPECIES	NUMBER COLLECTED
Rainbow darter	6
Redbreast sunfish	2
Stoneroller	121
White sucker	2
TOTAL	**438**

Overall, the IBI analysis indicated that Bennetts Fork was in poor condition (IBI score = 30). The most influential metrics on the score were the high percentage of trophic generalists, low percentage of piscivores, and the high percentage of tolerant species (Table 17).

Table 17. Bennetts Fork Index of Biotic Integrity analysis.

Metric Description	Scoring Criteria 1 3 5	Maximum Expected Species	Observed	Score
Number of Native Species	<5 5-11 >11	17	8	3
Number of Darter Species	<2 2 >2	4	1	1
Number of Sunfish Species less *Micropterus*	<2 2 >2	3	0	1
Number of Sucker Species	<1 1 >1	2	2	5
Number of Intolerant Species	<2 2 >2	3	0	1
Percent of Individuals as Tolerant	>20 20-10 <10		22.7	1
Percent of Individuals as Omnivores	>45 45-22 <22		28.4	3
Percent of Individuals as Specialists	<25 25-50 >50		1.4	1
Percent of Individuals as Piscivores	<1 1-5 >5		0	1
Catch Rate	<16 16-32 >32		78.6	5
Percent of Individuals as Hybrids	>1 1-TR 0		0.2	3
Percent of Individuals with Anomalies	>5 5-2 <2		0.4	5
			Total	**30 (Poor)**

Benthic macroinvertebrates collected in our sample comprised 24 families representing 27 identified genera (Table 18). The most abundant group in our collection was the caddisflies comprising about 49% of the total sample. Overall, a total of 32 taxa were identified from the sample of which 11 were EPT. Based on the EPT taxa richness and overall biotic index of all species collected, the relative health of the benthic community was classified as fair to good (3.5).

Table 18. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Bennetts Fork.

ORDER	FAMILY	*SPECIES*	NUMBER	PERCENT
ANNELIDA				0.2
	Oligochaeta		1	
COLEOPTERA				3.3
	Dryopidae	*Helichus* adults	6	
	Elmidae	*Macronychus glabratus* adults	1	
		Optioservus larva	1	
		Optioservus trivittatus adult	1	
	Psephenidae	*Psephenus herricki*	5	
DIPTERA				16.8
	Athericidae	*Atherix lantha*	30	
	Chironomidae		1	
	Empididae pupa		1	
	Simuliidae		1	
	Tipulidae	*Hexatoma*	1	
		Tipula	37	
EPHEMEROPTERA				19.0
	Baetidae	*Baetis*	29	
	Heptageniidae	*Stenonema femoratum*	1	
	Isonychiidae	*Isonychia*	50	
HETEROPTERA				1.2
	Gerridae	*Gerris remigis* male and female	2	
	Notonectidae	*Notonecta*	1	
	Veliidae	*Rhagovelia obesa* male and female	2	
ISOPODA				3.1
	Asellidae	*Lirceus*	13	
MEGALOPTERA				3.1
	Corydalidae	*Corydalus cornutus*	9	
		Nigronia serricornis	3	
	Sialidae	*Sialis*	1	
ODONATA				3.6
	Calopterygidae	*Calopteryx*	5	
	Cordulegastridae	*Cordulegaster maculata*	8	
	Gomphidae	*Gomphus lividus*	2	
PLECOPTERA				0.9
	Perlidae	*Acroneuria carolinensis*	4	
TRICHOPTERA				48.8
	Hydropsychidae	*Ceratopsyche bronta*	106	
		Ceratopsyche slossonae	7	

Table 18. Continued on next page

Table 18. Continued.

ORDER	FAMILY	*SPECIES*	NUMBER	PERCENT
TRICHOPTERA				
		Cheumatopsyche	79	
		Diplectrona modesta	1	
		Hydropsyche betteni/depravata	8	
	Philopotamidae	*Chimara*	1	
	Rhyacophilidae	*Rhyacophila fuscula*	4	

TAXA RICHNESS = 32
EPT TAXA RICHNESS = 11
BIOCLASSIFICATION = 3.5 (FAIR/GOOD)

Discussion

Bennetts Fork is typical of many streams in this region. The proliferation of coal mining within the watershed has undoubtedly degraded this stream, however, it is in better condition than some of its counterparts within the watershed. The stream does not offer any significant angling opportunities for sport species within the reach we surveyed. The occurrence of the blackside dace in this stream elevates the importance for stream protection, although the viability of the population is unknown.

