FISHERIES REPORT

Warmwater Streams and Rivers

Tennessee Wildlife Resources Agency--Region IV

Report 13-02

2012

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REPORT NO. 13-02
WARMWATER STREAM FISHERIES REPORT
REGION IV
2012

Prepared by

Bart D. Carter
Rick D. Bivens
Carl E. Williams
and
James W. Habera

TENNESSEE WILDLIFE RESOURCES AGENCY

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Cover: Cumberland darter (*Etheostoma susanae*) collected from Capuchin Creek, Campbell County.

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). Streams in Region IV, except for a few in Anderson, Campbell, Claiborne, and Scott 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, Holston and Big South Fork Cumberland River.

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.

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. 04-12. Four rivers and 13 streams were sampled and are included in this report. Surveys were conducted from April to August 2012. A total of 43 (IBI, CPUE) fish and four benthic macroinvertebrate 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

A percentage of the fish data collected in this report was 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. 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. In larger rivers, a boat was used in conjunction with the backpack samples to effectively sample deep pool habitat. Timed (10-min duration) runs were used until all habitat types had been depleted.

Streams sampled for the Cumberland Habitat Conservation Plan (HCP) utilized two techniques for collecting fish data. Catch-per-unit-effort samples (CPUE) were calculated for all target species covered under the HCP. An additional population estimate was made for blackside dace following the model described by Black and Mattingly (2007). Site lengths for these streams were typically around 200 meters and were sampled by a one pass electrofishing run utilizing one backpack electrofishing unit.

Catch-per-unit-effort samples were conducted in two rivers during 2012. 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 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 2012 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 and at four other locations for a total of eight samples. 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 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 us to develop a more accurate biotic index for benthic macroinvertebrates for the Ridge and Valley and Blue Ridge Ecoregions of east Tennessee. The illustrations on the following page 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 us 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 in order to fully evaluate the new 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.)

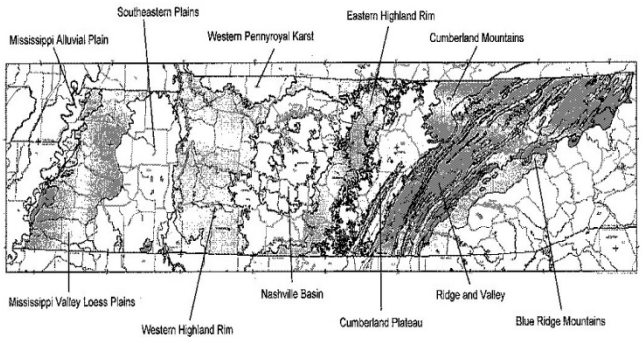
TOTAL ☐

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 LOW <0.01	GRADIENT MOD 0.01-0.05	GRADIENT HIGH >0.05	TEMPERATURE COLD <20°C	TEMPERATURE COOL <25°C	TEMPERATURE WARM >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 mid-western 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 for four large rivers sampled during 2012. 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. Catch per unit effort samples were also calculated for streams being monitored for the HCP. Additionally, a blackside dace (*Chrosomus cumberlandensis*) population estimate was generated for those streams where this species was present. Estimates were derived following the model described by Black and Mattingly (2007).

Benthic data collected for the 2012 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:

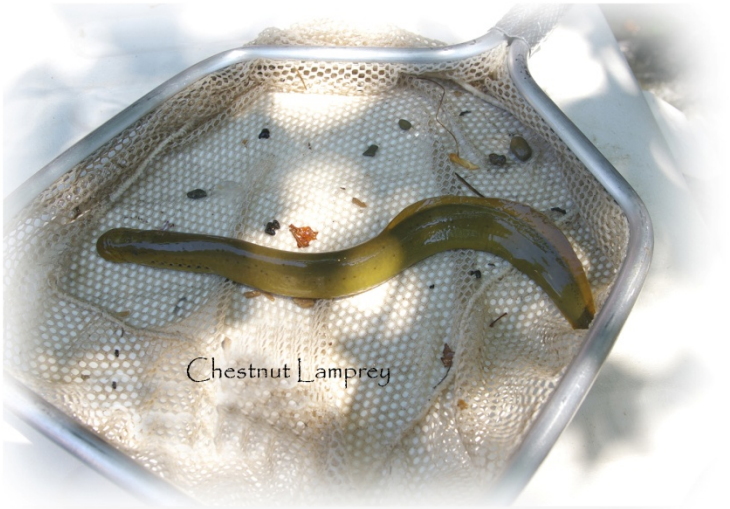
Score	Biotic Index Values	EPT Values
5 (Excellent)	< 5.14	> 33
4.6	5.14-5.18	32-33
4.4	5.19-5.23	30-31
4 (Good)	5.24-5.73	26-29
3.6	5.74-5.78	24-25
3.4	5.79-5.83	22-23
3	5.84-6.43	18-21
2.6	6.44-6.48	16-17
2.4	6.49-6.53	14-15
2	6.54-7.43	10-13
1.6	7.44-7.48	8-9
1.4	7.49-7.53	6-7
1 (Poor)	> 7.53	0-5

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 (2006) with minor modifications for taxa, which did not have assigned tolerance values.

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 river miles are impounded. Another 0.75 mile or so is impounded by Perrys Mill dam 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



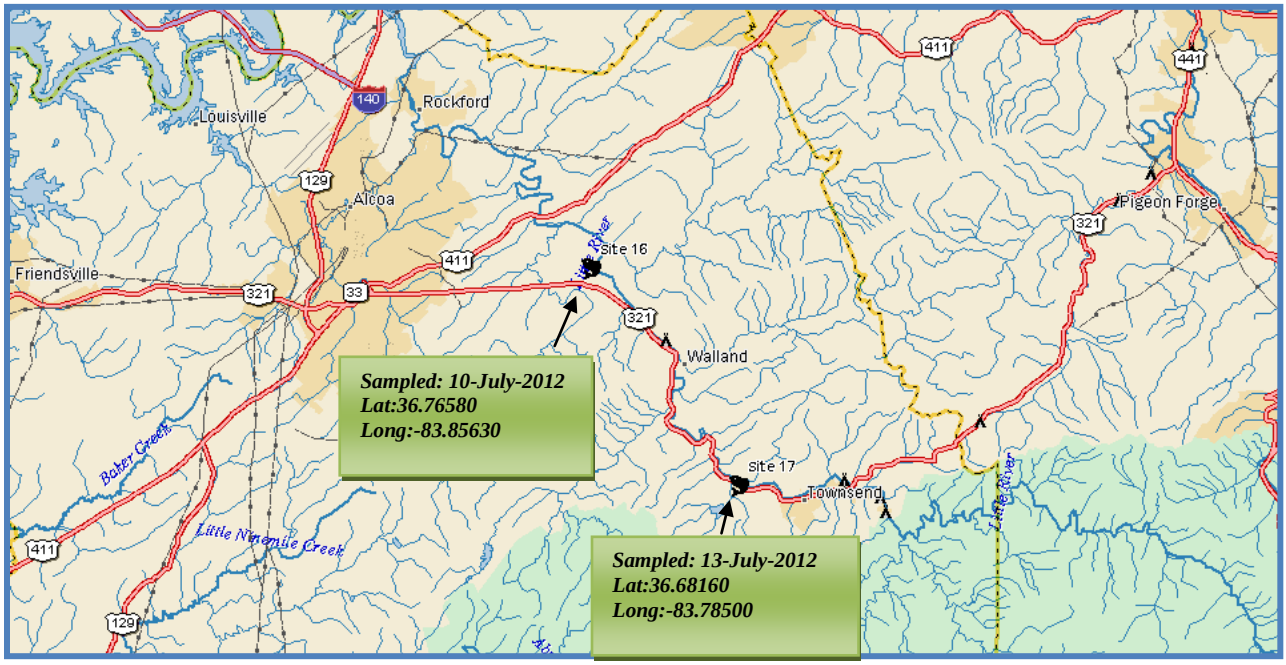
the boundary between Blount County and Knox County for the last few miles of its course.

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

Our 2012 survey of Little River consisted of two IBI sites (Coulters Bridge and Townsend). We cooperated with several agencies in conducting the two IBI 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 (Figure1).

Figure 1. Little River sample site locations 2012.



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).

Results

Collaborative community assessments of Little River have been ongoing since the 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 2012, one at Coulters Bridge (river mile 20) and one at Townsend (river mile 29.8). A total of 49 fish species were collected at the Coulters Bridge site while 32 were observed at Townsend. Overall, the IBI analysis indicated the fish community was in excellent condition at Coulters Bridge (IBI score 58). The analysis for the fish community at Townsend increased eight points to 58 when compared to the 2011 score (Figure 2). 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 1 lists the species and number of fish collected at the two IBI stations.

Figure 2. Trends in the Index of Biotic Integrity (IBI) at two stations in Little River (1987-2012).

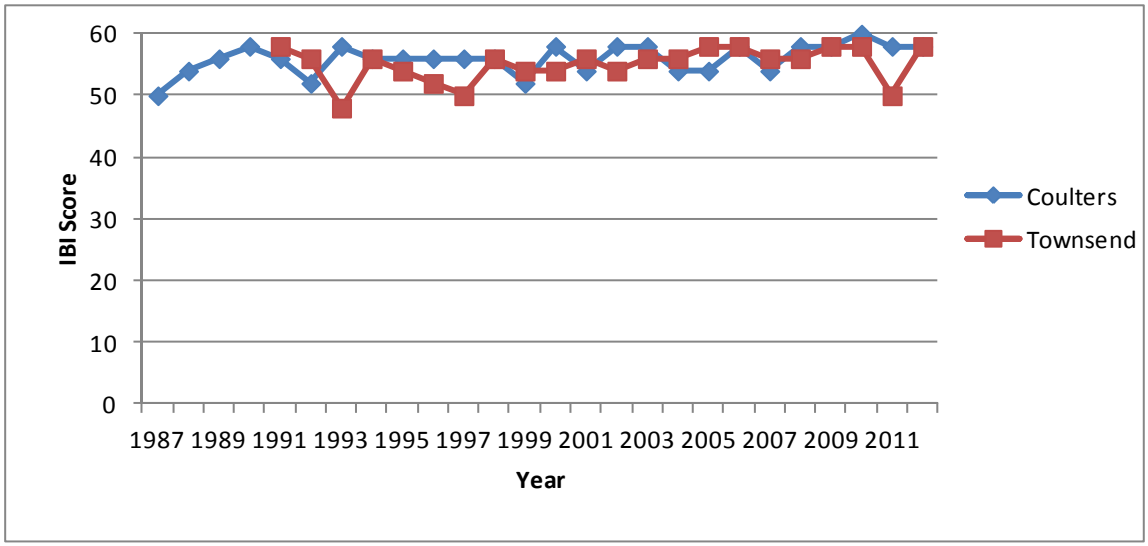


Table 1. Fish species collected at two Little River IBI stations 2012.

Site	Species	Number Collected
420123516	*Ambloplites rupestris*	59
420123516	*Ameiurus natalis*	1
420123516	*Aplodinotus grunniens*	3
420123516	*Campostoma oligolepis*	56
420123516	*Carpiodes cyprinus*	1
420123516	*Cottus carolinae*	21
420123516	*Cyprinella galactura*	59
420123516	*Cyprinella spiloptera*	7
420123516	*Cyprinus carpio*	7
420123516	*Dorosoma cepedianum*	13
420123516	*Erimystax insignis*	24
420123516	*Etheostoma blennioides*	40
420123516	*Etheostoma camurum*	2
420123516	*Etheostoma jessiae*	14
420123516	*Etheostoma rufilineatum*	336
420123516	*Etheostoma tennesseense*	23
420123516	*Etheostoma zonale*	53
420123516	*Fundulus catenatus*	10
420123516	*Hybopsis amblops*	25
420123516	*Hybrid lepomis spp.*	3
420123516	*Hypentelium nigricans*	25
420123516	*Ictalurus punctatus*	1
420123516	*Lampetra appendix*	1
420123516	*Lepisosteus osseus*	3
420123516	*Lepomis auritus*	106
420123516	*Lepomis cyanellus*	7
420123516	*Lepomis macrochirus*	12
420123516	*Lepomis microlophus*	5
420123516	*Luxilus chrysocephalus*	14
420123516	*Luxilus coccogenis*	23
420123516	*Lythrurus lirus*	54
420123516	*Micropterus dolomieu*	5
420123516	*Micropterus punctulatus*	1
420123516	*Micropterus salmoides*	3
420123516	*Moxostoma anisurum*	4
420123516	*Moxostoma carinatum*	12
420123516	*Moxostoma duquesneii*	65
420123516	*Moxostoma erythrurum*	42
420123516	*Nocomis micropogon*	9
420123516	*Notropis leuciodus*	83
420123516	*Notropis micropteryx*	111
420123516	*Notropis photogenis*	25
420123516	*Notropis telescopus*	25
420123516	*Notropis volucellus*	23
420123516	*Noturus eleutherus*	33
420123516	*Percina aurantiaca*	5
420123516	*Percina caprodes*	6
420123516	*Percina evides*	10
420123516	*Phenacobius uranops*	12
420123516	*Pylodictis olivaris*	1
420123517	*Ambloplites rupestris*	34
420123517	*Campostoma oligolepis*	42

Table 1. Continued.

Site	Species	Number Collected
420123517	*Cottus carolinae*	57
420123517	*Cyprinella galactura*	99
420123517	*Erimystax insignis*	5
420123517	*Etheostoma blennioides*	11
420123517	*Etheostoma rufilineatum*	203
420123517	*Etheostoma tennesseense*	24
420123517	*Etheostoma zonale*	8
420123517	*Fundulus catenatus*	5
420123517	*Hybopsis amblops*	8
420123517	*Hypentelium nigricans*	25
420123517	*Lampetra appendix*	8
420123517	*Lepomis auritus*	18
420123517	*Lepomis cyanellus*	1
420123517	*Lepomis macrochirus*	1
420123517	*Luxilus chrysocephalus*	23
420123517	*Luxilus coccogenis*	122
420123517	*Lythrurus lirus*	4
420123517	*Micropterus dolomieu*	19
420123517	*Moxostoma duquesneii*	40
420123517	*Moxostoma erythrurum*	1
420123517	*Nocomis micropogon*	12
420123517	*Notropis leuciodus*	169
420123517	*Notropis micropteryx*	12
420123517	*Notropis photogenis*	13
420123517	*Notropis telescopus*	384
420123517	*Notropis volucellus*	4
420123517	*Percina evides*	1

Benthic macroinvertebrates collected in our sample at Townsend comprised 37 families representing 56 identified genera (Table 2). The most abundant group in our collection was the dragonflies comprising 21.3% of the total sample. Overall, a total of 70 taxa were identified from the sample of which 31 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" (4.2).

Table 2. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Little River at Townsend during 2012.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
AMPHIPODA			2	0.6
ANNELIDA				1.6
	Oligochaeta		5	
COLEOPTERA				13.5
	Dryopidae	*Helichus* adults	7	
	Elmidae	*Dubiraphia* adults	4	
		Macronychus glabratus adults	10	
		Microcylloepus pusillus adult	1	
		Optioservus larvae	4	
		Optioservus trivittatus adults	2	
		Promoresia elegans larvae and adults	6	
		Stenelmis larva	1	
	Haliplidae	*Peltodytes* larva	1	
		Peltodytes sexmaculatus adult	1	
	Psephenidae	*Psephenus herricki*	6	

Table 2. Continued.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
DIPTERA				12.5
	Athericidae	*Atherix* lantha	5	
	Chironomidae		29	
	Simulidae		5	
	Tabanidae	*Chrysops*	1	
EPHEMEROPTERA				20.4
	Baetidae	*Acentrella*	2	
		Baetis	12	
		Barbaetis benfieldi	1	
		Labiobaetis	2	
		Procloeon	2	
	Ephemerellidae	*Serratella deficiens*	2	
		Serratella serratoides	4	
	Heptageniidae	*Epeorus rubidus/subpallidus*	2	
		Leucrocuta	4	
		Maccaffertium early instars	2	
		Maccaffertium ithaca	1	
		Maccaffertium mediopunctatum	2	
		Maccaffertium modestum	1	
		Stenacron interpunctatum	1	
		Stenacron pallidum	1	
	Isonychiidae	*Isonychia*	20	
	Leptohyphidae	*Tricorythodes*	4	
	Leptophlebiidae	*Paraleptophlebia*	1	
	Neoephemeridae	*Neoephemera purpurea*	1	
GASTROPODA				7.2
	Physidae		1	
	Pleuroceridae	*Leptoxis*	7	
		Pleurocera	15	
HETEROPTERA				1.9
	Mesoveliidae	*Mesovelia mulsanti* male and female	2	
	Nepidae	*Ranatra* nymphs	2	
	Veliidae	*Rhagovelia obesa* felmale and male	2	
HYDRACARINA			4	1.3
MEGALOPTERA				1.9
	Corydalidae	*Corydalus cornutus*	3	
		Nigronia serricornis	3	
ODONATA				21.3
	Aeshnidae	*Basiaeshna janata*	1	
		Boyeria vinosa	18	
	Calopterygidae	*Calopteryx*	2	
		Hetaerina americana	3	
	Coenagrionidae	*Argia moesta/translata*	3	
		Enallagma	1	
	Corduliidae	*Helocordulia ulheri*	1	
	Gomphidae	*Gomphus lividus*	3	
		Gomphus rogersi	2	
		Hagenius brevistylus	8	
		Hylogomphus adelphus	5	
		Hylogomphus early instars	5	
		Stylogomphus albistylus	9	
	Macromiidae	*Macromia*	7	
PELECYPODA				1.3
	Corbiculidae	*Corbicula fluminea*	2	
	Sphaeriidae	*Pisidium*	2	
PLECOPTERA				2.5
	Chloroperlidae early instar		1	
	Leuctridae	*Leuctra*	5	
	Pteronarcyidae	*Pteronarcys dorsata*	2	
TRICHOPTERA				14.1
	Brachycentridae	*Brachycentrus lateralis*	17	
	Hydropsychidae	*Ceratopsyche morosa*	3	
		Cheumatopsyche	4	
		Hydropsyche franclemonti	1	
		Hydropsyche venularis	8	
	Leptoceridae	*Nectopsyche exquisita*	3	
		Oecetis	2	
		Triaenodes early instar	1	
		Triaenodes ignitus	3	
		Triaenodes injustus	1	
	Polycentropodidae	*Polycentropus*	2	
			319	

TAXA RICHNESS = 70 EPT TAXA RICHNESS = 31 BIOCLASSIFICATION = 4.2 (GOOD)

Benthic macroinvertebrates collected in our sample at Coulters Bridge comprised 43 families representing 58 identified genera (Table 3). The most abundant group in our collection was the mayflies comprising 28.9% of the total sample. Overall, a total of 70 taxa were identified from the sample of which 28 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" (4.5).

Table 3. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Little River at Coulters Bridge during 2012 .

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
ANELLIDA				0.8
	Hirudinea		1	
	Oligochaeta		4	
COLEOPTERA				12.2
	Dryopidae	*Helichus* adults	19	
	Elmidae	*Dubiraphia* larva	1	
		Dubiraphia vittata adult	1	
		Macronychus glabratus adults	19	
		Optioservus larvae	3	
		Optioservus trivittatus adults	4	
		Promoresis elegans larvae and adults	17	
		Stenelmis larva	1	
	Gyrinidae	*Dineutus discolor* adults	2	
		Dineutus larvae	2	
		Gyrinus larva	1	
	Hydrophilidae	*Tropisternus natator* adults	2	
		Tropisternus larva	1	
	Pshenidae	*Psephenus herricki* larvae and adult	4	
	Staphylinidae	*Stenus*	1	
DIPTERA				13.3
	Athericidae	*Atherix lantha*	2	
	Chironomidae	larvae and pupa	73	
	Simulidae		8	
	Tipulidae	*Tipula*	2	
EPHEMEROPTERA				28.9
	Baetidae	*Acentrella*	12	
		Baetis	37	
		Callibaetis	2	
	Caenidae	*Caenis*	1	
	Ephemerellidae	*Drunella*	1	
		Serratella sp. 1	18	
		Serratella sp. 2	7	
	Heptageniidae	*Heptagenia*	1	
		Leucrocuta	1	
		Maccaffertium early instars	28	
		Maccaffertium mediopunctatum	24	
		Stenacron interpunctatum	6	
	Isonychiidae	*Isonychia*	30	
	Leptohyphidae	*Tricorythodes*	16	
GASTROPODA				6.3
	Ancylidae	*Ferrissia*	3	
	Physidae		2	
	Planorbidae		2	
	Pleuroceridae	*Leptoxis*	19	
		Pleurocera sp. with stripes	9	
		Pleurocera sp. yellow	5	
HEMIPTERA				3.1
	Corixidae	*Trichocorixa*	4	
	Gerridae	*Aquarius remigis* adult female	1	
	Nepidae	*Aquarius* nymph	1	
		Metrobates hesperius	1	
	Veliidae	*Rhagovelia obesa* males & females	13	
HYDRACARINA			7	1.1
ISOPODA				0.3
	Asellidae	*Lirceus*	2	

Table 3. Continued.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
LEPIDOPTERA				0.2
	Pyralidae	*Parapoynx*	1	
MEGALOPTERA				1.6
	Corydalidae	*Corydalus cornutus*	8	
		Nigronia serricornis	2	
ODONATA				13.0
	Aeshnidae	*Boyeria vinosa*	24	
	Calopterygidae	*Calopteryx*	9	
		Hetaerina americana	21	
	Gomphidae	*Dromogomphus spinosus*	3	
		Gomphus lividus	5	
		Gomphus early instars	3	
		Hagenius brevistylus	9	
		Stylogomphus albistylus	5	
	Macromiidae	*Macromia*	4	
PELECYPODA				2.5
	Corbiculidae	*Corbicula fluminea*	16	
PLECOPTERA				0.6
	Perlidae	*Perlesta*	1	
	Pteronarcyidae	*Pteronarcys dorsata*	3	
TRICHOPTERA				15.5
	Brachycentridae	*Brachycentrus lateralis*	10	
		Micrasema wataga	4	
	Hydropsychidae	*Ceratopsyche morosa*	4	
		Cheumatopsyche	17	
		Hydropsyche betteni/depravata	1	
		Hydropsyche venularis	16	
	Lepidostomatidae	*Lepidostoma*	1	
	Leptoceridae	*Nectopsyche exquisita*	1	
		Triaenodes ignitus	5	
		Triaenodes perna	13	
	Limnephilidae	*Pycnopsyche divergens*	1	
	Philopotamidae	*Chimara*	11	
	Polycentropodidae	*Polycentropus*	15	
TURBELLARIA			4	0.6
			638	

TAXA RICHNESS = 70 EPT TAXA RICHNESS = 28 BIOCLASSIFICATION = 4.5 (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 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 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 region's best streams and serves as a benchmark in evaluating other streams of similar size and character. Effective March 1, 2009, smallmouth bass regulations in Little River from Rockford Dam upstream to the Great Smoky

Mountains National Park boundary will protect bass 13 to 17 inches in length. One fish of the five fish daily creel limit can exceed 17 inches. 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 2014 to look at the sport fish will in all likelihood focus on the sample sites surveyed in 2011, 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.

