WARMWATER STREAMS FISHERIES REPORT
REGION IV
1998

Prepared by

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TENNESSEE WILDLIFE RESOURCES AGENCY
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Cover: A view of the Pigeon River near river mile 13.0. One of the three large rivers sampled in Region IV during 1998.

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INTRODUCTION

The fish fauna of Tennessee is the most diverse in the United States, with approximately 297 species of native fish and about 26 to 29 introduced species (Etnier and Starnes 1993). Region IV has 7,837 km of streams that total approximately 5,711 ha in 21 east Tennessee counties. There are approximately 1,287 km classified as coldwater streams (TWRA 1994). Streams in Region IV, except for a few in Anderson, Campbell, and Claiborne counties (Cumberland River System streams) are in the Ridge and Valley and Blue Ridge physiographic provinces of the upper Tennessee River drainage basin. The main river systems in the region are the Clinch, Powell, Little Tennessee, mainstream Tennessee River, French Broad, and Holston.

Streams and rivers across the state are of considerable value as they provide a variety of recreational opportunities. These include fishing, canoeing, swimming, and other riverine activities that are unmatched by other aquatic environments. Streams and rivers are also utilized as water sources both commercially and domestically. The management and protection of this resource is recognized by Tennessee Wildlife Resources Agency (TWRA) and has been put forth in the Strategic Plan (TWRA 1994) as a primary goal.

This is the twelfth 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 stream accounts. These accounts include a general summary of the survey work that took place along with the data collected and a management recommendation section for each stream. Sample site location maps and field data are also included.

METHODS

The streams to be sampled and the methods required are outlined in TWRA field request No. 98-4. A total of 9 streams were sampled and are included in this report. Stream surveys were conducted from June to August 1998. Forty-eight (6 IBI and 42 CPUE) fish samples and six benthic samples were collected.

SAMPLE SITE SELECTION

Index of Biotic Integrity (IBI) sample sites were selected that would give the broadest picture of impacts to the watershed. We typically located our sample site in close proximity to the mouth of a stream to maximize resident species collection. However, we positioned survey sites far enough upstream in order to decrease the probability of collecting transient species. Sample lengths ranged from approximately 100-300 meters and included all habitat types characteristic to the survey reach. Large river sampling sites (Nolichucky, Pigeon, and North Fork Holston rivers) were selected based on the length of the river and available access points. Typically we selected sample areas in these rivers that represented the best available habitat for any give reach being surveyed. Sampling locations were delineated in the field on 7.5 minute topographical maps and then digitally re-created using a commercially available software package. These maps have been included in each stream account and include the Tennessee Aquatic Database System (TADS) river reach number and quadrangle map coordinates. Map coordinates were obtained with a Motorola Traxar handheld GPS unit.

WATERSHED ANALYSIS

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

FISH COLLECTIONS

Fish data were collected by employing a slightly modified (Saylor and Alstedt 1990) Index of Biological Integrity (Karr et al. 1986). Fish were collected with standard electrofishing (backpack) and seining techniques. Typically, a 3 or 4.5 x 1.3 meter seine was used to make hauls in shallow pool and run areas in smaller streams (< 6 meter mean width). In larger streams, a 6 x 1.3 meter seine was used. Riffle and deeper run habitats were sampled with a seine in conjunction with a backpack electrofishing unit (100-600

VAC). An area approximating the length of the seine[2] (i.e., 3 meter x 3 meter) was electrofished in a downstream direction. A person with a dipnet assisted the person electrofishing in collecting those fish, which did not freely drift into the seine. Timed (5-min duration) backpack electrofishing runs were used to sample shoreline habitats. In both cases (seining or shocking) an estimate of area ($meter^2$) covered on each pass was calculated. Fish collections were made in all habitat types within the selected survey reach. Collections were made repeatedly for each habitat type until no new species was collected for three consecutive samples for each habitat type. All fish collected from each sample were enumerated and in the case of game fish, lengths and weights obtained. Anomalies (e.g., parasites, deformities, eroded fins, lesions, or tumors) were noted along with occurrences of hybridization. After processing, the captured fish were either held in captivity or released into the stream where they could not be recaptured.

Catch per unit effort samples (CPUE) were conducted in three rivers during 1997. Timed boat electrofishing runs were made in pool and shallower habitat where navigable. Efforts were made to sample the highest quality habitat in each sample site and include representation of all habitat types typical to the reaches surveyed. Total electrofishing time was calculated and was used to determine our catch-effort estimates (fish/hour).

Generally, fish were identified in the field and released. Problematic specimens were preserved in 10% formalin and later identified in the lab or taken to Dr. David A. Etnier at the University of Tennessee Knoxville (UTK). Most of the preserved fish collected in the 1997 samples were catalogued into our reference collection or deposited in the University of Tennessee Research Collection of Fishes. Common and scientific names of fishes used in this report are after Robins et al. (1991) and Etnier and Starnes (1993).

AGE and GROWTH

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

BENTHIC COLLECTIONS

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

Large particles and debris were picked from the samples and discarded in the field. The remaining sample was preserved in 50% isopropanol and later sorted in the laboratory. Organisms were enumerated and attempts were made to identify specimens to species level when possible. Many were identified to genus, and most were at least identified to family. Dr. David A. Etnier (UTK), examined problematic specimens and either made the determination or confirmed our identifications. Comparisons with identified specimens in our aquatic invertebrate collection were also useful in making determinations. For the most part, nomenclature of aquatic insects used in this report follows Brigham et al. (1982) and Louton (1982). Names of stoneflies (Plecoptera) are after Stewart and Stark (1988) and caddisflies are after Etnier et al. (in press) from which many of the determinations were made. Benthic results are presented in tabular form with each stream account.

HABITAT QUALITY ASSESSMENT

Stream habitat conditions were evaluated by employing a visually based habitat assessment technique developed by Barbour and Stribling (1995). This technique has been adopted by TDEC and is being implemented as a component of their monitoring protocols. We were primarily interested in assessing human-induced perturbations to the physical structure of streams. The technique permitted us to focus on a select set of habitat parameters that allowed us to make an integrated assessment of the habitat quality in each reach we were surveying. The scoring scheme is based on a 200 point scale and is partitioned into four categories. Categories and scoring ranges for both riffle/run prevalent streams and pool/glide prevalent streams are as follows:

Category	Score Range
Optimal	200-160
Suboptimal	159-110
Marginal	109-60
Poor	59-0

Our habitat assessment procedure involved three individuals **(performed by the same investigators on each stream)** making assessments for each survey reach. The three scores generated form these evaluations were then averaged for an overall score for that reach. The mean score obtained from the evaluations is reported in item 13 of the physicochemical and site location form.

WATER QUALITY MEASUREMENTS

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

DATA ANALYSIS

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

Total IBI score (sum of the 12 metric ratings)	**Integrity Class**	**Attributes**
58-60	Excellent	Comparable to the best situations without human disturbance; all regionally expected species for the habitat and stream size, including the most intolerant forms, are present with a full array if size classes; balanced trophic structure.

48-52	Good	Species richness somewhat below expectation, especially due to the loss of the most intolerant forms; some species are present with less than optimal abundance or size distributions; trophic structure shows some signs of stress.
40-44	Fair	Signs of additional deterioration include loss of intolerant forms, fewer species, highly skewed trophic structure (e.g., increasing frequency of omnivores and green sunfish or other tolerant species); older age classes of top predators may be rare.
28-34	Poor	Dominated by omnivores, tolerant forms, and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; hybrids and diseased fish often present.
12-22	Very poor	Few fish present, mostly introduced or tolerant forms;

		hybrids common; disease, parasites fin damage, and other anomalies regular.
	No fish	Repeated sampling finds no fish.

Catch per unit effort analysis was performed on the three large rivers sampled during 1998. Total time spent electrofishing at each site was used to calculate the CPUE estimates for each species collected. Length categorization analysis (Gabelhouse 1984) was used to calculate Proportional Stock Density (PSD) and Relative Stock Density (RSD) for black bass and rock bass populations sampled during 1998. Annual mortaility rates for black bass and rock bass were estimated (when the data met the criteria) according to the procedures described by Van Den Avyle (1993).

Benthic data collected for the 1998 surveys were also subjected to a similar type of biotic index that rates stream condition based on the overall taxa tolerance values and the number of 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	Bitoic 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 (Fair-Good)	5.84-6.43	18-21
2.6	6.44-6.48	16-17
2.4	6.49-6.53	14-15
2 (Fair)	6.54-7.43	10-13
1.6	7.44-7.48	8-9
1.4	7.49-7.53	6-7
1 (Poor)	>7.53	0-5

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

STREAM ACCOUNTS

Chestuee Creek

Introduction

We conducted an IBI survey of Chestuee Creek in order to assess the relative health of the aquatic community. In general, this stream flows through a well developed agricultural region of Monroe County, coursing through several small communities and towns before emptying into the Hiwassee River about 19 kilometers southwest of Etowah. The Agency has made no previous survey of this stream.

Study Area and Methods

Our survey of Chestuee Creek was conducted at the bridge crossing on County Road # 846 (Campground Road) about seven kilometers northwest of Engelwood. Our survey site encompassed about 200 meters of stream and included all habitat types typical to this reach. The stream gradient was fairly low; however, the most prominent habitat sequence was riffle/run with interspersed pools. Agricultural development in this portion of the county has led to degradation of the reach we surveyed. Heavy deposition of silt and sand was observed in the pool habitat (Figure 1), with recent development of numerous point bars. Water quality was typical for this type of stream, with no apparent problems indicated from our basic evaluation (Figure 1).

Our evaluation of the fish community was conducted through an Index of Biotic Integrity (IBI) survey. Conducting a timed qualitative survey with kick nets was used to collect benthic macroinvertebrates. Instream habitat and riparian zone within the survey reach was visually assessed and categorized (Barbour and Stribling 1995). All sampling strategies were performed in accordance with the Tennessee Wildlife Resources Agency (TWRA) survey protocols (TWRA 1998). Analysis of the fish and benthic samples followed procedures developed by Karr et al. (1996) and Lenat (1993).

Results

We collected a total of 52 fish comprising 10 species during our IBI survey (Table 1). The only game species collected during the survey were bluegill (*Lepomis macrochirus*) and green sunfish (*L. cyanellus*). The two most dominant species collected in the survey were banded sculpin (*Cottus carolinae*) and bluegill. Together these species comprised 75% of all fish encountered. Overall, the IBI analysis associated with this survey indicated degradation (score = 28). Fifty-eight percent of the IBI metrics received a score of 1, resulting in the "poor" designation. The overall lack of species richness in this stream had the strongest governing influence on the IBI rating (Table 1).

Benthic macroinvertebrates collected in our sample comprised 25 families representing 26 identified genera (Table 2). The most abundant organisms in our survey were caddisflies and dragonflies comprising 58 percent of the total sample. An overall total of 33 taxa were collected in our sample of which 9 were EPT. Based on the EPT taxa richness value and overall biotic index of all species collected, the relative health of the benthic community was classified as "fair to fair/good".

Our evaluation of the physical instream habitat and surrounding conditions of the riparian zone resulted in a mean score of 100. Based on this score and our overall observations, this reach of Chestuee Creek was designated as "marginal".

Discussion

In comparison with other streams sampled during 1998, this stream received the lowest IBI score. Apparent degradation within the watershed is most likely related to agricultural practices and has impaired the streams potential for supporting a diverse fish fauna and sport fishery. Any action related to controlling non-point source pollution would be of benefit to this stream.

Figure 1. Physiochemical and site location data collected on Chestuee Creek during 1998.

STREAM	CHESTUEE CREEK
WATERSHED	HIWASSEE RIVER
SITE	419980501
COUNTY	MONROE
QUADRANGLE	ENGELWOOD 132 NW
LAT-LONG	352721N-842514W
REACH	06020002-82.3
LENGTH	~ 200 m
AREA (SQ. KM.)	90.6
ELEVATION	850 FT
DATE	6-23-98
TIME	1527

COLLECTOR(S)

R.D. BIVENS, B.D. CARTER, C.E. WILLIAMS

1. CHANNEL CHARACTERISTICS

AVG. WIDTH	AVG. DEPTH	MAX. DEPTH
5.2	0.5	1.2+

2. ESTIMATED % OF STREAM IN POOLS IS 75

3. ESTIMATED POOL SUBSTRATE (%)

SILT	SAND	GRAVEL	RUBBLE	BOULDER	BEDROCK
30	40	20	10		

4. ESTIMATED RIFFLE SUBSTRATE (%)

SILT	SAND	GRAVEL	RUBBLE	BOULDER	BEDROCK
10	50	30	10		

5. ABUNDANCE OF LITTORAL AQUATIC PLANTS IS

NUMEROUS	AVERAGE	SCARCE
		X

6. INSTREAM COVER ABUNDANCE IS

GOOD IN	AVERAGE IN	POOR IN
20 %	30 %	50 %

7. SHADE OR CANOPY COVER GOOD OVER 70 %

8. FLOW (CFS) 15.4

COMPARED TO NORMAL

LOW	NORMAL	HIGH
	X	

9. PRESENT WEATHER

SUNNY AND HOT; AIR TEMP 90 F @ 1527

10. PAST WEATHER (last 24 hrs)

SAME; T-STORMS OVERNIGHT

11. WATER QUALITY

pH	TEMP	COND.	D.O.	% SAT.
7.0	20.1	285	8.1	89.8

12. COMMENTS

SAMPLE STATION LOCATED AT BRIDGE CROSSING ON CAMPGROUND RD. WATER TURBID AT TIME OF SAMPLE. HEAVY DEPOSITION OF SAND AND SILT IN POOL AREA. RECENT DEPOSITION HAS CREATED NUMEROUS POINT BARS.

13. $\bar{X}$ HABITAT ASSESSMENT SCORE 100

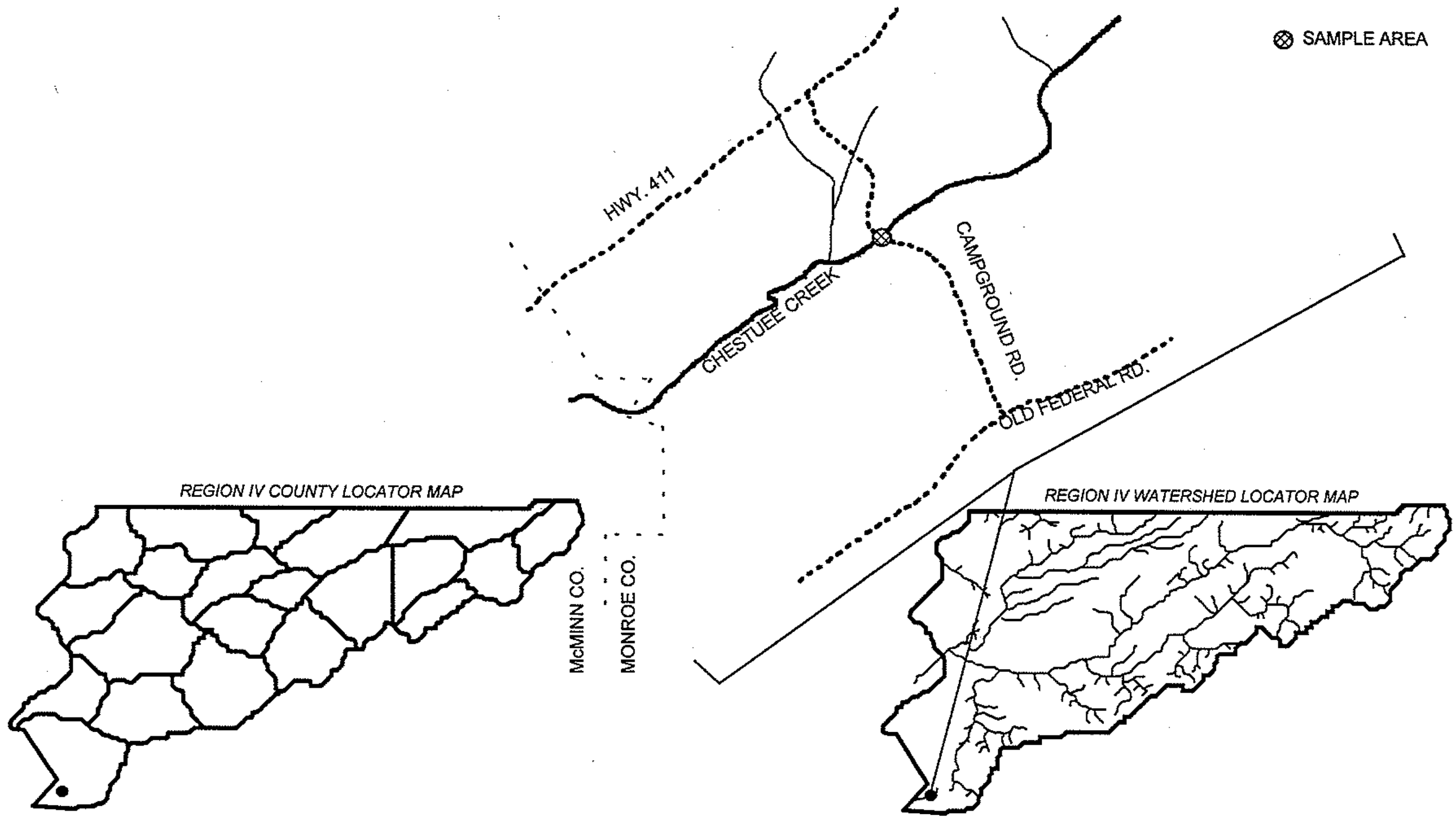


Table 1. Species list and IBI analysis for fish collected in Chestuee Creek during 1998.

SAMPLING TYPE: SEINING AND SHOCKING

GEAR TYPE: 4.5 m SEINE AND ONE BACKPACK UNIT @ 125 VAC

SPECIES	TADS CODE	NO. COLL.	RANGE(mm)	TOT. WEIGHT(g)	NOTE
Campostoma anomalum	45	1			
Catostomus commersoni	195	2			
Cottus carolinae	322	19			
Cyprinella galactura	54	1			
Etheostoma simoterum	435	1			
Hypentelium nigricans	207	2			
Lepomis macrochirus x cyanellus	345	1	71	4	
Lepomis cyanellus	347	3	52-92	28	
Lepomis macrochirus	351	20	40-141	229	
Minytrema melanops	218	1			
Moxostoma duquesnei	224	1			
	SUM:	52			

INDEX OF BIOTIC INTEGRITY

METRIC DESCRIPTION	SCORING CRITERIA 1	3	5	OBSERVED	SCORE
NUMBER OF NATIVE SP.	<12	12-22	>22	10	1
NUMBER OF DARTER SP.	<2	2-3	>3	1	1
NUMBER OF SUNFISH SP. *less Micropterus*	<2	2	>2	2	3
NUMBER OF SUCKER SP.	<2	2	>2	3	5
NUMBER OF INTOLERANT SP.	<2	2-3	>3	1	1
PERCENT OF INDIVIDUALS AS TOLERANT	>31	31-16	<16	9.8	5
PERCENT OF INDIVIDUALS AS OMNIVORES	>36	36-19	<19	3.9	5
PERCENT OF INDIVIDUALS AS SPECIALISTS	<21	21-40	>40	1.9	1
PERCENT OF INDIVIDUALS AS PISCIVORES	<2.0	2.0-4.0	>4.0	0	1
CATCH RATE	<19.2	19.2-38.2	>38.2	6.2	1
PERCENT OF INDIVIDUALS AS HYBRIDS	>1	TR-1	0	1.9	1
PERCENT OF INDIVIDUALS WITH ANOMALIES	>5	5-2	<2	3.9	3
					28

IBI RANGE:	0	12-22	28-34	40-44	48-52	58-60
STREAM DESIGNATION:	NO FISH	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

Table 2. Taxa list and associated biotic statistics calculated for benthic macroinvertebrates collected in Chestuee Creek during 1998.

CHESTUEE CREEK		**TAXA RICHNESS = 33**		
FIELD # 970		**EPT TAXA RICHNESS = 9**		
EFFORT = 3 MAN HOURS		**BIOCLASSIFICATION = 2.5 (FAIR-FAIR/GOOD)**		
			NUMBER	**PERCENT**
ANNELIDA				1.7
	Oligochaeta		4	
COLEOPTERA				7.0
	Elmidae	*Dubiraphia*	7	
		Macronychus glabratus	4	
		Optioservus	3	
		Stenelmis	1	
	Hydrophilidae	*Sperchopsis tessellatus*	1	
DIPTERA				3.9
	Chironomidae		8	
	Simuliidae		1	
EPHEMEROPTERA				15.3
	Baetidae		7	
	Ephemeridae	*Hexagenia*	6	
	Heptageniidae	*Stenonema*	16	
	Isonychiidae	*Isonychia*	6	
GASTROPODA				3.5
	Pleuroceridae	well developed irregular stria (unusual)	8	
HEMIPTERA				2.6
	Gerridae	*Gerris remigis*	3	
	Veliidae	*Rhagovelia obesa*	3	
ISOPODA				0.4
	Asellidae	*Asellus*	1	
MEGALOPTERA				4.4
	Corydalidae	*Nigronia serricornis*	6	
	Sialidae	*Sialis*	4	
ODONATA				18.3
	Aeshnidae	*Boyeria vinosa*	11	
	Calopterygidae	*Calopteryx*	13	
	Coenagrionidae	*Argia*	5	
		Enallagma	1	
	Cordulegastridae	*Cordulegaster*	1	
	Gomphidae	*Gomphus* (Genus A)	4	
		Gomphus lividus	5	
		Stylurus laurae	1	
	Macromiidae	*Macromia*	1	
PELECYPODA				3.1
	Corbiculidae	*Corbicula fluminea*	7	
TRICHOPTERA				39.7
	Hydropsychidae	*Cheumatopsyche*	41	
		Hydropsyche betteni/depravata	44	
	Leptoceridae	*Oecetis*	2	
		Triaenodes	2	
	Uenoidae	*Neophylax*	2	
		TOTAL	**229**	

Fourmile Creek

Introduction

We conducted an IBI survey of Fourmile Creek in order to assess the relative health of the aquatic community. The stream originates in Lee County Virginia just south of Highway 58 and flows in a southerly direction approximately 7.5 kilometers before emptying into the Powell River.

Study Area and Methods

Our survey of Fourmile Creek was conducted approximately 0.2 kilometers upstream of Thompson Mill along Fourmile Creek Road. Our survey site encompassed about 200 meters of stream and included all habitat types typical to this reach. The stream habitat in our survey reach was primarily characterized by short riffle/run habitat with small shallow pools interspersed. There was some agricultural development, however, it was limited in scope and was primarily represented by small farms producing few beef cattle and small amounts of tobacco. The stream substrate was relatively unimpacted by sediment, however, there was a high incidence of bedrock in both riffle and pool habitat (Figure 2). Instream cover was lacking and appeared to be a limiting factor (Figure 2). Water quality was typical for this type of stream, with no apparent problems indicated from our basic evaluation (Figure 2).

Our evaluation of the fish community was conducted through an Index of Biotic Integrity (IBI) survey. Conducting a timed qualitative survey with kick nets was used to collect benthic macroinvertebrates. Instream habitat and riparian zone within the survey reach was visually assessed and categorized (Barbour and Stribling 1995). All sampling strategies were performed in accordance with the Tennessee Wildlife Resources Agency (TWRA) survey protocols (TWRA 1998). Analysis of the fish and benthic samples followed procedures developed by Karr et al. (1996) and Lenat (1993).

Results

We collected a total of 427 fish comprising 12 species during our IBI survey (Table 3). The only game species collected during the survey was one hybrid sunfish. The two most dominant species collected in the survey were blacknose dace (*Rhinichthys atratulus*) and central stoneroller (*Campostoma anomalum*). Together these species comprised 68.6% of all fish collected in the sample. Overall, the IBI analysis (score = 36) associated with this survey indicated degradation and/or poor habitat quality. The IBI metrics that scored the lowest in our evaluation included the number of sunfish species in the sample, the number of intolerant species, and the percentage of trophic specialists in the sample (Table 3).

Benthic macroinvertebrates collected in our sample comprised 32 families representing 42 identified genera (Table 4). The most abundant organisms in our survey were caddisflies and mayflies comprising 54.7 percent of the total sample. An overall total of 54 taxa were collected in our sample of which 28 were EPT. Based on the EPT taxa richness value and overall biotic index of all species collected, the relative health of the benthic community was classified as "good to excellent".

Our evaluation of the physical instream habitat and surrounding conditions of the riparian zone resulted in a mean score of 140. Based on this score and our overall observations, this reach of Fourmile Creek was designated as "sub-optimal".

Discussion

Our observations led us to conclude that this stream was limited by the lack of habitat heterogeneity and was not being influenced to a great degree by land use within the watershed. Because of stream size and the lack of suitable habitat, the development of any kind of sport fishery is improbable.

Figure 2. Physiochemical and site location data collected on Fourmile Creek during 1998.

STREAM	FOURMILE CREEK
WATERSHED	POWELL RIVER
SITE	419980201
COUNTY	HANCOCK
QUADRANGLE	BACK VALLEY161 SE
LAT-LONG	363500N-832218W
REACH	06010206-
LENGTH	~ 200 m
AREA (SQ. KM.)	19.4
ELEVATION	1200 FT
DATE	6-12-98
TIME	1616

COLLECTOR(S)

B.D. CARTER, M.T. FAGG, W.T. THURMAN

1. CHANNEL CHARACTERISTICS

AVG. WIDTH	AVG. DEPTH	MAX. DEPTH
7.9 m	0.2 m	0.3 m

2. ESTIMATED % OF STREAM IN POOLS IS 20

3. ESTIMATED POOL SUBSTRATE (%)

SILT	SAND	GRAVEL	RUBBLE	BOULDER	BEDROCK
5	10	20	30	10	25

4. ESTIMATED RIFFLE SUBSTRATE (%)

SILT	SAND	GRAVEL	RUBBLE	BOULDER	BEDROCK
	10	40	20	10	20

5. ABUNDANCE OF LITTORAL AQUATIC PLANTS IS

NUMEROUS	AVERAGE	SCARCE
		X

6. INSTREAM COVER ABUNDANCE IS

GOOD IN	AVERAGE IN	POOR IN
10 %	30 %	60 %

7. SHADE OR CANOPY COVER GOOD OVER 80 %

8. FLOW (CFS) 13.2 COMPARED TO NORMAL

LOW	NORMAL	HIGH
	X	

9. PRESENT WEATHER

SUNNY AND MILD

10. PAST WEATHER (last 24 hrs)

SAME; T-STORMS OVERNIGHT

11. WATER QUALITY

pH	TEMP	COND.	D.O.	% SAT.
7.0	20.9	300	8.5	96.3

12. COMMENTS

SAMPLE SITE LOCATED ~ 0.2 KM UPSTREAM OF THOMPSON MILL ALONG FOURMILE CREEK RD. HIGH OCCURENCE OF BEDROCK IN SAMPLE AREA.

