FISHERIES REPORT
REPORT NO. 08-02
WARM WATER STREAM FISHERIES REPORT
REGION IV
2007

Prepared by

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Cover: Keith Thomas (TWRA Intern) with a blue sucker collected from the upper French Broad River in 2007.

TABLE OF CONTENTS

INTRODUCTION

The fish fauna of Tennessee is the most diverse in the United States, with approximately 307 species of native fish and about 30 to 33 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 2006) as a primary goal.

This is the twentieth 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. 04-07. A total of seven rivers and two streams were sampled and are included in this report. Stream surveys were conducted from April to October 2007. Forty-four (IBI, CPUE) fish samples and four benthic samples 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 were selected based on historical sampling locations 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 utilizing hand held Geographical Positioning Units (GPS) 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 metric 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 an Index of Biological Integrity (Karr et al. 1986). Fish were collected with standard electrofishing (backpack) and seining techniques. A 5 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., 5 meters x 5 meters) 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 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 2007. 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) for identification. Most of the preserved fish collected in the 2007 samples will be 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 Nelson et al. (2004), Powers and Mayden (2007) and Etnier and Starnes (1993).

BENTHIC COLLECTIONS

Qualitative benthic samples were collected from each IBI fish sample site (4 total). 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 70% ethanol 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). 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 temperature, pH, and conductivity. Data were taken from midstream and mid-depth at each site, using 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.

HABITAT QUALITY ANALYSIS

Beginning in 2004, the stream survey unit introduced an experimental habitat assessment form that built on the existing method by incorporating biological impairment and metric modifications to the standardized form (Smith et al. 2002). The major advantages of this evaluation procedure include more concise metrics and categories that identify the stream or river based on size, gradient, temperature, ecoregion and alterations of flow based on groundwater or hydroelectric influences.

The other issue we wanted to address with this new evaluation was the development of our own biotic index for benthic macroinvertebrates. By assigning an overall value to the water quality, habitat, and biological impairment of a given reach of stream we can begin to assign tolerance values to associated benthic insect species collected during the survey. This will ultimately allow use to develop a more accurate biotic index for benthic macroinvertebrates for the Ridge and Valley and Blue Ridge Ecoregions of east Tennessee. The illustrations below depict the layout of the experimental form including the 14 habitat/water quality metrics, the biotic index adjustment, ecoregion classification, and stream type.

We feel that this form allows use to be more precise in our evaluation of the stream habitat quality and gives us a more defined evaluation pertaining to stream morphology and location. We will continue to complete both habitat evaluations for each stream survey for the next couple of field seasons in order to fully evaluate the new form.

Experimental Stream Habitat Assessment Form

STREAM QUALITY ASSESSMENT FORM FORM:SQA-09-2004

Tennessee Wildlife Resources Agency Stream Survey Unit

STREAM:______________________ DATE:______________________

INVESTIGATOR:______________________ SITE CODE:______________________

LAT/LONG:______________________ ELEVATION:______________________

Rate Each Of The Following 14 Metrics:
0(EXCELLENT) 1(GOOD) 2(FAIR) 3(POOR) 4(VERY POOR)
note: 0 = pristine condition and 4 = worst condition

SCORE

1 SILTATION ☐
(fine particles that blanket [smother] the substrate)

2 SUBSTRATE EMBEDDEDNESS ☐
(interstitial spaces between gravel, cobble and boulder have become filled with fine deposits such as sand making the underside habitat unsuitable to aquatic life)

3 BED-LOAD MOVEMENT ☐
(condition pertaining to excessive bed load movement, and frequent formation and destruction of sand and gravel bars)

4 STATE OF SMALL RIPARIAN VEGETATION ☐
(grasses, shrubs, etc. that stabilize the soil surface and serve as runoff filters)

5 STATE OF LARGE RIPARIAN VEGETATION ☐
(canopy trees that provide long-term bank stability and shade)

6 BANK STABILITY ☐
(signs of bank erosion)

7 PHYSICAL DAMAGE TO STREAM HABITAT BY DOMESTIC LIVESTOCK ☐
(obvious signs of damage within riparian zone and instream habitat from livestock traffic)

8 ALTERATIONS OF NATURAL PHYSICAL CHARACTERS OF STREAMBED ☐
(channelization, gravel dredging, channel relocation, bridges, culverts, dams, fords etc.)

9 TURBIDITY ☐
(suspended solids "muddy or cloudy")

10 POINT SOURCE POLLUTION ☐
(FACTORY, MINING SOURCE, etc.)
(pipes or ditches conveying contaminated effluent adversely affecting water quality), chemical odor and/or unusual water or substrate coloration. (reddish algae [organic] or iron oxide [inorganic] often associated with severe earth disturbance)

11 ENRICHMENT ☐
(agricultural livestock waste and/or crop fertilizers, poorly functioning municipal waste water treatment facility or residential septic systems often indicated by filamentous algae etc.)

12 ATYPICAL WATER QUALITY PARAMETERS (BASIC) ☐
(unusually high or low pH, conductivity, dissolved oxygen, or temperature)

13 ENVIRONMENTALLY HARMFUL TRASH ☐
(human refuse including oil filters, engines, batteries, tires, etc. that may be toxic to aquatic organisms)

14 ALTERED STREAM FLOW (CFS) ☐
(abnormal fluctuations in flow volume [e.g. hydroelectric dam regulation], or low flow due to water consumption for municipal water, bottled water, crop irrigation, or other water demands.)

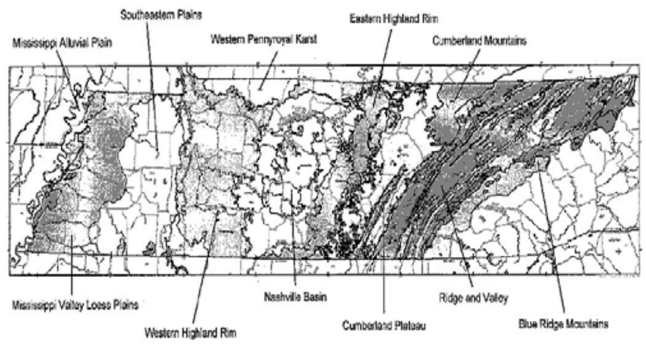
TOTAL ☐

BIOTIC INDEX ADJUSTMENT (BIA) + ☐
(does one or more of the previous 14 metrics seriously inhibit aquatic life?)
0 (no biological impairment) 5 (only the most sensitive taxa impaired)
10 (somewhat diverse but most intolerant forms absent) 15 (low diversity—tolerant forms only)
20 (little or no aquatic life present)

STREAM ASSESSMENT VALUE = TOTAL + BIA ⟶ ☐

0 - 10 (EXCELLENT) 11 - 21 (GOOD) 22 - 32 (FAIR) 33 - 43 (POOR) ≥44 (VERY POOR)

INDICATE (CIRCLE) ECOREGION:



STREAM TYPE:	GRADIENT			TEMPERATURE			
	LOW	MOD	HIGH	COLD	COOL	WARM	
	<0.01	0.01-0.05	>0.05	<20°C	<25°C	>25°C	Maximum Summer Temp
HEADWATER (0 - 2 METERS)	☐	☐	☐	☐	☐	☐	
SMALL CREEK (2.1 - 11.0 METERS)	☐	☐	☐	☐	☐	☐	
LARGE CREEK (11.1 - 21.0 METERS)	☐	☐	☐	☐	☐	☐	
SMALL RIVER 1 (21.1 - 111 METERS)	☐	☐	☐	☐	☐	☐	
SMALL RIVER 2 (111.1 - 201 METERS)	☐	☐	☐	☐	☐	☐	
MEDIUM RIVER (202 METERS - 502 METERS)	☐	☐	☐	☐	☐	☐	
LARGE RIVER (>503 METERS)	☐	☐	☐	☐	☐	☐	

CHECK IF STREAM IS:

A SPRING RUN (near source) ☐
A CREEK WITH SIGNIFICANT SPRING INFLUENCE ☐
A TAILWATER ☐

Ecoregion designations follow Griffith (USEPA) et al. Stream Type, and Gradient definitions generally follow Smith, R.K., P.L. Freeman, J.V. Higgins, K.S. Wheaton, T.W. FitzHugh, K.J. Ernstrom, A.A. Das. Priority Areas for Freshwater Conservation: A Biodiversity of the Southeastern United States. The Nature Conservancy. 2002.

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 TWRA (Bivens et al. 1995), 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).

Karr et al. (1986) criteria

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 of 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 five large rivers sampled during 2007. 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.

Benthic data collected for the 2007 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:

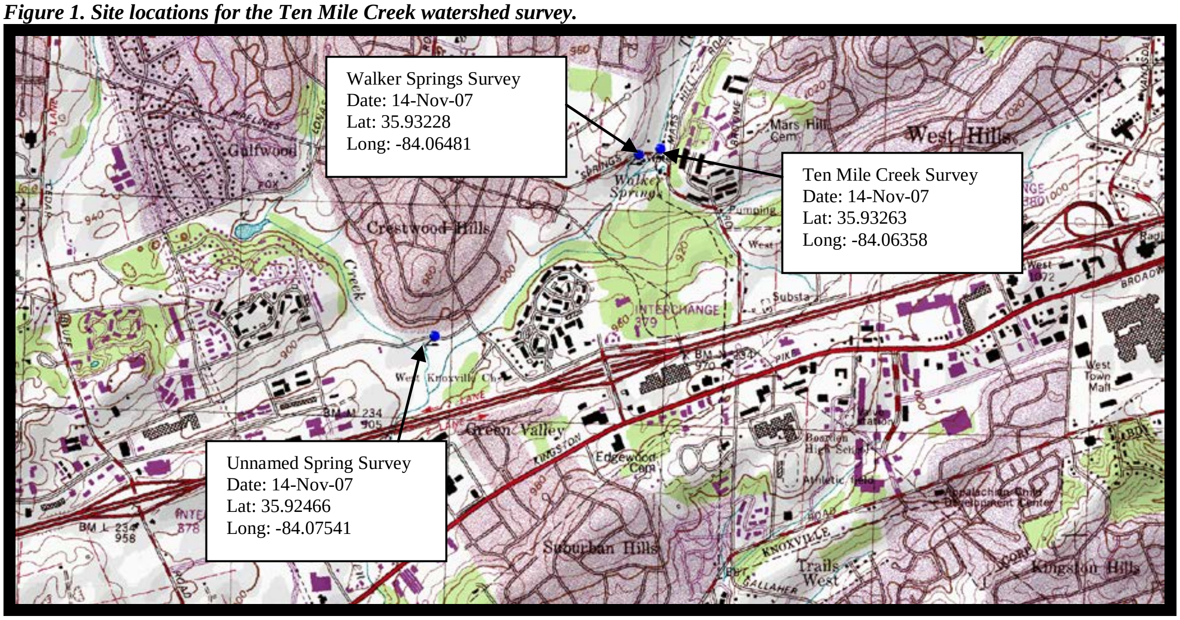
Score	Biotic Index Values	EPT Values
5 (Excellent)	< 5.14	> 33
4.6	5.14-5.18	32-33
4.4	5.19-5.23	30-31
4 (Good)	5.24-5.73	26-29
3.6	5.74-5.78	24-25
3.4	5.79-5.83	22-23
3	5.84-6.43	18-21
2.6	6.44-6.48	16-17
2.4	6.49-6.53	14-15
2	6.54-7.43	10-13
1.6	7.44-7.48	8-9
1.4	7.49-7.53	6-7
1 (Poor)	> 7.53	0-5

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.

Ten Mile Creek, Walker Springs and Unnamed Spring Tributary

Early in 2007 we were contacted by the Knoxville Chapter of the Izaac Walton League (KIWL) to assist them with investigating the fish community in Ten Mile Creek located in west Knox County. The KIWL's clean water center strives to advocate the responsible use of public lands and educate the public regarding the benefits of clean water. The KIWL represents an eight county area of east Tennessee and focuses on trash, silt and sewage in waters of this area. We cooperated with KIWL in conducting a qualitative survey of the fishes in Ten Mile Creek near the intersection of Walker Springs Road and Gallaher View Road (Figure 1).

Figure 1. Site locations for the Ten Mile Creek watershed survey.



Our survey consisted of a 900 second effort backpack electrofishing survey through habitats common to the reach of stream. The two most abundant species encountered were banded sculpin and western blacknose dace (Table 1). We were hopeful that we might encounter the flame chub in this stream given the relative close proximity of the Turkey Creek population and the significant spring influence of the stream. Following our survey of Ten Mile Creek, we took short samples at a nearby Walker Springs and at an unnamed spring tributary adjacent to Crosspark Road. Fish species encountered at these two sites are listed in Table 1.

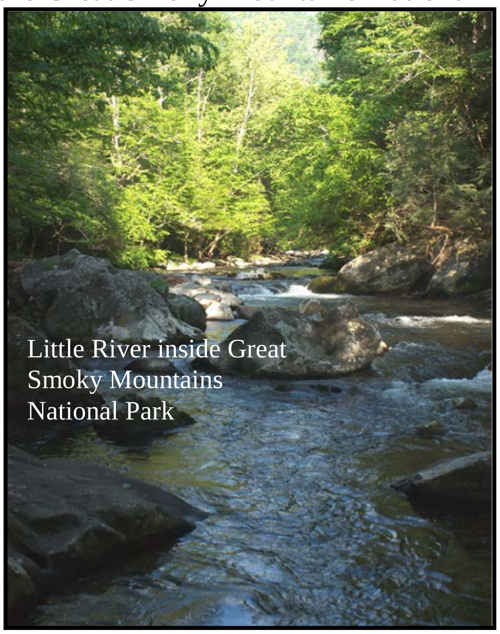
Table 1. Species occurrence for Ten Mile Creek and springs.

Ten Mile Creek	Walker Springs	Unnamed Spring Tributary
Catostomus commersonii	*Cottus carolinae*	*Campostoma oligolepis*
Cottus carolinae	*Rhinichthys obtusus*	*Cottus carolinae*
Etheostoma tennesseense	-	*Lepomis macrochirus*
Lepomis macrochirus	-	*Rhinichthys obtusus*
Rhinichthys obtusus	-	-
Semotilus atromaculatus	-	-
Cambarus bartonii cavatus	-	-

Little River

Introduction

Little River originates in Sevier County on the north slope of Clingmans Dome, in the Great Smoky Mountains National Park. It flows in a northwesterly direction for



about 95 kilometers, past Elkmont in the National Park, and Townsend, Walland, and Maryville in Blount County, and joins the Tennessee River near river mile 635.6. Fort Loudoun Reservoir, impounds the lower 6.8 miles of Little River with another 1.5 miles being impounded by the low head dam at Rockford (located at the backwaters of Fort Loudoun). In all, a little over eight lower river miles are impounded. Another 0.75 mile or so is impounded by Perrys Milldam downstream of Walland, near river mile 22. A third low head dam is located in Townsend near river mile 33.6. The river has a drainage area of approximately 982 km^2 at its confluence with the Tennessee River. The upper reach of the river (upstream of Walland) is located in the Blue Ridge physiographic province, and then transitions into the Ridge and Valley province from Walland to Fort Loudoun Reservoir. Little River is a very scenic stream in the Great Smoky Mountains National Park. There, it drains an area containing some of the most spectacular scenery in the southeastern United States. The Little River fishery within the National Park boundary is primarily wild rainbow and brown trout with smallmouth bass in the lower reaches. An excellent trout fishery exists, and is managed by the National Park Service. Little River's gradient becomes moderate as it leaves the National Park and flows through the Tuckaleechee Valley from Townsend to Walland. Excellent populations of smallmouth bass and rock bass exist there, and rainbow trout are stocked in spring and fall as water temperatures allow. This portion of the river has many developed campgrounds and is a popular recreation destination for tourists. While not as developed as Pigeon Forge, the Townsend area has grown significantly over the past two decades. Downstream of Walland, Little River leaves the mountains and no longer displays the extreme clarity and attractive rocky bottom of its upper reaches. Here it enters the Ridge and Valley province and resembles the more typical large river habitat with lower gradient and large deep pools interspersed with shallow shoal areas. Downstream of Perrys Milldam, the fishery, while still primarily smallmouth bass and rock bass, declines in quality relative to the upstream reach. This is probably related to limited availability of preferred smallmouth bass habitat. Near the small community of Rockford, Little River flows into a surprisingly large (given the size of the stream) embayment of Fort Loudon Lake. The Little River forms the boundary between Blount County and Knox County for the last few miles of its course.

Little River represents an important recreational resource for the state both in consumptive and non-consumptive uses. It supports an active tubing/rafting industry and is an important recreational resource for local residents and tourists alike. It is also the municipal water source of the cities of Alcoa and Maryville. It provides critical habitat for species of special concern and is home to over 50 species of fish (four listed federally). Additionally, its upper reach supports one of east Tennessee's better warm water sport fisheries. It provides anglers with the opportunity to catch all species of black bass, rock bass, and even stocked rainbow trout when water temperatures allow.

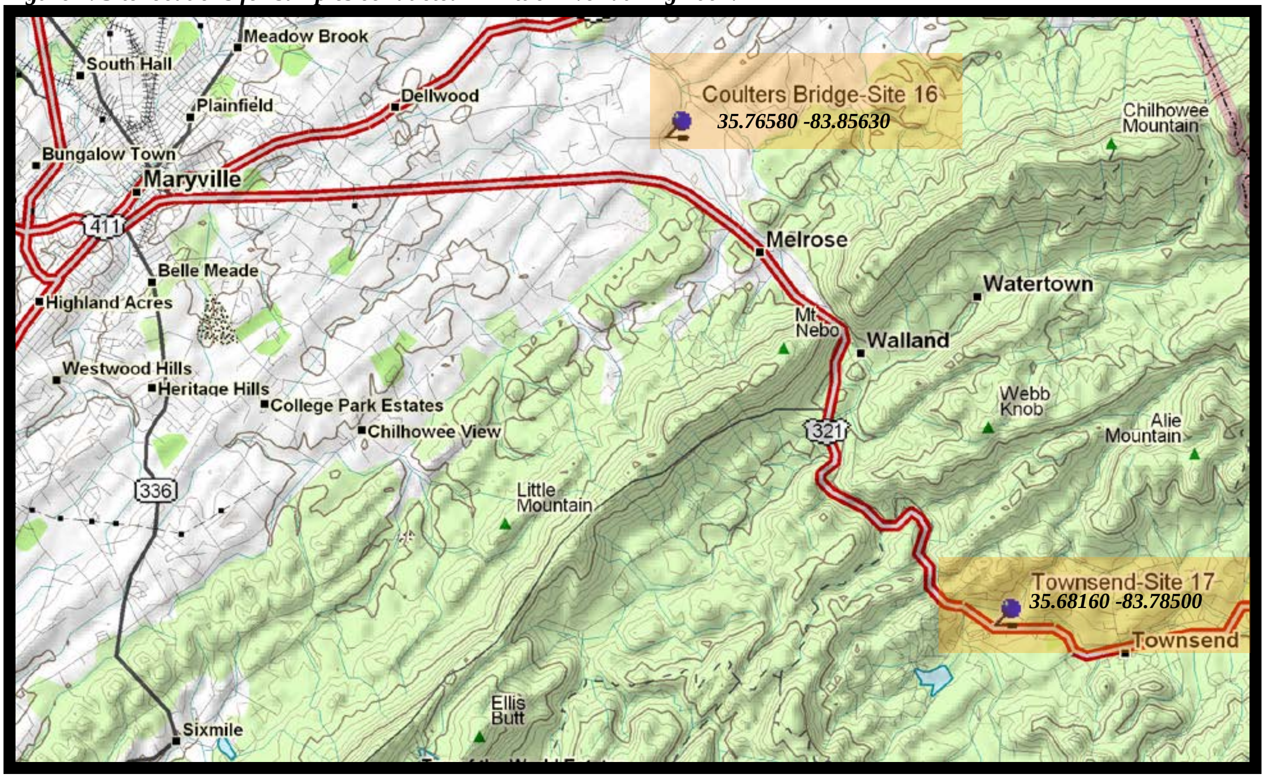
Study Area and Methods


Little River near Walland

Our 2007 survey of Little River was confined to two IBI sites (Coulters Bridge and Townsend). We cooperated with several agencies in conducting these two samples between July 10 and 13. The Coulters Bridge site (16) is located in the Ridge and Valley Province of Blount County while the Townsend site (17) lies in the transitional zone between the Blue Ridge and the Ridge and Valley Provinces (Figure 2).

Public access along the river is primarily limited to bridge crossings and small "pull-outs" along roads paralleling the river. There are several primitive launching areas for canoes or small boats and one developed access area managed by the Agency (Perrys Mill).

Figure 2. Site locations for samples conducted in Little River during 2007.



Fish were collected according to the IBI criteria described in the methods section of this report. Both backpack and boat electrofishing were used to collect samples from both stations. Qualitative benthic macroinvertebrates were collected at both stations and analyzed to produce a biotic index score similar to those derived for the fish IBI.

Results

Collaborative community assessments of Little River have been ongoing since the late 1980's. These surveys have primarily focused on evaluating relative health changes

in the fish community. Two Index of Biotic Integrity surveys were conducted in July 2007 at Coulter's Bridge (river mile 20) and Townsend (river mile 29.8). A total of 51 fish species were collected at the Coulters Bridge site while 30 were observed at Townsend. Overall, The IBI analysis indicated the fish community was in good condition at Coulters Bridge (IBI score 54). The condition of the fish community assessed slightly higher (IBI score 56) at the upper most station, Townsend. Both scores were slightly lower when compared to the previous year's analysis. Several rare or endangered species of fish inhabit Little River, and thus, the protection of the watershed is a high priority of managing agencies and local conservation groups. Table 2 lists the species and number of fish collected at the two IBI stations.

Table 2. Fish species collected at two Little River IBI stations during 2007.

Site	Species	Number Collected
420071116 (Coulters Bridge)	*Ambloplites rupestris*	14
420071116 (Coulters Bridge)	*Ameiurus natalis*	1
420071116 (Coulters Bridge)	*Aplodinotus grunniens*	2
420071116 (Coulters Bridge)	*Campostoma oligolepis*	65
420071116 (Coulters Bridge)	*Carpiodes cyprinus*	1
420071116 (Coulters Bridge)	*Cottus carolinae*	24
420071116 (Coulters Bridge)	*Cyprinella galactura*	45
420071116 (Coulters Bridge)	*Cyprinella spiloptera*	12
420071116 (Coulters Bridge)	*Cyprinus carpio*	5
420071116 (Coulters Bridge)	*Dorosoma cepedianum*	18
420071116 (Coulters Bridge)	*Erimystax insignis*	58
420071116 (Coulters Bridge)	*Etheostoma blennioides*	38
420071116 (Coulters Bridge)	*Etheostoma camurum*	3
420071116 (Coulters Bridge)	*Etheostoma jessiae*	5
420071116 (Coulters Bridge)	*Etheostoma rufilineatum*	413
420071116 (Coulters Bridge)	*Etheostoma tennesseense*	32
420071116 (Coulters Bridge)	*Etheostoma vulneratum*	2
420071116 (Coulters Bridge)	*Etheostoma zonale*	23
420071116 (Coulters Bridge)	*Fundulus catenatus*	15
420071116 (Coulters Bridge)	*Hybopsis amblops*	85
420071116 (Coulters Bridge)	*Hypentelium nigricans*	32
420071116 (Coulters Bridge)	*Ichthyomyzon sp.*	1
420071116 (Coulters Bridge)	*Lampetra appendix*	4
420071116 (Coulters Bridge)	*Lepisosteus osseus*	1
420071116 (Coulters Bridge)	*Lepomis auritus*	49
420071116 (Coulters Bridge)	*Lepomis cyanellus*	4
420071116 (Coulters Bridge)	*Lepomis macrochirus*	17
420071116 (Coulters Bridge)	*Luxilus chrysocephalus*	19
420071116 (Coulters Bridge)	*Luxilus coccogenis*	47
420071116 (Coulters Bridge)	*Lythrurus lirus*	1
420071116 (Coulters Bridge)	*Micropterus dolomieu*	14
420071116 (Coulters Bridge)	*Micropterus punctulatus*	2
420071116 (Coulters Bridge)	*Micropterus salmoides*	1
420071116 (Coulters Bridge)	*Minytrema melanops*	8
420071116 (Coulters Bridge)	*Moxostoma breviceps*	1
420071116 (Coulters Bridge)	*Moxostoma carinatum*	17
420071116 (Coulters Bridge)	*Moxostoma duquesneii*	70
420071116 (Coulters Bridge)	*Moxostoma erythrurum*	49
420071116 (Coulters Bridge)	*Nocomis micropogon*	35
420071116 (Coulters Bridge)	*Notropis leuciodus*	221
420071116 (Coulters Bridge)	*Notropis micropteryx*	71
420071116 (Coulters Bridge)	*Notropis photogenis*	36
420071116 (Coulters Bridge)	*Notropis telescopus*	58
420071116 (Coulters Bridge)	*Notropis volucellus*	47
420071116 (Coulters Bridge)	*Noturus eleutherus*	19
420071116 (Coulters Bridge)	*Percina aurantiaca*	5
420071116 (Coulters Bridge)	*Percina caprodes*	5
420071116 (Coulters Bridge)	*Percina evides*	40
420071116 (Coulters Bridge)	*Percina williamsi*	Q
420071116 (Coulters Bridge)	*Phenacobius uranops*	20
420071116 (Coulters Bridge)	*Pylodictis olivaris*	1
420071117 (Townsend)	*Ambloplites rupestris*	48
420071117 (Townsend)	*Campostoma oligolepis*	85

Table 2. Continued.