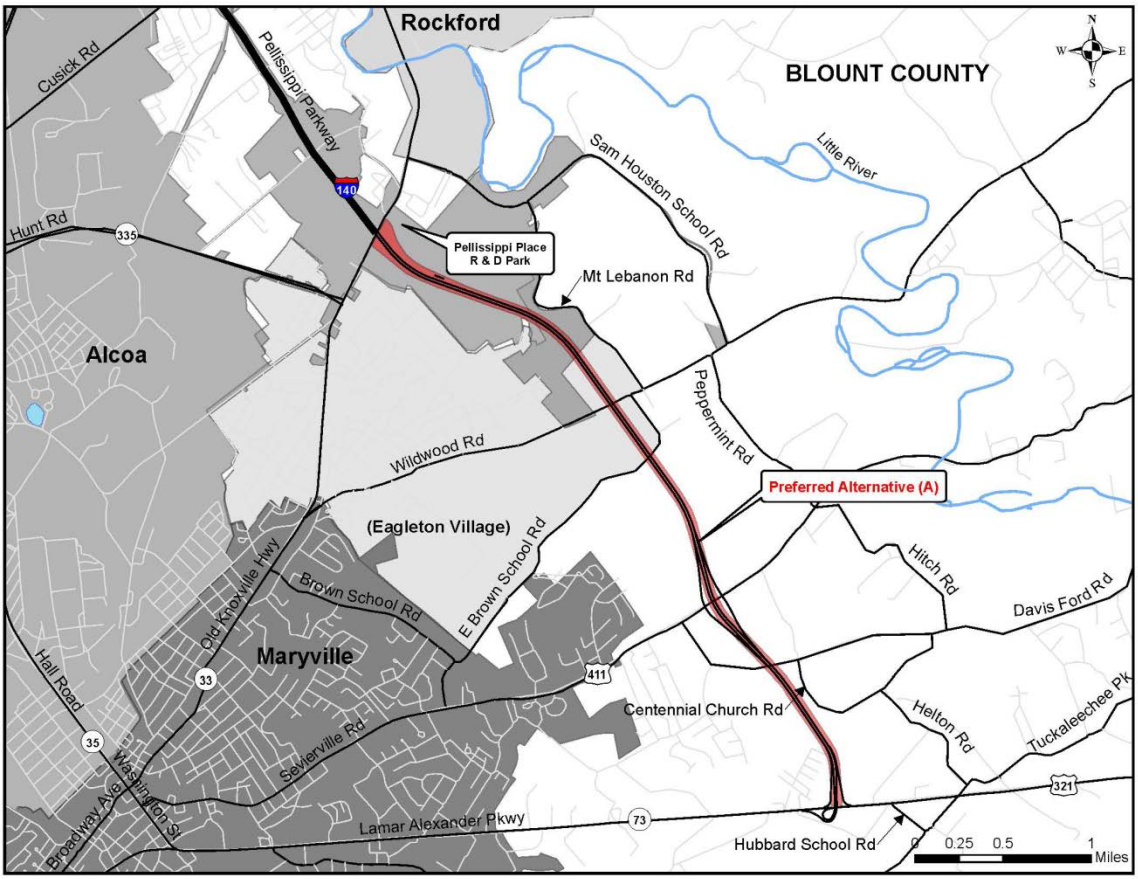
Pellissippi Parkway Extension Surveys

Introduction

The Tennessee Department of Transportation (TDOT), in cooperation with the Federal Highway Administration (FHWA), is proposing to extend and construct Pellissippi Parkway (SR 162) from its current terminus at SR 33 (Old Knoxville Highway) to SR 73 (US 321 or Lamar Alexander Highway) in Blount County. The length of the proposed extension would be approximately 4.4 miles. TDOT and FHWA are preparing an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) to identify and evaluate the environmental effects of the proposed project and to identify measures to minimize harm. The Draft Environmental Impact Statement (DEIS) for the project was approved by the Federal Highway Administration (FHWA) on April 16, 2010, and was circulated for public comment.

After consideration of input from the public, local officials and local, state and federal agencies, as well as weighing of the impacts of the project alternatives on the human and natural environment, TDOT has selected Alternative A (see map below) as its Preferred Alternative for the proposed project. Following the conclusion of the Tennessee Environmental Streamlining Agreement (TESA) Concurrence Point 4, Preferred Alternative and Preliminary Mitigation, TDOT will initiate the preparation of the Final Environmental Impact Statement (FEIS) to address the impacts of the Preferred Alternative. Additional technical studies will be conducted during summer 2012 and reported in the FEIS (TDOT 2012: http://www.tdot.state.tn.us/pellissippi/).

As part of the additional technical studies, the Tennessee Wildlife Resources Agency (TWRA) Region 4 Stream Unit was asked to initiate a survey of the fish and crayfish to determine if any listed species occur in any of the streams that are within the footprint of the proposed project. Five target areas were identified and the survey was conducted on 14 June 2012.



Map of Pellissippi Parkway Extension – Preferred Alternative.

http://www.tdot.state.tn.us/pellissippi/

Sample Methods

Fish and crayfish were qualitatively collected with standard backpack electrofishing techniques (TWRA 1998). Collection from each stream was with a single backpack electrofishing unit operating at 100 to 125 VAC and a person assisting with a dipnet. Sample lengths varied from about 100 to 200 m and 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 considered likely to occur with repeated efforts. Electrofishing times in seconds of actual "switch-on" time ranged from 687 to 1454 seconds and were recorded from the unit's timer. All fish collected from each sample were enumerated by actual number or in terms of relative abundance (i.e. common, abundant, or very abundant). In general, fish and crayfish were identified in the field and released. However, a few problematic *Notropis* specimens from Gravelly Creek were preserved in 10% formalin and later identified in the lab as sand shiners (*Notropis stramineus*). They will be catalogued into the Agency reference collection.

Common and scientific names of fishes used in this report are after Etnier and Starnes (1993), Nelson et al. (2004), and Powers and Mayden (2007).

Results and Discussion

Actual fish and crayfish samples were made from only three of the five target areas (Unnamed Little River trib. # 1, Peppermint Branch, and Gravelly Creek). Two of the unnamed tributaries are apparently intermittent drainage ditches and had no water when visited on 14 June 2012. No federal or state listed fish or crayfish species were found in any of the three streams sampled. The fish species encountered were all typical inhabitants of east Tennessee Ridge and Valley Ecoregion streams degraded by moderate to heavy siltation. No stream habitat or water quality data were collected during these surveys but heavy siltation and embeddedness was observed at all three locations.

Section 303(d) of the Clean Water Act mandates each state to identify and develop a list of waters (i.e., rivers and lakes) that do not meet water quality standards. Tennessee's 2008 303(d) list includes the Little River, Peppermint Branch, Crooked Creek, Gravelly Creek, and Flag Branch in the general study area. (TDOT 2012: http://www.tdot.state.tn.us/pellissippi/). These rivers and streams have been degraded by siltation and habitat lost as a result of discharges from agricultural activities and nearby developments. The species encountered during the survey were within the range of what was expected to occur in these types of streams.

Stream: Unnamed Little River trib. # 1 **Date:** 14 June 2012

Field Number: No number **Quadrangle:** Maryville

Coordinates: 35.80712N – 83.92546W **Elevation:** 820 ft.

Locality: Figure 1. The site was upstream of Sam Houston School Road crossing, at Mt Lebanon Road. Area started approx. 25 m upstream of Sam Houston School Road and was approx. 100 m in length. Blount Co., TN.

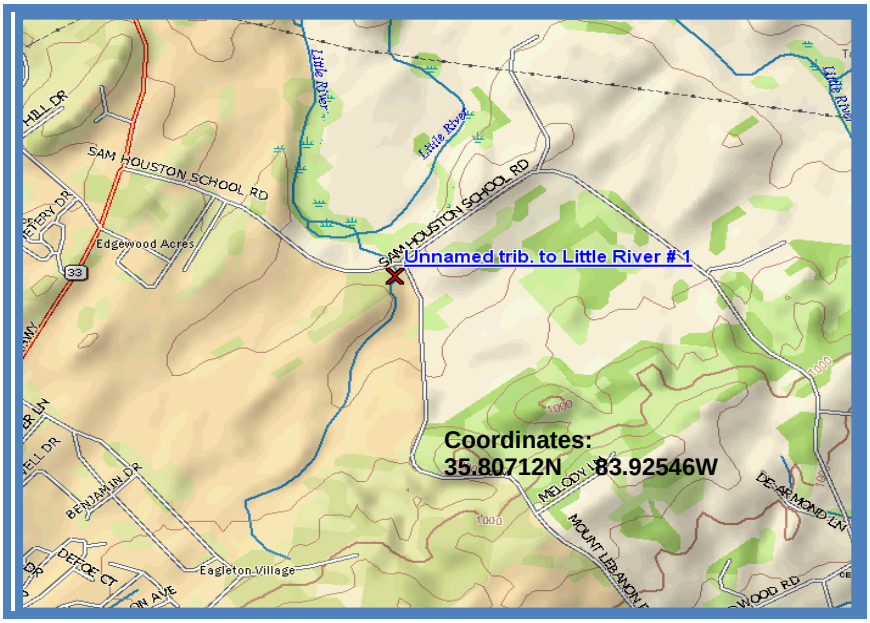
Comments: Observed stream siltation was fairly heavy. Occurrence of some water cress indicates some groundwater influence.

Effort: 687 seconds shocker time.

Species Collected:

		No. Collected
Lepomis auritus	redbreast sunfish	2
Lepomis cyanellus	green sunfish	2
Lepomis macrochirus	bluegill	21
L. auritus x L. macrochirus	redbreast x bluegill hybrid	1
Catostomus commersonii	white sucker	1
Hypentelium nigricans	northern hog sucker	1
Luxilus coccogenis	warpaint shiner	6
Luxilus chrysocephalus	striped shiner	abundant
Rhinichthys obtusus	western blacknose dace	abundant
Semotilus atromaculatus	creek chub	3
Etheostoma tennesseense	Tennessee darter	7
Cottus carolinae	banded sculpin	8

No crayfish collected



Map of Little River unnamed tributary # 1

Stream: Unnamed Little River trib. # 2 **Date:** 14 June 2012

Field Number: No number **Quadrangle:** Maryville

Coordinates: 35.79331N – 83.90697W **Elevation:** 900 ft.

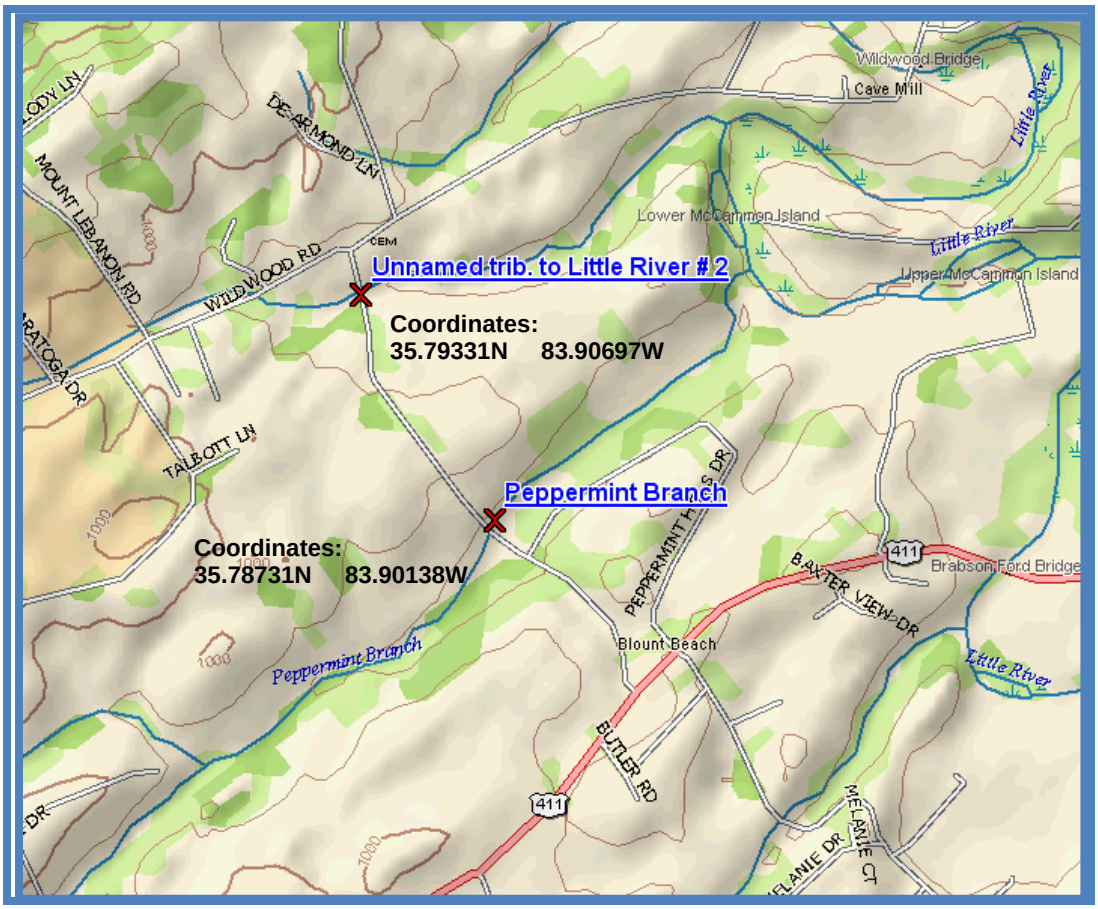
Locality: Figure 2. The site was upstream of the Peppermint Road crossing, just off Wildwood Road, near Mt Lebanon Church. Blount Co., TN.

Comments: Observed no water when visited on 14 June 2012. This is apparently an intermittent stream or wet weather conveyance.

Effort: None

Species Collected:

None



Map of Little River unnamed tributary # 2 and Peppermint Branch sample site.

Stream: Peppermint Branch **Date:** 14 June 2012

Field Number: No number **Quadrangle:** Maryville

Coordinates: 35.78731N – 83.90138W **Elevation:** 870 ft.

Locality: Figure 2. The site was at the Peppermint Road crossing; the sample area started approx. 200 m downstream of Peppermint Road and continued upstream to the bridge. Blount Co., TN.

Comments: Observed stream siltation was heavy.

Effort: 1454 seconds shocker time.

Species Collected:

		No. Collected
Lepomis auritus	redbreast sunfish	22
Lepomis cyanellus	green sunfish	2
Catostomus commersonii	white sucker	common
Campostoma oligolepis	largescale stoneroller	17
Luxilus chrysocephalus	striped shiner	4
Rhinichthys obtusus	western blacknose dace	very abundant
Semotilus atromaculatus	creek chub	very abundant
Etheostoma tennesseense	Tennessee darter	15
Cottus carolinae	banded sculpin	2

Cambarus bartonii cavatus – 2-2nd ♂, 2 juvenile ♂, 2 ♀, and 1 juvenile ♀

Stream: Unnamed Little River trib. # 3 **Date:** 14 June 2012

Field Number: No number **Quadrangle:** Maryville

Coordinates: 35.77846N – 83.89153W **Elevation:** 890 ft.
Coordinates: 35.77282N – 83.90047W **Elevation:** 925 ft.

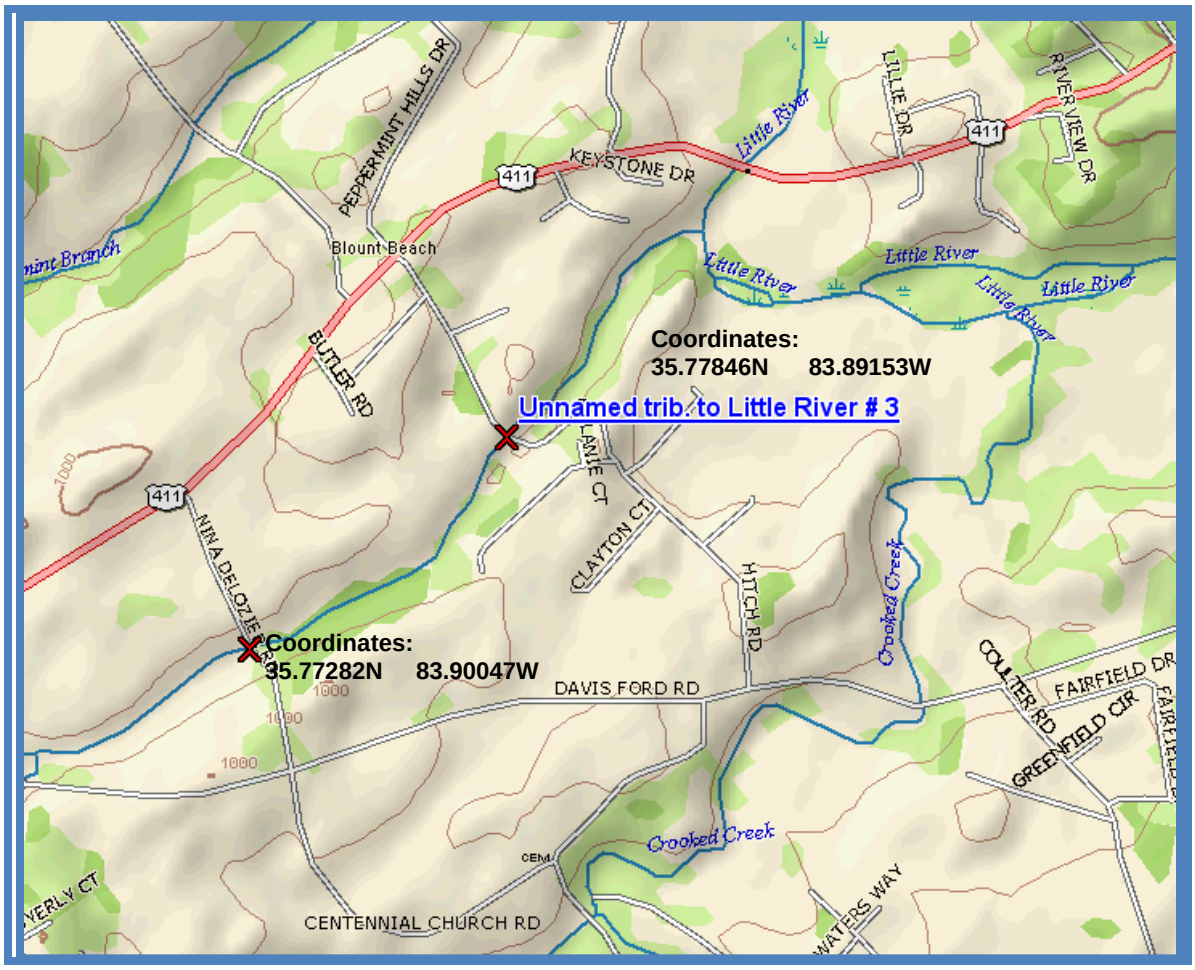
Locality: Figure 3. The sites were at the Hitch Road and the Nina Delozier Road crossings. Blount Co., TN.

Comments: Observed no water at either location when visited on 14 June 2012. This is apparently an intermittent stream or wet weather conveyance.

Effort: None

Species Collected:

None



Map of Little River unnamed tributary # 3

Stream: Gravelly Creek **Date:** 14 June 2012

Field Number: RDB-2012-10 **Quadrangle:** Maryville

Coordinates: 35.76527N – 83.88941W **Elevation:** 875 ft.

Locality: Figure 4. The site was upstream of the Helton Road crossing; at the mouth. It started at the stream crossing and went upstream for approx. 200 m. Blount Co., TN.

Comments: Observed stream siltation was heavy.

Effort: 1212 seconds shocker time.

Species Collected:

		No. Collected
Ambloplites rupestris	rock bass	1
Lepomis auritus	redbreast sunfish	12
Lepomis cyanellus	green sunfish	7
Lepomis macrochirus	bluegill	32
Lepomis microlophus	redear sunfish	1
L. cyanellus x L. macrochirus	green x bluegill hybrid	1
Catostomus commersonii	white sucker	1
Hypentelium nigricans	northern hog sucker	7
Minytrema melanops	spotted sucker	1
Campostoma oligolepis	largescale stoneroller	10
Cyprinella galactura	whitetail shiner	1
Hybopsis amblops	bigeye chub	5
Luxilus chrysocephalus	striped shiner	59
Notropis telescopus	telescope shiner	1
Notropis stramineus	sand shiner	12
Rhinichthys obtusus	western blacknose dace	12
Semotilus atromaculatus	creek chub	10
Etheostoma tennesseense	Tennessee darter	4
Cottus carolinae	banded sculpin	31
Gambusia affinis	western mosquitofish	5

Orconectes erichsonianus – 1 ♀
Orconectes forceps – 1-2nd ♂

Map of Gravelly Creek sample site

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).

Gizzard Shad

Our 2012 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 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.

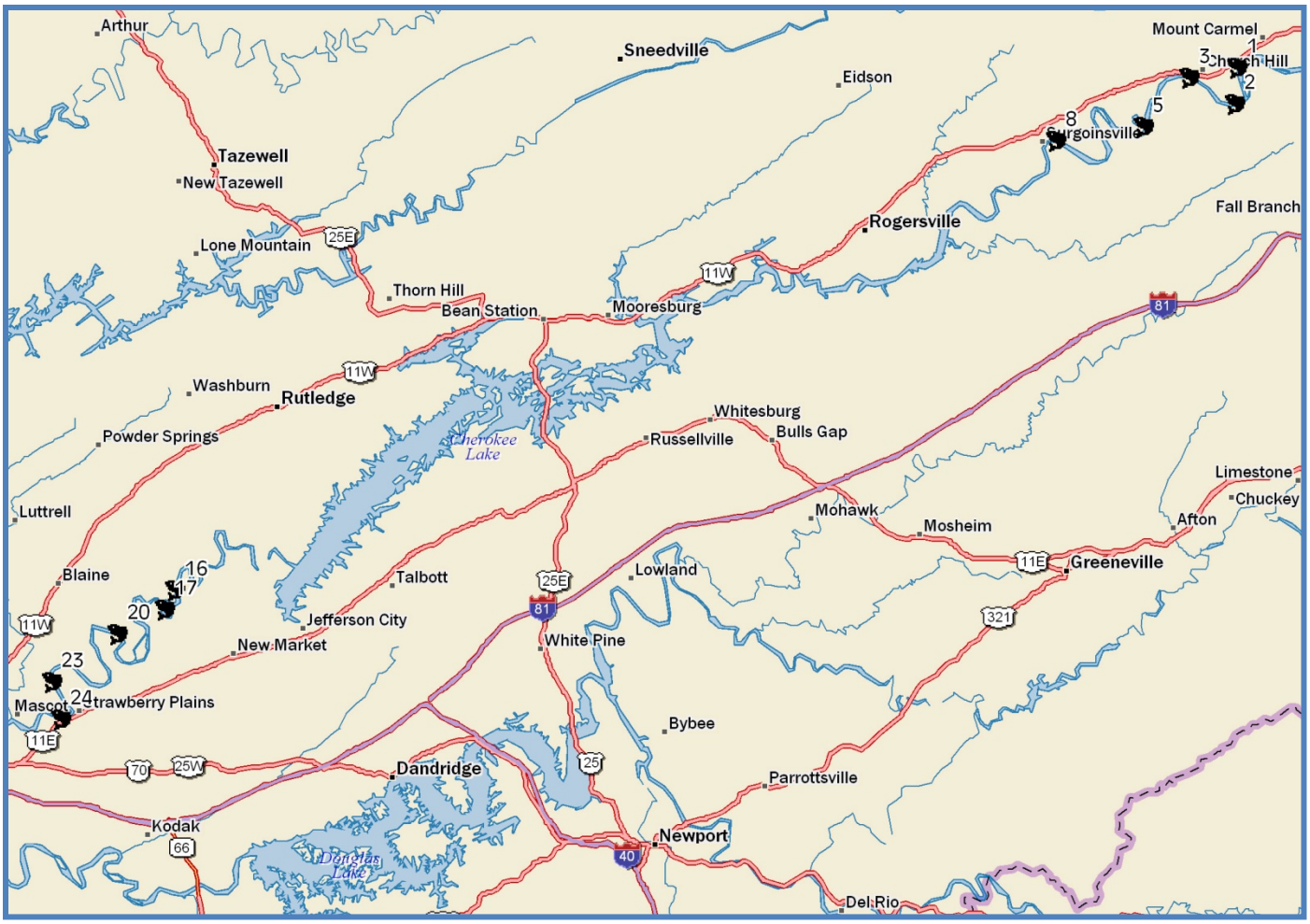
Study Area and Methods

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 17 and September 12, 2012, 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 primarily of wooded shorelines with interspersed rock outcroppings.

Figure 3. Site locations for samples conducted on the Holston River during 2012.



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 4). Water temperatures ranged from were 18 to 22 C upstream of Cherokee Reservoir and 23 to 24 C downstream of Cherokee Reservoir. Conductivity varied from 220 to 250 upstream of the reservoir and 270 to 282 µs/cm downstream of the reservoir (Table 4). 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.

Table 4. Physiochemical and site location data for samples conducted on the Holston River during 2012.

