FISHERIES REPORT

Warmwater Streams and Rivers

Tennessee Wildlife Resources Agency--Region IV

2010

FISHERIES REPORT
REPORT NO.11-03
WARMWATER STREAM FISHERIES REPORT
REGION IV
2010

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TENNESSEE WILDLIFE RESOURCES AGENCY

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Cover: Rick Bivens displays a native "highland" walleye collected from the New River, Campbell Co.

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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.

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

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

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

METHODS

The streams to be sampled and the methods required are outlined in TWRA field request No. 04-10. Four rivers and four streams were sampled and are included in this report. Surveys were conducted from May to November 2010. A total of 20 (IBI, CPUE) fish and 11 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.

Catch-per-unit-effort samples (CPUE) were conducted in three rivers during 2010. 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 2010 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 11 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 for the next couple of field seasons in order to fully evaluate the new form.

Experimental Stream Habitat Assessment Form

STREAM QUALITY ASSESSMENT FORM

FORM:SQA-09-2004

Tennessee Wildlife Resources Agency Stream Survey Unit

STREAM:____________________ DATE:____________________

INVESTIGATOR:____________________ SITE CODE:____________________

LAT/LONG:____________________ ELEVATION:____________________

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

SCORE

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

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

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

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

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

6 BANK STABILITY ☐
(signs of bank erosion)

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

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

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

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

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

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

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

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

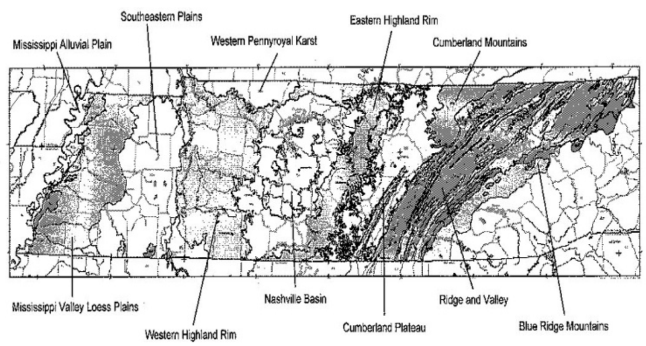
TOTAL ☐

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

STREAM ASSESSMENT VALUE = TOTAL + BIA → ☐

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

INDICATE (CIRCLE) ECOREGION:



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

CHECK IF STREAM IS:

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

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

DATA ANALYSIS

Twelve metrics described by Karr et al. (1986) were used to determine an IBI score for each stream surveyed. These metrics were designed to reflect fish community health from a variety of perspectives (Karr et al. 1986). Given that IBI metrics were developed for the midwestern United States, many state and federal agencies have modified the original twelve metrics to accommodate regional differences. Such modifications have been developed for Tennessee primarily through the efforts of TWRA (Bivens et al. 1995), TVA, and Tennessee Tech University. In developing our scoring criteria for the twelve metrics we reviewed pertinent literature [North American Atlas of Fishes (Lee et al. 1980), The Fishes of Tennessee (Etnier and Starnes 1993), various TWRA Annual Reports and unpublished data] to establish historical and more recent accounts of fishes expected to occur in the drainages we sampled. Scoring criteria for the twelve metrics were modified according to watershed size. Watersheds draining less than 13 kilometer^2 were assigned different scoring criteria than those draining greater areas. This was done to accommodate the inherent problems associated with small stream samples (e.g., lower catch rates and species richness). Young-of-the-year fish and non-native species were excluded from the IBI calculations. After calculating a final score, an integrity class was assigned to the stream reach based on that score. The classes used follow those described by Karr et al. (1986). Scoring criteria for the New River drainage IBI's are from Evans (1998).

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.

Evans (1998) criteria

5th Order Streams IBI	2nd, 3rd, and 4th Order Streams IBI	Classification
44-50	49-55	Excellent
37-43	41-48	Good
30-36	33-40	Fair
23-29	25-32	Poor
≤22	≤24	Very Poor

Catch-per-unit-effort analysis was performed for three large rivers sampled during 2010. Total time spent electrofishing at each site was used to calculate the CPUE estimates for each species collected. Length categorization analysis (Gabelhouse 1984) was used to calculate Proportional Stock Density (PSD) and Relative Stock Density (RSD) for black bass and rock bass populations sampled.

Benthic data collected for the 2010 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 Milldam downstream of Walland, near river mile 22. A third low head dam is located in Townsend near river mile 33.6. The river has a drainage area of approximately 982 km^2 at its confluence with the Tennessee River. The upper reach of the river (upstream of Walland) is located in the Blue Ridge physiographic province, and then transitions into the Ridge and Valley province from Walland to Fort Loudoun Reservoir. Little River is a very scenic stream in the Great Smoky Mountains National Park. There, it drains an area containing some of the most spectacular scenery in the southeastern United States. The Little River fishery within the National Park boundary is primarily wild rainbow and brown trout with smallmouth bass in the lower reaches. An excellent trout fishery exists, and is managed by the National Park Service. Little River's gradient becomes moderate as it leaves the National Park and flows through the Tuckaleechee Valley from Townsend to Walland. Excellent populations of smallmouth bass and rock bass exist there, and rainbow trout are stocked in spring and fall as water temperatures allow. This portion of the river has many developed campgrounds and is a popular recreation destination for tourists. While not as developed as Pigeon Forge, the Townsend area has grown significantly over the past two decades. Downstream of Walland, Little River leaves the mountains and no longer displays the extreme clarity and attractive rocky bottom of its upper reaches. Here it enters the Ridge and Valley province and resembles the more typical large river habitat with lower gradient and large deep pools interspersed with shallow shoal areas. Downstream of Perrys Milldam, the fishery, while still primarily smallmouth bass and rock bass, declines in quality relative to the upstream reach. This is probably related to limited availability of preferred smallmouth bass habitat. Near the small community of Rockford, Little River flows into a surprisingly large (given the size of the stream) embayment of Fort Loudon Lake. The Little River forms

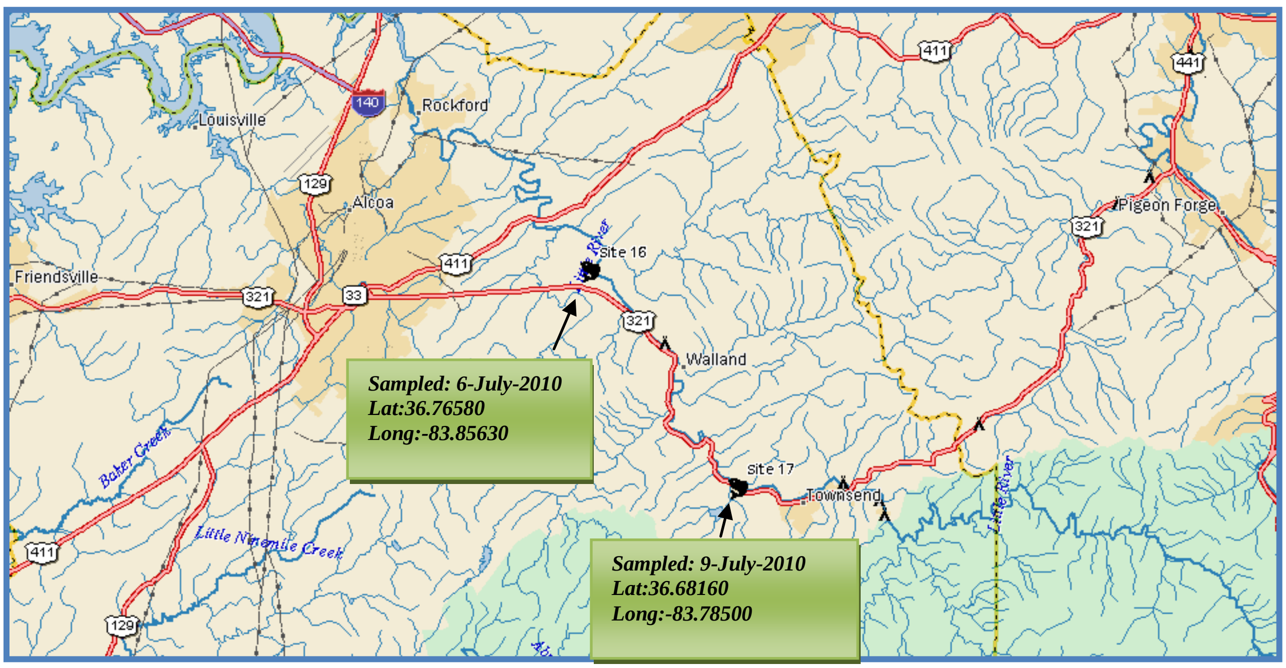
the boundary between Blount County and Knox County for the last few miles of its course.

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

Study Area and Methods

Our 2010 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 6 and 9. 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 2010.



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 2010, one at Coulters Bridge (river mile 20) and one at Townsend (river mile 29.8). A total of 51 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 60). The analysis for the fish community at Townsend remained stable at 58 when compared to the 2009 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 (1987-2010).

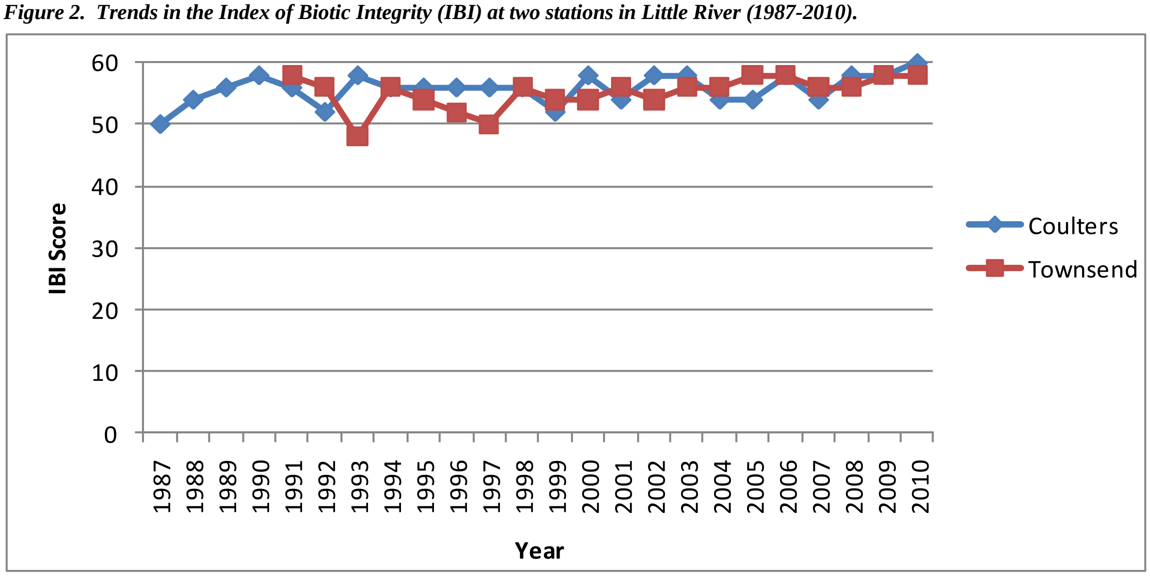


Table 1. Fish species collected at two Little River IBI stations 2010.

Site	Species	Number Collected
420100916 (Coulters Bridge)	*Ambloplites rupestris*	115
420100916 (Coulters Bridge)	*Ameiurus natalis*	4
420100916 (Coulters Bridge)	*Aplodinotus grunniens*	5
420100916 (Coulters Bridge)	*Campostoma oligolepis*	84
420100916 (Coulters Bridge)	*Cottus carolinae*	72
420100916 (Coulters Bridge)	*Cyprinella galactura*	55
420100916 (Coulters Bridge)	*Cyprinella spiloptera*	12
420100916 (Coulters Bridge)	*Cyprinus carpio*	4
420100916 (Coulters Bridge)	*Dorosoma cepedianum*	10
420100916 (Coulters Bridge)	*Erimystax insignis*	5
420100916 (Coulters Bridge)	*Etheostoma blennioides*	27
420100916 (Coulters Bridge)	*Etheostoma camurum*	6
420100916 (Coulters Bridge)	*Etheostoma jessiae*	18
420100916 (Coulters Bridge)	*Etheostoma rufilineatum*	584
420100916 (Coulters Bridge)	*Etheostoma tennesseense*	33
420100916 (Coulters Bridge)	*Etheostoma vulneratum*	2
420100916 (Coulters Bridge)	*Etheostoma zonale*	16
420100916 (Coulters Bridge)	*Fundulus catenatus*	6
420100916 (Coulters Bridge)	*Hybopsis amblops*	21
420100916 (Coulters Bridge)	*Hypentelium nigricans*	16
420100916 (Coulters Bridge)	*Ichthyomyzon greeleyi*	31
420100916 (Coulters Bridge)	*Ictalurus punctatus*	3
420100916 (Coulters Bridge)	*Lampetra appendix*	12
420100916 (Coulters Bridge)	*Lepisosteus osseus*	8
420100916 (Coulters Bridge)	*Lepomis auritus*	101
420100916 (Coulters Bridge)	*Lepomis cyanellus*	5
420100916 (Coulters Bridge)	*Lepomis macrochirus*	17
420100916 (Coulters Bridge)	*Luxilus chrysocephalus*	10
420100916 (Coulters Bridge)	*Luxilus coccogenis*	25
420100916 (Coulters Bridge)	*Lythrurus lirus*	7
420100916 (Coulters Bridge)	*Micropterus dolomieu*	6
420100916 (Coulters Bridge)	*Micropterus punctulatus*	1
420100916 (Coulters Bridge)	*Micropterus salmoides*	4
420100916 (Coulters Bridge)	*Minytrema melanops*	4
420100916 (Coulters Bridge)	*Moxostoma anisurum*	3
420100916 (Coulters Bridge)	*Moxostoma carinatum*	7
420100916 (Coulters Bridge)	*Moxostoma duquesneii*	42
420100916 (Coulters Bridge)	*Moxostoma erythrurum*	34
420100916 (Coulters Bridge)	*Nocomis micropogon*	19
420100916 (Coulters Bridge)	*Notropis leuciodus*	58
420100916 (Coulters Bridge)	*Notropis micropteryx*	79
420100916 (Coulters Bridge)	*Notropis photogenis*	17
420100916 (Coulters Bridge)	*Notropis stramineus*	7
420100916 (Coulters Bridge)	*Notropis telescopus*	87
420100916 (Coulters Bridge)	*Notropis volucellus*	9
420100916 (Coulters Bridge)	*Noturus eleutherus*	6
420100916 (Coulters Bridge)	*Percina aurantiaca*	8
420100916 (Coulters Bridge)	*Percina caprodes*	13
420100916 (Coulters Bridge)	*Percina evides*	13
420100916 (Coulters Bridge)	*Percina macrocephala*	1
420100916 (Coulters Bridge)	*Phenacobius uranops*	5
420100917 (Townsend)	*Ambloplites rupestris*	138
420100917 (Townsend)	*Campostoma oligolepis*	30
420100917 (Townsend)	*Catostomus commersonii*	2
420100917 (Townsend)	*Cottus carolinae*	78
420100917 (Townsend)	*Cyprinella galactura*	35

Table 1. Continued.

Site	Species	Number Collected
420100917 (Townsend)	*Erimystax insignis*	4
420100917 (Townsend)	*Etheostoma blennioides*	9
420100917 (Townsend)	*Etheostoma rufilineatum*	183
420100917 (Townsend)	*Etheostoma tennesseense*	20
420100917 (Townsend)	*Etheostoma zonale*	9
420100917 (Townsend)	*Fundulus catenatus*	1
420100917 (Townsend)	*Hybopsis amblops*	11
420100917 (Townsend)	*Hypentelium nigricans*	20
420100917 (Townsend)	*Ichthyomyzon greeleyi*	28
420100917 (Townsend)	*Lampetra appendix*	28
420100917 (Townsend)	*Lepomis auritus*	11
420100917 (Townsend)	*Lepomis cyanellus*	5
420100917 (Townsend)	*Lepomis macrochirus*	12
420100917 (Townsend)	*Luxilus chrysocephalus*	2
420100917 (Townsend)	*Luxilus coccogenis*	48
420100917 (Townsend)	*Lythrurus lirus*	16
420100917 (Townsend)	*Micropterus dolomieu*	7
420100917 (Townsend)	*Micropterus salmoides*	1
420100917 (Townsend)	*Moxostoma duquesneii*	15
420100917 (Townsend)	*Moxostoma erythrurum*	2
420100917 (Townsend)	*Nocomis micropogon*	26
420100917 (Townsend)	*Notropis leuciodus*	197
420100917 (Townsend)	*Notropis micropteryx*	3
420100917 (Townsend)	*Notropis photogenis*	24
420100917 (Townsend)	*Notropis telescopus*	216
420100917 (Townsend)	*Notropis volucellus*	2
420100917 (Townsend)	*Percina evides*	1

Benthic macroinvertebrates collected in our sample at Townsend comprised 37 families representing 60 identified genera (Table 2). The most abundant group in our collection was the mayflies comprising 27.3% of the total sample. Overall, a total of 74 taxa were identified from the sample of which 36 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 to Excellent" (4.5).

Table 2. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Little River at Townsend during 2010.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
ANNELIDA				0.5
	Oligochaeta		2	
COLEOPTERA				11.5
	Dryopidae	*Helichus* adults	7	
	Elmidae	*Dubiraphia* adult	1	
		Macronychus glabratus adults	6	
		Microcylloepus pusillus larvae and adults	4	
		Optioservus trivittatus adults	5	
		Promoresia elegans larvae and adults	21	
		Stenelmis adult	1	
	Psephenidae	*Psephenus herricki*	6	
DIPTERA				6.6
	Athericidae	*Atherix lantha*	2	
	Chironomidae		25	
	Simuliidae		1	
	Tabanidae	*Chyrsops*	1	
EPHEMEROPTERA				27.3
	Baetidae	early instars	3	
		Baetis	16	
		Barbaetis benfieldi	1	

Table 2. Continued.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
EPHEMEROPTERA				
		Heterocloeon	1	
		Labiobaetis	2	
		Procloeon	3	
	Ephemerellidae	*Eurylophella*	4	
		Serratella	10	
	Heptageniidae	*Epeorus rubidus/subpallidus*	2	
		Leucrocuta	4	
		Maccaffertium early instars	28	
		Maccaffertium ithaca	4	
		Stenacron	2	
	Isonychiidae	*Isonychia*	21	
	Leptohyphidae	*Tricorythodes*	13	
	Neoemphemeridae	*Neoephemera purpurea*	7	
GASTROPODA				4.1
	Ancylidae	*Ferrissia*	5	
	Physidae		3	
	Planorbidae		1	
	Pleuroceridae	*Leptoxis*	3	
		Pleurocera	6	
HETEROPTERA				0.5
	Veliidae	*Rhagovelia obesa*	2	
HYDRACARINA			1	0.2
MEGALOPTERA				2.7
	Corydalidae	*Corydalus cornutus*	7	
		Nigronia serricornis	4	
	Sialidae	*Sialis*	1	
ODONATA				16.3
	Aeshnidae	*Basiaeschna janata*	1	
		Boyeria vinosa	20	
	Calopterygidae	*Calopteryx*	5	
		Hetaerina americana	6	
	Coenagrionidae	*Argia sedula*	2	
	Cordulidae	*Helocordulia uhleri*	4	
		Neurocordulia obsoleta	1	
	Gomphidae	*Gomphus* (Genus A *rogersi*)	3	
		Gomphus lividus	3	
		Hagenius brevistylus	4	
		Hylogomphus brevis	3	
		Stylogomphus albistylus	14	
	Macromiidae	*Macromia*	6	
PELECYPODA				0.7
	Corbiculidae	*Corbicula flumenia*	3	
PLECOPTERA				5.4
	Leuctidae	*Leuctra*	5	
	Perlidae	*Acroneuria abnormis*	2	
		Paragnetina media	1	
		Perlesta	11	
	Pteronarcyidae	*Pteronarcys dorsata*	5	
TRICHOPTERA				23.7
	Brachycentridae	*Brachycentrus lateralis*	22	
		Micrasema wataga	7	
	Hydropsychidae	*Ceratopsyche bronta*	1	
		Ceratopsyche morosa	1	
		Ceratopsyche sparna	18	
		Cheumatopsyche	5	
		Hydropsyche franclemonti	2	
		Hydropsyche venularis	14	
	Leptoceridae	*Oecetis avara*	4	
		Triaenodes early instars	6	
		Triaenodes ignitus	13	
		Triaenodes perna	3	
	Limnephilidae	*Pycnopsyche divergens*	1	
		Pycnopsyche guttifer/scabripennis group	1	
		Pycnopsyche luculenta group	2	
	Philopotamidae	*Chimara* larva and pupa	2	
	Polycentropodidae	*Neuroclipsis crepuscularis*	1	
		Polycentropus	2	
TURBELLARIA			2	0.5

TAXA RICHNESS = 74 EPT TAXA RICHNESS = 36 BIOCLASSIFICATION = 4.5 (GOOD/EXCELLENT)

Benthic macroinvertebrates collected in our sample at Coulters Bridge comprised 35 families representing 51 identified genera (Table 3). The most abundant group in our collection was the mayflies comprising 36.8% of the total sample. Overall, a total of 59 taxa were identified from the sample of which 25 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" (4.3).