Management Recommendations

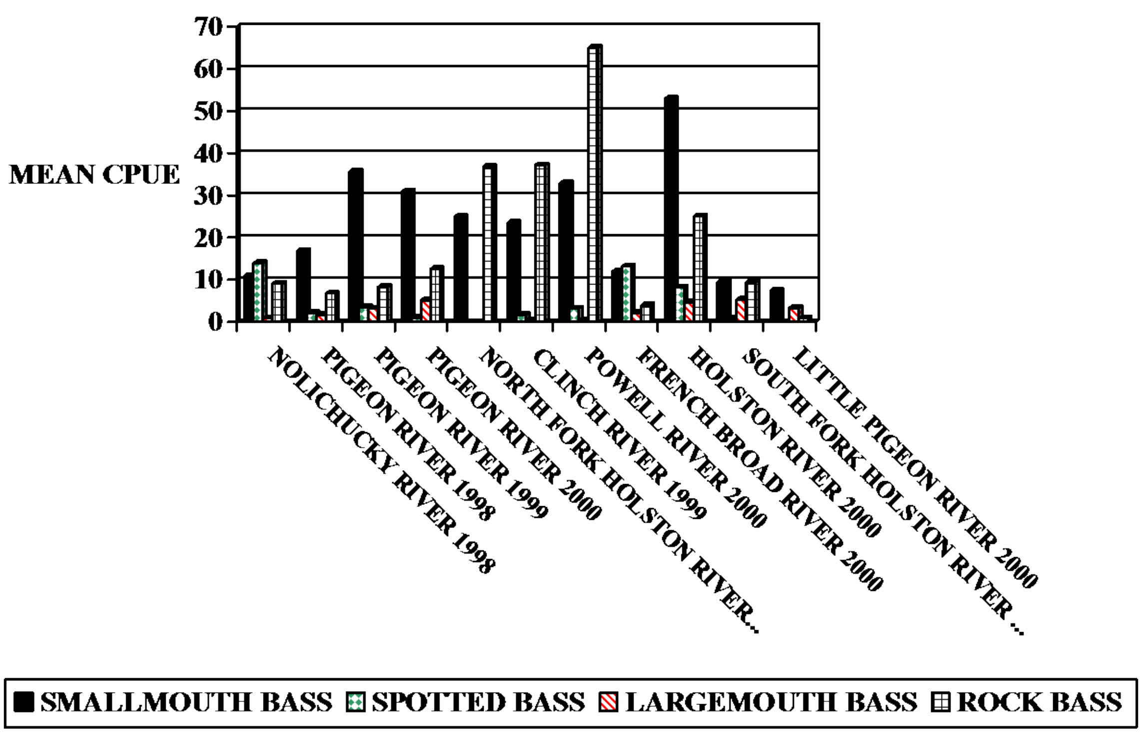
1. Notify the U.S. Fish and Wildlife Service regarding the collection of blackside dace.

Summary

We surveyed five rivers and one stream collecting 70 fish samples and one benthic sample. Our surveys encompassed approximately 253 river miles in eight counties.

In the nine large rivers sampled between 1998 and 2000, mean CPUE values for smallmouth bass have ranged from a high of 52.9/hour in the Holston River to a low 7.4/hour in the Little Pigeon River (Figure 58). The highest spotted bass CPUE value has been observed in the Nolichucky River followed closely by the French Broad. Overall, the highest values recorded for largemouth bass have come from the Pigeon, Holston, and South Fork Holston rivers. This species commonly occurs in the lower reaches of most of the rivers we have surveyed, and although lower in density, the largemouth bass has been the largest (length and weight) black bass species collected. Undoubtedly, the best rock bass population we have surveyed to date has been in the Powell River. The value recorded from here was almost double the second highest value, which came from the neighboring Clinch River. Based on our surveys to date, the highest density smallmouth bass population we have encountered has been in the Holston River followed by the Pigeon and Powell rivers. In discussing the Holston River it must be stated that the lower Holston (downstream of Cherokee Reservoir) has a totally different smallmouth population structure when compared to the population upstream of Cherokee Reservoir. Although the highest densities came from the lower Holston, quality size fish were only encountered in the reach above the dam, particularly between the communities of Church Hill and Surgoinsville. The population downstream of the reservoir is characterized by slow growth and a truncated age structure. It is believed that the temperature regimes within this tailwater portion of the river may be a regulating factor.