Site	Species	Number Collected
420071117 (Townsend)	*Catostomus commersonii*	1
420071117 (Townsend)	*Cottus carolinae*	97
420071117 (Townsend)	*Cyprinella galactura*	57
420071117 (Townsend)	*Erimystax insignis*	11
420071117 (Townsend)	*Etheostoma blennioides*	10
420071117 (Townsend)	*Etheostoma rufilineatum*	103
420071117 (Townsend)	*Etheostoma tennesseense*	37
420071117 (Townsend)	*Etheostoma zonale*	16
420071117 (Townsend)	*Fundulus catenatus*	3
420071117 (Townsend)	*Hybopsis amblops*	91
420071117 (Townsend)	*Hypentelium nigricans*	18
420071117 (Townsend)	*Ichthyomyzon greeleyi*	18
420071117 (Townsend)	*Lampetra appendix*	52
420071117 (Townsend)	*Lepomis auritus*	3
420071117 (Townsend)	*Lepomis macrochirus*	8
420071117 (Townsend)	*Luxilus chrysocephalus*	36
420071117 (Townsend)	*Luxilus coccogenis*	136
420071117 (Townsend)	*Lythrurus lirus*	2
420071117 (Townsend)	*Micropterus dolomieu*	14
420071117 (Townsend)	*Moxostoma duquesneii*	21
420071117 (Townsend)	*Nocomis micropogon*	33
420071117 (Townsend)	*Notropis leuciodus*	150
420071117 (Townsend)	*Notropis micropteryx*	9
420071117 (Townsend)	*Notropis photogenis*	23
420071117 (Townsend)	*Notropis telescopus*	198
420071117 (Townsend)	*Notropis volucellus*	14
420071117 (Townsend)	*Percina burtoni*	2
420071117 (Townsend)	*Percina evides*	11

Benthic macroinvertebrates collected in our sample at Townsend comprised 36 families representing identified 51 genera (Table 3). The most abundant group in our collection was the caddisflies comprising 26.6% of the total sample. Overall, a total of 60 taxa were identified from the sample of which 24 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 “good” (4.0).

Table 3. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Little River at Townsend.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
ANNELIDA				1.2
	Oligochaeta		3	
COLEOPTERA				13.5
	Dryopidae	*Helichus* adults	5	
	Elmidae	*Dubiraphia* adult	1	
		Macronychus glabratus adults	3	
		Microcylloepus pusillus larva	1	
		Optioservus larvae	3	
		Promoresia elegans adults	9	
		Stenelmis larvae	2	
	Gyrinidae	*Dineutus discolor 2* males and 2 females	4	
		Dineutus larva	1	
	Psephenidae	*Psephenus herricki*	6	
DIPTERA				9.7
	Athericidae	*Atherix lantha*	1	
	Chironomidae		22	
	Empididae		1	
	Tipulidae		1	
EPHEMEROPTERA				18.9
	Baetidae	*Baetis*	12	
	Caenidae	*Caenis*	4	
	Ephemerellidae	*Drunella allegheniensis* early instars	3	

Table 3. Continued.

	Heptageniidae	*Leucrocuta*	1	
		Maccaffertium early instars	5	
		Maccaffertium ithaca	1	
		Maccaffertium mediopunctatum	5	
		Stenacron interpunctatum	2	
	Isonychiidae	*Isonychia*	12	
	Leptohyphidae	*Tricorythodes*	4	
GASTROPODA				5.0
	Ancylidae	*Ferrissia*	1	
	Physidae		1	
	Pleuroceridae	*Leptoxis*	5	
		Pleurocera	6	
HETEROPTERA				0.8
	Veliidae	*Rhagovelia obesa* male and female	2	
HYDRACARINA			4	1.5
MEGALOPTERA				5.0
	Corydalidae	*Corydalus cornutus*	4	
		Nigronia serricornis	5	
	Sialidae	*Sialis*	4	
ODONATA				13.5
	Aeshnidae	*Boyeria vinosa*	16	
	Calopterygidae	*Calopteryx*	1	
		Hetaerina americana	5	
	Coenagrionidae	*Argia*	4	
	Corduliidae	*Helocordulia uhleri*	1	
	Gomphidae	*Gomphurus lineatifrons*	1	
		Gomphus descriptus	1	
		Hagenius brevistylus	1	
		Hylogomphus viridifrons	1	
		Lanthus vernalis	1	
		Stylogomphus albistylus	1	
	Macromiidae	*Macromia*	2	
PELECYPODA				2.3
	Corbiculidae	*Corbicula fluminea*	6	
PLECOPTERA				1.9
	Leuctridae	*Leuctra*	1	
	Perlidae	*Perlesta*	3	
	Pteronarcyidae	*Pteronarcys dorsata*	1	
TRICHOPTERA				26.6
	Brachycentridae	*Brachycentrus lateralis*	14	
		Micrasema wataga	7	
	Goeridae	*Goera calcarata*	2	
		Goera pupae	2	
	Hydropsychidae	*Ceratopsyche morosa*	1	
		Cheumatopsyche	9	
		Hydropsyche franclemonti	2	
		Hydropsyche venularis	14	
	Leptoceridae	*Mystacides sepulchralis*	2	
		Oecetis avara	1	
		Triaenodes early instars	2	
		Triaenodes ignitus	5	
		Triaenodes perna	1	
	Polycentropodidae	*Polycentropus*	7	
		Total	**259**	

TAXA RICHNESS = 60
EPT TAXA RICHNESS = 24
BIOCLASSIFICATION = 4.0 (GOOD)

Benthic macroinvertebrates collected in our sample at Coulter's Bridge comprised 33 families representing 41 identified genera (Table 4). The most abundant group in our collection was the mayflies comprising 32.7% of the total sample. Overall, a total of 50 taxa were identified from the sample of which 17 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/good-good” (3.8).

Table 4. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Little River at Coulter's Bridge.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
ANNELIDA				2.1
	Oligochaeta		7	
COLEOPTERA				17.6
	Dryopidae	*Helichus* adults	4	
	Dytiscidae	*Laccophilus maculosus maculosus*	1	
	Elmidae	*Dubirahia vittata* adult	1	
		Macronychus glabratus adults	9	
		Optioservus trivittatus adults	6	
		Optioservus larvae	3	
		Promoresia elegans adults and larvae	22	
	Gyrinidae	*Dineutus discolor* adults	5	
	Psephenidae	*Psephenus herricki*	7	
COLLEMBOLA				0.3
	Isotomidae	*Isotomurus palustris*	1	
DIPTERA				7.9
	Chironomidae		24	
	Simulidae		2	
EPHEMEROPTERA				32.7
	Baetidae	*Baetis*	11	
	Caenidae	*Caenis*	2	
	Ephemerellidae	*Ephemerella*	1	
		Serratella	10	
	Heptageniidae	*Maccaffertium* early instars	30	
		Maccaffertium mediopunctatum	8	
		Maccaffertium terminatum	1	
		Stenacron interpunctatum	8	
	Isonychiidae	*Isonychia*	22	
	Leptohyphidae	*Tricorythodes*	15	
GASTROPODA				5.2
	Physidae		3	
	Pleuroceridae	*Leptoxis*	6	
		Pleurocera (concolorus - pale olive)	2	
		Pleurocera (yellow w/dark spirals)	6	
HETEROPTERA				0.6
	Corixidae	*Trichocorixa*	1	
	Gerridae	*Metrobates hesperius*	1	
HYDRACARINA			7	2.1
MEGALOPTERA				3.3
	Corydalidae	*Corydalus cornutus*	4	
		Nigronia serricornis	2	
	Sialidae	*Sialis*	5	
ODONATA				5.2
	Aeshnidae	*Boyeria grafiana*	2	
		Boyeria vinosa	2	
	Calopterygidae	*Calopteryx*	1	
		Hetaerina americana	6	
	Coenagrionidae	*Argia*	1	
	Gomphidae	*Dromogomphus spinosus*	1	
		Gomphus lineatifrons	1	
		Stylogomphus albistylus	1	
	Macromiidae	*Macromia* (undetermined)	1	
		Macromia taeniolata	1	
PELECYPODA				1.8
	Corbiculidae	*Corbicula fluminea*	6	
PLECOPTERA				1.2
	Perlidae	*Perlesta*	2	
	Pteronarcyidae	*Pteronarcys dorsata*	2	
TRICHOPTERA				19.4
	Brachycentridae	*Brachycentrus lateralis*	16	
	Hydropsychidae	*Ceratopsyche morosa*	6	
		Cheumatopsyche	20	
		Hydropsyche venularis	18	
		Unidentified pupa	1	
	Leptoceridae	*Triaenodes perna*	1	
	Philopotamidae	*Chimarra*	2	
TURBELLARIA			2	0.6
		Total	**330**	

TAXA RICHNESS = 50
EPT TAXA RICHNESS = 17
BIOCLASSIFICATION = 3.8 (FAIR/GOOD-GOOD)

Discussion

Little River provides anglers with the opportunity to catch all species of black bass along with rock bass. Because of the low numbers of spotted and largemouth bass in Little River, it should not be considered to contain a viable sport fishery for these species.

The river represents an outstanding resource in the quality of the water and the species that inhabit it. With the growing development in the watershed it will be imperative to monitor activities such that mitigation measures can be taken to ensure that the river maintains its outstanding water quality and aesthetic value. Continued efforts by the watershed group will continue to play an important role in the management of the watershed and serve as a “watchdog” for unregulated activities.

Trout stocking during suitable months is very popular for residents and non-residents visiting the area. This program should continue at the current level unless use dictates the need for program expansion.

TWRA should continue to be involved with the cooperative community assessment surveys each year. These are important indicators of the health of one of the regions best streams and serves as a benchmark in evaluating other streams of similar size and character. Sport fishery surveys on Little River will be conducted on a three-year rotation in order to assess any changes in the fishery. Our return trip in 2008 to look at the sport fish will in all likelihood focus on the sample sites surveyed in 2005 (Carter et al. 2006), providing no new or more efficient sampling scheme is developed.

Management Recommendations

1. Initiate an angler use and harvest survey.

2. Develop a fishery management plan for the river.

3. Cooperate with the local watershed organization to protect and enhance the river and its tributaries.

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. Historically, 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 water at Eastman in Kingsport and 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 *Erimonax monacha* and snail darter *Percina tanasi*) and thirteen species of freshwater mussels (Ahlstedt 1986).

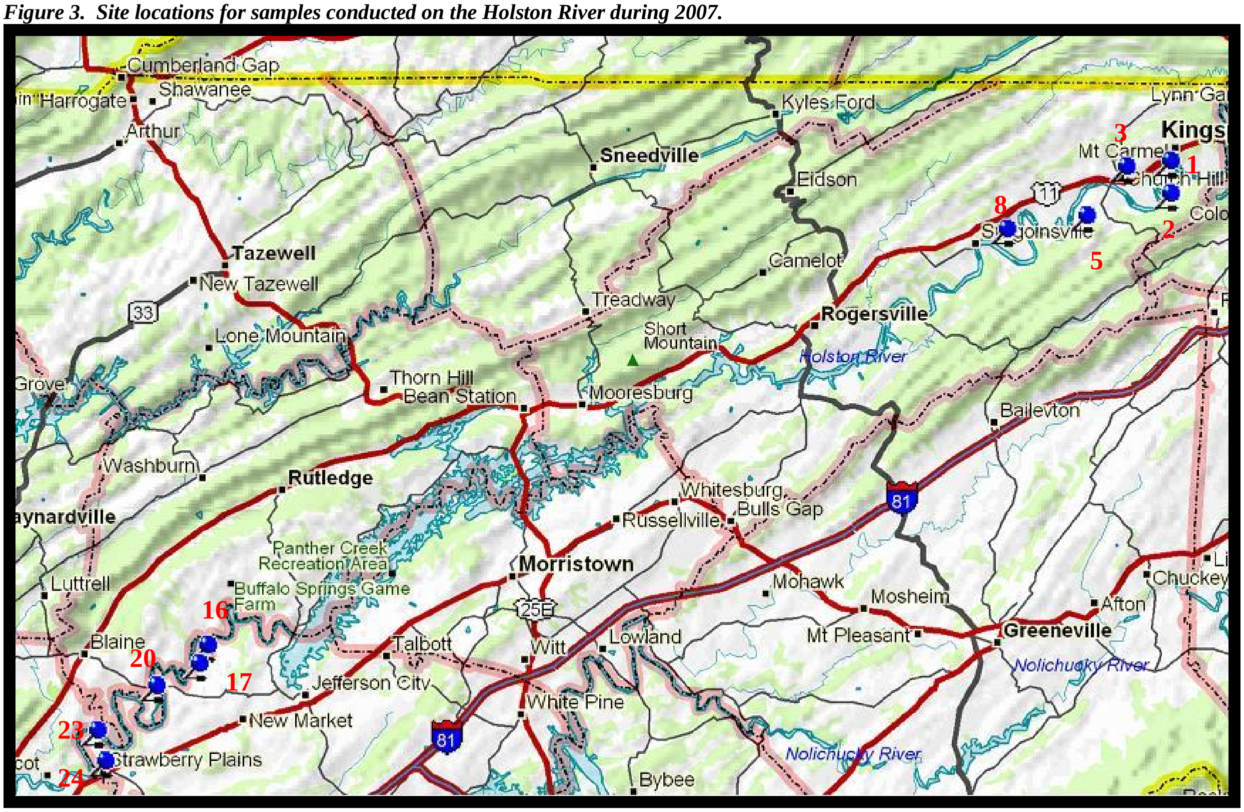
Our 2007 surveys focused on re-evaluating the black bass and rock bass populations in the river above and below Cherokee Dam. We conducted the first intensive survey of the these sport fish species in 2000 (Carter et al. 2001) characterizing black bass and rock bass population structure and developing 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 May 30 and June 5, 2007, we conducted 10 fish surveys between Kingsport and Mascot (Figure 3). Because this river is a tailwater, habitat availability fluctuates with water releases. However, in our survey sites, the habitat consisted

Figure 3. Site locations for samples conducted on the Holston River during 2007.



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. Measured channel widths ranged from 68 to 145 m, while site lengths fell between 125 and 1108 m (Table 5). Water temperatures ranged from 17.5 to 26 C upstream of Cherokee Reservoir and 15 to 21 C downstream of Cherokee Reservoir. Conductivity varied from 218 to 330 μs/cm (Table 5). Conductivity was generally lower downstream of Cherokee Reservoir. Because we were able to conduct the samples earlier in the year we were not hindered by the water star-grass in that portion of the river above Cherokee Reservoir. This made navigating the river much easier and probably increased our sampling efficiency to some degree. In recent years, the river channel becomes choked with this aquatic vegetation making navigation difficult during the summer months.

TWRA intern Keith Thomas with a couple of nice smallmouth collected near Church Hill.

Table 5. Physiochemical and site location data for samples conducted on the Holston River during 2007.

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420070801	1	Hawkins	Church Hill 188SW	136.3	36.52389	-82.68167	127	1108	17.5	275	1.7
420070802	2	Hawkins	Lovelace 189NW	134.1	36.46891	-82.68139	123	596	19	270	1.7
420070803	3	Hawkins	Church Hill 188SW	131.5	36.51694	-82.72306	111	375	20.5	305	1.7
420070805	5	Hawkins	Stony Point 180NE	127.5	36.48167	-82.76250	145	576	21	255	1.7
420030608	8	Hawkins	Stony Point 180NE	118.8	36.47167	-82.83833	139	419	26	330	1.7
420070816	16	Grainger/Jefferson	Joppa 155NE	38.8	36.14972	-83.60167	134.5	468	15	232	2.3
420070817	17	Grainger/Jefferson	Joppa 155NE	37.5	36.13583	-83.61028	68	125	15	230	2.3
420070820	20	Grainger/Jefferson	Mascot 155SW	28	36.11861	-83.65139	137.5	654	17	218	2.3
420070823	23	Jefferson/Knox	Mascot 155SW	19.7	36.08417	-83.70722	144	554	21	280	2.3
420070824	24	Knox	Mascot 155SW	17	36.05694	-83.70000	107.5	443	21	280	1.8

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 sites were sampled during daylight hours and had survey durations ranging from 900 to 1460 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 above Cherokee Reservoir averaged 110.8/hour (SD 19.6), while the spotted bass and largemouth bass estimates were 0/hour and 1.6/hour (SD 3.5), respectively (Table 6)**.** Comparatively, mean CPUE estimates at the same sites in 2000 and 2003 ranged 52.8/hour to 108.5/hour for smallmouth bass and 3.2/hour to 1.3/hour largemouth bass (Figure 4). No spotted bass have been collected at these sites thus far. Rock bass CPUE was 4.8/hour (SD 7.4) upstream of the reservoir in 2007. This is the lowest value (73% below 2000 value and 89% below 2003 value) recorded for this species since monitoring was initiated in 2000 (Figure 4). In samples conducted below Cherokee Reservoir in 2007, smallmouth bass catches averaged 49.6/hour (SD 35.1). Spotted bass and largemouth bass catch rates were not surprisingly lower at 0/hour and 0.2/hour (SD 0.4), respectively. In comparison, the CPUE value for smallmouth bass in 2000 was much higher at 107/hour and then approached a value (45.4/hour) in 2003 similar to that observed in the latest survey (Figure 5). Overall, we have observed a sharp decline in smallmouth bass between 2000 and 2003 and then a leveling of the value between 2003 and 2007. We feel this is primarily due to hydrologic cycles and in wet years (2000) flows are more favorable for smallmouth bass below Cherokee Reservoir than dry years (2003, 2007) due to changes in water release regimes.

We have documented unusual age and growth characteristics in this portion of the river as summarized in Carter et al. 2001. This could potentially contribute to population instability. Rock bass catches in this part of the river averaged 44.8/hour (SD 31.4) during 2007 (Table 6). This was somewhat lower than the values recorded for the 2000 and 2003 samples (Figure 5).

Table 6. Catch per unit effort and length-categorization indices of target species collected at ten sites on the Holston River during 2007 (Sites 1-8 above Cherokee Reservoir, sites 16-24 below Cherokee Reservoir).

Site Code	Smallmouth Bass CPUE	Spotted Bass CPUE	Largemouth Bass CPUE	Rock Bass CPUE
420070801	102.5	-	-	2.5
420070802	92.8	-	-	-
420070803	144	-	8	4
420070805	104	-	-	-
420030608	110.7	-	-	17.8
MEAN	110.8	-	1.6	4.8
STD DEV.	19.6	-	3.5	7.4
Sites 1-8	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis
	PSD = 49.3	PSD = 0	PSD = 0	PSD = 20
	RSD-Preferred = 38.0	RSD-Preferred = 0	RSD-Preferred = 0	RSD-Preferred = 0
	RSD-Memorable = 14.1	RSD-Memorable = 0	RSD-Memorable = 0	RSD-Memorable = 0
	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0
420070816	52	-	-	40
420070817	16	-	-	100
420070820	40	-	4	24
420070823	108	-	-	32
420070824	32	-	-	28
MEAN	49.6	-	0.2	44.8
STD DEV.	35.1	-	0.4	31.4
Sites 16-24	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis
	PSD = 43.7	PSD = 0	PSD = 0	PSD = 66.7
	RSD-Preferred = 25	RSD-Preferred = 0	RSD-Preferred = 0	RSD-Preferred = 20.4
	RSD-Memorable = 9.3	RSD-Memorable = 0	RSD-Memorable = 0	RSD-Memorable = 0
	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0

Figure 4. Trends in mean catch rate of black bass and rock bass collected between 2000-2007 from the Holston River above Cherokee Reservoir.

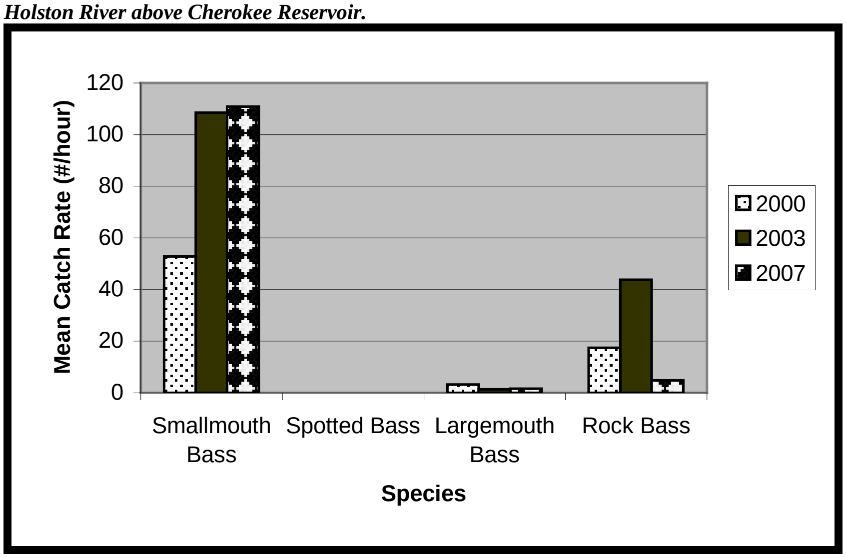
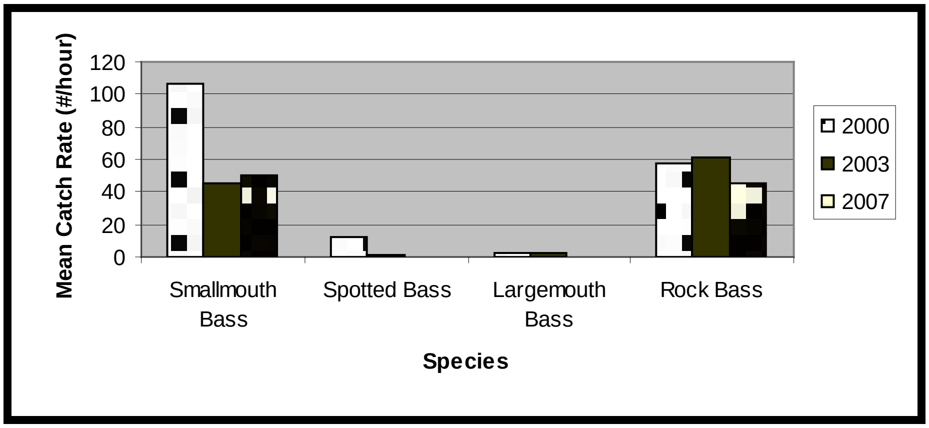
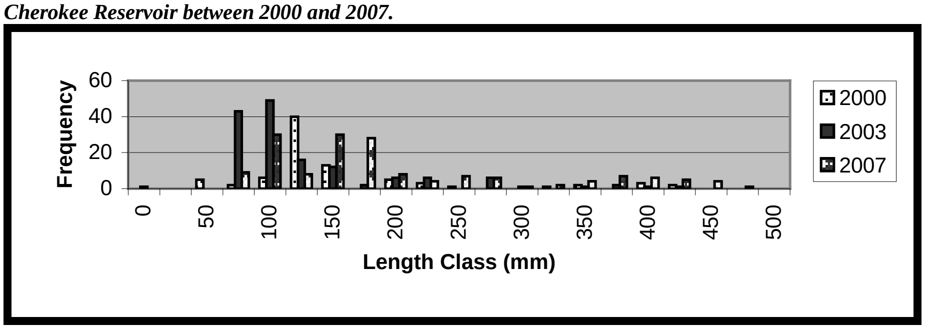


Figure 5. Trends in mean catch rate of black bass and rock bass collected between 2000-2007 from the Holston River below Cherokee Reservoir.



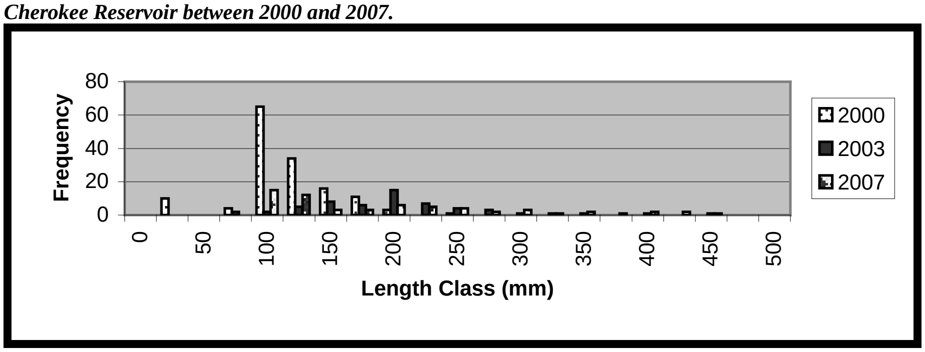
The majority of the smallmouth bass collected from the Holston River between 2000 and 2007 fell within the 75 mm to 275 mm length range both above and below Cherokee Reservoir (Figures 6 and 7). There was a higher representation of smaller bass in the sample taken above Cherokee in 2007 as was the general case for bass over 200 mm (Figure 6). There were more bass 375 mm and larger collected in the 2007 sample than in previous surveys.

Figure 6. Length frequency distributions for smallmouth bass collected from the Holston River above Cherokee Reservoir between 2000 and 2007.