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420120601	1	Hawkins	Church Hill 188SW	136.3	36.52389	-82.68167	127	1108	18	240	1.8
420120602	2	Hawkins	Lovelace 189NW	134.1	36.49740	-82.68520	123	596	19	220	1.8
420120603	3	Hawkins	Church Hill 188SW	131.5	36.51694	-82.72306	111	375	22	230	1.8
420120605	5	Hawkins	Stony Point 180NE	127.5	36.48167	-82.76250	145	576	21	220	1.8
420120608	8	Hawkins	Stony Point 180NE	118.8	36.47167	-82.83833	139	419	22	250	1.8
420120616	16	Grainger/Jefferson	Joppa 155NE	38.8	36.14972	-83.60167	134.5	468	23	280	2.7
420120617	17	Grainger/Jefferson	Joppa 155NE	37.5	36.13583	-83.61028	68	125	23	280	2.7
420120620	20	Grainger/Jefferson	Mascot 155SW	28	36.11861	-83.65139	137.5	654	23	280	2.7
420120623	23	Jefferson/Knox	Mascot 155SW	19.7	36.08417	-83.70722	144	554	24	270	2.7
420120624	24	Knox	Mascot 155SW	17	36.05694	-83.70000	107.5	443	24	282	2.7

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 1456 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 75.8/hour (SD 32.8). This was a 24.5% decrease in the overall mean catch of smallmouth bass from the value observed in 2009 but was still within the range of observed values between 2000 and 2009. There were no spotted or largemouth bass collected in this portion of the river during 2012 (Table 5). Rock bass CPUE was 38.4/hour (SD 34.9) upstream of the reservoir in 2012. This represented a 42% increase from a sample taken in 2009 and was the highest value recorded for this species since 2007 (Figure 4). In samples conducted below Cherokee Reservoir in 2012, smallmouth bass catches averaged 62.4/hour (SD 36.8). Spotted bass and largemouth bass catch rates remained low or absent with only one largemouth bass being collected in samples. In comparison, the smallmouth bass catch rate dropped by 28% in 2012 from the catch recorded in 2009 (Figure 5) but still remained higher than the catch observed in 2007. This trend stayed in keeping with our theory regarding the smallmouth density trends in relation to the hydrologic cycles. Wet

years (2009) favor smallmouth bass when compared to drier years (2007 and 2012) due to changes in water release regimes below Cherokee dam. Rock bass catches in this part of the river averaged 84.8/hour (SD 58.8) during 2012 (Figure 5). This was the highest recorded value for rock bass in the section of the river since sampling began in 2000.

Table 5. Catch per unit effort and length-categorization indices of target species collected at ten sites on the Holston River during 2012 (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
420120601	62.5	-	-	52.5
420120602	103.7	-	-	-
420120603	116.0	-	-	80.0
420120605	60.0	-	-	4.0
420120608	37.0	-	-	55.5
MEAN	***75.8***	-	-	***38.4***
STD DEV.	32.8	-	-	34.9
Sites 1-8	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis
	PSD = 44.1	PSD = 0	PSD = 0	PSD = 31.7
	RSD-Preferred = 20.5	RSD-Preferred = 0	RSD-Preferred = 0	RSD-Preferred = 4.8
	RSD-Memorable = 1.4	RSD-Memorable = 0	RSD-Memorable = 0	RSD-Memorable = 0
	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0
420120616	28.0	-	-	24.0
420120617	28.0	-	-	72.0
420120620	64.0	-	4.0	44.0
420120623	76.0	-	-	112.0
420120624	116.0	-	-	172.0
MEAN	***62.4***	-	***0.8***	***84.8***
STD DEV.	36.8	-	1.7	58.8
Sites 16-24	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis
	PSD = 28.5	PSD = 0	PSD = 0	PSD = 44.1
	RSD-Preferred = 11.4	RSD-Preferred = 0	RSD-Preferred = 0	RSD-Preferred = 0.9
	RSD-Memorable = 5.7	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 2007-2012 from the Holston River above Cherokee Reservoir.

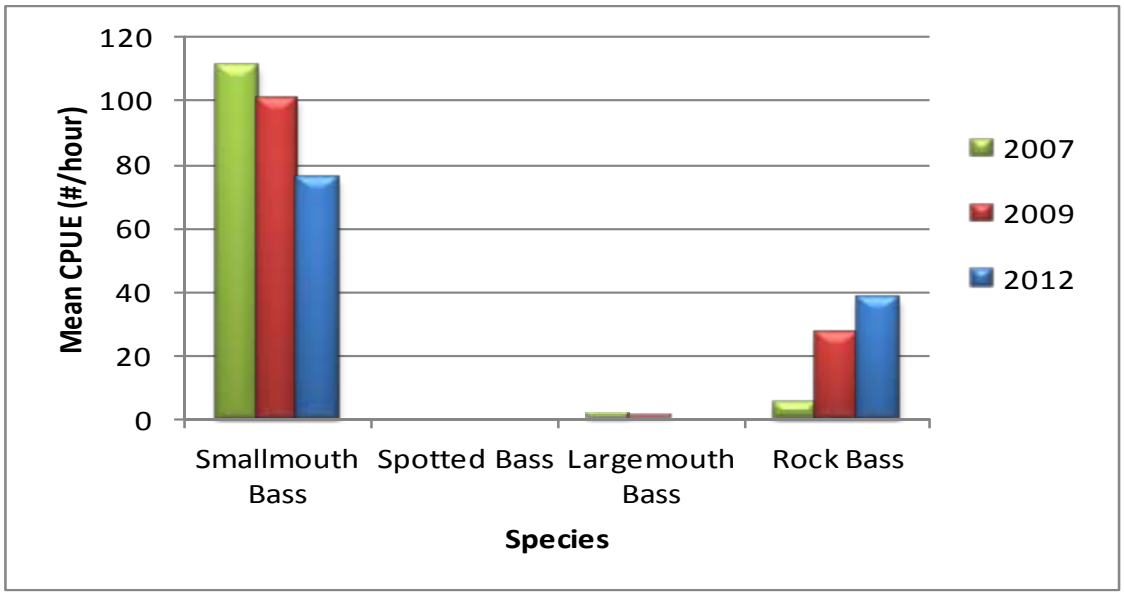
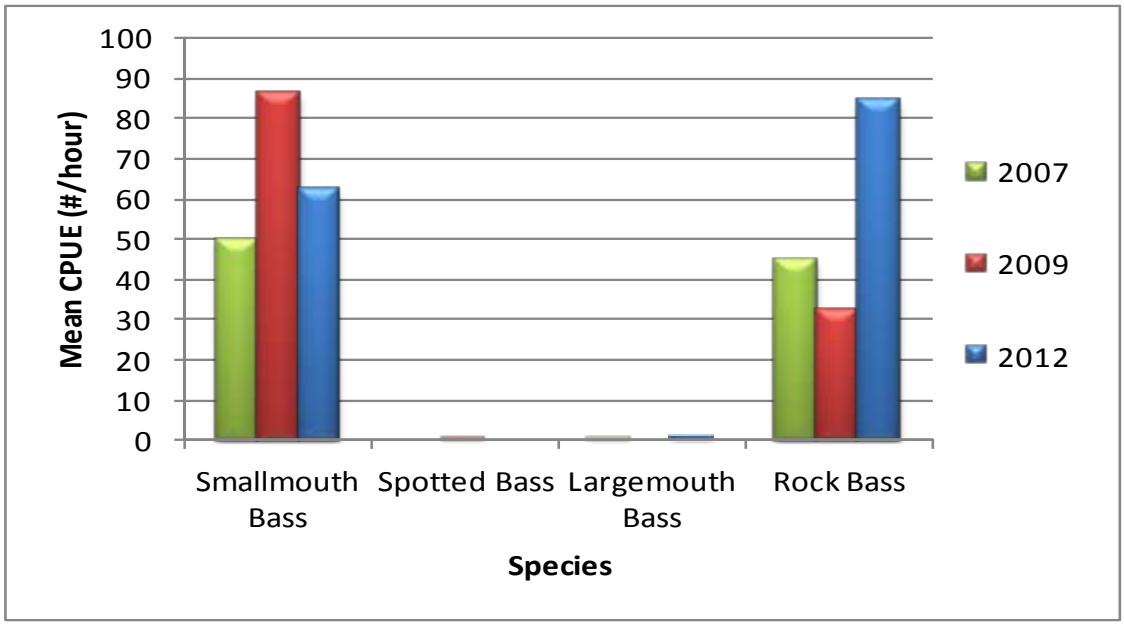
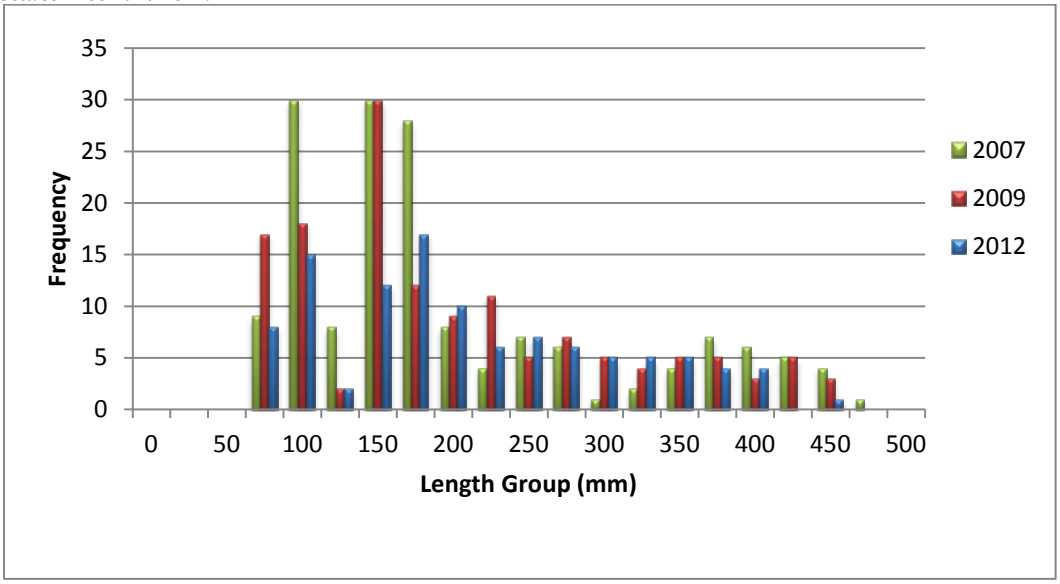


Figure 5. Trends in mean catch rate of black bass and rock bass collected between 2007 -2012 from the Holston River below Cherokee Reservoir.



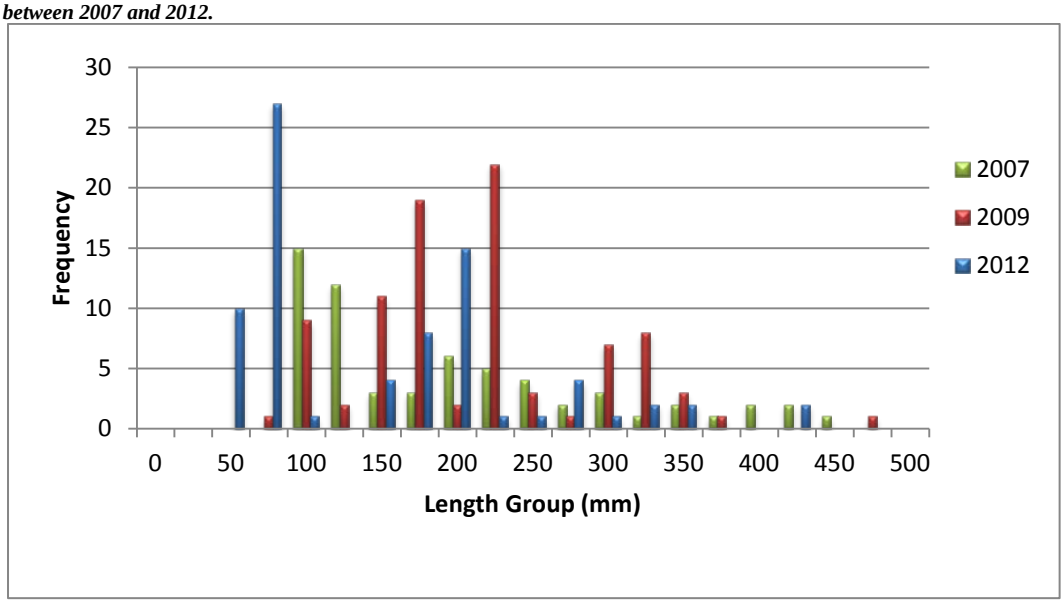
The majority of the smallmouth bass collected from the Holston River collected during 2012 fell within the 75 mm to 250 mm length range both above and below Cherokee Reservoir (Figures 6 and 7). There was a higher representation of juvenile bass in the sample taken below Cherokee in 2012 (Figure 7) although the frequency distribution for bass was more robust and more evenly distributed in the section of river above Cherokee reservoir (Figure 6).

Figure 6. Length frequency distributions for smallmouth bass collected from the Holston River above Cherokee Reservoir between 2007 and 2012.



Smallmouth bass below Cherokee Reservoir were most represented by fish in the 50 mm to 200 mm size range (Figure 7). There was poor recruitment into the 300 mm to 375 mm length range in this portion of the river most likely associated with the mediocre 2007 and presumably weak 2008 year class. This is based on the 4-5 year time period required for smallmouth bass to reach the 12 to 15 inch size range in this portion of the river.

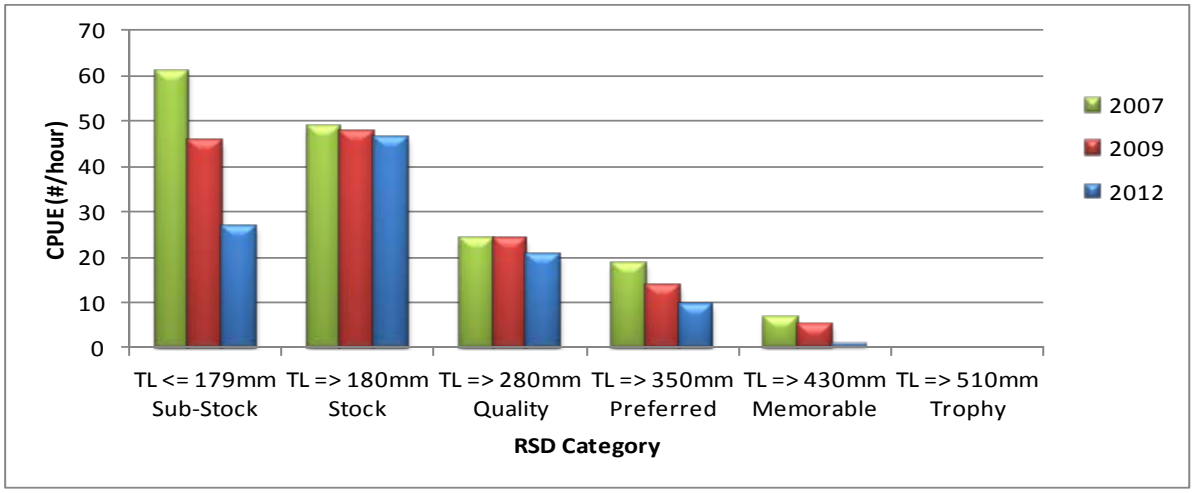
Figure 7. Length frequency distributions for smallmouth bass collected from the Holston River below Cherokee Reservoir between 2007 and 2012.



The 2012 relative stock density (RSD) for preferred smallmouth bass (TL ≥ 350 mm) above and below the reservoir was 20.5 and 11.4, respectively. The observed values for this same category in 2009 were 29.2 above the reservoir and 6.4 below. RSD for memorable (TL ≥ 430 mm) and trophy (TL ≥ 510 mm) size bass during 2012 were 1.4 and 0 above the reservoir and 5.4 and 0 below the reservoir. Overall we observed a decrease in the percentage of preferred and memorable size smallmouth when compared to the previous samples. The

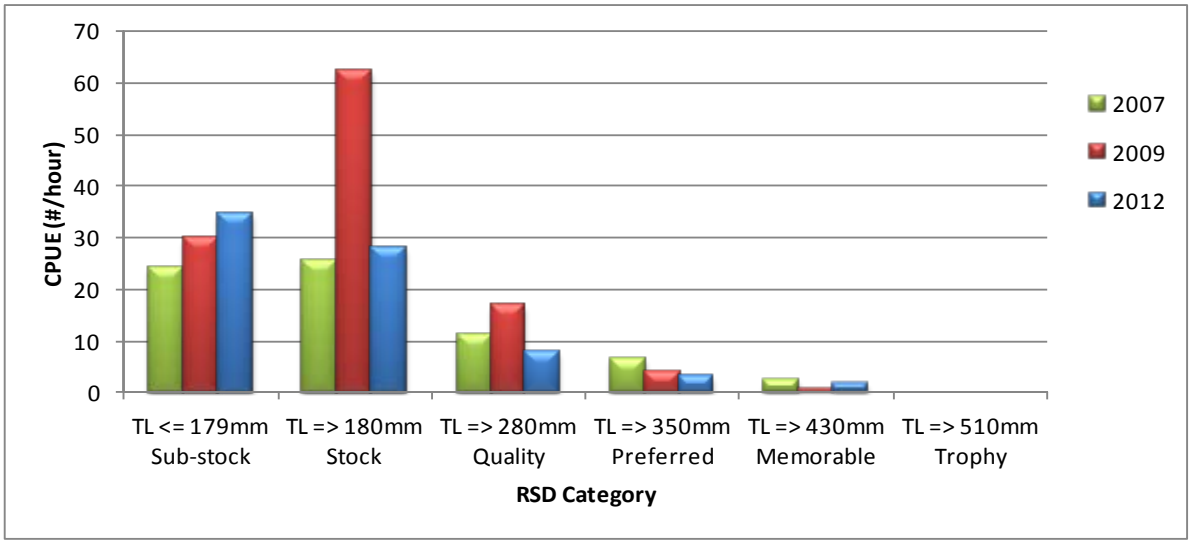
one exception was below Cherokee Reservoir, where the value for memorable bass increased. The PSD of smallmouth bass (ratio of quality size bass to stock size bass) was 44.1 above the reservoir and 28.5 below the reservoir during 2012. Catch per unit effort estimates by RSD category above Cherokee Reservoir remained relatively stable during 2009 with the exception of the sub-stock, preferred and memorable categories which showed the greatest decline when compared to previous samples (Figure 8). Although we did not collect any trophy size bass during the 2012 sample we have taken smallmouth in excess of 510 mm (20 in) in this reach 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 2007 and 2012.



Trends in catch per unit effort by RSD category below Cherokee Reservoir approximated those values in 2012 with the exception of the sub-stock category which was slightly higher than the two previous sample events. Overall we observed decreases in the catch of other size categories when compared with 2009 although the representation by memorable size fish was higher than 2009, approaching the value observed in 2007 (Figure 9).

Figure 9. Relative stock density (RSD) catch per unit effort for smallmouth bass collected in the Holston River below Cherokee Reservoir between 2007 and 2012.

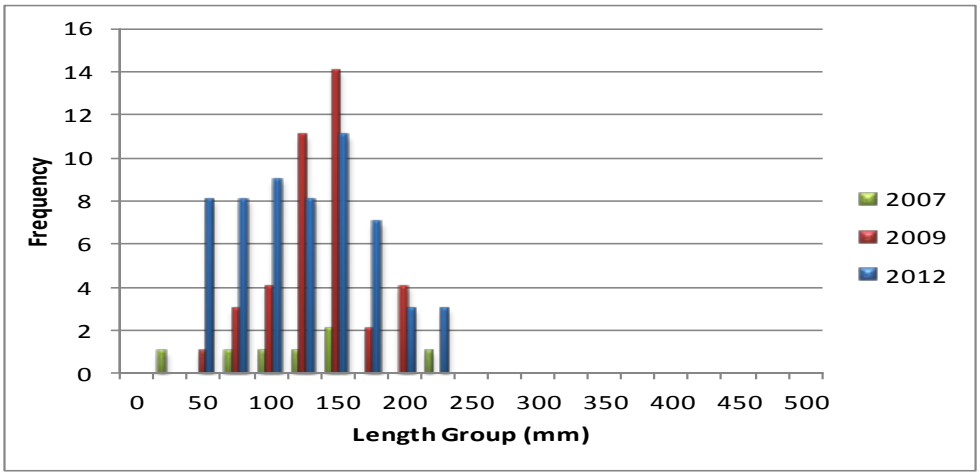


There were no spotted bass collected above or below Cherokee Reservoir during 2012. Riverine occurrence of spotted bass in most east Tennessee rivers is sporadic at best with the exception of the Nolichucky River where there is a viable fishery for this species.

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 reaches of rivers usually associated with some type of woody cover.

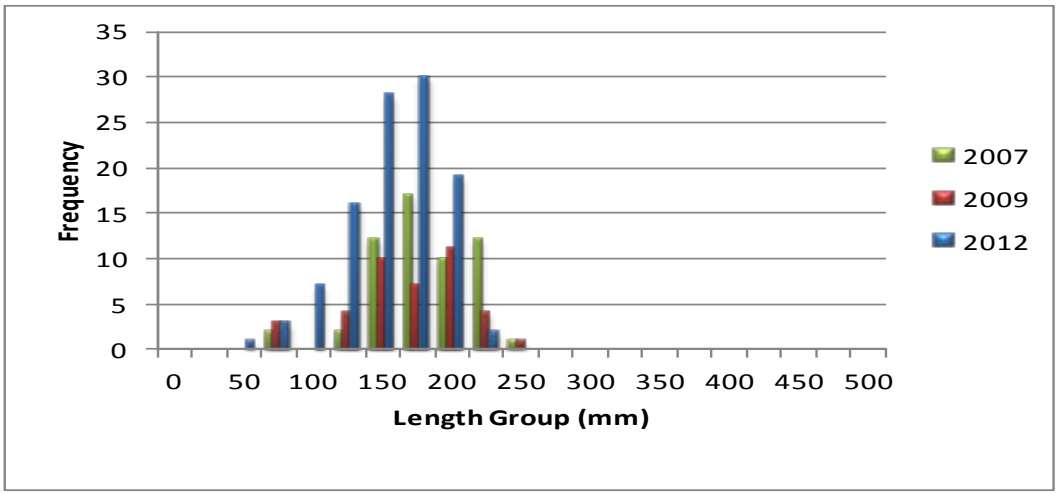
Individuals in the 100 to 175 mm range represented the majority of rock bass in our sample above Cherokee Reservoir and had the strongest showing for this species during 2012 when compared to previous surveys (Figure 10). Although rock bass persist in the upper Holston, they are not extremely abundant. 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 in 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 2007 and 2012.



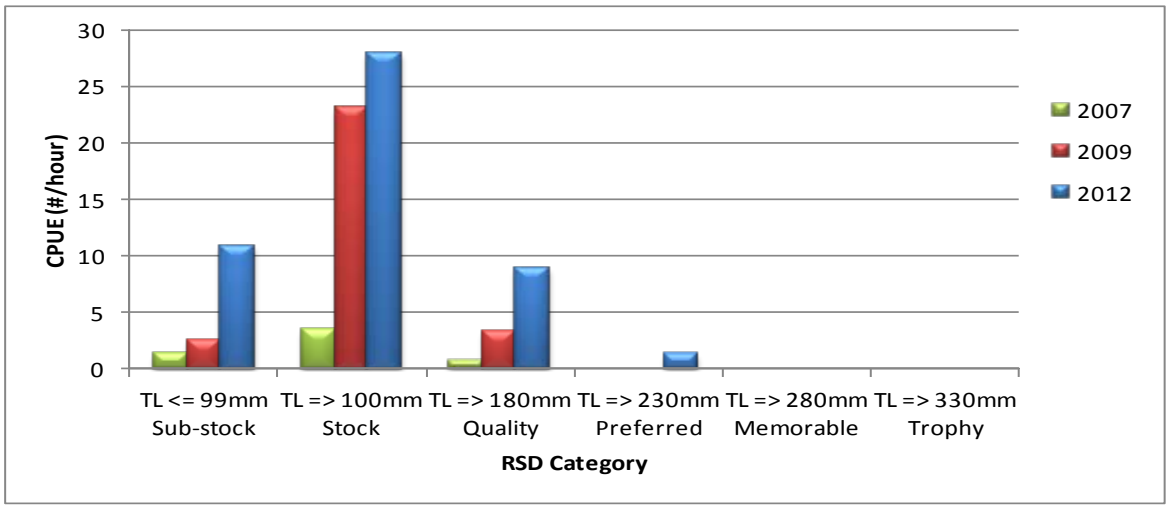
Below Cherokee Reservoir the size distribution for rock bass during the 2012 samples was primarily composed of fish in the 125 to 200 mm size group (Figure 11). Very similar to our observation in the river above the reservoir, rock bass abundance was up when compared to the 2007 and 2009 samples in this section of river.

Figure 11. Length frequency distributions for rock bass collected from the Holston River below Cherokee Reservoir between 2007 and 2012.