Table 3. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Little River at Coulters Bridge during 2010 .

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
ANNELIDA				2.4
	Hirudinea		1	
	Oligochaeta		10	
COLEOPTERA				11.2
	Dryopidae	*Helichus* adults	8	
	Elmidae	*Dubiraphia vittata* adults	3	
		Macronychus glabratus larva & adults	12	
		Optioservus larvae	2	
		Optioservus trivittatus adults	4	
		Promoresia elegans adults	12	
		Stenelmis larva & adult	2	
	Gyrinidae	*Dineutus discolor* adult	1	
	Hydrophilidae	*Enochrus* adult	1	
		Tropisternus natator adult	1	
	Psephenidae	*Psephenus herricki*	5	
DIPTERA				7.9
	Athericidae	*Atherix lantha*	4	
	Chironomidae		24	
	Simuliidae		8	
EPHEMEROPTERA				36.8
	Baetidae	*Baetis*	29	
	Ephemerellidae	*Drunella*	1	
		Eurylophella	3	
		Serratella	11	
	Ephemeridae	*Ephemera*	2	
	Heptageniidae	*Epeorus rubidus/subpallidus*	4	
		Leucrocuta	2	
		Maccaffertium early instars	15	
		Maccaffertium mediopunctatum	44	
		Maccaffertium modestum	1	
		Rithrogena	1	
	Isonychiidae	*Isonychia*	51	
	Leptohyphidae	*Tricorythodes*	4	
GASTROPODA				4.6
	Physidae		2	
	Pleuroceridae	*Leptoxis*	12	
		Pleurocera	7	
HETEROPTERA				1.5
	Saldidae	*Micracanthia humilis*	1	
	Veliidae	*Microvelia*	1	
		Rhagovelia obesa nymphs & adults	5	
HYDRACARINA			2	0.4
ISOPODA				0.2
	Asellidae	*Caecidotea*	1	
MEGALOPTERA				1.5
	Corydalidae	*Corydalus cornutus*	7	
ODONATA				9.4
	Aeshnidae	*Boyeria vinosa*	8	
	Calopterygidae	*Hetaerina americana*	11	
	Coenagrionidae	*Argia*	3	
	Gomphidae	*Gomphus lividus*	3	
		Hylogomphus adelphus	3	
		Hagenius brevistylus	4	
		Ophiogomphus mainensis	1	
		Stylogomphus albistylus	3	
	Macromiidae	*Macromia*	7	
PELECYPODA				0.7
	Corbiculidae	*Corbicula fluminea*	3	
PLECOPTERA				3.5
	Perlidae	*Acroneuria abnormis*	1	
		Perlesta	11	

Table 3. Continued.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
	Pteronarcyidae	*Pteronarcys dorsata*	4	
TRICHOPTERA				19.7
	Brachycentridae	*Brachycentrus lateralis*	14	
		Micrasema wataga	13	
	Hydropsychidae	*Ceratopsyche morosa*	16	
		Ceratopsyche sparna	4	
		Cheumatopsyche	13	
		Hydropsyche venularis	15	
	Leptoceridae	*Oecetis avara*	1	
		Triaenodes ignitus	8	
	Philopotamidae	*Chimara*	5	
	Polycentropodidae	*Polycentropus*	1	

TAXA RICHNESS = 59 EPT TAXA RICHNESS = 25 BIOCLASSIFICATION = 4.3 (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 2011 to look at the sport fish will in all likelihood focus on the sample sites surveyed in 2008, 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.

Titus Creek

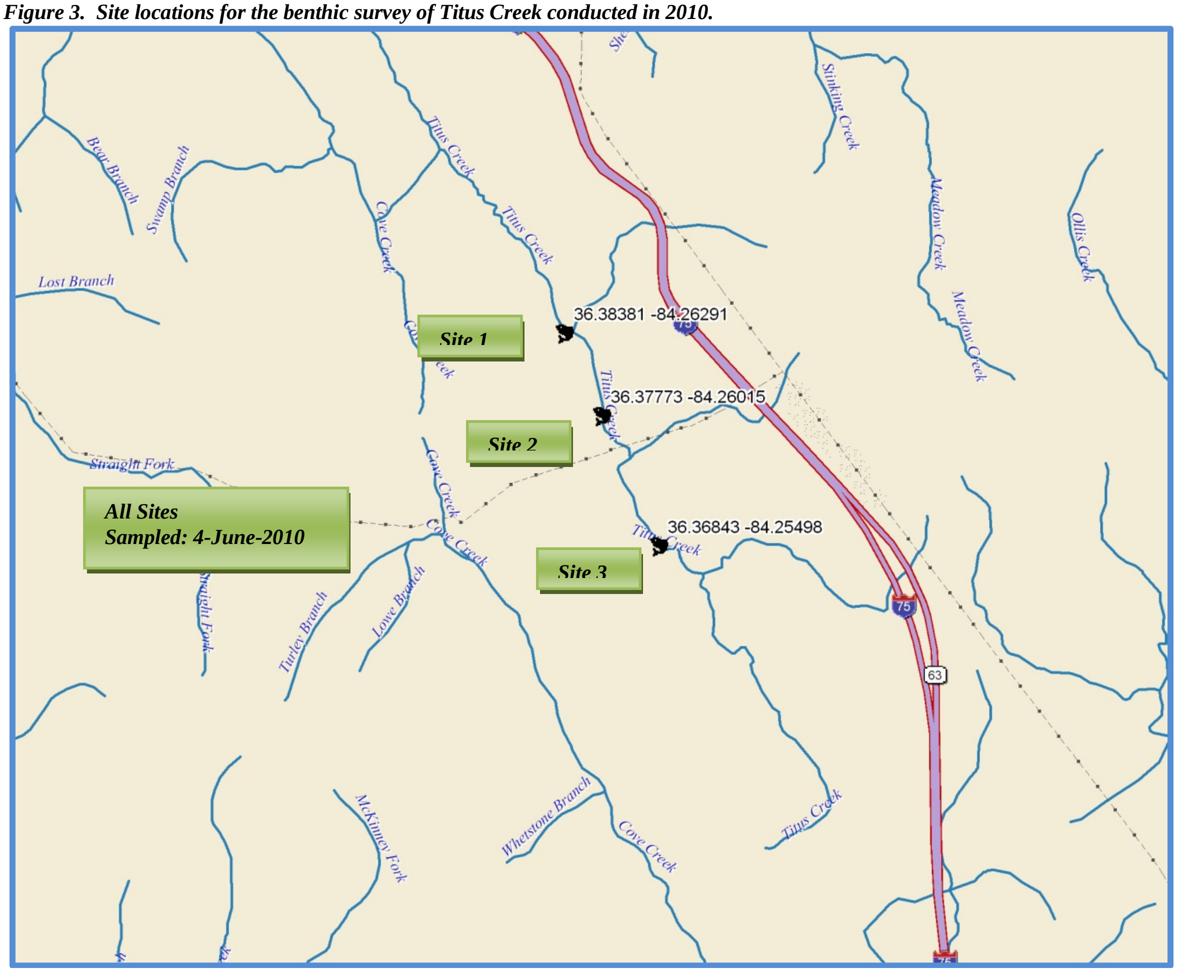
Introduction

The recent invasion of Hemlock Woolly Adelgid (HWA) into the Eastern U.S. has resulted in a unified effort by many natural resource management agencies to develop strategies to manage this exotic insect. Tennessee has been no exception to this effort, creating a HWA taskforce in 2005 to develop a management plan for the state's forest resources. This insect, when established in sufficient densities, attack hemlocks ultimately killing trees in a stand or the whole stand depending on the infestation level.

Study Area and Methods

In the spring of 2010, we were asked by TWRA's Forestry Division and the U.S. Forest Service to conduct a benthic macroinvertebrate survey of Titus Creek. Specifically, the request wanted us to characterize the benthic community before the release of an insect killing fungus targeted at controlling HWA in an experimental stand of hemlocks. On June 4, 2010 we selected three areas in Titus Creek to survey that would capture the area subjected to the aerial spraying of the fungal agent Mycotal (Figure 3).

Figure 3. Site locations for the benthic survey of Titus Creek conducted in 2010.



The stream at these locations averaged about 3-4 meters in width and had a low to moderate grade. There was a prevalence of sand and bedrock in the sample. Beaver activity was prevalent at the middle site and had altered much of the stream habitat. Cobbles were fairly abundant with gravels being the least abundant substrate component in our sample areas. Riffles were infrequent, but where they did occur, provided adequate habitat for collecting benthic organisms.

Results

We collected aquatic insects from Titus Creek (site 1) during a combined three hour effort. Benthic macroinvertebrates collected at the site comprised 28 families representing 40 identified genera (Table 4). The most abundant group in our collection was the stoneflies comprising 29.5% of the total sample. Overall, a total of 44 taxa were identified from the sample of which 21 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 4. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Titus Creek (Site 1) June 2010.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
ANNELIDA				1.1
	Oligochaeta		3	
COLEOPTERA				11.3
	Dryopidae	*Helichus* adults	24	
	Elmidae	*Dubiraphia quadrinotata* adults	2	
		Macronychus glabratus adult	1	
		Optoservus ovalis adult	1	
		Stenelmis adult	1	
	Hydrophilidae	*Helocombus* larva	1	
		Anacaena limbata adult	1	
DIPTERA				16.7
	Athericidae	*Atherix lantha*	1	
	Chironomidae	larvae and pupae	40	
	Tipulidae	*Tipula*	5	
EPHEMEROPTERA				6.2
	Caenidae	*Caenis*	2	
	Heptageniidae	*Heptagenia*	1	
		Maccaffertium ithaca	2	
		Maccaffertium vicarium	2	
		Stenacron interpunctatum	8	
	Leptophlebiida	*Habrophlebiodes*	2	
HETEROPTERA				4.4
	Gerridae	*Aquarius remigis* females	3	
	Veliidae	*Rhagovelia obesa* nymphs & adults	9	
ISOPODA				0.4
	Asellidae	*Caecidotea*	1	
MEGALOPTERA				1.8
	Corydalidae	*Corydalus cornutus*	1	
		Nigronia serricornis	3	
	Sialidae	*Sialis*	1	
ODONATA				5.1
	Aeshnidae	*Boyeria vinosa*	2	
	Calopterygidae	*Calopteryx dimidiata*	3	
	Corduliidae	*Helocordulia uhleri*	1	
	Gomphidae	*Gomphus lividus*	2	
		Lanthus vernalis	5	
		Stylogomphus sigmastylus	1	
PLECOPTERA				29.5
	Leuctridae	*Leuctra*	1	
	Peltoperlidae	*Peltoperla*	1	
	Perlidae	*Acroneuria abnormis*	1	
		Perlesta	76	
	Perlodidae	*Isoperla holochlora*	2	

Table 4. Continued.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
TRICHOPTERA				23.6
	Glossosomatidae	*Glossosoma nigrior* larvae & pupa	6	
	Hydropsychidae	*Cheumatopsyche* larvae & pupa	27	
		Ceratopsyche sparna	5	
		Diplectrona modesta	1	
		Hydropsyche betteni/depravata	8	
	Lepidostomatidae	*Lepidotsoma*	1	
	Limnephilidae	*Pycnopsyche guttifer/scabripennis* group	3	
		Pycnopsyche luculenta group	4	
	Philopotamidae	*Chimarra* larvae and pupa	9	
		Dolophilodes distincta pupa	1	

TAXA RICHNESS = 44 EPT TAXA RICHNESS = 21 BIOCLASSIFICATION = 4.0 (GOOD)

We collected aquatic insects from Titus Creek (site 2) during a combined two hour effort. Benthic macroinvertebrates collected at the site comprised 26 families representing 30 identified genera (Table 5). The most abundant group in our collection was the stoneflies comprising 27.6% of the total sample. Overall, a total of 35 taxa were identified from the sample of which 22 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 5. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Titus Creek (Site 2) June 2010.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
ANNELIDA				1.9
	Oligochaeta		3	
COLEOPTERA				2.6
	Dryopidae	*Helichus* adults	3	
	Elmidae	*Stenelmis* adult	1	
DIPTERA				14.7
	Athericidae	*Atherix lantha*	1	
	Chironomidae	larvae	18	
	Simuliidae		4	
EPHEMEROPTERA				19.2
	Baetidae	*Baetis*	2	
	Ephemerellidae	*Eurylophella*	4	
	Heptageniidae	*Heptagenia*	3	
		Maccaffertium ithaca	9	
		Maccaffertium vicarium	5	
		Stenacron interpunctatum	1	
		Stenacron pallidum	2	
	Isonychiidae	*Isonychia*	2	
	Leptophlebiidae	*Habrophlebiodes*	2	
HETEROPTERA				2.6
	Gerridae	*Aquarius* nymph	1	
	Veliidae	*Microvelia*	1	
		Rhagovelia obesa nymphs	2	
MEGALOPTERA				1.9
	Corydalidae	*Nigronia serricornis*	2	
	Sialidae	*Sialis*	1	
ODONATA				3.2
	Calopterygidae	*Calopteryx dimidiata*	2	
	Gomphidae	*Gomphus lividus*	3	
PLECOPTERA				27.6
	Leuctridae	*Leuctra*	1	
	Peltoperlidae	*Peltoperla*	1	
	Perlidae	*Eccoptura xanthenes*	1	
		Perlesta	39	
	Perlodidae	*Isoperla holochlora*	1	
TRICHOPTERA				26.3
	Glossosomatidae	*Glossosoma nigrior*	7	
	Hydropsychidae	*Ceratopsyche sparna*	4	
		Cheumatopsyche larvae & pupae	14	
		Hydropsyche betteni/depravata	8	
	Limnephilidae	*Pycnopsyche luculenta* group	3	
	Philopotamidae	*Dolophilodes distincta*	1	
		Wormaldia	2	
	Polycentropodidae	*Polycentropus* pupae	2	

TAXA RICHNESS = 35 EPT TAXA RICHNESS = 22 BIOCLASSIFICATION = 4.2 (GOOD)

We collected aquatic insects from Titus Creek (site 3) during a combined two hour effort. Benthic macroinvertebrates collected at the site comprised 28 families representing 33 identified genera (Table 6). The most abundant group in our collection was the beetles comprising 24.5% of the total sample. Overall, a total of 40 taxa were identified from the sample of which 18 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 6. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Titus Creek (Site 3) June 2010.

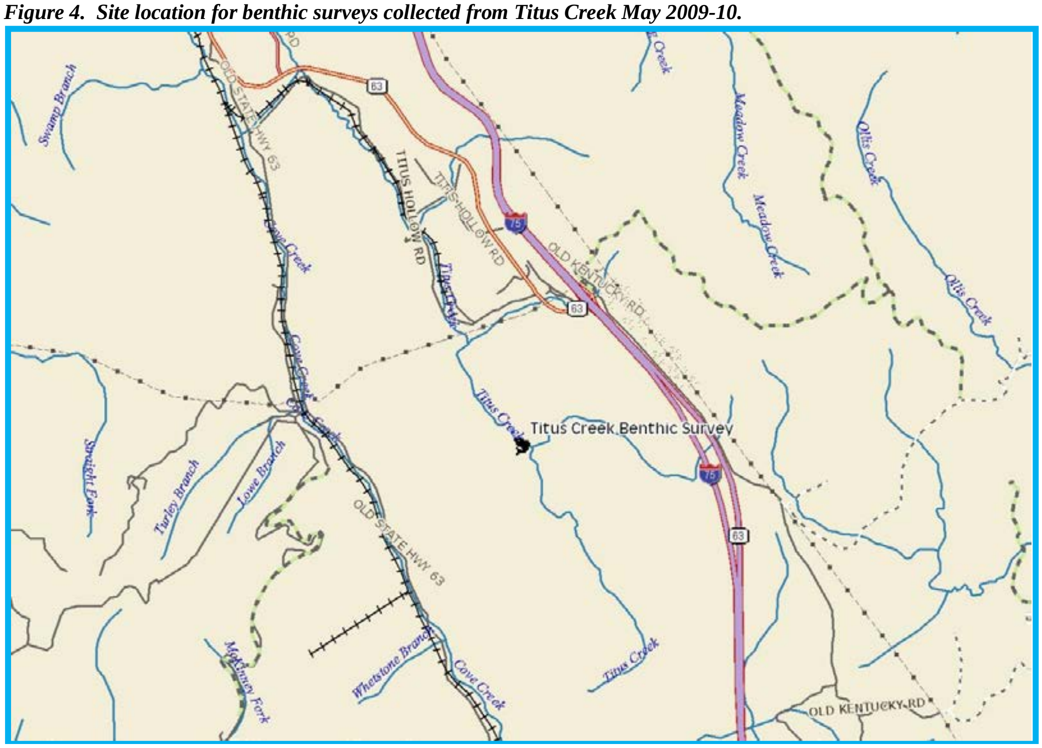
ORDER	FAMILY	SPECIES	NUMBER	PERCENT
ANNELIDA				2.0
	Hirudinea		1	
	Oligochaeta		3	
COLEOPTERA				24.5
	Dryopidae	*Helichus* adults	44	
	Elmidae	*Stenelmis* adults	4	
	Eubriidae	*Ectopria*	1	
DIPTERA				18.0
	Chironomidae	larvae	33	
	Tabanidae	*Chrysops*	1	
	Tipulidae	*Dricanota*	1	
		Hexatoma	1	
EPHEMEROPTERA				11.5
	Caenidae	*Caenis*	1	
	Ephemerellidae	*Eurylophella*	1	
	Heptageniidae	*Heptagenia*	1	
		Maccaffertium ithaca	11	
		Stenacron pallidum	4	
	Isonychiidae	*Isonychia*	2	
	Leptophlebiidae	*Habrophlebiodes*	3	
GASTROPODA				1.0
	Planorbidae		2	
HETEROPTERA				5.0
	Gerridae	*Aquarius conformis* male & female	2	
		Aquarius remigis male	1	
		Aquarius nymphs	2	
	Veliidae	*Microvelia*	1	
		Rhagovelia nymphs	4	
MEGALOPTERA				7.5
	Corydalidae	*Nigronia serricornis*	14	
	Sialidae	*Sialis*	1	
ODONATA				9.0
	Aeshnidae	*Boyeria grafiana*	1	
	Calopterygidae	*Calopteryx dimidiata*	2	
	Cordulegastridae	*Cordulegaster maculata*	1	
	Gomphidae	*Gomphus lividus*	13	
		Stylogomphus sigmastylus	1	
PLECOPTERA				10.0
	Leuctridae	*Leuctra*	6	
	Perlidae	*Acroneuria* early instars	2	
		Eccoptura xanthenes	6	
		Perlesta	6	
TRICHOPTERA				11.5
	Hydropsychidae	*Cheumatopsyche*	9	
		Diplectrona modesta	1	
		Hydropsyche betteni/depravata	1	
		Hydropsyche pupa	1	
	Limnephilidae	*Pycnopsyche guttifer/scabripennis* group	2	
		Pycnopsyche luculenta group	5	
	Philopotamidae	*Dolophilodes distincta*	3	
	Rhyacophilidae	*Rhyacophila carolina*	1	

TAXA RICHNESS = 40 EPT TAXA RICHNESS = 18 BIOCLASSIFICATION = 4.0 (GOOD)

Follow-up survey from 2009

In the spring of 2009, we were asked by TWRA's Forestry Division and the U.S. Forest Service to conduct a benthic macroinvertebrate survey of Titus Creek. Specifically, the request wanted us to characterize the benthic community before the release of an insect killing fungus targeted at controlling HWA in an experimental stand of hemlocks. On May 20, 2009 we selected an area on Titus Creek to survey within the area subjected to the aerial spraying of the fungal agent Mycotal (Figure 4). This site was revisited on May 10, 2010 to reassess the treatment. During both sampling events aquatic insects were collected during a combined 3 hour effort. Benthic data collected for the 2009-10 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 1995) 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.