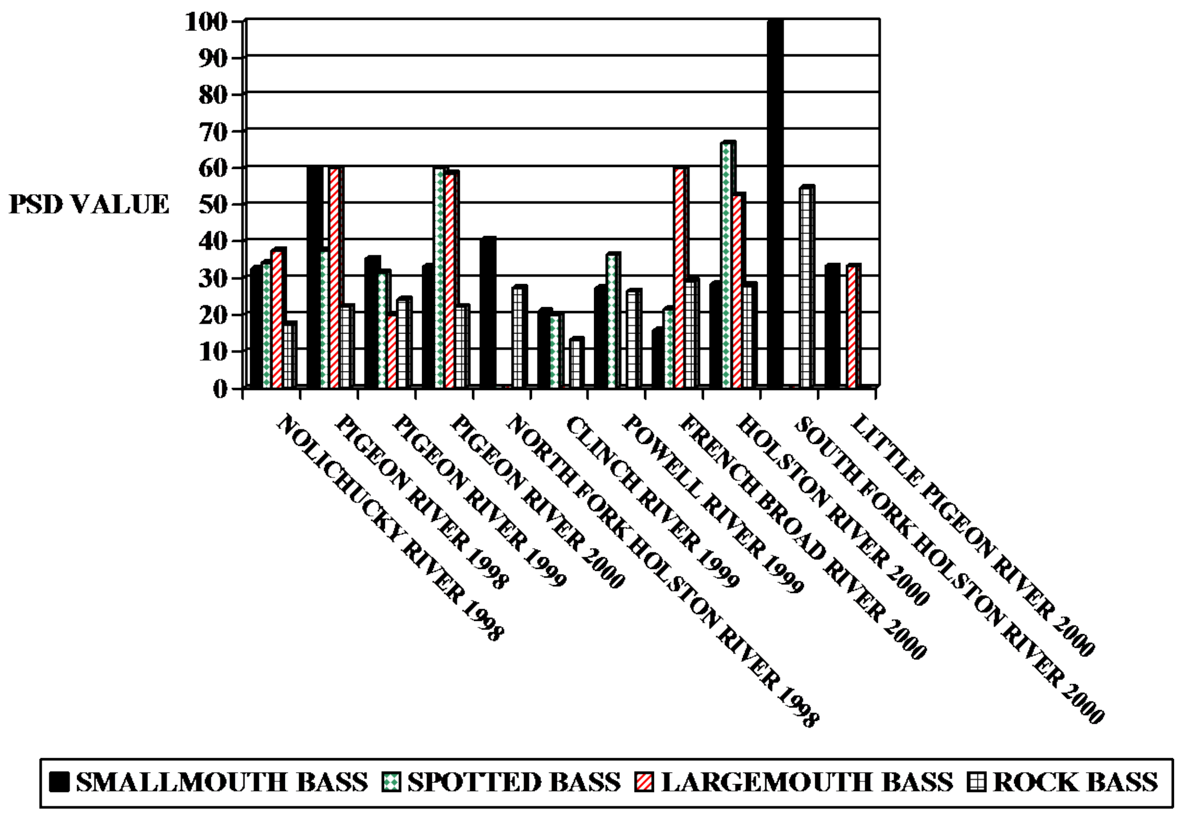
Figure 58. Mean CPUE values for black bass and rock bass collected from nine rivers surveyed between 1998 and 2000.



All of the rivers we have surveyed produce quality size smallmouth bass, however, the best are the Clinch, Powell, North Fork Holston, upper Holston and Pigeon rivers. These rivers have consistently produced quality size and above smallmouth bass during our surveys.

Proportional stock density (PSD) values for smallmouth bass have ranged from 100 in the South Fork Holston River to 15.8 in the French Broad River between 1998 and 2000. Spotted bass PSD values have ranged from 0 in the South Fork Holston and Little Pigeon rivers to 66.7 in the Holston River, while largemouth bass values ranged from 0 to 60 (Figure 59).

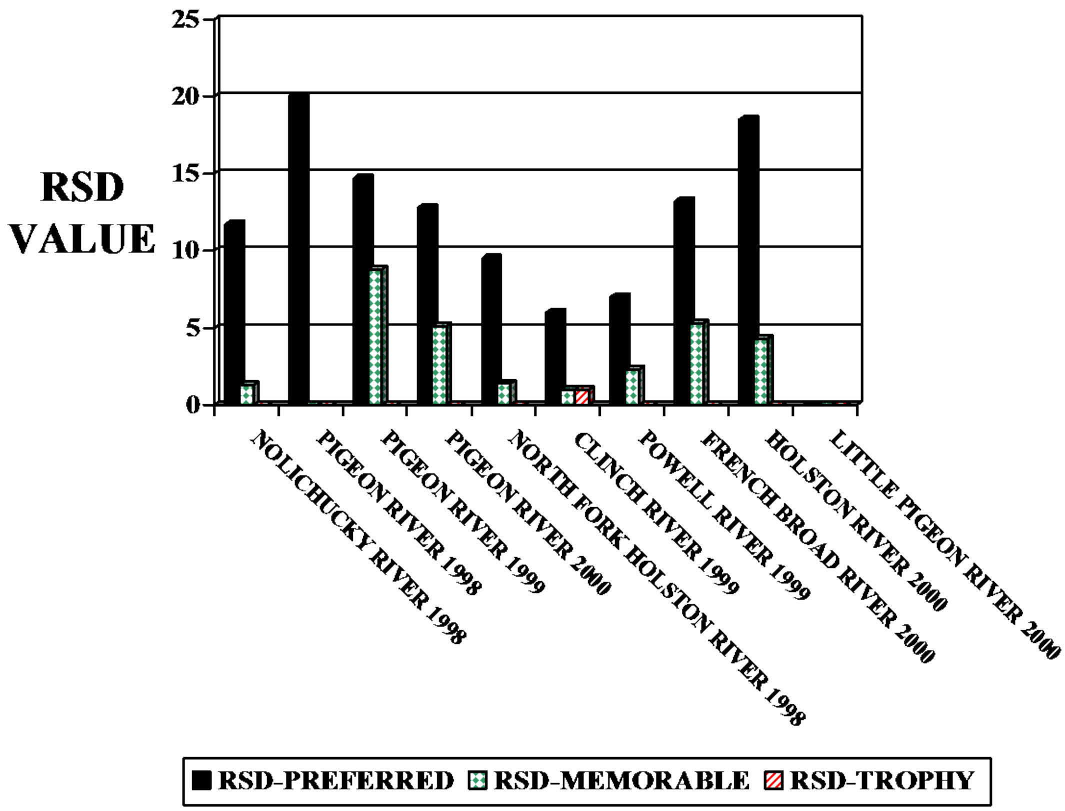
Figure 59. Proportional stock density values calculated for black bass and rock bass from nine rivers sampled between 1998 and 2000.