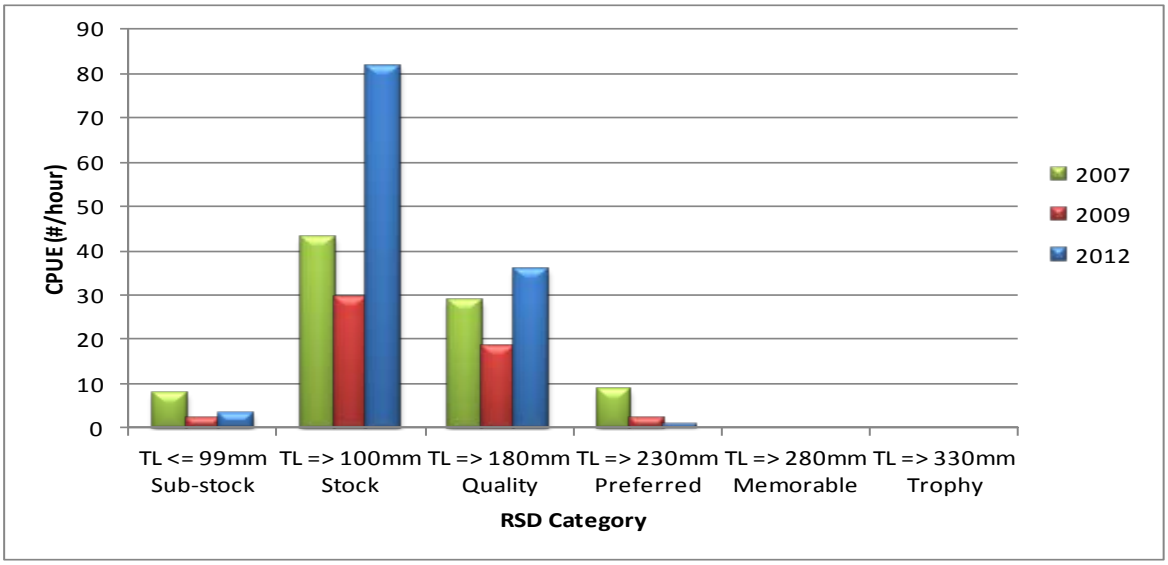
The RSD of preferred (TL ≥ 230 mm) rock bass was 4.8 above the reservoir and 0.9 below the reservoir (Table 6). RSD for memorable (TL ≥ 280 mm) and trophy (TL ≥ 330 mm) size rock bass was 0 both above and below the reservoir. The 2012 PSD of rock bass was 31.7 above the reservoir and 44.1 below the reservoir. Catch per unit effort estimates by RSD category above Cherokee Reservoir indicated the majority of our catch was stock size fish during 2012 (Figure 12). Overall, we did observe increases in all represented categories when compared to the 2007 and 2009 survey.

Figure 12. Relative stock density (RSD) catch per unit effort for rock bass collected from the Holston River above Cherokee Reservoir between 2007 and 2012.



In our samples collected below the reservoir, we observed higher catch rates in the stock and quality categories when compared to 2007 and 2009. The 2012 value for the stock category far exceeded those values recorded in the previous samples. The catch for the preferred category continued its downward trend similar to 2009.

Figure 13. Relative stock density (RSD) catch per unit effort for rock bass collected from the Holston River below Cherokee Reservoir between 2007 and 2012.



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 *(Acipenser fulvescens)* have been introduced into the river below the reservoir. TWRA is considering the experimental release of muskellunge into the river above John Sevier Dam to evaluate the potential for establishing a fishery for this species.

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 have shifted our sampling strategy to the spring months both above and below the reservoir. Our next scheduled sample of the Holston River will be in 2015.

Management Recommendations

1. Continue the Cherokee tailwater rainbow and brown 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.

5. Consider developing a muskellunge fishery in the river above John Sevier Dam.

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 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 April 27 and June 12, 2012 we sampled 14 sites (5 above Douglas Reservoir, 9 below Douglas Reservoir) (Figures 14 and 15). 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 us to survey in rough water where conventional aluminum electrofishing boats do not work.

Figure 14. Locations of samples conducted in the French Broad River above Douglas Reservoir during 2012.

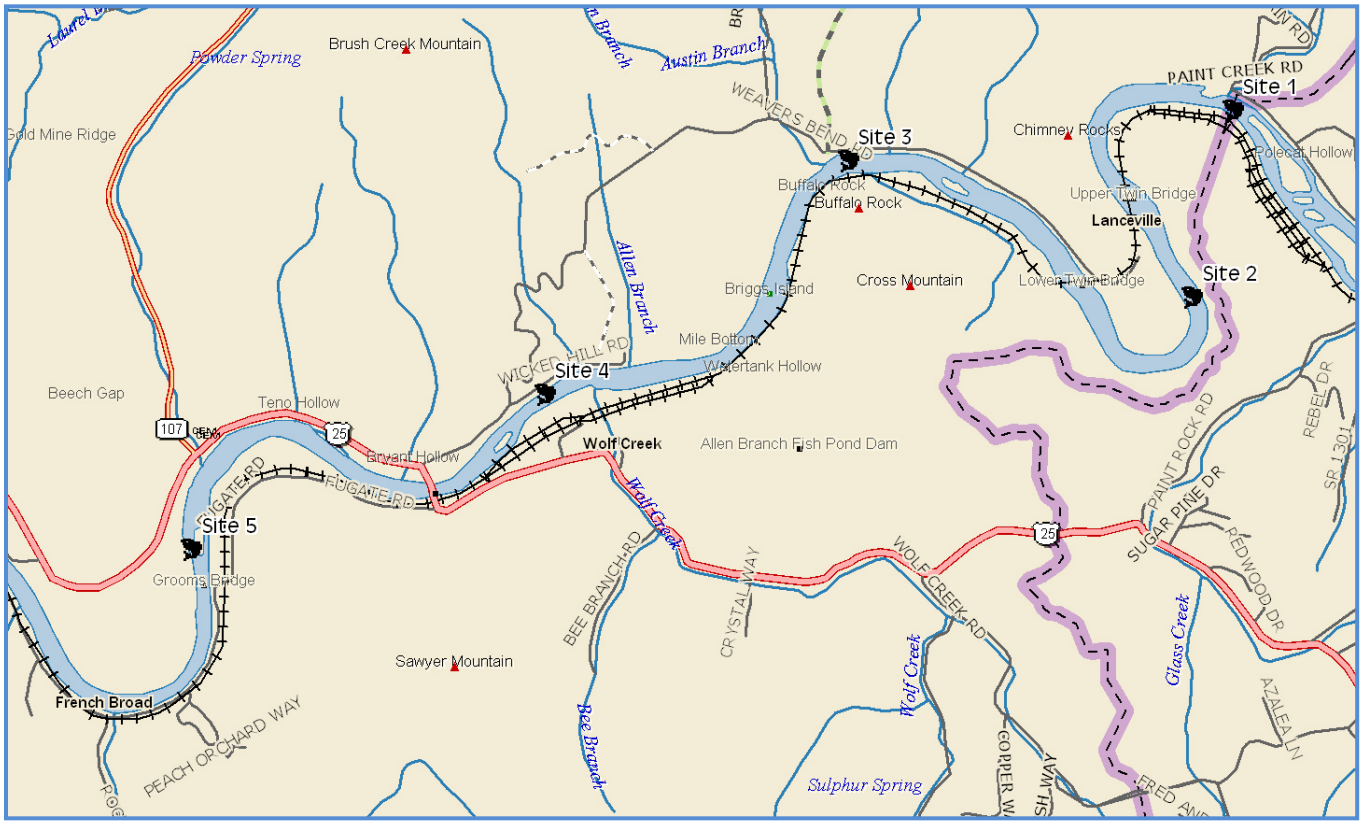
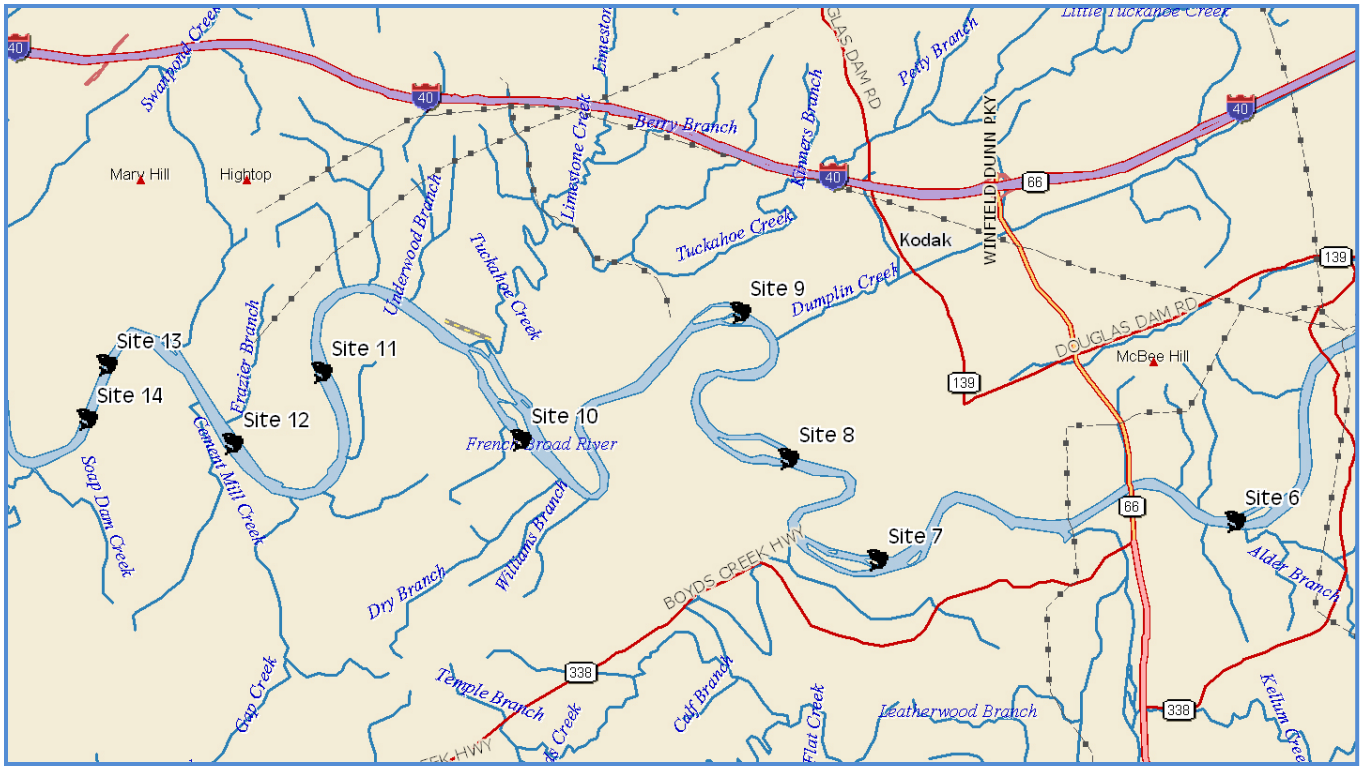


Figure 15. Site locations for samples conducted in the French Broad River below Douglas Reservoir during 2012.



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 6). Water temperatures ranged from 14 to 25.5 C. Conductivity varied from 60 to219 µs/cm (Table 6).

Table 6. Physiochemical and site location data for samples conducted on the French Broad River during 2012.

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420120501	1	Cocke	Paint Rock 182NW	99.5	35.94394	-82.89837	109	500	22.8	60	-
420120502	2	Cocke	Paint Rock 182NW	98.9	35.93274	-82.90164	86	494	23.5	60	-
420120503	3	Cocke	Paint Rock 182NW	97.3	35.94114	-82.9277	72	496	25.5	70	-
420120504	4	Cocke	Paint Rock 182NW	95.3	35.92685	-82.95068	85.5	431	25.0	60	-
420120505	5	Cocke	Paint Rock 182NW	93.6	35.91739	-82.97733	61	230	25.0	60	-
420120506	6	Sevier	Douglas Dam 156NE	29.5	35.93250	-83.56306	146.6	1246	14	129	2.6
420120507	7	Sevier	Douglas Dam 156NE	25.1	35.92667	-83.63028	221	551	18	105	1.0
420120508	8	Sevier	Boyds Creek 156NW	22.4	35.94222	-83.64694	91.5	845	15	120	-
420120509	9	Sevier	Boyds Creek 156NW	19.5	35.96444	-83.65611	167	1027	15	135	-
420120510	10	Knox	Boyds Creek 156NW	15.5	35.94500	-83.69722	304	818	15	135	-
420120511	11	Knox	Boyds Creek 156NW	11.8	35.95528	-83.73472	175	759	17	135	-
420120512	12	Knox	Boyds Creek 156NW	9.3	35.94472	-83.75111	183	927	17	140	-
420120513	13	Knox	Shooks Gap 147NE	7.3	35.95639	-83.77472	127	277	17.5	219	-
420120514	14	Knox	Shooks Gap 147NE	6.6	35.94806	-83.77806	123	921	16.9	139	3.1

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 522 to 2200 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 26.6/hour (SD 16.8), while the spotted bass and largemouth bass estimates were 2.0/hour (SD 2.8) and 0/hour, respectively (Table 7)**.** Comparatively, mean CPUE estimates in 2009 were 23.3/hour for smallmouth bass and 2.0/hour for spotted bass (Figure 16). The smallmouth bass catch increased 14% when compared to 2009. Two rock bass were collected upstream of the reservoir in 2012. The mean catch rate for this species was 1.6/hour (SD 2.1). Presence has been almost nonexistent in the river with the exception of the current collection and those collected in 2007. In samples conducted below Douglas Reservoir in 2012, smallmouth bass catches averaged 58.0/hour (SD 42.5). Spotted bass and largemouth bass catch rates were lower at 2.2/hour (SD 3.4) and 0.6/hour (SD 1.3), respectively. In comparison, the CPUE value for smallmouth bass in 2012 was about 25.5% lower than the value recorded in 2009 (Figure 17). Rock bass catches in this part of the river averaged 71.7/hour (SD 41.0) during 2012 (Table 7) and were only slightly lower (8.7%) than the 2009 value (Figure 17).

Table 7. Catch per unit effort and length categorization indices of target species collected at 14 sites on the French Broad River during 2012 (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
420120501	27.2	-	-	-
420120502	36.0	-	-	4.0
420120503	18.1	6.0	-	-
420120504	4.0	-	-	4.0
420120505	48.0	4.0	-	-
MEAN	***26.6***	***2.0***	-	***1.6***
STD. DEV.	***16.8***	***2.8***	-	***2.1***
Sites 1-5	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis
	PSD = 46.1 RSD-Preferred = 11.5 RSD-Memorable = 7.6 RSD-Trophy = 0	PSD = 0 RSD-Preferred = 0 RSD-Memorable = 0 RSD-Trophy = 0	PSD = 0 RSD-Preferred = 0 RSD-Memorable = 0 RSD-Trophy = 0	PSD = 50 RSD-Preferred = 0 RSD-Memorable = 0 RSD-Trophy = 0
420120506	27.0	2.7	2.7	81.1
420120507	91.6	-	-	111.1
420120508	60.0	-	3.3	53.3
420120509	18.0	1.6	-	39.3
420120510	42.4	9.0	-	24.2
420120511	32.0	-	-	84.0
420120512	156.0	-	-	28.0
420120513	42.8	7.1	-	150.0
420120514	52.7	-	-	75.0
MEAN	***58.0***	***2.2***	***0.6***	***71.7***
STD. DEV.	***42.5***	***3.4***	***1.3***	***41.0***
Sites 6-14	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis	Length-Categorization Analysis
	PSD = 28.9 RSD-Preferred = 15.9 RSD-Memorable = 7.2 RSD-Trophy = 0	PSD = 40.0 RSD-Preferred = 20 RSD-Memorable = 0 RSD-Trophy = 0	PSD = 100 RSD-Preferred = 0 RSD-Memorable = 0 RSD-Trophy = 0	PSD = 41.2 RSD-Preferred = 1.5 RSD-Memorable = 0 RSD-Trophy = 0

Figure 16. Trends in mean catch rate of black bass and rock bass collected between 2007-2012 from the French Broad River above Douglas Reservoir.

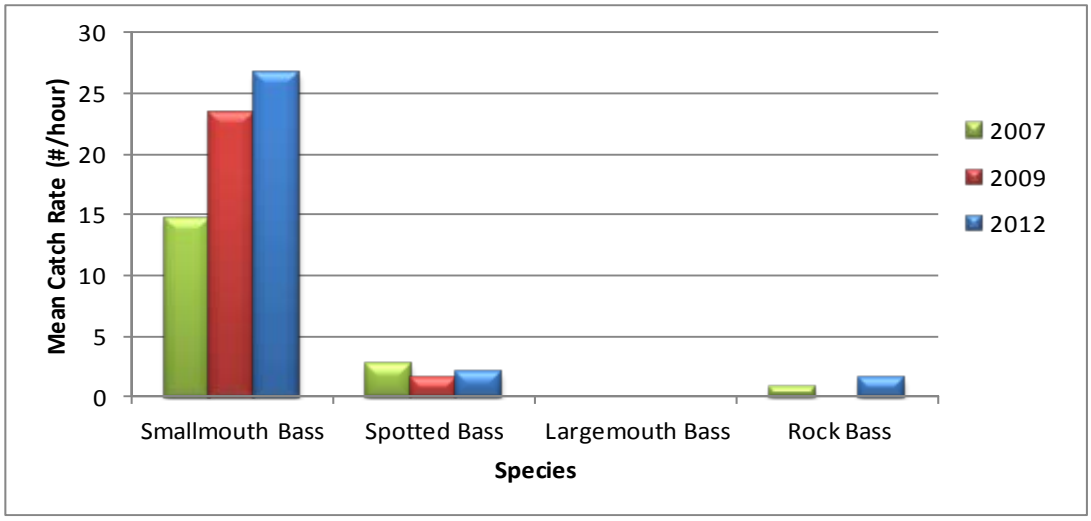
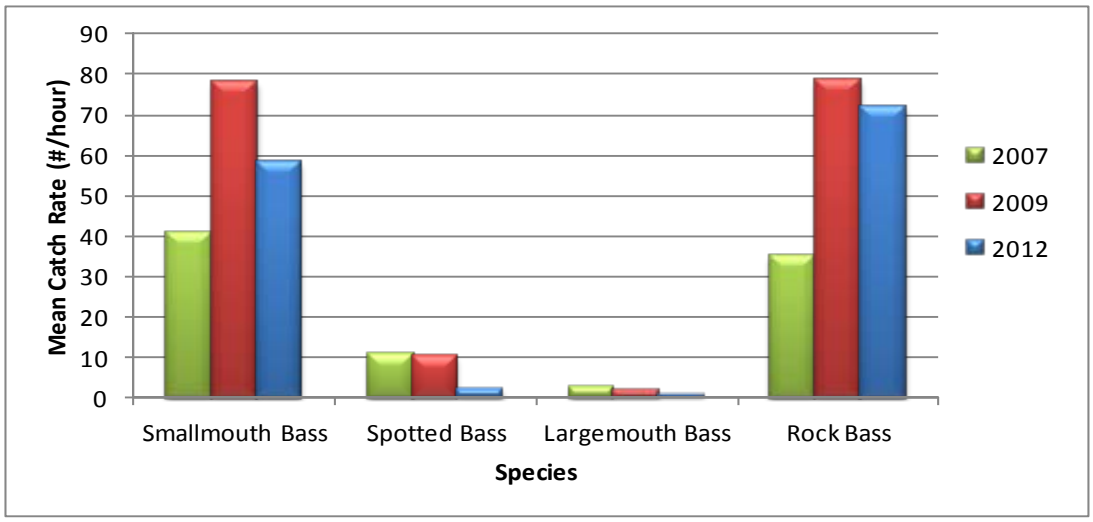
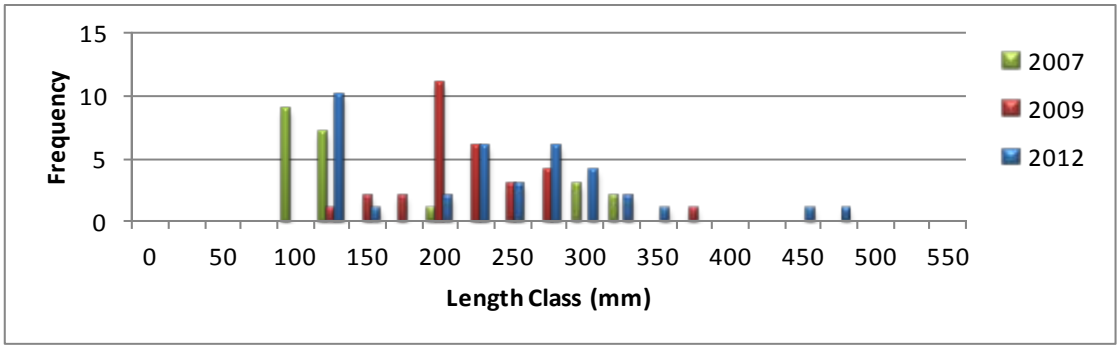


Figure 17. Trends in mean catch rate of black bass and rock bass collected from 2007-2012 in the French Broad River below Douglas Reservoir.



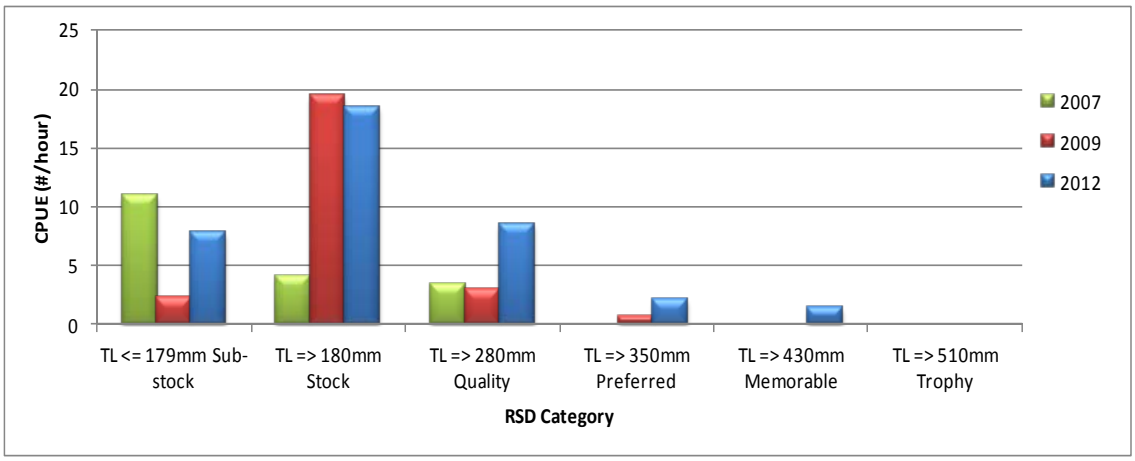
The length distribution of smallmouth bass above Douglas Reservoir was mainly comprised of individuals in the 125 to 300 mm size range. Unlike previous samples we did collect bass between the 18 and 20 inch class during this sample and a higher occurrence of bass in the 11 to 14 inch range (Figure 18).

Figure 18. Length frequency distributions for smallmouth bass collected from the French Broad River above Douglas Reservoir between 2007- 2012.



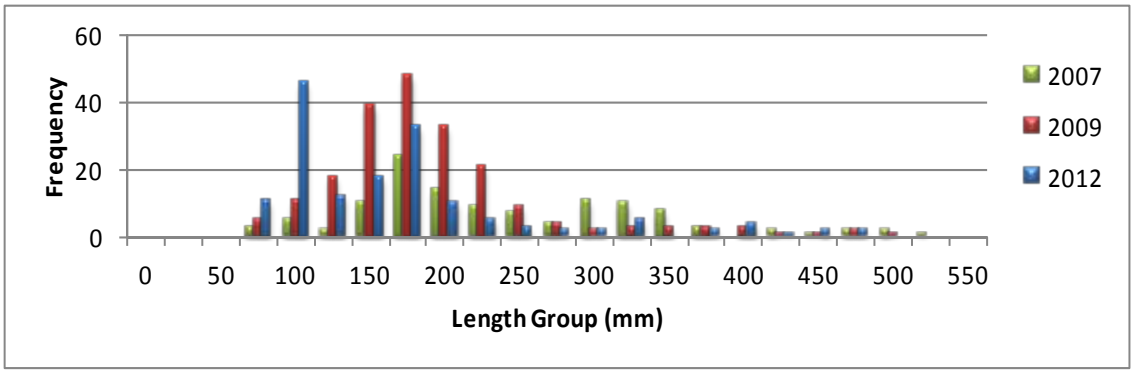
The 2012 Relative Stock Density (RSD) for preferred smallmouth bass (TL ≥ 350 mm) above the reservoir was 11.5. This was a significant increase from the 2009 value of 3.7(Figure 19). With the exception of the stock category we observed increases in all other RSD categories when compared to 2009. The PSD of smallmouth bass (ratio of quality size bass to stock size bass) was 46.1 above the reservoir indicating a good number of quality size bass in the population. The relative strength of the stock category in 2012 is encouraging for bolstering the size structure in coming years providing recruitment remains proportional. We did collect fish in the memorable category which has not occurred since 2004.

Figure 19. Relative stock density (RSD) catch per unit effort by category for smallmouth bass collected from the French Broad River above Douglas Reservoir between 2007-2012.