Figure 4. Site location for benthic surveys collected from Titus Creek May 2009-10.



The stream at this location averaged about 3 meters in width and had a low to moderate grade. There was a prevalence of sand and bedrock in the sample. Cobbles were fairly abundant with gravels being the least abundant substrate component in our sample area. Riffles were infrequent, but where they did occur, provided adequate habitat for collecting benthic organisms.

Results

Benthic macroinvertebrates collected at the site during 2009 comprised 31 families representing 37 identified genera (Table 7). The most abundant group in our collection was the mayflies comprising 22.2% of the total sample. Overall, a total of 46 taxa were identified from the sample of which 27 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 7. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Titus Creek, May 20, 2009.

Order	Family	Species	Number	Percent
ANNELIDA				2.6
	Branchiobdellida		3	
	Oligochaeta		2	
COLEOPTERA				9.8
	Dyopidae	*Helichus* adults	16	
	Elimidae	*Optioservus ovalis* adult	1	
		Stenelmis	2	
DIPTERA				17.0
	Ceratopogonidae	*Palpomyia complex*	1	
	Chironomidae	larvae	15	
	Simuliidae	larvae	6	
	Tipulidae	*Hexatoma*	2	
		Pilaria	2	
		Tipula	7	
EPHEMEROPTERA				22.2
	Baetidae	*Baetis*	18	
	Ephemerellidae	*Ephemerella*	1	
		Eurylophella	8	
	Ephemeridae	*Ephemera*	1	
	Heptageniidae	*Heptagenia*	9	
		Maccaffertium vicarium	2	
		Stenacron interpunctatum	2	
	Leptophlebiidae	*Habrophlebia vibrans*	1	
		Habrophlebiodes	1	
HETEROPTERA				2.6
	Gerridae	*Aquarius remigis* males and females	5	
MEGALOPTERA				3.6
	Corydalidae	*Nigronia serricornis*	6	
	Sialidae	*Sialis*	1	
ODONATA				2.6
	Calopterygidae	*Calopteryx maculata*	1	
	Cordulegastridae	*Cordulegaster maculata*	1	
	Corduliidae	*Helocordulia uhleri*	2	
	Gomphidae	*Gomphus rogersi*	1	
PLECOPTERA				20.1
	Leuctridae	*Leuctra*	4	
	Nemouridae	*Amphinemura delosa/nigritta*	6	
	Perlidae	*Acroneuria abnormis*	7	
		Eccoptura xanthenes	5	
	Perlodidae	*Isoperla holochlora*	5	
		Isoperla transmarina	8	
		Isoperla undetermined	2	
		Remenus bilobatus	2	
PELECYPODA				0.5
	Sphaeriidae	*Sphaerium*	1	

Table 7. Continued.

Order	Family	Species	Number	Percent
TRICHOPTERA				19.1
	Hydropsychidae	*Cheumatopsyche* pupa	1	
		Diplectrona modesta	1	
	Lepidostomatidae	*Lepidostoma*	3	
	Limnephilidae	*Pycnopsyche gentilis*	1	
		Pycnopsyche guttifer/scabripennis group	1	
		Pycnopsyche luculenta group	14	
	Polycentropodidae	*Polycentropus*	2	
	Rhyacophilidae	*Rhyacophila* larva and pupa	2	
	Uenoidae	*Neophylax aniqua*	9	
		Neophylax concinnus	1	
		Neophylax wigginsi	2	
		Total	194	

TAXA RICHNESS = 46   EPT TAXA RICHNESS = 27   BIOCLASSIFICATION = 4.5 (GOOD)

The follow up sample collected in 2010 was comprised of 31 families representing 35 identified genera (Table 8). As with the previous sample, the most abundant group was the mayflies contributing 41% of the total sample. A total of 42 taxa were identified from the sample of which 26 were EPT. Based on the EPT taxa richness and biotic index associated with all species collected, the relative health of the benthic community was classified as “Good” (4.2). This designation remained unchanged from the sample collected in 2009.

Table 8. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Titus Creek, May 10, 2010.

Order	Family	Species	Number	Percent
ANNELIDA				3.5
	Branchiobdellida		6	
COLEOPTERA				2.3
	Dryopidae	*Helichus* adults	3	
	Elmidae	*Optoservus ovalis* adult	1	
DIPTERA				2.9
	Chironomidae	larvae	3	
	Tipulidae	*Antocha*	1	
		Tipula	1	
EPHEMEROPTERA				41.0
	Ameletidae	*Ameletus lineatus*	1	
	Baetidae	*Baetis*	6	
	Ephemerellidae	*Ephemerella*	8	
		Eurylophella	7	
	Ephemeridae	*Ephemera*	1	
	Heptageniidae	*Heptagenia*	9	
		Maccaffertium early instar	1	
		Maccaffertium vicarium	1	
		Stenacron interpunctatum	33	
	Leptophlebiidae	*Habrophlebia vibrans*	2	
		Habrophlebiodes	2	
GASTROPODA				0.6
	Planorbidae		1	
HETEROPTERA				3.5
	Gerridae	*Aquarius remigis* males and females	6	
MEGALOPTERA				2.9
	Corydalidae	*Nigronia fasciatus*	1	
		Nigronia serricornis	3	
	Sialidae	*Sialis*	1	
ODONATA				6.9
	Aeshnidae	*Boyeria vinosa*	1	
	Calopterygidae	*Calopteryx maculata*	5	
	Cordulegastridae	*Cordulegaster maculata*	1	
	Corduliidae	*Helocordulia uhleri*	1	
	Gomphidae	*Gomphus rogersi*	4	

Table 8. Continued.

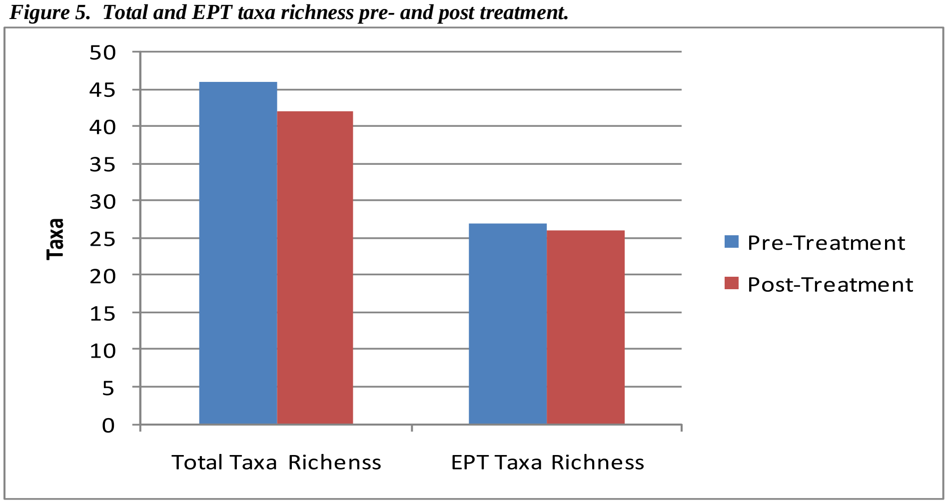
Order	Family	Species	Number	Percent
PLECOPTERA				13.3
	Leuctridae	*Leuctra*	4	
	Nemouridae	*Amphinemura delosa/nigritta*	1	
	Peltoperlidae	*Peltoperla*	1	
	Perlidae	*Acroneuria abnormis*	8	
		Eccoptura xanthenes	4	
	Perlodidae	*Isoperla holochlora*	3	
		Isoperla transmarina	2	
TRICHOPTERA				23.1
	Hydropsychidae	*Cheumatopsyche*	7	
		Diplectrona modesta	2	
	Lepidostomatidae	*Lepidostoma*	1	
	Limnephilidae	*Pycnopsyche guttifer/scabripennis* group	1	
		Pycnopsyche luculenta group	11	
	Polycentropodidae	*Polycentropus*	3	
	Rhyacophilidae	*Rhyacophila* pupae	2	
	Uenoidae	*Neophylax aniqua*	1	
		Neophylax wigginsi	12	
		Total	173	

TAXA RICHNESS = 42 EPT TAXA RICHNESS = 26 BIOCLASSIFICATION = 4.2 (GOOD)

Discussion

Our pre- and post treatment surveys revealed very little change in the benthic community. The observed differences were within the amount of sampling variability associated with these types of surveys. Total and EPT taxa richness was very similar between the samples indicating that there was most likely no effect from the application of the HWA control agent (Figure 5). Additional benthic surveys initiated in 2010 will focus on evaluating hemlock stands that received additional treatment (at the same inoculation rate) and stands treated at a higher inoculation rate.

Figure 5. Total and EPT taxa richness pre- and post treatment.



Management Recommendations

1. Conduct follow-up surveys of the benthic community to assess any impacts from the 2010 Mycotal application.

North Fork Holston River

Introduction

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

Study Area and Methods

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

During April 2010, six fish surveys (CPUE) were conducted on the North Fork between the TN/VA line and its confluence with the South Fork (Figure 6). We repeated our CPUE samples conducted in 2007. The riparian habitat along this reach consists primarily of wooded shorelines with interspersed fields and residential lawns. Submerged woody debri was fairly common in most of our sample areas. The river substrate was predominately composed of bedrock and boulders. Perpendicular/parallel (to flow) bedrock shelves were more abundant in the pool habitat, while a combination of boulder and bedrock comprised the majority of the riffle habitat. There were a few riffles within the survey areas that had cobble size substrate as the primary component. Measured mean channel widths ranged from 45.2 m to 68.3 m, while site lengths fell between 250 meters and 1,325 meters (Table 9). Water temperatures ranged from 10.5 C to 17.5 C and conductivity varied from 305 to 335 µs/cm (Table 9).

Figure 6. Site locations for the samples conducted in the North Fork Holston River 2010.

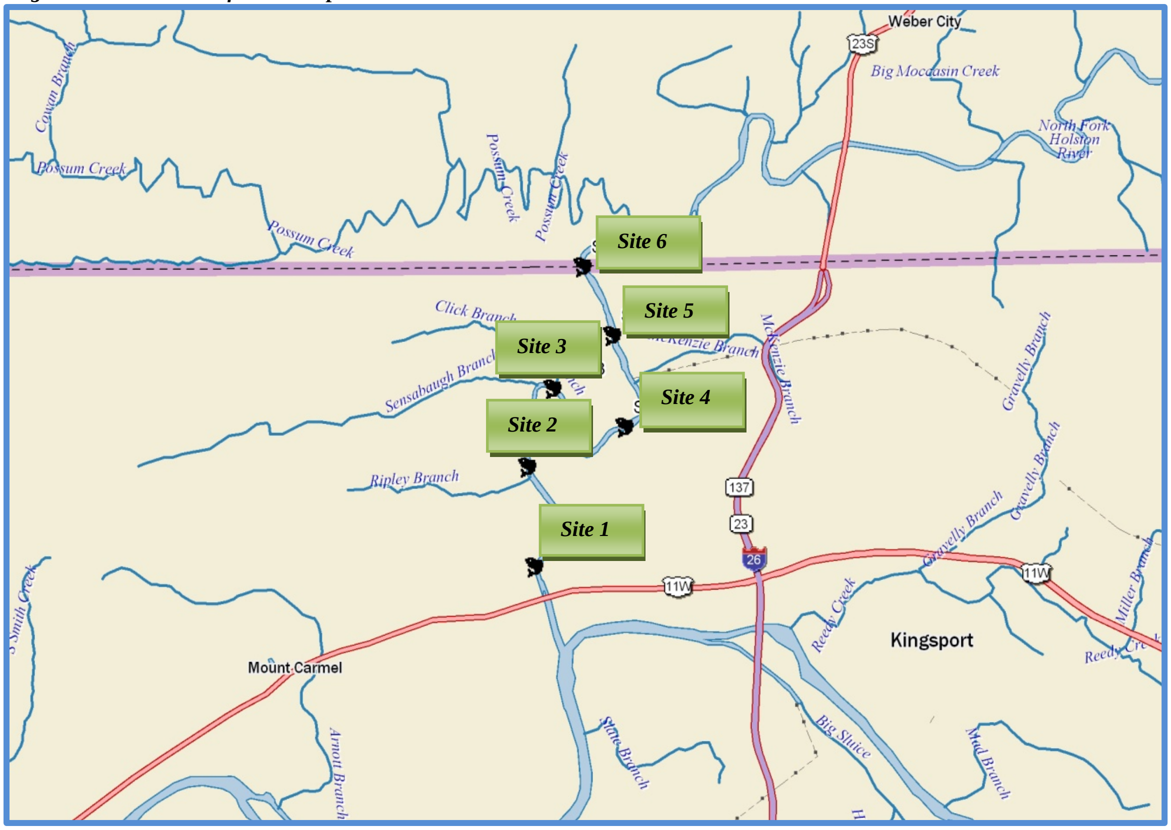


Table 9. Physiochemical and site location data for samples conducted on the North Fork Holston River during 2010.

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp.	Cond.	Secchi (m)
420100601	1	Hawkins/Sullivan	Kingsport 188SE	0.8	36.55799	-82.61641	68.3	293	17.5	335	3+
420100602	2	Hawkins/Sullivan	Kingsport 188SE	2.0	36.57000	-82.61750	54.4	1158	16.5	330	3+
420100603	3	Hawkins/Sullivan	Kingsport 188SE	2.7	36.57943	-82.61376	48.3	518	16.5	330	3+
420100604	4	Hawkins/Sullivan	Kingsport 188SE	4.0	36.57472	-82.60250	45.2	1325	16.5	320	3+
420100605	5	Hawkins/Sullivan	Kingsport 188SE	4.4	36.58583	-82.60444	52.0	953	15.0	312	3+
420100606	6	Hawkins/Sullivan	Kingsport 188SE	5.0	36.59416	-82.60888	58.0	250	10.5	305	3+

Fish were collected by boat electrofishing in accordance with the standard large river sampling protocols (TWRA 1998). Fixed-boom electrodes were used to transfer 4 amps DC at all sites. This current setting was determined effective in narcotizing smallmouth bass and rock bass. All sites were sampled during daylight hours and had survey durations ranging from 602 to 1822 seconds. CPUE values were calculated for each target species at each site. Length categorization indices were calculated for target species following Gabelhouse (1984).

Results

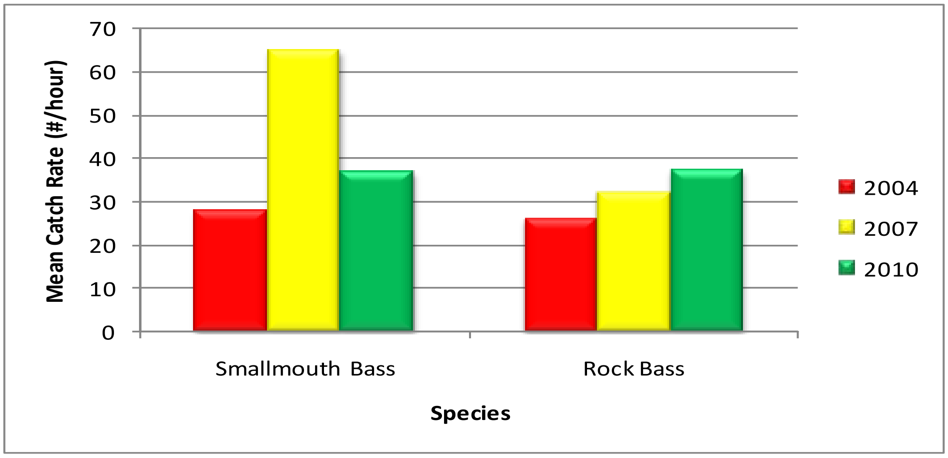
Both smallmouth bass and rock bass were collected from all six sites. Smallmouth bass was the only black bass collected during our surveys. CPUE estimates for this species averaged 36.9/hour which was a 43% decrease from our 2007 value (Table 10). The overall decrease is most likely associated with the significant decline in the number of bass collected at site 2 when compared to the 2007 sample. We encountered a large number of bass at this site which were most likely transient fish from the Holston River. It is not uncommon for large smallmouth to migrate from the larger Holston River to the smaller tributaries such as the North Fork to spawn. The same trend was also observed at site 5. The decline at both of these sites was the main factor in the overall decrease observed in 2010.

Table 10. Catch per unit effort and length categorization indices of target species collected at six sites on the North Fork Holston River during 2010.

Site Code	Smallmouth Bass CPUE	Rock Bass CPUE
420100601	56.2	50.0
420100602	20.0	24.0
420100603	39.4	28.9
420100604	50.0	13.1
420100605	10.5	57.8
420100606	45.8	50.0
MEAN	36.9	37.3
STD. DEV.	17.9	17.7
	Smallmouth Bass Length-Categorization Analysis	**Rock Bass Length-Categorization Analysis**
	PSD = 58.6	PSD = 8.2
	RSD-Preferred = 17.4	RSD-Preferred = 0
	RSD-Memorable = 2.2	RSD-Memorable = 0
	RSD-Trophy = 0	RSD-Trophy = 0

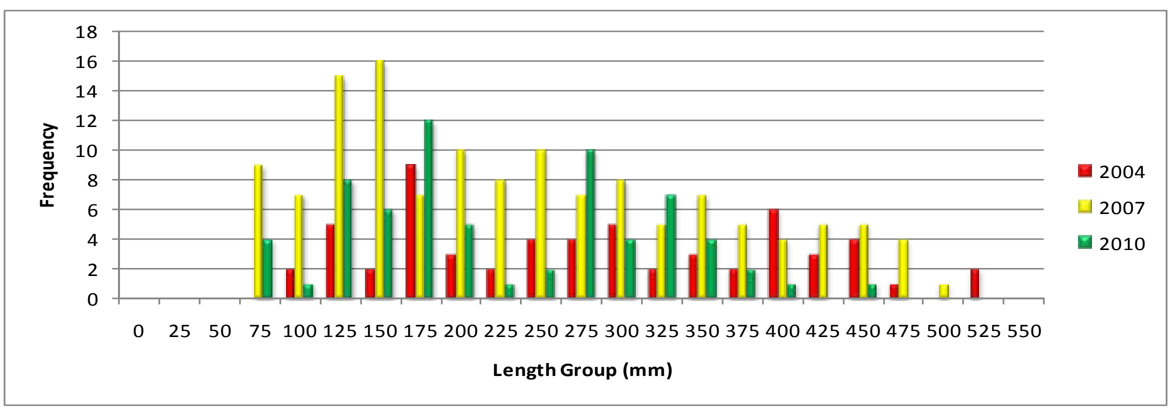
In 2010, our highest catches were observed at sites 1 and 4. Overall these sites remained the most consistent in terms of CPUE when compared to 2007. Rock bass were generally less abundant than smallmouth bass encountered in our survey areas and had an average CPUE of 37.3 which was up 15.8% from 2007 (Table 10). The sites where the catch rates were highest usually had at least one shoreline that had good boulder cover. Although our 2010 catch was somewhat less than observed in 2007 it still exceeded the 2004 value and is most closely aligned with 31.8 average observed between 1998 and 2007 (Figure 7). Comparatively, rock bass abundance increased somewhat over our 2007 value and was higher than the value observed in 2004. Although we did observe good numbers of smallmouth bass and rock bass, river flows were extremely low during 2007. This could ultimately have an impact on the number of larger fish as drought conditions tend to have more influence over regulating these size groups than they do with smaller size classes and also effects recruitment of larger fish. Although no trophy category smallmouth bass were collected in 2010, we are confident that 20 + inch smallmouth bass reside in the river.