The South Fork Holston River has had the highest recorded PSD value for rock bass (13 fish) of the nine rivers sampled between 1998 and 2000 (Figure 59).

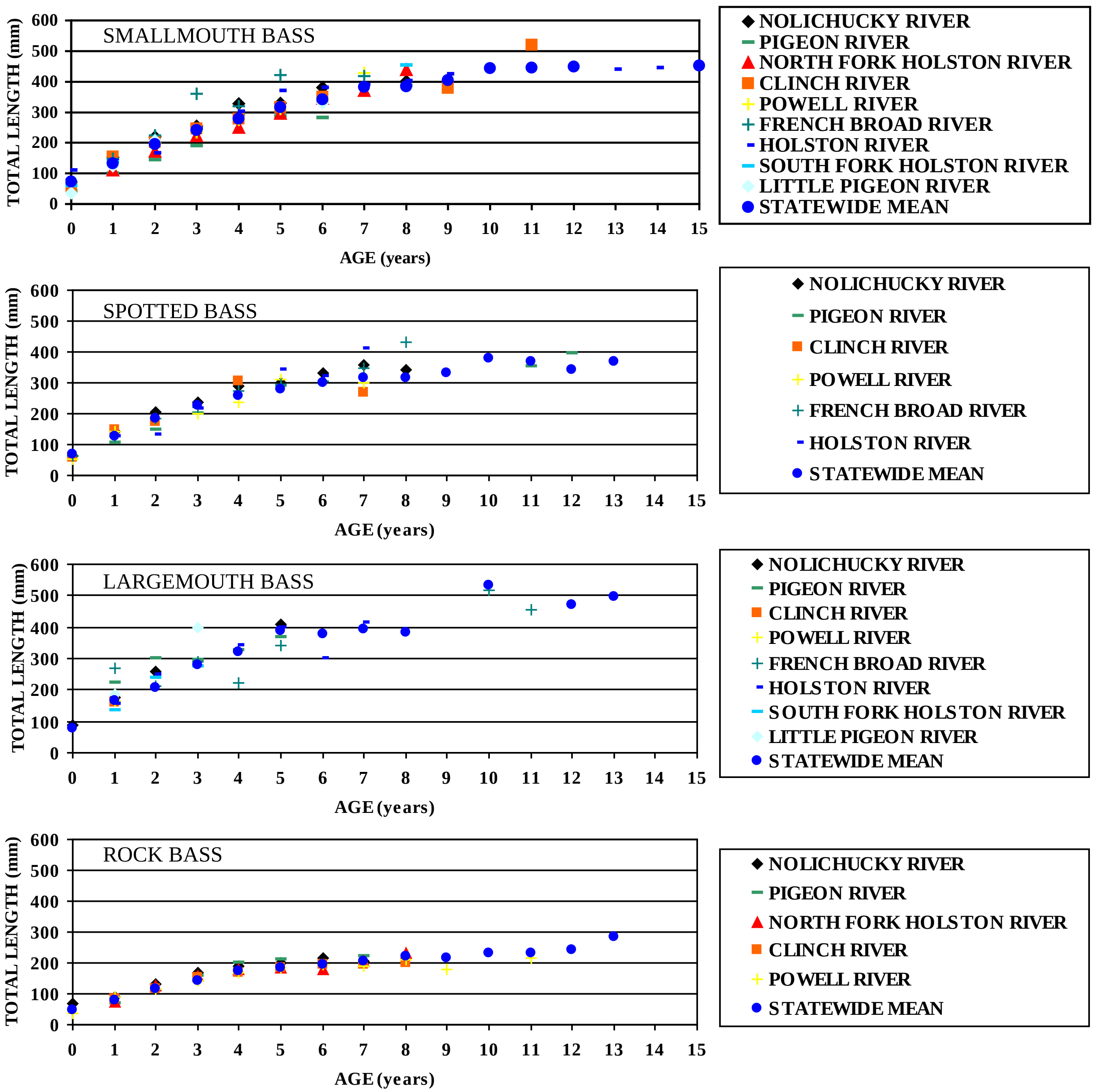
Relative stock density (RSD) analysis indicated the Pigeon River has consistently had high values for preferred smallmouth bass (total length => 350mm). The Holston (upper Holston) and French Broad rivers were runner-ups for producing preferred smallmouth bass (Figure 60). All of the rivers surveyed produced memorable size (total length =>430mm) smallmouth with the exception of the Little Pigeon River. The only the river to produce a trophy size (total length => 510mm) smallmouth bass has been the Clinch River. Although the Clinch River has been the only river where we have sampled smallmouth in excess of 20 inches, they are known to occur in the majority of the other rivers we have surveyed over the last three years.