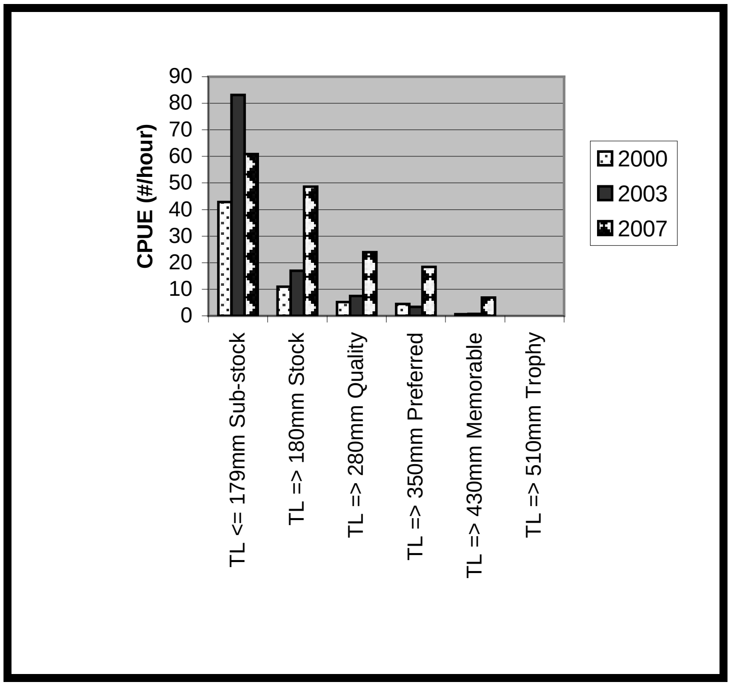
Below the reservoir the trend was somewhat opposite from the upstream samples. Here the smaller size classes of bass were better represented in the 2000 sample although a few more were captured between 100 mm and 125 mm in 2007. There was also a slight increase in the number of smallmouth 350 mm and larger collected in 2007 (Figure 7).

Figure 7. Length frequency distributions for smallmouth bass collected from the Holston River below Cherokee Reservoir between 2000 and 2007.



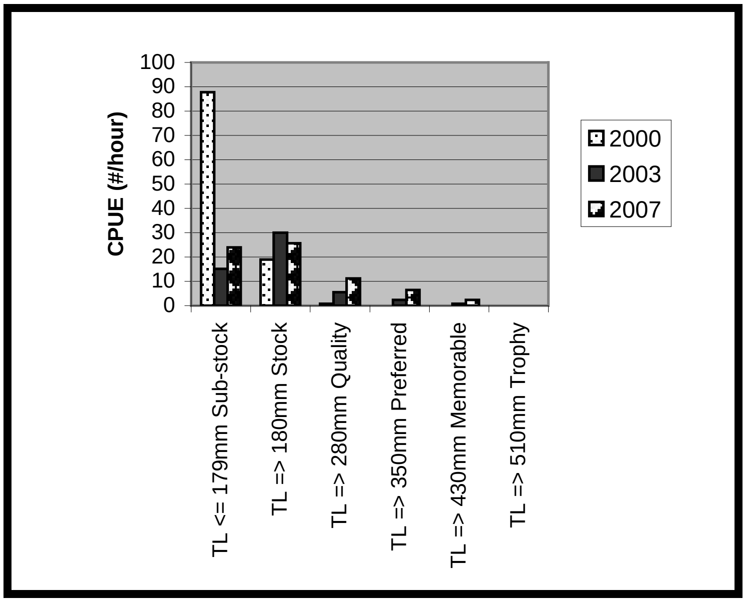
The 2007 Relative Stock Density (RSD) for preferred smallmouth bass (TL $\geq$ 350 mm) above and below the reservoir was 38 and 25, respectively. The observed values for this same category in 2000 were 41.1 above the reservoir and 0 below. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass during 2007 were 14.1 and 0 above the reservoir and 9.1 and 0 below the reservoir. Overall we observed a substantial increase in the percentage of preferred and memorable size smallmouth when compared to the previous samples. The PSD of smallmouth bass (ratio of quality size bass to stock size bass) was 49.3 above the reservoir and 43.7 below the reservoir during 2007. Catch per unit effort estimates by RSD category were more robust for each respective category in 2007. We observed substantial increases in all size categories with the exception of sub-stock which declined, but still remained above the value observed in 2000 (Figure 8). Although the sub-stock value was somewhat lower in 2007, year class recruitment was still high indicating good survival of juvenile bass. Although we did not collect any trophy size bass during the 2007 sample we have taken smallmouth in excess of 510 mm (20 in) in the section of the river.

Figure 8. Relative stock density (RSD) catch per unit effort for smallmouth bass collected in the Holston River above Cherokee Reservoir between 2000 and 2007.



Trends in catch per unit effort by RSD category below Cherokee Reservoir appeared to be more stable in 2007 than in earlier samples. We did observe more bass in the quality and above categories than we did in 2000 or 2003 (Figure 9). We did observe good sub-stock recruitment in 2007 although it was only 27% of the value observed in 2000. Recruitment into the larger size categories during 2007 was more consistent than previously recorded (Figure 9).

Figure 9. Relative stock density (RSD) catch per unit effort for smallmouth bass collected in the Holston River below Cherokee Reservoir between 2000 and 2007.

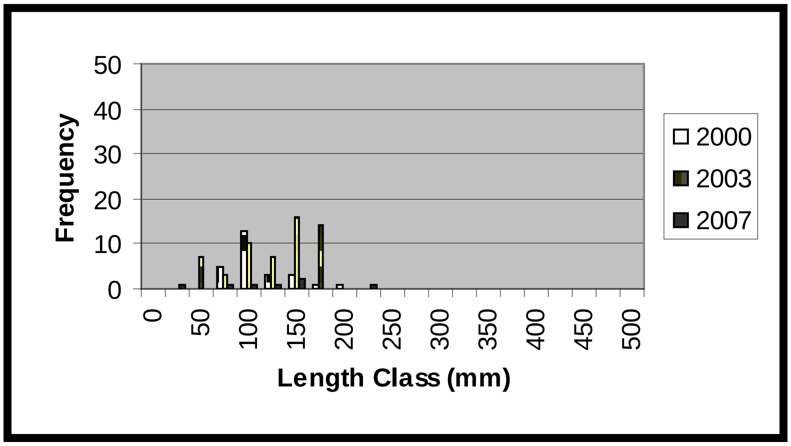


There were no spotted bass collected above Cherokee Reservoir during 2007. Riverine occurrence of spotted bass in most east Tennessee rivers is sporadic at best with the exception of the Nolichucky River where there is a viable fishery for this species. Likewise, there were no spotted bass collected in our samples below Cherokee Reservoir.

Because so few largemouth bass were collected in the samples above and below the reservoir during both years it is difficult to make any conclusion regarding these populations. Like spotted bass, largemouth bass tend to occur sporadically and unpredictably in larger rivers of east Tennessee. Where found, they tend to inhabit the more sluggish and lower reaches of rivers usually associated with some type of woody cover.

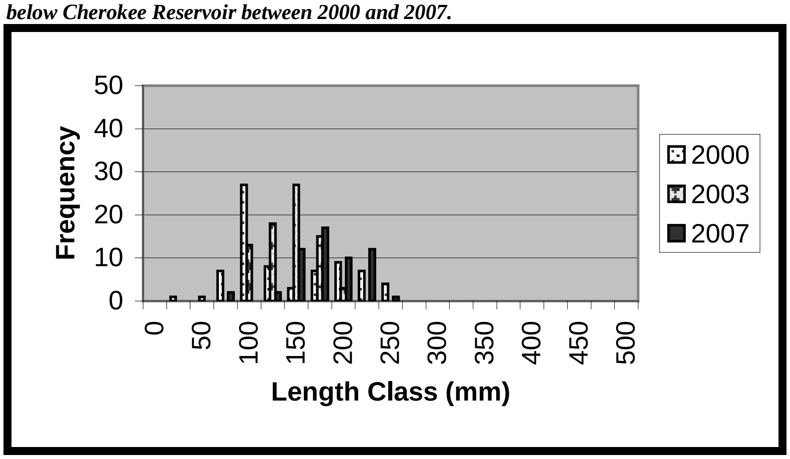
Individuals in the 75 to 150 mm range represented the majority of rock bass in our sample (Figure 10). Very few rock bass (7) were collected in this section of the river when compared to historical surveys. In 2003, rock bass were fairly well represented at all of our sample sites. In 2007, the majority of the rock bass collected came from site 8 which is the farthest downstream in this reach of river. Although rock bass persist in the upper Holston, they are not extremely abundant. Remarks from anglers fishing the river 20 years ago would often refer to the abundance of rock bass in this section of the river. It is unclear why the numbers of rock bass are at the levels currently observed. Since rock bass is a fairly intolerant species it could be several factors such as flow regimes or decrease in habitat quality that are regulating this species. One noticeable change that has taken place recent history is the significant increase in the growth of aquatic vegetation during the summer months. During peak growth much of the river channel is occupied by river weed or star grass which may have a negative influence on habitat availability for rock bass.

Figure 10. Length frequency distributions for rock bass collected from the Holston River above Cherokee Reservoir between 2000 and 2007.



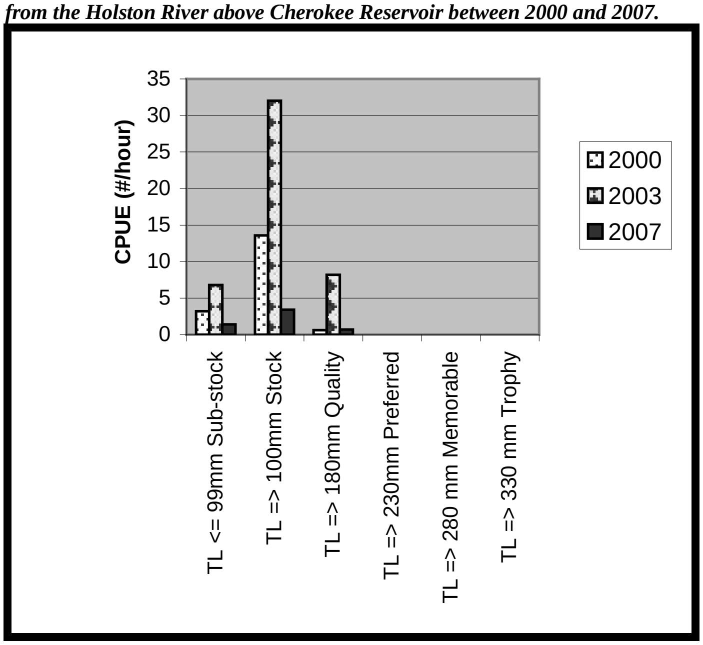
Below Cherokee Reservoir the size distributions for rock bass during all samples were primarily composed of fish in the 100 to 225 mm size group (Figure 11). The most notable difference in the distributions above and below the reservoir was simply the number of fish collected. There seemed to be more suitable habitat downstream of the reservoir than above in the form of boulder/rubble banks and rocky outcroppings, which were the most likely factors contributing to the difference.

Figure 11. Length frequency distributions for rock bass collected from the Holston River below Cherokee Reservoir between 2000 and 2007.



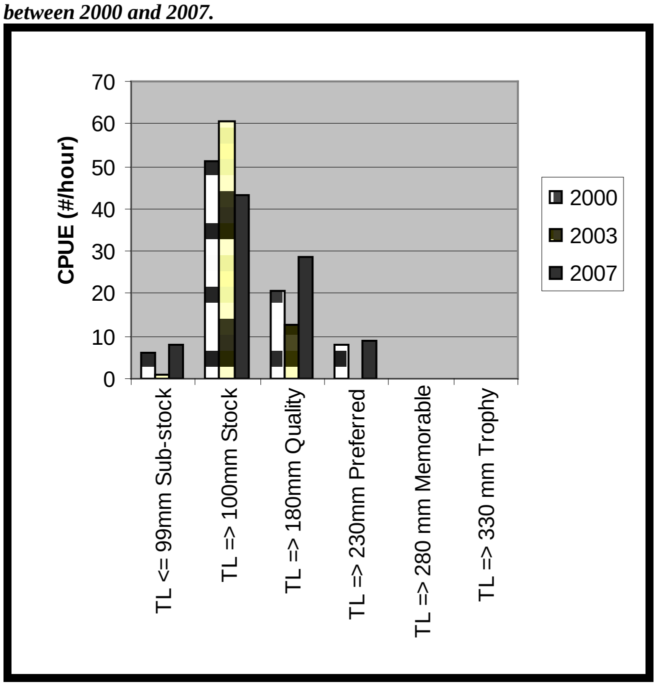
The RSD of preferred (TL $\geq$ 230 mm) rock bass was 0 above reservoir and 20.4 below the reservoir (Table 6). RSD for memorable (TL $\geq$ 280 mm) and trophy (TL $\geq$ 330 mm) size rock bass was also 0 in 2007. The 2007 PSD of rock bass was 20 above the reservoir and 66.7 below the reservoir. Catch per unit effort estimates by RSD category above Cherokee Reservoir indicated the majority of our catch was stock size fish during 2007 (Figure 12). Overall, all categories were substantially lower than any of the previous samples. There were very few rock bass in the quality category and it does appear that most of the stock size rock bass in 2003 did not recruit to larger size classes. In 2007, we recorded the lowest catch of sub-stock rock bass as well. Although this usually does not indicate a problem, based on the observed catches in other size categories there probably is not going to be strong recruitment into any of the size categories in the near future. Hopefully, our return trip in 2009 will give us a better understanding of what to expect from the population over the next several years.

Figure 12. Relative stock density (RSD) catch per unit effort for rock bass collected from the Holston River above Cherokee Reservoir between 2000 and 2007.



In our samples collected below the reservoir in 2007 we did see good recruitment into the larger size classes based on the strong group of stock size rock bass observed in 2003. Both the quality and preferred categories showed good increases in 2007 (Figure 13). Although not as strong as in 2003, we did observe a good catch of sub-stock rock bass in 2007. Overall, it appears that the rock bass population below Cherokee Reservoir is more stable than that above. This is most likely related to the lack of aquatic vegetation and the higher occurrence of more preferred habitat.

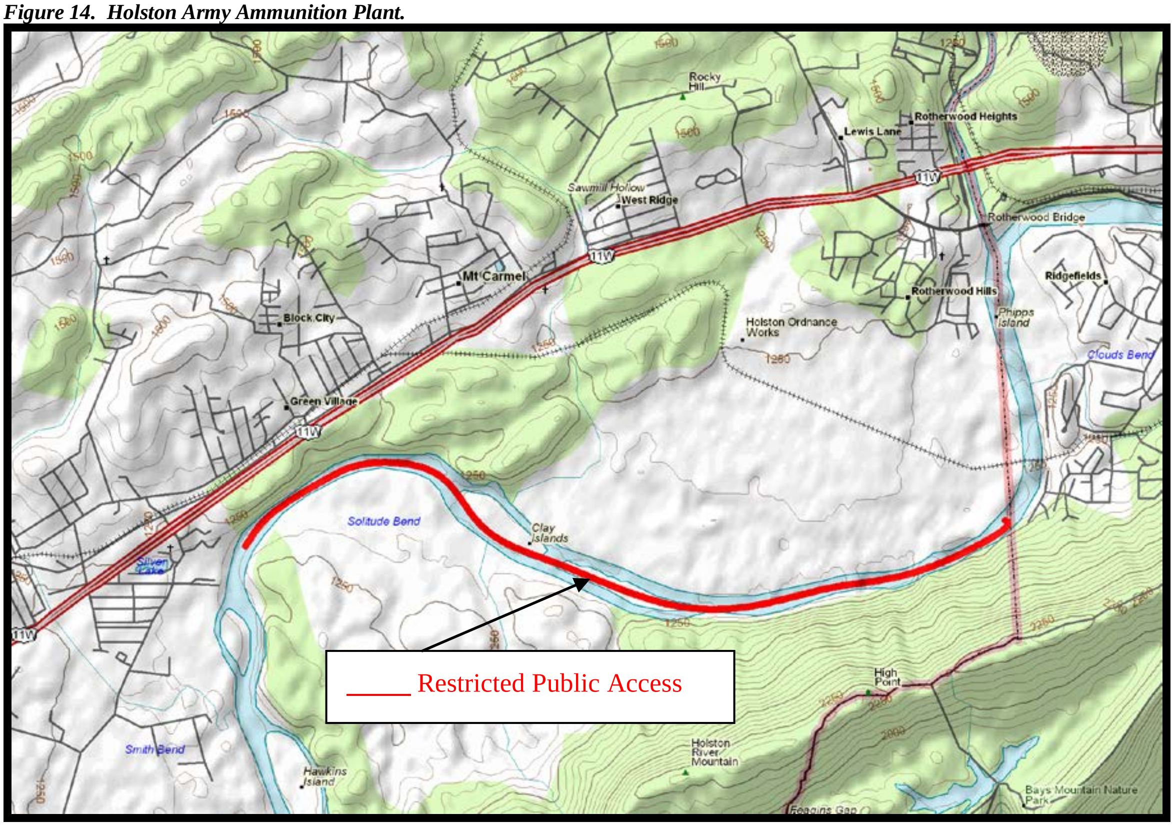
Figure 13. Relative stock density (RSD) catch per unit effort for rock bass collected from the Holston River below Cherokee Reservoir between 2000 and 2007.



Holston Army Ammunition Plant (HAAP) Public Fishing Events

During September 2007, the Holston Army Ammunition Plant (HAAP) conducted its first ever fishing events within the reservation. Historically, only controlled hunting has been allowed on the property until recent inquiries by the public prompted HAAP personnel to consider allowing anglers to fish. This portion of the Holston River had never been open to the angling public. The HAAP is located near Kingsport and lies between Highway 11W and the Holston River (Figure 14).

Figure 14. Holston Army Ammunition Plant.



Between September 1st and 9th the HAAP held four fishing events that allowed anglers to fish in waters that had been restricted since the construction of the plant. Based on an executive summary from HAAP (HAAP 2007), 130 applicants applied for the four events and 64 were selected to fish during the events (16/event). A total of 801 fish were caught during the four events. The majority of the fish caught were smallmouth bass. The largest smallmouth caught was 21 inches in length and one angler managed to catch 59 smallmouth during one of the events. The HAAP is hopeful they can continue the program in the future.

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. Lake sturgeon was recently introduced into the river below the reservoir.

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 Reservoir has drastically improved the D.O. levels in the tailwater resulting in restoration projects that would have historically not been considered.

For the most part we were able to improve our sampling efficiency above the reservoir. This was due to the lack of aquatic vegetation during our sample. The proliferation of aquatic vegetation during the summer months makes sampling the river above the reservoir difficult. Because of this we will most likely shift our sampling strategy to the spring months both above and below the reservoir. Our next scheduled sample of the Holston River will be in 2009.

Management Recommendations

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

2. Initiate an angler use and harvest survey.

3. Develop a fishery management plan for the river.

4. Continue to cooperate with lake sturgeon re-introduction efforts.

North Fork Holston River

Introduction

The North Fork Holston River has a reputation of being one of the regions best riverine smallmouth bass fisheries. This is supported by frequent reports of quality size smallmouth bass being caught in the 8.3 kilometer section between the TN/VA line and the confluence with the South Fork Holston River near Kingsport. Our interest in surveying the short reach that flows through Tennessee, was to continue compiling baseline catch per unit effort (CPUE) estimates and population size structure data on these populations. The Agency has conducted limited surveys (1 site each) of the river in 1989 and 1997 (Bivens and Williams 1990, Bivens et al. 1998) and more extensive surveys of sport fish populations in 1998, 2001 and 2004 (Carter et al. 1999, 2002, 2005). Because of the lack of information regarding angler use and harvest in warmwater river fisheries in east Tennessee the TWRA contracted with Tennessee Technological University in 2001 to conduct a creel survey on the North Fork. Between March 1 and October 31, 2001 a roving creel was conducted along the 8.3 km section that flows through Tennessee (Bettoli 2002).

Study Area and Methods

The North Fork Holston River originates in Virginia and flows in a southwesterly direction before converging with the South Fork Holston River near Kingsport. In Tennessee, the 8.3 kilometer reach of the river courses through the Ridge and Valley province of Hawkins and Sullivan counties. Land use is primarily residential with a few small farms interspersed. Public access along the river is primarily limited to bridge crossings and small “pull-outs” along roads paralleling the river. There are a few primitive launching areas for canoes or small boats on private land.

During April 2007, six fish surveys (CPUE) were conducted on the North Fork between the TN/VA line and its confluence with the South Fork (Figure 15). We repeated our CPUE samples conducted in 2004. The riparian habitat along this reach consists primarily of wooded shorelines with interspersed fields and residential lawns. Submerged woody debri was fairly common in most of our sample areas. The river substrate was predominately composed of bedrock and boulders. Perpendicular/parallel (to flow) bedrock shelves were more abundant in the pool habitat, while a combination of boulder and bedrock comprised the majority of the riffle habitat. There were a few riffles within the survey areas that had cobble size substrate as the primary component. Measured mean channel widths ranged from 45.2 m to 68.3 m, while site lengths fell between 250 meters and 1,325 meters (Table 7). Water temperatures ranged from 17.5 C to 19.5 C and conductivity varied from 245 to 260 μs/cm (Table 7).

Figure 15. Site locations for the samples conducted in the North Fork Holston River 2007.

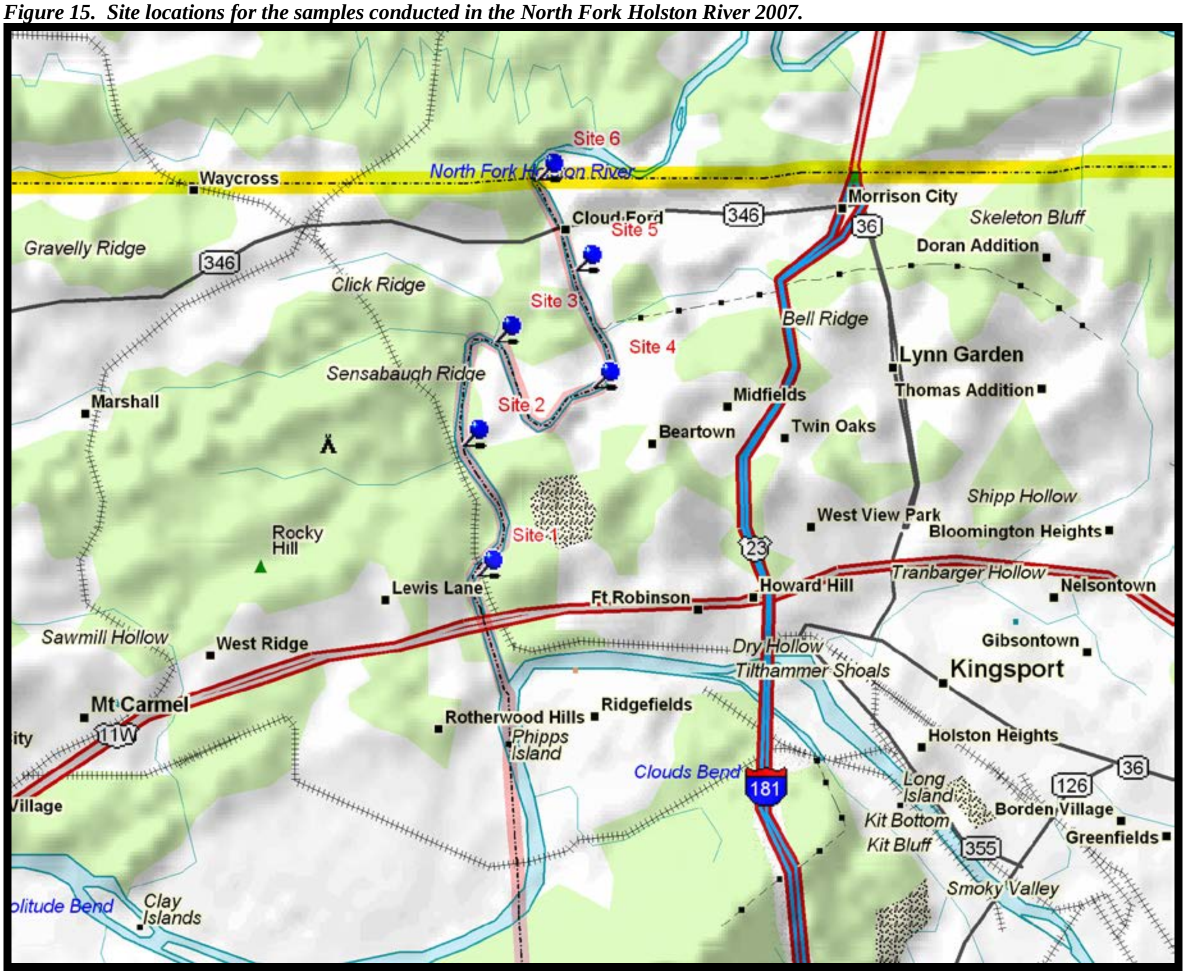


Table 7. Physiochemical and site location data for samples conducted on the North Fork Holston River during 2007.

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420070501	1	Hawkins/Sullivan	Kingsport 188SE	0.8	36.55805	-82.65183	68.3	293	19.5	260	2+
420070502	2	Hawkins/Sullivan	Kingsport 188SE	2.0	36.57000	-82.61750	54.4	1158	19	255	2+
420070503	3	Hawkins/Sullivan	Kingsport 188SE	2.7	36.58055	-82.61361	48.3	518	19	255	2+
420070504	4	Hawkins/Sullivan	Kingsport 188SE	4.0	36.57472	-82.60250	45.2	1325	18.5	260	2+
420070505	5	Hawkins/Sullivan	Kingsport 188SE	4.4	36.58583	-82.60444	52.0	953	17.5	245	2+
420070506	6	Hawkins/Sullivan	Kingsport 188SE	5.0	36.59416	-82.60888	58.0	250	17.5	245	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 amps DC at all sites. This current setting was determined effective in narcotizing smallmouth bass and rock bass. All sites were sampled during daylight hours and had survey durations ranging from 881 to 1700 seconds. CPUE values were calculated for each target species at each site. Length categorization indices were calculated for target species following Gabelhouse (1984).