13. $\bar{X}$ HABITAT ASSESSMENT SCORE 140

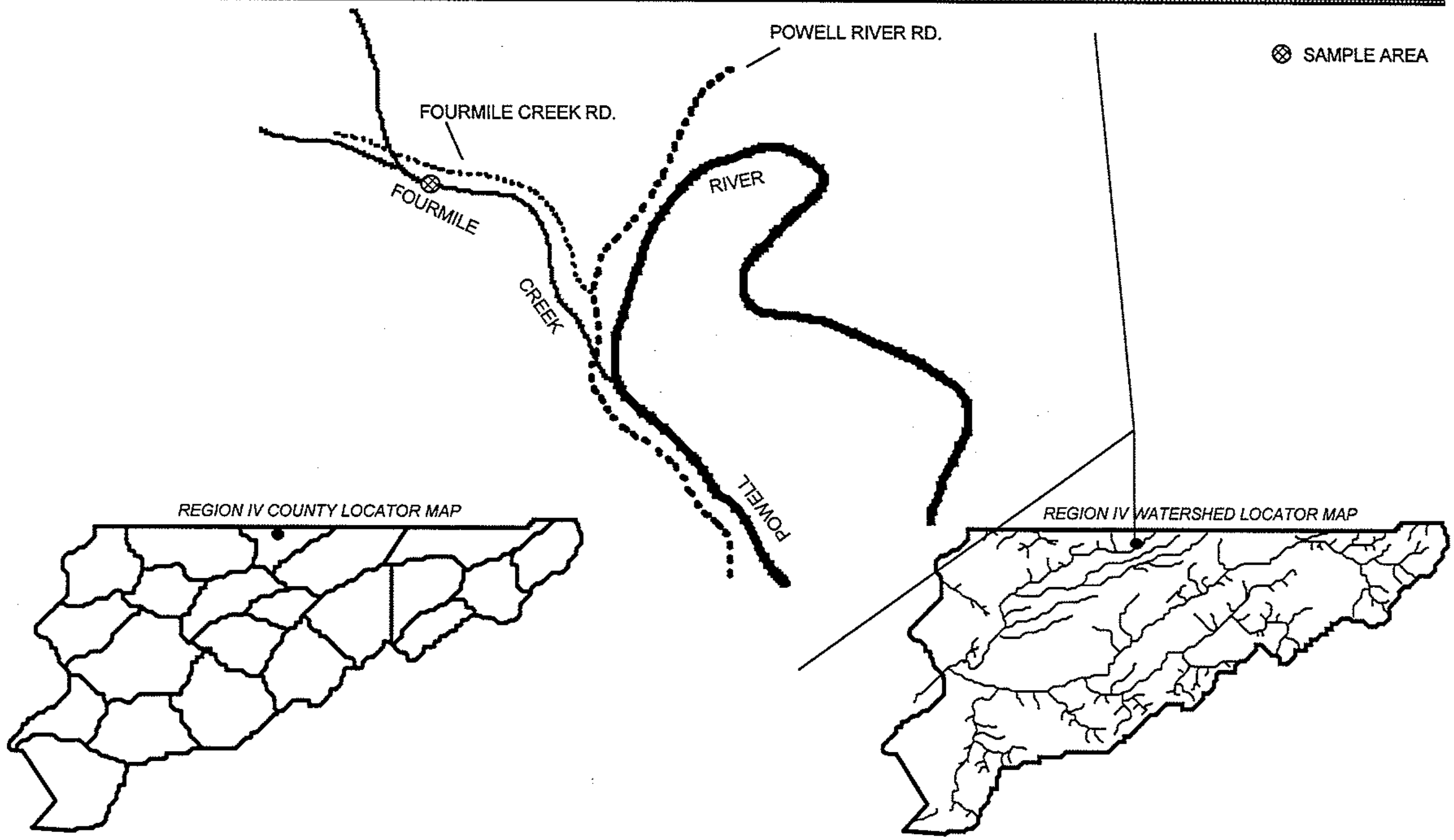


Table 3. Species list and IBI analysis for fish collected in Fourmile Creek during 1998.

SAMPLING TYPE: SEINING AND SHOCKING

GEAR TYPE: 4.5 m SEINE AND ONE BACKPACK UNIT @ 125 VAC

SPECIES	TADS CODE	NO. COLL.	RANGE(mm)	TOT. WEIGHT(g)	NOTE
Campostoma anomalum	45	95			
Cottus carolinae	322	81			
Etheostoma blenniodes	398	14			
Etheostoma kennicotti	418	2			
Etheostoma simoterum	435	2			
Hypentelium nigricans	207	8			
Lepomis sp. (hybrid)	345	1	90	10	
Luxilus chrysocephalus	89	20			
Luxilus coccogenis	90	1			
Moxostoma erythrurum	225	2			
Notropis leuciodus	128	1			
Notropis telescopus	138	2			
Rhinichthys atratulus	184	198			
	SUM:	427			

INDEX OF BIOTIC INTEGRITY

METRIC DESCRIPTION	SCORING CRITERIA 1	3	5	OBSERVED	SCORE
NUMBER OF NATIVE SP.	<7	7-13	>13	12	3
NUMBER OF DARTER SP.	0	1	>1	3	5
NUMBER OF SUNFISH SP. *less Micropterus*	0	1	>1	0	1
NUMBER OF SUCKER SP.	0	1	>1	2	5
NUMBER OF INTOLERANT SP.	<2	2	>2	1	1
PERCENT OF INDIVIDUALS AS TOLERANT	>38	38-20	<20	4.7	5
PERCENT OF INDIVIDUALS AS OMNIVORES	>47	47-24	<24	27	3
PERCENT OF INDIVIDUALS AS SPECIALISTS	<14	14-27	>27	5.2	1
PERCENT OF INDIVIDUALS AS PISCIVORES	<1.9	1.9-3.6	>3.6	0	1
CATCH RATE	<28.9	28.9-57.7	>57.7	43.6	3
PERCENT OF INDIVIDUALS AS HYBRIDS	>1	TR-1	0	0.2	3
PERCENT OF INDIVIDUALS WITH ANOMALIES	>5	5-2	<2	0	5
					36

IBI RANGE:	**0**	**12-22**	**28-34**	**40-44**	**48-52**	**58-60**
STREAM DESIGNATION:	**NO FISH**	**VERY POOR**	**POOR**	**FAIR**	**GOOD**	**EXCELLENT**

Table 4. Taxa list and associated biotic statistics calculated for benthic macroinvertebrates collected in Fourmile Creek during 1998.

FOURMILE CREEK	TAXA RICHNESS = 54
FIELD # 964	EPT TAXA RICHNESS = 28
EFFORT = 3 MAN HOURS	BIOCLASSIFICATION = 4.5 (GOOD-EXCELLENT)

ANNELIDA				0.3
	Oligochaeta		1	
COLEOPTERA				8
	Elmidae	*Dubiraphia*	2	
		Macronychus glabratus	2	
		Optioservus	1	
		Promoresia	1	
		Stenelmis	13	
	Psephenidae	*Psephenus herricki*	13	
DIPTERA				12.1
	Chironomidae		26	
	Simuliidae		20	
	Tipulidae	*Antocha*	1	
		Tipula	1	
EPHEMEROPTERA				38.9
	Baetidae		28	
	Ephemerellidae	*Drunella*	2	
		Ephemerella	4	
		Eurylophella	3	
		Serratella	18	
	Ephemeridae	*Ephemera*	2	
	Heptageniidae	*Epeorus rubidus/subpallidus*	33	
		Stenacron	5	
		Stenonema	36	
	Isonychiidae	*Isonychia*	21	
	Leptophlebiidae	*Habrophlebiodes*	2	
		Paraleptophlebia	1	
GASTROPODA				7.3
	Pleuroceridae	*elongated spiral*	7	
		stout form	22	
HEMIPTERA				1.0
	Corixidae		1	
	Gerridae	*Gerris*	2	
	Veliidae	*Rhagovelia obesa*	1	
HYDRACARINA			1	0.3
ISOPODA				0.3
	Asellidae	*Lirceus*	1	
MEGALOPTERA				3.0
	Corydalidae	*Nigronia fasciatus*	1	
		Nigronia serricornis	11	
ODONATA				6.5
	Aeshnidae	*Boyeria vinosa*	1	
	Calopterygidae	*Calopteryx*	12	
	Gomphidae	*Gomphus (Genus A)*	9	
		Gomphus lividus	1	
		Hagenius brevistylus	2	
		Stylogomphus albistylus	1	
PELECYPODA				0.3
	Sphaeriidae	*Sphaerium*	1	
PLECOPTERA				6.3
	Leuctridae		3	
	Peltoperlidae	*Peltoperla*	3	
	Perlidae	*Neoperla*	10	
		Paragnetina	2	
		Perlesta	7	
TRICHOPTERA				15.8
	Glossosomatidae	*Glossosoma*	5	
	Hydropsychidae	*Ceratopsyche cheilonis*	4	
		Ceratopsyche sparna	16	
		Cheumatopsyche	12	
		Hydropsyche rotosa	2	
	Limnephilidae	*Pycnopsyche*	4	
	Philopotamidae	*Chimara*	1	
	Polycentropodidae	*Polycentropus*	2	
	Rhyacophilidae	*Rhyacophila carolina group*	2	
		Rhyacophila fuscula	5	
	Uenoidae	*Neophylax*	10	
			398	

Martin Creek

Introduction

We conducted an IBI survey of Martin Creek in order to assess the relative health of the aquatic community. The stream originates in Lee County Virginia just north of Highway 58 near the community of Rose Hill and flows in a southerly direction approximately 12 kilometers before emptying into the Powell River. A portion of the stream in Virginia is managed as a put and take trout fishery. This segment of the stream receives about nine stockings of catchable (254-279mm) rainbow trout annually (Bill Kittrell, VAGF, pers. comm.).

Study Area and Methods

Our survey of Martin Creek was conducted approximately 300 meters upstream of the Powell River confluence along Hopkins Road. The survey site encompassed about 300 meters of stream and included all habitat types typical to this reach. The stream habitat in our survey reach was primarily characterized by short gravel riffle/run habitat with gravel/rubble pools interspersed. Land use in the watershed appeared to be primarily agricultural in nature and was more extensive than in the adjacent Fourmile Creek watershed. The stream substrate was relatively unimpacted by sediment, as evidence by the low percentage of silt/sand (Figure 3) and degree of substrate embeddedness. The water quality in Martin Creek could best be described as "spring like" as much of the creek's flow is influenced by springs. The water quality (Figure 3) and substrate composition was indicative of the karst topography within the watershed.

Our evaluation of the fish community was conducted through an Index of Biotic Integrity (IBI) survey. Conducting a timed qualitative survey with kick nets was used to collect benthic macroinvertebrates. Instream habitat and riparian zone within the survey reach was visually assessed and categorized (Barbour and Stribling 1995). All sampling strategies were performed in accordance with the Tennessee Wildlife Resources Agency (TWRA) survey protocols (TWRA 1998). Analysis of the fish and benthic samples followed procedures developed by Karr et al. (1996) and Lenat (1993).

Results

We collected a total of 700 fish comprising 22 species during our IBI survey (Table 5). Three game species were collected in our survey, which included stocked rainbow trout (*Oncorhynchus mykiss*). The two most dominant species collected in the survey were warpaint shiner (*Luxilus coccogenis*) and central stoneroller (*Campostoma* *anomalum*). Together these species comprised 39.7% of all fish collected in the sample. Overall, the IBI analysis associated with this survey indicated Martin Creek was in good condition based on the score of 50. This was the highest IBI score calculated for any stream sampled during 1998. The only metric that had a strong negative influence on the overall score was the low percentage of piscivores in the sample (Table 5).

Benthic macroinvertebrates collected in our sample comprised 27 families representing 33 identified genera (Table 6). The most abundant organisms in our survey were mayflies and caddisflies comprising 63 percent of the total sample. An overall total of 45 taxa were collected in our sample of which 19 were EPT. Based on the EPT taxa richness value and overall biotic index of all species collected, the relative health of the benthic community was classified as "good".

Our evaluation of the physical instream habitat and surrounding conditions of the riparian zone resulted in a mean score of 159. Based on this score and our overall observations, this reach of Martin Creek was designated as "sub-optimal".

Discussion

Our observations led us to conclude Martin Creek was in above average condition based on our survey results. The water quality and stream size allows this stream to support a diverse fish and benthic community. Although the quantity of habitat capable of supporting game species was questionable the quality was above average. This stream would be a good candidate for habitat enhancement focusing on increasing available cover. Some caution should be exercised in interpreting the IBI score since a few of the species collected may have been transients from the Powell River. However, with this in mind, we feel the stream would retain an above average score and could serve as a reference stream for the surrounding area.

Martin Creek is a cool, spring-influenced stream that deserves an elevated level of protection and could be considered a candidate for trout stocking. Very few streams in the Ridge and Valley Ecoregion have the qualities that this stream exhibits. Any action that would address non-point source pollution and riparian protection within the watershed would help this stream retain its unique characteristics.

Figure 3. Physiochemical and site location data collected on Martin Creek during 1998.

STREAM	MARTIN CREEK
WATERSHED	POWELL RIVER
SITE	419980101
COUNTY	HANCOCK
QUADRANGLE	BACK VALLEY161 SE
LAT-LONG	363527N-832001W
REACH	06010206-23.0
LENGTH	~ 300 m
AREA (SQ. KM.)	59.8
ELEVATION	1200 FT
DATE	6-11-98
TIME	1148

COLLECTOR(S)

B.D. CARTER, M.T. FAGG, W.T. THURMAN AND W. AKINS

1. CHANNEL CHARACTERISTICS

AVG. WIDTH	AVG. DEPTH	MAX. DEPTH
10 m	0.4 m	0.7 m

2. ESTIMATED % OF STREAM IN POOLS IS 40

3. ESTIMATED POOL SUBSTRATE (%)

SILT	SAND	GRAVEL	RUBBLE	BOULDER	BEDROCK
10	10	40	15	5	20

4. ESTIMATED RIFFLE SUBSTRATE (%)

SILT	SAND	GRAVEL	RUBBLE	BOULDER	BEDROCK
5	10	35	25	15	10

5. ABUNDANCE OF LITTORAL AQUATIC PLANTS IS

NUMEROUS	AVERAGE	SCARCE
	X WATER WILLOW	

6. INSTREAM COVER ABUNDANCE IS

GOOD IN	AVERAGE IN	POOR IN
20 %	40 %	40 %

7. SHADE OR CANOPY COVER GOOD OVER 40 %

8. FLOW (CFS) 50.6

COMPARED TO NORMAL

LOW	NORMAL	HIGH
		X

9. PRESENT WEATHER

PT. CLOUDY AND MILD; AIR TEMP. 74 F @ 1150

10. PAST WEATHER (last 24 hrs)

SAME; T-STORMS OVERNIGHT

11. WATER QUALITY

pH	TEMP	COND.	D.O.	% SAT.
7.2	16.6	238	9.5	97.9

12. COMMENTS

WELL DEVELOPED RIFFLE AREAS WITH LITTLE EMBEDDEDNESS. INFLUENCE OF LIMESTONE GEOLOGY EVIDENT. SAMPLE AREA LOCATED @ HOPKINS RD. X-ING.

13. $\bar{X}$ HABITAT ASSESSMENT SCORE 159

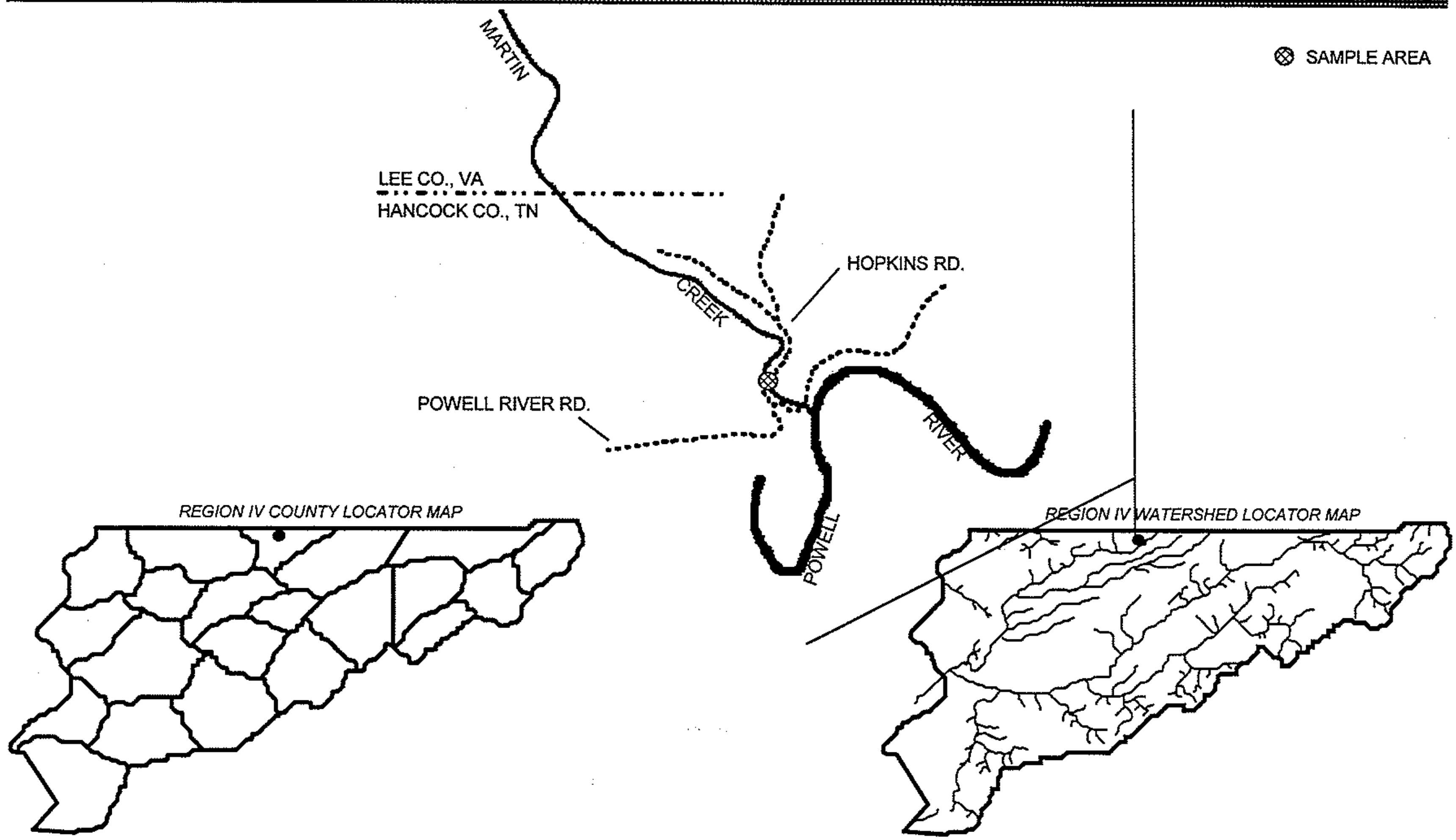


Table 5. Species list and IBI analysis for fish collected in Martin Creek during 1998.

SAMPLING TYPE: SEINING AND SHOCKING

GEAR TYPE: 4.5 m SEINE AND ONE BACKPACK UNIT @ 125 VAC

SPECIES	TADS CODE	NO. COLL.	RANGE(mm)	TOT. WEIGHT(g)	NOTE
Ambloplites rupestris	342	5	149-223	624	
Campostoma anomalum	45	99			
Cottus carolinae	322	90			
Erimystax insignis	68	10			
Etheostoma blenniodes	398	21			
Etheostoma flabellare	411	1			
Etheostoma rufilineatum	431	50			
Etheostoma simoterum	435	6			
Hybopsis amblops	79	20			
Hypentelium nigricans	207	6			
Lepomis macrochirus	351	1	75	3	
Luxilus chrysocephalus	89	50			
Luxilus coccogenis	90	179			
Moxostoma erythrurum	225	2			
Nocomis micropogon	110	2			
Notropis leuciodus	128	27			
Notropis telescopus	138	48			
Oncorhynchus mykiss	279	2	275-311	548	
Percina evides	467	3			
Phenacobius uranops	159	7			
Pimephales notatus	176	1			
Rhinichthys atratulus	184	70			
	SUM:	700			

INDEX OF BIOTIC INTEGRITY

METRIC DESCRIPTION	SCORING CRITERIA 1	3	5	OBSERVED	SCORE
NUMBER OF NATIVE SP.	<11	11-20	>20	21	5
NUMBER OF DARTER SP.	<2	2-3	>3	5	5
NUMBER OF SUNFISH SP. *less Micropterus*	<2	2	>2	2	3
NUMBER OF SUCKER SP.	<2	2	>2	2	3
NUMBER OF INTOLERANT SP.	<2	2	>2	4	5
PERCENT OF INDIVIDUALS AS TOLERANT	>32	32-17	<17	7.2	5
PERCENT OF INDIVIDUALS AS OMNIVORES	>39	39-20	<20	16	5
PERCENT OF INDIVIDUALS AS SPECIALISTS	<19	19-37	>37	26.2	3
PERCENT OF INDIVIDUALS AS PISCIVORES	<2.0	2.0-4.0	>4.0	0.7	1
CATCH RATE	<21.3	21.3-42.5	>42.5	43.9	5
PERCENT OF INDIVIDUALS AS HYBRIDS	>1	TR-1	0	0	5
PERCENT OF INDIVIDUALS WITH ANOMALIES	>5	5-2	<2	0.1	5
					50

IBI RANGE:	0	12-22	28-34	40-44	48-52	58-60
STREAM DESIGNATION:	NO FISH	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

Table 6. Taxa list and associated biotic statistics calculated for benthic macroinvertebrates collected in Martin Creek during 1998.

MARTIN CREEK		TAXA RICHNESS = 45		
FIELD # 962		EPT TAXA RICHNESS = 19		
EFFORT = 3 MAN HOURS		BIOCLASSIFICATION = 4 (GOOD)		
			NUMBER	PERCENT
ANNELIDA				1
	Oligochaeta		4	
COLEOPTERA				4.9
	Dryopidae	*Helichus*	1	
	Elmidae	*Dubiraphia*	3	
		Optioservus trivitatus	5	
		Promoresia	3	
	Psepheniidae	*Psephenus herricki*	7	
DIPTERA				9.8
	Chironomidae		21	
	Simuliidae		16	
	Tipulidae	*Tipula*	1	
EPHEMEROPTERA				34.6
	Baetidae		17	
	Caenidae	*Caenis*	3	
	Ephemerellidae	*Eurylophella*	8	
		Serratella	12	
	Ephemeridae	*Ephemera*	2	
	Heptageniidae	*Epeorus rubidus/subpallidus*	3	
		Heptagenia	2	
		Stenacron	19	
		Stenonema	25	
	Isonychiidae	*Isonychia*	43	
GASTROPODA				8
	Pleuroceridae sp.	*elongated spiral w/well developed stria*	18	
	Pleuroceridae sp.	*smooth elongated spiral*	4	
	Pleuroceridae	*Leptoxis*	9	
HEMIPTERA				2.1
	Corixidae		6	
	Veliidae	*Rhagovelia obesa*	2	
HYDRACARINA			1	0.3
ISOPODA				0.5
	Asellidae	*Lirceus*	2	
MEGALOPTERA				2.6
	Corydalidae	*Corydalus cornutus*	1	
		Nigronia serricornis	9	
ODONATA				7
	Aeshnidae	*Boyeria vinosa*	3	
	Calopterygidae	*Calopteryx*	9	
	Gomphidae	*Gomphus (Genus A)*	5	
		Gomphus lividus	5	
		Hagenius brevistylus	3	
		Ophiogomphus mainensis	2	
PELECYPODA				0.3
	Sphaeriidae	*Sphaerium*	1	
	Unionidae	*one relic only*		
PLECOPTERA				0.5
	Perlidae	*Paragnetina*	2	
TRICHOPTERA				28.4
	Hydropsychidae	*Ceratopsyche bronta*	1	
		Ceratopsyche cheilonis	17	
		Ceratopsyche sparna	24	
		Cheumatopsyche	16	
		Hydropsyche betteni/depravata	34	
	Philopotamidae	*Chimara*	14	
		Wormaldia	1	
	Rhyacophilidae	*Rhyacophila fuscula*	3	
		TOTAL	387	

Big Creek

Introduction

We conducted an IBI survey of Big Creek in order to assess the relative health of the aquatic community. Big Creek originates just north of the community of Mount Vernon and flows in a northwesterly direction for about 11 kilometers before emptying into Tellico River near the community of Big Creek. The Agency investigated a concrete induced fish kill in this stream during 1992 (TWRA, unpublished data).

Study Area and Methods

Our survey of Big Creek was conducted at the confluence of Big Creek and Laurel Branch along Sink Road. The majority of the stream flows through wooded ridges with minimal development in the low-lying areas. The majority of the development is restricted to residential homes. The reach of stream we surveyed could be characterized as riffle/run habitat with gravel/rubble dominating the substrate composition (Figure 4). At the time of our sample the stream appeared to be transporting an above average sediment load. However, the impairment to the stream seemed to be decreased due to the above average gradient in the sample reach. The measurement of basic water quality parameters did not reveal any problems that may limit the aquatic community (Figure 4). Our sample reach was approximately 250 meters in length and encompassed all habitat types typical to this reach.

Our evaluation of the fish community was conducted through an Index of Biotic Integrity (IBI) survey. Conducting a timed qualitative survey with kick nets was used to collect benthic macroinvertebrates. Instream habitat and riparian zones within the survey reach were visually assessed and categorized (Barbour and Stribling 1995). All sampling strategies were performed in accordance with the Tennessee Wildlife Resources Agency (TWRA) survey protocols (TWRA 1998). Analysis of the fish and benthic samples followed procedures developed by Karr et al. (1996) and Lenat (1993).

Results

We collected a total of 360 fish comprising 18 species during our IBI survey (Table 7). Four game species were collected in our survey including rock bass (*Amblopites rupestris*) and spotted bass (*Micropterus punctulatus*). The two most dominant species collected in the survey were warpaint shiner (*Luxilus coccogenis*) and central stoneroller (*Campostoma anomalum*). Together these species comprised 53.6% of all fish collected in the sample. Overall, the IBI analysis associated with this survey indicated Big Creek was in fair to good condition based on the score of 46. The three IBI metrics that had the most negative influence on the overall score were high percentage of omnivores in the sample, the low percent of piscivores, and the low catch rate (Table 7).