Figure 7. Trends in mean catch rate of black bass and rock bass collected between 2004 and 2010 from the North Fork Holston River.



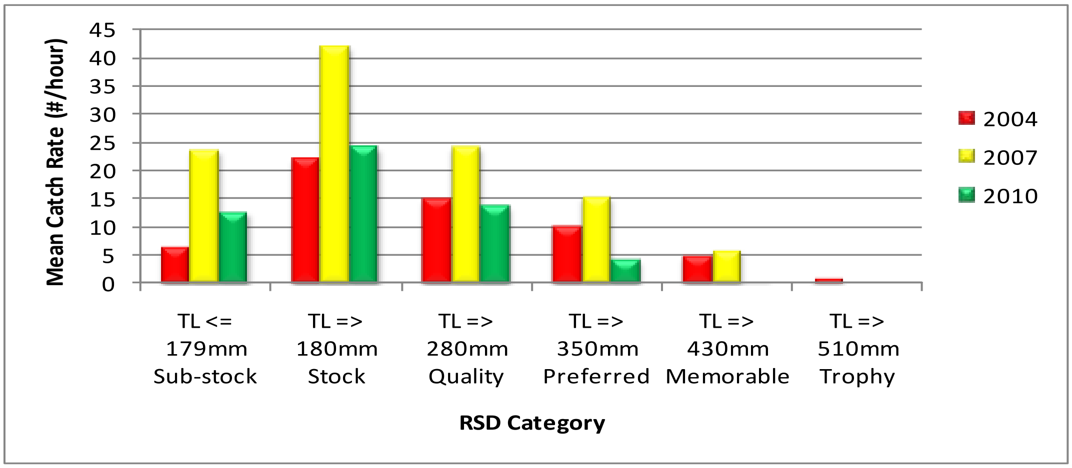
The majority of the smallmouth bass collected in the North Fork Holston River during 2010 fell within the 125 mm to 300 mm length range (Figure 8). The size distribution in 2010 showed good representation in all size classes with the exception of bass over 450 mm which was down from 2007. This can be explained by the absence of transient spawning bass from the Holston River that were collected in 2007. The 2010 distribution most likely reflects the normal size structure of the resident population.

Figure 8. Length frequency distributions for smallmouth bass collected from the North Fork Holston River between 2004 and 2010.



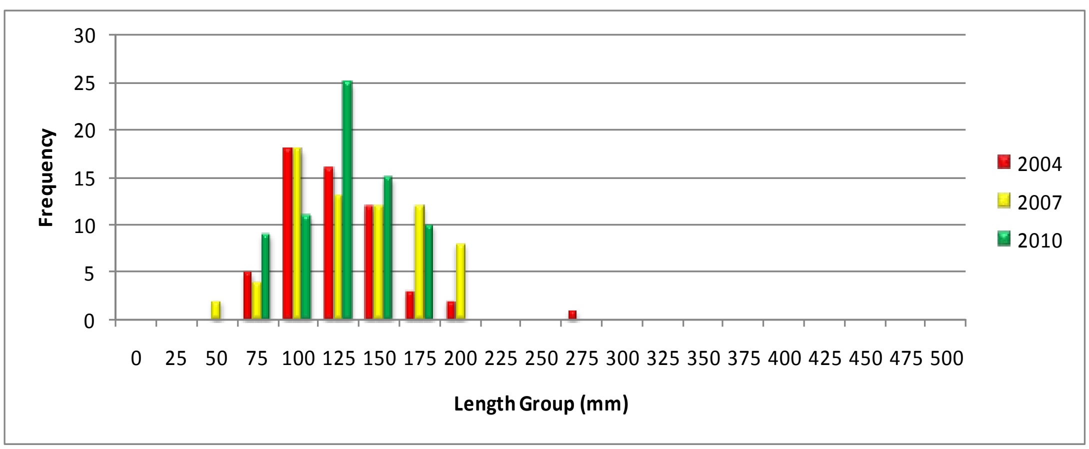
Length categorization analysis indicated the Relative Stock Density (RSD) for preferred smallmouth bass (TL $\geq$ 350 mm) was 17.4, a decrease of 52% from the 2007 value. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass was 2.2 and 0, respectively. All RSD categories decreased considerably between the 2007 sample and the 2010 due to the absence of the larger transient fish in the sample. The ratio of quality (TL ≥ 280 mm) smallmouth bass to stock size bass (TL ≥ 180 mm) remained relatively stable in 2010 at 58.6 when compared to the 2007 value (57.6). Catch per unit effort estimates by RSD category indicated the majority of the catch was in the RSD-S category, following the trends observed in 2004 and 2007(Figure 9). Overall, the proportional distribution of CPUE was lower in all categories when compared to the 2007 but was higher in the sub-stock and stock categories when compared to 2004.

Figure 9. Relative stock density (RSD) catch per unit effort for smallmouth bass collected from the North Fork Holston River between 2004 and 2010.



Individuals in the 100 mm to 200 mm range represented the majority of rock bass in our sample (Figure 10). Length categorization analysis indicated the RSD for preferred rock bass (TL ≥ 230 mm) was 0. This was the same as the value observed in 2007.

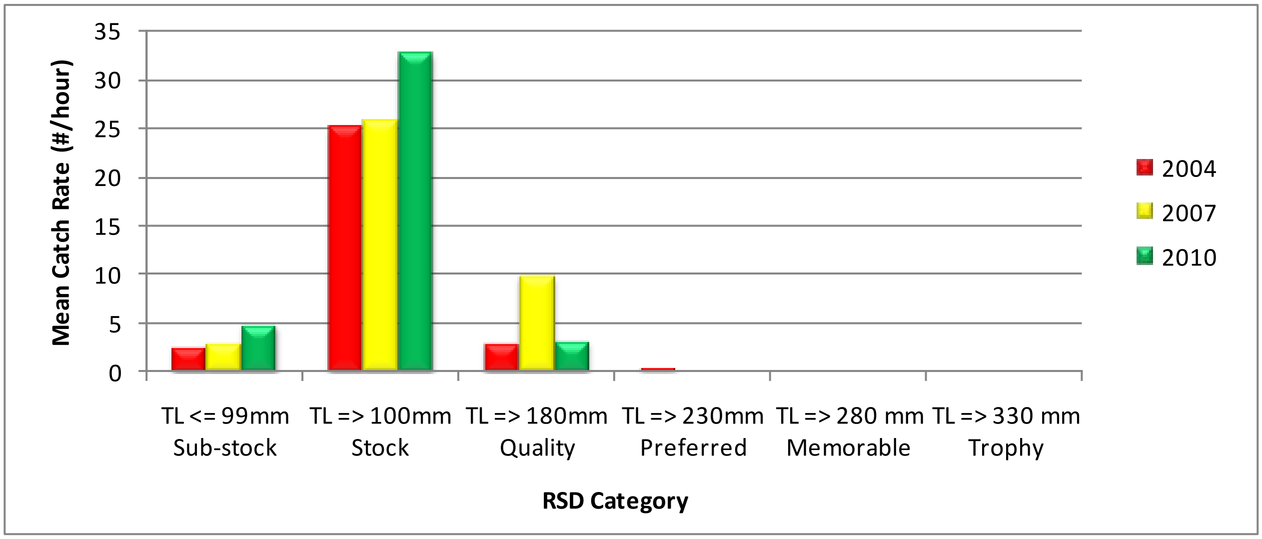
Figure 10. Length frequency distributions for rock bass collected from the North Fork Holston River between 2004 and 2010.



RSD for memorable (TL ≥ 280 mm) and trophy (TL ≥ 330 mm) size rock bass was 0. The ratio of quality (TL ≥ 180 mm) rock bass to stock size rock bass (TL ≥ 100 mm) was 8.2 which was a substantial decrease from the 2007 value. This was caused by poor recruitment of stock size fish in to the quality category, most likely associated with the decrease of habitat from the drought conditions.

Catch data by RSD category revealed a high number of rock bass in the RSD-S category with poor recruitment into the RSD-Q as observed in 2004 (Figure 11).

Figure 11. Relative stock density (RSD) catch per unit effort by category for rock bass collected from the North Fork Holston River between 2004 and 2010.



Discussion

The North Fork Holston River provides anglers with the opportunity to catch substantial numbers of quality size smallmouth bass and rock bass. Catches of smallmouth bass in 2010 both in number and size were somewhat lower than observed in 2007. As discussed, this is most likely associated with the absence of larger fish that were collected in 2007 and are thought to have been transient spawning fish from the Holston River. In 2001, a roving creel survey was conducted on the North Fork indicating relatively high angling pressure and moderate harvest (Bettoli 2002, Carter et al. 2003). All information from our survey data indicates that the smallmouth bass population, although fluctuating under drought conditions, has continued to produce good numbers of quality fish.

Surveys on the North Fork Holston River will be conducted on a three-year rotation in order to assess any changes in the fishery. The North Fork has been under consideration for some time regarding smallmouth bass regulations. In March 2008, a 13-17 inch protected length range with a five bass creel limit, of which only one can exceed 17 inches was place on the North Fork between the state line and the confluence with the South Fork.

Management Recommendations

1. Develop a fishery management plan for the river.

Pigeon River

Introduction

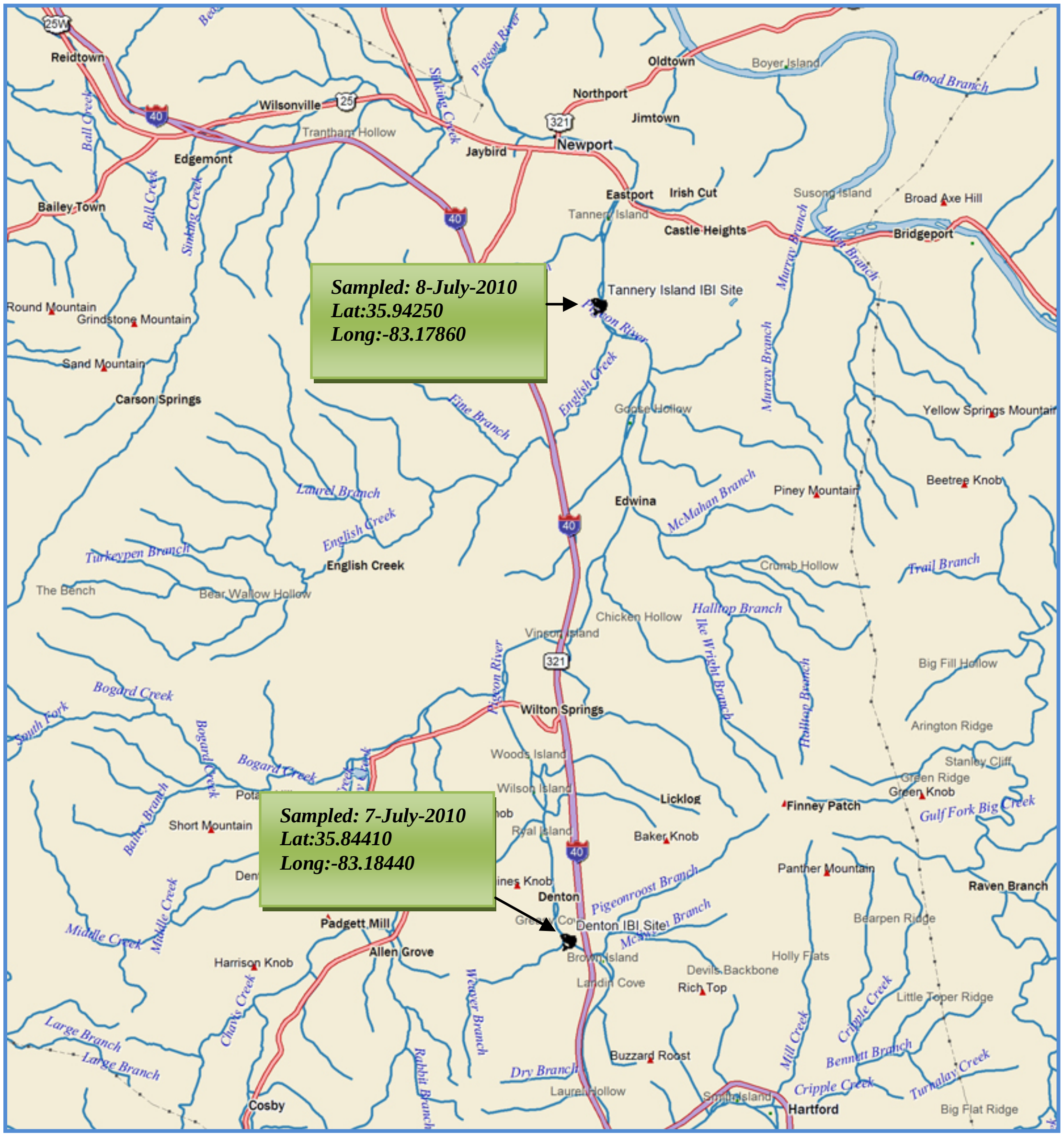
The Pigeon River has had a long history of pollution problems, stemming primarily from the discharge of wastewater from the Champion Paper Mill in Canton, North Carolina. This discharge has undoubtedly had a profound effect on the recreational use of the river and after the discovery of elevated dioxin 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 2010 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 (Bivens et al. 1998) and five sites in 1998 (Carter et al. 1999). Since 1999, data has been collected at five to six sites between river mile 4.0 and 20.5. During 1998, a 508 mm minimum (20-inch) length limit on smallmouth bass with a one fish possession limit was passed by the Tennessee Wildlife Resources Commission (TWRC). This regulation was implemented on March 1, 1999.

Study Area and Methods

The Pigeon River originates in North Carolina and flows in a northwesterly direction before emptying into the French Broad River near river mile 73.8. The river has a drainage area of approximately 1,784 km^2 at its confluence with the French Broad River. In Tennessee, approximately 35 kilometers of the Pigeon River flows through mountainous terrain with interspersed communities and small farms before joining the French Broad River near Newport. Public access along the river is primarily limited to bridge crossings and small "pull-outs" along roads paralleling the river. There are a few primitive launching areas for canoes or small boats and one moderately developed launch at Denton. On July 7 and 8, 2010, we conducted IBI fish surveys at Tannery Island (PRM 8.2) and Denton (PRM 16.6) (Figure 12).

Figure 12. Site locations for the IBI samples conducted in the Pigeon River during 2010.



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.

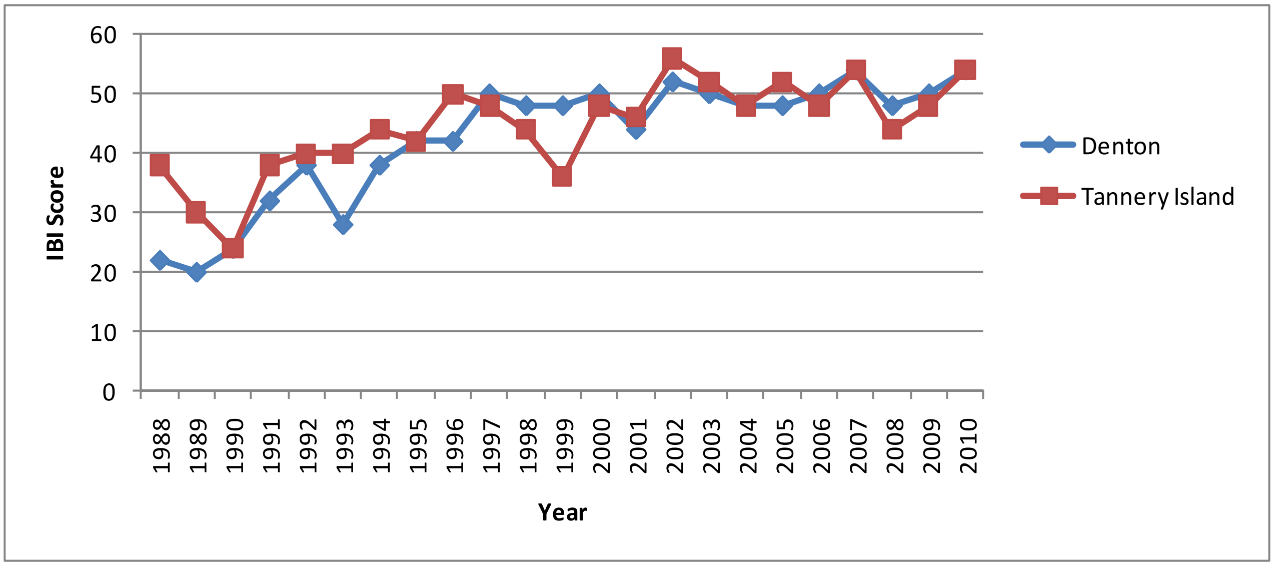
Results

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 38 fish species were collected at the Tannery Island site while 29 were observed at Denton (Table 11). Overall, The IBI analysis indicated the fish community was in good to excellent condition at Tannery Island (IBI score 54). This was a six point improvement over the 2009 score (48). The condition of the fish community assessed the same at the Denton site scoring 54 (Good/Excellent), which was four points higher than the previous year (Figure 13).

Table 11. Fish species collected at the two Pigeon River IBI stations during 2010.

Pigeon River Mile	8.2 (Tannery Island)	Number Collected	16.6 (Denton)	Number Collected
	420091401		420091403	
	Ambloplites rupestris	12	*Ambloplites rupestris*	46
	Campostoma oligolepis	53	*Ameiurus natalis*	2
	Cottus carolinae	50	*Campostoma anomalum*	85
	Cyprinella galactura	56	*Carpiodes cyprinus*	1
	Cyprinella spiloptera	23	*Cottus carolinae*	67
	Cyprinus carpio	4	*Cyprinella galactura*	193
	Dorosoma cepedianum	39	*Cyprinella spiloptera*	1
	Etheostoma blennioides	167	*Dorosoma cepedianum*	30
	Etheostoma kennicotti	5	*Etheostoma blennioides*	36
	Etheostoma rufilineatum	552	*Etheostoma camurum*	1
	Etheostoma tennesseense	26	*Etheostoma rufilineatum*	304
	Hybopsis amblops	1	*Etheostoma tennesseense*	32
	Hypentelium nigricans	31	*Hybopsis amblops*	7
	Ichthyomyzon greeleyi	1	*Hypentelium nigricans*	35
	Ichthyomyzon sp.	3	*Ichthyomyzon bdellium*	5
	Ictalurus punctatus	6	*Ictalurus punctatus*	1
	Ictiobus bubalus	8	*Ictiobus niger*	2
	Ictiobus niger	9	*Lepomis auritus*	48
	Lepomis auritus	74	*Lepomis cyanellus*	2
	Lepomis cyanellus	1	*Micropterus dolomieu*	23
	Lepomis macrochirus	5	*Moxostoma carinatum*	3
	Micropterus dolomieu	8	*Moxostoma duquesneii*	20
	Micropterus punctulatus	10	*Moxostoma erythrurum*	14
	Micropterus salmoides	8	*Notropis leuciodus*	4
	Moxostoma breviceps	11	*Notropis micropteryx*	56
	Moxostoma carinatum	5	*Notropis telescopus*	42
	Moxostoma duquesneii	35	*Oncorhynchus mykiss*	2
	Moxostoma erythrurum	24	*Percina caprodes*	20
	Nocomis micropogon	1	*Sander vitreum*	1
	Notropis micropteryx	137		
	Notropis photogenis	40		
	Notropis telescopus	4		
	Notropis volucellus	1		
	Noturus eleutherus	1		
	Percina caprodes	28		
	Percina evides	3		
	Pylodictis olivaris	1		
	Sander vitreum	1		

Figure 13. Trends in Index of Biotic Integrity (IBI) at two stations on the Pigeon River (1988-2010).