Figure 60. Selected relative stock density values calculated for smallmouth bass from eight rivers surveyed between 1998 and 2000 (South Fork Holston River omitted).



Growth of all black bass species was fairly consistent among the nine rivers surveyed between 1998 and 2000 (except smallmouth in the lower Holston River). Rock bass were not aged during 2000, data presented for this species was collected during 1998-99. The mean length at age values generated for each river also compare quite well with the overall statewide length at age data. This indicates that the black bass and rock bass growth within the region is consistent with populations across the state (Figure 61). The few outliers, particularly with spotted bass and largemouth bass were due to only one fish being represented in that age group.

Figure 61. Mean length at age for black bass and rock bass collected from nine rivers between 1998 and 2000 (rock bass data from 1998-99).



Comparisons of length at age among the nine rivers indicated similar growth patterns through age-6; however, it does appear that smallmouth bass in the Nolichucky River generally have a higher mean length at age through age-6 (Table 19). Furthermore, evaluations between the nine rivers surveyed between 1998-99 and other populations across the U.S. were fairly comparable for the represented age groups (Table 19).

Table 19. Mean length at age (1-6) for smallmouth bass from nine east Tennessee rivers and comparisons with other populations across the United States.

River	Mean Length					
	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
Nolichucky River	153	219	255	328	329	380
Pigeon River	101	144	217	292	287	282
North Fork Holston River	110	172	223	250	296	346
Clinch River	155	203	246	279	315	350
Powell River	141	200	234	275	312	342
French Broad River	147	224	360*	319*	421	-
Holston River	141	167	245	303	370*	381
South Fork Holston River	137	-	-	-	-	-
Little Pigeon River	124	207	-	-	-	330*
Shoals Reach (Alabama) [a]	179	261	337	414	454	511
White River (Missouri) [b]	64	144	201	231	269	326
Big Buffalo Creek (Missouri) [c]	79	152	206	249	284	328
Glover Creek (Oklahoma) [d]	91	160	215	246	299	341
Maquoketa River (Iowa) [e]	94	155	221	279	343	404
New River (West Virginia) [f]	107	176	236	281	-	-
Galena River (Wisconsin) [g]	-	173	239	302	368	394
Southeastern United States [h]	107	202	292	346	391	455
United States (high-growth) [i]	118	258	358	411	445	451

[a] Slipke et al. (1998)
[b] Lowry (1953)
[c] Fajen (1959)
[d] Orth et al. (1983)
[e] Paragamian (1984)
[f] Austen and Orth (1988)
[g] Forbes (1989)
[h] Carlander (1977)
[i] Anderson and Weithman (1978)

* only one individual in age group

Potential time required to reach 305 mm (12 in), 356 mm (14 in), and 406 mm (16 in) was calculated for smallmouth bass in six of the nine rivers surveyed between 1998 and 2000

(Table 20). Based on the analysis, the smallmouth bass from the French Broad River required less time to reach the 305 and 356 mm size than bass in the other rivers. The Clinch and the Nolichucky tied at 7.8 years for the 406 mm size class. Overall, smallmouth bass from the Powell River required more time to reach each respective size class than smallmouth bass from any of the other rivers surveyed between 1998 and 2000.

Table 20. Potential time (years) required for smallmouth bass to reach 305mm (12"), 356mm (14"), and 406mm (16") in selected east Tennessee rivers.

River	305mm	356mm	406mm
Nolichucky River	3.8 years	5.4 years	7.8 years
Pigeon River	5.1 years	6.7 years	8.8 years
Clinch River	4.7 years	6.1 years	7.8 years
Powell River	5.2 years	7.0 years	9.5 years
French Broad River	2.9 years	3.8 years	4.7 years
Holston River	4.0 years	6.0 years	8.8 years

Based on the analysis of the five large rivers sampled between 1998 and 1999, it appears that the Pigeon, French Broad, and Holston rivers have the greatest potential for recruitment (high RSD-preferred and memorable values) of smallmouth bass into the trophy (TL $\geq$ 510 mm) category although none were collected in the 1998-2000 surveys. This may indicate a recruitment problem which could be caused by an above average mortality rate for older age classes of smallmouth bass. Unlike these rivers, the Clinch River had smallmouth bass in RSD-trophy category although the RSD values for preferred and memorable smallmouth bass were lower. The 1998-2000 survey data were our attempts to begin building the database necessary to formulate sound management plans for the sport fishes in these rivers. However, without angler use data we will only be able to partially evaluate all factors that influence these fisheries. We will continue to survey these rivers on a three-year rotation in order to assess any changes in the sport fish population structure and to aid in future management decisions.