Results

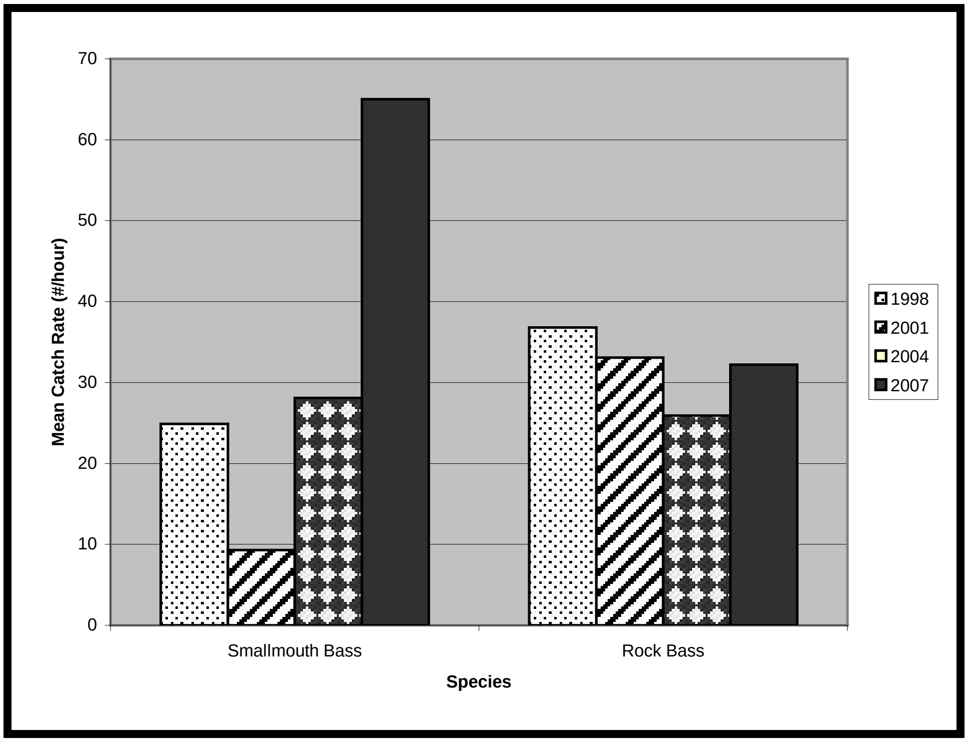
Both smallmouth bass and rock bass were collected from all six sites. Smallmouth bass was the only black bass collected during our surveys. CPUE estimates for this species averaged 65.0/hour which was a 131% increase over our value for 2004 (Table 8).

Table 8. Catch per unit effort and length categorization indices of target species collected at six sites on the North Fork Holston River during 2007.

Site Code	Smallmouth Bass CPUE	Rock Bass CPUE
420070501	50.0	27.7
420070502	80.8	46.8
420070503	63.1	23.6
420070504	47.3	26.3
420070505	61.5	43.5
420070506	87.5	25.0
MEAN	65.0	32.2
STD. DEV.	16.2	10.2
	Smallmouth Bass Length-Categorization Analysis	**Rock Bass Length-Categorization Analysis**
	PSD = 57.6	PSD = 31.7
	RSD-Preferred = 36.5	RSD-Preferred = 0
	RSD-Memorable = 14.1	RSD-Memorable = 0
	RSD-Trophy = 0	RSD-Trophy = 0

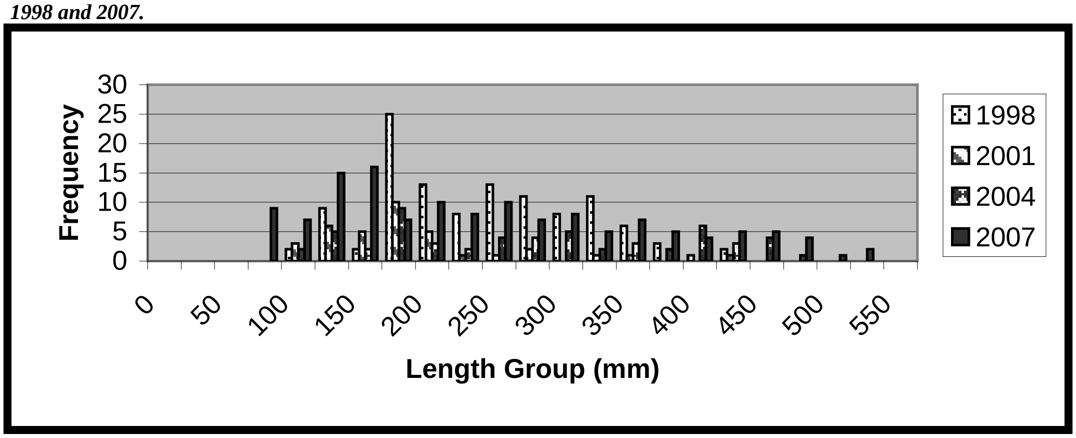
Sites 2 and 6 had the highest catch rates of the six sites sampled and were about 29% higher on average than the total sample average. We feel that this could be related to the higher occurrence of perpendicular/parallel bedrock shelves (and subsequent troughs) in these sites, which appeared to be, preferred habitat (smallmouth would hold in deeper troughs just below or to the side of bedrock shelves). Rock bass were generally less abundant than smallmouth bass encountered in our survey areas and had an average CPUE of 32.2 which was up 24.3% from 2004 (Table 8). The sites where the catch rates were highest usually had at least one shoreline that had good boulder cover. Our 2007 catch far exceeded those values previously observed for smallmouth bass in the North Fork (Figure 16). The number of quality and preferred bass was particularly impressive especially at site 2. Comparatively, rock bass abundance increased somewhat over our 2004 value but was still lower than values recorded for the 1998 and 2001 samples. Although we did observe good numbers of smallmouth bass and rock bass, river flows were extremely low during 2007. This could ultimately have an impact on the number of larger fish as drought conditions tend to have more influence over regulating these size groups than they do with smaller fish. Although no trophy category smallmouth bass were collected, we are confident that 20 + inch smallmouth bass reside in the river.

Figure 16. Trends in mean catch rate of black bass and rock bass collected between 1998 and 2007 from the North Fork Holston River.



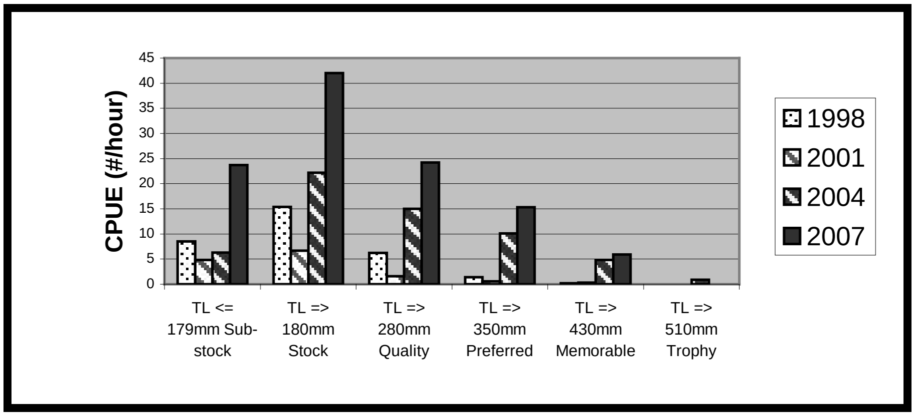
The majority of the smallmouth bass collected in the North Fork Holston River during 2007 fell within the 125 mm to 275 mm length range (Figure 17). Unlike previous years, the size distribution in 2007 showed good representation in all size classes with noticeable increases in abundance for size classes over 450 mm.

Figure 17. Length frequency distributions for smallmouth bass collected from the North Fork Holston River between 1998 and 2007.



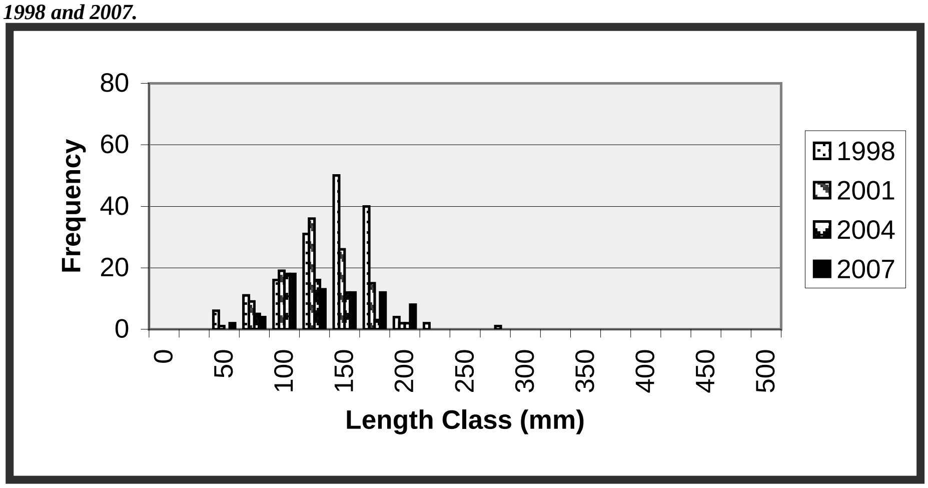
Length categorization analysis indicated the Relative Stock Density (RSD) for preferred smallmouth bass (TL $\geq$ 350 mm) was 36.5, a decrease of 20% from the 2004 value. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass was 14.1 and 0, respectively. All RSD categories decreased slightly between the 2004 sample and the 2007. Although there were numerous large bass in the 2007 sample we did not collect any in the trophy category as was the case in 2004. The ratio of quality (TL $\geq$ 280 mm) smallmouth bass to stock size bass (TL $\geq$ 180 mm) was 57.6 (2004 value = 67.4). Catch per unit effort estimates by RSD category indicated the majority of the catch was in the RSD-S (Figure 18). Overall the proportional distribution of CPUE was higher in all categories when compared to the 1998 and 2001 sample with the exception of the trophy category. There was a real strong showing of stock size bass in 2007 that should carry forward provided mortality was not significantly increased by the drought conditions in 2007.

Figure 18. Relative stock density (RSD) catch per unit effort for smallmouth bass collected from the North Fork Holston River between 1998 and 2007.



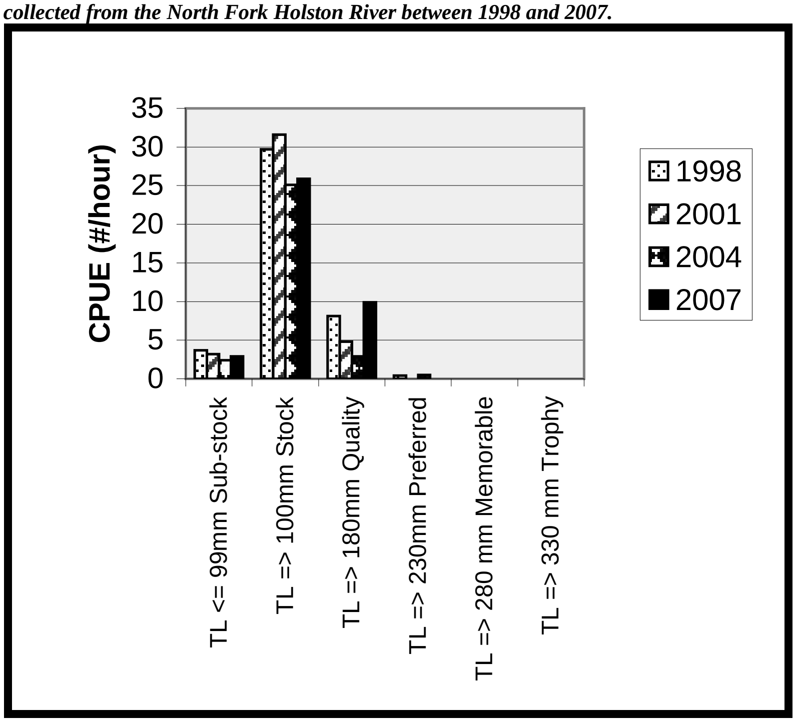
Individuals in the 100 mm to 200 mm range represented the majority of rock bass in our sample (Figure 19). Length categorization analysis indicated the RSD for preferred rock bass (TL ≥ 230 mm) was 0. This was a decline from the value observed in 2004 (1.9).

Figure 19. Length frequency distributions for rock bass collected from the North Fork Holston River between 1998 and 2007.



RSD for memorable (TL ≥ 280 mm) and trophy (TL ≥ 330 mm) size rock bass was 0. The ratio of quality (TL ≥ 180 mm) rock bass to stock size rock bass (TL ≥ 100 mm) was 31.7. Catch data by RSD category revealed a high number of rock bass in the RSD-S category with good recruitment into the RSD-Q (Figure 20). These trends were similar to previous sample years although the overall 2004 values were somewhat depressed. This is most likely related to timing of our sample, which has shown to result in lower catches of rock bass in other rivers.

Figure 20. Relative stock density (RSD) catch per unit effort by category for rock bass collected from the North Fork Holston River between 1998 and 2007.



Discussion

The North Fork Holston River provides anglers with the opportunity to catch substantial numbers of quality size smallmouth bass and rock bass. Catches of smallmouth bass in 2007 exceeded those values previously recorded. Our findings from spring and fall samples have indicated that size structure and catch rates generally increase during these time periods when compared to summer samples. In 2001, a roving creel survey was conducted on the North Fork indicating relatively high angling pressure and moderate harvest (Betolli 2002, Carter et al. 2003). All information from our survey data indicates that the smallmouth bass population, although fluctuating under drought conditions (1998 and 2001 surveys), has continued to produce good numbers of quality fish.

Surveys on the North Fork Holston River will be conducted on a three-year rotation in order to assess any changes in the fishery. The North Fork has been under consideration for some time regarding smallmouth bass regulations. The relatively short reach of river in Tennessee coupled with the relatively high angling pressure and the rivers ability to produce quality size fish makes it a good candidate for management.

Management Recommendations

1. Develop a fishery management plan for the river.

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 collections by the TWRA were conducted in 1990 near river mile 78 (Bivens and Williams 1991) and multiple survey sites between the state line and Knoxville in 2000 (Carter et al. 2001). The TVA (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.

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 near Knoxville 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 12,302 hectares (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.

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 May 17 and 23, 2007 we sampled 14 sites (5 above Douglas Reservoir, 9 below Douglas Reservoir (Figures 21, 22). Boat electrofishing was used at both localities. Due to the nature of the river above Douglas Reservoir, we used our inflatable cataraft to survey this section of the river. This boat allows use to survey in rough water where conventional aluminum electrofishing boats do not work.

Figure 21. Locations of samples conducted in the French Broad River above Douglas Reservoir during 2007.

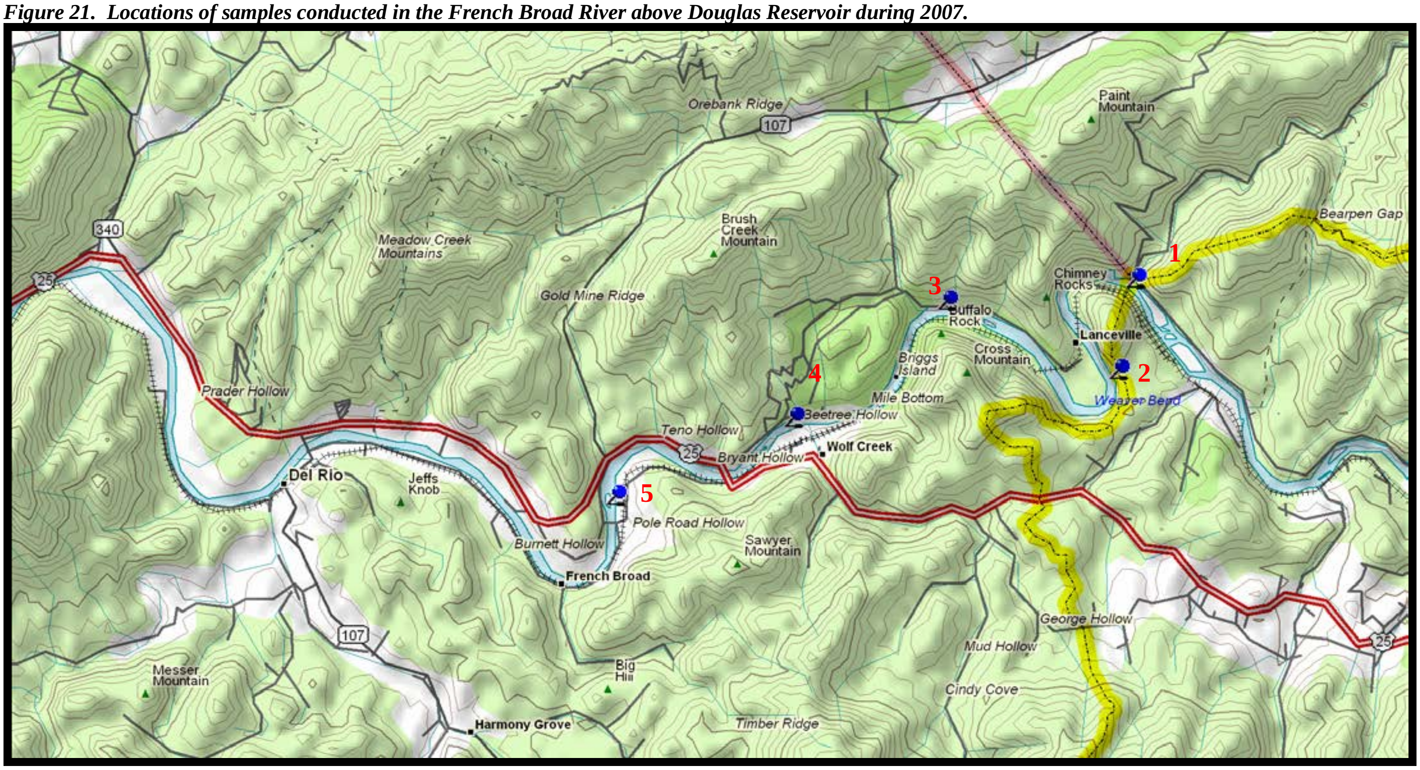
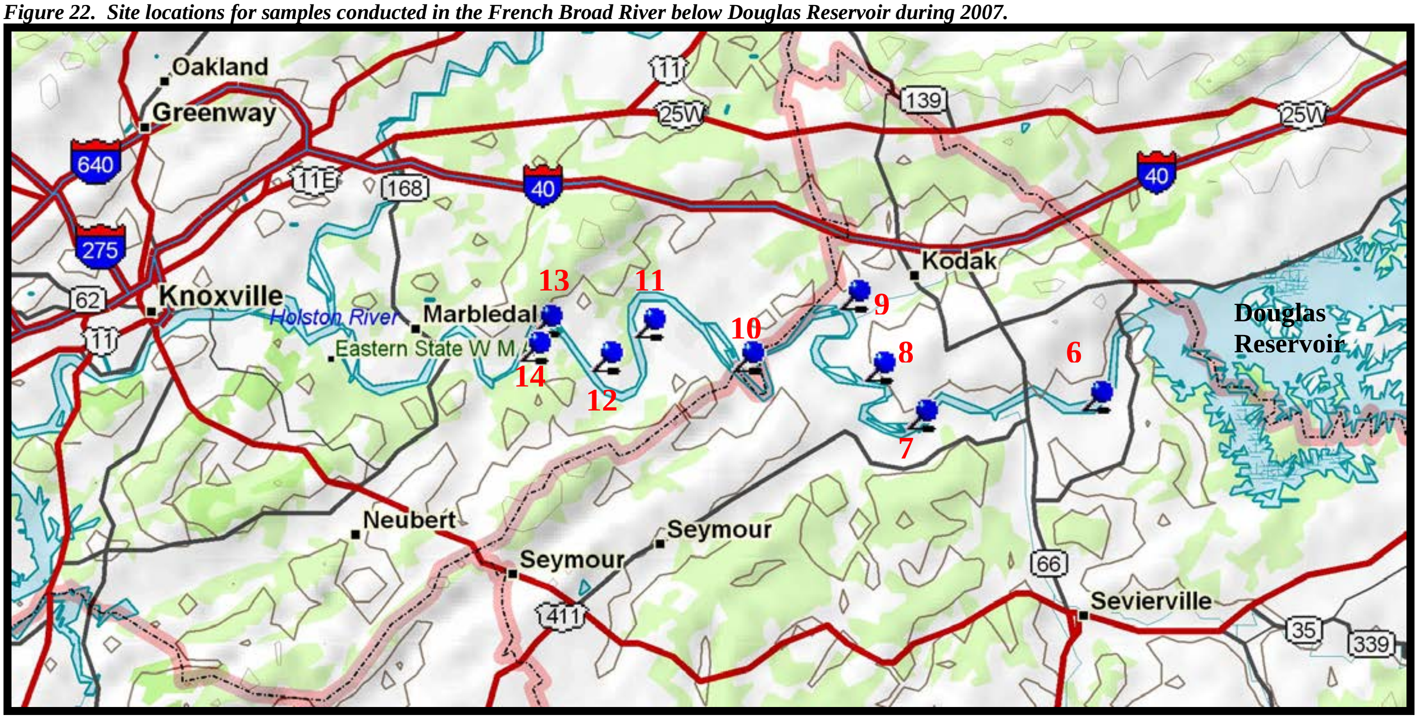


Figure 22. Site locations for samples conducted in the French Broad River below Douglas Reservoir during 2007.



In the reach of river we sampled, 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 to more suitable topography. 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 61 to 304 m, while site lengths fell between 230 and 1246 m (Table 9). Water temperatures ranged from 16 to 23 C. Conductivity varied from 52 to 145 μs/cm (Table 9).

Table 9. Physiochemical and site location data for samples conducted on the French Broad River during 2007.

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420070701	1	Cocke	Paint Rock 182NW	99.5	35.94394	-82.89837	109	500	20	52	1.1
420070702	2	Cocke	Paint Rock 182NW	98.9	35.93274	-82.90164	86	494	22	55	1.1
420070703	3	Cocke	Paint Rock 182NW	97.3	35.94114	-082.9277	72	496	22	59	1.1
420070704	4	Cocke	Paint Rock 182NW	95.3	35.92685	-82.95068	85.5	431	23	58	1.1
420070705	5	Cocke	Paint Rock 182NW	93.6	35.91739	-82.97733	61	230	22	60	1.1
420070706	6	Sevier	Douglas Dam 156NE	29.5	35.93250	-83.56306	146.6	1246	13	110	3.9
420070707	7	Sevier	Douglas Dam 156NE	25.1	35.92667	-83.63028	221	551	16	110	3.9
420070708	8	Sevier	Boyds Creek 156NW	22.4	35.94222	-83.64694	91.5	845	18	145	3.9
420070709	9	Sevier	Boyds Creek 156NW	19.5	35.96444	-83.65611	167	1027	17.5	120	3.9
420070710	10	Knox	Boyds Creek 156NW	15.5	35.94500	-83.69722	304	818	18.5	120	3.9
420070711	11	Knox	Boyds Creek 156NW	11.8	35.95528	-83.73472	175	759	18.5	120	3.9
420070712	12	Knox	Boyds Creek 156NW	9.3	35.94472	-83.75111	183	927	20	128	3.9
420070713	13	Knox	Shooks Gap 147NE	7.3	35.95639	-83.77472	127	277	20	125	3.9
420070714	14	Knox	Shooks Gap 147NE	6.6	35.94806	-83.77806	123	921	20.5	125	3.9

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 sites were sampled during daylight hours and had survey durations ranging from 523 to 2216 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 above Douglas Reservoir averaged 14.6/hour (SD 12.7), while the spotted bass and largemouth bass estimates were 2.6/hour (SD 2.6) and 0/hour, respectively (Table 10). Comparatively, mean CPUE estimates at the same sites in 2000 and 2004 ranged 31.4/hour to 22.9/hour for smallmouth bass and 5.2/hour to 0/hour spotted bass (Figure 23). We feel the observed decline in smallmouth bass in this portion of the river is related to the flooding that took place in 2004 after our sample was collected that year. We did observe good numbers of smaller bass in 2007 although the larger size classes still seemed to be lower than previous observations. No largemouth bass were collected from this reach of river in 2004. Rock bass CPUE was 0.8/hour (SD 1.7) upstream of the reservoir in 2007. This was the first time since we have initiated sampling in 2000 that rock bass have been collected from these sites. This finding is encouraging since the upper French Broad has historically had habitat conditions that are not considered favorable for this species. In samples conducted below Douglas Reservoir in 2007, smallmouth bass catches averaged 40.8/hour (SD 33.2). Spotted bass and largemouth bass catch rates were not surprisingly lower at 10.6/hour (SD 15.3) and 2.8/hour (SD 6.9), respectively. In comparison, the CPUE value for smallmouth bass in 2003 was much lower at 2.8/hour (Figure 24). We did not include our values collected in 2000, since these samples were collected at high flow and at different sites. Overall, we observed a sharp increase in smallmouth bass between 2003 and 2007. Our sample timing in 2003 was later (June) which probably decreased our catches. Rock bass catches in this part of the river averaged 34.8/hour (SD 34.2) during 2007 (Table 10). This was significantly higher than the values recorded for the 2003 samples (Figure 24).