Benthic macroinvertebrates collected at the Tannery Island site comprised 34 families representing 38 identified genera (Table 12). The most abundant group in our collection was the caddisflies comprising 38% of the total sample. Overall, a total of 51 taxa were identified from the sample of which 18 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 Tannery Island (river mile 8.2) July, 2010.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
ANELLIDA				3.6
	Hirudinea		2	
	Oligochaeta		13	
COLEOPTERA				1.7
	Elmidae	*Ancyronyx variegatus* adults	2	
		Macronychus glabratus adult	1	
		Microcylloepus pusillus adults	2	
		Promoresia elegans adults	2	
DECAPODA				0.2
	Cambaridae	*Orconectes virilis* juvenile	1	
DIPTERA				11.3
	Athericidae	*Atherix lantha*	2	
	Chironomidae		24	
	Empididae		1	
	Simuliidae		18	
	Tipulidae	*Antocha* larva and pupae	2	
EPHEMEROPTERA				21.4
	Baetidae	early instars	20	
		Acentrella	6	
		Heterocloeon	3	
	Caenidae	*Caenis*	1	
	Ephemerellidae	*Serratella deficiens*	5	
	Heptageniidae	*Epeorus* early instar	1	
		Maccaffertium early instars	11	
		Maccaffertium ithaca	1	
		Maccaffertium mediopunctatum	5	
	Isonychiidae	*Isonychia*	36	

Table 12. Continued.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
GASTROPODA				6.0
	Ancylidae	*Ferrissia*	6	
	Physidae		3	
	Planorbidae		3	
	Pleuroceridae	*Leptoxis* (1 is juvenile)	4	
		Pleurocera	9	
HETEROPTERA				0.5
	Veliidae	*Rhagovelia obesa* nymphs	2	
HYDRACARINA			4	1.0
MEGALOPTERA				3.1
	Corydalidae	*Corydalus cornutus*	11	
		Nigronia serricornis	2	
ODONATA				9.4
	Aeshnidae	*Basiaeshna janata* early instar	1	
		Boyeria vinosa	6	
	Calopterygidae	*Hetaerina americana*	17	
	Coenagrionidae	*Argia sedula*	4	
		Enallagma	7	
	Corduliidae	early instar - questionable determination	1	
	Gomphidae	*Dromogomphus spinosus*	1	
		Lanthus early instar	1	
	Macromiidae	*Macromia*	1	
PELECYPODA				2.6
	Corbiculidae	*Corbicula fluminea*	9	
	Sphaeriidae	*Pisidium*	2	
PLECOPTERA				0.5
	Pteronarcyidae	*Pteronarcys dorsata*	2	
TRICHOPTERA				38.0
	Brachycentridae	*Brachycentrus lateralis*	23	
		Brachycentrus numerosus	1	
	Hydropsychidae	*Ceratopsyche morosa*	69	
		Cheumatopsyche	51	
		Hydropsyche franclemonti	1	
		Hydropsyche venularis	2	
	Hydroptilidae	*Hydroptila* larvae and pupa	5	
	Lepidostomatidae	*Lepidostoma*	2	
	Leptoceridae	*Oecetis avara*	4	
TURBELLARIA			3	0.7

TAXA RICHNESS = 51 EPT TAXA RICHNESS = 18 BIOCLASSIFICATION = 4.0 (GOOD)

Benthic macroinvertebrates collected at the Denton site comprised 35 families representing 41 identified genera (Table 13). The most abundant groups in our collection were the caddisflies and mayflies comprising about 35% of the total sample. Overall, a total of 51 taxa were identified from the sample of which 22 were EPT. Based on the EPT taxa richness and overall biotic index of all species collected, the relative health of the benthic community was classified as “Fair to Good” (3.3).

Table 13. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from the Pigeon River at Denton (river mile 17.1) July, 2010.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
AMPHIPODA				0.5
	Crangonyctidae		3	
ANNELIDA				2.1
	Oligochaeta		12	
COLEOPTERA				5.4
	Dryopidae	*Helichus*	4	
	Elmidae	*Ancyronyx variegatus*	2	
		Macronychus glabratus adults	8	
		Microcylloepus pusillus adults	3	
	Gyrinidae	*Dineutus discolor* adult males and females	5	
		Dineutus larvae	3	
	Hydrophilidae	*Cymbiodyta* adult	1	
	Psephenidae	*Psephenus herricki*	3	
	Staphylinidae	*Stenus* adult	1	

Table 13. Continued.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
DECAPODA				1.4
	Cambaridae	*Cambarus longirostris* juveniles	2	
		Orconectes forceps juveniles	5	
		Orconectes virilis juvenile	1	
DIPTERA				8.4
	Chironomidae		31	
	Simuliidae		10	
	Tipulidae	*Antocha*	5	
		Tipula	1	
EPHEMEROPTERA				35.2
	Baetidae	*Acentrella*	5	
		Baetis	66	
		Centroptilum	1	
	Ephemerellidae	*Eurylophella*	1	
	Ephemerellidae	*Serratella deficiens*	18	
	Heptagenidae	*Maccaffertium* early instars	44	
		Maccaffertium ithaca	14	
		Maccaffertium mediopunctatum	4	
		Stenacron early instar	1	
	Isonychiidae	*Isonychia*	43	
GASTROPODA				1.3
	Physidae		4	
	Pleuroceridae	*Leptoxis*	3	
HETEROPTERA				0.4
	Veliidae	*Rhagovelia obesa* males	2	
HYDRACARINA				0.2
			1	
ISOPODA				0.9
	Asellidae	*Caecidotea*	5	
MEGALOPTERA				3.9
	Corydalidae	*Corydalus cornutus*	20	
		Nigronia serricornis	2	
ODONATA				2.1
	Aeshnidae	*Boyeria vinosa*	6	
	Coenagrionidae	*Argia*	3	
	Gomphidae	*Gomphus lividus*	1	
	Macromiidae	*Macromia*	2	
PELECYPODA				2.1
	Corbiclidae	*Corbicula fluminea*	12	
PLECOPTERA				0.9
	Perlidae	*Acroneuria abnormis* early instars	5	
TRICHOPTERA				35.2
	Brachycentridae	*Brachycentrus lateralis*	4	
	Hydropsychidae	*Ceratopsyche morosa*	57	
		Ceratopsyche sparna	35	
		Cheumatopsyche	55	
		Hydropsyche franclemonti	23	
		Hydropsyche venularis	1	
	Hydroptilidae	*Leucotrichia pictipes* larvae and pupae	9	
	Lepidostomatidae	*Lepidostoma*	1	
	Leptoceridae	*Oecetis avara*	3	
		Triaenodes perna	2	
	Limnephilidae	*Pycnopsyche gentilis*	1	
	Polycentropodidae	*Polycentropus*	6	

TAXA RICHNESS = 51   EPT TAXA RICHNESS = 22   BIOCLASSIFICATION = 3.3 (FAIR/GOOD)

In December of 2009, an experimental stocking of fingerling rainbow trout was accomplished between river mile 19 and 26. The experimental release of 41,793 (100-125 mm) rainbow trout was done to evaluate the possibility of developing a put grow and take trout fishery in the upper reach of the river. All trout received an adipose fin clip so that their origin could be determined if recaptured. Characteristically, the river develops a thermal bottleneck toward the end of June each year that would limit the number of trout that would survive the remainder of the summer. Our hope was that growth would be high enough that most of these fish would reach a harvestable size by the time water temperatures became unsuitable for trout survival. In early May, we conducted surveys in the upper reach of the river to try and collect some of the trout released in December. We were able to collect 13 fin clipped trout during our efforts. These trout had an average length of 218 mm (8.8 inches) and appeared to be in good condition. Conservatively, these trout grew about 3.3 inches between December and May and had attained harvestable size. Subsequently, we stocked another 40,000 rainbow trout in 2010 which were slightly larger on average than the fish released in 2009. We will evaluate their growth in May 2011 to determine if the slightly larger stocking size has a significant outcome on the average size of the trout in early summer or if an earlier stocking scheme (i.e. releasing fish in October) would produce a larger fish by late spring.

In 2006, the Pigeon River was put into a 3-year rotational sampling scheme (black bass and rock bass) after being annually sampled since 1998. Due to high flows in the fall of 2009 we were unable to sample the river. On November 17, 2010 we conducted sport fish surveys at five sites between Newport and Walters Powerhouse (Figure 14). We were unable to complete one of our CPUE survey sites (site 2) due to flood damage at this location. Because this portion of the river is a tailwater, habitat availability fluctuates with water releases. However, in our survey sites during low flow, the habitat consisted primarily of wooded shorelines with interspersed rock outcroppings. Submerged woody debris was fairly common in most of our sample areas. The river substrate was predominately boulder/cobble in riffle areas and bedrock with interspersed boulder/cobble in the pool areas. Measured channel widths ranged from 35.3 to 64.3 m, while site lengths fell between 80 and 839 m (Table 14). Water temperatures ranged from 10.5 to 12 C and conductivity varied from 130 to150 µs/cm (Table 14).

Figure 14. Site locations for samples conducted in the Pigeon River during 2010.

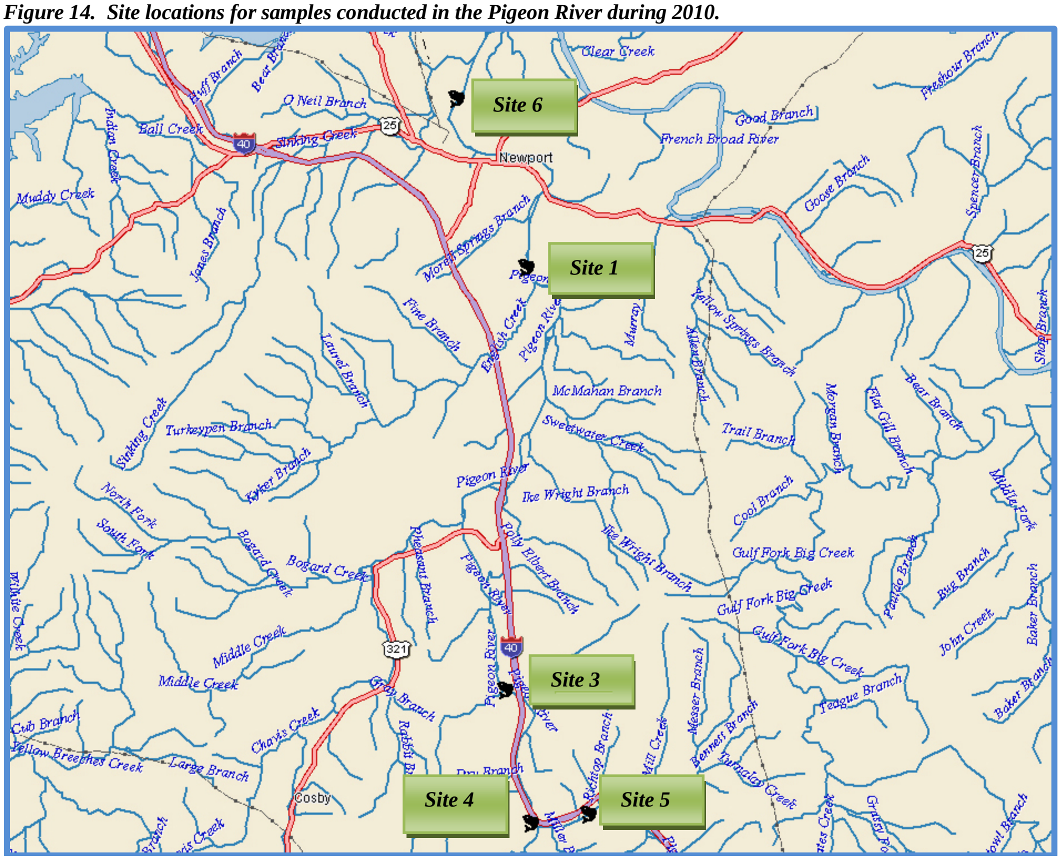


Table 14. Physiochemical and site location data for CPUE samples conducted in the Pigeon River during 2010.

Site Code	Site	County	Quad	River Mile	Latitude	Longitude	Mean Width (m)	Length (m)	Temp. C	Cond.	Secchi (m)
420100701	1	Cocke	Newport 173NW	8.1	35.94236	-83.17906	53.6	392	12	150	3.0
420100702	No Sample						-	-	-	-	-
420100703	3	Cocke	Hartford 173SW	16.6	35.84343	-83.18493	-	414	12	139	3.0
420100704	4	Cocke	Hartford 173SW	19	35.81298	-83.17837	35.3	80	-	-	-
420100705	5	Cocke	Hartford 173SW	20.5	35.81380	-83.16261	47.3	839	10.5	149	3.0
420100706	6	Cocke	Newport 173NW	4.0	35.98182	-83.19912	54	193	12	130	3.0

Catch-per-unit-effort fish samples were collected by boat electrofishing in accordance with the standard large river sampling protocols (TWRA 1998). Fixed-boom electrodes were used to transfer 4-5 amps DC at all sites. This current setting was determined effective in narcotizing all target species (black bass and rock bass). All fish collected were returned to the river. Additionally, efforts were made to identify non-target species encountered at each survey site. All sites were sampled during daylight hours and had survey durations ranging from 674 to 2,723 seconds. Catch-per-unit-effort values were calculated for each target species at each site. Length categorization indices were calculated for target species following Gabelhouse (1984). Index of Biotic Integrity samples were collected using both backpack and boat electrofishing in accordance with standardized protocols.

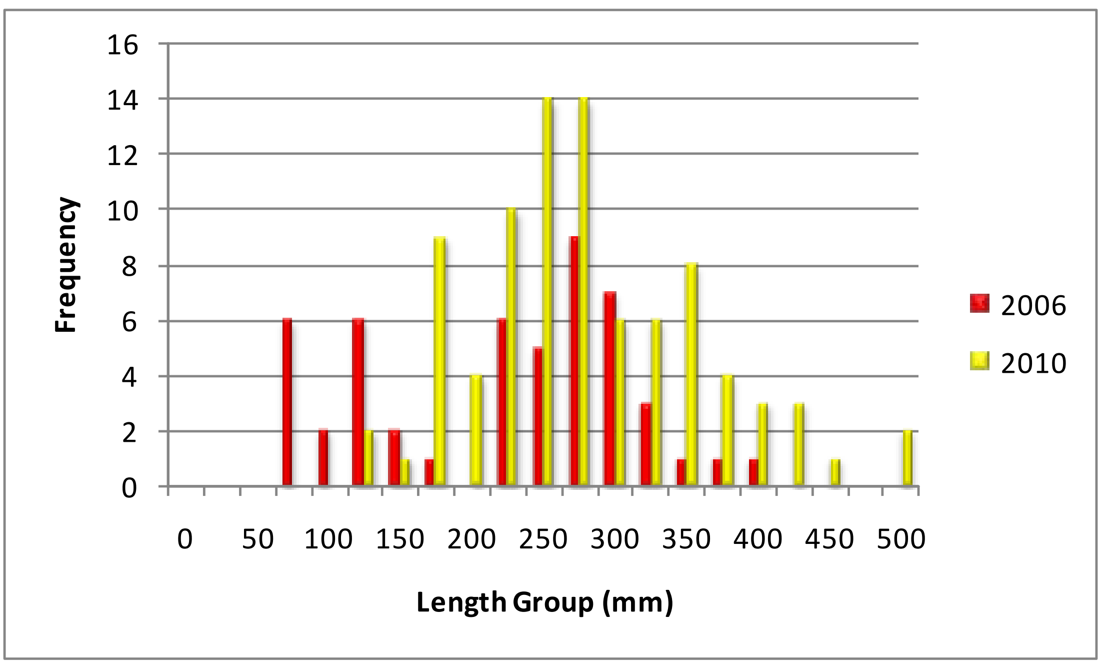
During our surveys, smallmouth bass and rock bass were collected from all sample sites with the exception of site 6. Spotted bass were not collected at any of the sampling stations. Largemouth bass were present at site 1 only. Smallmouth bass was the most abundant black bass species at any of the survey sites. CPUE estimates for this species averaged 46.7/hour (Table 15). Our highest observed catches of smallmouth bass were recorded at site 4 (Bluffton) and site 1 (Tannery Island). Rock bass CPUE was highest at sites 1 and 3, averaging 17.0/hour for all sites. The highest catch rate for this species was recorded at site 3 (41.3/hour), which also had the highest value in 2006. Overall, we observed a 115% increase in the mean catch rate of smallmouth bass between the 2006 and 2010 samples. In 2010 we were able to collect our first smallmouth bass in what is considered the trophy class (>20 inches) from sample site 1. Both fish were 520 mm in length and had an average weight of 1994 grams (4.3 pounds). Angler accounts have verified that this size fish is occasionally caught in the river but up until this sample, bass of this size have eluded our electrofishing equipment. Our change in sampling strategy has increased our odds of collecting bass in this size range as the cooler water temperatures cause a shift in habitat usage that allows us to more effectively sample larger fish.

Table 15. Catch per unit effort and length categorization indices of target species collected at five sites on the Pigeon River during 2010.

Site Code	Smallmouth Bass CPUE	Spotted Bass CPUE	Largemouth Bass CPUE	Rock Bass CPUE
420100701	60.0	0	6.6	30.0
420100702	Not Sampled	Not Sampled	Not Sampled	Not Sampled
420100703	36.9	0	0	41.3
420100704	88.8	0	0	11.1
420100705	48.0	0	0	2.6
420100706	0	0	0	0
MEAN	46.7	0	1.3	17.0
STD. DEV.	32.5	0	2.9	17.9
	Smallmouth Bass Length-Categorization Analysis	**Spotted Bass Length-Categorization Analysis**	**Largemouth Bass Length-Categorization Analysis**	**Rock Bass Length-Categorization Analysis**
	PSD = 54.2	PSD = 0	PSD = 0	PSD = 59.3
	RSD-Preferred = 25.3	RSD-Preferred = 0	RSD-Preferred = 0	RSD-Preferred = 6.2
	RSD-Memorable = 7.2	RSD-Memorable = 0	RSD-Memorable = 0	RSD-Memorable = 0
	RSD-Trophy = 2.4	RSD-Trophy = 0	RSD-Trophy = 0	RSD-Trophy = 0

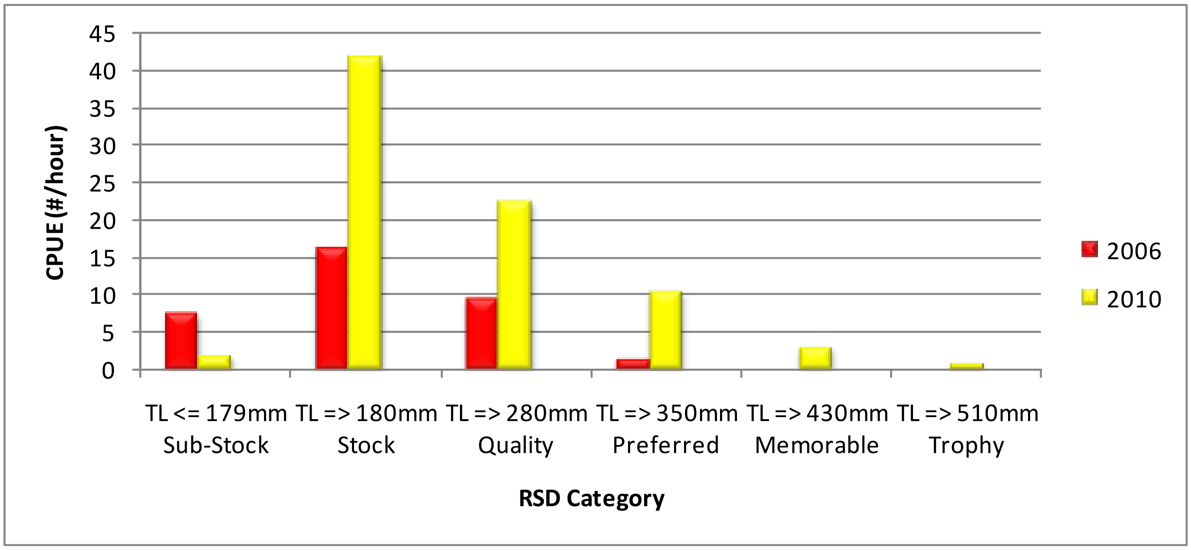
The majority of the smallmouth bass collected from the Pigeon River during 2010 fell within the 175 to 350 mm length range (Figure 15). Bass less than 125 mm were not represented in the 2010 sample but were present in the 2006 survey. Length categorization analysis indicated the Relative Stock Density (RSD) for preferred smallmouth bass (TL $\geq$ 350 mm) was 25.3, which was

Figure 15. Length frequency distribution for smallmouth bass collected from the Pigeon River during 2006 and 2010.



up considerably from the sample taken in 2006. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass were 7.2 and 2.4, respectively. The PSD of smallmouth bass (ratio of quality size bass to stock size bass) was 54.2. Catch per unit effort estimates by RSD category indicated smallmouth bass exceeded 2006 catches in all RSD categories except sub-stock (Figure 16). Overall, we noticed substantial increases in all RSD categories when compared to 2006. The most notable jump was in the stock category where the catch rate increased 160% over the value observed in 2006. This should result in good fishing for the next few years if these fish recruit to the larger size classes.