Recent phone surveys of Tennessee anglers have revealed that anglers fishing in warmwater streams took and average of 7 trips per season and traveled 29 miles to the stream they visited most frequently (Jakus et al. 1999). Anglers caught an average of 3.5 bass and released, on average, 3.0 bass (Jakus et al. 1999). Most of the anglers interviewed supported size limits for black bass (1997-98 average 71%) and indicated they would support a minimum length limit that fell between 12 and 14 inches (Jakus et al. 1999). Furthermore, about 62% of the anglers interviewed said they would also support some type of protected length range (PLR) regulation for stream dwelling black bass populations (Jakus et al. 1999). This information is encouraging since the development of warmwater stream and river management plans may include regulation revisions for certain riverine species.

Over the past six years the stream survey unit has been conducting Index of Biotic Integrity surveys in various watersheds within the region. These have been done in response to requests made by TWRA personnel, cooperative effort requests, and general interest in determining the state of certain streams. Our compilation of these surveys has given us a reference database for many streams in the region that can be used for comparison purposes should we return for a routine survey or responding to a water quality issue. Table 21 lists our results for various streams surveyed during this time period.

Table 21. Index of Biotic Integrity and Benthic Biotic Index scores for samples conducted between 1994 and 2000.

Water	Watershed	Year Surveyed	County	IBI Score	Benthic BI Score
Capuchin Creek	Cumberland River	1994	Campbell	44 (Fair)	3 (Fair/Good)
Trammel Branch	Cumberland River	1994	Campbell	36 (Poor/Fair)	3 (Fair/Good)
Hatfield Creek	Cumberland River	1994	Campbell	42 (Fair)	3 (Fair/Good)
Baird Creek	Cumberland River	1994	Campbell	38 (Poor/Fair)	3 (Fair/Good)
Clear Fork (Site 1)	Cumberland River	1994	Campbell	52 (Good)	3 (Fair/Good)
Clear Fork (Site 2)	Cumberland River	1994	Claiborne	40 (Fair)	N/A
Clear Fork (Site 3)	Cumberland River	1994	Claiborne	24 (Very Poor/Poor)	1 (Poor)
Elk Fork Creek	Clear Fork	1994	Campbell	40 (Fair)	2 (Fair)
Fall Branch	Clear Fork	1994	Campbell	28 (Poor)	1 (Poor)
Crooked Creek	Clear Fork	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Burnt Pone Creek	Clear Fork	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Whistle Creek	Clear Fork	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Little Elk Creek	Clear Fork	1994	Campbell	40 (Fair)	2 (Fair)
Lick Fork	Clear Fork	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Terry Creek	Clear Fork	1994	Campbell	48 (Good)	2 (Fair)
Crouches Creek	Clear Fork	1994	Campbell	28 (Poor)	1 (Poor)
Hickory Creek (Site 1)	Clear Fork	1994	Campbell	46 (Fair/Good)	3 (Fair/Good)
Hickory Creek (Site 2)	Clear Fork	1994	Campbell	48 (Good)	2 (Fair)
White Oak Creek	Clear Fork	1994	Campbell	30 (Poor)	2 (Fair)
No Business Branch	Clear Fork	1994	Campbell	30 (Poor)	3 (Fair/Good)
Laurel Fork	Clear Fork	1994	Campbell	52 (Good)	3 (Fair/Good)
Lick Creek	Clear Fork	1994	Campbell	44 (Fair)	3 (Fair/Good)
Davis Creek	Clear Fork	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Rock Creek	Clear Fork	1994	Campbell	54 (Good/Excellent)	3 (Fair/Good)
Little Tackett Creek	Clear Fork	1994	Claiborne	28 (Poor)	3 (Fair/Good)
Unnamed tributary to Little Tackett Creek	Clear Fork	1994	Claiborne	0 (No Fish)	3 (Fair/Good)
Rose Creek	Clear Fork	1994	Campbell	36 (Poor/Fair)	2 (Fair)
Rock Creek	Clear Fork	1994	Claiborne	28 (Poor)	2 (Fair)
Tracy Branch	Clear Fork	1994	Claiborne	34 (Poor)	2 (Fair)
Little Yellow Creek (Site 1)	Cumberland River	1994	Claiborne	38 (Poor/Fair)	N/A
Little Yellow Creek (Site 2)	Cumberland River	1994	Claiborne	38 (Poor/Fair)	N/A

Table 21. Continued on next page

Table 21. Continued.