Table 10. Catch per unit effort and length categorization indices of target species collected at nine sites on the French Broad River during 2007 (Sites 1-5 above Douglas Reservoir, sites 6-14 below Douglas Reservoir).

Site Code	Smallmouth Bass CPUE	Spotted Bass CPUE	Largemouth Bass CPUE	Rock Bass CPUE
420070701	8.8	2.9	-	-
420070702	29.6	-	-	-
420070703	27.2	6.1	-	-
420070704	3.6	-	-	-
420070705	4	4	-	4
MEAN	14.6	2.6	-	0.8
STD. DEV.	12.7	2.6	-	1.7
Sites 1-5	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis
	PSD = 83.3	PSD = 0	PSD = 0	PSD = 0
	RSD-Preferred = 0	RSD-Preferred = 0	RSD-Preferred = 0	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
420070706	18.4	-	21	10.5
420070707	77.8	-	-	83.3
420070708	93.3	-	-	53.3
420070709	8.2	24.5	1.6	86.9
420070710	54.5	9.1	3.0	9.1
420070711	13.3	-	-	6.7
420070712	64	-	-	-
420070713	-	42.8	-	50
420070714	37.8	18.9	-	13.5
MEAN	40.8	10.6	2.8	34.8
STD. DEV.	33.2	15.3	6.9	34.2
Sites 6-14	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis
	PSD = 45.3	PSD = 39.3	PSD = 50	PSD = 50
	RSD-Preferred = 19.6	RSD-Preferred = 7.1	RSD-Preferred = 50	RSD-Preferred = 6.9
	RSD-Memorable = 8.2	RSD-Memorable = 0	RSD-Memorable = 25	RSD-Memorable = 0
	RSD-Trophy = 2.1	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0

Figure 23. Trends in mean catch rate of black bass and rock bass collected from 2000-2007 in the French Broad River above Douglas Reservoir.

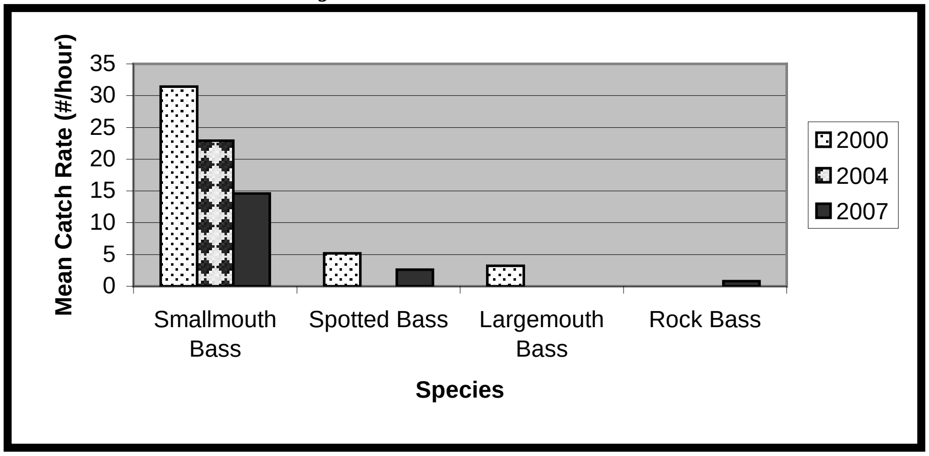
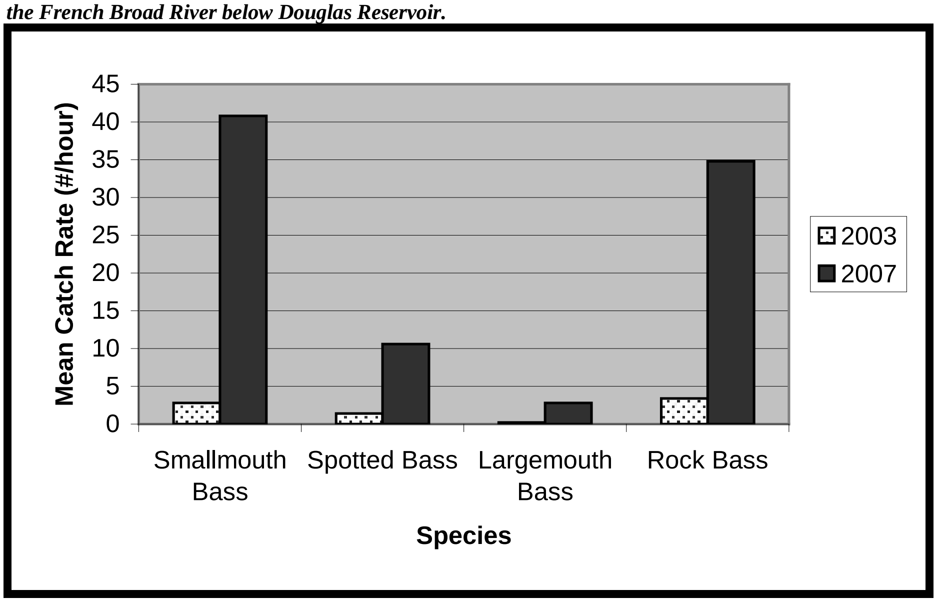
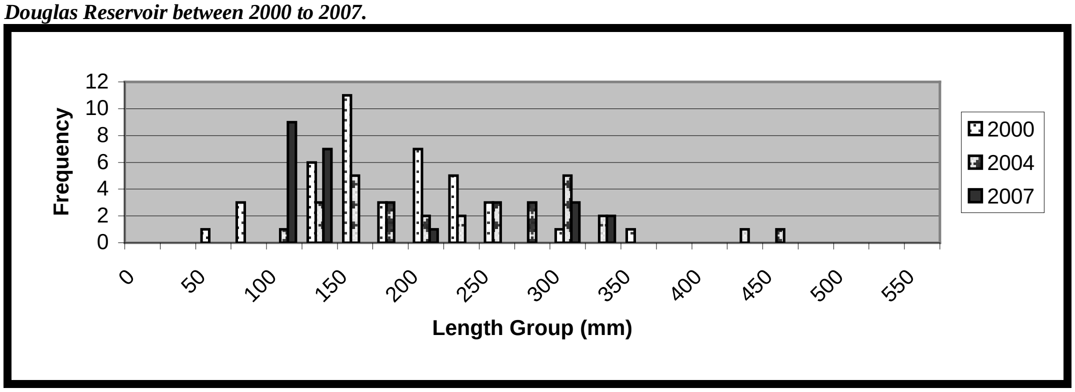


Figure 24. Trends in mean catch rate of black bass and rock bass collected from 2000-2007 in the French Broad River below Douglas Reservoir.



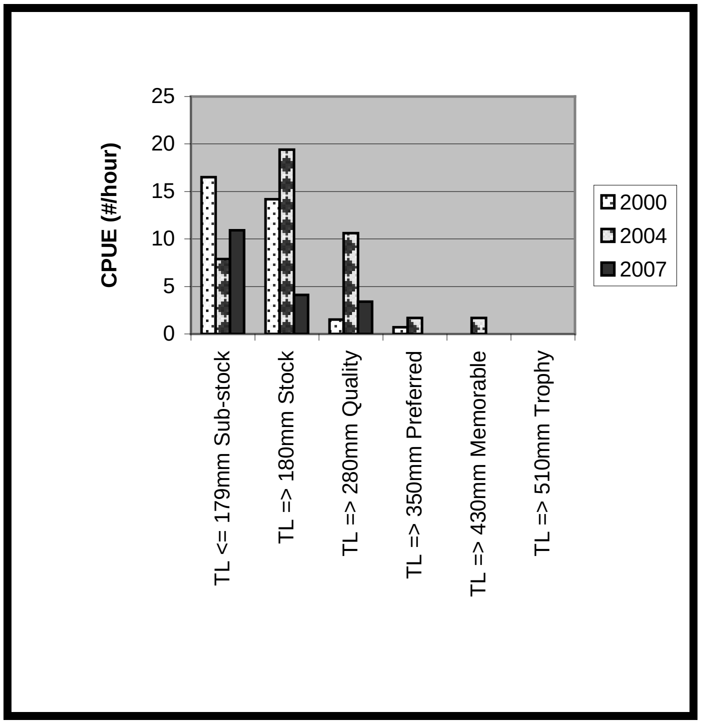
The length distribution of smallmouth bass was predominantly comprised of individuals in the 100 to 150 mm size range. Five bass 300 mm and over (12 in) were collected during 2007 (Figure 25).

Figure 25. Length frequency distribution for smallmouth bass collected from the French Broad River above Douglas Reservoir between 2000 to 2007.



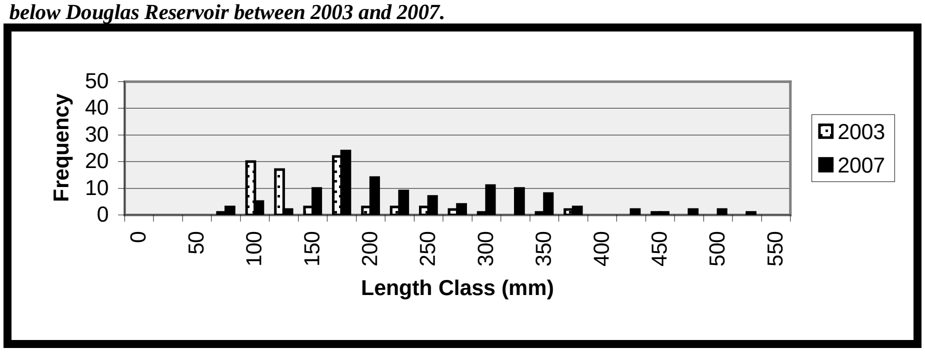
The 2007 Relative Stock Density (RSD) for preferred smallmouth bass (TL $\geq$ 350 mm) above the reservoir was 0. This was a decrease from 1.7 in the 2004 when both preferred and memorable size smallmouth were collected from this reach of river (Figure 26). With the exception of the sub-stock category we observed substantial declines in all other respective RSD values. The PSD of smallmouth bass (ratio of quality size bass to stock size bass) was 83.3 above the reservoir indicating an almost even proportion of stock and quality bass in the sample. The relative strength of the sub-stock category is encouraging for bolstering the size structure in coming years providing recruitment remains proportional. The declines we observed in 2007 are most likely remnants from flooding that hit the watershed in 2004. With low flows in 2007, the juvenile bass should have done well and hopefully will begin to recruit in subsequent years.

Figure 26. Relative stock density (RSD) catch per unit effort by category for smallmouth bass collected from the French Broad River above Douglas Reservoir between 2000 and 2007.



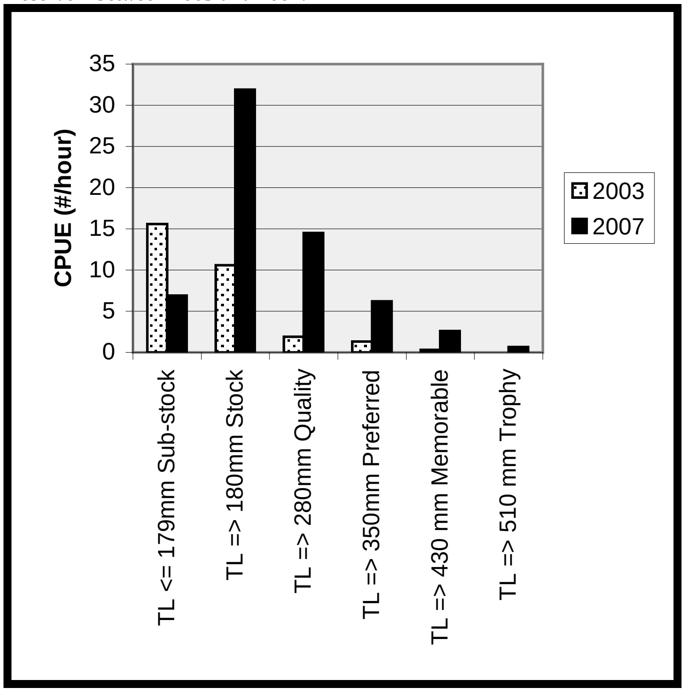
The length distribution of smallmouth bass was predominantly comprised of individuals in the 150 to 350 mm size range. We did collect two bass that were 20 inches or greater. Overall, there was an abundance of quality size bass in this section of the river when compared to 2003 (Figure 27).

Figure 27. Length frequency distribution for smallmouth bass collected from the French Broad River below Douglas Reservoir between 2003 and 2007.



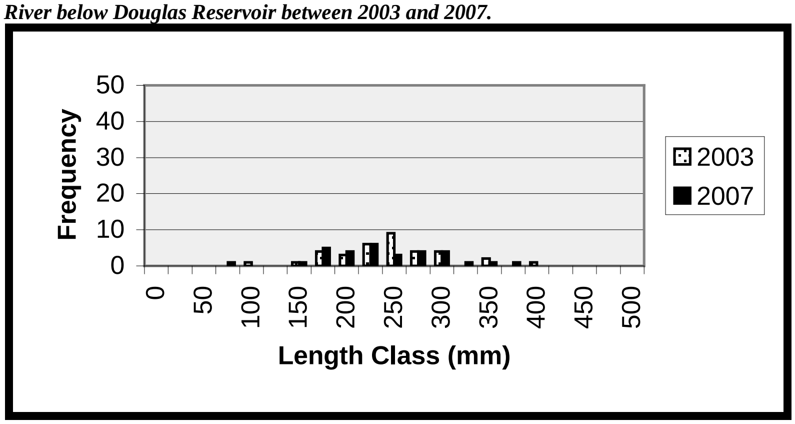
Trends in catch per unit effort by RSD category below Douglas Reservoir appeared to be more robust in 2007 than in the earlier sample. We did observe significant increases in the number of stock and quality size bass in 2007 (Figure 28). The PSD for smallmouth bass improved considerably from 18.7 in 2003 to 45.3 in 2007. We did catch bass in every RSD category and for the first time recorded bass in the trophy category. There was a relatively low occurrence of sub-stock bass in 2007. Hopefully, this was an artifact of sampling and does not reflect weak year classes.

Figure 28. Relative stock density (RSD) catch per unit effort by category for smallmouth bass collected from the French Broad River below Douglas Reservoir between 2003 and 2007.



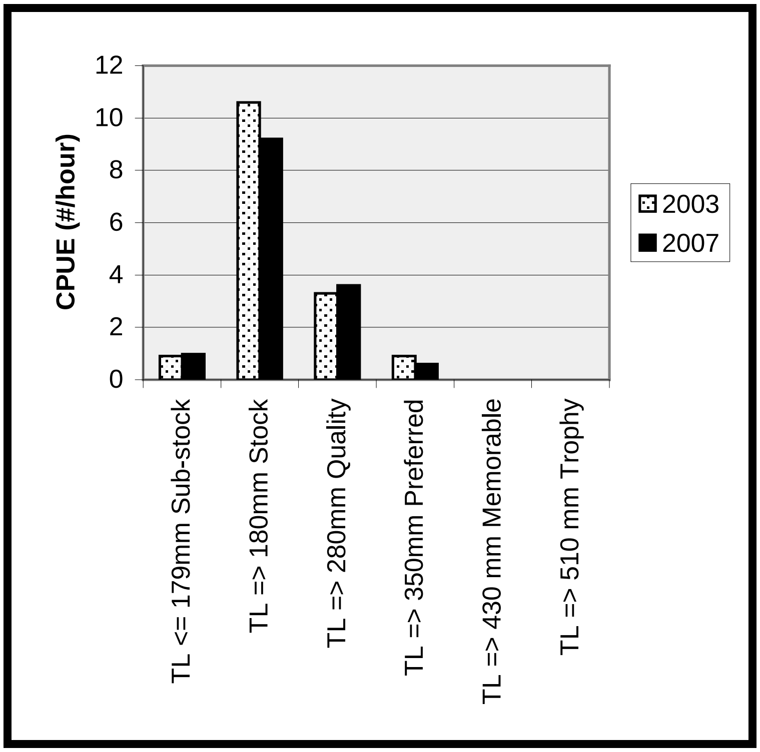
The majority of spotted bass collected from the French Broad River during 2007 fell within the 100 mm to 325 mm length range (Figure 29). Only four spotted bass were collected from the upper French Broad ranging from 100 mm to 250 mm. Because of the low number, no analyses were conducted for these fish. A total of 31 spotted bass were collected from the lower French Broad (Figure 29). Most of these fish ranged from 175 mm to 325 mm.

Figure 29. Length frequency distribution for spotted bass collected in the French Broad River below Douglas Reservoir between 2003 and 2007.



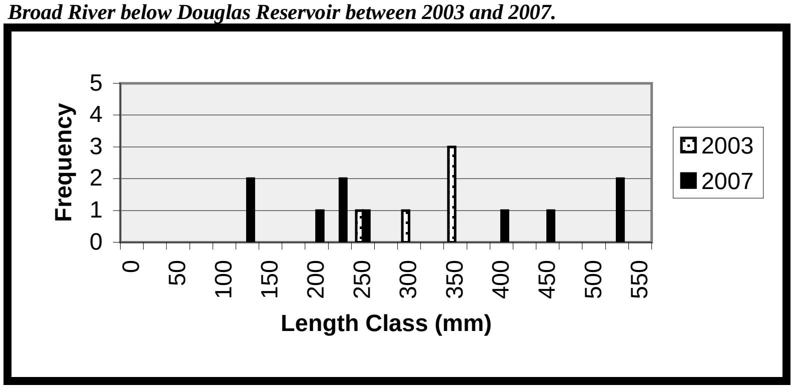
Length categorization analysis indicated the RSD for preferred spotted bass (TL ≥ 350 mm) in the lower French Broad was 7.1. RSD for memorable (TL ≥ 430 mm) and trophy (TL ≥ 510 mm) size bass was 0. The PSD of spotted bass was 39.3. Catch per unit effort estimates by RSD category revealed favorable numbers of spotted bass above the RSD-S category although the number of preferred spotted bass were slightly lower than in 2003 (Figure 30). We did observe a slight decrease in the number of stock size fish but found a slight increase in the number of quality size bass. The 2007 sub-stock catch was almost identical to 2003 value.

Figure 30. Relative stock density (RSD) catch per unit effort by category for spotted bass collected from the French Broad River below Douglas Reservoir between 2003 and 2007.



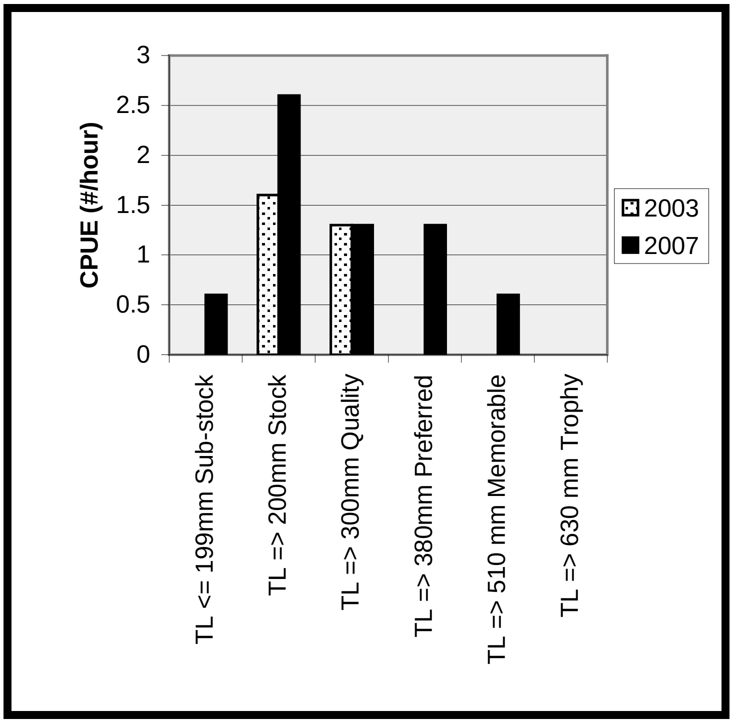
Very few largemouth bass were collected in the French Broad during 2007. None were collected in samples above Douglas Reservoir. Of those collected below the reservoir, all fell within the 125 mm to 550 mm length range (Figure 31).

Figure 31. Length frequency distributions for largemouth bass collected from the French Broad River below Douglas Reservoir between 2003 and 2007.



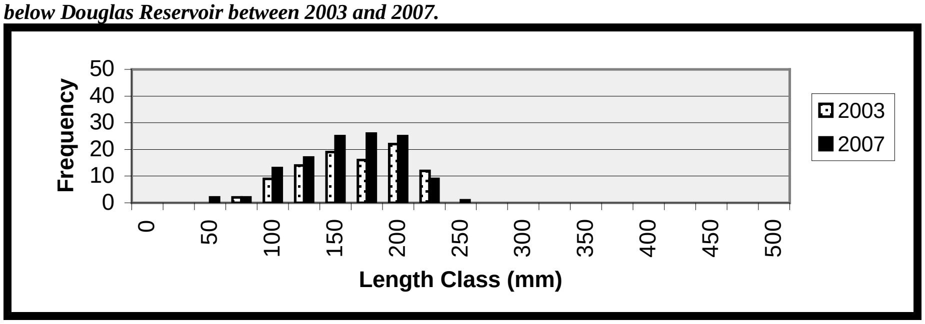
Our collection of largemouth bass doubled between the two samples although the catch in 2007 was not that impressive (10). Length categorization analysis indicated the RSD for preferred largemouth bass (TL ≥ 380 mm) was 50. RSD for memorable (TL ≥ 510 mm) and trophy (TL ≥ 630 mm) size largemouth bass was 25 and 0, respectively. The PSD of largemouth bass was 50. The highest catch rate by RSD category was for stock size largemouth bass. Although numbers were extremely low, recruitment into the quality category was good and we did observe largemouth in the preferred and memorable categories (Figure 32).

Figure 32. Relative stock density (RSD) catch per unit effort by category for largemouth bass collected from the French Broad River below Douglas Reservoir between 2003 and 2007.



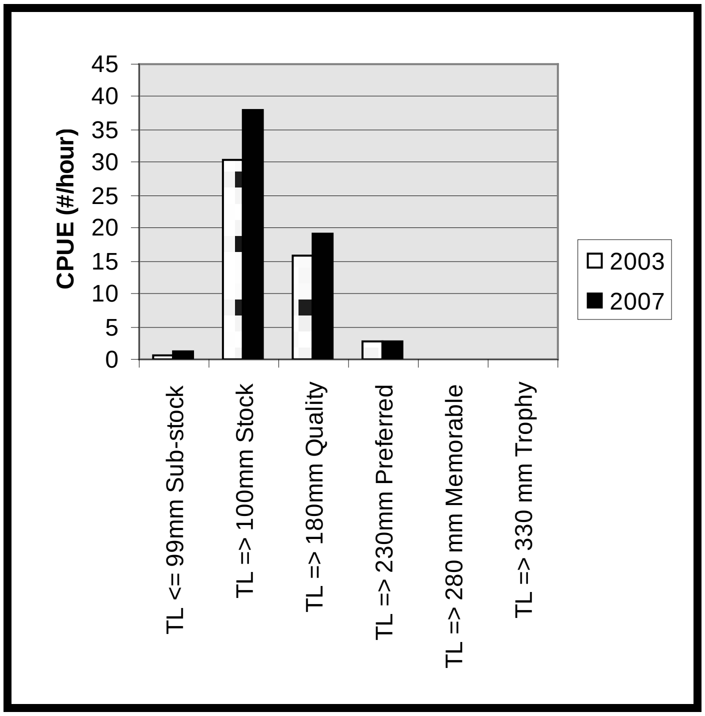
We only collected one rock bass from the upper French Broad River. Although a single individual, this represents the first time we have collected this species from this reach of the river. The fish was 200 mm in length and appeared to be in good condition. A total of 120 rock bass were collected in our survey of the lower French Broad River. The size distribution was fairly typical of other riverine populations with the bulk of the fish falling in the 75 to 225mm length range (Figure 33). Although the size distribution was similar between samples, the frequency of rock bass in each respective size category was greater in 2007 for most size groups.

Figure 33. Length frequency distributions for rock bass collected from the French Broad River below Douglas Reservoir between 2003 and 2007.



PSD for the population in the lower French Broad was 50. The value for preferred rock bass (TL ≥ 230 mm) was 6.9. The value for memorable (TL ≥ 280 mm) and trophy (TL ≥ 330 mm) rock bass was 0. Sub-stock catch of rock bass was low (Figure 34), 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. Even with lower susceptibility to capture we did manage to observe an increase in this size category between 2003 and 2007. Recruitment of rock bass into the stock and quality size was good with about 48% of the catch comprised of quality (TL > 180 mm) size fish or larger (Figure 34). Our catch rate of preferred rock bass remained at the same value observed in 2003.