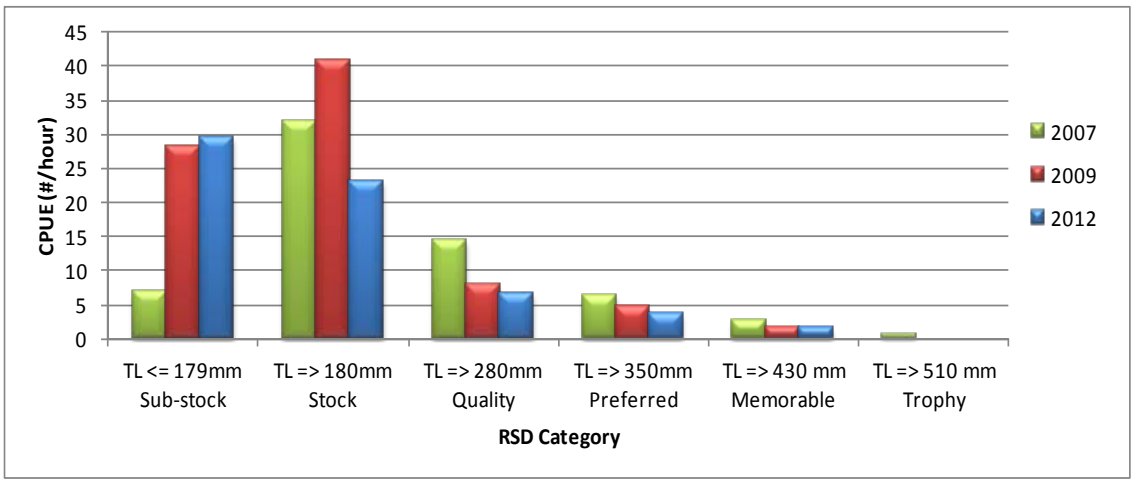
The length distribution of smallmouth bass below Douglas Reservoir was predominantly comprised of individuals in the 75 to 225 mm size range. We did collect two bass that were in the 19 inch class. Overall, the abundance of quality size bass in this section of the river was similar to number of fish collected in 2009 (Figure 20).

Figure 20. Length frequency distribution for smallmouth bass collected from the French Broad River below Douglas Reservoir between 2007-2012.



Trends in catch per unit effort by RSD category below Douglas Reservoir appeared to follow a downward trend when compared to 2007 and 2009. This was evident in all size groups with the exception of the sub-stock category which increased slightly and the memorable size groups remained relatively unchanged (Figure 21). The PSD for smallmouth bass increased to 28.9 in 2012 from 19.1 in 2009 reflecting higher recruitment of bass into quality size.

Figure 21. Relative stock density (RSD) catch per unit effort by category for smallmouth bass collected from the French Broad River below Douglas Reservoir between 2007-2012.

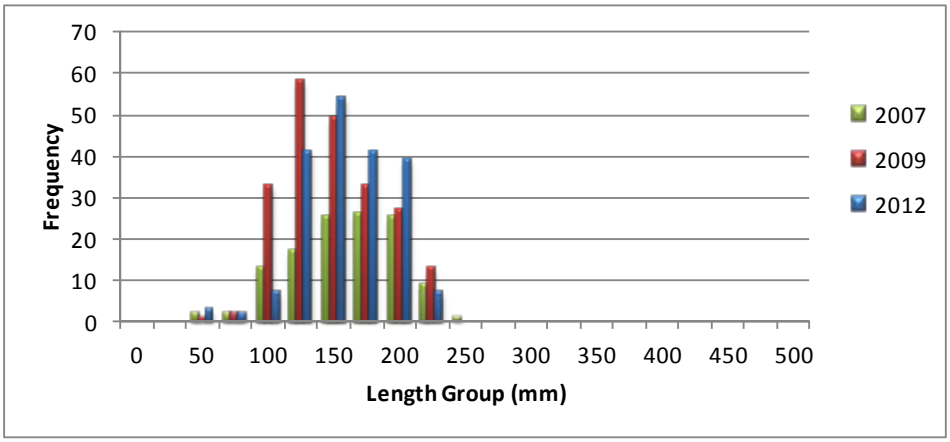


The majority of the six spotted bass collected from the French Broad River during 2012 fell within the 200 mm to 325 mm length range (Figure 22). Only three spotted bass were collected from the upper French Broad, ranging from 200 mm to 350 mm. Because of the low number, no analyses were conducted for these fish.

Very few (2) largemouth bass were collected in the French Broad during 2012. None were collected in samples above Douglas Reservoir. Of those collected below the reservoir, one was 362 mm in length and the other was 210 mm. Because of the low number, no analyses were conducted for these fish.

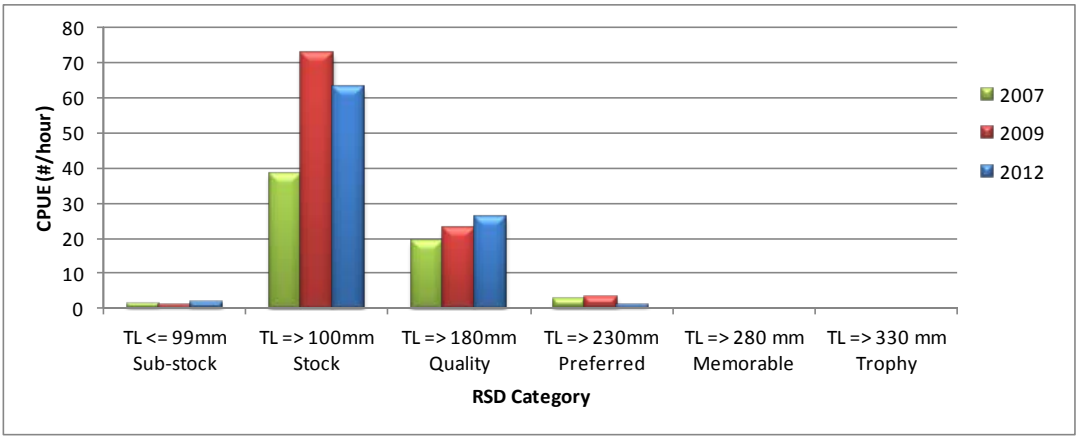
We did collect two rock bass in the French Broad above Douglas Reservoir in 2012 (none in 2009 and one in 2007). We are hopeful that this species continues to persist in this section of the river. Rock bass a fairly intolerant to pollution and therefore are good indicators of habitat quality. We were encouraged to see them in our 2012 sample and will be monitoring trends in future surveys. A total of 194 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 125 mm to 200 mm length range in 2012 (Figure 22).

Figure 22. Length frequency distributions for rock bass collected from the French Broad River below Douglas Reservoir between 2007-2012.



PSD for the rock bass population in the lower French Broad was 41.2. This was up from the 2009 value of 31.4. The value for preferred rock bass (TL ≥ 230 mm) was 1.5. Memorable (TL ≥ 280 mm) and trophy (TL ≥ 330 mm) rock bass values were 0. Sub-stock catch of rock bass was low (Figure 23), however, this does not necessarily indicate the lack of reproduction. The vulnerability of these smaller fish to the electrofishing gear is considerably lower than larger size groups. Recruitment of rock bass into the stock and quality size was good in 2012 with about 40% of the catch comprised of quality (TL > 180 mm) size fish or larger (Figure 23). Our catch rate of preferred rock bass decreased from the value in 2009.

Figure 23. Relative stock density (RSD) catch per unit effort by category for rock bass collected in the French Broad River below Douglas Reservoir between 2007-2012.



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 above Douglas reservoir is moderate at best, 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. In the tailwater section of the river below Douglas Reservoir, smallmouth bass fishing opportunities could be ranked as one of the region's best, producing some trophy size bass and numerous smallmouth that would be considered quality size. Water quality improvements to the tailwater section of the river by TVA have allowed for the recovery of selected species of fish and mussels. The snail darter, listed as threatened, is the most notable success story in the tailwater. Lake sturgeon stockings into the tailwater are continuing in hopes of recovering this species to some of its former range.

The establishment of a musky *(Esox masquinongy)* fishery in the reach of river upstream of Douglas Reservoir was initiated in 2009. 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.) and until 2009 was the only possibility for musky to enter the Tennessee portion of the river. Between 2010 and 2011 we were able to release 1,000 musky in the French Broad between river mile 77.4 and 100. In 2012, there were no musky stocked into the French Broad due to low survival at the hatchery. We will continue to pursue out sources of musky for release into the French Broad as TWRA currently does not have a musky production program.

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, Seven Islands and at Huffaker Ferry in Kodak. 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 2015 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 (in progress) upstream of Douglas Reservoir.

Cove Creek

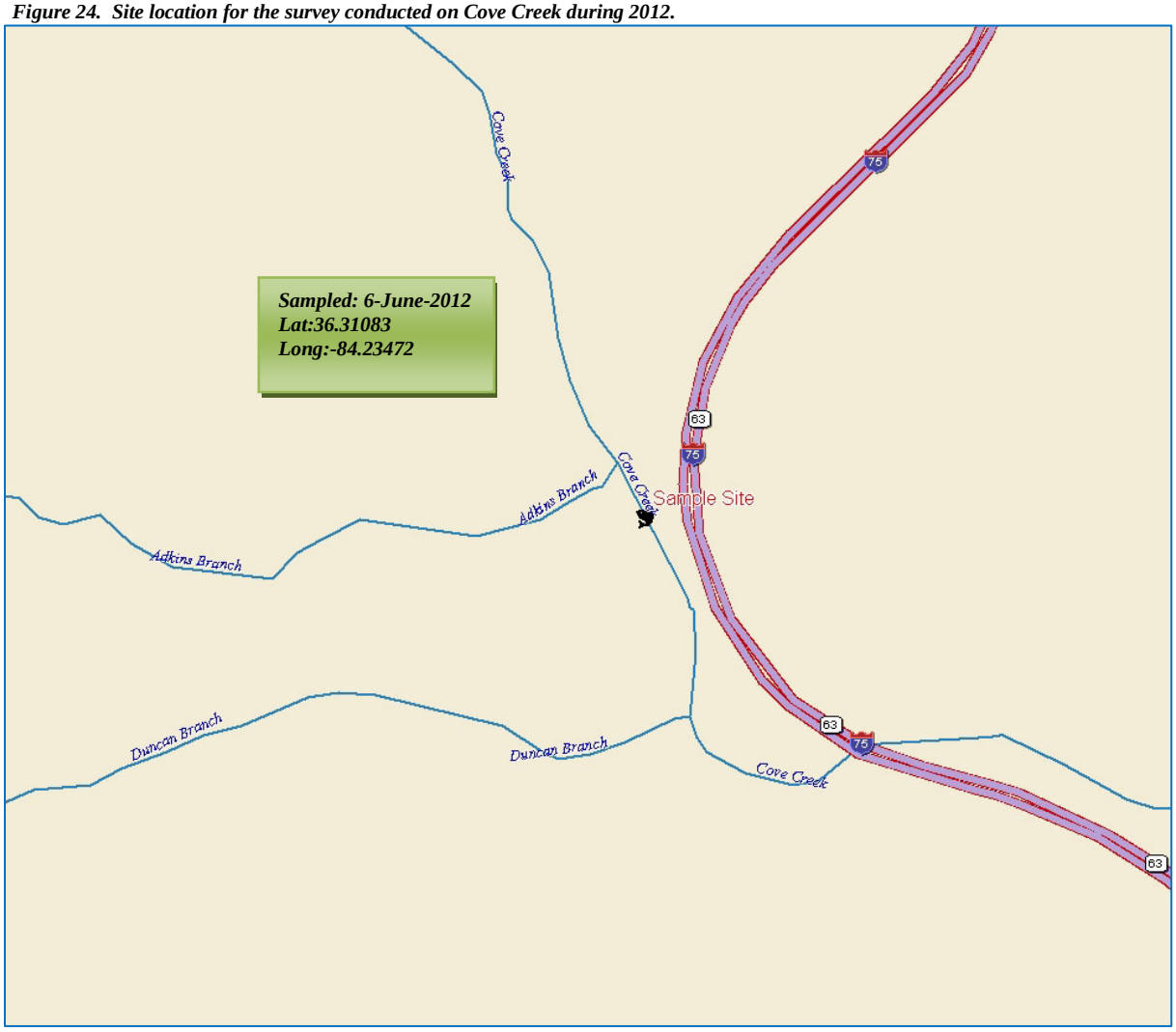
Introduction

Cove Creek was sampled in 2012 in cooperation with the USEPA as a reference site for coal mine permit renewal sampling being conducted in Campbell Co. The Agency surveyed Cove Creek at this site in 1996 to gather baseline data for TADS and to evaluate the relative health of the stream.

Study Area and Methods

Our survey of Cove Creek was located along old Hwy. 63 downstream of Adkins Branch and adjacent to Red Ash Baptist Church (Figure 24). The survey was conducted on June 6, 2012. One Index of Biotic Integrity (IBI) survey was conducted in order to assess the relative health of the stream. We surveyed about 500 meters of the stream in order to fulfill the depletion requirements of the IBI. The stream at this location was moderately graded and had substrate composition of primarily gravel, cobble and bedrock in the riffle areas and silt, sand and gravel in the pools. In stream habitat was a fairly even mix of pool and riffle/run habitat. Both riparian zones were intact and well vegetated with shrubs and trees. We used one backpack electrofishing unit in combination with a 15' seine to collect fish.

Figure 24. Site location for the survey conducted on Cove Creek during 2012.



Results

We collected a total of 333 fish representing 13 species during the sample (Table 8). The two dominant species collected were striped shiner and largescale stoneroller minnow. Together, these two species comprised 65% of the fish collected. Two darter species were collected which included redline darter and rainbow darter. One sucker species (northern hog sucker) was also collected during the survey effort. Game species collected included rock bass, green sunfish, bluegill, smallmouth bass and spotted bass. With the exception of bluegill, other game species occurred at low abundance.

Table 8. Fish and species collected from Cove Creek during 2012.

SPECIES	NUMBER
Campostoma oligolepis	185
Etheostoma caeruleum	31
Luxilus chrysocephalus	33
Percina caprodes	10
Ambloplites rupestris	4
Etheostoma rufilineatum	14
Hypentelium nigricans	7
Lepomis cyanellus x L. macrochirus	4
Lepomis cyanellus	9
Lepomis macrochirus	20
Micropterus dolomieu	6
Semotilus atromaculatus	6
Pimephales notatus	2
Micropertus punctatus	2

Overall, the IBI analysis indicated Cove Creek was in poor condition (IBI score = 32). Generally streams in this classification are dominated by omnivores, tolerant forms, and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; hybrids and diseased fish are often present. The most influential metrics on our score were the low number of

Table 9. Cove Creek Index of Biotic Integrity analysis 2012.

Metric Description	Scoring Criteria 1 3 5	Observed	Score
Number of Native Species	<10 10-19 >19	13	3
Number of Darter Species	<3 3-4 >4	3	3
Number of Sunfish Species less *Micropterus sp.*	<2 2 >2	3	5
Number of Sucker Species	<2 2 >2	1	1
Number of Intolerant Species	<2 2-3 >3	1	1
Percent of Individuals as Tolerant	>33 33-17 <17	14.4	5
Percent of Individuals as Omnivores	>39 39-20 <20	56.1	1
Percent of Individuals as Specialists	<19 19-36 >36	16.5	1
Percent of Individuals as Piscivores	<2 2-4 >4	3.6	3
Catch Rate	<22 22-43 >43	22.7	3
Percent of Individuals as Hybrids	>1 Trace-1 0	1.2	1
Percent of Individuals with Anomalies	>5 2-5 <2	0.3	5
		Total	**32 (Poor)**

sucker species, low number of intolerant species, low percentage of trophic specialists, and high percentage of omnivores in the sample (Table 9).

Discussion

As is the case with many streams located in the area coal mining has had a negative influence on the fish community in this stream. Our 1996 assessment resulted in an IBI score of 28 (poor). The 2012 assessment improved slightly to 32 but the stream was still categorized as poor based on the fish community we sampled. The occurrence of redline darter was new in the 2012 survey which had a positive influence on the score. Given the current land use in the area and the continued development within the watershed, it is not likely that Cove Creek will ever recover to its full potential.

Management Recommendations

1. Any action that would address non-point source pollution within the watershed would be beneficial.

Pigeon River

Introduction

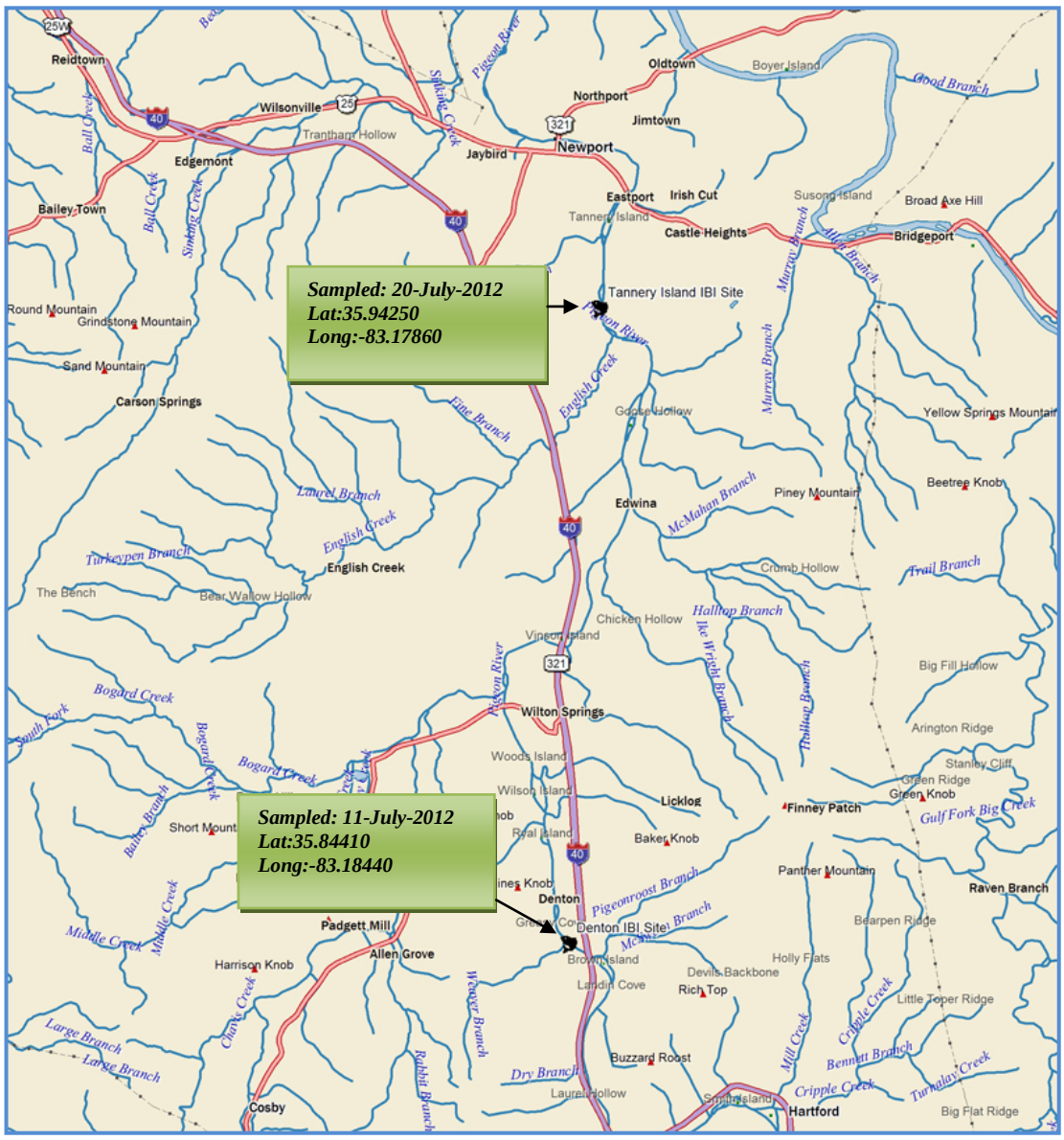
The Pigeon River has had a long history of pollution problems, stemming primarily from the discharge of wastewater from the Champion Paper Mill in Canton, North Carolina. This discharge has undoubtedly had a profound effect on the recreational use of the river and after the discovery of elevated dioxin 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, one near river mile 8.2 (Tannery Island) and one at river mile 16.6 (Denton).

Our 2011 surveys focused on continuing the evaluation of 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 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. 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,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 20, 2012, we conducted IBI fish surveys at Tannery Island (PRM 8.2) and Denton (PRM 16.6) (Figure 25).

Figure 25. Site locations for the IBI samples conducted in the Pigeon River during 2012.



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.

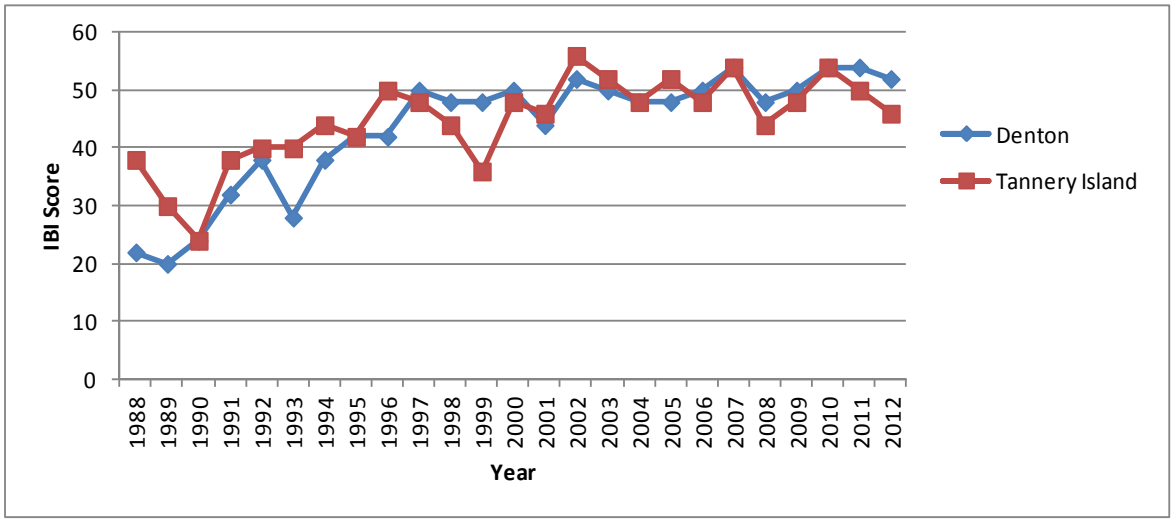
Results

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. A total of 31 fish species were collected at both the Tannery Island and Denton sites (Table 10). Overall, the IBI analysis indicated the fish community was in fair/good condition at Tannery Island (IBI score 46). This was a four point decrease from the 2011 score. The condition of the fish community assessed "good" at the Denton site in 2012(52) (Figure 26).

Table 10. Fish species collected at the two Pigeon River IBI stations during 2012.

Pigeon River Mile	8.2 (Tannery Island)	Number Collected	16.6 (Denton)	Number Collected
	420123601		420123603	
	Ambloplites rupestris	12	*Ambloplites rupestris*	25
	Ameiurus natalis	1	*Ameiurus natalis*	1
	Campostoma oligolepis	159	*Campostoma oligolepis*	153
	Carpiodes carpio	1	*Cottus carolinae*	41
	Cyprinella galactura	31	*Cyprinella galactura*	299
	Cyprinella spiloptera	16	*Cyprinella spiloptera*	4
	Cyprinus carpio	4	*Dorosoma cepedianum*	69
	Dorosoma cepedianum	110	*Etheostoma blennioides*	26
	Dorosoma petenense	1	*Etheostoma rufilineatum*	235
	Etheostoma blennioides	234	*Etheostoma tennesseense*	13
	Etheostoma kennicotti	13	*Hybopsis amblops*	7
	Etheostoma rufilineatum	620	*Hypentelium nigricans*	32
	Hypentelium nigricans	23	*Ichthyomyzon bdellium*	6
	Ichthyomyzon bdellium	2	*Ictalurus punctatus*	11
	Ictiobus bubalus	13	*Ictiobus bubalus*	7
	Ictiobus niger	3	*Ictiobus niger*	3
	Lepomis auritus	19	*Lepomis auritus*	46
	Lepomis macrochirus	9	*Lepomis cyanellus*	2
	Micropterus dolomieu	10	*Lepomis macrochirus*	2
	Micropterus salmoides	7	*Micropterus dolomieu*	32
	Moxostoma anisurum	3	*Moxostoma anisurum*	5
	Moxostoma breviceps	11	*Moxostoma breviceps*	1
	Moxostoma carinatum	6	*Moxostoma carinatum*	1
	Moxostoma duquesneii	31	*Moxostoma duquesneii*	26
	Moxostoma erythrurum	18	*Moxostoma erythrurum*	11
	Notemigonus crysoleucas	2	*Notropis micropteryx*	20
	Notropis micropteryx	23	*Notropis photogenis*	13
	Notropis photogenis	4	*Notropis telescopus*	228
	Notropis telescopus	17	*Pomoxis annularis*	17
	Pomoxis annularis	2	*Pomoxis nigromaculatus*	1
	Pylodictis olivaris	2	*Sander vitreus*	8

Figure 26. Trends in Index of Biotic Integrity (IBI) at two stations on the Pigeon River (1988-2012).