Benthic macroinvertebrates collected in our sample comprised 28 families representing 32 identified genera (Table 8). The most abundant organisms in our survey were mayflies and caddisflies comprising about 59 percent of the total sample. An overall total of 38 taxa were collected in our sample of which 13 were EPT. Based on the EPT taxa richness value and overall biotic index of all species collected, the relative health of the benthic community was classified as "good".

Our evaluation of the physical instream habitat and surrounding conditions of the riparian zone resulted in a mean score of 112. Based on this score and our overall observations, this reach of Big Creek was designated as "sub-optimal".

Discussion

Our evaluation of Big Creek led us to conclude that this stream was in fair condition. However, there were some observed activities within the watershed that may have future implications on water quality. These included clearing of riparian zones, development of camping areas along the stream margins, and increased residential development. Based on our observations this stream did not support a significant sport fishery for any of the game species collected. Any action that would address sedimentation and riparian zone protection would be beneficial.

Figure 4. Physiochemical and site location data collected on Big Creek during 1998.

STREAM	BIG CREEK
WATERSHED	TELLICO RIVER
SITE	419980601
COUNTY	MONROE
QUADRANGLE	MT. VERNON 132 NE
LAT-LONG	352718N-841649W
REACH	06010204-48.0
LENGTH	~ 250 m
AREA (SQ. KM.)	21.5
ELEVATION	820 FT
DATE	6-24-97
TIME	1323

COLLECTOR(S)

R.D. BIVENS, B.D. CARTER, C.E. WILLIAMS

1. CHANNEL CHARACTERISTICS

AVG. WIDTH	AVG. DEPTH	MAX. DEPTH
7.0 m	0.5 m	1.2 m

2. ESTIMATED % OF STREAM IN POOLS IS 40

3. ESTIMATED POOL SUBSTRATE (%)

SILT	SAND	GRAVEL	RUBBLE	BOULDER	BEDROCK
20	15	30	20	15	

4. ESTIMATED RIFFLE SUBSTRATE (%)

SILT	SAND	GRAVEL	RUBBLE	BOULDER	BEDROCK
5	10	20	40	25	

5. ABUNDANCE OF LITTORAL AQUATIC PLANTS IS

NUMEROUS	AVERAGE	SCARCE
		X

6. INSTREAM COVER ABUNDANCE IS

GOOD IN	AVERAGE IN	POOR IN
20 %	40 %	40 %

7. SHADE OR CANOPY COVER GOOD OVER 50 %

8. FLOW (CFS) 22.5

COMPARED TO NORMAL

LOW	NORMAL	HIGH
	X	

9. PRESENT WEATHER

SUNNY AND HOT; AIR TEMP 91 F @ 1352

10. PAST WEATHER (last 24 hrs)

SAME

11. WATER QUALITY

pH	TEMP	COND.	D.O.	% SAT.
7.0	22	220	8.9	102

12. COMMENTS

SAMPLE STATION LOCATED AT THE CONFLUENCE OF BIG CREEK AND LAUREL BRANCH. HEAVY SEDIMENT LOAD IN SURVEY REACH.

13. $\bar{X}$ HABITAT ASSESSMENT SCORE 112

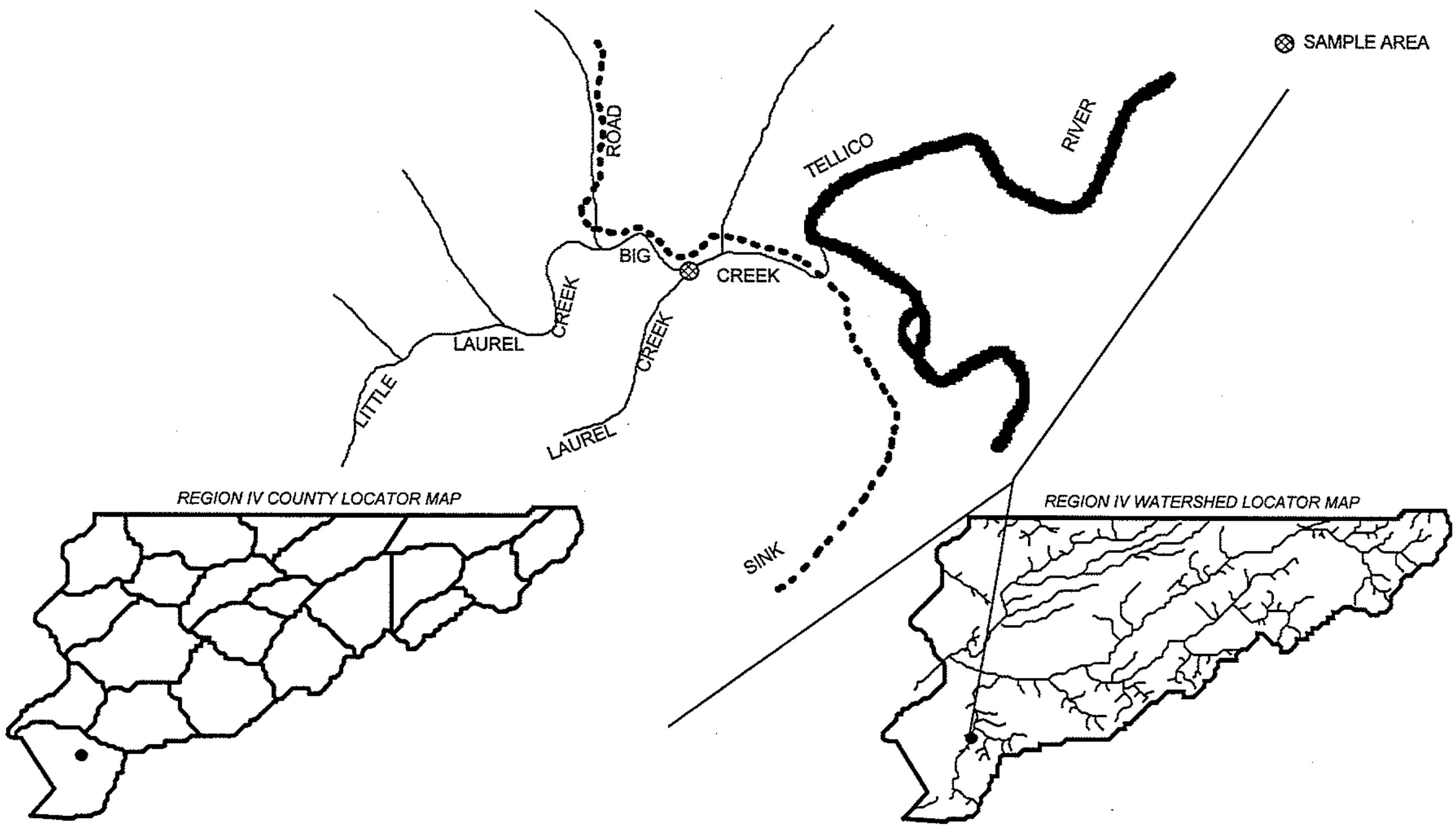


Table 7. Species list and IBI analysis for fish collected in Big Creek during 1998.

SAMPLING TYPE: SEINING AND SHOCKING

GEAR TYPE: 4.5 m SEINE AND ONE BACKPACK UNIT @ 125 VAC

SPECIES	TADS CODE	NO. COLL.	RANGE(mm)	TOT. WEIGHT(g)	NOTE
Ambloplites rupestris	342	2	127-282	388	
Campostoma anomalum	45	129			
Cottus carolinae	322	36			
Cyprinella galactura	54	1			
Etheostoma blenniodes	398	4			
Etheostoma rufilineatum	431	11			
Etheostoma simoterum	435	17			
Hybopsis amblops	79	2			
Hypentelium nigricans	207	11			
Lepomis auritus	346	1	94	13	
Lepomis macrochirus	351	2	65-75	8	
Luxilus chrysocephalus	89	59			
Luxilus coccogenis	90	64			
Micropterus punctulatus	363	2	211-212	238	
Moxostoma duquesnei	224	2			
Nocomis micropogon	110	5			
Notropis leuciodus	128	6			
Percina caprodes	464	6			
	SUM:	360			

INDEX OF BIOTIC INTEGRITY

METRIC DESCRIPTION	SCORING CRITERIA 1	3	5	OBSERVED	SCORE
NUMBER OF NATIVE SP.	<8	8-14	>14	17	5
NUMBER OF DARTER SP.	0	1	>1	4	5
NUMBER OF SUNFISH SP. *less Micropterus*	0	1	>1	2	5
NUMBER OF SUCKER SP.	0	1	>1	2	5
NUMBER OF INTOLERANT SP.	<2	2	>2	2	3
PERCENT OF INDIVIDUALS AS TOLERANT	>37	37-19	<19	16.4	5
PERCENT OF INDIVIDUALS AS OMNIVORES	>46	46-24	<24	53.7	1
PERCENT OF INDIVIDUALS AS SPECIALISTS	<15	15-28	>28	30.6	5
PERCENT OF INDIVIDUALS AS PISCIVORES	<2.0	2.0-3.8	>3.8	1.1	1
CATCH RATE	<28.1	28.1-56.0	>56.0	27.6	1
PERCENT OF INDIVIDUALS AS HYBRIDS	>1	TR-1	0	0	5
PERCENT OF INDIVIDUALS WITH ANOMALIES	>5	5-2	<2	1.4	5
					46

IBI RANGE:	0	12-22	28-34	40-44	48-52	58-60
STREAM DESIGNATION:	NO FISH	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

Table 8. Taxa list and associated bitoic statistics calculated for benthic macroinvertebrates collected in Big Creek during 1998.

BIG CREEK		**TAXA RICHNESS = 38**		
FIELD # 973		**EPT TAXA RICHNESS = 13**		
EFFORT = 3 MAN HOURS		**BIOCLASSIFICATION = 4 (GOOD)**		
			NUMBER	**PERCENT**
COLEOPTERA				9.8
	Dryopidae	*Helichus*	7	
	Elmidae	*Dubiraphia*	6	
		Optioservus	1	
		Stenelmis	9	
	Gyrinidae	*Dineutus robertsi*	1	
	Ptilodactilidae	*Anchytarsus bicolor*	1	
DIPTERA				6.3
	Chironomidae		8	
	Dixidae	*Dixa*	1	
	Simuliidae		3	
	Tipulidae	*Antocha*	1	
		Tipula	3	
EPHEMEROPTERA				26
	Baetidae		18	
	Ephemerellidae	*Eurylophella*	1	
	Heptageniidae	*Stenacron*	1	
		Stenonema	23	
	Isonychiidae	*Isonychia*	22	
	Leptophlebiidae	*Habrophlebiodes*	1	
GASTROPODA				3.9
	Pleuroceridae		10	
HEMIPTERA				1.6
	Gerridae	*Gerris conformis*	2	
	Veliidae	*Rhagovelia obesa*	2	
MEGALOPTERA				6.3
	Corydalidae	*Corydalus cornutus*	8	
		Nigronia serricornis	8	
ODONATA				8.3
	Aeshnidae	*Boyeria vinosa*	4	
	Calopterygidae	*Calopteryx*	3	
	Coenagrionidae	*Argia*	1	
	Gomphidae	*Gomphus (Genus A)*	1	
		Gomphus lividus	4	
		Hagenius brevistylus	2	
		Stylogomphus albistylus	1	
		Stylurus laurae	5	
PELECYPODA				0.4
	Corbiculidae	*Corbicula fluminea*	1	
PLECOPTERA				4.3
	Leuctridae		1	
	Peltoperlidae	*Peltoperla*	10	
TRICHOPTERA				33.1
	Hydropsychidae	*Cheumatopsyche*	45	
		Hydropsyche betteni/depravata	31	
	Leptoceridae	*Triaenodes*	1	
	Limnephilidae	*Pycnopsyche*	1	
	Uenoidae	*Neophylax*	6	
		TOTAL	**254**	

Nolichucky River

Introduction

The Nolichucky River represents an important recreational resource for the state both in consumptive and non-consumptive uses. It provides critical habitat for species of special concern and is home to approximately 50 species of fish and has historically contained at least 21 species of mussels (Ahlstedt 1986). Additionally, it supports one of east Tennessee's better warmwater sport fisheries. The Nolichucky River and its tributaries have been the subject of numerous biological and chemical investigations that span some 40 years. These investigations have concentrated on evaluating pollution levels and documenting sources for mitigation. Much of the upper reach of the Nolichucky River has been consistently impacted by sand dredging and mica mining in North Carolina and extensive agricultural development along the entire length in Tennessee. However, in recent years, the Nolichucky River has improved in water quality as a result of mitigation and education conducted during these early studies. The Agency has made limited surveys of the river that focused primarily on collecting basic fish, benthic, and water quality data (Bivens 1988). Our survey of the Nolichucky River focused on developing a fish species list and assessing the relative condition of the sport fish populations in the river from The North Carolina state line to its confluence with the French Broad River.

Study Area and Methods

The Nolichucky River originates in North Carolina and flows in a southwesterly direction before emptying into the French Broad River near river mile 69.0. The river has a drainage area of approximately 2,827 $kilometers^2$. In Tennessee, approximately 159 kilometers of the Nolichucky River flows through the Blue Ridge and Ridge and Valley provinces of east Tennessee coursing through or by the towns of Erwin, Greeneville and Morristown before joining the French Broad River near the community of White Pine. Public access (found in Unicoi, Washington, Greene, Cocke and Hamblen counties) along the river is primarily limited to bridge crossings and small "pull-outs" along roads paralleling the river. There are several primitive launching areas for canoes or small boats and four developed launching areas managed by the Tennessee Wildlife Resources Agency (Easterly Bridge and Birds Bridge), the City of Greeneville (Kinser Park) and the U.S. Forest Service (Chestoa).

Between July and August 1998, we conducted 31 fish surveys between the North Carolina state line and the French Broad River (Figure 5). In our survey sites, the riparian habitat consisted primarily of wooded shorelines with interspersed agricultural fields. There were several reaches of the river where one or both side of the river were confined within rock palisades. Submerged woody debri was fairly common in most of our sample areas. The river substrate was predominately boulder/cobble in riffle areas and bedrock with interspersed boulders/cobble in the pool habitat. We observed a dramatic shift in substrate composition between sites 15 and 19. This portion of the river, influenced by Davy Crockett Dam, has seen significant deposition of sand and mica, which has all but filled the river channel. During periods of low flow, navigation of the river within this reach is restricted to a narrow main current channel with the remaining channel dewatered or having depths less than 0.3 meter. Measured mean channel widths ranged from 27.5 meters to 100.6 meters, while site lengths fell between 223 meters and 1,311 meters (Table 9). Water temperatures ranged from 23 C to 29 C and conductivity varied from 75 to 335 (Table 9).

Fish were collected by boat electrofishing in accordance with the standard large river sampling protocols (TWRA 1998). Fixed-boom electrodes were used to transfer 4-5 amps DC at all sites. This current setting was determined effective in narcotizing all target species (black bass and rock bass). Additonally, efforts were made to identify non-target species and compile a list for each survey site. All sites were sampled during daylight hours and had survey durations ranging from 900 to 3963 seconds. Catch-per-unit-effort (CPUE) values were calculated for each target species at each site.

Otoliths were extracted from all target species and sent to the Nashville office for analysis. Ages were determined by viewing the transverse section of saggital otoliths submerged in water and illuminated by fiberoptic cable. Stomach contents from all black bass and rock bass were extracted and preserved in 10% formalin. Lab identification of stomach contents was made to the lowest possible level and then grouped into one of six categories. These included crayfish, fish, snails, aquatic insects, terrestrial insects and other.

Length categorization indices were calculated for target species following Gabelhouse (1984). Annual mortality estimates were derived for target species whose data met the requirements described by Van Den Avyle (1993).

Results

Smallmouth bass (*Micropterus dolomieui*), spotted bass (*M. punctulatus*) and rock bass (*Ambloplites rupestris*) were present at the majority of the 31 sampling stations (Table 10). Largemouth bass (*M. salmoides*) were encountered less frequently and were primarily restricted to the lower half of the river. Spotted bass, on average, was the most abundant black bass species at any of the survey sites. CPUE estimates for this species averaged 13.9/hour, while the smallmouth bass and largemouth bass estimates were 10.9/hour and 0.9/hour, respectively (Table 10). There was no discernable trend in the catch distribution of spotted bass and smallmouth bass from downstream to upstream (Table 10). Largemouth bass appeared to be most abundant in the lower half of the river where slow sluggish pools and increased debri loading were more common. Rock bass CPUE varied considerably between sites and averaged 9.0/hour. There appeared to be a pattern of increasing catch rate for rock bass as we progressed upstream. We noticed substantial habitat shifts within the river that coincided with the frequency in which we encountered rock bass from downstream to upstream. Muskellunge *(Esox masquinongy)* were stocked in the river during 1988 (1,000: ~203 mm) and 1995 (100: ~254 mm) in the upper 32 kilometers (river mile 80-99). These fish have since dispersed and have been recently reported as far downstream as river mile 36.0. During our survey, we collected a total of five musky at sites 14 and 23 ranging in length from 711 mm to 940 mm. There associated catch rates were 6.6/hour at site 14 and 0.3/hour at site 23.

The majority of the smallmouth bass collected in the Nolichucky River during 1998 fell within the 125 mm to 250 mm length range (Figure 6). Our data indicated that fish under 125 mm, were not vulnerable to the sampling gear. Length categorization analysis indicated the Relative Stock Density (RSD) for preferred smallmouth bass (TL ≥ 350 mm) was 11.7. RSD for memorable (TL ≥ 430 mm) and trophy (TL ≥ 510 mm) size bass were 1.3 and 0, respectively. The ratio of quality (TL ≥ 280 mm) smallmouth bass to stock size bass (TL ≥ 180 mm) was 32.5. Catch per unit effort estimates by RSD category indicated smallmouth bass had relatively high catch rates for the category RSD-Q and above and was only slightly lower than the values calculated for spotted bass (Figure 7). Overall, growth rates for smallmouth were slightly higher than the statewide average for age groups represented in the 1998 sample (Figure 8). Stomach content analysis from smallmouth bass collected in the Nolichucky during 1998 indicated a strong reliance on aquatic insects for age-0 bass (Figure 9). As fish matured, the diet shifted, and was comprised primarily of crayfish and fish for bass ages 1 and older, although insects (aquatic and terrestrial) continued to play a substantial role in the diet (Figure 9). The mortality estimate that was calculated for smallmouth bass ages 1-6 was about 38%.

The majority of the spotted bass collected in the Nolichucky River during 1998 fell within the 125 mm to 325 mm length range (Figure 6). Our data indicated that fish under 125 mm, for the most part, were not effectively sampled. Length categorization analysis indicated the RSD for preferred spotted bass (TL ≥ 350 mm) was 5.3. RSD for memorable (TL ≥ 430 mm) and trophy (TL ≥ 510 mm) size bass was 0. The ratio of quality (TL ≥ 280 mm) spotted bass to stock size bass (TL ≥ 180 mm) was 34.2. Catch per unit effort estimates by RSD category revealed a relatively high number of RSD-Q spotted bass, but fewer bass in the RSD-P category and above in comparison to smallmouth bass (Figure 7). Overall, growth rates for spotted bass were slightly higher than the statewide average (Figure 8). Stomach content analysis from spotted bass collected in the Nolichucky during 1998 indicated a strong reliance on aquatic insects for age-0 bass (Figure 10). As fish matured, the diet shifted, and was comprised primarily of crayfish and fish for bass ages 1 and older, although insects (aquatic and terrestrial) continued to play a substantial role in the diet up through the oldest age groups collected (Figure 10). The mortality estimate that was calculated for spotted bass ages 2-6 was about 33%.

Largemouth bass collected in the Nolichucky River during 1998 fell within the 125 mm to 250 mm length range (Figure 6). Length categorization analysis indicated the RSD for preferred largemouth bass (TL ≥ 380 mm) was 12.5. RSD for memorable (TL ≥ 510 mm) and trophy (TL ≥ 630 mm) size largemouth bass was 0. The ratio of quality

(TL $\geq$ 300 mm) largemouth bass to stock size bass (TL $\geq$ 200 mm) was 37.5. The catch rate for largemouth bass was highest in the RSD-S category with relatively few individuals in the RSD-Q category and above (Figure 7). Overall, growth rates for largemouth bass in the 1998 sample were slightly higher than the statewide average for the four age groups represented (Figure 8). Stomach content analysis from largemouth bass collected in the Nolichucky during 1998 indicated a strong dependence on terrestrial insects for age-0 bass (Figure 11). As fish matured, the diet shifted, and was comprised primarily of crayfish and fish for bass ages 1 and older (Figure 11). Because of the low sample size, the stomach analysis for largemouth is somewhat weak; however, the available data does give a general trend in food habits for the ages represented. No annual mortality estimate was calculated for largemouth bass due to the low number of individuals in our sample.

Individuals in the 100 mm to 175 mm range represented the majority of rock bass in our sample (Figure). Length categorization analysis indicated the RSD for preferred rock bass (TL $\geq$ 230 mm) was 0. RSD for memorable (TL $\geq$ 280 mm) and trophy (TL $\geq$ 330 mm) size rock bass was 0. The ratio of quality (TL $\geq$ 180 mm) rock bass to stock size rock bass (TL $\geq$ 100 mm) was 17.4. Annual growth rates for rock bass collected in the 1998 sample approximated those reported for the statewide average (Figure 8). Stomach content analysis from rock bass collected in the Nolichucky during 1998 indicated a strong dependence on aquatic insects for age-0 rock bass (Figure 12). As fish matured, the diet shifted, and crayfish became a more important component for rock bass ages 2 and older (Figure 12). Unlike the black bass collected, both terrestrial and aquatic insects remained a significant component of the diet for all ages of rock bass beyond age 1 (Figure 12). The annual mortality estimate calculated for rock bass ages 3-5 was about 65%.

Several other species were collected or observed during our survey of the Nolichucky River, which included both state and federally listed species *(Cycleptus elongatus, Carpiodes velifer, and Etheostoma acuticeps)*. A list of species occurrence by site can be found in Table 11.

Discussion

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

Currently we have no angler use/harvest data on the river to aid in evaluating the effects that angler use may or may not have on the sport fishery. It is imperative that we obtain this data in order to answer fish management questions as well as public inquiries.

The occurrence of musky in the river warrants continued stocking when fish become available. Based on our observations and information from anglers the stocking program has met with some success and there have been rumors of reproduction in the river although these claims have not been verified. We have requested 1,000 fish for the 1999 stocking season and would like to see stocking continue at some level.

Surveys on the Nolichucky River will be conducted on a five year rotation in order to assess any changes in the fishery. Our return trip in 2003 will in all likelihood not be as intensive as the 1998 survey. We will probably choose a percentage of sites sampled in 1998 that will be most descriptive in assessing the fish population structure in the river.

Figure 5. Site locations for samples conducted on the Nolichucky River during 1998.

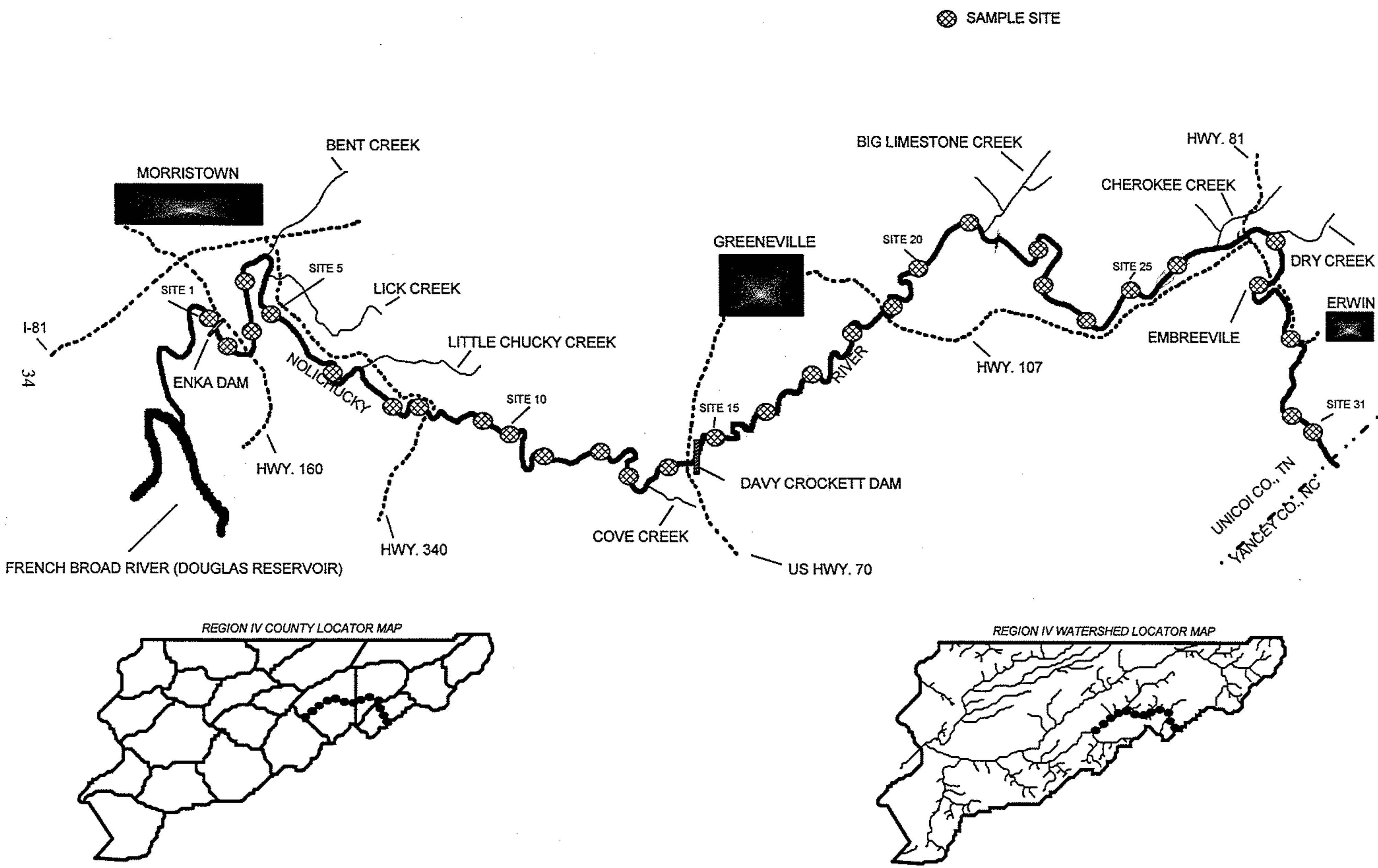


Table 9. Physiochemical and site location data for samples conducted on the Nolichucky River during 1998.