Figure 16. Relative stock density (RSD) catch per unit effort for smallmouth bass collected from the Pigeon River during 2006 and 2010.



There were no spotted bass collected from the Pigeon River in 2010 (2 collected in 2004, 0 in 2005, 0 in 2006). Because no spotted bass were collected in the sample, no useful information could be derived regarding the size structure of this species.

Only two largemouth bass were collected from all of our sites surveyed in 2010. Largemouth bass have always been a rarity at all of our sample stations and it is not unexpected to survey all sample stations without observing this species. The largemouth collected ranged in length from 75 to 152 mm.

Individuals in the 150 to 200 mm range represented the majority of rock bass in our sample (Figure 17). Length categorization analysis indicated the RSD for preferred rock bass (TL $\geq$ 230 mm) was 6.2 which was an increase from the value of 0 in 2006. RSD for memorable (TL $\geq$ 280 mm) and trophy (TL $\geq$ 330 mm) size rock bass was 0. The PSD of rock bass was 59.3, which was an improvement over the observed value of 28 in 2006. Catch per unit effort estimates by RSD category indicated the majority of our catch was stock size fish (Figure 18) with about 35% of the catch representing quality size fish. Unlike 2006, we did observe rock bass in the preferred category but we did not catch any rock bass in the sub-stock category. Unlike 2006, we did have a representation of rock bass in the preferred category.

Figure 17. Length frequency distribution for rock bass collected from the Pigeon River during 2006 and 2010.

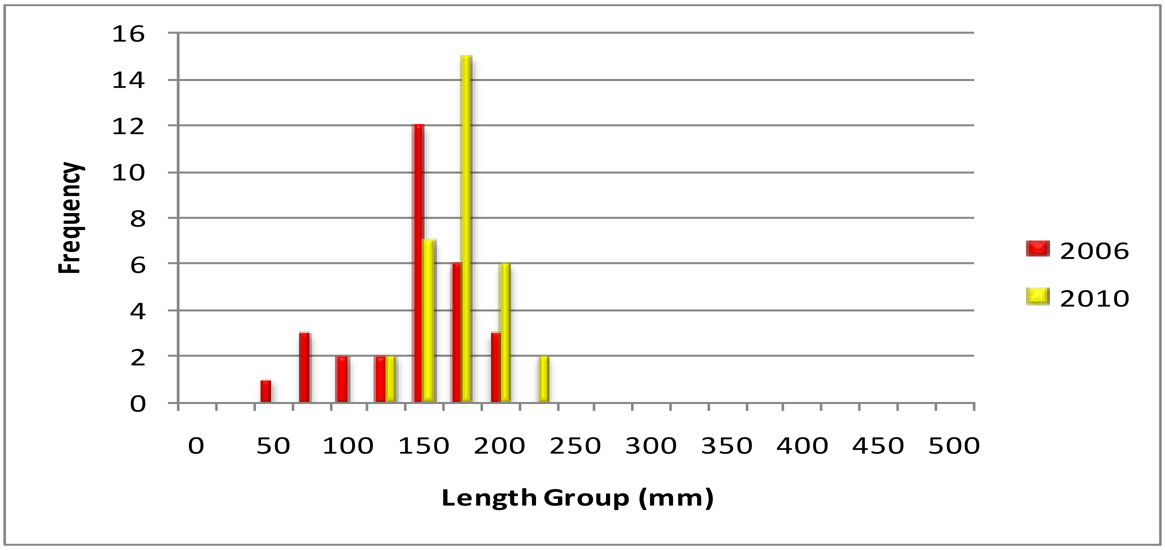
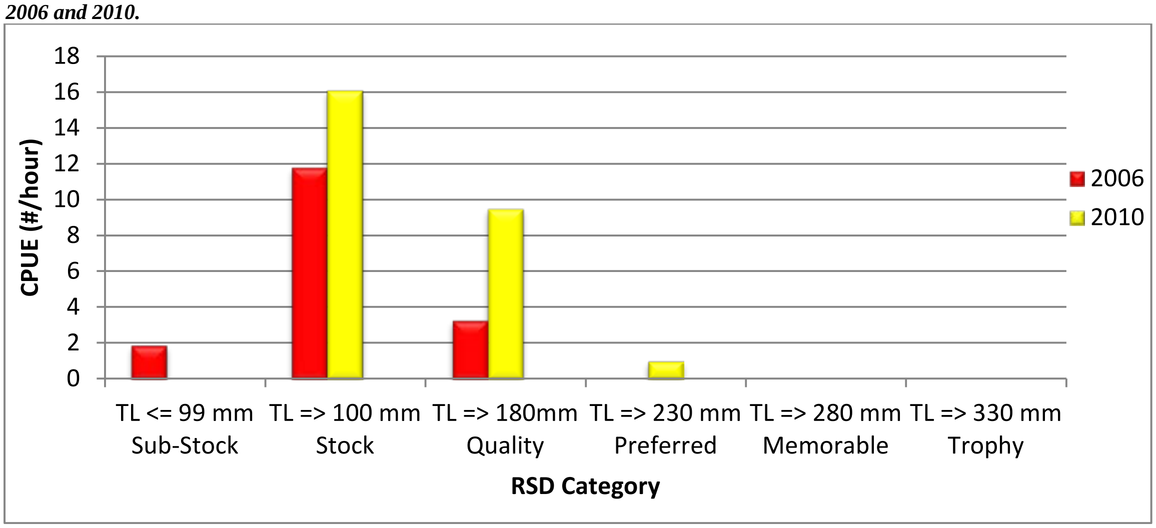


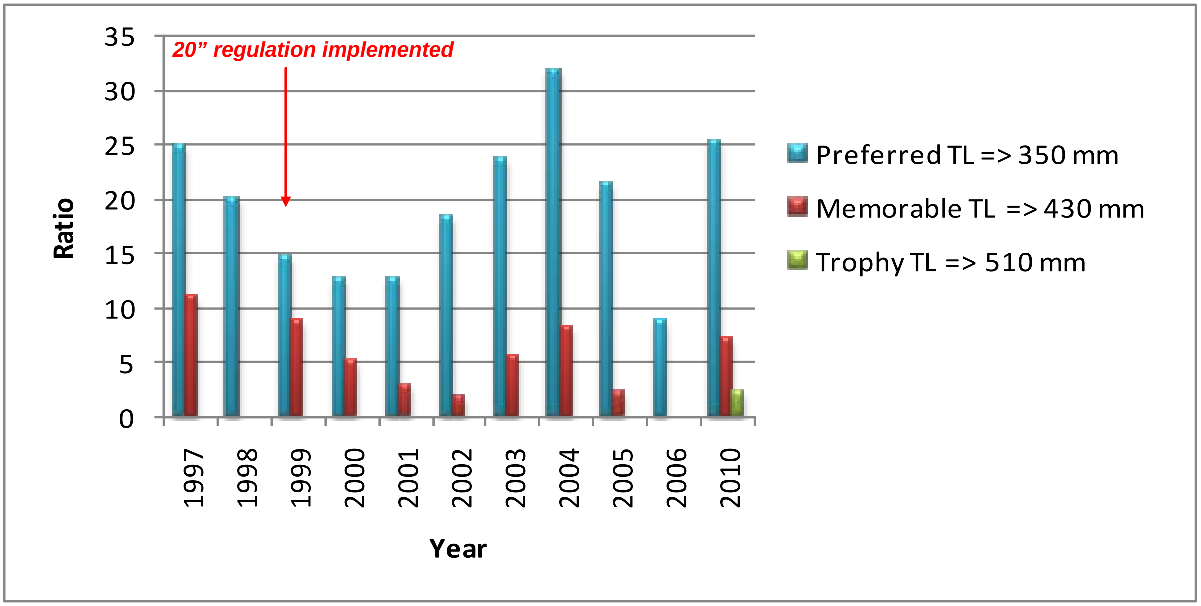
Figure 18. Relative stock density (RSD) catch per unit effort by category for rock bass collected from the Pigeon River during 2006 and 2010.



Discussion

The Pigeon River provides anglers with the opportunity to catch all species of black bass as well as rock bass. Perhaps the greatest potential for elevating this river's "trophy" status lies in the smallmouth bass population. The last black bass and rock bass survey of the Pigeon was in 2006. The river was put into a rotational survey scheme after 2006 and was scheduled to be sampled in 2009. Unfortunately, excessive generation from the Waterville Powerhouse precluded us from sampling during September or October. During 2006, we recorded the lowest percentage of preferred smallmouth bass to date (Figure 19). This figure rebounded nicely in 2010 and was the second highest value recorded for this category since monitoring began. The 2010 preferred catch was 29% higher than the 11 year average and 187% higher than the 2006 value. Smallmouth bass in the memorable category increased in 2010 and for the first time since monitoring began in 1997, we collected two bass in the trophy category.

Figure 19. Trends in the ratio of preferred, memorable, and trophy smallmouth bass collected from the Pigeon River 1997-2010.



Water quality improvement over the last 20 years has primarily been the result of more advanced wastewater treatment at the Blue Ridge Paper Mill in Canton, North Carolina. The improved water quality has undoubtedly had an effect on the amount of recreation that is currently taking place, particularly whitewater rafting. It has also resulted in the return of a few species (e.g. silver shiner, telescope shiner) previously not encountered in the annual surveys and the implementation of a fish and mollusk recovery effort. During 2006, there were at least two instances of pesticides entering the river. During these events, both benthic invertebrates and fish were killed. Investigations by TWRA and TDEC resulted in identifying the areas of agricultural runoff into the river. A remediation plan to control the runoff of agricultural pesticides is being developed by TDEC and TWRA.

In December 2010, another 40,000 rainbow trout were released into the Pigeon River between Walters Powerhouse and Bluffton. The objective of this experimental release is to evaluate the potential for establishing a seasonal trout fishery. We will evaluate the release in 2011 to determine trout distribution and survival in the river. We are hopeful that a seasonal fishery can be established in the upper reach of the river based on the persistence of wild trout in this section of the river.

We will monitor black bass and rock bass populations in the Pigeon River during late September or October in order to maintain our efficiency in characterizing the smallmouth bass populations in the river. Index of Biotic Integrity samples will continue on an annual basis.

Management Recommendations

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

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

3. Develop a management plan for the river.

4. Continue cooperative efforts to reintroduce common species.

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

New River

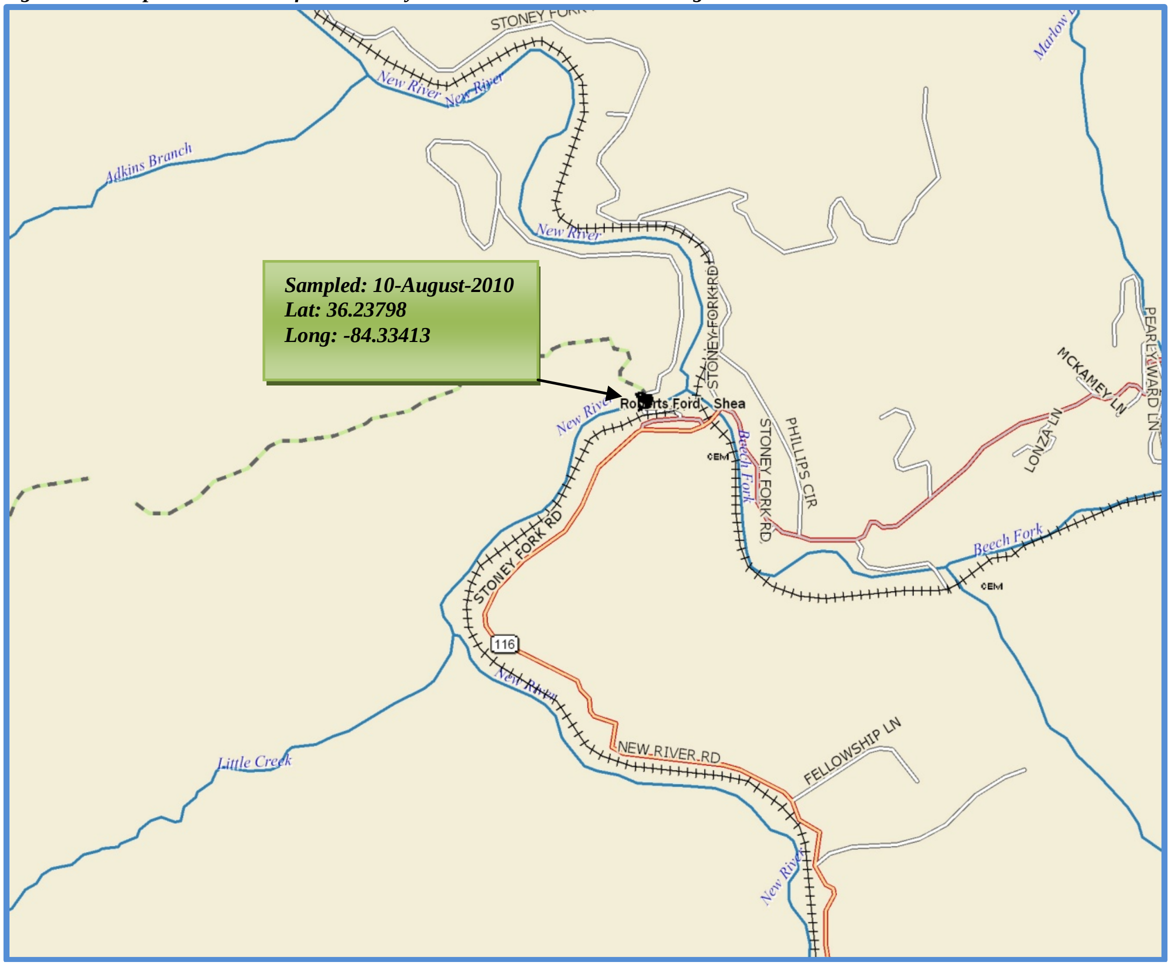
Introduction

The New River drainage has had a long history of ecological abuse. The most prominent influence on overall watershed and water quality has been the continued development of the coal mining industry in the region since the turn of the century. With the shift to surface mining in recent history the influence on water quality has shifted from acidic pulses from deep mines (prevalent in the early 1900's) to siltation from surface mining operations. The most recent investigations in the watershed were by Evans (1998), who completed extensive surveys within the watershed and developed specific assessment criteria for fish assemblages. It was summarized from these investigations that some recovery has taken place in the watershed and many streams support fairly diverse communities of fish. The Agency has conducted surveys within the watershed in a limited number of streams (Bivens and Williams 1990; Carter et al. 2003; Carter et al. 2005). With the resurgence of coal mining in the last few years, the watershed stands to receive another inoculation of degraded water quality if activities are not stringently monitored. Our efforts in the New River during 2010 were limited, and primarily focused on gathering information on the sport fishery.

Study Area and Methods

The New River encompasses a drainage area of 989 km^2 and courses some 55 miles through Scott, Campbell, and Anderson counties before joining the Clear Fork (Evans 1998). The convergence of the New River and Clear Fork form the headwaters of the Big South Fork of the Cumberland River. Access to the river is mostly through private holdings, however, the Big South Fork National Recreation Area bounds the lower reach of the river. Our survey of the New River was a follow up monitoring of the sport species at our sample site established in 2004. The sample site is located at Robert Ford near the confluence with Beech Fork (Figure 20). At our sampling station we used boat electrofishing to effectively sample shallow and deep habitats within the area. Fish were collected in accordance with the standard large river sampling protocols (TWRA 1998). Fixed-boom electrodes were used to transfer 4-5 amps DC. This current setting was determined effective in narcotizing all target species. Catch-per-unit-effort (CPUE) values were calculated for each target species. Length categorization indices were calculated for target sport species following Gabelhouse (1984).

Figure 20. Sample site locations for the surveys conducted in New River during 2010.

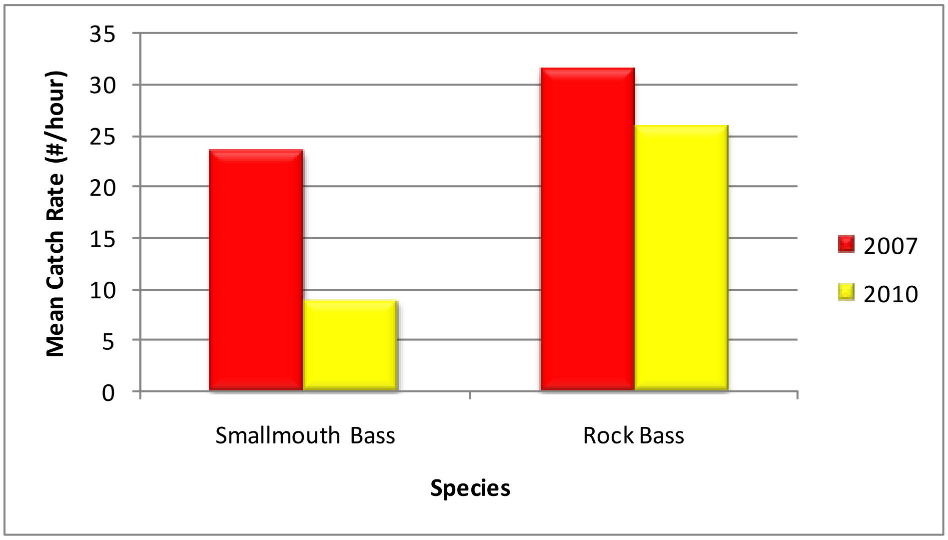


At our sample location gravel and rubble were the dominant substrate components, although bedrock was fairly common in the pool habitat. Coal fines were prevalent at the site, which was not unexpected. Temperature at the site was 26.6 C and the water clarity was good. The river was very low but we were able to negotiate shallow areas and sample the same area that was surveyed in 2007.

Results

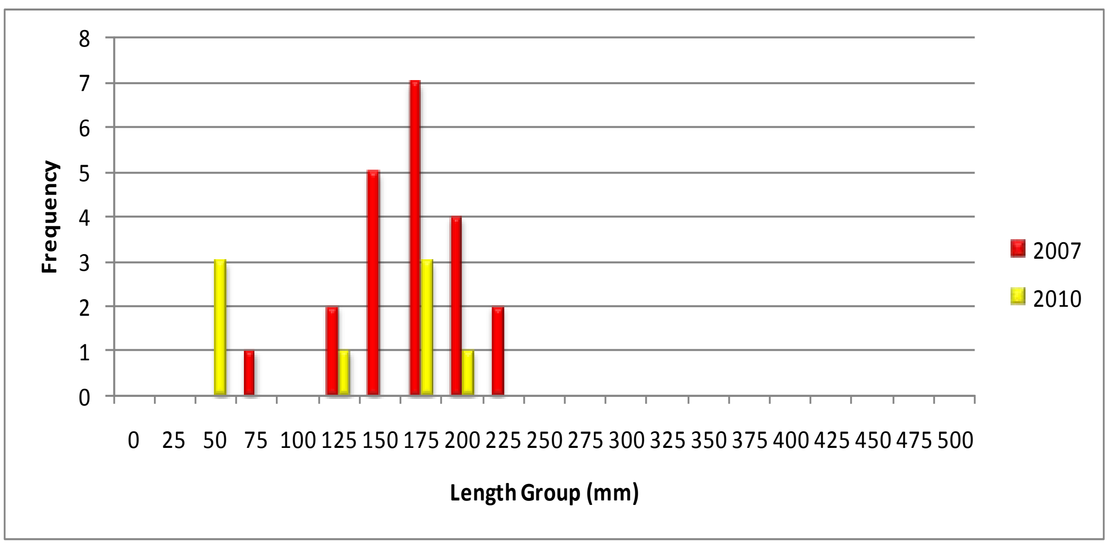
Of the game species collected, rock bass and smallmouth bass were the dominant species. We also collected longear sunfish and have collected walleye in the past although none were observed during this sample. A total of 23 rock bass and 8 smallmouth bass were collected from the survey site. The observed number of rock bass remained relatively consistent to the 2007 value but the catch of smallmouth bass was down considerably from the 21 observed in 2007. The catch rate for smallmouth bass and rock bass was 8.9 and 25.8, respectively (Figure 21).