Benthic macroinvertebrates collected at the Tannery Island site comprised 35 families representing 39 identified genera (Table 11). The most abundant group in our collection was the caddisflies comprising 24.6% of the total sample. Overall, a total of 53 taxa were identified from the sample of which 13 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” (3.0).

Table 11. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from the Pigeon River at Tannery Island (river mile 8.2) July, 2012.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
AMPHIPODA			5	1.8
ANNELIDA				4.3
	Hirudinea		3	
	Oligochaeta		9	
COLEOPTERA				3.6
	Dytiscidae	*Laccophilus maculosus maculosus* male	1	
	Elmidae	*Ancyronyx variegatus* adult	2	
		Macronychus glabratus adult	1	
		Optioservus larva	1	
		Promoresia elegans adult	1	
		Stenelmis adult	1	
	Gyrinidae	*Dineutus discolor* female	1	
	Haliplidae	*Peltodytes muticus* adult	1	
	Psephenidae	*Psephenus herricki* larva	1	
DIPTERA				12.9
	Chironomidae		31	
	Empididae larva		1	
	Simuliidae		3	
	Tipulidae	*Tipula*	1	
EPHEMEROPTERA				8.6
	Baetidae	*Acentrella*	1	
		Baetis	3	
		Hetercloeon	7	
	Ephemerellidae	*Serratella deficiens*	1	
	Heptageniidae	*Maccaffertium* early instars	4	
		Maccaffertium mediopunctatum	6	
	Isonychiidae	*Isonychia*	2	
GASTROPODA				7.1
	Ancylidae	*Ferrissia*	1	
	Lymnaeidae		1	
	Physidae		3	
	Planorbidae		4	
	Pleuroceridae	*Leptoxis*	2	
		Pleurocera	9	
HETEROPTERA				1.8
	Belostomatidae	*Belostoma* nymph	1	
	Corixidae adult		1	
	Gerridae	*Metrobates hesperius*	3	
HYDRACARINA			19	6.8
ISOPODA				1.1
	Asellidae	*Caecidotea*	3	
MEGALOPTERA				3.2
	Corydalidae	*Corydalus cornutus*	9	
ODONATA				20.4
	Aeshnidae	*Basiaeschna janata*	3	
		Boyeria vinosa	6	
	Calopterygidae	*Hetaerina americana*	18	
	Coenagrionidae	*Argia moesta/translata*	3	
		Argia sedula	2	
		Enallagma	11	
		Ischnura hastata	5	
	Gomphidae	*Dromogomphus spinosus*	1	
		Hagenius brevistylus	2	
	Macromiidae	*Macromia*	6	
PELECYPODA				1.8
	Corbiculidae	*Corbicula fluminea*	5	
PLECOPTERA				0.4
	Leuctridae	*Leuctra*	1	
TRICHOPTERA				24.6
	Brachycentridae	*Brachycentrus lateralis*	1	
	Hydropsychidae	Pupae	3	
		Ceratopsyche morosa	18	
		Ceratopsyche sparna	1	
		Cheumatopsyche	29	
	Leptoceridae	*Oecetis*	3	
		Triaenodes ignitus	14	
TURBELLARIA			5	1.8
			280	

TAXA RICHNESS = 53 EPT TAXA RICHNESS = 13 BIOCLASSIFICATION = 3.0 (FAIR/GOOD)

Benthic macroinvertebrates collected at the Denton site comprised 37 families representing 48 identified genera (Table 12). The most abundant groups in our collection were the caddisflies and mayflies comprising about 58% of the total sample. Overall, a total of 59 taxa were identified from the sample of which 26 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 12. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from the Pigeon River at Denton (river mile 17.1) July, 2012.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
AMPHIPODA			2	0.4
ANNELIDA				2.7
	Hirudinea		2	
	Oligochaeta		12	
COLEOPTERA				4.8
	Dryopidae	*Helichus* adults	6	
	Elmidae	*Dubiraphia* adult	1	
		Macronychus glabratus adults	5	
		Promoresia elegans larva	1	
	Gyrinidae	*Dineutus* larvae	5	
		Dineutus discolor males and females	4	
		Gyrinus larva	1	
	Psephenidae	*Psephenus herricki*	2	
DIPTERA				16.2
	Athericidae	*Atherix lantha*	4	
	Chironomidae		68	
	Simuliidae		7	
	Tipulidae	*Antocha*	5	
		Tipula	1	
EPHEMEROPTERA				27.8
	Baetidae	*Acentrella*	15	
		Baetis	26	
		Heterocloeon	3	
	Caenidae	*Caenis*	4	
	Ephemerellidae	*Serratella*	14	
	Heptageniidae	*Maccaffertium* early instars	36	
		Maccaffertium ithaca	10	
		Maccaffertium mediopunctatum	1	
		Maccaffertium modestum	1	
		Stenacron interpunctatum	4	
	Isonychiidae	*Isonychia*	31	
	Leptohyphidae	*Tricorythodes*	1	
GASTROPODA				2.7
	Planorbidae	small specimen	1	
	Pleuroceridae	*Leptoxis*	9	
		Pleurocera relics	3	
	Viviparidae	*Campeloma*	1	
HETEROPTERA				0.8
	Gerridae	*Trepobates* female	1	
	Veliidae	*Rhagovelia obesa* adult female and nymphs	3	
HYDRACARINA				1.3
ISOPODA			7	
				2.7
	Asellidae	*Caecidotea*	14	
MEGALOPTERA				6.1
	Corydalidae	*Corydalus cornutus*	26	
		Nigronia serricornis	6	
ODONATA				2.9
	Aeshnidae	*Basiaeschna janata*	1	
		Boyeria vinosa	7	
	Coenagrionidae	*Argia moesta*	1	
		Argia sedula	2	
	Gomphidae	*Dromogomphus spinosus*	1	
		Stylurus spiniceps	1	
	Macromiidae	*Macromia*	2	
PELECYPODA				0.8
	Corbiculidae	*Corbicula fluminea*	3	
	Sphaeriidae	*Psidium*	1	
PLECOPTERA				0.8
	Perlidae	*Acroneuria abnormis*	4	
TRICHOPTERA				30.3
	Brachycentridae	*Brachycentrus lateralis*	3	
	Hydropsychidae	*Ceratopsyche morosa*	45	
		Ceratopsyche sparna	11	
		Cheumatopsyche	66	
		Hydropshche franclemonti	3	
		Hydropshche venularis	7	
	Hydroptilidae	*Hydroptila*	3	
		Leucotrichia pictipes	1	
	Lepidostomatidae	*Lepidostoma*	1	
	Leptoceridae	*Oecetis*	2	
		Triaenodes ignitus	1	
	Polycentropodidae	*Nyctiophylax*	1	
		Polycentropus	14	
	Psychomiidae	*Lype diversa*	1	

TAXA RICHNESS = 59 EPT TAXA RICHNESS = 26 BIOCLASSIFICATION = 4.0 (GOOD)

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.

Capuchin Creek

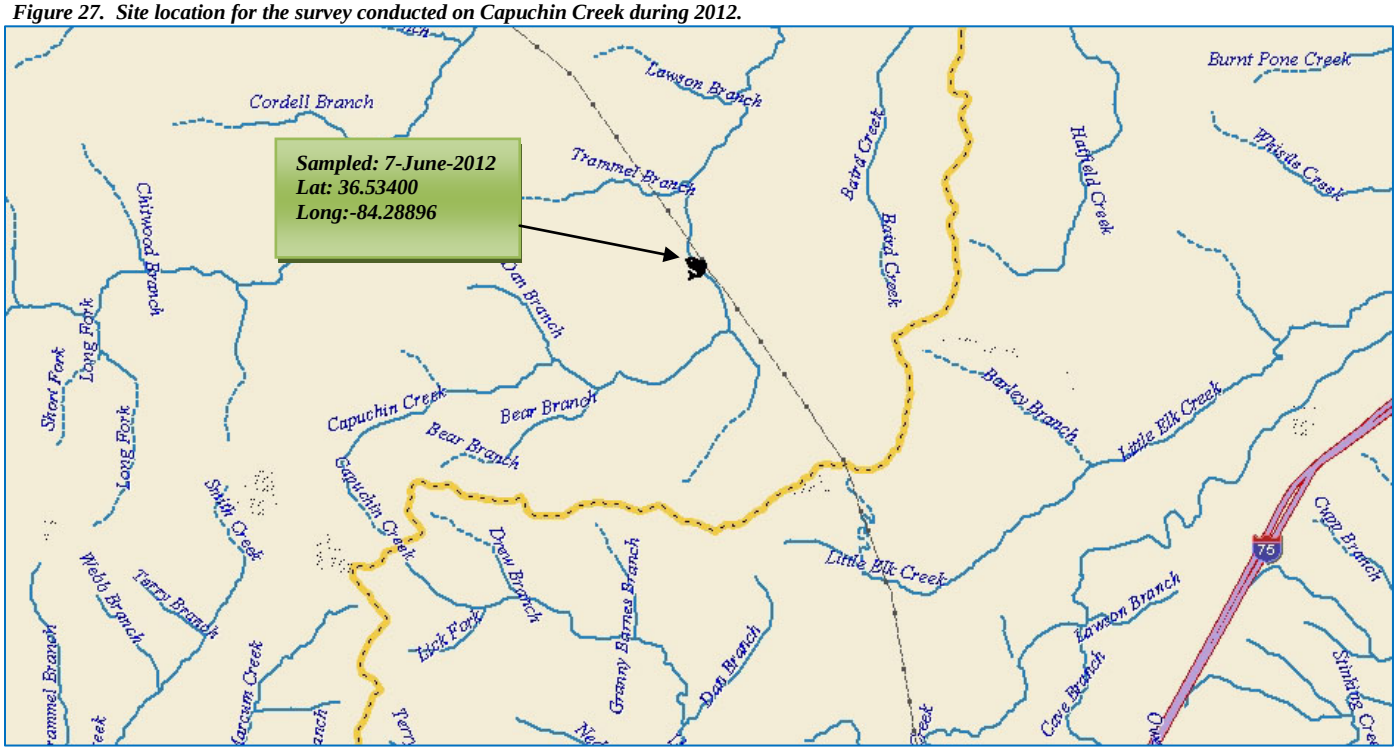
Introduction

Capuchin Creek was sampled in 2012 in cooperation with the U.S. Environmental Protection Agency as a reference site for coal mine permit renewal sampling being conducted in Campbell Co. The Agency surveyed Capuchin Creek at a downstream site in 1994 to gather baseline data for TADS and to evaluate the relative health of the stream.

Study Area and Methods

Our survey of Capuchin Creek was located along the old jeep road between Trammel Branch and Bear Branch in Scott Co. (Figure 27). The survey was conducted on June 7, 2012. One Index of Biotic Integrity (IBI) survey was conducted in order to assess the relative health of the stream. We surveyed about 500 meters of the stream in order to fulfill the depletion requirements of the IBI. The stream at this location was moderately graded and had substrate composition of primarily gravel, cobble and bedrock in the riffle areas and silt, sand and gravel in the pools. In stream habitat was a fairly even mix of pool and riffle/run habitat. Both riparian zones were intact and well vegetated with shrubs and trees. We used one backpack electrofishing unit in combination with a 15' seine to collect fish.

Figure 27. Site location for the survey conducted on Capuchin Creek during 2012.



Results

We collected a total of 263 fish representing eight species during the sample (Table 13). The two dominant species collected were creek chub and stripetail darter. Together, these two species comprised 76% of the fish collected. One sucker species (northern hog sucker) was also collected during the survey effort. Game species collected included rock bass and green sunfish. Two blackside dace and 11 Cumberland arrow daters were also collected from the site.

Table 13. Fish species collected from Capuchin Creek during 2012.

SPECIES	NUMBER
Ambloplites rupestris	1
Campostoma anamolum	28
Chrosomus cumberlandensis	2
Etheostoma kennicotti	72
Etheostoma sagitta sagitta	11
Hypentelium nigricans	4
Lepomis cyanellus	17
Semotilus atromaculatus	128

Overall, the IBI analysis indicated Capuchin Creek was in poor to fair condition (IBI score = 38). Generally streams in this classification are dominated by omnivores, tolerant forms, and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; hybrids and diseased fish are often present. The most influential metrics on our score were the low number of

Table 14. Capuchin Creek Index of Biotic Integrity analysis 2012.

Metric Description	Scoring Criteria 1 3 5	Observed	Score
Number of Native Species	<5 5-11 >11	8	3
Number of Darter Species	<2 2 >2	2	3
Number of Sunfish Species less *Micropterus sp.*	<2 2 >2	2	3
Number of Sucker Species	<1 1 >1	1	3
Number of Intolerant Species	<2 2 >2	2	3
Percent of Individuals as Tolerant	>20 20-10 <10	55.1	1
Percent of Individuals as Omnivores	>45 45-22 <22	0	5
Percent of Individuals as Specialists	<25 25-50 >50	31.5	3
Percent of Individuals as Piscivores	<1 1-5 >5	0.38	1
Catch Rate	<16 16-32 >32	30.1	3
Percent of Individuals as Hybrids	>1 Trace-1 0	0	5
Percent of Individuals with Anomalies	>5 2-5 <2	0.38	5
		Total	**38 (Poor/Fair)**

piscivorous species, high percentage of tolerant species, and low percentage of trophic specialists (Table 14).

Discussion

As is the case with many streams located in the area coal mining has had a negative influence on the fish community in this stream. Our 1994 assessment of the stream at a location further down in the watershed resulted in a score of 44 (fair). As part of another grant project surveying current Cumberland arrow darter distribution, we conducted a qualitative survey at the same station sampled in 1994. Here we collected two Cumberland darters (*Etheostoma susanae*) which have been recently listed by the USFWS as endangered. Given the current land use in the area and the continued development within the watershed, it is not likely that Capuchin Creek will ever recover to its full potential.

Management Recommendations

1. Any action that would address non-point source pollution within the watershed would be beneficial.

Straight Fork

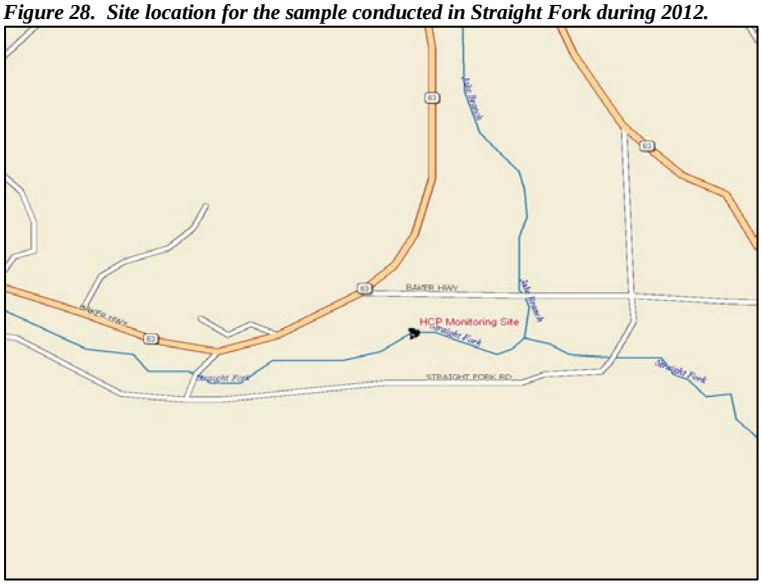
Introduction

Straight Fork was chosen for monitoring due to TWRA's planned forestry activity within the watershed and the occurrence of blackside dace in the stream. The blackside dace (federally listed) is the species of concern in this system and was identified as one of the key species for monitoring under the Habitat Conservation Plan (HCP).

Study Area and Methods

The area we surveyed was located near the confluence with Jake Branch (Figure 28). We conducted the survey on August 3, 2012. Our survey was actually on private land but was at the upper extent of the blackside dace distribution. There is a substantial reach of the stream above our survey site that flows through private land that depending on use, could have impacts on the population we are monitoring. We were confined to the reach of stream below Jake Branch due to low pH above this confluence that limits the occurrence of blackside dace. We surveyed approximately 208 meters of stream, recording our total electrofishing time so that subsequent samples could be repeated with same amount of effort. We used one backpack electrofishing unit operating at 150 volts DC to stun fish which were collected by the backpack operator or the netter assisting with the survey. A population estimate was derived for blackside dace using a one pass electrofishing model developed by Black and Mattingly (2007). Basic water quality collected at the site indicated a conductivity of 355 µs/cm, a pH of 6.0, and water temperature of 21.5 C. Overall, the physical habitat and condition of the stream scored 111 (marginal/sub-optimal). The most influential metrics on the overall score were the amount of sediment deposition, instability of the stream banks and substrate embeddedness.

Figure 28. Site location for the sample conducted in Straight Fork during 2012.



Results

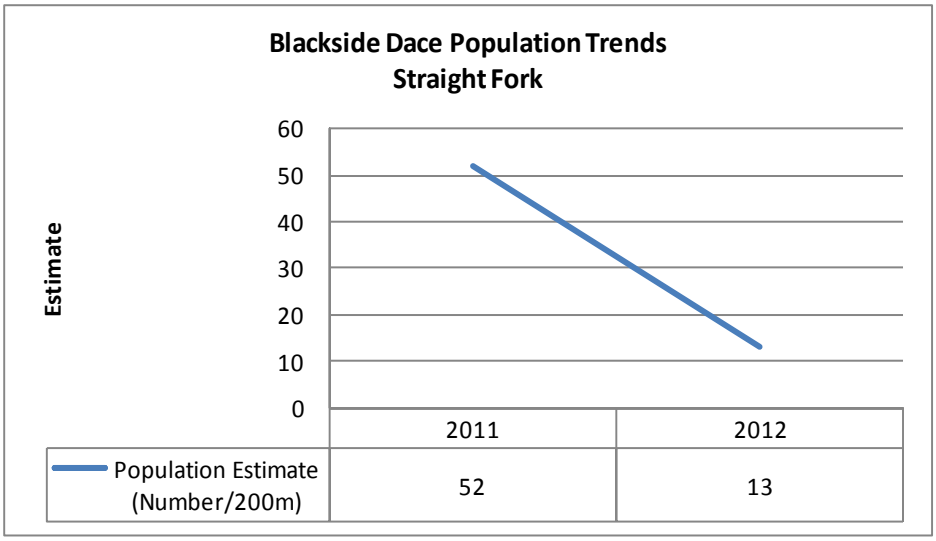
We collected four fish species (5 in 2011) during our 2012 survey of Straight Fork. The most common species were creek chub followed by the two

sunfish species. Four blackside dace were collected within our sample area (Table 15). Based on the one pass electrofishing catch, our estimate of the population size within our sample area was 13 dace/200m (Figure 29). This was down from 52 recorded in the 2011 survey. Blackside dace abundance is highly variable from year to year depending on flow conditions. Straight Fork flow was very low during 2012 and Jake Branch (tributary) almost went dry according to a resident on the stream. We did not collect largemouth bass or western blacknose dace in the 2012 sample but recorded redbreast sunfish that was not collected in 2011. These values will be used to develop trends over a five year period and serve as a benchmark for comparison should forestry practices take place within the watershed.

Table 15. Fish species collected from Straight Fork 2012.

Species	Abundance
Chrosomus cumberlandensis	4 (pop. est. = 13)
Lepomis cyanellus	Common
Lepomis auritus	Common
Semotilus atromaculatus	Abundant

Figure 29. Blackside dace population trends in Straight Fork 2011-12.



Discussion

Straight Fork is still under the influence of acid mine drainage and if not for the buffering effect of Jake Branch, recovery of stream would not be realized for some distance downstream of our sample location. In previous surveys of the stream, we have documented pH as low as 2.3 in tributaries to Straight Fork. We will return to repeat the sample in 2013 to add to the HCP database.

Management Recommendations

1. Continue to monitor blackside dace annually for the next three years.

Jake Branch

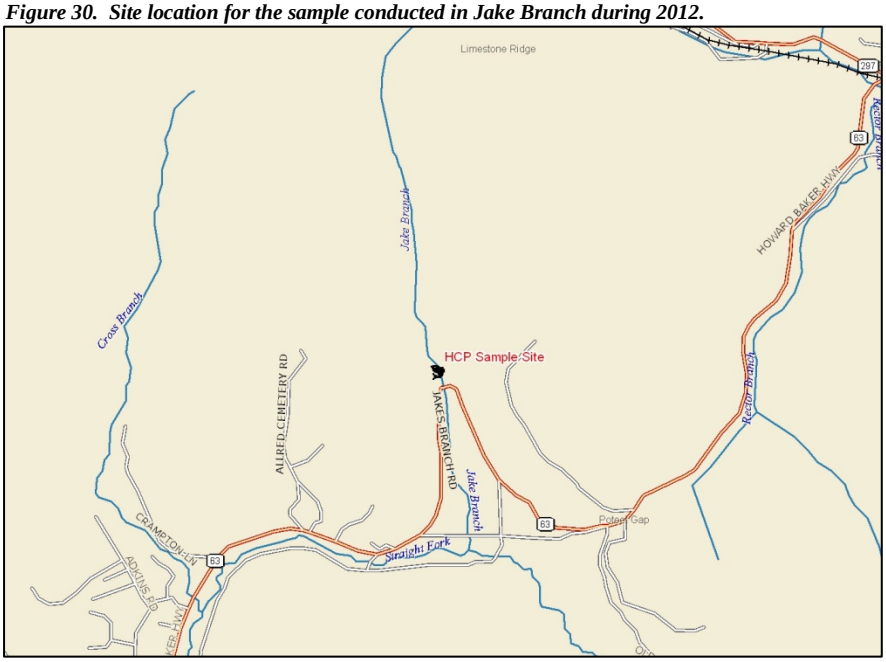
Introduction

Jake Branch was chosen for monitoring due to TWRA's planned forestry activity within the watershed and the occurrence of blackside dace in the stream. The blackside dace (federally listed) is the species of concern in this system and was identified as one of the key species for monitoring under the HCP.

Study Area and Methods

The area we surveyed was located approximately 0.6 miles upstream from the confluence with Straight Fork on the Bridge's property (Figure 30). We conducted the survey on August 3, 2012. Our survey was actually on private land but was at the upper extent of the blackside dace distribution. We did some initial distribution work to identify the area of the stream that had the best population of blackside dace prior to establishing the monitoring site. We were confined to the reach of stream located at the downstream boundary of the private property and the first farm road crossing upstream from the landowner residence. We surveyed approximately 178 meters of stream, recording our total electrofishing time so that subsequent samples could be repeated with same amount of effort. We used one backpack electrofishing unit operating at 150 volts DC to stun fish which were collected by the backpack operator or the netter assisting with the survey. A population estimate was derived for blackside dace using a one pass electrofishing model developed by Black and Mattingly (2007). Basic water quality collected at the site indicated a conductivity of 295 µs/cm, a pH of 6.0, and water temperature of 22 C. Overall, the physical habitat and condition of the stream scored 124 (sub-optimal). The most influential metrics on the overall score were the bank vegetative protection and the width of the riparian zone.

Figure 30. Site location for the sample conducted in Jake Branch during 2012.