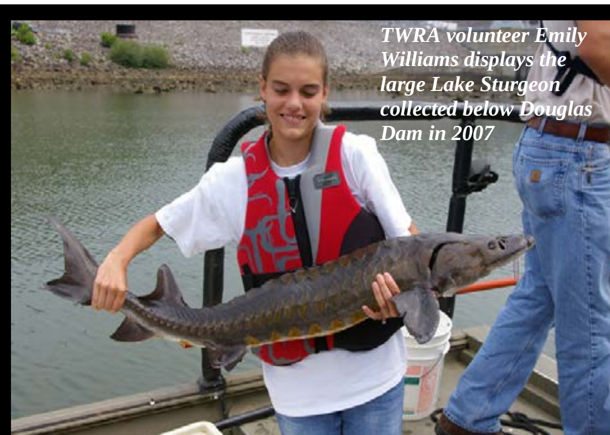
Figure 34. Relative stock density (RSD) catch per unit effort by category for rock bass collected in the French Broad River below Douglas Reservoir between 2003 and 2007.



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 have encountered that would be sought by anglers is the channel catfish. 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. Lake sturgeon stockings into the tailwater are continuing in hopes of recovering this species to some of its former range. We did respond to reports of anglers catching sturgeon near Douglas Dam in July. We worked with TVA in sampling the area between the dam and Highway 338 bridge. We were able to collect two sturgeon, one about 25 inches in length and the other approximately 45 inches. Another interesting find in the upper French Broad was the blue sucker. We did manage to collect one specimen during the 2007 effort near the confluence with Brush Creek. This represents the first collection of blue sucker above Douglas Reservoir in recent history and was an encouraging finding given the water quality history in this reach of river.

Blue Sucker collected from French Broad River near river mile 98.2



TWRA volunteer Emily Williams displays the large Lake Sturgeon collected below Douglas Dam in 2007

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.). 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), Highway 66 Bridge (TWRA) near Sevierville, and at Seven Islands. There are a few primitive ramps and pull-outs along some of the roads paralleling the river above and below Douglas Reservoir. We are scheduled to return to the French Broad in 2009 to sample sites above and below Douglas Reservoir.

Management Recommendations

1. Develop a fishery management plan for the river.

2. Initiate an angler use survey on the river.

3. Continue the cooperative annual sturgeon monitoring.

4. Develop additional public access above Douglas Reservoir.

5. Develop a musky stocking program upstream of Douglas Reservoir.

Nolichucky River

Introduction

The Nolichucky River represents an important recreational resource for the state both in consumptive and non-consumptive uses. It provides critical habitat for species of special concern and is home to approximately 50 species of fish and has historically supported at least 21 species of mussels (Ahlstedt 1986). Additionally, it supports one of east Tennessee's better warmwater sport fisheries. The Nolichucky River and its tributaries have been the subject of numerous biological and chemical investigations that span some 40 years. These investigations have concentrated on evaluating pollution levels and documenting sources for mitigation. Much of the upper reach of the Nolichucky River has been consistently impacted by sand dredging and mica mining in North Carolina and extensive agricultural development along the entire length in Tennessee. However, in recent years, the Nolichucky River has improved in water quality as a result of mitigation and education conducted during these early studies. The Agency has made limited surveys of the river that focused primarily on collecting basic fish, benthic, and water quality data (Bivens 1988). Extensive sport fish population surveys were conducted in 1998 (Carter et al. 1999) from the North Carolina state line to the French Broad River. Our survey of the Nolichucky River focused on re-evaluating the sport fish populations and developing long-term community assessment sites. Our 2004 assessment (Carter et al. 2005) of the sport fish populations was derived from 10 sample sites between river mile 27.9 and mile 99.1. Our 1998 survey consisted of 31 sample sites, falling between river mile 7.6 and mile 99.1. After our initial evaluation in 1998, the Nolichucky River was put into a 3-year rotational sampling schedule with eight other rivers. Sport fish sampling sites were reduced to those that would best characterize these populations.

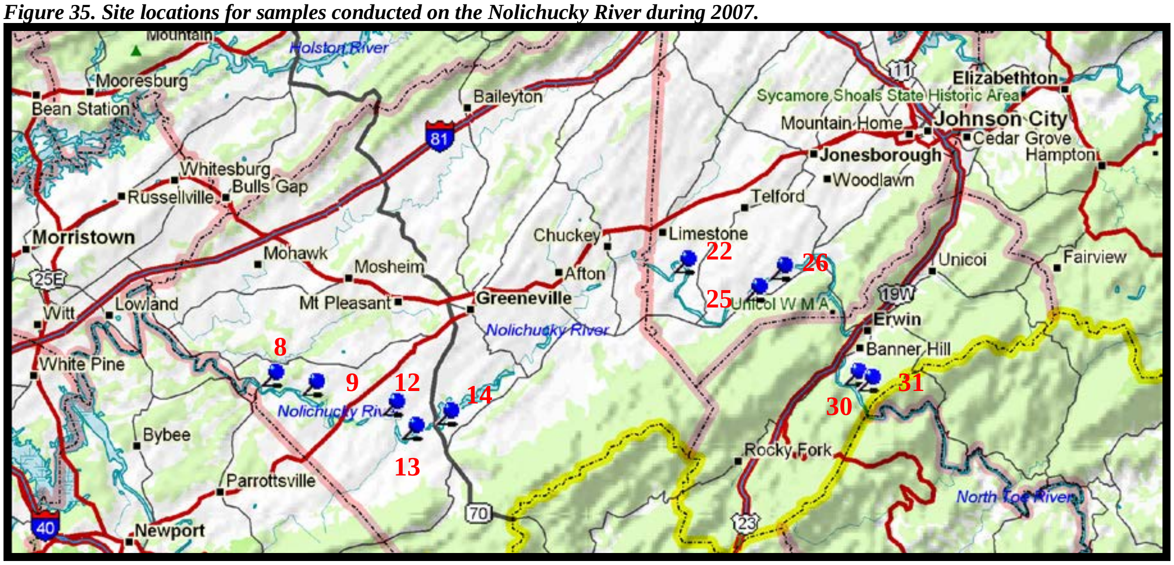
Study Area and Methods

The Nolichucky River originates in North Carolina and flows in a southwesterly direction before emptying into the French Broad River near river mile 69.0. The river has a drainage area of approximately 2,827 kilometers^2. In Tennessee, approximately 159 kilometers of the Nolichucky River flows through the Blue Ridge and Ridge and Valley provinces of east Tennessee, coursing through or by the towns of Erwin, Greeneville, and Morristown before joining the French Broad River near the community of White Pine.

Public access (found in Unicoi, Washington, Greene, Cocke, and Hamblen counties) along the river is primarily limited to bridge crossings and small "pull-outs" along roads paralleling the river. There are several primitive launching areas for canoes or small boats and five developed launching areas managed by the Tennessee Wildlife Resources Agency (Easterly Bridge, Birds Bridge, and Davy Crocket State Park), the City of Greeneville (Kinser Park), and the U.S. Forest Service (Chestoa).

Between May 8 and 16, 2007, we conducted 10 fish surveys between the North Carolina state line and the French Broad River (Figure 35).

Figure 35. Site locations for samples conducted on the Nolichucky River during 2007.



In our survey sites, the riparian habitat consisted primarily of wooded shorelines with interspersed agricultural fields. There were several reaches of the river where one or both sides of the river were confined within rock palisades. Submerged woody debri was fairly common in most of our sample areas. The river substrate was predominately boulder/cobble in riffle areas and bedrock with interspersed boulders/cobble in the pool habitat. Measured mean channel widths ranged from 50 meters to 100.6 meters, while site lengths fell between 241 meters and 1,224 meters (Table 11). Water temperatures ranged from 15.8 C to 22 C and conductivity varied from 60 to 145 (Table 11).

Table 11. Physiochemical and site location data for samples conducted on the Nolichucky River during 2007.

Site Code	Site	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp. C	Cond.	Secchi (m)
420070608	8	Parrottsville 172SE	27.9	36.09707	-83.05132	87.3	1094	22	140	1.3
420070609	9	Parrottsville 172SE	30.9	36.09037	-83.00844	57.3	321	22	145	1.3
420070612	12	Cedar Creek 181SW	39.1	36.07348	-82.92312	59.6	663	20	115	1.2
420070613	13	Cedar Creek 181SW	42.5	36.05399	-82.90385	100.6	650	20.5	128	1.2
420070614	14	Davy Crockett Lake 181SE	45.7	36.06542	-82.86884	80.5	1224	19	105	1.2
420070622	22	Telford 190NE	71.4	36.19329	-82.62080	66.3	300	19	75	1.2
420070625	25	Telford 190NE	80.3	36.17006	-82.54678	57.7	890	18	70	1.2
420070626	26	Telford 190NE	82.9	36.18831	-82.51960	50	769	15.8	60	1.2
420070630	30	Chestoa 199SW	98	36.09918	-82.44337	53.3	241	21	60	1.2
420070631	31	Chestoa 199SW	99.1	36.09449	-82.42855	80.3	426	21	60	1.2

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). All sites were sampled during daylight hours and had survey durations ranging from 1,086 to 2,681 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).

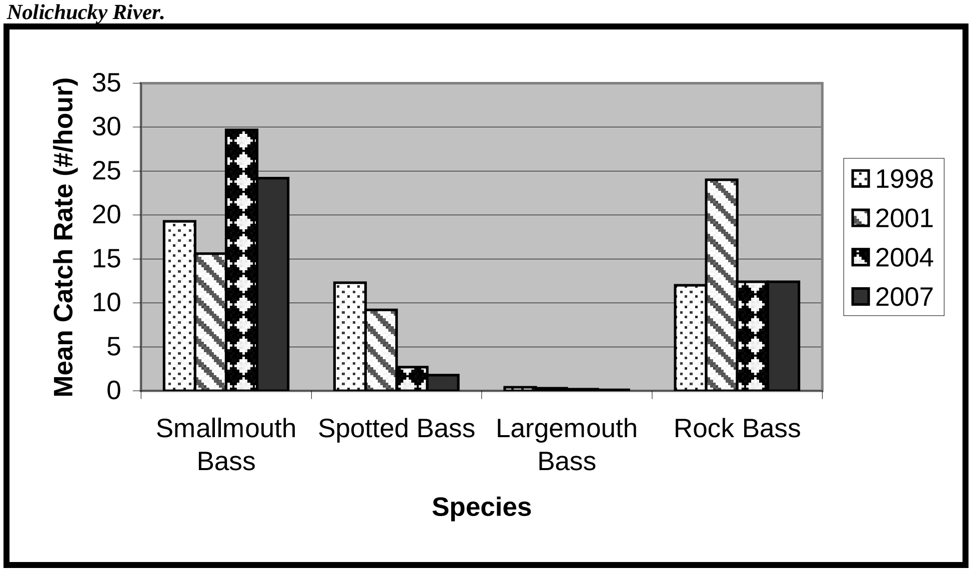
Results

CPUE estimates for smallmouth bass averaged 24.2/hour (SD 16.5), while the mean spotted bass estimate was 1.8/hour (SD 3.4). Largemouth and rock bass estimates were 0.1/hour (SD 0.4) and 12.4/hour (SD 10.5), respectively (Table 12). Comparatively, there was a slight decline in the mean catch rate of all black bass species during 2007 (Figure 36). Rock bass catch remained the same when compared to the 2004 sample, but was about half of the value observed in 2001.

Table 12. Catch per unit effort and length categorization indices of target species collected at 10 sites in the Nolichucky River during 2007.

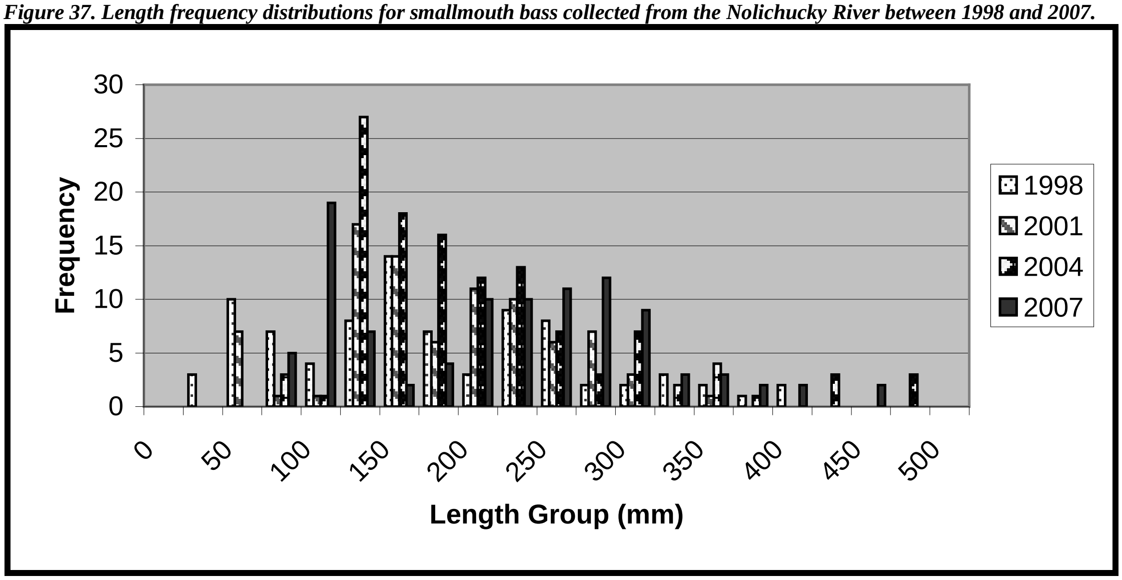
Site Code	Smallmouth Bass CPUE	Spotted Bass CPUE	Largemouth Bass CPUE	Rock Bass CPUE
420070608	23.3	-	-	20
420070609	23.5	2.9	-	20.5
420070612	15.9	-	-	2.2
420070613	33.3	-	-	-
420070614	10.7	5.3	-	1.8
420070622	3.3	10.0	-	13.3
420070625	28.9	-	-	13.1
420070626	14.8	-	-	5.5
420070630	63.8	-	-	33.3
420070631	24.3	-	1.3	14.8
MEAN	24.2	1.8	0.1	12.4
STD. DEV.	16.5	3.4	0.4	10.5
	Length-Categorization Analysis	**Length-Categorization Analysis**	**Length-Categorization Analysis**	**Length-Categorization Analysis**
	PSD = 30	PSD = 25	PSD = 0	PSD = 56.2
	RSD-PREFERRED = 9	RSD-PREFERRED = 0	RSD-PREFERRED = 0	RSD-PREFERRED = 6.2
	RSD-MEMORABLE = 2	RSD-MEMORABLE = 0	RSD-MEMORABLE = 0	RSD-MEMORABLE = 0
	RSD- TROPHY = 0	RSD- TROPHY = 0	RSD- TROPHY = 0	RSD- TROPHY = 0

Figure 36. Trends in mean catch rate of black bass and rock bass collected between 1998-2007 from the Nolichucky River.



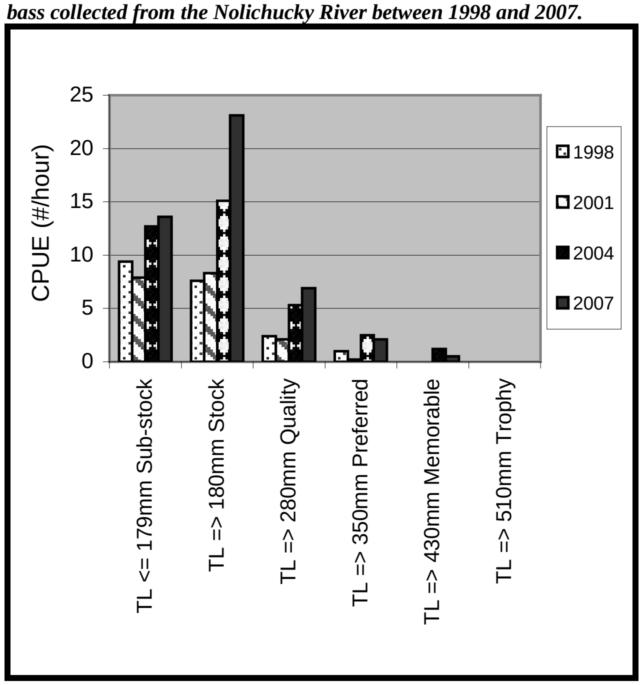
The size distributions of smallmouth bass between 1998 and 2004 changed somewhat among our 10 sampling stations (Figure 37). Generally, we observed a fairly substantial decrease in the 125 mm to 200 mm size class, while the 250 mm to 325 mm class showed some improvement over the 2004 sample. We did observe recruitment of bass in to the 9 to 12 inch range which matched up nicely with the abundance of 5 to 7 inch bass in 2004. Our catch of larger bass was somewhat lower than in 2004 although we did manage to collect two bass over 17 inches. There were very good numbers of 75 to 100 mm bass in 2007 which will hopefully recruit.

Figure 37. Length frequency distributions for smallmouth bass collected from the Nolichucky River between 1998 and 2007.



Length categorization analysis indicated the relative stock density (RSD) of preferred smallmouth bass (TL $\geq$ 350 mm) was 9 (Table 12). RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass were 2 and 0, respectively. The PSD of smallmouth bass (ratio of quality size bass to stock size bass) was 30. In comparison to the 2004 survey, we observed decreases in the number of preferred and memorable size bass, although the number of sub-stock, stock and quality size bass all exhibited increases. Probably the most dramatic comparison was in the catch rate by RSD category. With the exception of sub-stock and stock bass we observed a doubling in the catch rates of quality, preferred, and memorable size bass (Figure 38). Although no trophy bass were collected, we are certain that there is a component to the fishery that comprises bass in excess of 508 mm (20 inches).

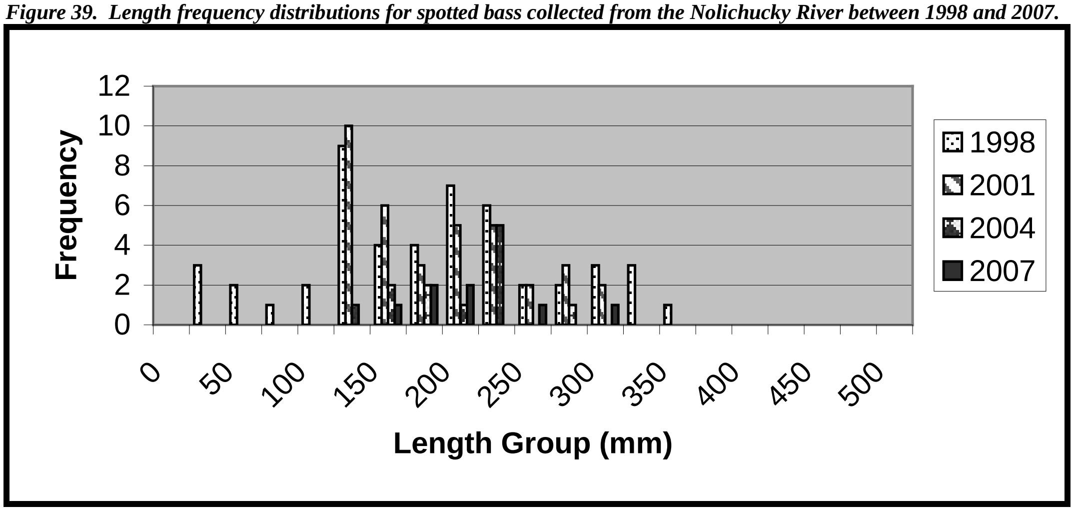
Figure 38. Relative stock density (RSD) catch per unit effort for smallmouth bass collected from the Nolichucky River between 1998 and 2007.



Age and growth characteristics for the smallmouth bass population in the Nolichucky River were characterized in 1998 (Carter et al. 1999). For the most part, the Nolichucky River has had growth rates similar to other large river populations with the same age structure. We did not collect otoliths from smallmouth bass in 2007, assuming that the values generated from the 1998 survey typify the general growth characteristics of this population. In general, it takes a smallmouth bass in the Nolichucky River about 3.8 years to reach 305 mm (12 inches), and about 7.8 years to attain a length of 406 mm (16 inches).

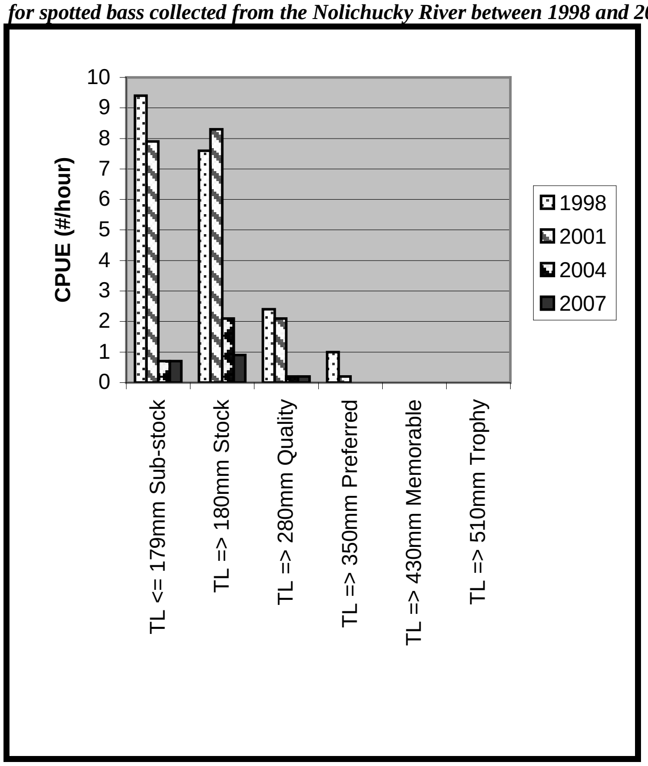
The majority of spotted bass from the Nolichucky River were within the 150 mm and 225 mm size groups (Figure 39). We have observed a slow decline in the number spotted bass collected from the river since our initial survey in 1998. Based on the length frequency distributions between 1998 and 2007, there appears to have been very little spotted bass reproduction since 1998. Several years of drought between the sampling periods probably had the most influential effect on this species. Spotted bass densities tend to fluctuate considerably in riverine habitats in east Tennessee, although the Nolichucky historically harbored a stronger population than other rivers in the region.

Figure 39. Length frequency distributions for spotted bass collected from the Nolichucky River between 1998 and 2007.



Length categorization analysis indicated the RSD for preferred spotted bass (TL ≥ 350 mm) was 0 in 2007. RSD for memorable (TL ≥ 430 mm) and trophy (TL ≥ 510 mm) size bass was 0. The PSD for spotted bass increased from 11.1 in 2004 to 25 in 2007. Catch per unit effort estimates by RSD category revealed very few spotted bass in any of the RSD categories (Figure 40).

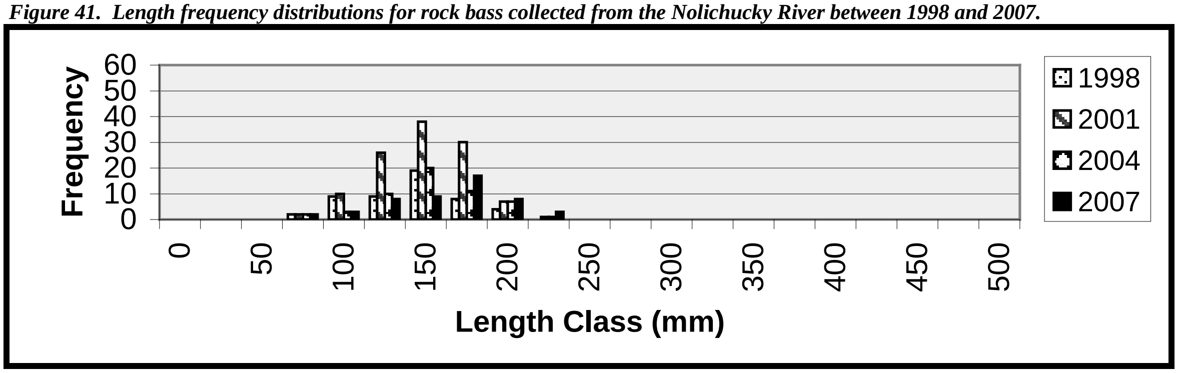
Figure 40. Relative stock density (RSD) catch per unit effort by category for spotted bass collected from the Nolichucky River between 1998 and 2007.



Only one largemouth bass was collected in the 2007 sample. It was 249 mm long and was collected at site 31; our most upstream site. The collection of largemouth bass in the Nolichucky River between 1998 and 2007 has been sporadic and generally restricted to the lower reaches of the river where preferred habitat occurs. This is fairly typical of most large river systems in east Tennessee where largemouth bass contribute very little to the overall fishery.

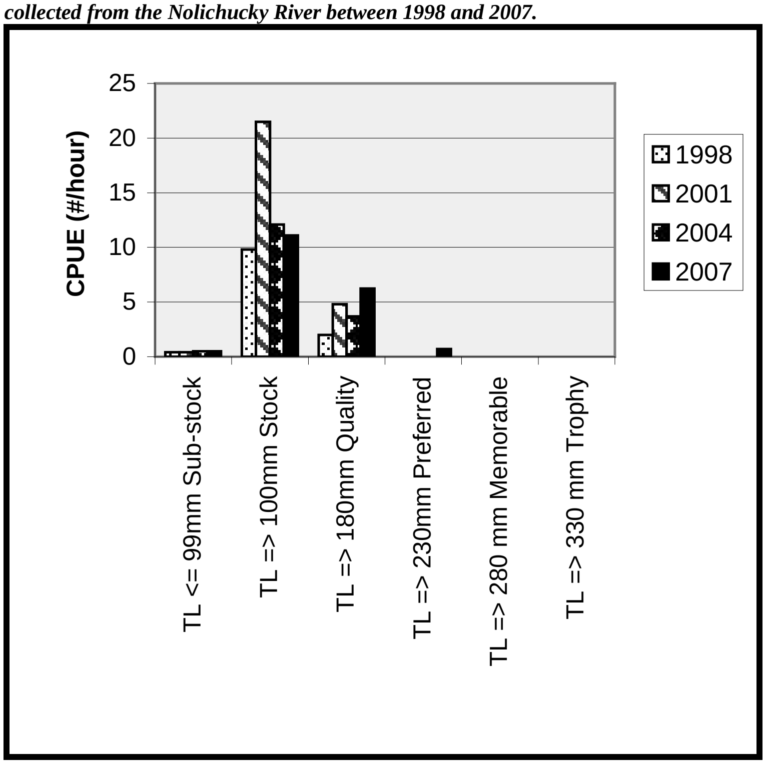
Individuals in the 125 to 200 mm range represented the majority of rock bass in our samples collected between 1998 and 2007 (Figure 41). The length frequency distribution for 2007 was fairly similar to the previous samples. In most cases, we observed a slight increase in the number of rock bass in each size class when compared to 2004.