Figure 21. CPUE for smallmouth bass and rock bass collected from New River 2007 and 2010.



The majority of smallmouth bass collected during 2010 fell within the 175 mm to 225 mm length range (Figure 22). Because of the limited access at our site we felt the number we collected was poor relative to the number observed in 2007. The low water condition probably had the greatest influence on the distribution of fish in the river and our ability to capture them.

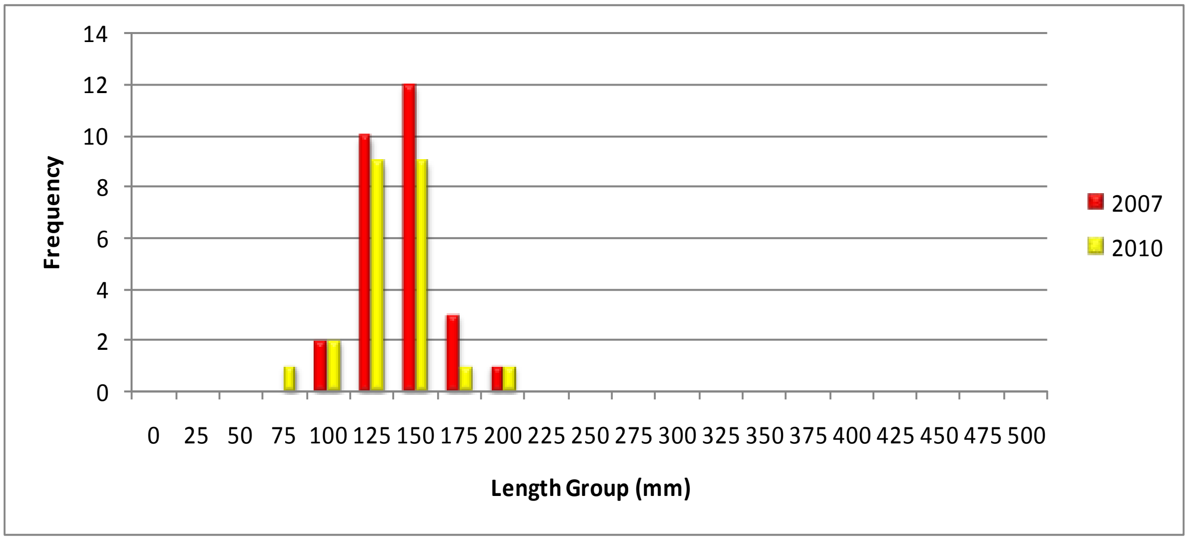
Figure 22. Length frequency distribution for smallmouth bass collected in the New River 2007 and 2010.



Length categorization analysis indicated the relative stock density (RSD) for smallmouth bass was 0 in all categories. PSD could not be calculated because there were no quality size ($\geq$ 280 mm) bass collected in the sample. The catch rates for sub-stock and stock size bass were both 4.5/hour.

Rock bass collected from the New River in 2010 fell within the 75 mm to 225 mm length range (Figure 23). As with smallmouth bass we had a limited amount of suitable habitat to sample, so we feel that the number we collected was good, given our sampling situation.

Figure 23. Length frequency distribution for rock bass collected in the New River 2007 and 2010.



Length categorization analysis indicated the relative stock density (RSD) for rock bass was 0 in all categories. PSD for rock bass was 4.5. Given that rock bass are more sensitive to habitat alterations it was encouraging to see the number that we did, given the land use history within the watershed.

Qualitative Survey at Cordell

The Cumberland Mountain region of Anderson, Campbell and Scott counties has had a long history of degradation due primarily from the influences of timber harvest and coal mining. TWRA's Environmental Services Division in Nashville requested cursory surveys of streams in the New River watershed in September 2010 to begin compiling current information on the biological and chemical condition of the New River and its tributaries. This effort was triggered by the development of a multi-agency New River initiative that is focusing on the evaluation, monitoring and reclamation of degraded water within the watershed. As part of this initiative, we conducted one qualitative survey of the New River in conjunction with a benthic macroinvertebrate sample on September 29, 2010. The survey conducted in New River was located at the bridge crossing at Cordell. The majority of the substrate within our sample was loose gravel or cobble in the riffles and gravel/cobble mix in the pool habitat.

We collected a total of 400 fish representing 20 species during the sample (Table 16). The two dominant species collected were central stoneroller and rosyface shiner. Together, these two species comprised 70% of the fish collected. Five darter species were collected which included bluebreast darter, greenside darter, emerald darter, bloodfin darter, and logperch. Two sucker species (northern hog sucker and black redhorse) were collected here with the northern hog sucker being the most abundant. Game species collected included longear sunfish, rock bass, spotted bass, and smallmouth bass. Both rock bass and smallmouth bass were equally abundant comprising 75% of the total number of game fish collected.

Table 16. Fish species collected in New River during 2010.

SPECIES	NUMBER
Campostoma anomalum	46
Notropis rubellus	235
Notropis vollucellus	9
Lythrurus fasciolaris	4
Cyprinella galactura	3
Luxilis chrysocephalus	7
Pimephales notatus	3
Nocomis micropogon	5
Hypentelium nigricans	3
Moxostoma dequesneii	2
Ameiurus natalis	1
Ambloplites rupestris	3
Lepomis megalotis	1
Micropterus dolomieu	3
Micropterus punctulatus	1
Etheostoma camurum	36
Etheostoma blenniodes	16
Etheostoma baileyi	1
Ehteostoma sanguifluum	20
Percina caprodes	1

Benthic macroinvertebrates collected in New River comprised 29 families representing 37 identified genera (Table 17). The most abundant group in our collection was the mayflies comprising 39.2% of the total sample. Overall, a total of 43 taxa were identified from the sample of which 14 were EPT. Based on the EPT taxa richness and overall biotic index of all species collected, the relative health of the benthic community was classified as “Fair to Good” (3.5).

Table 17. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from New River in 2010.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
ANNELIDA				1.9
	Oligochaeta		6	
COLEOPTERA				5.3
	Dryopidae	*Helichus* adults	6	
	Elmidae	*Optoservus* larvae	3	
	Eubriidae	*Ectopria*	2	
	Gyrinidae	*Dineutus discolor* male and females	3	
	Psephenidae	*Psephenus herricki*	3	
DIPTERA				10.3
	Athericidae	*Atherix lantha*	2	
	Ceratopogonidae	*Palpomyia* complex	1	
	Chironomidae	larvae	27	
	Simuliidae	larvae	3	
EPHEMEROPTERA				39.2
	Baetidae	*Acentrella*	3	
		Baetis	17	
	Caenidae	*Brachycercus*	1	
		Caenis	2	
	Ephemerellidae	*Eurylophella*	1	
	Ephemeridae	*Ephemera*	5	
	Heptageniidae	*Maccaffertium* early instar	29	
		Maccaffertium mediopunctatum	7	
		Maccaffertium vicarium	9	
		Stenacron interpunctatum	19	
	Isonychiidae	*Isonychia*	32	

Table 17. Continued.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
HETEROPTERA				0.9
	Gerridae	*Metrobates hesperius*	2	
	Nepidae	*Ranatra nigra*	1	
LEPIDOPTERA				0.3
	Pyralidae		1	
MEGALOPTERA				9.7
	Corydalidae	*Corydalus cornutus*	30	
	Sialidae	*Sialis*	1	
ODONATA				17.2
	Aeshnidae	*Basiaeshna janata*	2	
		Boyeria grafiana	1	
	Calopterygidae	*Calopteryx dimidiata*	1	
	Coenagrionidae	*Argia*	16	
		Enallagma divagans	4	
	Gomphidae	very early instar	1	
		Dromogomphus spinosus	1	
		Gomphus lividus	2	
		Gomphus quadricolor	4	
		Gomphus rogersi	1	
		Hylogomphus brevis	1	
		Progomphus obscurus	8	
	Macromiidae	*Didymops transversa*	2	
		Macromia	11	
PELECYPODA				2.8
	Corbiculidae	*Corbicula fluminea*	9	
TRICHOPTERA				12.2
	Hydropsychidae	very early instar	1	
		Cheumatopsyche	12	
		Ceratopsyche sparna	1	
		Hydropsyche dicantha	6	
	Philopotamidae	*Chimarra*	19	

TAXA RICHNESS = 43 EPT TAXA RICHNESS = 14 BIOCLASSIFICATION = 3.5 (FAIR/GOOD)

Discussion

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

Management Recommendations

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

2. Ensure that future coal extraction is carefully monitored.

3. Consider winter rainbow trout stocking.

Smoky Creek

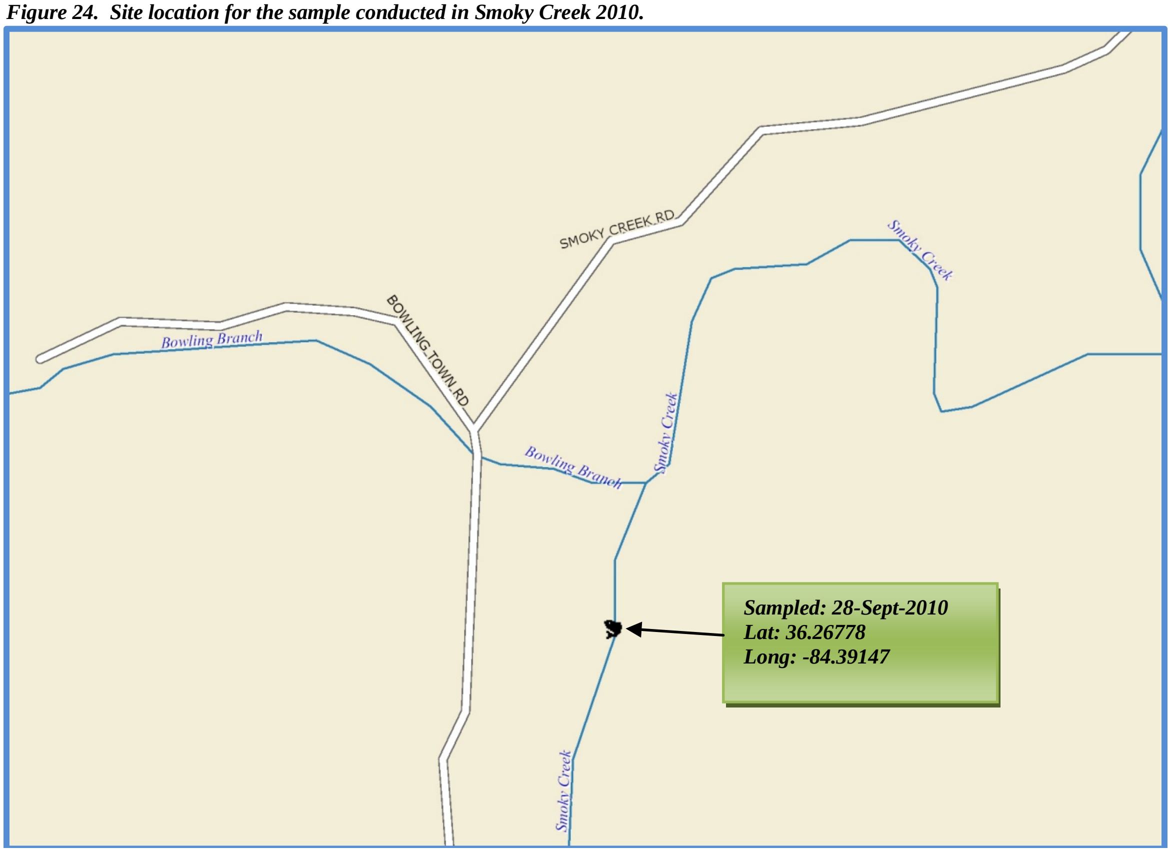
Introduction

The Cumberland Mountain region of Anderson, Campbell and Scott counties has had a long history of degradation due primarily from the influences of timber harvest and coal mining. TWRA's Environmental Services Division in Nashville requested cursory surveys of streams in the New River watershed in September 2010 to begin compiling current information on the biological and chemical condition of the New River and its tributaries. This effort was triggered by the development of a multi-agency New River initiative that is focusing on the evaluation, monitoring and reclamation of degraded water within the watershed. As part of this initiative, we conducted one fish IBI survey of Smoky Creek in conjunction with a benthic macroinvertebrate sample on September 28, 2010.

Study Area and Methods

The survey conducted in Smoky Creek was located approximately 1.5 road miles southwest of bridge crossing New River at Smoky Junction (Figure 24). The majority of the substrate within our sample was loose gravel or cobble in the riffles and gravel/cobble mix in the pool habitat. There was some indication of substantial bed load movement as gravel bar formation was common and substrate instability was noticeable in many areas of the site.

Figure 24. Site location for the sample conducted in Smoky Creek 2010.



Our evaluation of the fish community was accomplished through an Index of Biotic Integrity (IBI) survey. We incorporated the use of one backpack electrofisher and a 5 meter seine to collect fish in shallower habitat at both sites.

Analysis of the IBI data followed those criteria described by Evans (1998). Benthic organisms were collected with kick nets during a timed survey. Analysis of the benthic samples followed procedures developed by Lenat (1993).

Results

We collected a total of 659 fish representing 21 species during the sample (Table 18). The two dominant species collected were sand shiner and rosyface shiner. Together, these two species comprised 35% of the fish collected. Eight darter species were collected which included rainbow darter, bluebreast darter, greenside darter, emerald darter, bloodfin darter, ashy darter, blackside darter and logperch. Three sucker species (northern hog sucker, black redhorse, and white sucker) were collected here with the northern hog sucker being the most abundant. Game species collected included longear sunfish, rock bass, bluegill, spotted bass, and smallmouth bass. The most abundant game species was longear sunfish comprising 85% of the total number of game fish collected.

Table 18. Fish species collected in Smoky Creek during 2010.

SPECIES	NUMBER
Ambloplites rupestris	1
Campostoma anomalum	54
Catostomus commersonii	1
Ehteostoma sanguifluum	17
Etheostoma baileyi	1
Etheostoma blenniodes	23
Etheostoma caeruleum	52
Etheostoma camurum	84
Ethesotoma cinereum	13
Hypentelium nigricans	18
Lepomis macrochirus	2
Lepomis megalotis	40
Luxilis chrysocephalus	72
Lythrurus fasciolaris	38
Micropterus dolomieu	3
Micropterus punctulatus	1
Moxostoma dequesneii	1
Notropis rubellus	101
Notropis stramineus	129
Percina caprodes	5
Percina maculata	3

Overall, the IBI analysis indicated Smoky Creek was in fair condition (IBI score = 38). The most influential metrics on our score were the low percentage of suckers, smallmouth bass and rock bass in the population (Table 19). This was most likely attributed the lack of preferred habitat, particularly cover associated with stream margins and sufficient pool habitat. There was only an average percentage of benthic feeding fishes and a relatively high percentage of trophic generalists which influenced the score. The 2010 IBI score remained relatively consistent with the value reported by Evans (1998) (IBI score = 40), who surveyed the same section of stream in 1996.

Table 19. Smoky Creek Index of Biotic Integrity analysis 2010.

Metric Description	Scoring Criteria 1 3 5	Observed	Score
Number of Native Species	<15 15-17 >17	21	5
Number of Darter Species	<5 5-6 >6	8	5
Number of Intolerant Species.	<2 2 >2	4	5
Percent Benthic Invertivores	<20.7 between >36.6	33.1	3
Percent Generalist Feeders	>33.5 between <18.5	19.5	3
Percent Suckers	<3.1 between >8.2	3	1
Percent Smallmouth Bass and Rock Bass	<1.2 between >3.3	0.6	1
Percent Pioneering Species	>17.6 between <5.1	10.9	5
Percent Simple Spawners	<13.5 between > 23.3	55.2	5
CPUE (Catch per Unit Effort)	<10.2 between >22.1	179.3	5
		Total	**38 (Fair)**

Benthic macroinvertebrates collected in Smoky Creek comprised 29 families representing 35 identified genera (Table 20). The most abundant group in our collection was the mayflies comprising 43.4% of the total sample. Overall, a total of 41 taxa were identified from the sample of which 12 were EPT. Based on the EPT taxa richness and overall biotic index of all species collected, the relative health of the benthic community was classified as “Fair to Good” (3.5).

Table 20. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from Smoky Creek in 2010.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
ANNELIDA				1.3
	Oligochaeta		4	
COLEOPTERA				10.7
	Dryopidae	*Helichus* adults	16	
		Hydroporus adults	6	
	Elmidae	*Ancyronyx variegatus* adult	1	
		Optioservus adult	1	
	Gyrinidae	*Dineutus dineutus* males and females	5	
		Dineutus robertsi adult female	1	
	Psephenidae	*Psephenus herricki*	4	
DIPTERA				8.5
	Athericidae	*Atherix lantha*	6	
	Chironomidae		14	
	Culicidae	*Anopheles*	1	
	Tabanidae	*Tabanus*	4	
	Tipulidae	*Hexatoma*	1	
		Tipula	1	
EPHEMEROPTERA				43.4
	Baetidae	*Baetis*	9	
	Caenidae	*Caenis*	1	
	Heptageniidae	*Maccaffertium* sp. early instars	9	
		Maccaffertium vicarium	61	
	Isonychidae	*Isonychia*	58	
HETEROPTERA				2.2
	Nepidae	*Ranatra nigra*	2	
	Veliidae	*Microvelia*	1	
		Rhagovelia obesa males and females	4	
HYDRACARINA			1	0.3
LEPIDOPTERA				0.3
	Pyralidae		1	

Table 20. Continued.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
MEGALOPTERA				7.9
	Corydalidae	*Corydalus cornutus*	22	
		Nigronia serricornis	3	
ODONATA				9.4
	Aeshnidae	*Boyeria vinosa*	14	
	Calopterygidae	*Calopteryx*	3	
	Coenagrionidae	*Argia*	1	
		Enallagma	3	
	Corduliidae	*Helocordulia uhleri*	2	
	Gomphidae	*Dromogomphus spinosus*	1	
		Gomhus lividus	5	
	Macromiidae	*Macromia*	1	
PLECOPTERA				0.9
	Chloroperlidae	early instar	1	
	Perlidae	*Acroneuria* early instar	1	
		Acroneuria carolinensis	1	
TRICHOPTERA				15.1
	Hydropsychidae	*Ceratopsyche sparna*	5	
		Cheumatopsyche	32	
		Diplectrona modesta	1	
		Hydropsyche dicantha	1	
	Philopotamidae	*Chimara*	8	
	Polycentropodidae	*Polycentropus*	1	

TAXA RICHNESS = 41 EPT TAXA RICHNESS = 12 BIOCLASSIFICATION = 3.5 (FAIR/GOOD)

Discussion

As is the case with many streams located within the New River watershed, years of coal extraction and timber harvest have taken a toll on the aquatic resources. Smoky Creek is no exception although the stream appears to be in better than average condition when compared to other streams in the area. With the development of the inter-agency New River Initiative the collection of current data will be crucial in assessing changes within the watershed especially if mine reclamation projects are funded within the watershed.