SITE CODE	DATE	COUNTY(S)	QUADRANGLE	COORDINATES	RIVER MILE	MEAN WIDTH (m)	LENGTH (m)	SECCHI (m)
419980901	8-24-98	HAMBLEN	SPRINGVALE 172NW	360850N-831252W	7.6	71.3	537	0.8
419980902	7-21-98	HAMBLEN/COCKE	SPRINGVALE 172NW	360747N-831148W	9	78.3	931	1.2
419980903	7-21-98	HAMBLEN/COCKE	SPRINGVALE 172NW	360836N-831041W	11.4	68	719	1.1
419980904	7-21-98	HAMBLEN/COCKE	SPRINGVALE 172NW	361014N-831114W	13.5	74.6	1311	1.1
419980905	7-21-98	GREENE/COCKE	SPRINGVALE 172NW	360910N-830958W	17.6	73.3	1172	1.6
419980906	7-21-98	GREENE/COCKE	PARROTTSVILLE 172SE	360641N-830702W	22.2	59.6	949	1.3
419980907	8-26-98	COCKE	PARROTTSVILLE 172SE	360530N-830413W	26.2	89	561	1.4
419980908	8-26-98	GREENE	PARROTTSVILLE 172SE	360546N-830305W	27.9	87.3	1094	1.4
419980909	8-26-98	GREENE	PARROTTSVILLE 172SE	360534N-830034W	30.9	57.3	321	1.7
419980910	8-25-98	GREENE	CEDAR CREEK 181SW	360500N-825915W	32.6	78.6	564	1.4
419980911	8-25-98	GREENE	CEDAR CREEK 181SW	360419N-825807W	36.5	59.6	642	1.3
419980912	8-25-98	GREENE	CEDAR CREEK 181SW	360429N-825537W	39.1	59.6	663	1.3
419980913	8-25-98	GREENE	CEDAR CREEK 181SW	360318N-825413W	42.5	100.6	650	1.2
419980914	8-25-98	GREENE	DAVY CROCKETT LAKE 181SE	360354N-825212W	45.7	80.5	1224	1
419980915	8-24-98	GREENE	DAVY CROCKETT LAKE 181SE	360447N-825048W	47.9	78.6	399	N/A
419980916	8-24-98	GREENE	DAVY CROCKETT LAKE 181SE	360549N-824906W	51.2	72.3	447	1.6
419980917	8-24-98	GREENE	DAVY CROCKETT LAKE 181SE	360658N-824701W	54.1	55.6	605	1.6
419980918	8-11-98	GREENE	GREENEVILLE 181NE	360836N-824507W	58.4	55.7	505	1
419980919	8-11-98	GREENE	CHUCKEY 190NW	360924N-824306W	61	43.5	488	1.4
419980920	8-11-98	GREENE	CHUCKEY 190NW	361020N-824222W	64.3	27.5	223	0.9
419980921	8-11-98	GREENE	CHUCKEY 190NW	361238N-823541W	68.1	52.3	350	1.2
419980922	8-11-98	WASHINGTON	TELFORD 190NE	361132N-823718W	71.4	66.3	300	1
419980923	8-11-98	WASHINGTON	TELFORD 190NE	361056N-823647W	74.3	49.6	411	1.2
419980924	8-10-98	WASHINGTON	TELFORD 190NE	360901N-823441W	78.8	49	1079	0.6
419980925	8-10-98	WASHINGTON	TELFORD 190NE	361007N-823000W	80.3	57.7	890	0.6
419980926	8-10-98	WASHINGTON	TELFORD 190NE	361117N-823105W	82.9	50	769	0.5
419980927	8-10-98	WASHINGTON	ERWIN 199NW	361157N-832710W	87.3	57.2	788	1.4
419980928	7-20-98	WASHINGTON	ERWIN 199NW	361026N-822800W	89.6	68	431	2
419980929	7-20-98	UNICOI	ERWIN 199NW	360828N-822625W	93.8	54.3	373	2.1
419980930	7-20-98	UNICOI	CHESTOA 199SW	360527N-822637W	98	53.3	241	1.4
419980931	7-20-98	UNICOI	CHESTOA 199SW	360536N-822540W	99.1	80.3	426	1.1

Table 10. Catch per unit effort and length-categorization indices of target species collected at thirty-one sites on the Nolichucky River during 1998.

SITECODE	SMALLMOUTH BASS CPUE (#/HOUR)	SPOTTED BASS CPUE (#/HOUR)	LARGEMOUTH BASS CPUE (#/HOUR)	ROCK BASS CPUE (#/HOUR)
419980901	2.2	8.8	3.3	0.9
419980902	2	6		
419980903		4	2	6
419980904	8.8		2.2	4.4
419980905	8	9		1
419980906	8	13	2	4
419980907	15	17.5		2.5
419980908	18	2		8
419980909	16.6	6.6		
419980910	10	12.5		
419980911	5	10		25
419980912	20	20		15
419980913	37.5	17.5		10
419980914	6.6	11.6	1.6	6.6
409980915	5	20	5	
419980916		40	5	
419980917	3.3	23.3		
419980918		16.6		
419980919	10	45	5	5
419980920	15	15		10
419980921	20	5		30
419980922	15	35		30
419980923	3.3	6.6		10
419980924	6	12		14
419980925	30	10		2.5
419980926	16	14		12
419980927	12	32		12
419980928	7.1	7.1		8.6
419980929	3.7	5		25
419980930	22			30
419980931	11.1	6.6	2.2	5.5
MEAN	10.9	13.9	0.9	9.0
STD. DEV.	8.5	10.9	1.5	9.5
	LENGTH-CATEGORIZATION ANALYSIS PSD = 32.5 RSD-PREFERRED = 11.7 RSD-MEMORABLE = 1.3 RSD-TROPHY = 0	LENGTH-CATEGORIZATION ANALYSIS PSD = 34.2 RSD-PREFERRED = 5.3 RSD-MEMORABLE = 0 RSD-TROPHY = 0	LENGTH-CATEGORIZATION ANALYSIS PSD = 37.5 RSD-PREFERRED = 12.5 RSD-MEMORABLE = 0 RSD-TROPHY = 0	LENGTH-CATEGORIZATION ANALYSIS PSD = 17.4 RSD-PREFERRED = 0 RSD-MEMORABLE = 0 RSD-TROPHY = 0

* sitecodes are listed from downstream to upstream

Figure 6. Length frequency distributions for black bass and rock bass collected in the Nolichucky River during 1998.

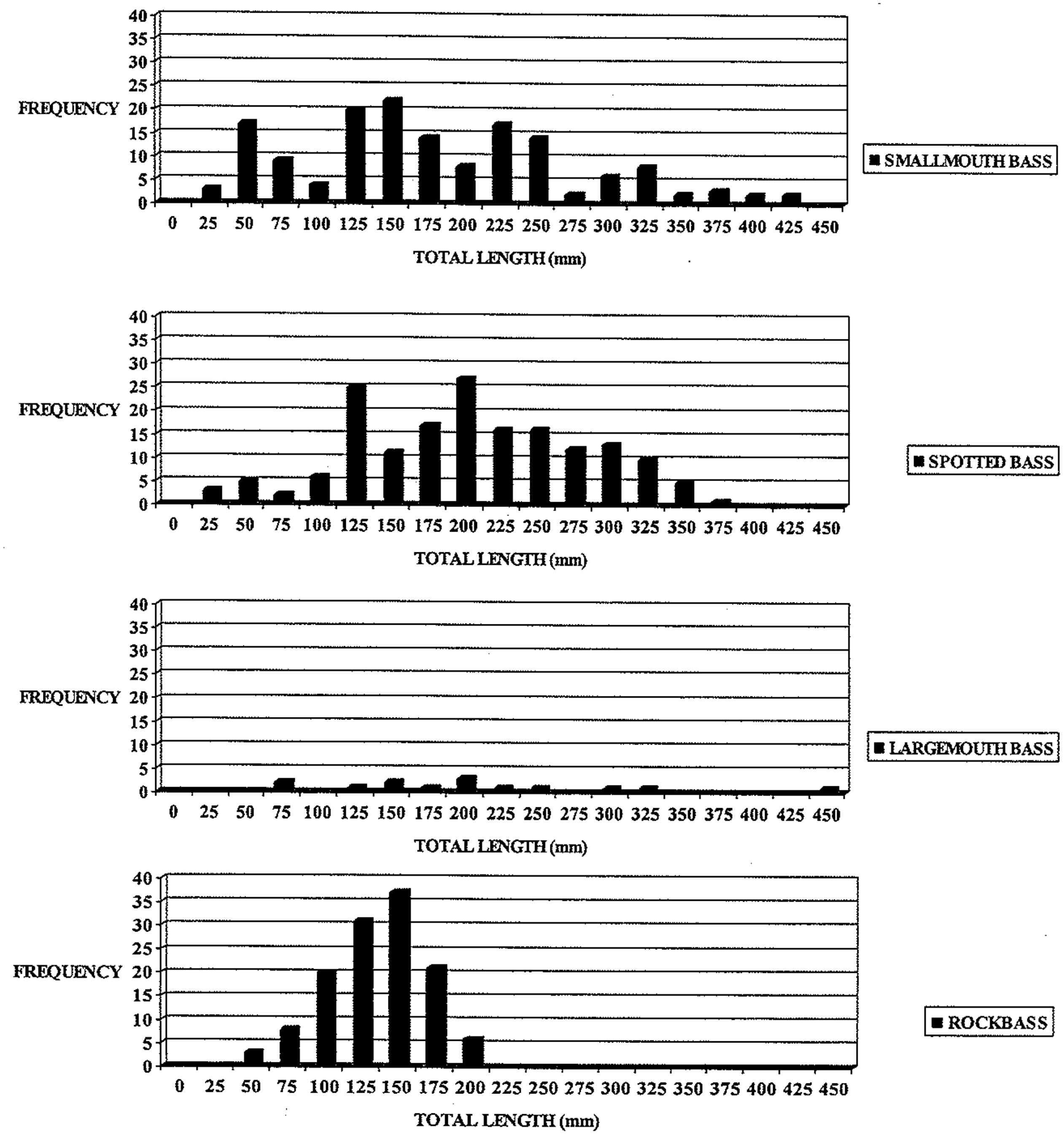
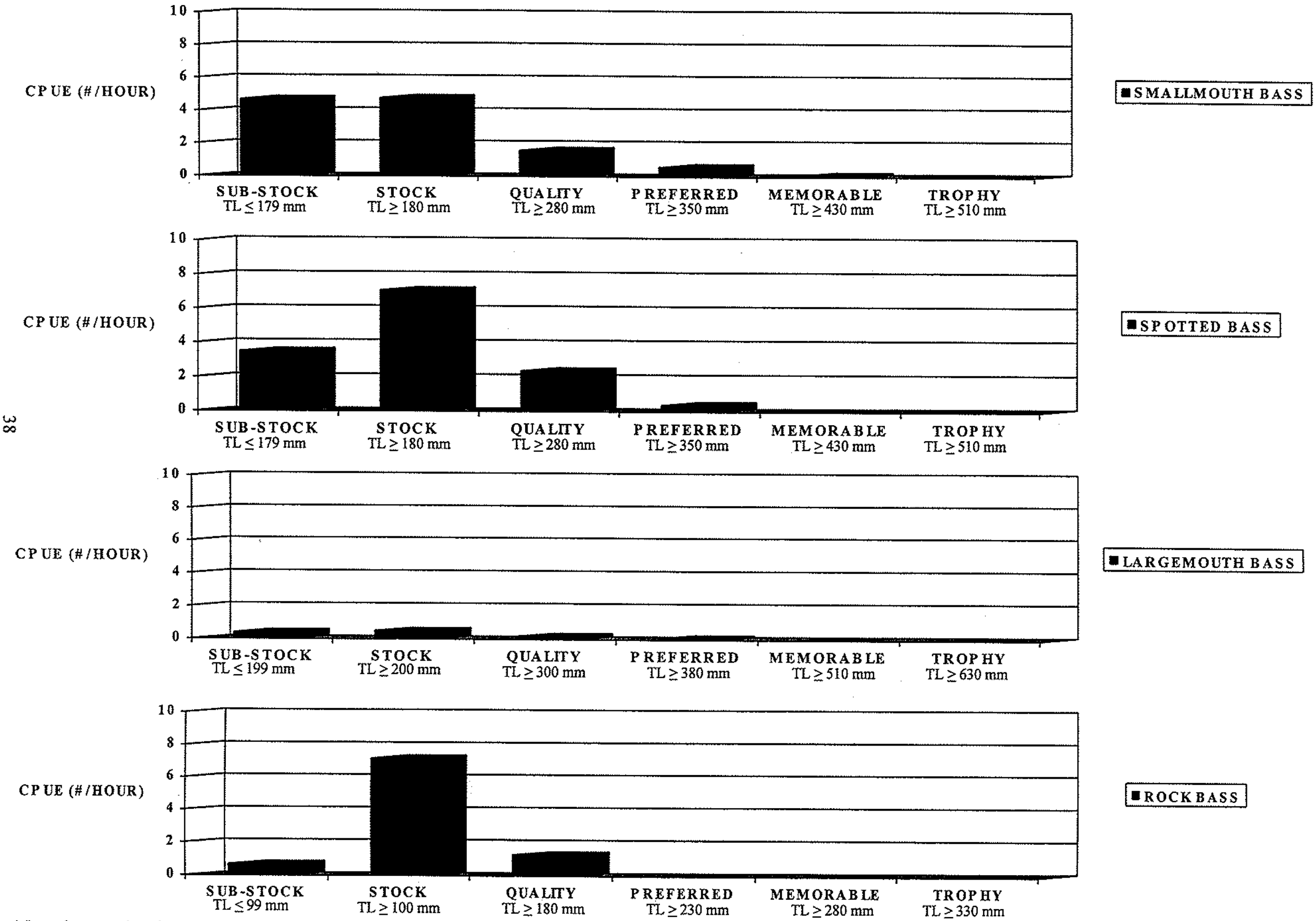


Figure 7. Relative stock density (RSD) catch per unit effort by category* for black bass and rock bass collected in the Nolichucky River during 1998.



* Length categories after Gabelhouse (1984)

Figure 8. Mean length at age for black bass and rock bass collected in the Nolichucky River during 1998. Statewide mean based on 1995-98 data (TWRA, unpublished data).

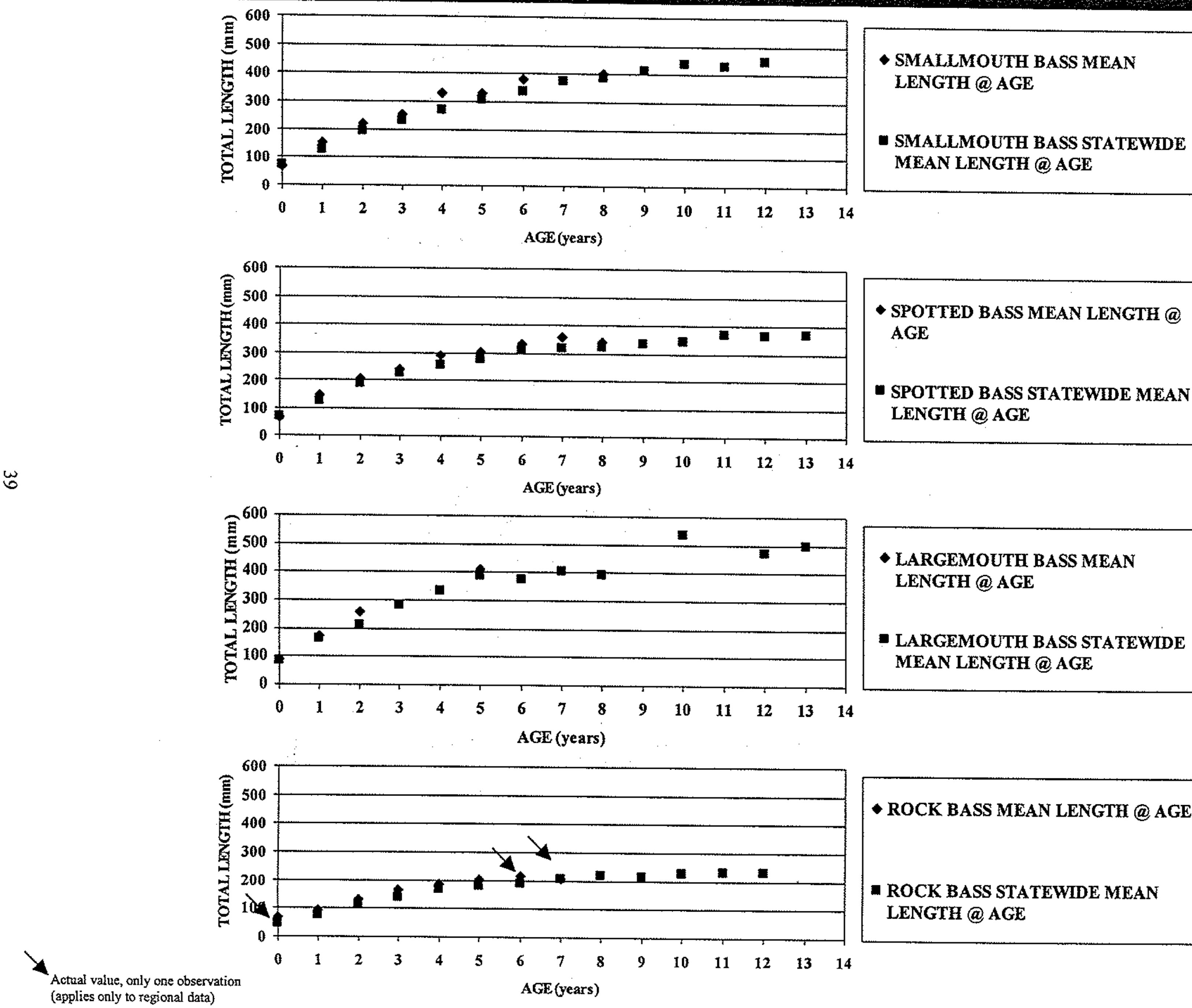


Figure 9. Percent occurrence of identified food items consumed by various ages of smallmouth bass collected in the Nolichucky River during 1998.

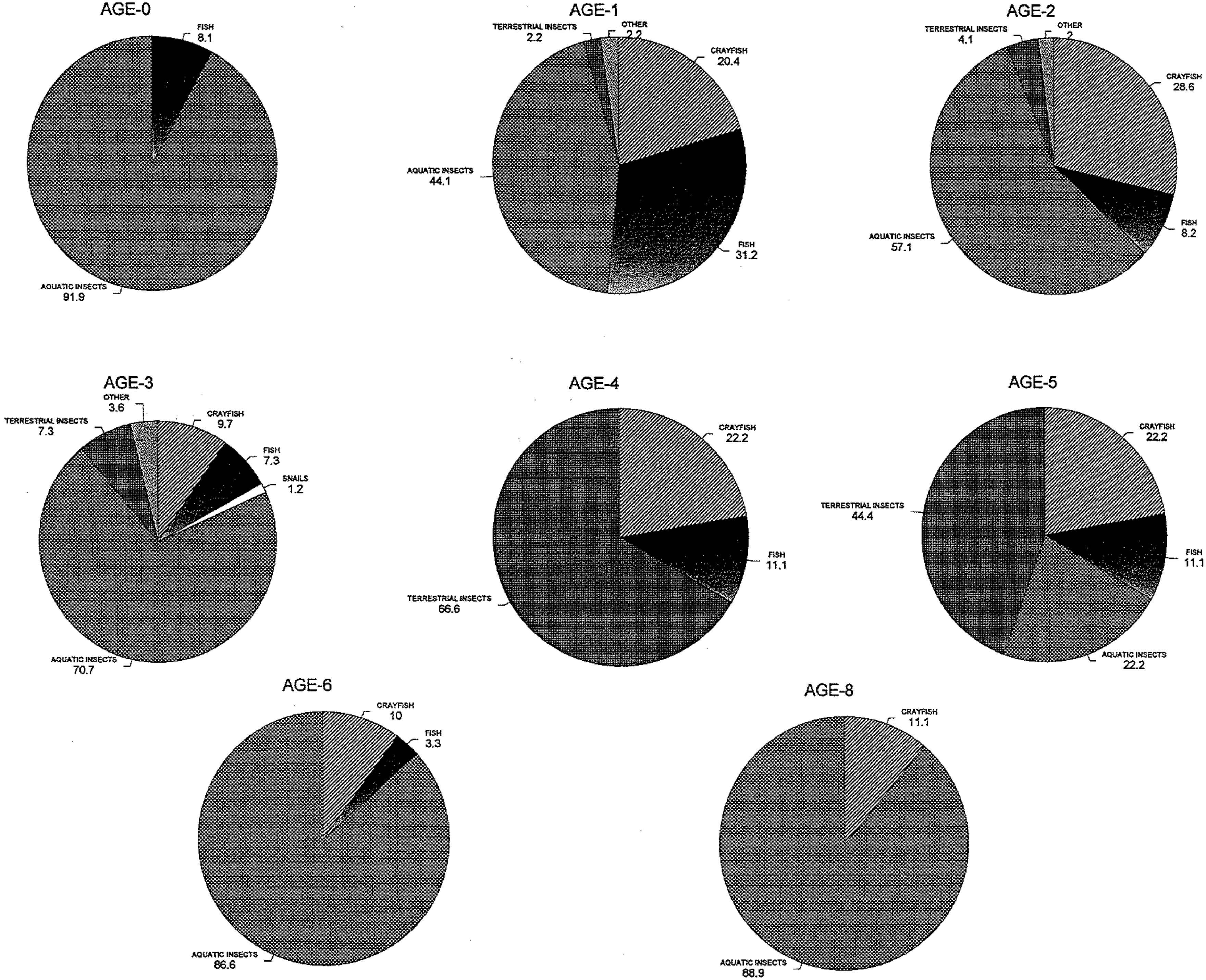


Figure 10. Percent occurrence of identified food items consumed by various ages of spotted bass collected in the Nolichucky River during 1998.

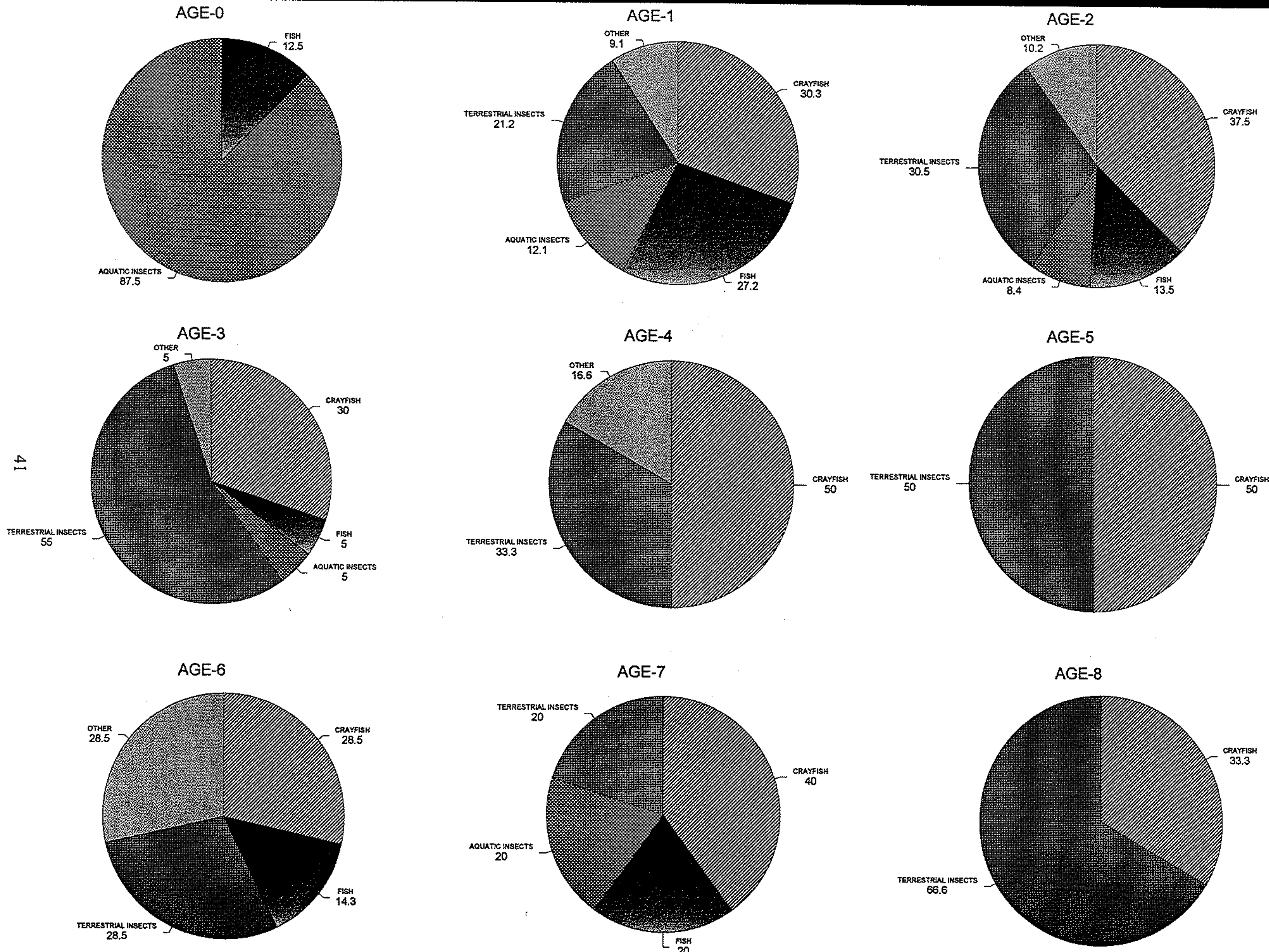


Figure 11. Percent occurrence of identified food items consumed by various ages of largemouth bass collected in the Nolichucky River during 1998.