Figure 41. Length frequency distributions for rock bass collected from the Nolichucky River between 1998 and 2007.



RSD analysis indicated the RSD for preferred rock bass (TL ≥ 230 mm) was 6.2. this was an increase over the value recorded for 2004 (0). RSD for both memorable (TL ≥ 280 mm) and trophy (TL ≥ 330 mm) size rock bass was 0. The PSD of rock bass was 56.2. Catch per unit effort estimates by RSD category indicated the majority of our catch was stock size fish (Figure 42). We did observe and increase in the catch of quality and preferred size rock bass in 2007. The strong showing of stock size rock bass in 2001 appeared to recruit as some of these fish were responsible for the increases we observed in the quality and preferred categories in 2007.

Figure 42. Relative stock density (RSD) catch per unit effort by category for rock bass collected from the Nolichucky River between 1998 and 2007.

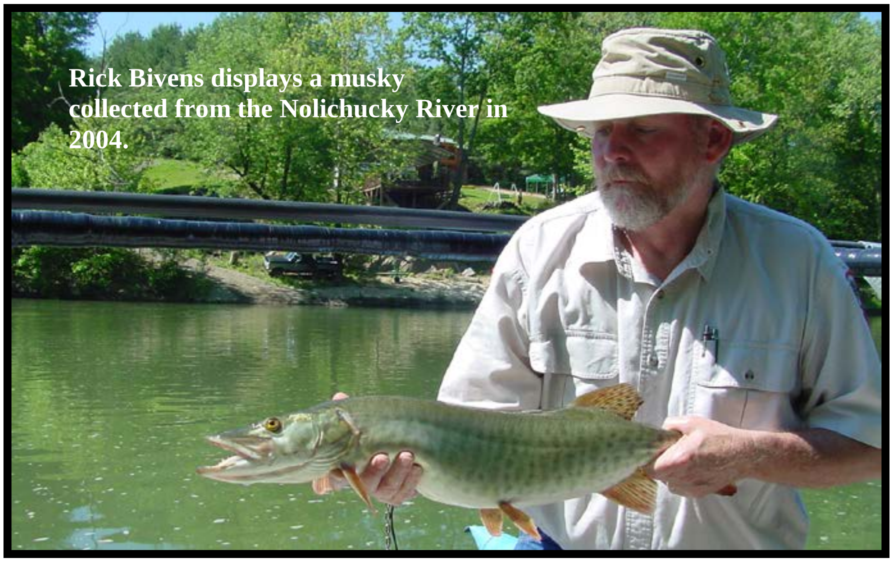


Because of our confidence in determining age and growth characteristics (based on previous samples) we did not collect any otolith samples from rock bass in 2007. Therefore, no mortality or potential population growth statistics could be calculated. Age and growth and mortality of rock bass in the Nolichucky River are assumed to be similar to those reported from our 1998 assessment (Carter et al. 1999).

Discussion

The Nolichucky River provides anglers with the opportunity to catch all species of black bass, rock bass, muskellunge, channel catfish, and flathead catfish. During the winter months the upper reaches of the Nolichucky are stocked with rainbow trout from the U.S. Fish and Wildlife Service hatchery in Erwin. This provides additional recreational opportunities for winter anglers frequenting the river. In recent years, the river has seen an increase in use, with the establishment of several rafting companies and the increased recognition of the river's sport fishery.

The occurrence of musky in the river warrants continued stocking when fish become available. Based on our observations and information from anglers the stocking program has met with some success and there have been rumors of reproduction in the river although these claims have not been verified. We did not collect any musky during the 2007 surveys.


Rick Bivens displays a musky collected from the Nolichucky River in 2004.

Surveys on the Nolichucky River will be conducted on a three-year rotation in order to assess any changes in the fishery. Our return trip in 2010, will in all likelihood repeat the surveys conducted in 2007.

Management Recommendations

1. Develop a fishery management plan for the river.

2. Continue to stock musky 203 to 254 mm at a rate of 27-40/mile (when available).

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, catfish, and redbreast sunfish (TDEC 1996). In 2003, all consumption advisories were removed from the river. Since 1988, inter-agency Index of Biotic Integrity samples have been conducted at two localities near river mile 8.2 (Tannery Island) and river mile 16.6 (Denton).

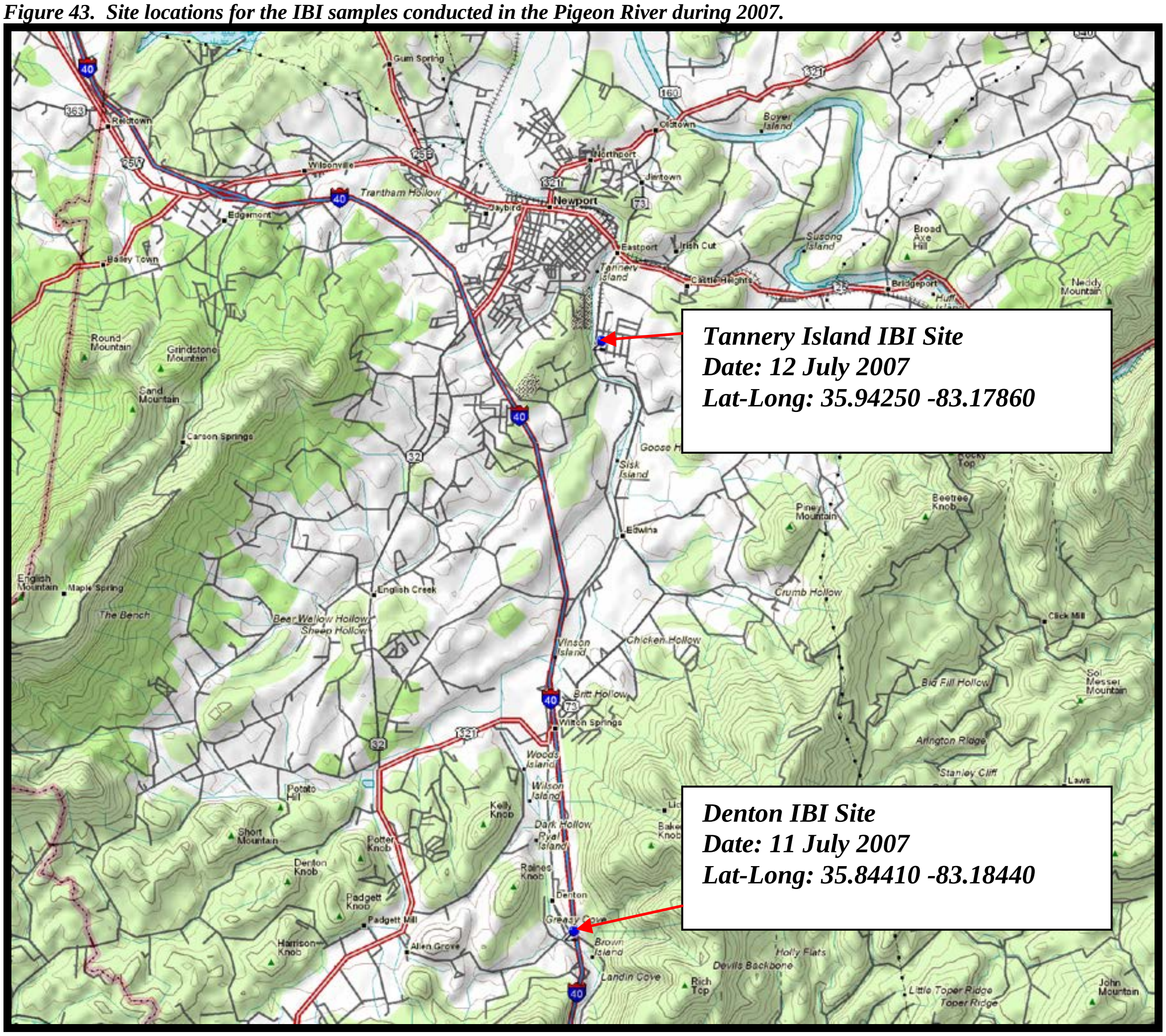
Our 2007 surveys focused on continuing to evaluate the fish community at two long-term IBI stations. Catch effort data along with otolith samples from rock bass and black bass were collected from three sites in 1997 (Bivens et al. 1998) and five sites in 1998 (Carter et al. 1999). Since 1999, data has been collected at five to six sites between river mile 4.0 and 20.5 (Carter et al. 2000-2007). 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 crossings and small "pull-outs" along roads paralleling the river. There are a few primitive launching areas for canoes or small boats and one moderately developed launch at Denton. On July 11 and 12, 2007, we conducted two IBI fish surveys at Tannery Island (PRM 8.1) and Denton (PRM 16.6) (Figure 43).

A view of the Pigeon River near river mile 19 (minimum flow)

Figure 43. Site locations for the IBI samples conducted in the Pigeon River during 2007.



Fish were collected according to the IBI criteria described in the methods section of this report. Both backpack and boat electrofishing were used to collect samples from both stations. Qualitative benthic macroinvertebrates were collected at both stations and analyzed to produce a biotic index score similar to those derived for the fish IBI.

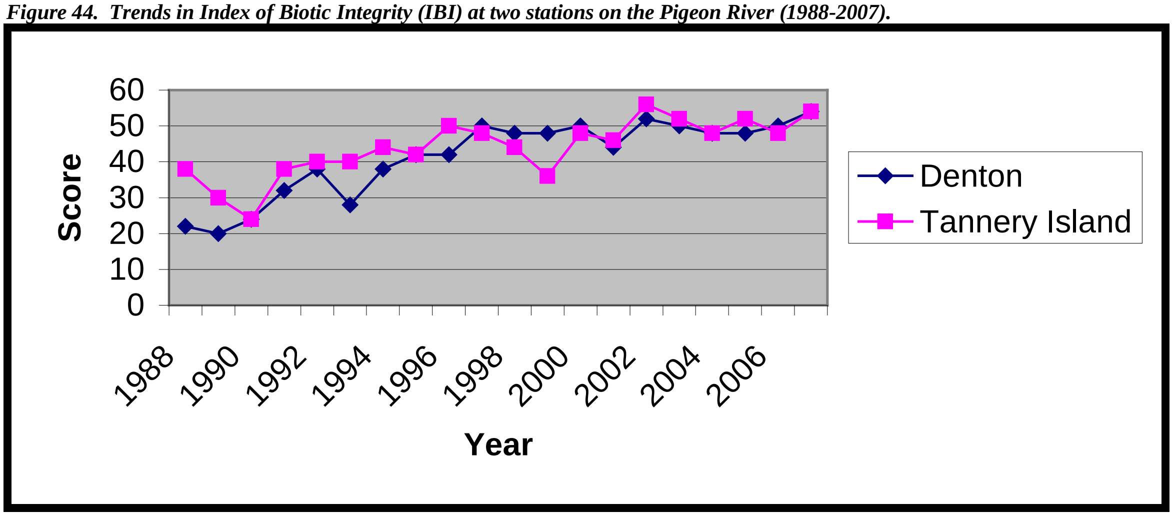
Results

Collaborative community assessments of Pigeon River have been ongoing since the late 1980's. These surveys have primarily focused on evaluating relative health changes in the fish community. Two Index of Biotic Integrity surveys were conducted at Tannery Island and Denton. A total of 39 fish species were collected at the Tannery Island site while 29 were observed at Denton (Table 13). Overall, The IBI analysis indicated the fish community was in good condition at Tannery Island (IBI score 54). The condition of the fish community assessed the same (IBI score 54) at the upper most station, Denton. Both scores were higher when compared to the previous year's analysis. The score at Tannery Island increased six points over the 2006 score while the score at Denton increased four points (Figure 44).

Table 13. Fish species collected at the two Pigeon River IBI stations during 2007.

Pigeon River Mile	8.1	Number Collected	16.6	Number Collected
	420071201		420071203	
	Ambloplites rupestris	17	*Ambloplites rupestris*	45
	Ameiurus natalis	1	*Aplodinotus grunniens*	1
	Aplodinotus grunniens	1	*Campostoma oligolepis*	116
	Campostoma oligolepis	85	*Cottus carolinae*	119
	Carpiodes cyprinus	1	*Cyprinella galactura*	161
	Cyprinella galactura	86	*Dorosoma cepedianum*	76
	Cyprinella spiloptera	13	*Etheostoma blennioides*	27
	Cyprinus carpio	5	*Etheostoma camurum*	1
	Dorosoma cepedianum	96	*Etheostoma rufilineatum*	320
	Etheostoma blennioides	418	*Etheostoma tennesseense*	9
	Etheostoma kennicotti	3	*Hybrid Lepomis spp.*	3
	Etheostoma rufilineatum	542	*Hybopsis amblops*	76
	Etheostoma tennesseense	130	*Hypentelium nigricans*	9
	Etheostoma zonale	12	*Ichthyomyzon bdellium*	2
	Gambusia affinis	1	*Ictalurus punctatus*	8
	Hybopsis amblops	3	*Lepomis auritus*	1
	Hypentelium nigricans	76	*Lepomis cyanellus*	4
	Ichthyomyzon bdellium	3	*Lepomis macrochirus*	45
	Ichthyomyzon greeleyi	13	*Micropterus dolomieu*	1
	Ictiobus bubalus	3	*Micropterus punctulatus*	3
	Ictiobus niger	1	*Moxostoma carinatum*	23
	Lepomis auritus	14	*Moxostoma duquesneii*	1
	Lepomis cyanellus	6	*Moxostoma breviceps*	5
	Lepomis macrochirus	10	*Notropis photogenis*	98
	Micropterus dolomieu	12	*Notropis telescopus*	1
	Micropterus salmoides	3	*Oncorhynchus mykiss*	6
	Moxostoma anisurum	3	*Percina caprodes*	3
	Moxostoma carinatum	2	*Percina evides*	2
	Moxostoma duquesneii	29	*Sander vitreum*	
	Moxostoma erythrurum	10		
	Moxostoma breviceps	2		
	Notropis photogenis	34		
	Notropis micropteryx	10		
	Notropis telescopus	39		
	Percina caprodes	20		
	Percina evides	19		
	Percina shumardi	1		
	Sander canadense	1		
	Sander vitreum	2		

Figure 44. Trends in Index of Biotic Integrity (IBI) at two stations on the Pigeon River (1988-2007).



Benthic macroinvertebrates collected at the Tannery Island site comprised 33 families representing 39 identified genera (Table 14). The most abundant group in our collection was the caddisflies comprising 31% of the total sample. Overall, a total of 51 taxa were identified from the sample of which 15 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/good-good" (3.7).

Table 14 . Taxa list and associated biotic statistics for benthic macroinvertebrates collected from the Pigeon River at Tannery Island (river mile 8.1).

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
AMPHIPODA				1.9
	Crangonyctidae		5	
ANNELIDA				3.1
	Hirudinea		1	
	Oligochaeta		7	
COLEOPTERA				11.1
	Dryopidae	*Helichus*	1	
	Elmidae	*Ancyronyx variegatus* larva	1	
		Dubiraphia vittata adults	2	
		Macronychus glabratus adults	8	
		Microcylloepus pusillus adults	5	
		Optioservus larva	1	
		Promoresia elegans larvae & adults	6	
		Stenelmis adult	1	
	Gyrinidae	*Dineutus discolor* male & females	3	
		Dineutus larva	1	
DIPTERA				7.3
	Chironomidae		8	
	Simuliidae		7	
	Tipulidae	*Tipula*	4	
EPHEMEROPTERA				11.1
	Baetidae	*Acentrella*	3	
		Baetis	9	
	Caenidae	*Caenis*	2	
	Ephemerellidae	*Serratella*	2	
	Heptageniidae	*Maccaffertium mediopunctatum*	10	
		Maccaffertium pudicum	2	
	Isonychiidae	*Isonychia*	1	
GASTROPODA				6.1
	Ancylidae	*Ferrissia*	1	
	Physidae		6	
	Planorbidae		1	
	Pleuroceridae	*Pleurocera* (pale olive form)	6	
		Pleurocera (yellow striped form)	2	
HETEROPTERA				1.1
	Veliidae	*Rhagovelia obesa* ♂, ♀, & nymph	3	
HYDRACARINA			1	0.4
ISOPODA				5.3
	Asellidae	*Caecidotea*	14	
MEGALOPTERA				3.1
	Corydalidae	*Corydalus cornutus*	7	
	Sialidae	*Sialis*	1	
ODONATA				17.2
	Aeshnidae	*Boyeria vinosa*	6	
	Calopterygidae	*Calopteryx dimidiata*	4	
		Hetaerina americana	5	
	Coenagrionidae	*Argia*	14	
		Enalagma signatum	1	
		Enalagma sp.	4	
	Gomphidae	*Hagenius brevistylus*	2	
		Hylogomphus brevis	2	
	Macromiidae	*Macromia georgina*	2	
		Macromia sp.	5	
PELECYPODA				1.1
	Corbiculidae	*Corbicula fluminea*	3	
TRICHOPTERA				31.3
	Brachycentridae	*Brachycentrus lateralis*	12	
	Hydropsychidae	*Ceratopsyche morosa*	26	
		Cheumatopsyche	21	
		Hydropsyche venularis	5	
		Unidentified pupa	1	
	Lepidostomatidae	*Lepidostoma*	3	
	Leptoceridae	*Oecetis avara*	1	
		Triaenodes ignitus	9	
	Polycentropodidae	*Neureclipsis*	4	
		Total	**262**	

TAXA RICHNESS = 51
EPT TAXA RICHNESS = 15
BIOCLASSIFICATION = 3.7 (FAIR/GOOD-GOOD)

Benthic macroinvertebrates collected at the Denton site comprised 32 families representing 33 identified genera (Table 15). The most abundant group in our collection was the mayflies comprising 35.3% of the total sample. Overall, a total of 45 taxa were identified from the sample of which 20 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/good" (3.5).

Table 15. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from the Pigeon River at Denton (river mile 16.6).

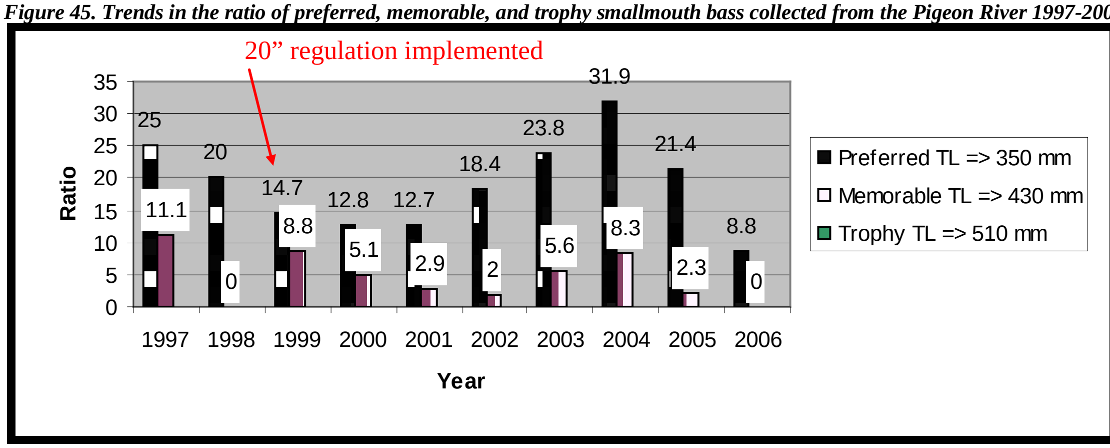
ORDER	FAMILY	SPECIES	NUMBER	PERCENT
AMPHIPODA				1.0
	Crangonyctidae		4	
ANNELIDA				1.6
	Hirudinea		1	
	Oligochaeta		5	
COLEOPTERA				8.6
	Dryopidae	*Helichus* adults	9	
	Elmidae	*Macronychus glabratus* larvae and adults	9	
		Microcylloepus pusillus	2	
		Optioservus ovalis adult	1	
		Promoresia elegans adults	3	
	Gyrinidae	*Dineutus discolor*	2	
		Dineutus larvae	6	
	Psephenidae	*Psephenus herricki*	1	
DIPTERA				10.5
	Athericidae	*Atherix lantha*	1	
	Chironomidae		34	
	Empididae		1	
	Simuliidae		3	
	Tipulidae	*Tipula*	1	
EPHEMEROPTERA				35.3
	Baetidae	*Baetis*	28	
	Caenidae	*Caenis*	4	
	Ephemerellidae	*Serratella deficiens*	18	
		Serratella sp. (maxillary palp present)	1	
	Ephemeridae	*Hexagenia*	1	
	Heptageniidae	*Maccaffertium* early instars	15	
		Maccaffertium ithaca	32	
		Maccaffertium mediopunctatum	8	
		Stenacron early instar	1	
	Isonychiidae	*Isonychia*	27	
GASTROPODA				0.5
	Physidae		2	
HETEROPTERA				0.3
	Veliidae	*Rhagovelia obesa* nymph	1	
ISOPODA				2.6
	Asellidae	*Caecidotea*	10	
MEGALOPTERA				5.2
	Corydalidae	*Corydalus cornutus*	14	
		Nigronia serricornis	6	
ODONATA				1.3
	Aeshnidae	*Boyeria vinosa*	1	
	Gomphidae	*Hagenius brevistylus*	3	
	Macromiidae	*Macromia*	1	
PELECYPODA				1.3
	Corbiculidae	*Corbicula fluminea*	5	
PLECOPTERA				1.3
	Perlidae	*Acroneuria abnormis*	4	
		Paragnetina media	1	
TRICHOPTERA				30.1
	Brachycentridae	*Brachycentrus lateralis*	49	
		Brachycentrus numerosus	4	
	Hydropsychidae	*Ceratopsyche morosa*	33	
		Ceratopsyche sparna	5	
		Cheumatopsyche	8	
		Hydropsyche franclemonti	9	
	Hydroptilidae	*Hydroptila*	2	
	Lepidostomatidae	*Lepidostoma* larvae and pupa	3	
	Polycentropodidae	*Neureclipsis crepuscularis*	2	
TURBELLARIA			1	0.3
		Total	**382**	

TAXA RICHNESS = 45
EPT TAXA RICHNESS = 20
BIOCLASSIFICATION = 3.5 (FAIR-GOOD)

Discussion

The Pigeon River provides anglers with the opportunity to catch all species of black bass as well as 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 18.9% between 1997-2006) and that these fish are growing slightly slower than the statewide average (Carter et al. 1999), there would appear to be good potential for trophy management of the smallmouth bass population in this river. During 2006, we recorded the lowest percentage of preferred smallmouth bass to date (Figure 45). Overall, the value decreased 59% from the previous year and was 53% lower than the ten year average. There was no memorable size bass collected in 2006, which only occurred in one other instance (1998) during the ten year time period.

Figure 45. Trends in the ratio of preferred, memorable, and trophy smallmouth bass collected from the Pigeon River 1997-2006.



Water quality improvement over the last 20 years has primarily been the result of more advanced wastewater treatment at the Blue Ridge 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. silver shiner, telescope shiner) previously not encountered in the annual surveys and the implementation of a fish and mollusk recovery effort. During 2006, there were at least two instances of pesticides entering the river. During these events, both benthic invertebrates and fish were killed. Investigations by TWRA and TDEC resulted in identifying the areas of agricultural runoff into the river. A remediation plan to control the runoff of agricultural pesticides is being developed by TDEC and TWRA.

We will monitor black bass and rock bass populations in the Pigeon River during late September or October in order to increase our efficiency in characterizing the smallmouth bass populations in the river. We will continue to monitor the Pigeon River; however, it will occur on a less frequent schedule. The next scheduled sample for black bass and rock bass will be in 2009. IBI samples will continue on an annual basis.

Management Recommendations

1. Continue monitoring the sport fish population every three years.

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

3. Develop a management plan for the river.

4. Continue cooperative efforts to reintroduce common species.

5. Closely monitor black fly control program being conducted by the University of Tennessee.

6. Consider developing a put and take or delayed harvest trout stocking program in the upper reach of the river (mile 16 and above).