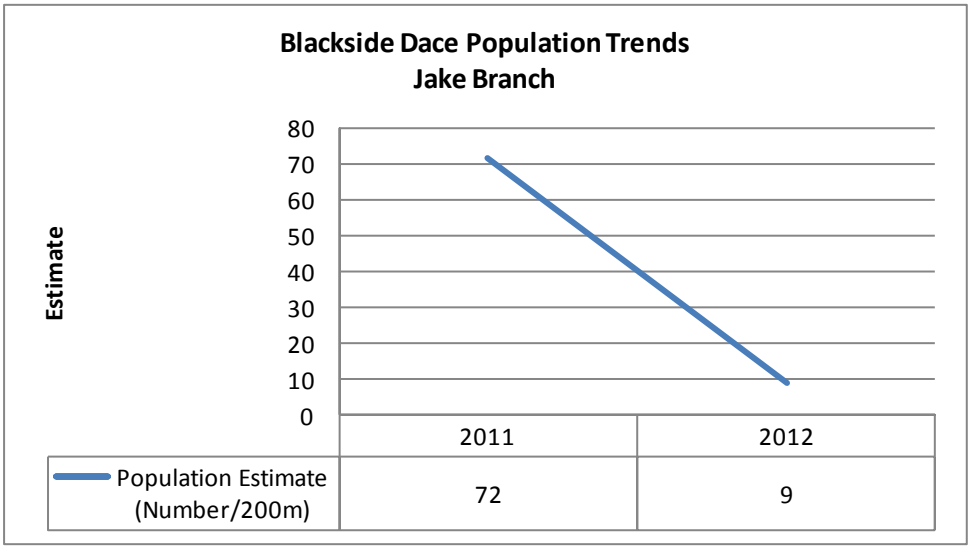
Results

We collected four fish species (same in 2011) during our survey of Jake Branch. The most common species were creek chub followed by green sunfish. Three blackside dace (22 in 2011) were collected within our sample area (Table 16). Based on the one pass electrofishing catch, our estimate of the population size within our sample area was 9 dace/200m (Figure 31). This was down from our 2011 estimate of 72. Blackside dace abundance is highly variable from year to year depending on flow conditions. Jake Branch flow was very low during 2012 and almost went dry according to a resident on the stream. These values will be used to develop trends over a five year period and serve as a benchmark for comparison should forestry practices take place within the watershed.

Table 16. Fish species collected from Jake Branch 2012.

Species	Abundance
Campostoma anomalum	Rare
Chrosomus cumberlandensis	3 (pop. est. = 9)
Lepomis cyanellus	Abundant
Semotilus atromaculatus	Abundant

Figure 31. Blackside dace population trends in Jake Branch 2011-12.



Discussion

There is the potential to manage the Jake Branch watershed for early successional forest type as identified in the HCP plan. Therefore, we will monitor the blackside dace in this stream in order to document trends in relation to TWRA's activities. We will return to repeat the sample in 2013 to add to the HCP database.

Management Recommendations

1. Continue to monitor blackside dace annually for the next three years.

Hudson Branch

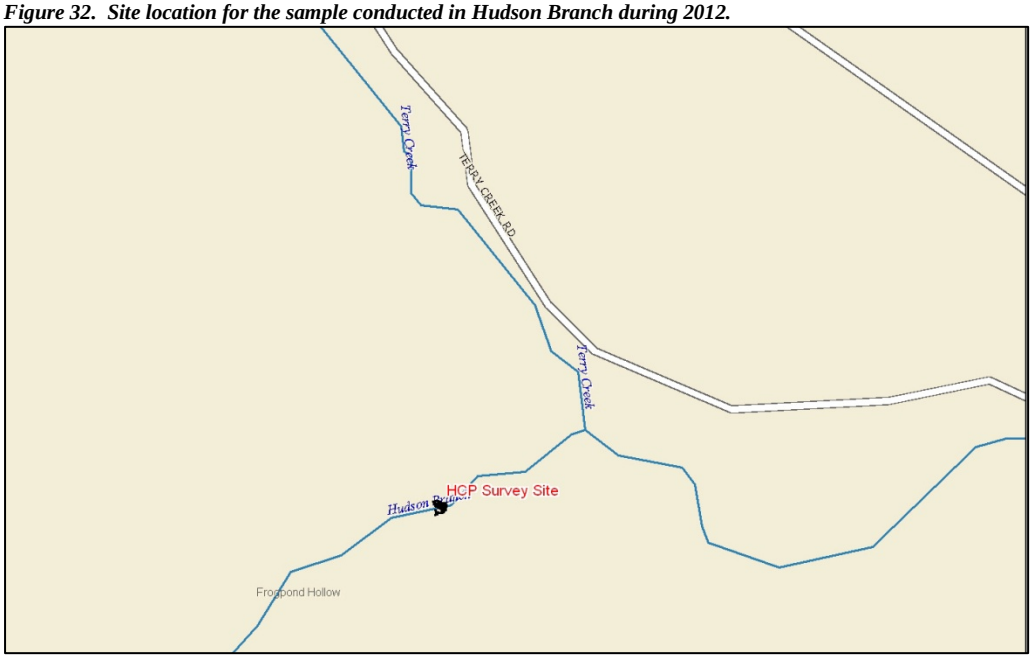
Introduction

Hudson Branch was chosen for monitoring due to TWRA's potential forestry activity within the watershed and the occurrence of blackside dace and Cumberland arrow darter in the stream. The blackside dace (federally listed) and Cumberland arrow darter (state listed) are species of concern in this system and were identified as key species for monitoring under the HCP.

Study Area and Methods

The area we surveyed was located approximately 0.1 miles upstream from the confluence with Terry Creek on private property (Figure 32). We conducted the survey on August 27, 2012. We surveyed approximately 234 meters of stream, recording our total electrofishing time so that subsequent samples could be repeated with same amount of effort. We used one backpack electrofishing unit operating at 300 volts DC to stun fish which were collected by the backpack operator or the netter assisting with the survey. A population estimate was derived for blackside dace using a one pass electrofishing model developed by Black and Mattingly (2007). Catch per unit effort (fish/hour) was calculated for Cumberland arrow darter. Basic water quality collected at the site indicated a conductivity of 140 µs/cm, a pH of 6.0, and water temperature of 21 C. Overall, the physical habitat and condition of the stream scored 89 (marginal). The most influential metrics on the overall score were sedimentation, epifaunal substrate and the bank instability. During the spring of 2012 a flash flood hit this watershed causing extreme alteration to the stream channel resulting in the lower habitat quality score. To compound the issue with the high water event, the stream was almost dry at the time of the survey.

Figure 32. Site location for the sample conducted in Hudson Branch during 2012.



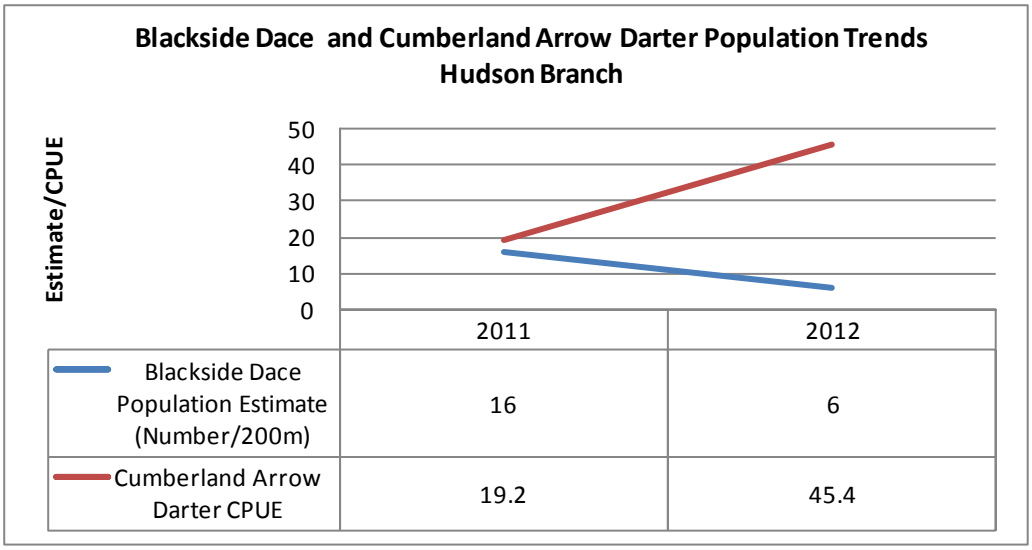
Results

We collected six fish species (6 in 2011) during our survey of Hudson Branch. The most common species collected in our survey was creek chub. Two blackside dace (5 in 2011) were collected within our sample area (Table 17). Based on the one pass electrofishing catch, our estimate of the population size within our sample area was 6 dace/200m (Figure 32). This was down from 16 recorded in the 2011 survey. Five Cumberland arrow darters were also collected (5 in 2011) during our survey. Based on our catch and the amount of electrofishing effort expended at the site we calculated a CPUE of 45.4/hour for this species. These values will be used to develop trends over a five year period and serve as a benchmark for comparison within the watershed.

Table 17. Fish species collected from Hudson Branch 2012.

Species	Abundance
Campostoma anomalum	Rare
Chrosomus cumberlandensis	2 (pop. est. = 6)
Etheostoma kennicotti	Scarce
Etheostoma sagitta sagitta	5 (CPUE = 45.4)
Lepomis cyanellus	Scarce
Semotilus atromaculatus	Common

Figure 32. Blackside dace and Cumberland arrow darter population trends in Hudson Branch 2011-12.



Discussion

There are no plans by TWRA forestry to conduct activity within this watershed currently. However, given the occurrence of blackside dace and Cumberland arrow darter we wanted to begin building background data as a control. We will return to repeat the sample in 2013 to add to the HCP database.

Management Recommendations

1. Continue to monitor blackside dace and Cumberland arrow darter annually for the next three years.

Terry Creek

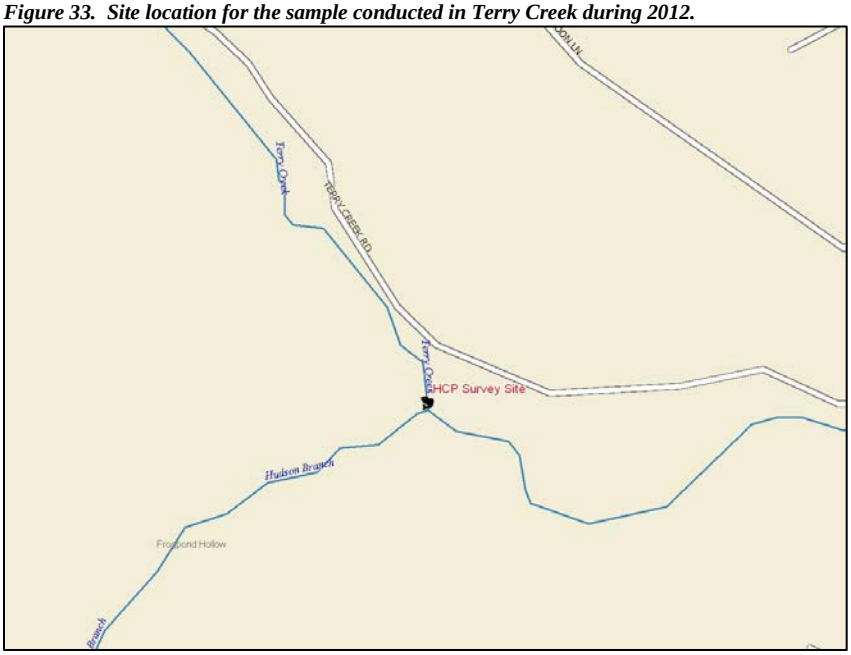
Introduction

Terry Creek was chosen for monitoring due to TWRA's potential forestry activity within the watershed and the occurrence of blackside dace and Cumberland arrow darter in the stream. The blackside dace (federally listed) and Cumberland arrow darter (state listed) are species of concern in this system and were identified as key species for monitoring under the HCP.

Study Area and Methods

The area we surveyed was located just upstream from the confluence with Hudson Branch on private property (Figure 33). We conducted the survey on August 27, 2012. We surveyed approximately 113 meters of stream, recording our total electrofishing time so that subsequent samples could be repeated with same amount of effort. We used one backpack electrofishing unit operating at 250 volts DC to stun fish which were collected by the backpack operator or the netter assisting with the survey. A population estimate was derived for blackside dace using a one pass electrofishing model developed by Black and Mattingly (2007). Catch per unit effort (fish/hour) was calculated for Cumberland arrow darter. Basic water quality collected at the site indicated a conductivity of 85 µs/cm, a pH of 6.0, and water temperature of 22 C. Overall, the physical habitat and condition of the stream scored 106 (sub-optimal). The most influential metrics on the overall score were the bank vegetative protection, lack of epifaunal substrate and bank instability.

Figure 33. Site location for the sample conducted in Terry Creek during 2012.



Results

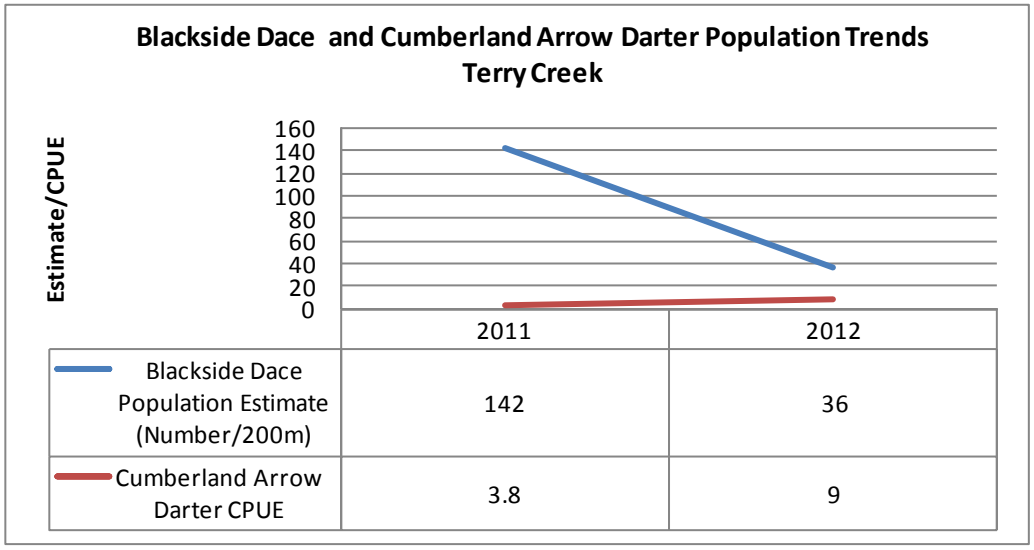
We collected nine fish species during our survey of Terry Creek. The most common species was creek chub. Due to flooding in 2012, the abundance of many species collected in 2012 had decreased. Three species collected in

2011 were not observed at all in 2012. These included southern redbelly dace, redbreast sunfish, and white sucker. Eleven blackside dace were collected within our sample area (Table 18). This was down from 43 in 2011. Based on the one pass electrofishing catch, our estimate of the population size within our sample area was 36 dace/200m (Figure 34). This was down from 142/200m in 2011. One Cumberland arrow darter was collected during our survey. Based on our catch and the amount of electrofishing effort expended at the site we calculated a CPUE of 9.0/hour for this species (3.8 in 2011). These values will be used to develop trends over a five year period and serve as a benchmark for comparison purposes within the watershed.

Table 18. Fish species collected from Terry Creek 2012.

Species	Abundance
Campostoma anomalum	Rare
Chrosomus cumberlandensis	11 (pop. est.= 36)
Etheostoma caeruleum	Common
Etheostoma kennicotti	Common
Etheostoma sagitta sagitta	1 (CPUE = 9.0/hour)
Hypentelium nigricans	Scarce
Lepomis cyanellus	Scarce
Luxilus chrysocephalus	Scarce
Semotilus atromaculatus	Common

Figure 34. Blackside dace and Cumberland arrow darter population trends in Terry Creek 2011-12.



Discussion

There are no plans by TWRA forestry to conduct activity within this watershed currently. However, given the occurrence of blackside dace and Cumberland arrow darter we wanted to begin building background data as a control. We will return to repeat the sample in 2013 to add to the HCP database.

Management Recommendations

1. Continue to monitor blackside dace and Cumberland arrow darter annually for the next three years.

Lick Fork

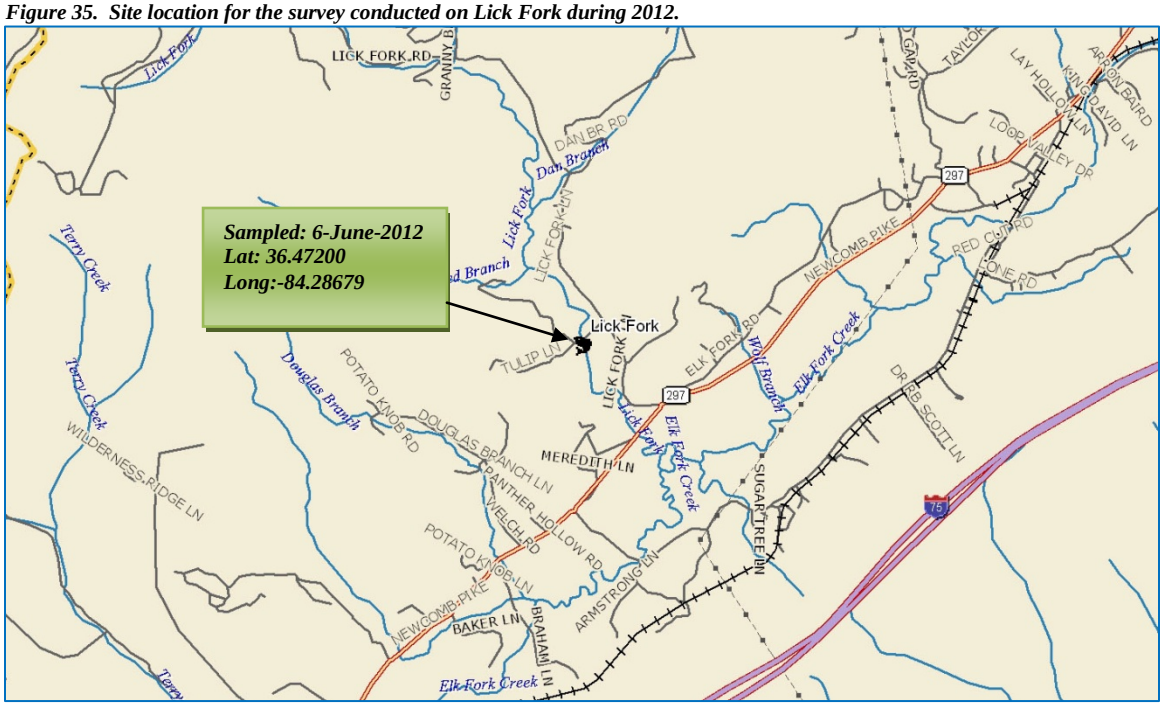
Introduction

Lick Fork was sampled in 2012 in cooperation with the USEPA for coal mine permit renewal being conducted in Campbell Co. The Agency surveyed Lick Fork this site in 1994 to gather baseline data for TADS and to evaluate the relative health of the stream. The site was surveyed again in 2012 as part of the Cumberland arrow darter status survey.

Study Area and Methods

Our survey of Capuchin Creek was located at the bridge crossing on Tulip Lane (Figure 35). The survey was conducted on June 6, 2012. One Index of Biotic Integrity (IBI) survey was conducted in order to assess the relative health of the stream. We surveyed about 500 meters of the stream in order to fulfill the depletion requirements of the IBI. The stream at this location was moderately graded and had substrate composition of primarily gravel, cobble and bedrock in the riffle areas and silt, sand and gravel in the pools. In stream habitat was a fairly even mix of pool and riffle/run habitat. Both riparian zones were intact and well vegetated with shrubs and trees. We used one backpack electrofishing unit in combination with a 20' seine to collect fish.

Figure 35. Site location for the survey conducted on Lick Fork during 2012.



Results

We collected a total of 181 fish representing nine species during the sample (Table 19). The two dominant species collected were creek chub and stripetail darter. Together, these two species comprised 75% of the fish collected. Three darter species were collected which included Cumberland arrow darter, stripetail darter and rainbow darter. One sucker species (northern hog sucker) was also collected during the survey effort. Game species collected included redbreast sunfish and green sunfish.

Table 19. Fish and species collected from Lick Fork during 2012.

SPECIES	NUMBER
Campostoma anomalum	1
Etheostoma caeruleum	11
Etheostoma kennicotti	29
Etheostoma sagitta sagitta	1
Hypentelium nigricans	1
Lepomis auritus	3
Lepomis cyanellus	26
Lepomis cyanellus x Lepomis auritus	2
Rhinichthys obtusus	1
Semotilus atromaculatus	106

Overall, the IBI analysis indicated Lick Fork was in poor condition (IBI score = 30). Generally streams in this classification are dominated by omnivores, tolerant forms, and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; hybrids and diseased fish are often present. The most influential metrics on our score were the low number of piscivorous species, high percentage of tolerant species, and low percentage of trophic specialists (Table 20).

Table 20. Lick Fork Index of Biotic Integrity analysis 2012.

Metric Description	Scoring Criteria 1 3 5	Observed	Score
Number of Native Species	<5 5-11 >11	8	3
Number of Darter Species	<2 2 >2	3	5
Number of Sunfish Species less *Micropterus sp.*	<2 2 >2	1	1
Number of Sucker Species	<1 1 >1	1	3
Number of Intolerant Species	<2 2 >2	1	1
Percent of Individuals as Tolerant	>20 20-10 <10	72.9	1
Percent of Individuals as Omnivores	>45 45-22 <22	0	5
Percent of Individuals as Specialists	<25 25-50 >50	22.6	1
Percent of Individuals as Piscivores	<1 1-5 >5	0	1
Catch Rate	<16 16-32 >32	17.9	3
Percent of Individuals as Hybrids	>1 Trace-1 0	1.1	1
Percent of Individuals with Anomalies	>5 2-5 <2	0	5
		Total	**30 (Poor)**

Discussion

As is the case with many streams located in the area coal mining has had a negative influence on the fish community in this stream. Our 1994 assessment of the stream at a location resulted in a score of 38 (poor/fair). Given the current land use in the area and the continued development within the watershed, it is not likely that Lick Fork will ever recover to its full potential.

Management Recommendations

1. Any action that would address non-point source pollution within the watershed would be beneficial.

Little Elk Creek

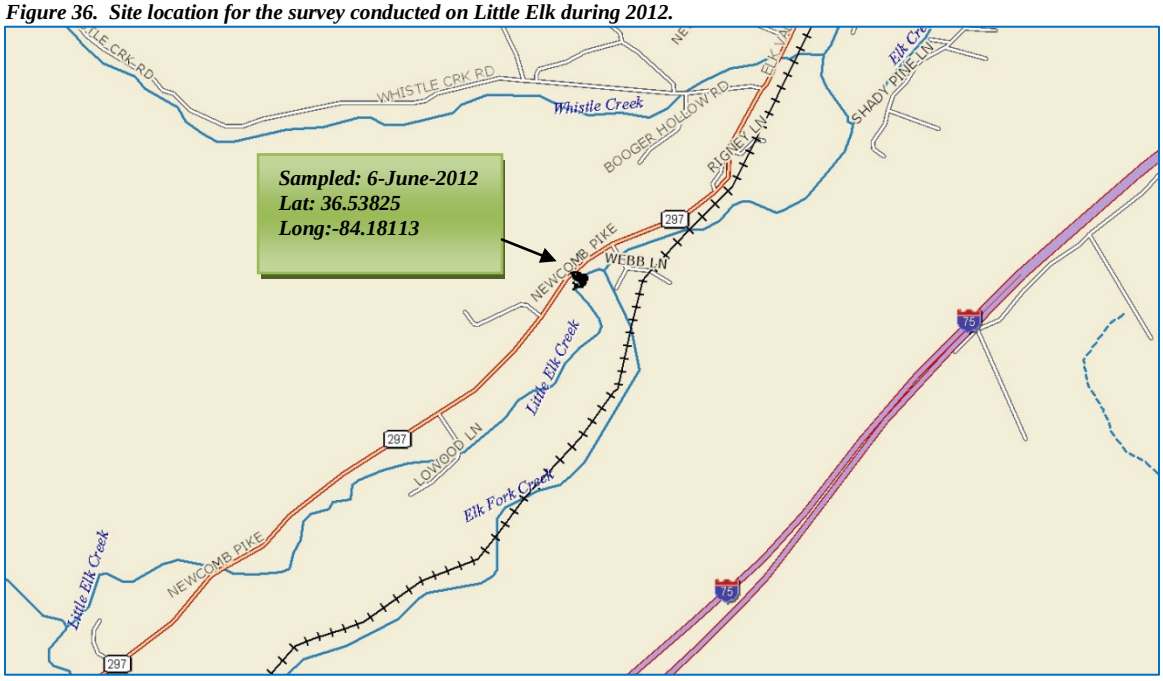
Introduction

Little Elk Creek was sampled in 2012 in cooperation with the USEPA for coal mine permit renewal being conducted in Campbell Co. The Agency surveyed this site in1994 to gather baseline data for TADS and to evaluate the relative health of the stream.