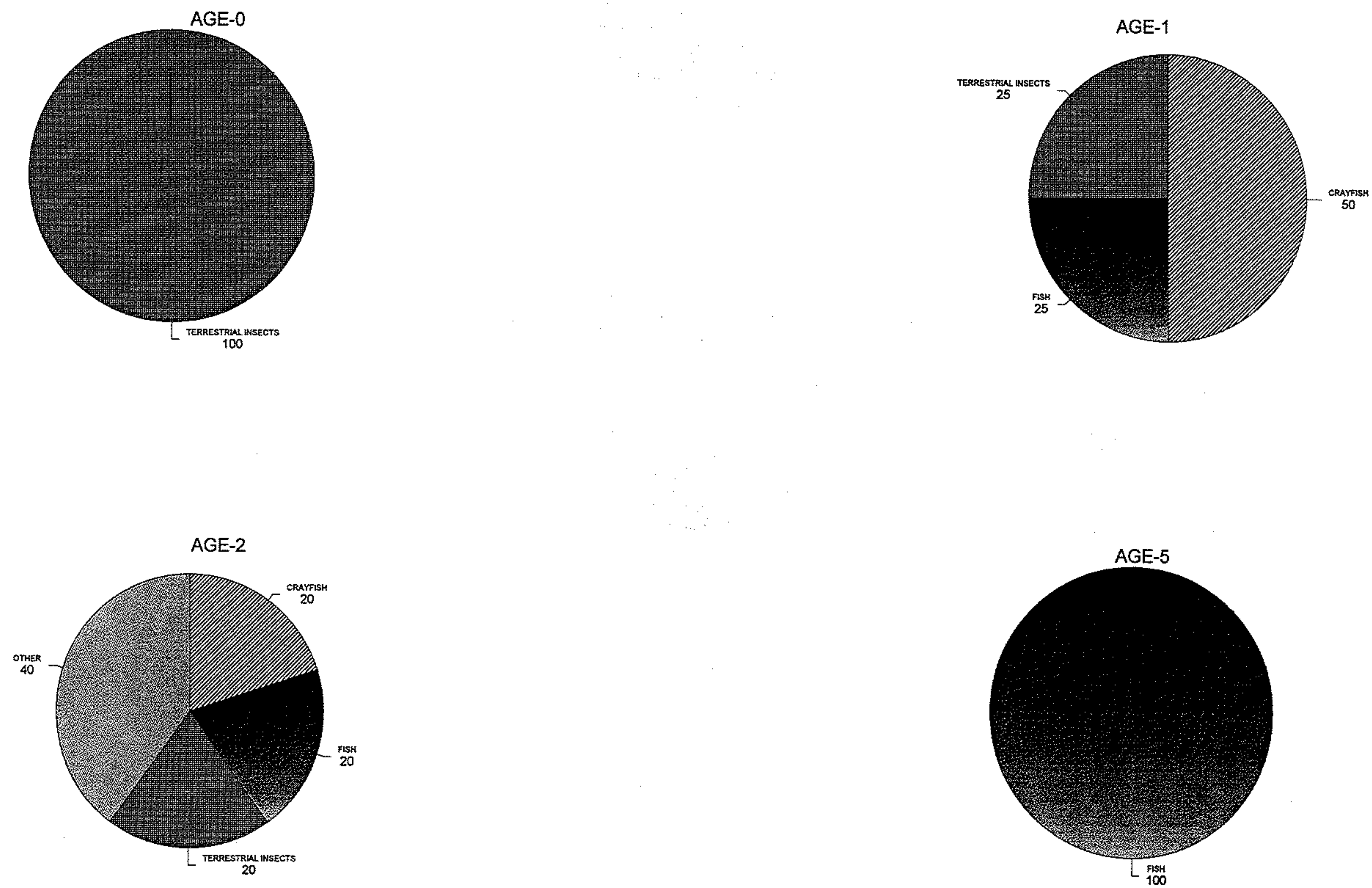


Figure 12. Percent occurrence of identified food items consumed by various ages of rock bass collected in the Nolichucky River during 1998.

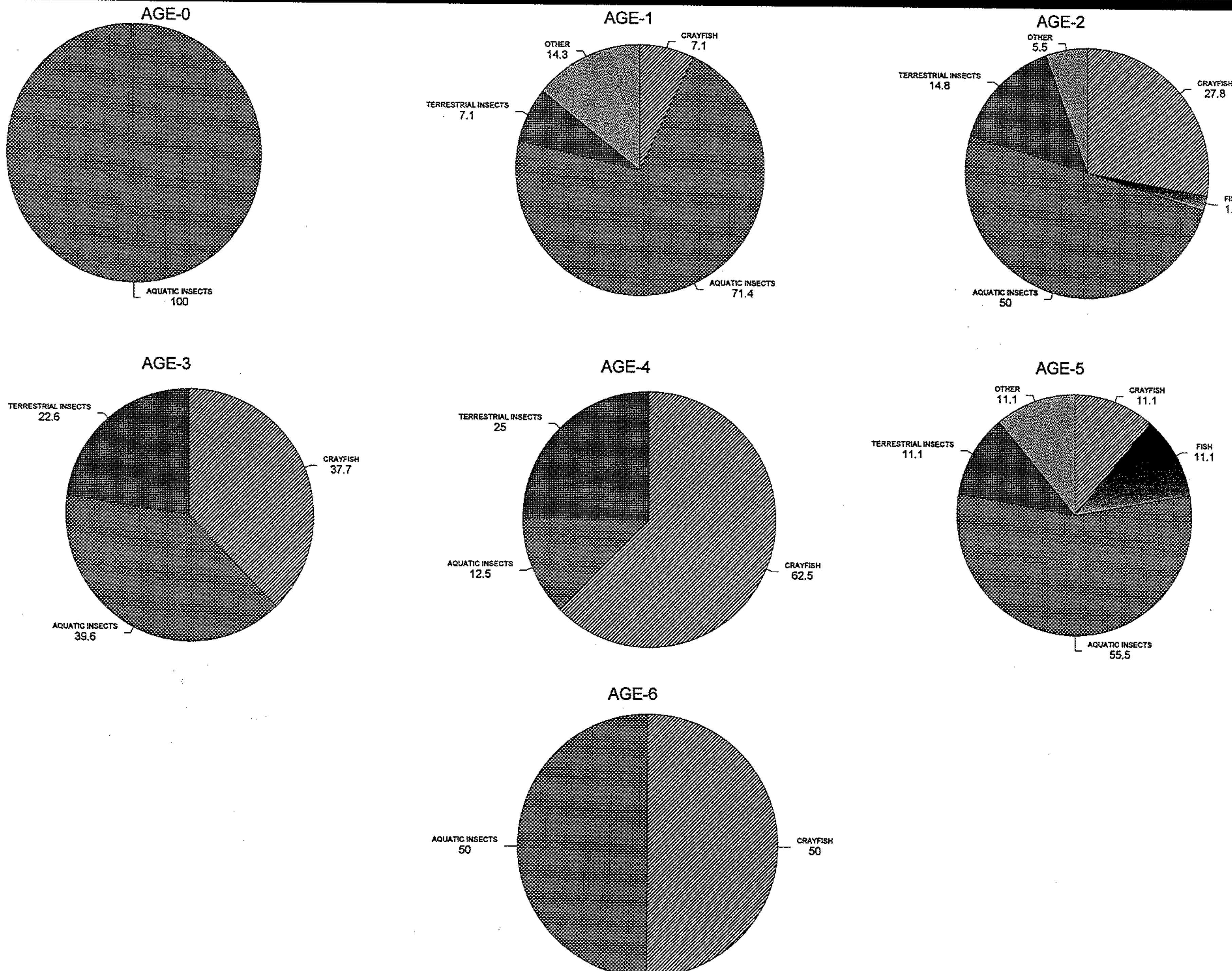


Table 11. Distribution of fish species collected in the Nolichucky River during 1998.

	NOLICHUCKY RIVER MILE →		7.6	9.0	11.4	13.5	17.8	22.2	26.2	27.9	30.9	32.6	36.5	39.1	42.5	45.7	47.9	51.2	54.1	58.4	61.0	64.3	68.1	71.4	74.3	78.8	80.3	82.9	87.3	89.6	93.8	98.0	99
	SITE CODE →		419980901	419980902	419980903	419980904	419980905	419980906	419980907	419980908	419980909	419980910	419980911	419980912	419980913	419980914	419980915	419980916	419980917	419980918	419980919	419980920	419980921	419980922	419980923	419980924	419980925	419980926	419980927	419980928	419980929	419980930	419980931
FAMILY	SCIENTIFIC NAME	STATUS																															
CATOSTOMIDAE	*Carpiodes carpio*					●	●	●		●				●	●						●												
	Carpiodes cyprinus		●									●				●							●					●			●		
	Carpiodes velifer																								●								
	Cycleptus elongatus	C2									●																						
	Hypentelium nigricans		●	●	●	●	●	●	●	●	●	●	●	●	●	●		●		●	●	●		●	●	●	●	●	●	●	●	●	●
	Ictiobus bubalus		●	●	●	●	●		●	●	●		●	●	●	●																	
	Ictiobus niger							●																									
	Moxostoma anisurum		●					●							●	●				●			●			●	●	●	●	●	●	●	●
	Moxostoma carinatum		●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●	●	●	●	●	●	●	●	●		●	●
	Moxostoma duquesnei		●		●	●	●	●	●	●	●	●	●		●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
	Moxostoma erythrurum			●			●	●	●	●	●	●		●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●		●	●
	Moxostoma macrolepidotum		●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●				●	●	●	●	●	●	●	●	●	●	●
CENTRARCHIDAE	*Ambloplites rupestris*		●		●	●	●	●	●	●	●		●	●	●	●					●	●	●	●	●	●	●	●	●	●	●	●	●
	Lepomis auritus			●		●	●	●	●	●	●	●	●	●	●	●	●	●		●		●	●	●	●	●	●	●	●	●	●	●	●
	Lepomis cyanellus				●																												
	Lepomis macrochirus		●	●	●	●	●	●	●		●	●	●	●		●	●	●	●	●	●		●	●					●	●	●	●	●
	Lepomis microlophus		●														●			●													
	Lepomis gulosus															●															●		
	Lepomis sp. (hybrid)				●																												
	Micropterus dolomieu		●	●		●	●	●	●	●	●	●	●	●	●	●	●		●		●	●	●	●	●	●	●	●	●	●	●	●	●
	Micropterus punctulatus		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
	Micropterus salmoides		●		●	●		●								●	●	●			●												●
	Pomoxis annualris		●					●																		●							
	Pomoxis nigromaculatis										●					●		●	●		●												
CLUPEIDAE	*Dorosoma cepedianum*		●			●			●		●		●	●	●	●					●						●	●		●	●		●
COTTIDAE	*Cottus carolinae*																									●					●		
CYPRINIDAE	*Cyprinella galactura*																								●		●	●	●	●	●	●	●
	Cyprinella spiloptera		●	●	●	●	●	●		●	●	●		●		●	●	●	●	●		●	●	●	●	●	●	●	●	●			
	Cyprinus carpio		●		●		●	●	●				●		●				●	●	●		●			●	●		●		●		
	Erimystax insignis									●																							
	Hybopsis amblops						●	●																									
	Luxilus chrysocephalus									●																							
	Luxilus coccogenis																				●	●				●	●		●		●	●	●
	Nocomis micropogon		●							●					●						●		●	●		●					●	●	●
	Notropis leuciodus																																●
	Notropis rubellus		●		●	●	●	●		●	●	●							●			●	●	●	●	●	●	●	●		●		●
	Notropis spectrunculus																														●		
	Notropis telescopus					●			●																	●		●			●	●	●
	Notropis volucellus				●	●	●	●							●					●	●	●		●	●	●	●	●	●				
	Pimephales notatus						●	●																									
ESOCIDAE	*Esox masquinongy*															●									●								
ICTALURIDAE	*Ameiurus natalis*															●									●					●			
	Ictalurus punctatus		●	●		●	●		●	●	●			●		●		●	●	●		●		●		●	●	●	●	●			●
	Noturus eleutherus									●																							
	Pylodictus olivaris		●			●	●	●	●	●	●	●		●		●					●		●	●			●	●			●		●
LEPISOSTEIDAE	*Lepisosteus oculatus*		●																														
	Lepisosteus osseus		●			●	●			●					●	●						●						●					●
MORONIDAE	*Morone chrysops*		●																														
PERCIDAE	*Etheostoma aculiceps*	INM				●		●		●																							
	Etheostoma blennioides						●		●		●				●	●													●				
	Ehteostoma camurum														●																		
	Etheostoma simoterum						●																							●			
	Etheostoma zonale						●	●	●			●																					●
	Percina aurantiaca	INM													●	●												●			●	●	●
	Percina caprodes		●												●	●														●	●		●
	Percina evides									●																							
	Percina squamata																														●	●	
	Stizostedion canadense		●																														
PETROMYZONTIDAE	*Ichthyomyzon sp.*				●																												
	Lampetra sp.																									●		●	●	●	●		●
SALMONIDAE	*Oncorhynchus mykiss*																									●			●				
SCIAENIDAE	*Aplodinotus grunniens*		●																														

FE = FEDERALLY ENDANGERED, FT = FEDERALLY THREATENED, ST = STATE THREATENED, INM = IN NEED OF MANAGEMENT, C2 = FEDERAL CATEGORY 2

Oven Creek

Introduction

We conducted an IBI survey of Oven Creek in order to assess the relative health of the aquatic community. The stream originates near the community of Parrottsville and flows in a northerly direction before meeting the Nolichucky River near river mile 26.5. The Agency has made no previous survey of this stream.

Study Area and Methods

Our survey of Oven Creek was conducted upstream of the road crossing on Goodwater Road and about 1.2 kilometers upstream of the mouth. The survey site encompassed about 200 meters of stream and included all habitat types typical to this reach. The stream habitat in our survey reach was primarily characterized as a low gradient stream with few riffle/run sequences and long meandering pools. Land use in the watershed appeared to be primarily agricultural in nature. The stream substrate had a predominance of bedrock in both riffle and pool habitat and a fair representation of silt in pools (Figure 13). Water quality parameters measured in Oven Creek were within normal ranges and did not appear to be a limiting factor (Figure 13).

Our evaluation of the fish community was conducted through an Index of Biotic Integrity (IBI) survey. Conducting a timed qualitative survey with kick nets was used to evaluate the benthic community. Instream habitat and riparian zone within the survey reach was visually assessed and categorized (Barbour and Stribling 1995). All sampling strategies were performed in accordance with the Tennessee Wildlife Resources Agency (TWRA) survey protocols (TWRA 1998). Analysis of the fish and benthic samples followed procedures developed by Karr et al. (1996) and Lenat (1993).

Results

We collected a total of fish 756 comprising 21 species during our IBI survey (Table 12). Five game species were collected in our survey, of which three were *Lepomis* species (Table 12). The two most dominant species collected in the survey were striped shiner (*Luxilus chrysocepahalus*) and central stoneroller (*Campostoma anomalum*). Together these species comprised 59.3% of all fish collected in the sample. Overall, the IBI analysis associated with this survey indicated Oven Creek was in fair condition based on the score of 40. Overall, the high percentage of trophic generalists and tolerant species in the sample combined with the high incidence of anomalies had the strongest negative influence on the score (Table 12).

Benthic macroinvertebrates collected in our sample comprised 32 families representing 39 identified genera (Table 13). The most abundant organisms in our survey were dipterans (true flies) and caddisflies comprising about 56 percent of the total sample. An overall total of 47 taxa were collected in our sample of which 14 were EPT. Based on the EPT taxa richness value and overall biotic index of all species collected, the relative health of the benthic community was classified as "fair to fair/good".

Our evaluation of the physical instream habitat and surrounding conditions of the riparian zone resulted in a mean score of 114. The derivation of this score was primarily influenced by the lack of instream cover and habitat heterogeneity. Based on this score, the habitat within this reach of Oven Creek was characterized as "sub-optimal".

Discussion

Oven Creek is typical of a small Ridge and Valley stream that provides enough quality habitats to offer limited angling opportunities for certain sunfish species (*Lepomis*). However, because of its small size and lack of access it probably receives very little angling attention and should not be considered a sport fishery.

Figure 13. Physiochemical and site location data collected on Oven Creek during 1998.

STREAM	OVEN CREEK
WATERSHED	NOLICHUCKY RIVER
SITE	419980301
COUNTY	COCKE
QUADRANGLE	PARROTTSVILLE 172 SE
LAT-LONG	360511N-830341W
REACH	06010108-
LENGTH	~ 200 m
AREA (SQ. KM.)	29.5
ELEVATION	1085 FT
DATE	6-17-98
TIME	0853

COLLECTOR(S)

R.D. BIVENS, B.D. CARTER, C.E. WILLIAMS

1. CHANNEL CHARACTERISTICS

AVG. WIDTH	AVG. DEPTH	MAX. DEPTH
6.8 m	0.3 m	0.8 m

2. ESTIMATED % OF STREAM IN POOLS IS 70

3. ESTIMATED POOL SUBSTRATE (%)

SILT	SAND	GRAVEL	RUBBLE	BOULDER	BEDROCK
20	15	20	10	5	30

4. ESTIMATED RIFFLE SUBSTRATE (%)

SILT	SAND	GRAVEL	RUBBLE	BOULDER	BEDROCK
5	10	10	25	10	40

5. ABUNDANCE OF LITTORAL AQUATIC PLANTS IS

NUMEROUS	AVERAGE	SCARCE
	X WATER WILLOW	

6. INSTREAM COVER ABUNDANCE IS

GOOD IN	AVERAGE IN	POOR IN
10 %	40 %	50 %

7. SHADE OR CANOPY COVER GOOD OVER 70 %

8. FLOW (CFS) 6.9 COMPARED TO NORMAL

LOW	NORMAL	HIGH
	X	

9. PRESENT WEATHER

SUNNY AND MILD; AIR TEMP 74 F @ 0859

10. PAST WEATHER (last 24 hrs)

SAME; SCATTERD T-STORMS

11. WATER QUALITY

pH	TEMP	COND.	D.O.	% SAT.
7.2	17.9	480	8.5	90.0

12. COMMENTS

SAMPLE SITE LOCATED AT FIRST BRIDGE X-ING ON GOODWATER RD. ON PROPERTY OF MICHEAL OBRIST.

13. $\bar{X}$ HABITAT ASSESSMENT SCORE 114

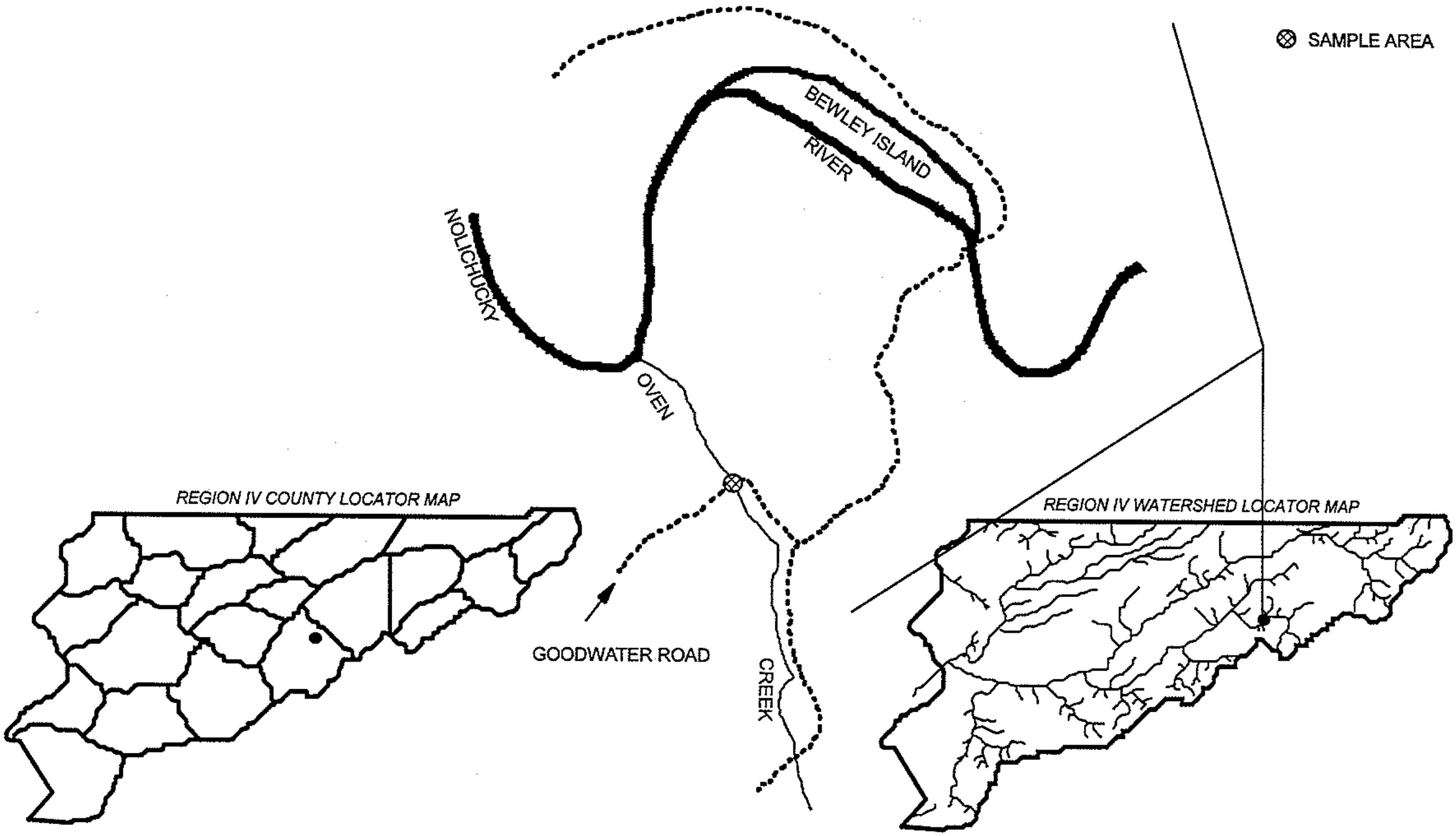


Table 12. Species list and IBI analysis for fish collected in Oven Creek during 1998.

SAMPLING TYPE: SEINING AND SHOCKING

GEAR TYPE: 4.5 m SEINE AND ONE BACKPACK UNIT @ 100 VAC

SPECIES	TADS CODE	NO. COLL.	RANGE(mm)	TOT. WEIGHT(g)	NOTE
Ambloplites rupestris	342	8	42-132	156	
Campostoma anomalum	45	91			
Catostomus commersoni	195	8			
Cottus carolinae	322	32			
Cyprinella spiloptera	57	6			
Etheostoma jessiae	416	1			
Etheostoma rufilineatum	431	2			
Etheostoma simoterum	435	31			
Hybopsis amblops	79	38			
Hypentelium nigricans	207	7			
Lepomis auritus	346	4	100-151	178	
Lepomis cyanellus	347	2	54-83	13	
Lepomis macrochirus	351	22	47-126	154	
Lepomis macrochirus x auritus	345	1	80	10	
Luxilus chrysocephalus	89	358			
Micropterus salmoides	364	2			YOY--not included in IBI
Moxostoma duquesnei	224	7			
Notropis rubellus	131	16			
Notropis telescopus	138	53			
Notropis volucellus	140	56			
Pimephales notatus	176	3			
Rhinichthys atratulus	184	8			
	SUM:	756			

INDEX OF BIOTIC INTEGRITY

METRIC DESCRIPTION	SCORING CRITERIA 1	3	5	OBSERVED	SCORE
NUMBER OF NATIVE SP.	<9	9-16	>16	19	5
NUMBER OF DARTER SP.	<2	2	>2	3	5
NUMBER OF SUNFISH SP. *less Micropterus*	<2	2	>2	3	5
NUMBER OF SUCKER SP.	<2	2	>2	3	5
NUMBER OF INTOLERANT SP.	<2	2	>2	3	5
PERCENT OF INDIVIDUALS AS TOLERANT	>36	36-19	<19	49.9	1
PERCENT OF INDIVIDUALS AS OMNIVORES	>44	44-23	<23	61.3	1
PERCENT OF INDIVIDUALS AS SPECIALISTS	<16	16-31	>31	26.3	3
PERCENT OF INDIVIDUALS AS PISCIVORES	<2	2-4	>4	1.1	1
CATCH RATE	<25.8	25.8-51.5	>51.5	67.5	5
PERCENT OF INDIVIDUALS AS HYBRIDS	>1	TR-1	0	0.1	3
PERCENT OF INDIVIDUALS WITH ANOMALIES	>5	5-2	<2	17.9	1
					40

IBI RANGE:	**0**	**12-22**	**28-34**	**40-44**	**48-52**	**58-60**
STREAM DESIGNATION:	**NO FISH**	**VERY POOR**	**POOR**	**FAIR**	**GOOD**	**EXCELLENT**

Table 13. Taxa list and associated biotic statistics calculated for benthic macroinvertebrates collected in Oven Creek during 1998.

OVEN CREEK	TAXA RICHNESS = 47
FIELD # 965	EPT TAXA RICHNESS = 14
EFFORT = 3 MAN HOURS	BIOCLASSIFICATION = 2.9 (FAIR-FAIR/GOOD)

			NUMBER	PERCENT
ANNELIDA				0.8
	Oligochaeta		3	
COLEOPTERA				14.8
	Dytiscidae	*Hydroporus*	10	
	Elmidae	*Dubiraphia*	14	
		Microcylloepus pusillus	1	
		Stenelmis	17	
	Haliplidae	*Peltodytes*	8	
	Helodidae		1	
	Hydrophilidae	*Berosus*	1	
		Tropisternis blatchleyi blatchleyi	1	
		Tropisternis lateralis nimbatus	1	
	Psepheniidae	*Psephenus herricki*	4	
DIPTERA				15.3
	Chironomidae		37	
	Simuliidae		17	
	Tipulidae	*Hexatoma*	2	
		Tipula	4	
EPHEMEROPTERA				10.0
	Baetidae		12	
	Caenidae	*Caenis*	2	
	Ephemeridae	*Ephemera*	5	
	Heptageniidae	*Stenacron*	15	
		Stenonema	2	
	Isonychiidae	*Isonychia*	1	
	Leptophlebiidae	*Habrophlebiodes*	2	
GASTROPODA				0.5
	Physidae		2	
HEMIPTERA				0.5
	Veliidae	*Rhagovelia obesa*	2	
HYDRACARINA			1	0.3
ISOPODA				3.6
	Asellidae	*Asellus*	6	
		Lirceus	8	
MEGALOPTERA				3.6
	Corydalidae	*Corydalus cornutus*	1	
		Nigronia serricornis	8	
	Sialidae	*Sialis*	5	
ODONATA				6.6
	Aeshnidae	*Basiaeshna janata*	1	
		Boyeria vinosa	9	
	Calopterygidae	*Calopteryx*	4	
	Coenagrionidae	*Argia*	3	
		Enallagma	2	
	Gomphidae	*Gomphus lividus*	4	
		Hagenius brevistylus	2	
		Stylogomphus albistylus	1	
PELECYPODA				1.8
	Corbiculidae	*Corbicula fluminea*	6	
	Unionidae	*Villosa iris*	1	
PLECOPTERA				1.8
	Perlidae	*Perlesta*	7	
TRICHOPTERA				40.4
	Hydropsychidae	*Ceratopsyche sparna*	1	
		Cheumatopsyche	95	
		Hydropsyche betteni/depravata	50	
	Leptoceridae	*Triaenodes*	2	
	Philopotamidae	*Chimara*	4	
	Uenoidae	*Neophylax*	6	
		TOTAL	391	

Cherokee Creek

Introduction

We conducted an IBI survey of Cherokee Creek in order to assess the relative health of the aquatic community. The stream originates near the community of Midway about 3 kilometers southwest of Johnson City. It flows in a southwesterly direction for about 15 kilometers before emptying into the Nolichucky River near river mile 83. The Agency has made no previous survey of this stream.