Water	Watershed	Year Surveyed	County	IBI Score	Benthic BI Score
Little Yellow Creek (Site 3)	Cumberland River	1994	Claiborne	36 (Poor/Fair)	N/A
Hickory Creek	Clinch River	1995	Knox	46 (Fair/Good)	3 (Fair/Good)
White Creek	Clinch River	1995	Union	34 (Poor) (Spring Creek)	4 (Good)
Little Sycamore Creek	Clinch River	1995	Claiborne	40 (Fair)	4.5 (Good/Excellent)
Big War Creek	Clinch River	1995	Hancock	50 (Good)	4 (Good)
North Fork Clinch River	Clinch River	1995	Hancock	46 (Fair/Good)	4 (Good)
Old Town Creek (Site 1)	Powell River	1995	Claiborne	40 (Fair)	4 (Good)
Old Town Creek (Site 2)	Powell River	1995	Claiborne	42 (Fair)	4 (Good)
Indian Creek	Powell River	1995	Claiborne	N/A	4 (Good)
Sweetwater Creek	Tennessee River	1995	Loudon	30 (Poor)	3 (Fair/Good)
Burnett Creek	French Broad River	1995	Knox	46 (Fair/Good)	3 (Fair/Good)
Jockey Creek	Nolichucky River	1995	Greene	34 (Poor)	3 (Fair/Good)
South Indian Creek (Sandy Bottoms)	Nolichucky River	1995	Unicoi	38 (Poor/Fair)	4 (Good)
South Indian Creek (Ernestville)	Nolichucky River	1995	Unicoi	44 (Fair)	4 (Good)
Spivey Creek	Nolichucky River	1995	Unicoi	54 (Good/Excellent)	4 (Good)
Little Flat Creek	Holston River	1995	Knox	42 (Fair)	3 (Fair/Good)
Beech Creek	Holston River	1995	Hawkins	48 (Good)	4 (Good)
Big Creek	Holston River	1995	Hawkins	46 (Fair/Good)	4 (Good)
Alexander Creek	Holston River	1995	Hawkins	34 (Poor)	4 (Good)
Thomas Creek	South Fork Holston River	1995	Sullivan	54 (Good/Excellent)	4 (Good)
Hinds Creek	Clinch River	1996	Anderson	36 (Poor/Fair)	3 (Fair/Good)
Cove Creek	Clinch River	1996	Campbell	28 (Poor)	3 (Fair/Good)
Titus Creek	Clinch River	1996	Campbell	42 (Fair)	3 (Fair/Good)
Cloyd Creek	Tennessee River	1996	Loudon	36 (Poor/Fair)	4 (Good)
Sinking Creek	Little Tennessee River	1996	Loudon	34 (Poor)	4 (Good)
Baker Creek	Little Tennessee River	1996	Loudon	26 (Very Poor/Poor)	3 (Fair/Good)
Little Baker Creek	Little Tennessee River	1996	Blount	38 (Poor/Fair)	4 (Good)
Ninemile Creek	Little Tennessee River	1996	Blount	24 (Very Poor/Poor)	4 (Good)
East Fork Little Pigeon River	French Broad River	1996	Sevier	36 (Poor/Fair)	3 (Fair/Good)
Dunn Creek	French Broad River	1996	Sevier	32 (Poor)	4 (Good)
Wilhite Creek	French Broad River	1996	Sevier	44 (Fair)	4 (Good)

Table 21. Continued on next page

Table 21. Continued.

Water	Watershed	Year Surveyed	County	IBI Score	Benthic BI Score
Watauga River (above Watauga Res.)	Holston River	1996	Johnson	42 (Fair)	4 (Good)
Stony Fork	Big South Fork	1996	Campbell	38 (Poor/Fair)	4 (Good)
Bullett Creek	Hiwassee River	1997	Monroe	50 (Good)	4.5 (Good/Excellent)
Canoe Branch	Powell River	1997	Claiborne	26 (Very Poor/Poor) (Spring Creek)	4.7 (Excellent)
Town Creek	Tennessee River	1997	Loudon	34 (Poor)	2 (Fair)
Bat Creek	Little Tennessee River	1997	Monroe	30 (Poor)	1.5 (Poor/Fair)
Island Creek	Little Tennessee River	1997	Monroe	40 (Fair)	4 (Good)
Little Pigeon River	French Broad River	1997	Sevier	40 (Fair)	2 (Fair)
West Prong Little Pigeon River	French Broad River	1997	Sevier	46 (Fair/Good)	2 (Fair)
Flat Creek	French Broad River	1997	Sevier	30 (Poor)	3.8 (Good)
Clear Creek	French Broad River	1997	Jefferson	34 (Poor)	2.2 (Fair)
Richland Creek	Nolichucky River	1997	Greene	30 (Poor)	2.3 (Fair)
Middle Creek	Nolichucky River	1997	Greene	34 (Poor)	4 (Good)
Sinking Creek	Pigeon River	1997	Cocke	30 (Poor)	3.8 (Good)
Chestuee Creek	Hiwassee River	1998	Monroe	28 (Poor)	2.5 (Fair/Fair to Good)
Fourmile Creek	Powell River	1998	Hancock	36 (Poor/Fair)	4.5 (Good/Excellent)
Martin Creek	Powell River	1998	Hancock	50 (Good)	4 (Good)
Big Creek	Tellico River	1998	Monroe	46 (Fair/Good)	4 (Good)
Oven Creek	Nolichucky River	1998	Cocke	40 (Fair)	2.9 (Fair/Good)
Cherokee Creek	Nolichucky River	1998	Washington	36 (Poor/Fair)	2.8 (Fair/Good)
Bennetts Fork	Cumblerland River	2000	Claiborne	30 (Poor)	3.5 (Fair/Good)