New River

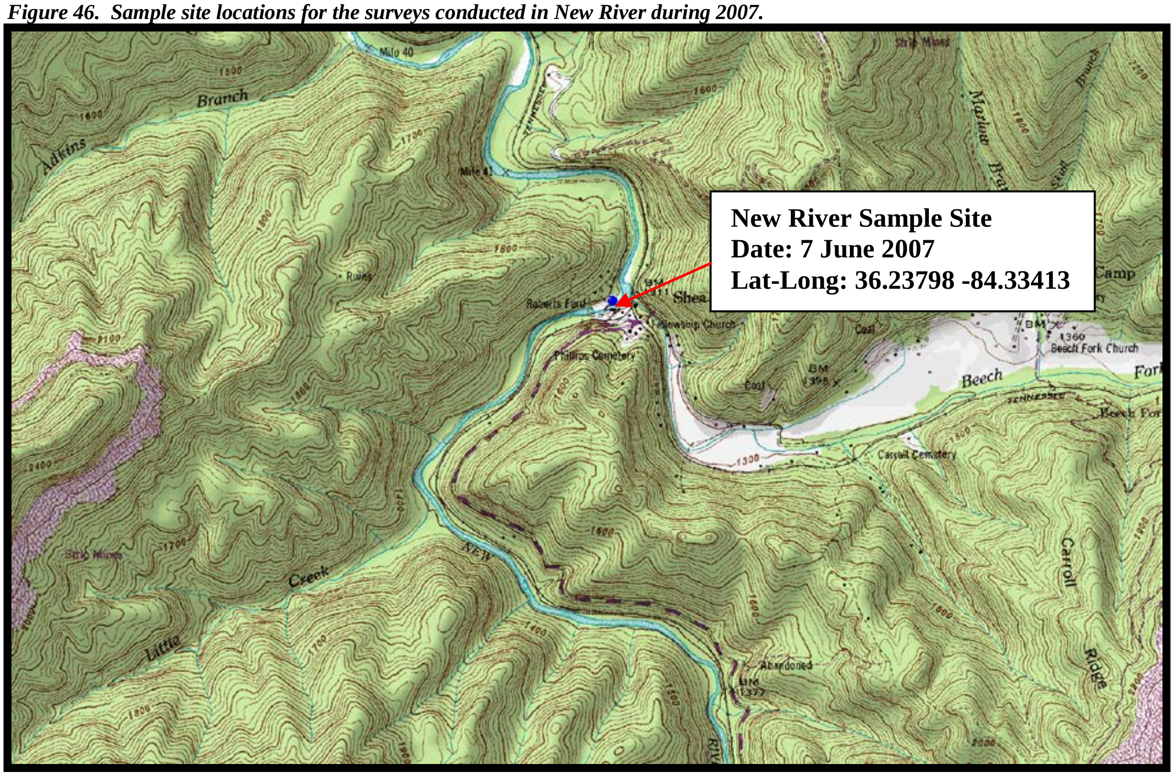
Introduction

The New River drainage has had a long history of ecological abuse. The most prominent influence on overall watershed and water quality has been the continued development of the coal mining industry in the region since the turn of the century. With the shift to surface mining in recent history the influence on water quality has shifted from acidic pulses from deep mines (prevalent in the early 1900's) to siltation from surface mining operations. The most recent investigations in the watershed were by Evans (1998), who completed extensive surveys within the watershed and developed specific assessment criteria for fish assemblages. It was summarized from these investigations that some recovery has taken place in the watershed and many streams support fairly diverse communities of fish. The Agency has conducted surveys within the watershed in a limited number of streams (Bivens and Williams 1990; Carter et al. 2003; Carter et al. 2005). With the resurgence of coal mining in the last few years, the watershed stands to receive another inoculation of degraded water quality if activities are not stringently monitored. Our efforts in the New River during 2007 were limited, and primarily focused on gathering information on the sport species.

Study Area and Methods

The New River encompasses a drainage area of 989 km^2 and courses some 55 miles through Scott, Campbell, and Anderson counties before joining the Clear Fork River (Evans 1998). The convergence of the New River and Clear Fork form the headwaters of the Big South Fork of the Cumberland River. Access to the river is mostly through private holdings, however, the Big South Fork National Recreation Area bounds the lower reach of the river. Our survey of the New River was a follow up monitoring of the sport species at our sample site established in 2004. The sample site is located at Robert Ford near the confluence with Beech Fork (Figure 46). At our sampling station we used boat electrofishing to effectively sample shallow and deep habitats within the area. Fish were collected in accordance with the standard large river sampling protocols (TWRA 1998). Fixed-boom electrodes were used to transfer 4-5 amps DC. This current setting was determined effective in narcotizing all target species. Catch-per-unit-effort (CPUE) values were calculated for each target sport species. Length categorization indices were calculated for target sport species following Gabelhouse (1984).

Figure 46. Sample site locations for the surveys conducted in New River during 2007.

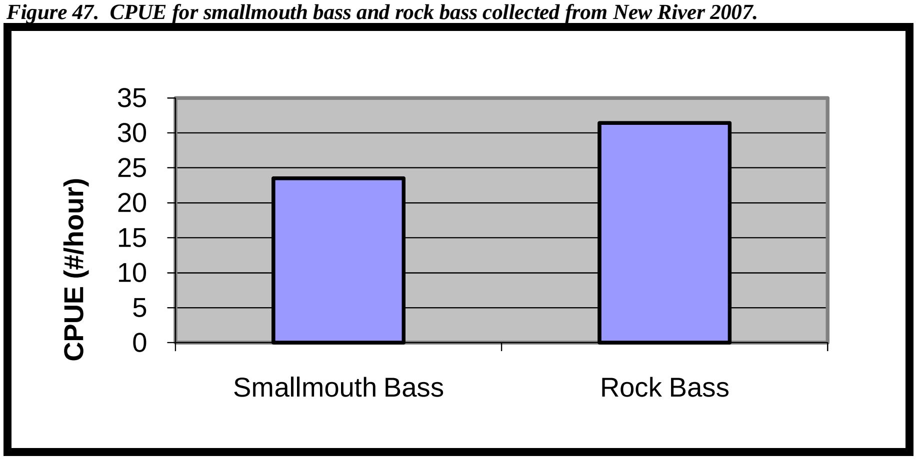


At our sample location gravel and rubble were the dominant substrate components, although bedrock was fairly common in the pool habitat. Coal fines were prevalent at the site, which was not unexpected. Temperature at the site was 22 C and the water clarity was good (secchi disk reading of 1.3).

Results

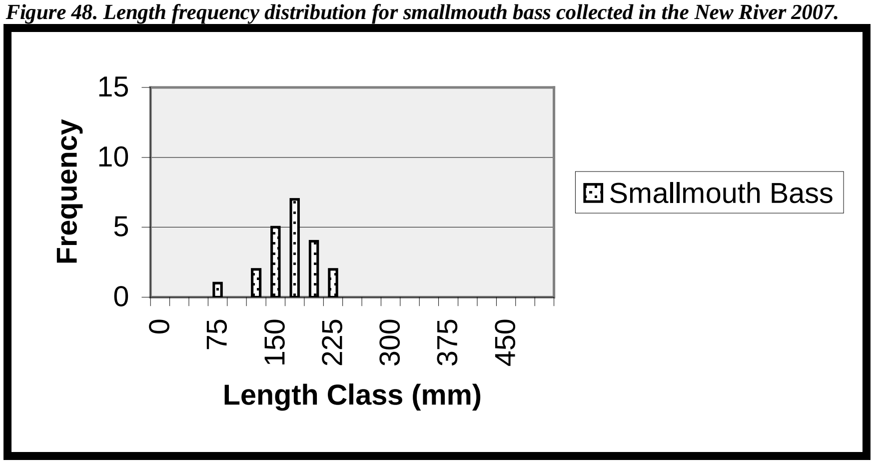
Of the game species collected, rock bass and smallmouth bass were the dominant species. We also collected longear sunfish and one walleye. The walleye was 676 mm (26.6 inches) in length and weighed 2892 grams (6.3 pounds). A fin clip was taken from this fish for genetic analysis. A total of 28 rock bass and 21 smallmouth bass were collected from the survey site. The catch rate for smallmouth bass and rock bass was 23.5 and 31.4, respectively (Figure 47).

Figure 47. CPUE for smallmouth bass and rock bass collected from New River 2007.



The majority of smallmouth bass collected during 2007 fell within the 150 mm to 225 mm length range (Figure 48). Because of the limited access at our site we felt the number we collected was good given the available habitat in the river. The size structure is fairly typical for a river this size although we do suspect that bass larger than those captured inhabit the river.

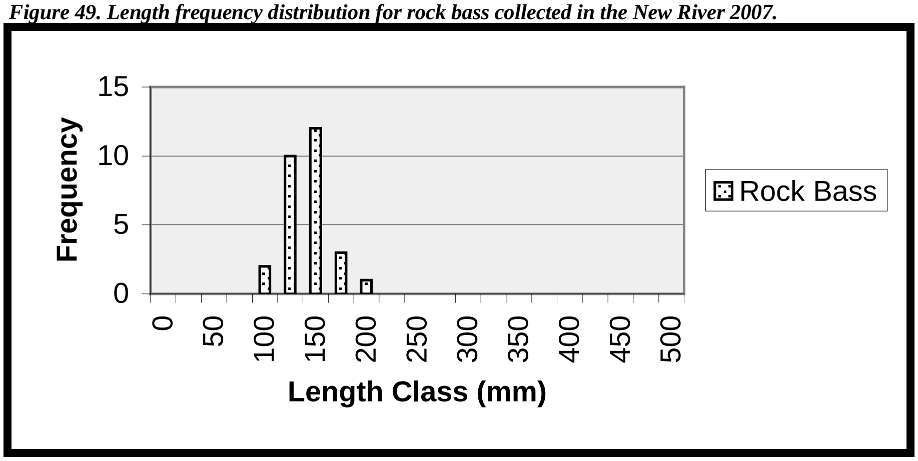
Figure 48. Length frequency distribution for smallmouth bass collected in the New River 2007.



Length categorization analysis indicated the relative stock density (RSD) for smallmouth bass was 0 in all categories. PSD could not be calculated because there were no quality size (≥ 280 mm) bass collected in the sample. The catch rates for sub-stock and stock size bass were 20.5 and 33.3.

Rock bass collected from the New River fell within the 125 mm to 175 mm length range (Figure 49). As with smallmouth bass we had a limited amount of suitable habitat to sample, so we feel that the number we collected was good, given our sampling situation.

Figure 49. Length frequency distribution for rock bass collected in the New River 2007.



Length categorization analysis indicated the relative stock density (RSD) for rock bass was 0 in all categories. PSD for rock bass was 14.3. Given that rock bass are more sensitive to habitat alterations it was encouraging to see the number that we did, given the land use history within the watershed.

Discussion

The New River watershed has been subjected to an array of natural resource extraction activities dating back to the early 1900's. Most of these activities have had some deleterious effect on watershed quality and ultimately led to the near sterilization of many tributary streams within the watershed. With the passing of legislation regarding water quality protection, the New River has gradually improved through the years and managers are now observing water quality conditions that have not been seen in this watershed in the past 100 years. The Agency has made efforts to enhance some sport species in the New River, particularly smallmouth bass and musky. Even though the river has recovered somewhat, there is much needed improvement to be accomplished within the watershed. Old mining sites still negatively influence water quality, and with resurgence in the coal mining industry the watershed could once again be under the influence of this activity if close monitoring is not undertaken. The Cumberland Mountain region offers many natural features and settings that can be found nowhere else in the state, and the New River that drains a large portion of the region is one of these.

Management Recommendations

1. Periodically monitor the river to determine relative health changes and sport fish abundance.

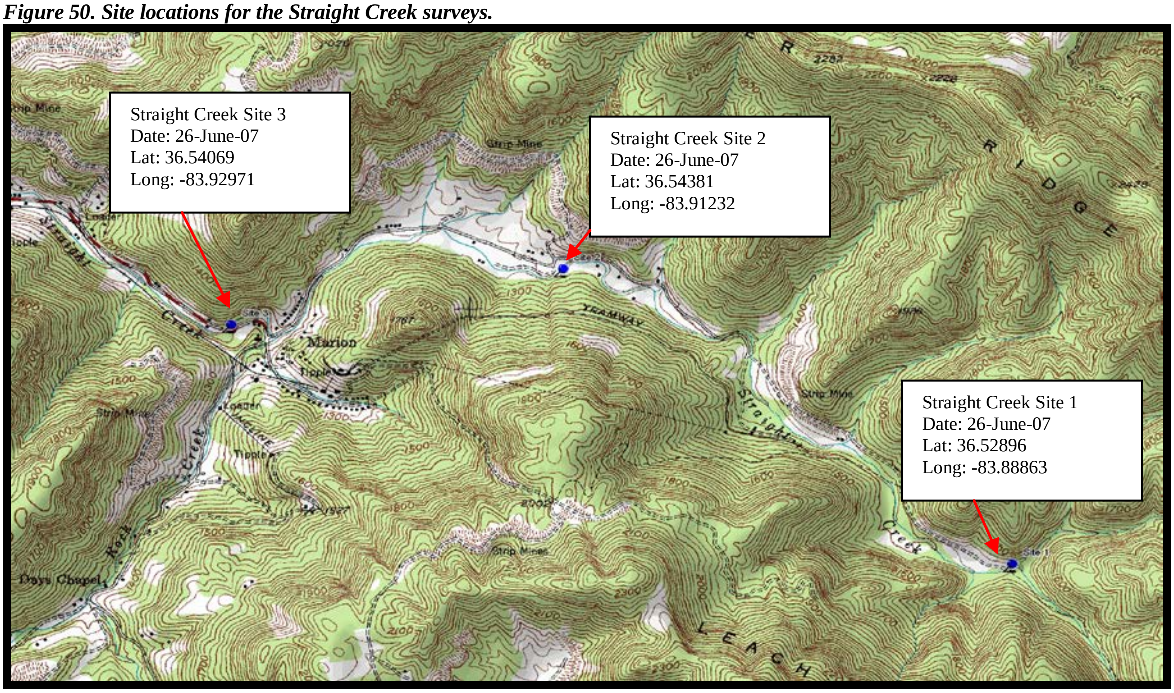
2. Ensure that future coal extraction is carefully monitored.

3. Consider winter rainbow trout stocking.

Straight Creek

In 2006 we were contacted by the USFWS Cookeville Office to assist with conducting qualitative surveys of Straight Creek to document the possible occurrence of blackside dace. On June 26, 2007, we conducted three surveys from the headwaters of Straight Creek downstream to an area just below the Rock Creek confluence (Figure 50). We collected basic water quality data in conjunction with the fish surveys. Because of the historical and ongoing coal mining in the watershed, we did observe elevated conductivities at our three sample stations (range 910-950). This made electrofishing difficult, so we incorporated some seine samples into the surveys in order to increase our effectiveness.

Figure 50. Site locations for the Straight Creek surveys.



Creek chub was the only species of fish collected at the uppermost site (site 1). At site 2 we did collect three additional species (western blacknose dace, fathead minnow, and white sucker). Central stoneroller was the only other additional species we observed and it was collected at site 3 (Table 16). The only record for blackside dace from Straight Creek was collected by Chris O'Bara in 1985 about ¼ mile upstream from the mouth (O'Bara 1985). Given the amount of coal extraction and logging within the watershed since this finding, it is probable that blackside dace were eliminated from the stream. Our surveys did not extend downstream to the historical collection locality but focused on areas typical of habitat currently inhabited by blackside dace in other streams. Future surveys of the stream will include the lower reaches of the stream to update the findings of O'Bara 1895.

Table 16. Species occurrence for the Straight Creek surveys.

Straight Creek Site 1	Straight Creek Site 2	Straight Creek Site 3
Semotilus atromacualtus	*Catostomus commersonii* *Pimephales notatus* *Rhinichthys obtusus* *Semotilus atromacualtus*	*Campostoma anomalum* *Rhinichthys obtusus* *Semotilus atromacualtus*

Summary

During 2007, we surveyed seven rivers collecting 44 fish samples and four benthic samples. We also collected CPUE data on black bass and rock bass from five rivers. These included the Holston River, North Fork Holston River, French Broad River, Nolichucky River, and New River. Index of Biotic Integrity surveys were cooperative conducted in Little River and the Pigeon River. Overall, CPUE estimates for black bass and rock bass looked relatively good despite the ongoing drought. We did observe some substantial increases in smallmouth bass catches in some of the rivers surveyed, particularly the lower French Broad and the North Fork Holston.

The IBI surveys for Little River and the Pigeon River remained relatively stable when compared to the previous year, although we did observe an increase in the score at the scores at both sites on the Pigeon River. Benthic macroinvertebrate scores appeared to be depressed both in Little River and the Pigeon River most likely associated with the drought conditions experienced during 2007. Fish reintroductions continued on the Pigeon River with many of the introduced species collected in the 2007 IBI samples. The identification and evaluation of the fish kills above Tannery Island prompted more regulatory action for 2007 by TDEC and TWRA.

Over the past 14 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 17 lists our results for various streams surveyed during this time period.

Table 17. Index of Biotic Integrity and Benthic Biotic Index scores for samples conducted between 1994 and 2007.

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)

Table 17. Continued.

Water	Watershed	Year Surveyed	County	IBI Score	Benthic BI Score
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
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) (SC)	4 (Good)
Little Sycamore Creek	Clinch River	1995	Claiborne	40 (Fair)	4.5 (Good/Excel).
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)
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/Excel.)
Canoe Branch	Powell River	1997	Claiborne	26 (V Poor/Poor) (SC)	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 -Good)
Fourmile Creek	Powell River	1998	Hancock	36 (Poor/Fair)	4.5 (Good/Excel.)
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)
Gulf Fork Big Creek	French Broad River	2001	Cocke	42 (Fair)	4.0 (Good)
Nolichucky River	French Broad River	2001	Unicoi	56 (Good/Excellent)	4.0 (Good)
North Fork Holston River	Holston River	2001	Hawkins	50 (Good)	4.5 (Good)
Stinking Creek	Cumberland River	2002	Campbell	42 (Fair)	4.5 (Good)
Straight Fork	Cumberland River	2002	Campbell	18 (Very Poor)	3.0 (Fair/Good)
Montgomery Fork	Cumberland River	2002	Campbell	48 (Good)	3.5 (Fair/Good)
Turkey Creek	Holston River	2003	Hamblen	34 (Poor)	1.5 (Poor)
Spring Creek	Holston River	2003	Hamblen	34 (Poor)	2.2 (Fair)
Cedar Creek	Holston River	2003	Hamblen	30 (Poor)	3.5 (Fair/Good)
Fall Creek	Holston River	2003	Hamblen	32 (Poor)	2.3 (Fair)
Holley Creek	Nolichucky River	2003	Greene	30 (Poor)	2.4 (Fair)
College Creek	Nolichucky River	2003	Greene	36 (Poor/Fair)	2.2 (Fair)

Table 17. Continued.

Water	Watershed	Year Surveyed	County	IBI Score	Benthic BI Score
Kendrick Creek	South Fork Holston River	2004	Sullivan	34 (Poor)	3.8 (Fair/Good-Good)
Sinking Creek	South Fork Holston River	2004	Sullivan	32 (Poor)	3.8 (Fair/Good-Good)
Mud Creek	Nolichucky River	2004	Greene	46 (Fair/Good)	4.0 (Good)
New River (Site 1)	Big South Fork Cumberland River	2004	Anderson	30 (Poor)	4.2 (Good)
New River (Site 2)	Big South Fork Cumberland River	2004	Campbell	42 (Fair)	3.5 (Fair/Good)
Indian Fork	Big South Fork Cumberland River	2004	Anderson	41 (Fair)	3.8 (Fair/Good-Good)
Unnamed Tributary to Taylor Branch	Hiwassee River	2005	Bradley	48 (Good)	4.0 (Good)
Little River (Coulters Bridge)	Tennessee River	2005	Blount	54 (Good/Excellent)	-
Little River (Townsend)	Tennessee River	2005	Blount	48 (Good)	-
Williams Creek	Clinch River	2005	Grainger	42 (Fair)	4.3 (Good)
Beaver Creek (Site 1)	Holston River	2005	Jefferson	38 (Poor/Fair)	2.8 (Fair/Fair-Good)
Beaver Creek (Site 2)	Holston River	2005	Jefferson	30 (Poor)	3.2 (Fair/Good)
Doe Creek	Holston River	2005	Johnson	46 (Fair/Good)	4.0 (Good)
Gap Creek	Nolichucky River	2005	Greene	36 (Poor/Fair)	3.5 (Fair/Good)
Pigeon River (Tannery Island)	French Broad River	2005	Cocke	52 (Good)	2.8 (Fair/Fair-Good)
Pigeon River (Denton)	French Broad River	2005	Cocke	48 (Good)	3.8 (Fair-Good/Good)
Little River (Coulters Bridge)	Tennessee River	2006	Blount	58 (Excellent)	4.2 (Good)
Little River (Townsend)	Tennessee River	2006	Blount	58 (Excellent)	4.7 (Good-Excellent)
Pigeon River (Tannery Island)	French Broad River	2006	Cocke	48 (Good)	3.5 (Fair-Good)
Pigeon River (Denton)	French Broad River	2006	Cocke	50 (Good)	3.8 (Fair-Good/Good)
Pigeon River (Hwy. 73 Bridge)	French Broad River	2006	Cocke	-	3.8 (Fair-Good/Good)
Little River (Coulters Bridge)	Tennessee River	2007	Blount	54 (Good)	3.8 (Fair-Good/Good)
Little River (Townsend)	Tennessee River	2007	Blount	56 (Good/Excellent)	4.0 (Good)
Pigeon River (Tannery Island)	French Broad River	2007	Cocke	54 (Good)	3.7 (Fair-Good/Good)
Pigeon River (Denton)	French Broad River	2007	Cocke	54 (Good)	3.5 (Fair/Good)

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APPENDIX A

Common and scientific names of fishes used in this report (Nelson et al. 2004)

Family	Common Name	Scientific Name
Acipenseridae	Lake sturgeon	*Acipenser fulvescens*
Catostomidae	Black buffalo	*Ictiobus niger*
	Black redhorse	*Moxostoma duquesneii*
	Blue sucker	*Cycleptus enlongatus*
	Golden redhorse	*Moxostoma erythrurum*
	Northern hog sucker	*Hypentelium nigricans*
	Quillback	*Carpiodes cyprinus*
	River redhorse	*Moxostoma carinatum*
	Silver redhorse	*Moxostoma anisurum*
	Smallmouth buffalo	*Ictiobus bubalus*
	Smallmouth redhorse	*Moxostoma breviceps*
	Spotted sucker	*Minytreram melanops*
	White sucker	*Catostomus commersonii*
Centrachidae	Bluegill	*Lepomis macrochirus*
	Green sunfish	*Lepomis cyanellus*
	Largemouth bass	*Micropterus salmoides*
	Redbreast sunfish	*Lepomis auritus*
	Rock bass	*Ambloplites rupestris*
	Smallmouth bass	*Micropterus dolomieu*
	Spotted bass	*Micropterus punctulatus*
Clupeidae	Gizzard shad	*Dorosoma cepedianum*
Cottidae	Banded sculpin	*Cottus carolinae*
Cyprinidae	Bigeye chub	*Hybopsis amblops*
	Blackside Dace	*Phoxinus cumberlandensis*
	Blotched chub	*Erimystax insignis*
	Bluntnose minnow	*Pimephales notatus*
	Carp	*Cyprinus carpio*
	Central stoneroller	*Campostoma anomalum*
	Creek chub	*Semotilus atromaculatus*
	Largescale stoneroller	*Campostoma oligolepis*
	Mimic shiner	*Notropis vollucelus*
	Mountain shiner	*Lythrurus lirus*
	River chub	*Nocomis micropogon*
	Highland shiner	*Notropis micropteryx*
	Silver shiner	*Notropis photogenis*
	Spotfin shiner	*Cyprinella spiloptera*
	Stargazing minnow	*Phenocobius uranops*
	Striped shiner	*Luxilus chrysocephalus*
	Telescope shiner	*Notropis telescopus*
	Tennessee shiner	*Notropis leuciodus*
	Warpaint shiner	*Luxilus coccogenis*
	Western blacknose dace	*Rhinichthys obtusus*
	Whitetail shiner	*Cyprinella galactura*

Fundulidae	Northern studfish	*Fundulus catenatus*
Ictaluridae	Channel catfish	*Ictalurus punctatus*
	Flathead catfish	*Pylodictus olivaris*
	Mountain madtom	*Noturus eleutherus*
	Yellow bullhead	*Ameiurus natalis*
Lepisosteidae	Longnose gar	*Lepisosteus osseus*
Moronidae	White Bass	*Morone chrysops*
Percidae	Tennessee darter	*Etheostoma tennessense*
	Banded darter	*Etheostoma zonale*
	Blotchside logperch	*Percina burtoni*
	Bluebreast darter	*Etheostoma camurum*
	Blueside darter	*Etheostoma jessiae*
	Gilt darter	*Percina evides*
	Greenside darter	*Etheostoma blenniodes*
	Logperch	*Percina caprodes*
	Longhead darter	*Percina macrocephala*
	Redline darter	*Etheostoma ruflineatum*
	River darter	*Percina shumardi*
	Sauger	*Sander canadense*
	Stripetail darter	*Etheostoma kennocotti*
	Tangerine darter	*Percina aurantiaca*
	Walleye	*Sander vitreum*
	Wounded darter	*Etheostoma vulneratum*
Petromyzontidae	American brook lamprey	*Lampetra appendix*
	Mountain brook lamprey	*Icthyomyzon greeleyi*
	Ohio lamprey	*Icthyomyzon bdellium*
Poeciliidae	Western mosquitofish	*Gambusia affinis*
Salmonidae	Rainbow trout	*Oncorhynchus mykiss*
Sciaenidae	Drum	*Aplodinotus grunniens*