Study Area and Methods

Our survey of Cherokee Creek was conducted in a reach between the bridge crossings on Taylors Bridge Road and Treadway Trail. The survey site encompassed about 200 meters of stream and included all habitat types typical to this reach. The stream habitat in our survey reach was primarily characterized as a low gradient stream with few riffle/run sequences and long meandering pools. Land use in the watershed appeared to be primarily agricultural in nature with the majority of the activities revolving around beef cattle and tobacco production. The stream substrate was fairly impacted by sediment based on our visual assessment (Figure 14). Additionally, we have observed, on several occasions, heavy sediment loading during rain events.

Our evaluation of the fish community was conducted through an Index of Biotic Integrity (IBI) survey. Conducting a timed qualitative survey with kick nets was used to evaluate the benthic community. Instream habitat and riparian zone within the survey reach was visually assessed and categorized (Barbour and Stribling 1995). All sampling strategies were performed in accordance with the Tennessee Wildlife Resources Agency (TWRA) survey protocols (TWRA 1998). Analysis of the fish and benthic samples followed procedures developed by Karr et al. (1996) and Lenat (1993).

Results

We collected a total of 285 fish comprising 17 species during our IBI survey (Table 14). Two game species were collected in our survey, which included bluegill (*Lepomis macrochirus*) and the introduced redbreast sunfish (*L. auritus*). The two most dominant species collected in the survey were rosyface shiner (*Notropis rubellus*) and central stoneroller (*Campostoma anomalum*). Together these species comprised 42.4% of all fish collected in the sample. Overall, the IBI analysis associated with this survey indicated Cherokee Creek was in poor to fair condition based on the score of 36. Overall, the lack of fish in the sample and the low number of intolerant and piscivorous species in the sample had the strongest bearing in the IBI score. (Table 14).

Benthic macroinvertebrates collected in our sample comprised 22 families representing 23 identified genera (Table 15). The most abundant organisms in our survey were mayflies and caddisflies comprising 61 percent of the total sample. An overall total of 29 taxa were collected in our sample of which 9 were EPT. Based on the EPT taxa richness value and overall biotic index of all species collected, the relative health of the benthic community was classified as "fair to fair/good".

Our evaluation of the physical instream habitat and surrounding conditions of the riparian zone resulted in a mean score of 100. The derivation of this score was primarily influenced by the lack of instream cover and the above average sedimentation observed in the stream. Based on this score and our overall observations, this reach of Cherokee Creek was designated as "marginal".

Discussion

Our observations led us to conclude Cherokee Creek was in a degraded state. The main influence governing this stream was the land practices within the watershed. There appeared to be a lot of non-point source sedimentation, however, we located one point source originating from a cattle yard at a nearby dairy operation. Based on our observations, the stream did not appear to offer any significant angling opportunities.

Figure 14. Physiochemical and site location data collected on Cherokee Creek during 1998.

STREAM	CHEROKEE CREEK
WATERSHED	NOLICHUCKY RIVER
SITE	419981001
COUNTY	WASHINGTON
QUADRANGLE	ERWIN 199 NW
LAT-LONG	361217N-822920W
REACH	06010108-74.0
LENGTH	~200 m
AREA (SQ. KM.)	58.3
ELEVATION	1510 FT
DATE	9-28-98
TIME	1330

COLLECTOR(S)

R.D. BIVENS, B.D. CARTER, C.E. WILLIAMS AND NEAL BATES

1. CHANNEL CHARACTERISTICS

AVG. WIDTH	AVG. DEPTH	MAX. DEPTH
N/A	N/A	N/A

2. ESTIMATED % OF STREAM IN POOLS IS 60

3. ESTIMATED POOL SUBSTRATE (%)

SILT	SAND	GRAVEL	RUBBLE	BOULDER	BEDROCK
20	25	10	20	15	10

4. ESTIMATED RIFFLE SUBSTRATE (%)

SILT	SAND	GRAVEL	RUBBLE	BOULDER	BEDROCK
10	20	50	15	5	

5. ABUNDANCE OF LITTORAL AQUATIC PLANTS IS

NUMEROUS	AVERAGE	SCARCE
		X

6. INSTREAM COVER ABUNDANCE IS

GOOD IN	AVERAGE IN	POOR IN
10 %	30 %	60 %

7. SHADE OR CANOPY COVER GOOD OVER 60 %

8. FLOW (CFS) 16.5

COMPARED TO NORMAL: LOW	NORMAL	HIGH
	X	

9. PRESENT WEATHER

SUNNY AND HOT

10. PAST WEATHER (last 24 hrs)

SAME

11. WATER QUALITY

pH	TEMP	COND.	D.O.	% SAT.
6.8	20.5	365	N/A	N/A

12. COMMENTS

SAMPLE SITE LOCATED BETWEEN TAYLOR BRIDGE RD. X-ING AND BRIDGE X-ING ON TREADWAY TRAIL.

13. $\bar{X}$ HABITAT ASSESSMENT SCORE 100

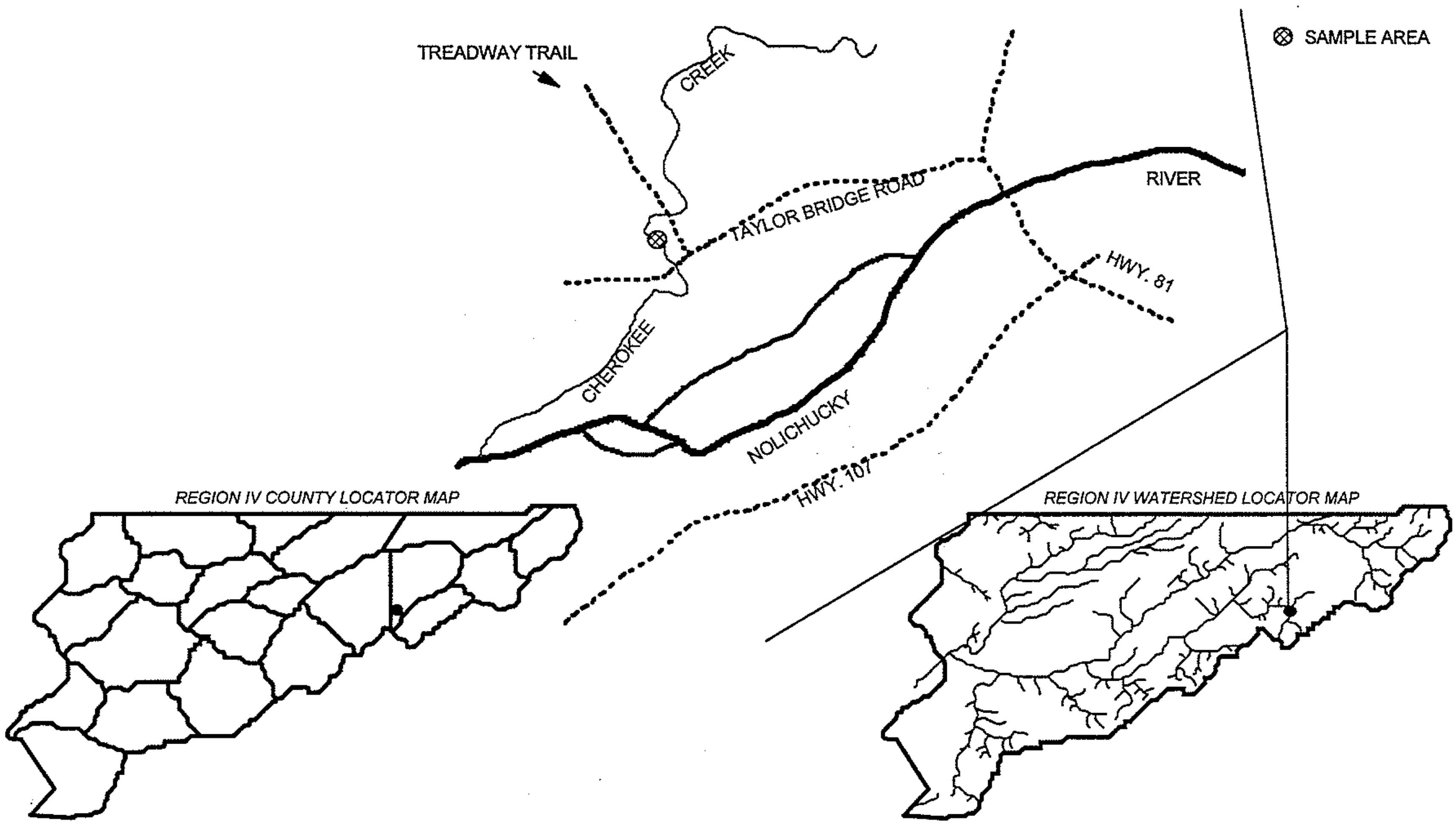


Table 14. Species list and IBI analysis for fish collected in Cherokee Creek during 1998.

SAMPLING TYPE: SEINING AND SHOCKING

GEAR TYPE: 4.5 m SEINE AND ONE BACKPACK UNIT @ 125 VAC

SPECIES	TADS CODE	NO. COLL.	RANGE(mm)	TOT. WEIGHT(g)	NOTE
Ambloplites rupestris	342	3	61-139	52	
Campostoma anomalum	45	65			
Catostomus commersoni	195	12			
Cyprinella galactura	54	10			
Cyprinella spiloptera	57	9			
Etheostoma blennoides	398	1			
Etheostoma simoterum	435	52			
Hypentelium nigricans	207	1			
Lepomis auritus	346	3	59-98	31	
Lepomis macrochirus	351	4	73-104	53	
Lepomis sp. (hybrid)	345	1	48	2	
Luxilus coccogenis	90	21			
Moxostma erythrurum	225	3			
Nocomis micropogon	110	2			
Notropis rubellus	131	56			
Notropis telescopus	138	40			
Notropis volucellus	140	1			
Semotilus atromaculatus	188	1			
	SUM:	285			

INDEX OF BIOTIC INTEGRITY

METRIC DESCRIPTION	SCORING CRITERIA 1	3	5	OBSERVED	SCORE
NUMBER OF NATIVE SP.	<10	10-19	>19	16	3
NUMBER OF DARTER SP.	<2	2	>2	2	3
NUMBER OF SUNFISH SP. *less Micropterus*	<2	2	>2	2	3
NUMBER OF SUCKER SP.	<2	2	>2	3	5
NUMBER OF INTOLERANT SP.	<2	2	>2	1	1
PERCENT OF INDIVIDUALS AS TOLERANT	>33	33-17	<17	7.8	5
PERCENT OF INDIVIDUALS AS OMNIVORES	>40	40-21	<21	23.8	3
PERCENT OF INDIVIDUALS AS SPECIALISTS	<19	19-36	>36	39.1	5
PERCENT OF INDIVIDUALS AS PISCIVORES	<2	2-4	>4	1.1	1
CATCH RATE	<21.9	21.9-43.7	>43.7	21.4	1
PERCENT OF INDIVIDUALS AS HYBRIDS	>1	TR-1	0	0.3	3
PERCENT OF INDIVIDUALS WITH ANOMALIES	>5	5-2	<2	3.9	3
					36

IBI RANGE:	**0**	**12-22**	**28-34**	**40-44**	**48-52**	**58-60**
STREAM DESIGNATION:	**NO FISH**	**VERY POOR**	**POOR**	**FAIR**	**GOOD**	**EXCELLENT**

Table 15. Taxa list and associated biotic statistics calculated for benthic macroinvertebrates collected in Cherokee Creek during 1998.

CHEROKEE CREEK		**TAXA RICHNESS = 29**		
FIELD # 1044		**EPT TAXA RICHNESS = 9**		
EFFORT = 3 MAN HOURS		**BIOCLASSIFICATION = 2.8 (FAIR-FAIR/GOOD)**		
			NUMBER	**PERCENT**
ANNELIDA				0.3
	Oligochaeta		1	
COLEOPTERA				8.8
	Elmidae	*Dubiraphia* larva and adult	27	
		Stenelmis larva	4	
	Psephenidae	*Psephenus herricki*	2	
DIPTERA				6.4
	Chironomidae		14	
	Dixidae	*Dixa*	2	
	Simuliidae		4	
	Tipulidae	*Dicranota*	1	
		Hexatoma	1	
		Tipula	2	
EPHEMEROPTERA				21.9
	Baetidae	*Baetis*	40	
	Ephemeridae	*Ephemera*	1	
	Heptageniidae	*Stenonema*	15	
	Isonychiidae	*Isonychia*	26	
GASTROPODA				1.1
	Pleuroceridae		4	
HEMIPTERA				2.4
	Corixidae		1	
	Veliidae	*Rhagovelia obesa*	8	
MEGALOPTERA				3.7
	Corydalidae	*Nigronia serricornis*	11	
	Sialidae	*Sialis*	3	
ODONATA				12.8
	Aeshnidae	*Boyeria vinosa*	17	
	Calopterygidae	*Calopteryx*	26	
	Gomphidae	*Hagenius brevistylus*	1	
		Stylurus scudderi	4	
PELECYPODA				3.2
	Corbiculidae	*Corbicula fluminea*	12	
TRICHOPTERA				39.5
	Hydropsychidae	*Ceratopsyche sparna*	4	
		Cheumatopsyche	100	
		Hydropsyche betteni/depravata	41	
		Hydropsyche rotosa	2	
	Philopotamidae	*Chimara*	1	
		TOTAL	**374**	

Pigeon River

Introduction

The Pigeon River has had a long history of pollution problems, stemming primarily from the 80+-year discharge of wastewater from the Champion Paper Mill in Canton, North Carolina. This discharge has undoubtedly had a profound effect on the recreational use of the river and after the discovery of elevated dioxin levels in the 1980's raised concerns about public health (TDEC 1996). Although the river has received increased attention in recent years, the recreational use of the river has not reached 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). Despite the continued posting of consumption advisories, the river draws a relatively substantial amount of angling pressure. Since 1988, cooperative Index of Biotic Integrity samples have been conducted at two localities near river mile 8.2 (Tannery Island) and river mile 16.6 (Denton).

Our 1998 surveys focused on collecting ototlith samples from rock bass and black bass as well as continuing our collection of catch effort data. We returned to our established sampling areas in 1998, which encompassed approximately 20.5km of river between the city of Newport and the community of Hartford. Catch effort data along with otolith samples from rock bass and black bass were collected from three sites in 1997 (Bivens et al. 1998). During 1998, a 508-mm minimum length limit with a possession limit of one fish over 508-mm was passed by the Tennessee Wildlife Resources Commission (TWRC). This regulation will be implemented during the 1999-2000 season.

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. 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 the city of Newport. Public access along the river is primarily limited to bridge crossing and small "pull-outs" along roads paralleling the river. There are a few primitive launching areas for canoes or small boats.

Between June and August 1998, we conducted five fish surveys between Tannery Island and the community of Hartford (Figure 15). 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 debri was fairly common in most of our sample areas. The river substrate was predominately boulder cobble in riffle areas and bedrock with interspersed boulders/cobble in the pool habitat. Measured channel widths ranged from 35.3 m to 64.3 m, while site lengths fell between 80 m and 869 m (Table 16). Water temperatures ranged from 17 C to 26 C and conductivity varied from 130 to 168 (Table 16).

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 all target species (black bass and rock bass). Additionally, efforts were made to identify non-target species encountered at eahc survey site. All sites were sampled during daylight hours and had survey durations ranging from 1000 to 6000 seconds. Catch-per-unit-effort (CPUE) values were calculated for each target species at each site.

Otoliths were extracted from all target fish and sent to the Nashville office for analysis. Ages were determined by viewing the transverse section of saggital otoliths submerged in water and illuminated by fiberoptic cable. Stomach contents from all black bass and rock bass were extracted and preserved on 10% formalin. Lab identification of stomach contents was made to lowest possible level and then grouped into one of six categories. These included crayfish, fish, snails, aquatic insects, terrestrial insects and other.

Length categorization indices were calculated for target species following Gabelhouse (1984). Annual mortality estimates were derived for target species whose data met the requirements described by Van Den Avyle (1993).

Results

All species of black bass and rock bass were collected from sites 1,2 and 5. At site three all species of bass were present with the exception of largemouth bass. Only smallmouth bass were collected at the Bluffton site (site 4). Smallmouth bass were the most abundant black bass species at any of the survey sites. CPUE estimates for this species averaged 16.8/hour, while the spotted bass and largemouth bass estimates were 2.1/hour and 1.6/hour, respectively (Table 17). There was a general trend of increasing catch rate for smallmouth bass from downstream to upstream (Table 17). Largemouth bass appeared to be most abundant in the lower reaches of the river, while spotted bass displayed no apparent pattern (Table 17). Rock bass CPUE varied considerably between sites and averaged 6.7/hour. The highest catch rate for this species was recorded at site 3 (15.3/hour), which was 56% above the five site average.

The majority of the smallmouth bass collected in the Pigeon River during 1998 fell within the 125 mm to 275 mm length range (Figure 16). Our data indicated that fish under 100 mm, were for the most part, not vulnerable to the sampling gear. Length categorization analysis indicated the Relative Stock Density (RSD) for preferred smallmouth bass (TL $\geq$ 350 mm) was 20. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass was 0. The ratio of quality (TL $\geq$ 280 mm) smallmouth bass to stock size bass (TL $\geq$ 180 mm) was 60. Catch per unit effort estimates by RSD category indicated smallmouth bass had the highest catch rates of any of the black bass species collected for the category RSD-Q and above (Figure 17). Overall, growth rates for smallmouth were consistent or slightly lower than the statewide average for age groups represented in the 1998 sample (Figure 18). Stomach content analysis from smallmouth bass collected in the Pigeon River during 1998 indicated a strong reliance on aquatic insects for age-0 bass (Figure 19). As fish matured, the diet shifted, and was comprised primarily of crayfish and fish for bass ages 2 and older, although insects (aquatic and terrestrial) continued to play a role in the diet of this species (Figure 19). Based on the 1998 data, the mortality estimate that was calculated for smallmouth bass ages 2-5 was about 30%.

The majority of the spotted bass collected in the Pigeon River during 1998 fell within the 125 mm to 200 mm length range (Figure 16). Our data indicated that fish under 100 mm, were for the most part, not effectively sampled. Length categorization analysis indicated the RSD for preferred spotted bass (TL $\geq$ 350 mm) was 25. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass was 0. The ratio of quality (TL $\geq$ 280 mm) spotted bass to stock size bass (TL $\geq$ 180 mm) was 37.5. Catch per unit effort estimates by RSD category revealed very few spotted bass above the RSD-S category, indicating a relative lack of larger fish available to anglers (Figure 17). Overall, growth rates for spotted bass were slightly lower for ages 1-3 when compared to the statewide average (Figure 18). Growth for spotted bass beyond age 3, approximated the values reported for the statewide average. Stomach content analysis from spotted bass collected in the Pigeon River during 1998 indicated a strong reliance on crayfish for all ages of bass in the sample, although insects (aquatic and terrestrial) seemed to be important to bass between the ages of 2 and 3 (Figure 20). The number of spotted bass taken in 1998 did not meet the requirements of the regression analysis used to calculate annual mortality. Therefore, an estimate was not calculated.

Largemouth bass collected in the Pigeon River during 1998 fell within the 200 mm to 300 mm length range (Figure 16). Length categorization analysis indicated the RSD for preferred largemouth bass (TL $\geq$ 380 mm) was 20. RSD for memorable (TL $\geq$ 510 mm) and trophy (TL $\geq$ 630 mm) size largemouth bass was 0. The ratio of quality (TL $\geq$ 300 mm) largemouth bass to stock size bass (TL $\geq$ 200 mm) was 60. The catch rate for largemouth bass in RSD-Q and above were slightly higher than those observed for spotted bass (Figure 17). Overall, growth rates for largemouth bass were slightly higher for ages 1 and 2 when compared to the statewide average (Figure 18). Mean annual growth of largemouth bass beyond age two was similar to the statewide average. Stomach content analysis from largemouth bass collected in the Pigeon River during 1998 indicated a strong reliance on aquatic insects for age-0 bass (Figure 21). As fish matured, the diet shifted, and was comprised primarily of crayfish and fish for bass ages 2 and older. Food items other than fish or crayfish were non-existant in our stomach samples from bass ages 3-5 (Figure 21). No annual mortality estimate was calculated for largemouth bass due to the low number of individuals in our sample.

Individuals in the 125 mm to 200 mm range represented the majority of rock bass in our sample (Figure 16). Length categorization analysis indicated the RSD for preferred rock bass (TL $\geq$ 230 mm) was 2.8. RSD for memorable (TL $\geq$ 280 mm) and trophy (TL $\geq$ 330 mm) size rock bass was 0. The ratio of quality (TL $\geq$ 180 mm) rock bass to stock size rock bass (TL $\geq$ 100 mm) was 22.2. Annual growth rates for rock bass collected in the 1998 sample approximated those reported for the statewide average (Figure 18). Stomach content analysis from rock bass collected in the Pigeon River during 1998 indicated a strong reliance on aquatic insects for age-1 rock bass (Figure 22). As fish matured, the diet shifted, and crayfish became a more important component for rock bass ages 2 and older (Figure 22). Unlike the black bass collected, both terrestrial and aquatic insects remained a significant component of the diet for all ages of rock bass beyond age 1 (Figure 22). Due to the low sample size no annual mortality estimate was calculated.

Several other species were collected or observed (48) during our survey of the Pigeon River. A list of species occurrence by site can be found in Table 18.

Discussion

The Pigeon River provides anglers with the opportunity to catch all species of black bass and rock bass. Perhaps the greatest potential for elevating this fishery to "trophy" status lies in the smallmouth bass population. Given that a fair percentage of smallmouth bass are reaching the preferred category and that these fish are growing slightly slower than the statewide average, there would appear to be potential for managing the smallmouth bass population in this river. With the implementation of the new regulation during the 1999-2000 season, shifts in the smallmouth bass population structure may be forthcoming.

Currently we have no angler use/harvest data on the river to aid in evaluating this new regulation. However, through the use of computer models and continued monitoring of the fishery through electrofishing we should be able to detect any significant changes in the fishery.

Surveys on the Pigeon River will be conducted on an annual basis in order to assess any changes in the fishery that may result from the new regulation. We are considering adding an additional downstream site to our sampling regime in order to add to our sample size and evaluate the fish community structure in this portion of the river. Development and implementation of an angler use survey would be beneficial in determining exploitation rates and aid in evaluating any population effects resulting from the new regulation.

Figure 15. Site locations for samples conducted on the Pigeon River during 1998.

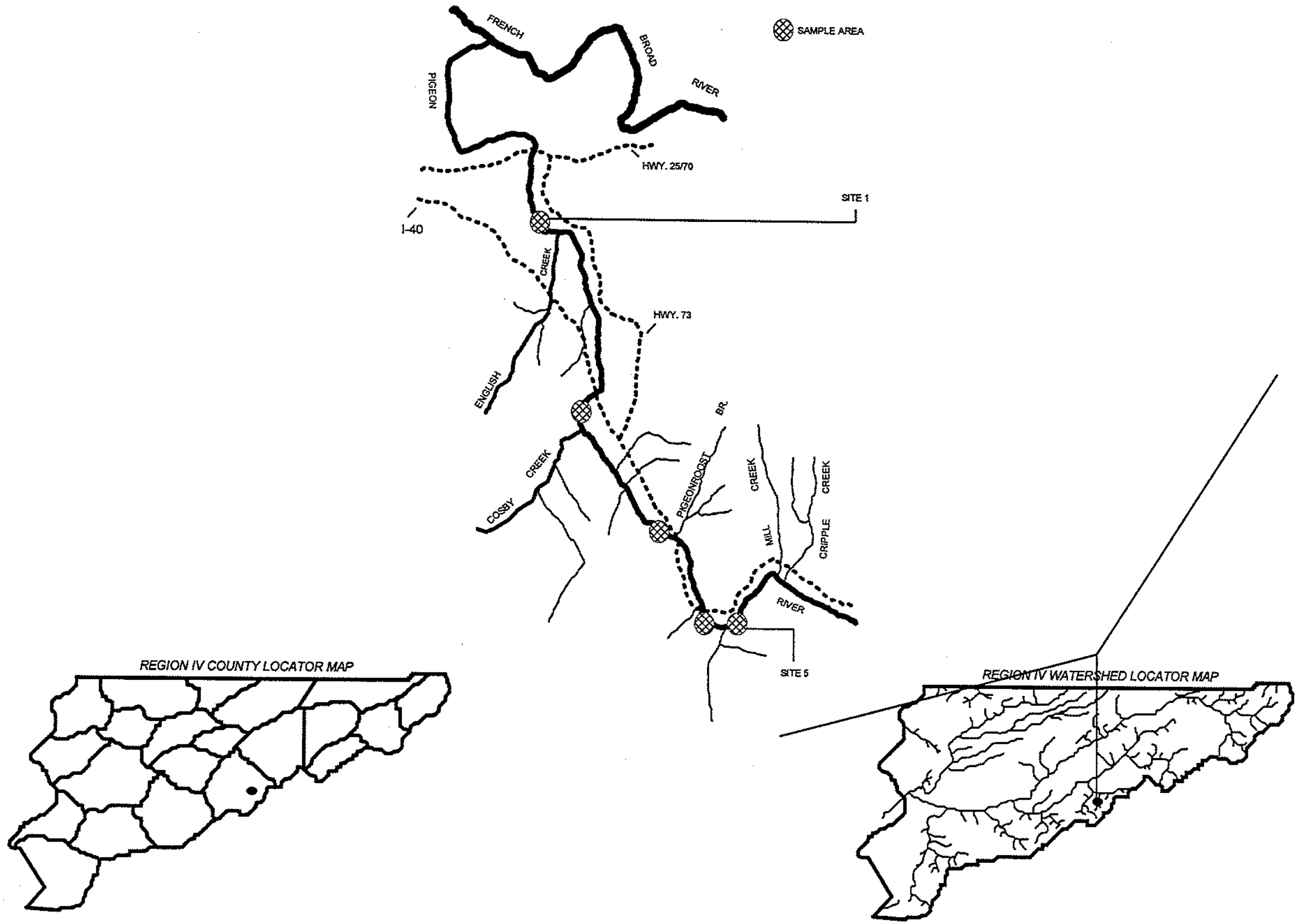


Table 16. Physiochemical and site location data for samples conducted on the Pigeon River during 1998.