As is the case in many areas of east Tennessee, streams are suffering primarily from residential/commercial development and poor agricultural practices. The primary product of these activities, sedimentation, is ultimately regulating the full potential of many streams.

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APPENDIX A

Common and scientific names of fishes used in this report

Family	Common Name	Scientific Name
Atherinidae	Brook silverside	*Labidesthes sicculus*
Catostomidae	River carpsucker	*Carpiodes carpio*
	Quillback	*Carpiodes cyprinus*
	Highfin carpsucker	*Carpiodes velifer*
	White sucker	*Catostomus commersoni*
	Northern hogsucker	*Hypentelium nigricans*
	Smallmouth buffalo	*Ictiobus bubalus*
	Black buffalo	*Ictiobus niger*
	Spotted sucker	*Minytrema melanops*
	Silver redhorse	*Moxostoma anisurum*
	River redhorse	*Moxostoma carinatum*
	Black redhorse	*Moxostoma duquesnei*
	Golden redhorse	*Moxostoma erythrurum*
	Shorthead redhorse	*Moxostoma macrolepidotum*
Centrarchidae	Rock bass	*Ambloplites rupestris*
	Redbreast sunfish	*Lepomis auritus*
	Green sunfish	*Lepomis cyanellus*
	Warmouth	*Lepomis gulossus*
	Bluegill	*Lepomis macrochirus*
	Redear sunfish	*Lepomis microlophus*
	Smallmouth bass	*Micropterus dolomieu*
	Spotted bass	*Micropterus punctulatus*
	Largemouth bass	*Micropterus salmoides*
	White crappie	*Pomoxis annularis*
	Black crappie	*Pomoxis nigromaculatus*
Clupeidae	Gizzard shad	*Dorosoma cepedianum*
Cottidae	Banded sculpin	*Cottus carolinae*
Cyprinidae	Stoneroller	*Campostoma anomalum*
	Whitetail shiner	*Cyprinella galactura*
	Spotfin chub	*Cyprinella monacha*
	Spotfin shiner	*Cyprinella spiloptera*
	Carp	*Cyprinus carpio*
	Streamline chub	*Erimystax dissimilis*
	Bigeye chub	*Hybopsis amblops*
	Striped shiner	*Luxilus chrysocephalus*
	Warpaint shiner	*Luxilus coccogenis*
	River chub	*Nocomis micropogon*
	Tennessee shiner	*Notropis leuciodus*
	Silver shiner	*Notropis photogenis*
	Rosyface shiner	*Notropis rubellus*
	Telescope shiner	*Notropis telescopus*
	Mimic shiner	*Notropis vollucellus*
	Stargazing minnow	*Phenacobius uranops*

Family	Common Name	Scientific Name
	Blackside dace	*Phoxinus cumberlandensis*
	Bluntnose minnow	*Pimephales notatus*
	Blacknose dace	*Rhinichthys atratulus*
	Creek chub	*Semotilus atromaculatus*
Hiodontidae	Mooneye	*Hiodon tergisus*
Ictaluridae	White catfish	*Ameiurus catus*
	Yellow bullhead	*Ameiurus natalis*
	Channel catfish	*Ictalurus punctatus*
	Mountain madtom	*Noturus eleutherus*
	Flathead catfish	*Pylodictus olivaris*
Lepisosteidae	Spotted gar	*Lepisosteus oculatus*
	Longnose gar	*Lepisosteus osseus*
Moronidae	White bass	*Morone chrysops*
	Yellow bass	*Morone mississippiensis*
	Striped bass	*Morone saxatilis*
Percidae	Greenside darter	*Etheostoma blenniodes*
	Rainbow darter	*Etheostoma caeruleum*
	Blueside darter	*Etheostoma jessia*
	Redline darter	*Etheostoma ruflineatum*
	Snubnose darter	*Etheostoma simoterum*
	Banded darter	*Etheostoma zonale*
	Logperch	*Percina caprodes*
	Dusky darter	*Percina sciera*
	Gilt darter	*Percina evides*
	Sauger	*Stizostedium canadense*
	Walleye	*Stizostedium vitreum*
Petromyzontidae	Lamprey sp.	*Ichthyomyzon sp.*
Salmonidae	Rainbow trout	*Oncorhynchus mykiss*
	Brown trout	*Salmo trutta*
Sciaenidae	Drum	*Aplodinotus grunniens*