Management Recommendations

1. Continue inter-agency cooperation with grant proposal and monitoring protocol development.

Beech Fork

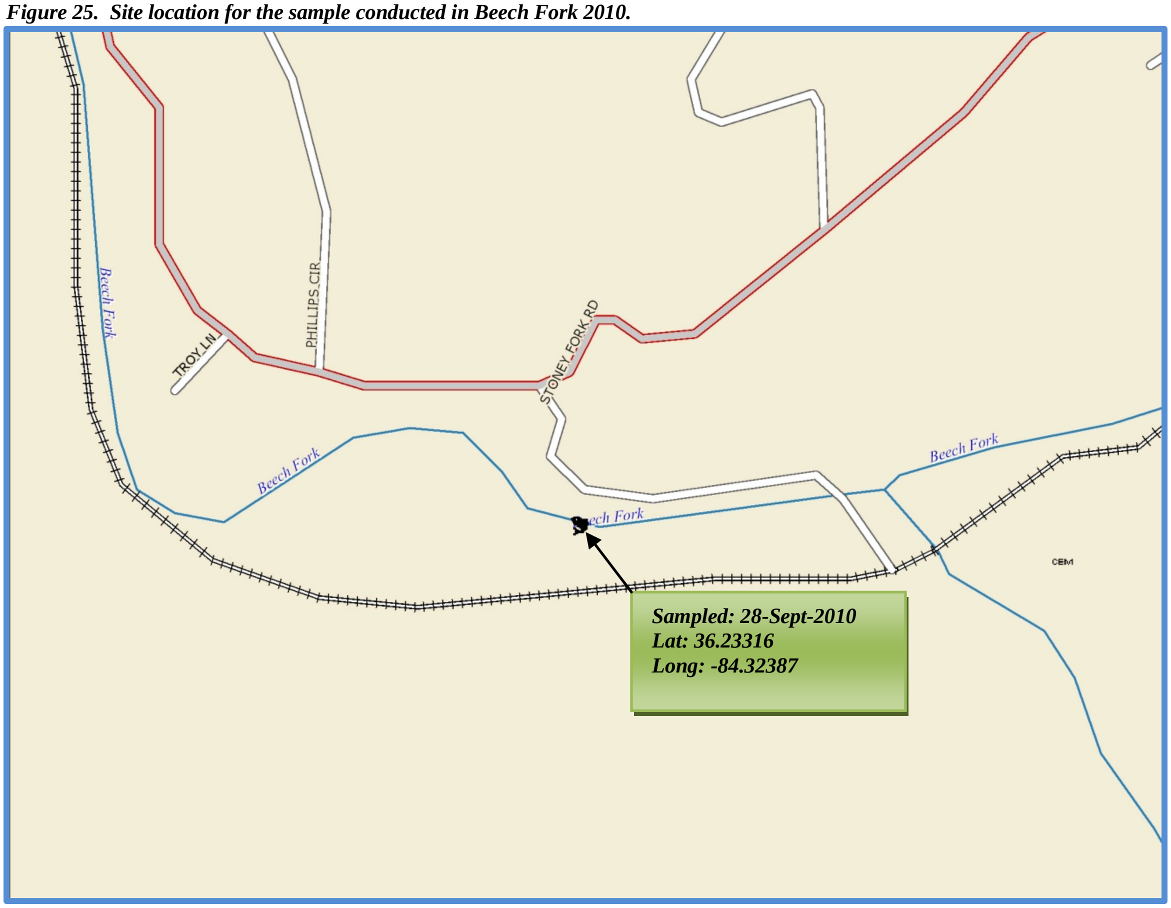
Introduction

The Cumberland Mountain region of Anderson, Campbell and Scott counties has had a long history of degradation due primarily from the influences of timber harvest and coal mining. TWRA's Environmental Services Division in Nashville requested cursory surveys of streams in the New River watershed in the September 2010 to begin compiling current information on the biological and chemical condition of the New River and its tributaries. This effort was triggered by the development of a multi-agency New River initiative that is focusing on the evaluation, monitoring and reclamation of degraded water within the watershed. As part of this initiative, we conducted one fish IBI survey of Beech Fork.

Study Area and Methods

The survey conducted in Beech Creek was located approximately 0.9 road miles upstream of the bridge at the mouth of Beech Fork (Figure 25). The majority of the substrate within our sample was loose gravel or cobble in the riffles and gravel/cobble mix in the pool habitat.

Figure 25. Site location for the sample conducted in Beech Fork 2010.



Our evaluation of the fish community was accomplished through an Index of Biotic Integrity (IBI) survey. We incorporated the use of one backpack electrofisher and a 5 meter seine to collect fish in shallower habitat at both sites. Analysis of the IBI data followed those criteria described by Evans (1998).

Results

We collected a total of 398 fish representing 18 species during the sample (Table 21). The two dominant species collected were central stoneroller and striped shiner. Together, these two species comprised 49.7% of the fish collected. Five darter species were collected which included rainbow darter, bluebreast darter, greenside darter, bloodfin darter, and ashy darter. Three sucker species (northern hog sucker, black redhorse, and golden redhorse) were collected here with the northern hog sucker being the most abundant. Game species collected included longear sunfish, rock bass, and smallmouth bass. Equally abundant game species were smallmouth bass and rock bass, collectively comprising 70% of the total number of game fish collected.

Table 21. Fish species collected in Beech Fork during 2010.

SPECIES	NUMBER
Campostoma anomalum	134
Notropis rubellus	22
Notropis stramineus	3
Notropis volucellus	2
Lythrurus fasciolaris	57
Luxilis chrysocephalus	64
Hypentelium nigricans	24
Moxostoma dequesneii	1
Moxostoma erythrurum	1
Ambloplites rupestris	7
Lepomis megalotis	6
Micropterus dolomieu	7
Etheostoma caeruleum	45
Etheostoma camurum	13
Etheostoma blenniodes	7
Ehteostoma sanguifluum	1
Ethesotoma cinereum	1
Rhinichtys obtusus	3

Overall, the IBI analysis indicated Beech Fork was in good condition (IBI score = 47). The most influential metrics on our score were the number of darters, percentage benthic invertivores, percent suckers, and percent pioneering species in the population (Table 22). The 2010 IBI score remained relatively consistent with the value reported by Evans (1998) (IBI score = 43), who surveyed the same section of stream in 1996.

Table 22. Beech Fork Index of Biotic Integrity analysis 2010.

Metric Description	Scoring Criteria 1 3 5	Observed	Score
Number of Native Species	<15 15-17 >17	18	5
Number of Darter Species	<5 5-6 >6	5	3
Number of Intolerant Species.	<2 2 >2	3	5
Percent Benthic Invertivores	<20.7 between >36.6	24.1	3
Percent Generalist Feeders	>33.5 between <18.5	0.7	5
Percent Suckers	<3.1 between >8.2	6.5	3
Percent Creek chubs	>17 between <2.3	0	5
Percent Smallmouth Bass and Rock Bass	<1.2 between >3.3	3.5	5
Percent Pioneering Species	>17.6 between <5.1	16	3
Percent Simple Spawners	<13.5 between > 23.3	26.3	5
CPUE (Catch per Unit Effort)	<10.2 between >22.1	54.9	5
		Total	**47 (Good)**

Discussion

As is the case with many streams located within the New River watershed, years of coal extraction and timber harvest have taken a toll on the aquatic resources. Beech Fork is no exception although the stream appears to be in better than average condition when compared to other streams in the area. With the development of the inter-agency New River Initiative the collection of current data will be crucial in assessing changes within the watershed especially if mine reclamation projects are funded within the watershed.

Management Recommendations

1. Continue inter-agency cooperation with grant proposal and monitoring protocol development.

Unnamed Tributary to Big Branch

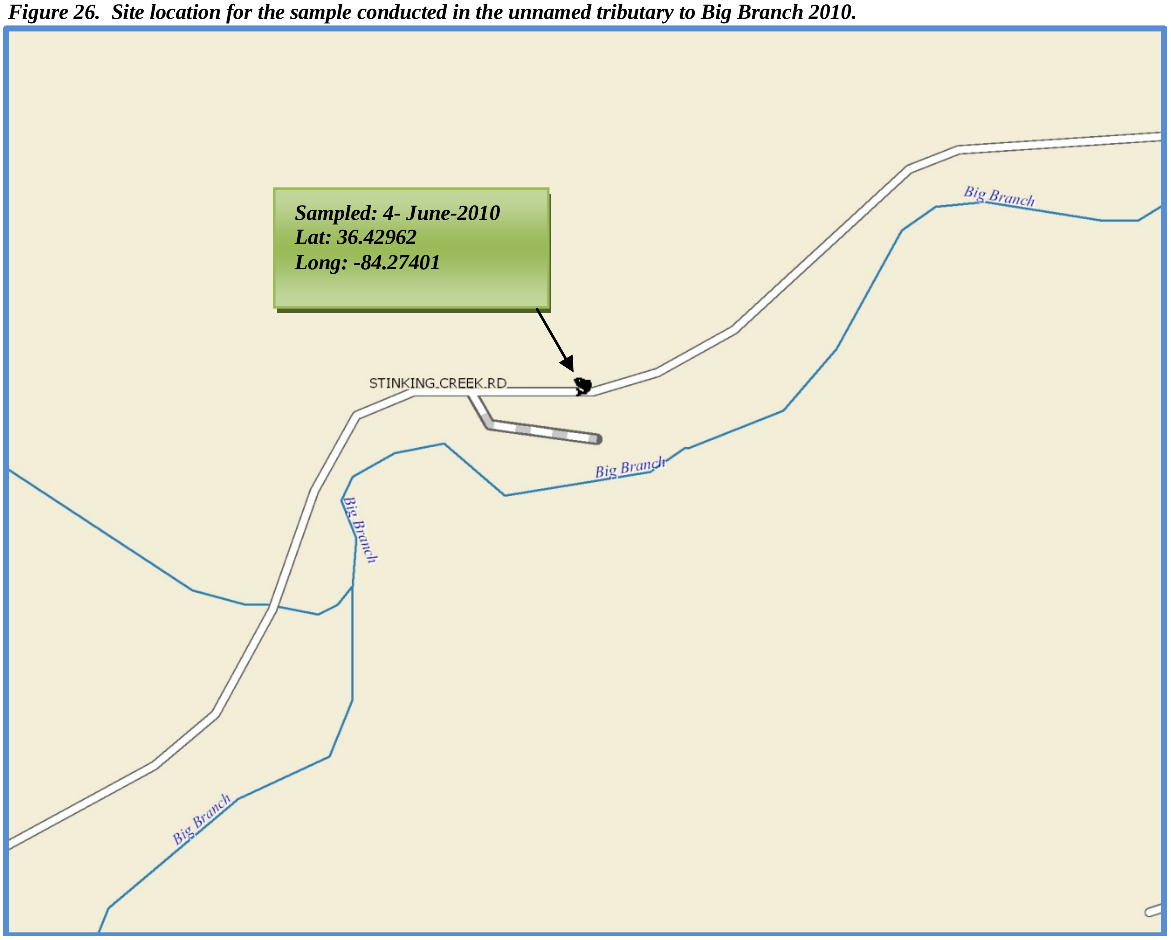
Introduction

The recent invasion of Hemlock Woolly Adelgid (HWA) into the Eastern U.S. has resulted in a unified effort by many natural resource management agencies to develop strategies to manage this exotic insect. Tennessee has been no exception to this effort, creating a HWA taskforce in 2005 to develop a management plan for the state's forest resources. This insect, when established in sufficient densities, attack hemlocks ultimately killing trees in a stand or the whole stand depending on the infestation level.

Study Area and Methods

In the spring of 2010 we were asked by TWRA's Forestry Division and the U.S. Forest Service to conduct a benthic macroinvertebrate survey of the tributary to Big Branch as a control stream that would be compared to Titus Creek which was subject to the HWA treatment. On June 4, 2010 we surveyed a section of the tributary close to its confluence with Big Branch (Figure 26).

Figure 26. Site location for the sample conducted in the unnamed tributary to Big Branch 2010.



Results

We collected aquatic insects from the tributary during a combined three hour effort. Benthic macroinvertebrates collected at the site comprised 20 families representing 26 identified genera (Table 23). The most abundant group in our collection was the caddisflies comprising 47.2% of the total sample. Overall, a total of 30 taxa were identified from the sample of which 21 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 23. Taxa list and associated biotic statistics for benthic macroinvertebrates collected from the unnamed tributary to Big Branch June 2010.

ORDER	FAMILY	SPECIES	NUMBER	PERCENT
DIPTERA				12.4
	Chironomidae	larvae	16	
	Dixidae	*Dixa*	2	
	Tipulidae	*Hexatoma*	4	
EPHEMEROPTERA				12.9
	Baetidae	*Baetis*	2	
	Heptageniidae	*Epeorus dispar*	1	
		Epeorus rubidus/subpallidus	1	
		Leucrocuta	2	
		Maccaffertium meririvulanum	7	
		Stenacron carolina	4	
	Leptophlebiidae	*Habrophlebiodes*	6	
HETEROPTERA				0.6
	Veliidae	*Rhagovelia* nymph	1	
MEGALOPTERA				1.1
	Corydalidae	*Nigronia fasciatus*	1	
		Nigronia serricornis	1	
NEMATOMORPHA		Nematomorpha sp. - horsehair worm	1	0.6
ODONATA				6.2
	Aeshnidae	*Boyeria grafiana*	1	
	Gomphidae	*Lanthus vernalis*	10	
PLECOPTERA				19.1
	Leuctridae	*Leuctra*	2	
	Peltoperlidae	*Peltoperla*	26	
	Perlidae	*Acroneuria carolinensis*	2	
		Eccoptura xanthenes	1	
	Perlodidae	*Isoperla holochlora*	2	
		Remenus bilobatus	1	
TRICHOPTERA				47.2
	Hydropsychidae	*Diplectrona modesta*	50	
	Glossosomatidae	*Agapetus*	1	
		Glossosoma nigrior	2	
	Limnephilidae	*Pycnopsyche luculenta* group	1	
	Philopotamidae	*Dolophilodes distincta* larvae & pupa	22	
	Polycentropodidae	*Polycentropus*	2	
	Uenoidae	*Neophylax aniqua*	4	
		Neophylax concinnus	2	

TAXA RICHNESS = 30 EPT TAXA RICHNESS = 21 BIOCLASSIFICATION = 4.0 (GOOD)

Discussion

This small tributary appears to be relatively unimpacted by logging or mining activities. The small size of the stream is most likely the reason for the lower insect diversity observed in this stream. We will resurvey the stream in June 2011 as part of the follow for the experimental HWA treatment.

Management Recommendations

1. Conduct follow-up surveys of the benthic community as part of the Mycotol application assessment.

Summary

During 2010, we collected 20 fish and 11 benthic macroinvertebrate samples. These included samples from Little River, North Fork Holston River, New River, and Pigeon River. Additionally, four streams were also surveyed.

Overall, CPUE estimates for black bass and rock bass looked relatively good despite several years of low water. The North Fork Holston was down somewhat from the 2007 sample which we feel was related to the absence of larger transient fish from the Holston River. The Pigeon River smallmouth bass population illustrated substantial improvement from the 2006 sample. We observed a 115% increase in our average catch rate and for the first time since monitoring was initiated, collected two smallmouth in the 20 inch class. Overall, rock bass CPUE remained relatively consistent among the three rivers sampled when compared to the most recent surveys. Rainbow trout stocked into the Pigeon River during December 2009 showed good growth when recaptured in May 2010. These fish averaged 218 mm (8.8 inches) and had grown an estimated 3.3 inches during the period. The New River sport fish assessment illustrated a decline in the catch of smallmouth bass. However, the rock bass catch remained relatively consistent with the value observed in 2007.

Muskellunge stocking within the region continued in 2010. Approximately 1,500 fingerling musky were released in the French Broad and Nolichucky rivers during 2010.

The IBI surveys for Little River and the Pigeon River either remained the same or showed improvement when compared to the 2009 values. In Little River, the Townsend site remained consistent with 2009 value whereas the Coulters Bridge site improved slightly from the previous year. In both situations, the fish communities received scores of excellent. The Pigeon River exhibited increases at both sites in 2010, increasing six points at the Tannery Island site and four points at the Denton site. Fish reintroductions continued on the Pigeon River with many of the introduced species collected in the 2010 IBI samples. Benthic macroinvertebrate diversity in Little River and the Pigeon rivers looked good during 2010. Trends in Little River and the Pigeon River saw an upswing in 2010. Biotic index values either remained consistent with the 2009 values or improved slightly (Pigeon River at Denton).

Our re-assessment of the fungal application to control HWA within the Titus Creek watershed illustrated no apparent impact on the aquatic benthic community. Additional surveys were conducted in 2010 and will be re-evaluated in the summer of 2011.

Our collaborative efforts with the New River Initiative resulted in the completion of two IBI surveys in Smoky Creek and Beech Fork. Smoky Creek remained relatively consistent with the previous evaluation declining two points from 1996 to 2010 (40 vs. 38). Beech Fork showed some improvement over the same time period increasing three points from the 1996 evaluation (43 vs. 47).

Over the past 17 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 24 lists our results for various streams surveyed during this time period.

Table 24. Index of Biotic Integrity and Benthic Biotic Index scores for samples conducted between 1994 and 2010.

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

Table 24. Continued.

Water	Watershed	Year Surveyed	County	IBI Score	Benthic BI Score
Bullett Creek	Hiwassee River	1997	Monroe	50 (Good)	4.5 (Good/Excel.)
Canoe Branch	Powell River	1997	Claiborne	26 (V Poor/Poor) (SC)	4.7 (Excellent)
Town Creek	Tennessee River	1997	Loudon	34 (Poor)	2 (Fair)
Bat Creek	Little Tennessee River	1997	Monroe	30 (Poor)	1.5 (Poor/Fair)
Island Creek	Little Tennessee River	1997	Monroe	40 (Fair)	4 (Good)
Little Pigeon River	French Broad River	1997	Sevier	40 (Fair)	2 (Fair)
West Prong Little Pigeon River	French Broad River	1997	Sevier	46 (Fair/Good)	2 (Fair)
Flat Creek	French Broad River	1997	Sevier	30 (Poor)	3.8 (Good)
Clear Creek	French Broad River	1997	Jefferson	34 (Poor)	2.2 (Fair)
Richland Creek	Nolichucky River	1997	Greene	30 (Poor)	2.3 (Fair)
Middle Creek	Nolichucky River	1997	Greene	34 (Poor)	4 (Good)
Sinking Creek	Pigeon River	1997	Cocke	30 (Poor)	3.8 (Good)
Chestuee Creek	Hiwassee River	1998	Monroe	28 (Poor)	2.5 (Fair/Fair -Good)
Fourmile Creek	Powell River	1998	Hancock	36 (Poor/Fair)	4.5 (Good/Excel.)
Martin Creek	Powell River	1998	Hancock	50 (Good)	4 (Good)
Big Creek	Tellico River	1998	Monroe	46 (Fair/Good)	4 (Good)
Oven Creek	Nolichucky River	1998	Cocke	40 (Fair)	2.9 (Fair/Good)
Cherokee Creek	Nolichucky River	1998	Washington	36 (Poor/Fair)	2.8 (Fair/Good)
Bennetts Fork	Cumblerland River	2000	Claiborne	30 (Poor)	3.5 (Fair/Good)
Gulf Fork Big Creek	French Broad River	2001	Cocke	42 (Fair)	4.0 (Good)
Nolichucky River	French Broad River	2001	Unicoi	56 (Good/Excellent)	4.0 (Good)
North Fork Holston River	Holston River	2001	Hawkins	50 (Good)	4.5 (Good)
Stinking Creek	Cumberland River	2002	Campbell	42 (Fair)	4.5 (Good)
Straight Fork	Cumberland River	2002	Campbell	18 (Very Poor)	3.0 (Fair/Good)
Montgomery Fork	Cumberland River	2002	Campbell	48 (Good)	3.5 (Fair/Good)
Turkey Creek	Holston River	2003	Hamblen	34 (Poor)	1.5 (Poor)
Spring Creek	Holston River	2003	Hamblen	34 (Poor)	2.2 (Fair)
Cedar Creek	Holston River	2003	Hamblen	30 (Poor)	3.5 (Fair/Good)
Fall Creek	Holston River	2003	Hamblen	32 (Poor)	2.3 (Fair)
Holley Creek	Nolichucky River	2003	Greene	30 (Poor)	2.4 (Fair)
College Creek	Nolichucky River	2003	Greene	36 (Poor/Fair)	2.2 (Fair)
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)

Table 24. Continued.

Water	Watershed	Year Surveyed	County	IBI Score	Benthic BI Score
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)	-

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