SITE CODE	DATE	COUNTY(S)	QUADRANGLE	COORDINATES	RIVER MILE	MEAN WIDTH (m)	LENGTH (m)	ECCHI (m	TEMPERATURE (C)	CONDUCTIVITY
419980701	8/7/98	COCKE	NEWPORT 173NW	355633N/831043W	8.2	N/A	N/A	N/A	N/A	N/A
419980702	6/29/98	COCKE	NEWPORT 173NW	355322N/831147W	13.0	64.3	869	N/A	26.0	168
419980703	8/7/98	COCKE	HARTFORD 173SW	355039N/831104W	16.6	N/A	N/A	N/A	N/A	N/A
419980704	6/29/98	COCKE	HARTFORD 173SW	354847N/831041W	19.0	35.3	80	N/A	17.0	130
419980705	6/29/98	COCKE	HARTFORD 173SW	354849N/830945W	20.5	47.3	839	N/A	22.5	130

Table 17. Catch per unit effort and length-categorization indices of target species collected at five sites on the Pigeon River during 1998.

SITECODE	SMALLMOUTH BASS CPUE (#/HOUR)	SPOTTED BASS CPUE (#/HOUR)	LARGEMOUTH BASS CPUE (#/HOUR)	ROCK BASS CPUE (#/HOUR)
419980701	3.1	1.2	0.6	4.3
419980702	8.4	3	6.1	8.4
419980703	16.9	5.3	0	15.3
419980704	33.3	0	0	0
419980705	22.2	1.1	1.1	5.5
MEAN	16.8	2.1	1.6	6.7
STD. DEV.	11.8	2.1	2.6	5.7
	LENGTH-CATEGORIZATION ANALYSIS	**LENGTH-CATEGORIZATION ANALYSIS**	**LENGTH-CATEGORIZATION ANALYSIS**	**LENGTH-CATEGORIZATION ANALYSIS**
	PSD = 60	PSD = 37.5	PSD = 60	PSD = 22.2
	RSD-PREFERRED = 20	RSD-PREFERRED = 25	RSD-PREFERRED = 20	RSD-PREFERRED = 2.8
	RSD-MEMORABLE = 0	RSD-MEMORABLE = 0	RSD-MEMORABLE = 0	RSD-MEMORABLE = 0
	RSD-TROPHY = 0	RSD-TROPHY = 0	RSD-TROPHY = 0	RSD-TROPHY = 0

* sitecodes are listed form downstream to upstream

Figure 16 . Length frequency distributions for black bass and rock bass collected in the Pigeon River during 1998.

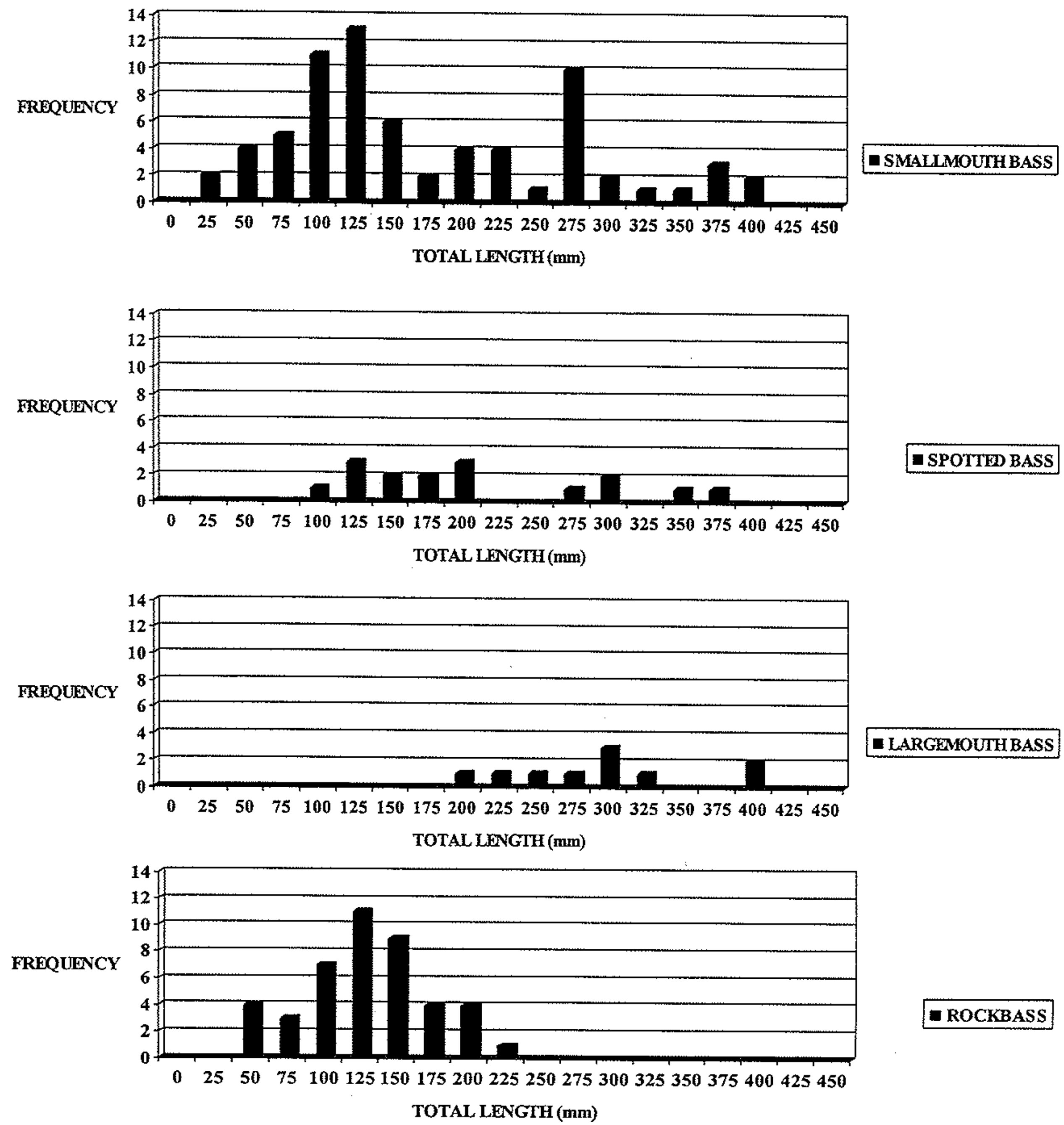
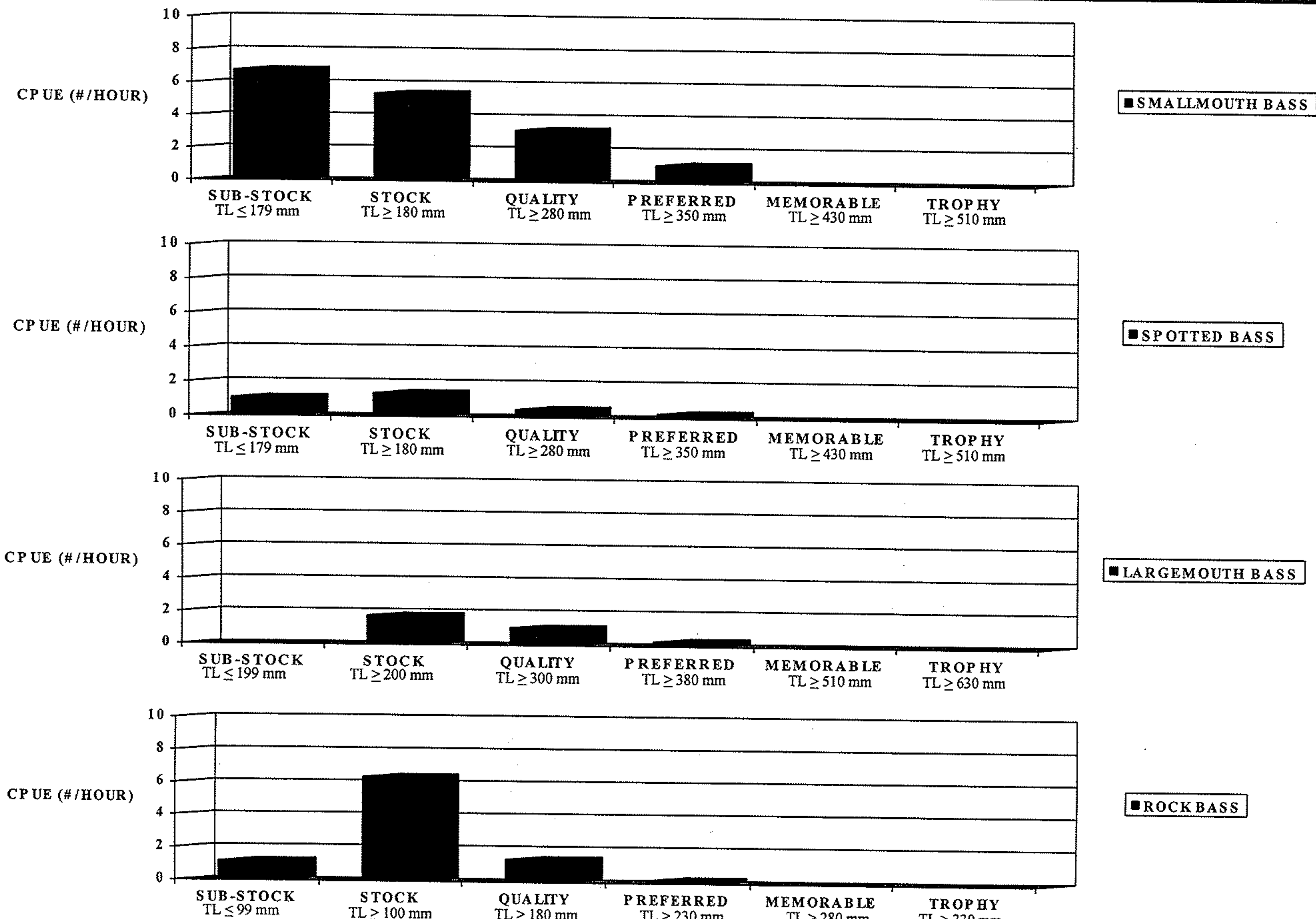


Figure 17. Relative stock density (RSD) catch per unit effort by category* for black bass and rock bass collected in the Pigeon River during 1998.



* Length categories after Gabelhouse (1984)

Figure 18. Mean length at age for black bass and rock bass collected in the Pigeon River during 1998. Statewide mean based on 1995-98 data (TWRA, unpublished data).

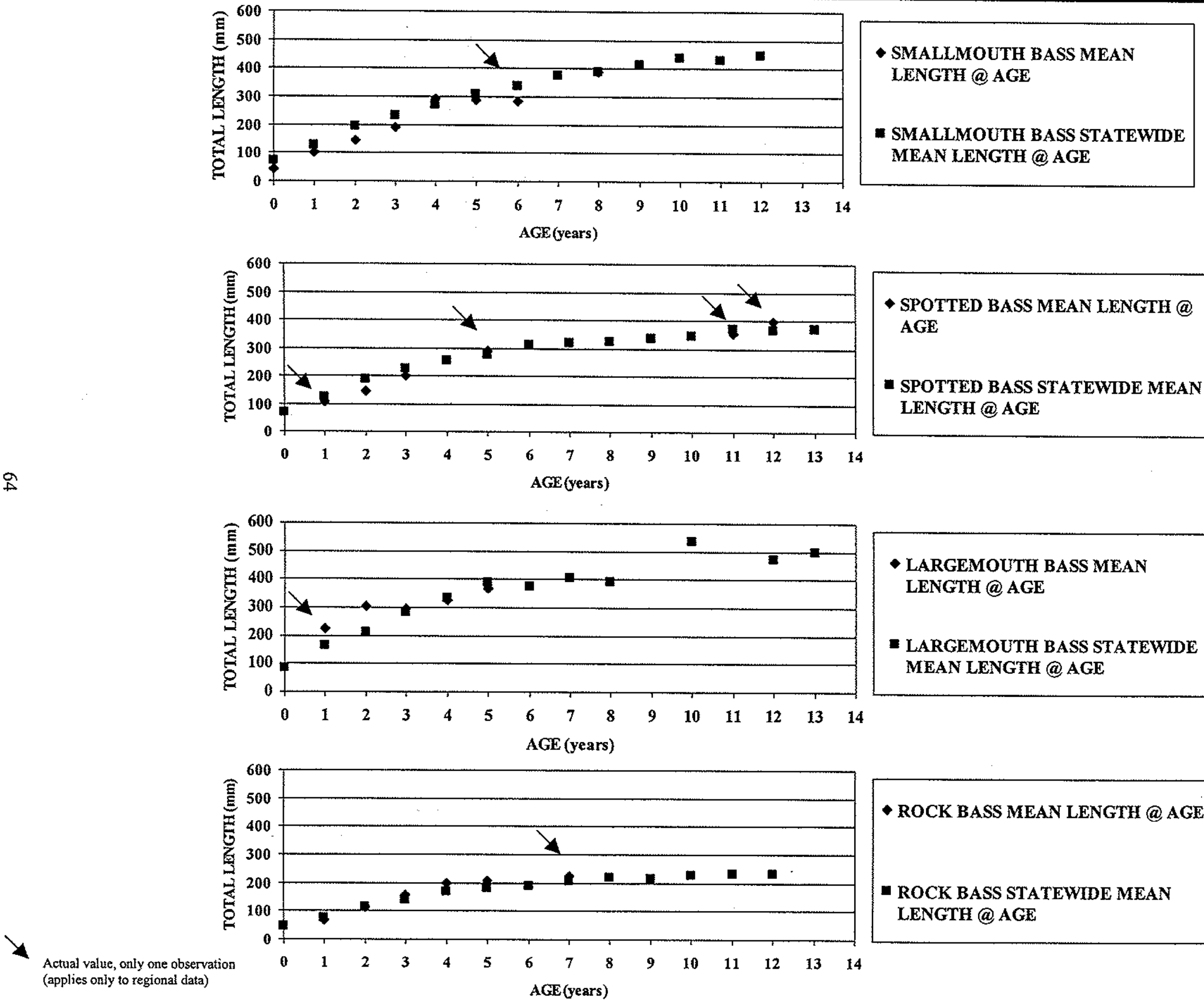


Figure 19. Percent occurrence of identified food items consumed by various ages of smallmouth bass collected in the Pigeon River during 1998.

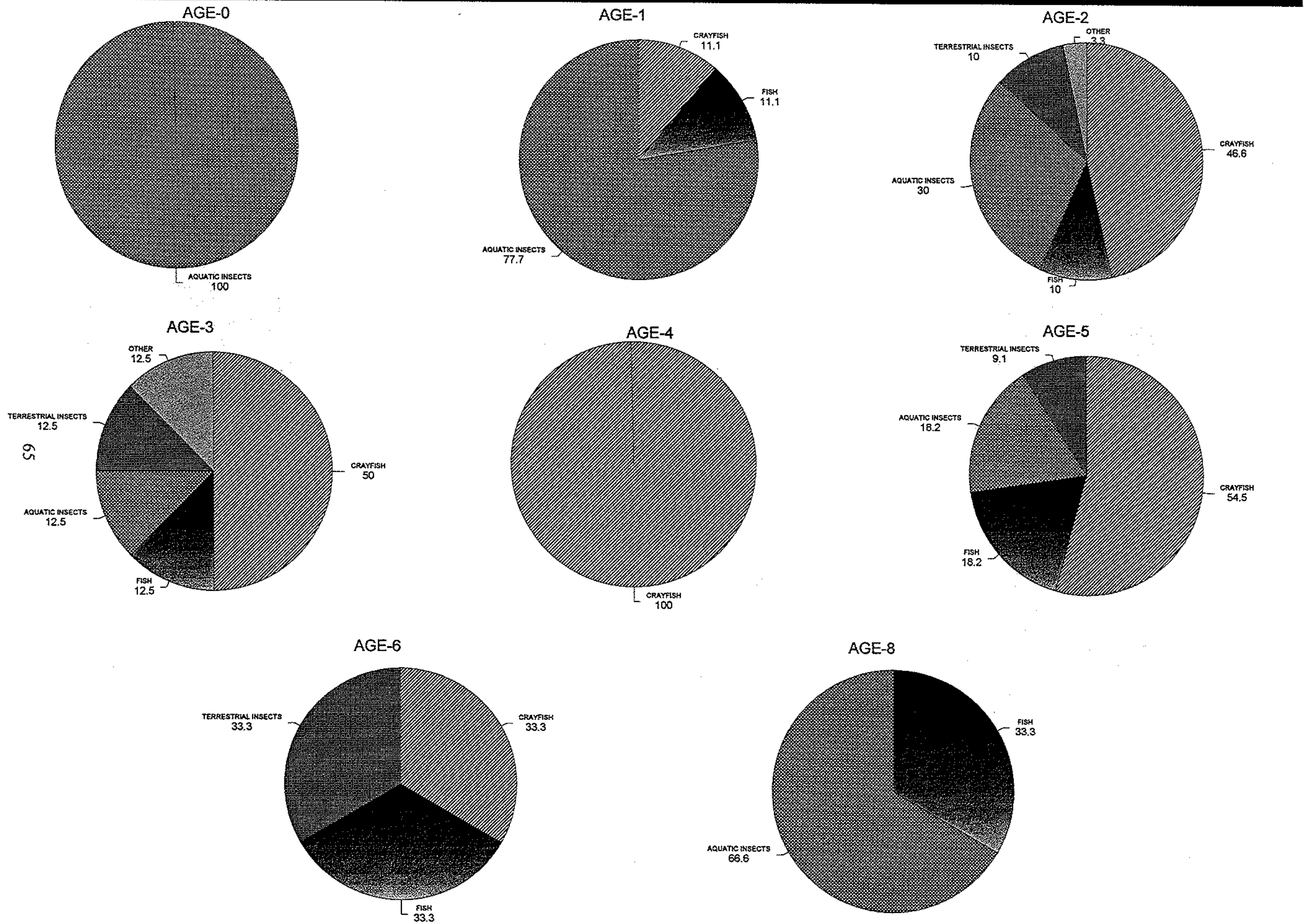


Figure 20. Percent occurrence of identified food items consumed by various ages of spotted bass collected in the Pigeon River during 1998.

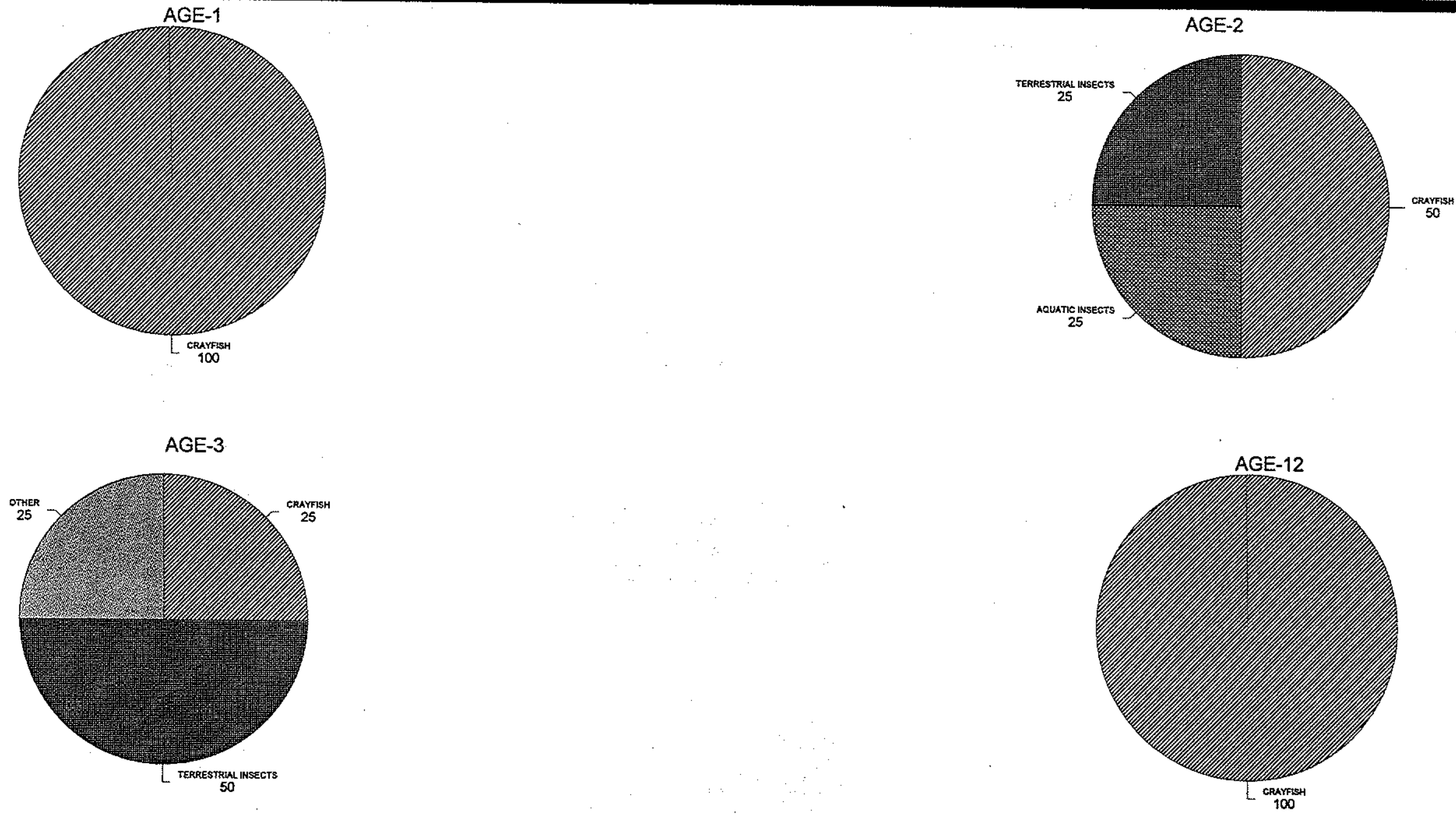


Figure 21. Percent occurrence of identified food items consumed by various ages of largemouth bass collected in the Pigeon River during 1998.

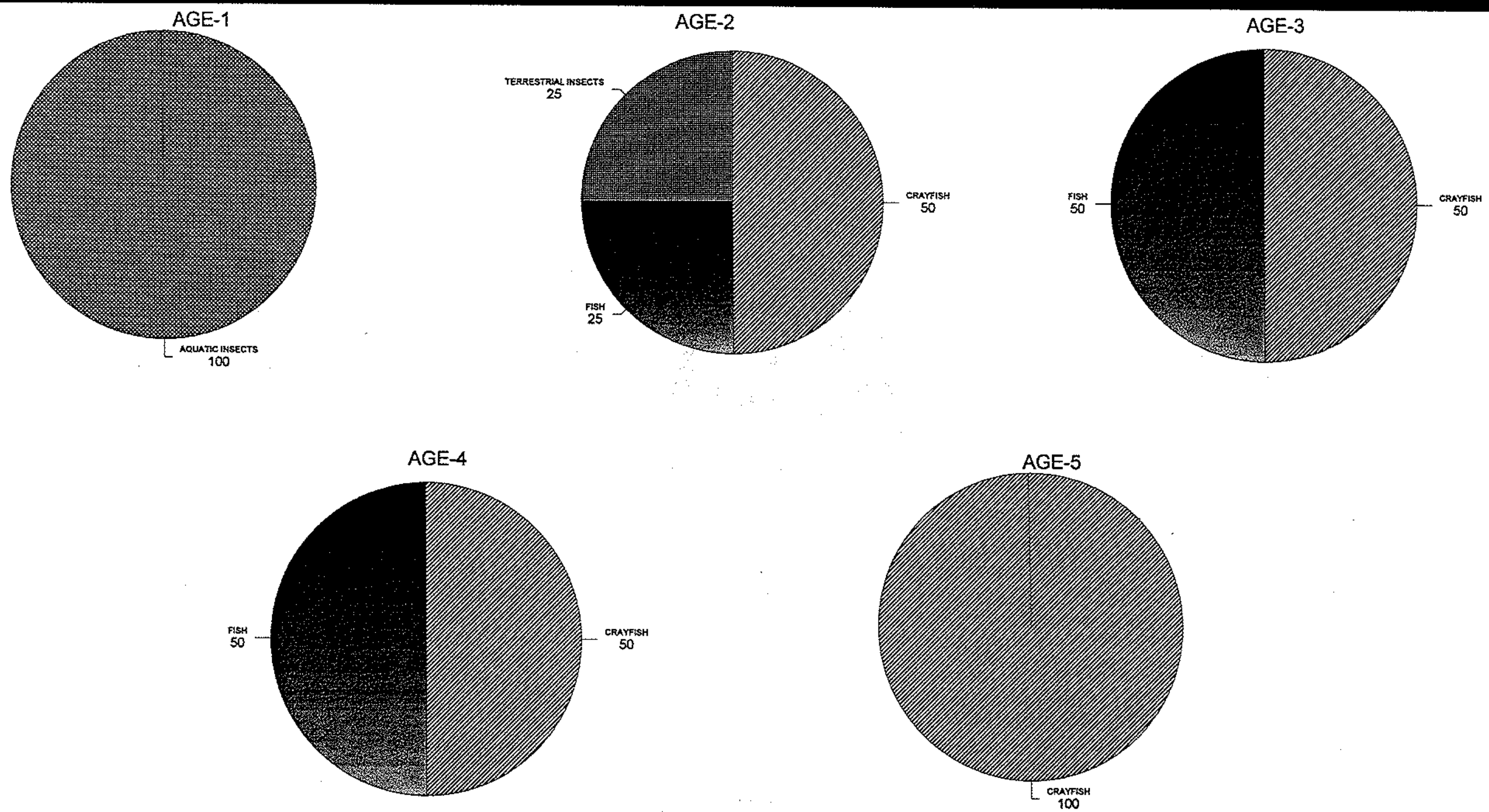


Figure 22. Percent occurrence of identified food items consumed by various ages of rock bass collected in the Pigeon River during 1998.