Study Area and Methods

Our survey of Little Elk Creek was located near the mouth just upstream of its confluence with Elk Fork Creek (Figure 36). The survey was conducted on June 6, 2012. One Index of Biotic Integrity (IBI) survey was conducted in order to assess the relative health of the stream. We surveyed about 500 meters of the stream in order to fulfill the depletion requirements of the IBI. The stream at this location was moderately graded and had substrate composition of primarily gravel, cobble and bedrock in the riffle areas and silt, sand and gravel in the pools. In stream habitat was a fairly even mix of pool and riffle/run habitat. Both riparian zones were intact and well vegetated with shrubs and trees. We used one backpack electrofishing unit in combination with a 15' seine to collect fish.

Figure 36. Site location for the survey conducted on Little Elk during 2012.



Results

We collected a total of 173 fish representing 14 species during the sample (Table 21). The two dominant species collected were redbreast sunfish and rainbow darter. Together, these two species comprised 43% of the fish collected. Two darter species were collected which included stripetail darter and rainbow darter. Two sucker species northern hog sucker and golden redhorse were also collected during the survey effort. Game species collected included redbreast sunfish, green sunfish, bluegill, longear sunfish, largemouth bass and warmouth.

Table 21. Fish and species collected from Little Elk Creek during 2012.

SPECIES	NUMBER
Campostoma anomalum	1
Etheostoma caeruleum	32
Etheostoma kennicotti	15
Hypentelium nigricans	13
Lepomis auritus	42
Lepomis cyanellus	10
Lepomis cyanellus x Lepomis macrochirus	1
Lepomis gulosus	1
Lepomis macrochirus	8
Lepomis megalotis	5
Luxilus chrosocephalus	12
Micropterus salmoides	4
Moxostoma erythrurum	12
Pimephales notatus	3
Semotilus atromaculatus	14

Overall, the IBI analysis indicated Capuchin Creek was in fair condition (IBI score = 42). The status of this stream remained relatively unchanged for our 1994 assessment which resulted in a score of 40. The most influential metrics on our score were the low number of intolerant species and the high percentage of tolerant species (Table 22).

Table 22. Little Elk Creek Index of Biotic Integrity analysis 2012.

Metric Description	Scoring Criteria 1 3 5	Observed	Score
Number of Native Species	<5 5-11 >11	13	5
Number of Darter Species	<2 2 >2	2	3
Number of Sunfish Species less *Micropterus sp.*	<2 2 >2	5	5
Number of Sucker Species	<1 1 >1	2	5
Number of Intolerant Species	<2 2 >2	0	1
Percent of Individuals as Tolerant	>20 20-10 <10	20.8	1
Percent of Individuals as Omnivores	>45 45-22 <22	15.6	5
Percent of Individuals as Specialists	<25 25-50 >50	27.1	3
Percent of Individuals as Piscivores	<1 1-5 >5	2.3	3
Catch Rate	<16 16-32 >32	16.1	3
Percent of Individuals as Hybrids	>1 Trace-1 0	0.5	3
Percent of Individuals with Anomalies	>5 2-5 <2	1.1	5
		Total	**42 (Fair)**

Discussion

As is the case with many streams located in the area coal mining has had a negative influence on the fish community in this stream. Although somewhat degraded, the fish community here was fairly diverse. Given the current land use in the area and the continued development within the watershed, it is not likely that Little Elk Creek will ever recover to its full potential.

Management Recommendations

1. Any action that would address non-point source pollution within the watershed would be beneficial.

Stinking Creek

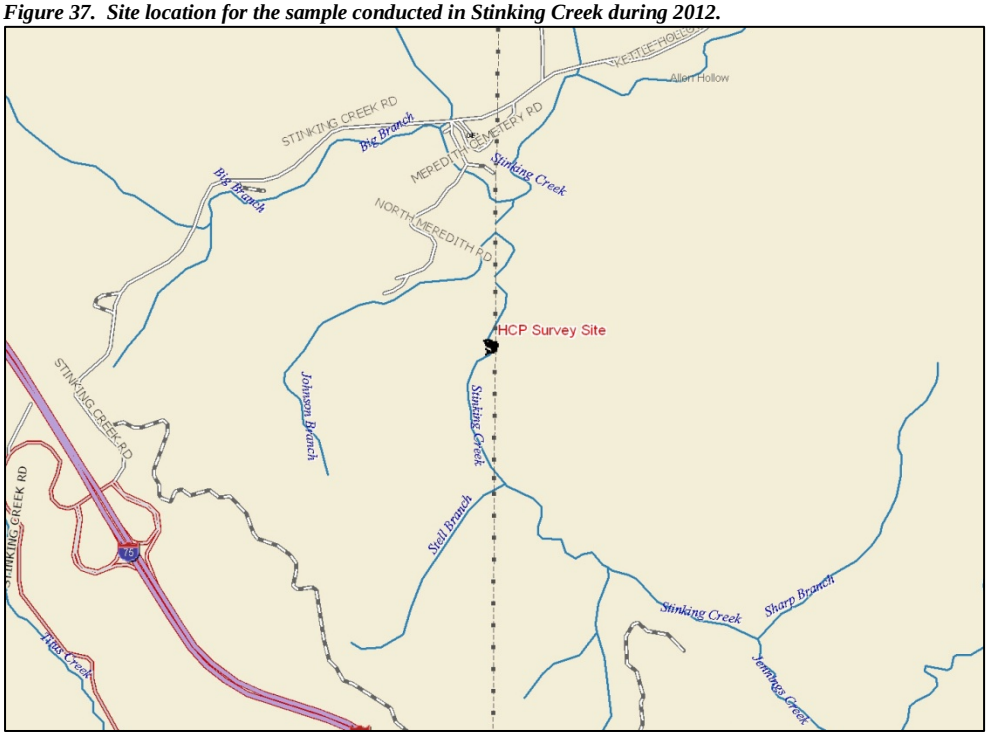
Introduction

Stinking Creek was chosen for monitoring due to TWRA's potential forestry activity within the watershed and the occurrence of Cumberland arrow darter in the stream. The Cumberland arrow darter (state listed) is a species of concern in this system and was identified as key species for monitoring under the HCP.

Study Area and Methods

The area we surveyed was located about 200 m upstream from the first road crossing after entering North Cumberland WMA (Figure 37). We conducted the survey on August 27, 2012. We surveyed approximately 200 meters of stream, recording our total electrofishing time so that subsequent samples could be repeated with same amount of effort. We used one backpack electrofishing unit operating at 250 volts AC to stun fish which were collected by the backpack operator or the netter assisting with the survey. Catch per unit effort (fish/hour) was calculated for Cumberland arrow darter. Basic water quality collected at the site indicated a conductivity of 145 µs/cm, a pH of 5.8, and water temperature of 24 C. Overall, the physical habitat and condition of the stream scored 128 (sub-optimal). The most influential metric on the overall score was the channel flow status due to dry conditions.

Figure 37. Site location for the sample conducted in Stinking Creek during 2012.



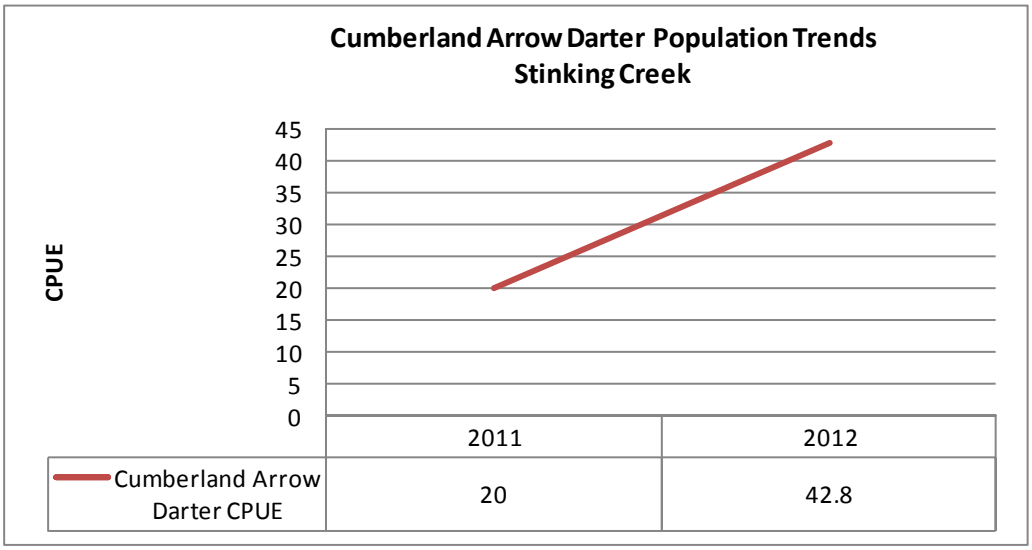
Results

We collected 16 fish species during our survey of Stinking Creek. There were several species in the survey that were common (Table 21). Twenty-one Cumberland arrow darters were collected during our survey. This was up substantially from the six collected in 2011. Based on our catch and the amount of electrofishing effort expended at the site we calculated a CPUE of 42.8/hour (20 in 2011) for this species (Figure 38). This value will be used to develop trends over the next three years and serve as a benchmark for comparison should forestry practices take place within the watershed.

Table 23. Fish species collected from Stinking Creek 2012.

Species	Abundance
Ambloplites rupestris	Rare
Campostoma anomalum	Scarce
Catostomus commersonnii	Rare
Cyprinella galactura	Rare
Etheostoma sagitta sagitta	21 (CPUE = 42.8/hour)
Etheostoma caeruleum	Common
Etheostoma kennicotti	Common
Hypentelium nigricans	Common
Lepomis auritus	Scarce
Lepomis macrochirus	Rare
Luxilus chrysocephalus	Rare
Micropterus dolomieu	Scarce
Notropis rubellus	Abundant
Percina maculata	Rare (1)
Pimephales notatus	Common
Semotilus atromaculatus	Abundant

Figure 38. Cumberland arrow darter population trends in Stinking Creek 2011-12



Discussion

There are plans by TWRA forestry to conduct forest management activities within this watershed in the future. We are monitoring Cumberland arrow darter to begin building background data for activities that will take place

here and evaluate any influence these activities may have on this species. We will return to repeat the sample in 2013 to add to the HCP database.

Management Recommendations

1. Continue to monitor Cumberland arrow darter annually for the next three years.

Louse Creek

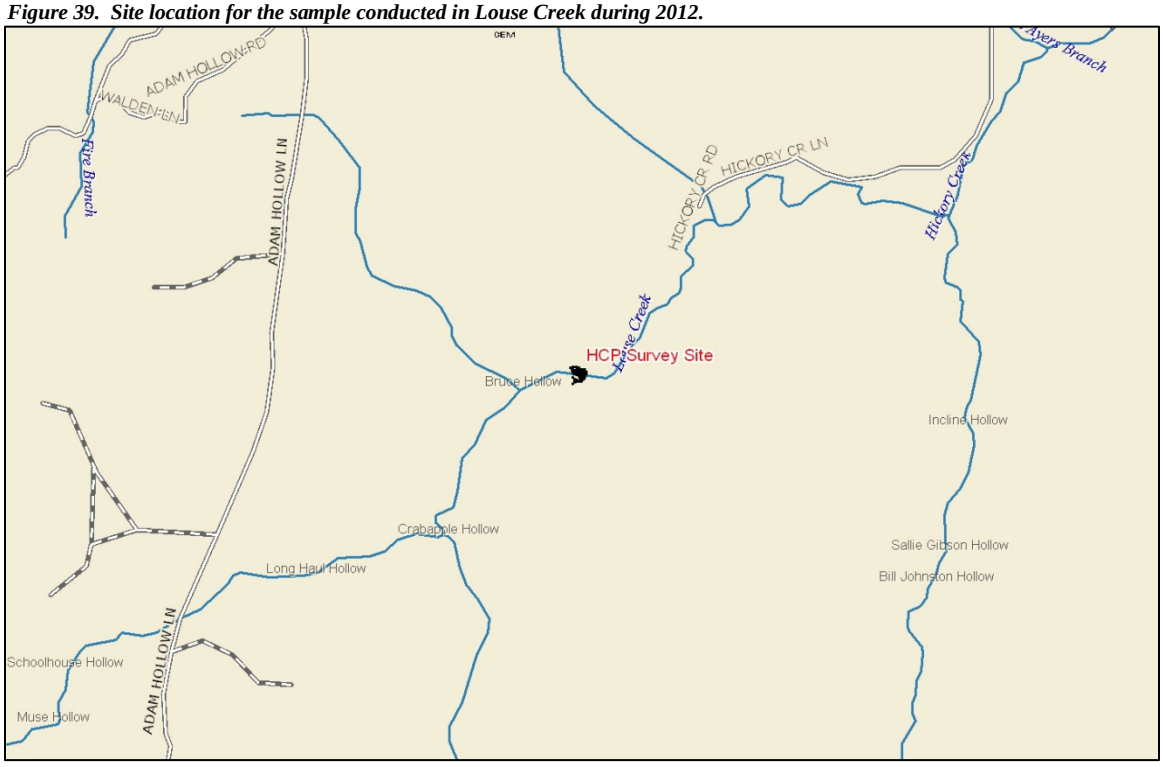
Introduction

Louse Creek was chosen for monitoring due to TWRA's potential forestry activity within the watershed and the occurrence of blackside dace and Cumberland arrow darter in the stream. The blackside dace (federally listed) and Cumberland arrow darter (state listed) are species of concern in this system and were identified as key species for monitoring under the HCP.

Study Area and Methods

The area we surveyed was located just upstream from the logging access road (Figure 39). We conducted the survey on August 27, 2012. We surveyed approximately 190 meters of stream, recording our total electrofishing time so that subsequent samples could be repeated with same amount of effort. We used one backpack electrofishing unit operating at 250 volts DC to stun fish which were collected by the backpack operator or the netter assisting with the survey. A population estimate for blackside dace was generated using a one pass electrofishing model developed by Black and Mattingly (2007). Catch per unit effort (fish/hour) was calculated for Cumberland arrow darter. Basic water quality collected at the site indicated a conductivity of 135 µs/cm, a pH of 6.0, and water temperature of 24 C. Overall, the physical habitat and condition of the stream scored 121 (sub-optimal) which was similar to the previous year's score 127. The most influential metric on the overall score was bank instability.

Figure 39. Site location for the sample conducted in Louse Creek during 2012.



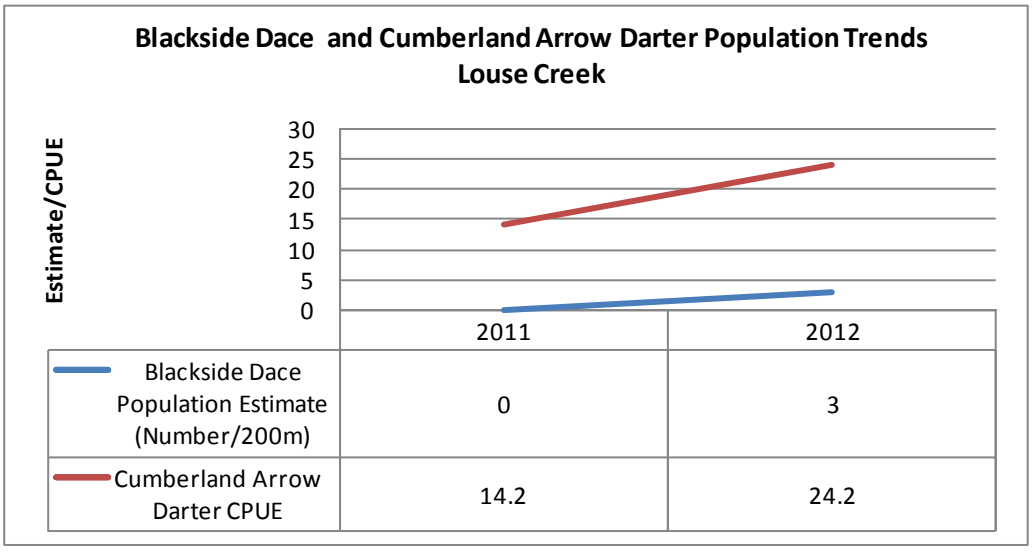
Results

We collected 11 fish species during our survey of Louse Creek. The most common species were creek chub, stripetail darter, stoneroller, smallmouth bass and rainbow darter (Table 24). We did collect one blackside dace collect in our survey site. We did not observe any blackside dace in our 2011 survey. Based on the one pass electrofishing catch, our estimate of the population size within our sample area was 3 dace/200m. Eight Cumberland arrow darters were collected during our survey. Based on our catch and the amount of electrofishing effort expended at the site we calculated a CPUE of 24.2/hour for this species (Figure 40). These values will be used to develop trends over the next three years and serve as a benchmark for comparison should forestry practices take place within the watershed.

Table 24. Fish species collected from Louse Creek 2012.

Species	Abundance
Campostoma anamolum	Common
Catostomus commersonii	Scarce
Chrosomus cumberlandensis	1 (pop. est. = 3)
Etheostoma caeruleum	Abundant
Etheostoma kennicotti	Common
Etheostoma sagitta sagitta	8 (CPUE = 24.2)
Hypentelium nigricans	Common
Lepomis macrochirus	Rare
Micropterus dolomieu	Common
Rhinichthys obtusus	Scarce
Semotilus atromaculatus	Abundant

Figure 40. Blackside dace and Cumberland arrow darter population trends in Louse Creek 2011-12.



Discussion

There are no plans by TWRA forestry to conduct activity within this watershed currently. However, given the occurrence of blackside dace and Cumberland arrow darter we wanted to begin building background data for

activities that may take place in the future. We will return to repeat the sample in 2013 to add to the HCP database.

Management Recommendations

1. Continue to monitor blackside dace and Cumberland arrow darter annually for the next three years.

Summary

During 2012, we collected 43 fish and four benthic macroinvertebrate samples. These included samples from Little River, Holston River, French Broad River River, and Pigeon River. Additionally, 15 streams were also surveyed for a variety of projects ongoing in 2012 (i.e. North Cumberland HCP).

Overall, CPUE estimates for black bass and rock bass looked relatively good despite several years of low water. In most instances, we observed declines in our smallmouth bass catch in the Holston and French Broad rivers. In the Holston, the catch of smallmouth bass was lower both below and above Cherokee reservoir when compared to the 2009 sample. However, rock bass illustrated increases in both stretches of the river, with the most noticeable being observed in the river below Cherokee reservoir. In the French Broad River, catches of smallmouth bass were up in the section above Douglas reservoir when compared to 2009 but declined in the section of river below the reservoir. Rock bass numbers increased slightly in the river above Douglas while a nominal decrease was observed in the river below the reservoir.

The IBI surveys for Little River and the Pigeon River changes slightly when compared to the 2011 values. In Little River, the Townsend site increased eight points from the 2011 value whereas the Coulters Bridge retained the same score as the previous year. The Pigeon River exhibited a decline of four points at the Tannery Island site when compared to 2011. Likewise, the score at the Denton decreased slightly from the previous year. Fish reintroductions continued on the Pigeon River with many of the introduced species collected in the 2012 IBI samples. Benthic macroinvertebrate diversity in Little River and the Pigeon rivers looked good during 2012.

Streams monitored for the HCP were completed and the second year of monitoring data for species covered under the plan was generated. We will continue to monitor these select streams over the next three years to establish benchmarks to relate to TWRA's forestry activities in these watersheds.

Over the past several 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 25 lists our results for various streams surveyed during this time period.

Table 25. Index of Biotic Integrity and Benthic Biotic Index scores for samples conducted between 1994 and 2012.

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 Cumberland River	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Burnt Pone Creek	Clear Fork Cumberland River	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Whistle Creek	Clear Fork Cumberland River	1994	Campbell	38 (Poor/Fair)	2 (Fair)

Table 25. Continued.

Water	Watershed	Year Surveyed	County	IBI Score	Benthic BI Score
Little Elk Creek	Clear Fork Cumberland River	1994	Campbell	40 (Fair)	2 (Fair)
Lick Fork	Clear Fork Cumberland River	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Terry Creek	Clear Fork Cumberland River	1994	Campbell	48 (Good)	2 (Fair)
Crouches Creek	Clear Fork Cumberland River	1994	Campbell	28 (Poor)	1 (Poor)
Hickory Creek (Site 1)	Clear Fork Cumberland River	1994	Campbell	46 (Fair/Good)	3 (Fair/Good)
Hickory Creek (Site 2)	Clear Fork Cumberland River	1994	Campbell	48 (Good)	2 (Fair)
White Oak Creek	Clear Fork Cumberland River	1994	Campbell	30 (Poor)	2 (Fair)
No Business Branch	Clear Fork Cumberland River	1994	Campbell	30 (Poor)	3 (Fair/Good)
Laurel Fork	Clear Fork Cumberland River	1994	Campbell	52 (Good)	3 (Fair/Good)
Lick Creek	Clear Fork Cumberland River	1994	Campbell	44 (Fair)	3 (Fair/Good)
Davis Creek	Clear Fork Cumberland River	1994	Campbell	38 (Poor/Fair)	2 (Fair)
Rock Creek	Clear Fork Cumberland River	1994	Campbell	54 (Good/Excellent)	3 (Fair/Good)
Little Tackett Creek	Clear Fork Cumberland River	1994	Claiborne	28 (Poor)	3 (Fair/Good)
Unnamed tributary to Little Tackett Creek	Clear Fork Cumberland River	1994	Claiborne	0 (No Fish)	3 (Fair/Good)
Rose Creek	Clear Fork Cumberland River	1994	Campbell	36 (Poor/Fair)	2 (Fair)
Rock Creek	Clear Fork Cumberland River	1994	Claiborne	28 (Poor)	2 (Fair)
Tracy Branch	Clear Fork Cumberland River	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)

Table 25. Continued.

Water	Watershed	Year Surveyed	County	IBI Score	Benthic BI Score
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)
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)
Little River (Coulters Bridge)	Tennessee River	2008	Blount	58 (Excellent)	3.8 (Fair-Good/Good)
Little River (Townsend)	Tennessee River	2008	Blount	56 (Good/Excellent)	3.0 (Fair/Good)
Pigeon River (Tannery Island)	French Broad River	2008	Cocke	44 (Fair)	2.0 (Fair)
Pigeon River (Denton)	French Broad River	2008	Cocke	48 (Good)	3.0 (Fair/Good)
Little River (Coulters Bridge)	Tennessee River	2009	Blount	58 (Excellent)	4.3 (Good)
Little River (Townsend)	Tennessee River	2009	Blount	58 (Excellent)	4.5 (Good)
Pigeon River (Tannery Island)	French Broad River	2009	Cocke	48 (Good)	3.0 (Fair/Good) July
Pigeon River (Denton)	French Broad River	2009	Cocke	50 (Good)	3.0 (Fair/Good) July
Pigeon River (Waterville)	French Broad River	2009	Cocke	-	4.5 (Good) March
Pigeon River (Denton)	French Broad River	2009	Cocke	-	4.3 (Good) March
Pigeon River (Tannery Island)	French Broad River	2009	Cocke	-	4.0 (Good) March
Poplar Creek	Clinch River	2009	Anderson	30 (Poor)	3.7 (Fair/Good-Good)
Titus Creek	Clinch River	2009	Campbell	-	4.5 (Good)
Pigeon River (Tannery Island)	French Broad River	2010	Cocke	54 (Good)	4.0 (Good)
Pigeon River (Denton)	French Broad River	2010	Cocke	54 (Good)	3.3 (Fair/Good)
Little River (Coulters Bridge)	Tennessee River	2010	Blount	60 (Excellent)	4.3 (Good)
Little River (Townsend)	Tennessee River	2010	Blount	58 (Excellent)	4.5 (Good/Excellent)
Smoky Creek	New River	2010	Scott	37 (Fair)	3.5 (Fair/Good)
Beech Fork	New River	2010	Campbell	47 (Good)	-
Pigeon River (Tannery Island)	French Broad River	2011	Cocke	50 (Good	2.5 (Fair)
Pigeon River (Denton)	French Broad River	2011	Cocke	54 (Good)	3.3 (Fair/Good)
Little River (Coulters Bridge)	Tennessee River	2011	Blount	58 (Excellent)	4.3 (Good)
Little River (Townsend)	Tennessee River	2011	Blount	50 (Good)	4.3 (Good)
Little River (Coulters Bridge)	Tennessee River	2012	Blount	58 (Excellent)	4.5 (Good)
Little River (Townsend)	Tennessee River	2012	Blount	58 (Excellent)	4.2 (Good)
Cove Creek	Clinch river	2012	Campbell	32 (Poor)	-
Pigeon River (Tannery Island)	French Broad River	2012	Cocke	46 (Good	3.0 (Fair/Good)
Pigeon River (Denton)	French Broad River	2012	Cocke	52 (Good)	4.0 (Good)
Capuchin Creek	Clear Fork Cumberland River	2012	Campbell	38 (Poor/Fair)	-
Little Elk Creek	Clear Fork Cumberland River	2012	Campbell	42 (Fair)	-

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