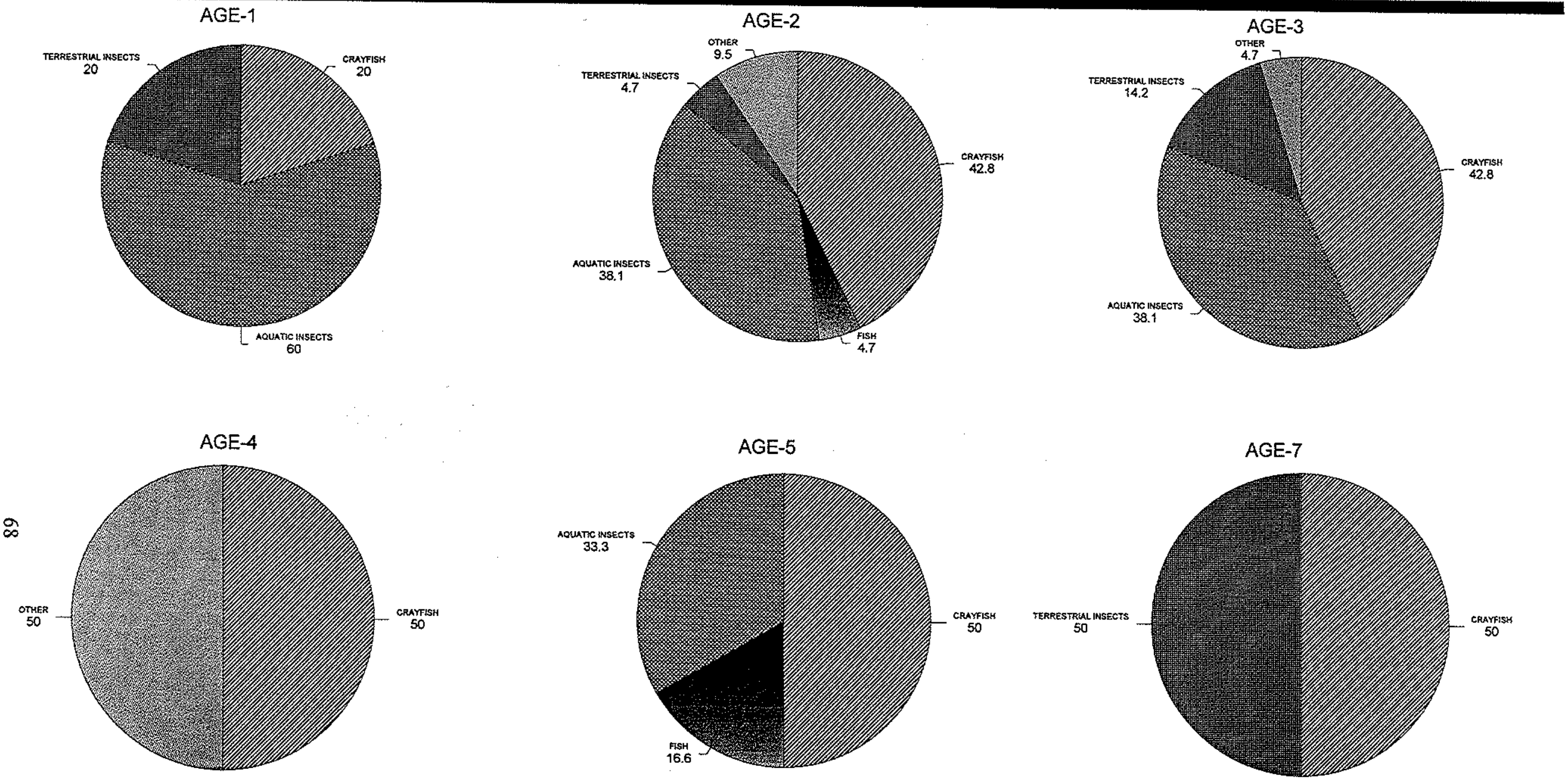


Table 18. Distribution of fish species collected in the Pigeon River during 1998.

	PIGEON RIVER MILE →		8.2	13.0	16.6	19.0	20.5
	SAMPLE TYPE →		IBI/CPUE SURVEY	CPUE SURVEY	IBI/CPUE SURVEY	CPUE SURVEY	CPUE SURVEY
	SITE CODE →		419980701	419980702	419980703	419980704	419980705
FAMILY	SCIENTIFIC NAME	STATUS*					
CATOSTOMIDAE	*Carpiodes carpio*		●				
	Carpiodes cyprinus		●				
	Catostomus commersoni						●
	Hypentelium nigricans		●	●	●	●	●
	Ictiobus bubalus		●	●	●	●	●
	Ictiobus niger		●	●	●		
	Moxostoma anisurum		●				
	Moxostoma carinatum		●	●			
	Moxostoma duquesnei		●	●	●	●	●
	Moxostoma erythrurum		●	●			●
	Moxostoma macrolepidotum		●	●			
CENTRARCHIDAE	*Ambloplites rupestris*		●	●	●		
	Lepomis auritus		●	●	●	●	
	Lepomis cyanellus				●		
	Lepomis macrochirus		●	●	●		●
	Lepomis gulosus		●				
	Micropterus dolomieu		●	●	●	●	●
	Micropterus punctulatus		●	●	●		●
	Micropterus salmoides		●	●			●
	Pomoxis annularis			●	●	●	●
	Pomoxis nigromaculatis		●	●	●		
CLUPEIDAE	*Dorosoma cepedianum*		●	●	●	●	●
COTTIDAE	*Cottus carolinae*		●		●	●	●
CYPRINIDAE	*Campostoma anomalum*		●		●	●	
	Cyprinella galactura		●		●	●	●
	Cyprinus carpio		●	●			●
	Hybopsis amblops		●		●		●
	Nocomis micropogon		●				
	Notropis leuciodus				●		
	Notropis photogenis		●		●		●
	Notropis rubellus		●				
	Notropis telescopus				●		
	Phenacobius crassilabrum				●		
	Rhinichthys cataractae		●		●		
ICTALURIDAE	*Ameiurus natalis*						●
	Ictalurus punctatus		●	●			●
PERCIDAE	*Etheostoma blennioides*		●		●		
	Etheostoma b. gutselli	SE				●	
	Etheostoma rufilineatum		●		●		
	Etheostoma simoterum		●		●		●
	Etheostoma swannanoa				●		
	Percina caprodes		●	●	●	●	●
	Stizostedion canadense		●		●	●	●
	Stizostedion vitreum		●				
PETROMYZONTIDAE	*Ichthyomyzon bdellium*		●				
	Ichthyomyzon sp.			●			
SALMONIDAE	*Oncorhynchus mykiss*				●	●	
SCIAENIDAE	*Aplodinotus grunniens*		●	●	●	●	

* FE = FEDERALLY ENDANGERED, FT = FEDERALLY THREATENED, ST = STATE THREATENED, INM = IN NEED OF MANAGEMENT, SE = STATE ENDANGERED

North Fork Holston River

Introduction

The North Fork Holston River has a reputation of being one of the regions best riverine smallmouth bass fisheries. This is supported by frequent reports of quality size smallmouth bass being caught in the 8.3 kilometer section between the TN/VA line and the confluence with the South Fork Holston River near Kingsport. Our interest in surveying the short reach that flows through Tennessee, was to gather data that would characterize the growth and longevity of smallmouth bass and rock bass and to begin compiling baseline catch per unit effort (CPUE) estimates on these populations. The Agency has conducted a limited surveys (1 site each) of the river in 1989 and 1997 (Bivens and Williams 1990, Bivens et al. 1998).

Study Area and Methods

The North Fork Holston River originates in Virginia and flows in a southwesterly direction before emptying into 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 crossing and small "pull-outs" along roads paralleling the river. There are a few primitive launching areas for canoes or small boats.

During July 1998, six fish surveys were conducted on the North Fork between the TN/VA line and its confluence with the South Fork (Figure 23). The riparian habitat along this reach consisted 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 19). Water temperatures ranged from 26 C to 29 C and conductivity varied from 470 to 520 (Table 19).

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 (*Micropterus dolomieu*) and rock bass (*Ambloplites rupestris*). Efforts were made at each sample site to identify and compile a species list of non-target species.

All sites were sampled during daylight hours and had survey durations ranging from 1613 to 4695 seconds. CPUE values were calculated for each target species at each site.

Otoliths were extracted from all target fish and sent to the Nashville office for analysis. Ages were determined by viewing the transverse section of saggital otoliths submerged in water and illuminated by fiberoptic cable. Stomach contents from all smallmouth bass and rock bass were extracted and preserved in 10% formalin. Lab identification of stomach contents was made to the lowest possible level and then grouped into one of six categories. These included crayfish, fish, snails, aquatic insects, terrestrial insects and other.

Length categorization indices were calculated for target species following Gabelhouse (1984). Annual mortality estimates were derived for target species whose data met the requirements described by Van Den Avyle (1993).

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 24.9/hour (Table 20). Sites 4 and 6 had the highest catch rates of the six sites sampled and were about 20% higher than the six site average. We feel that this could be related to the higher occurrence of perpendicular/parallel bedrock shelves (and subsequent troughs) in these sites, which appeared to be, preferred habitat (smallmouth would hold in deeper water troughs just below or to the side of bedrock shelves). Rock bass were generally more abundant than other game species encountered in our survey areas and had an average CPUE of 36.8 (Table 20). The sites where the catch rates were highest usually had at least one shoreline that had good boulder cover. There was no discernable trend from downstream to upstream in the catch of either species.

The majority of the smallmouth bass collected in the Pigeon River during 1998 fell within the 125 mm to 275 mm length range (Figure 24). Our data indicates fish under 125 mm were not vulnerable to the sampling gear. Length categorization analysis indicated the Relative Stock Density (RSD) for preferred smallmouth bass (TL $\geq$ 350 mm) was 9.5. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass was 1.4 and 0, respectively. The ratio of quality (TL $\geq$ 280 mm) smallmouth bass to stock size bass (TL $\geq$ 180 mm) was 40.5. Catch per unit effort estimates by RSD category indicated the majority of the catch was in the RSD-S with good recruitment to the RSD-Q (Figure 25). Overall, annual growth rates for smallmouth bass mirrored those reported for the statewide average (Figure 26). Stomach content analysis from smallmouth bass collected in the North Fork Holston River during 1998 indicated a strong reliance on aquatic insects for age-1 bass (Figure 27). As fish matured, the diet shifted, and was comprised primarily of crayfish and fish for bass ages 2 and older, although insects (aquatic and terrestrial) continued to play a substantial role in the diet through age 4

(Figure 27). One unusual occurrence that was noted, was the higher frequency of snails in the stomach contents of smallmouth bass from the North Fork. This was unique among the three large rivers sampled in 1998 and appeared to a stable diet component for bass ages 2-5. The mortality estimate that was calculated for smallmouth bass ages 2-6 was about 25%.

Individuals in the 125 mm to 175 mm range represented the majority of rock bass in our sample (Figure 24). Length categorization analysis indicated the RSD for preferred rock bass (TL ≥ 230 mm) was 1.4. 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 27.3. Catch data by RSD category revealed a high number of rock bass in the RSD-S category with somewhat poor recruitment into the RSD-Q and RSD-P categories. Annual growth rates for rock bass collected in the 1998 sample approximated those reported for the statewide average (Figure 26). Stomach content analysis from rock bass collected in the North Fork Holston River during 1998 indicated a strong reliance on aquatic and terrestrial insects for rock bass ages 1-2 (Figure 28). As fish matured, the diet shifted, and crayfish became a more important component for rock bass ages 3 and older (Figure 28). Unlike the smallmouth bass collected, both terrestrial and aquatic insects remained a significant component of the diet for most ages of rock bass (Figure 28). The annual mortality rate calculated for rock bass ages 3-5 was about 45%.

Several other species were collected or observed (30) during our survey of the North Fork Holston River including the federally threatened spotfin chub *(Cyprinella monacha)*. A list of species occurrence by site can be found in Table 21.

Discussion

The North Fork Holston River provides anglers with the opportunity to catch substantial numbers of quality size smallmouth bass and to a lesser extent rock bass. Based on the length categorization analysis for smallmouth bass it appears the recruitment of memorable size smallmouth bass (TL ≥ 430 mm) was greatest in this river when compared to the other two large river samples taken during 1998. This may indicate a higher potential for the development of a trophy fishery in this river.

Surveys on the North Fork Holston River will be conducted on a five year rotation order to assess any changes in the fishery. Development and implementation of an angler use survey would be beneficial in determining exploitation rates and aid in evaluating any population effects resulting from angling.

Figure 23. Site locations for samples conducted on North Fork Holston River during 1998.

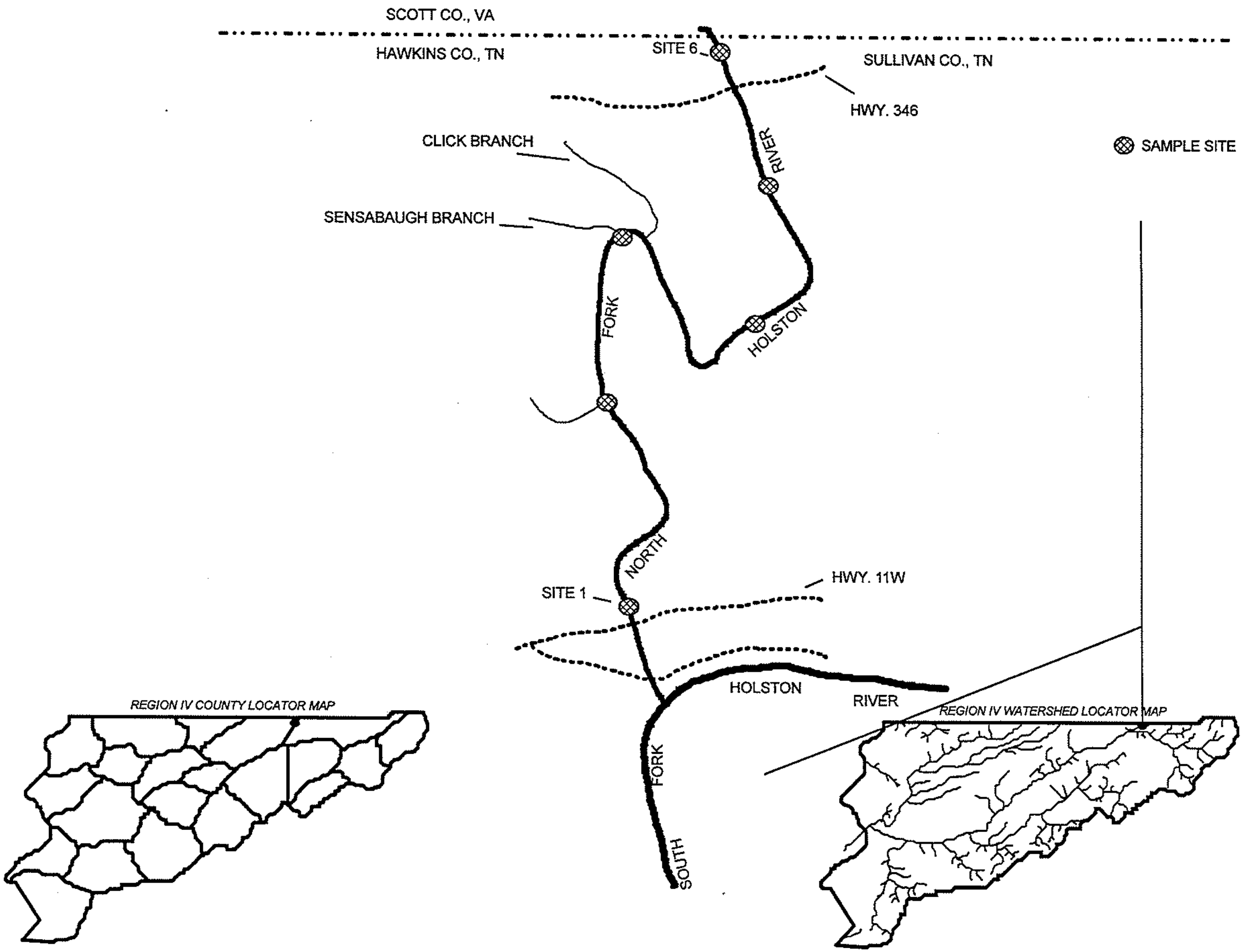


Table 19. Physiochemical and site location data for samples conducted on the North Fork Holston River during 1998.

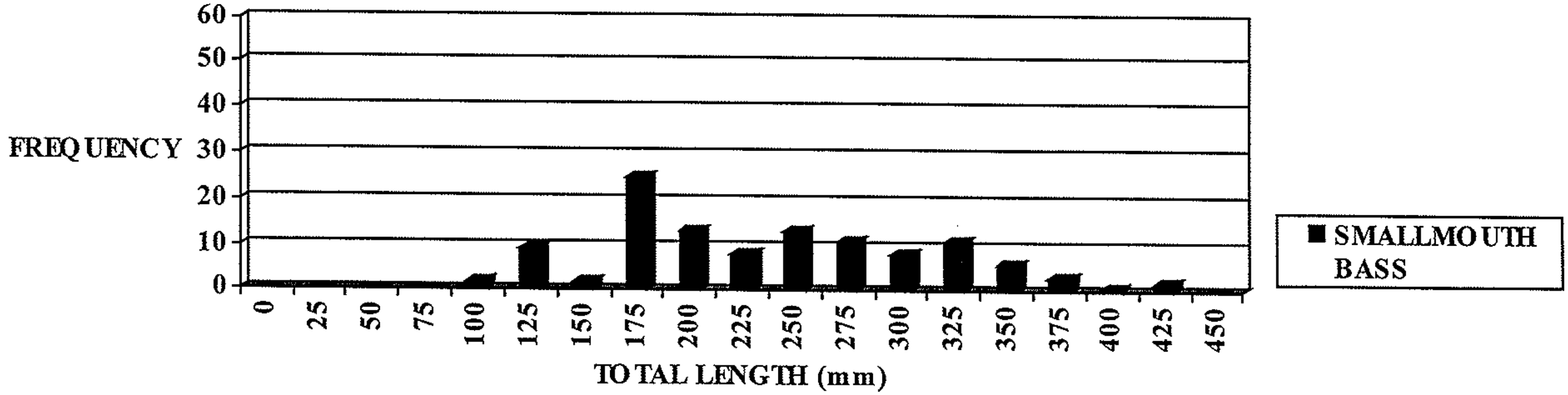
SITE CODE	DATE	COUNTY(S)	QUADRANGLE	COORDINATES	RIVER MILE	MEAN WIDTH (m)	LENGTH (m)	SECCHI (m)	TEMPERATURE (C)	CONDUCTIVITY
419980801	7/14/98	HAWKINS/SULLIVAN	KINGSPORT 188SE	363329N/823657W	0.8	68.3	293	N/A	26.0	510
419980802	7/14/98	HAWKINS/SULLIVAN	KINGSPORT 188SE	363412N/823703W	2.0	54.4	1158	N/A	26.0	510
419980803	7/13/98	HAWKINS/SULLIVAN	KINGSPORT 188SE	363450N-823649W	2.7	48.3	518	N/A	29.0	520
419980804	7/13/98	HAWKINS/SULLIVAN	KINGSPORT 188SE	363429N/823609W	4.0	45.2	1325	N/A	28.0	500
419980805	7/13/98	HAWKINS/SULLIVAN	KINGSPORT 188SE	363509N/823616W	4.4	52.0	953	N/A	26.8	500
419980806	7/13/98	HAWKINS/SULLIVAN	KINGSPORT 188SE	363539N/823632W	5.0	58.0	250	N/A	26.0	470

Table 20. Catch per unit effort and length-categorization indices of target species collected at six sites on the North Fork Holston River during 1998.

SITECODE	SMALLMOUTH BASS CPUE (#/HOUR)	ROCK BASS CPUE (#/HOUR)
419980801	24	22
419980802	29.2	36.9
419980803	10	45
419980804	30	10
419980805	26	42
419980806	30	65
MEAN	24.9	36.8
STD DEV	7.7	19
	LENGTH-CATEGORIZATION ANALYSIS PSD = 40.5 RSD-PREFERRED = 9.5 RSD-MEMORABLE = 1.4 RSD-TROPHY = 0	**LENGTH-CATEGORIZATION ANALYSIS** PSD = 27.3 RSD-PREFERRED = 1.4 RSD-MEMORABLE = 0 RSD-TROPHY = 0

* sitecodes are listed from downstream to upstream

Figure 24. Length frequency distributions for smallmouth bass and rock bass collected in the North Fork Holston River during 1998.



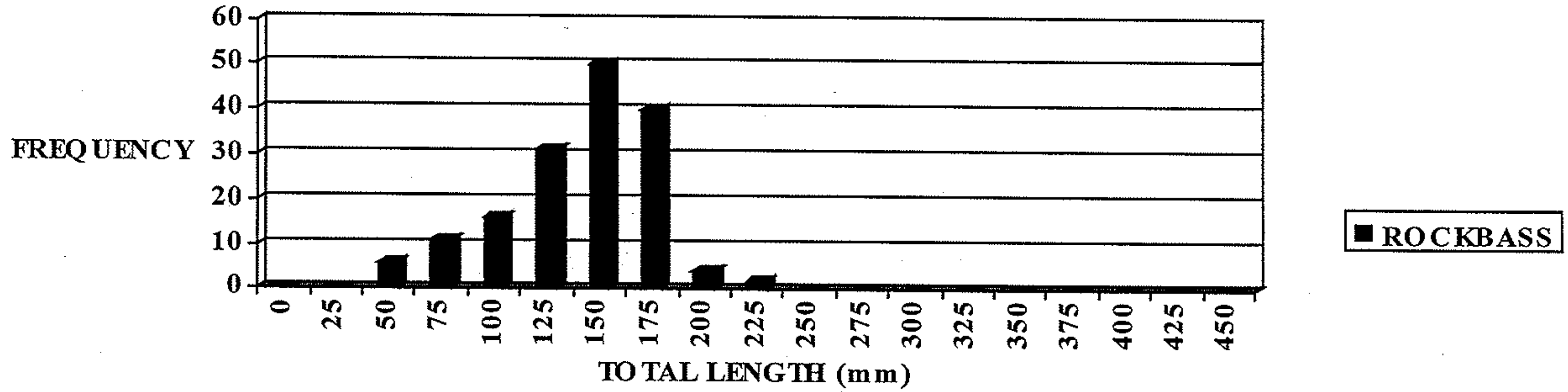
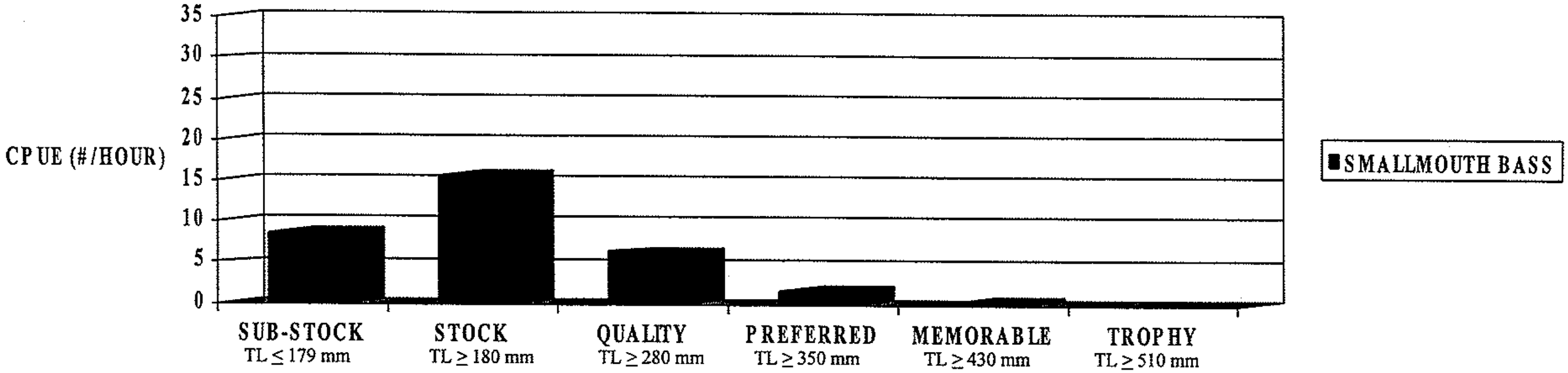
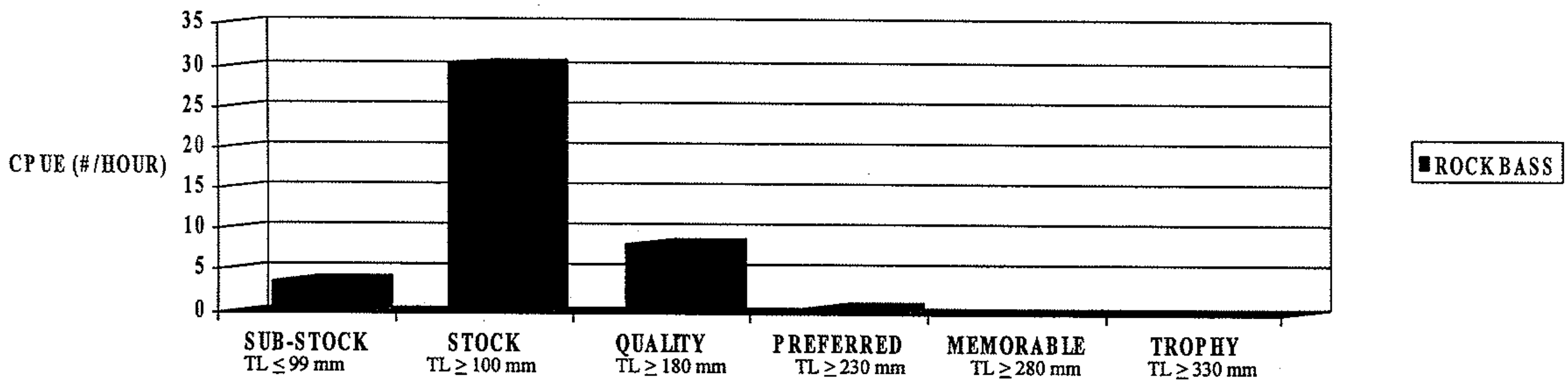


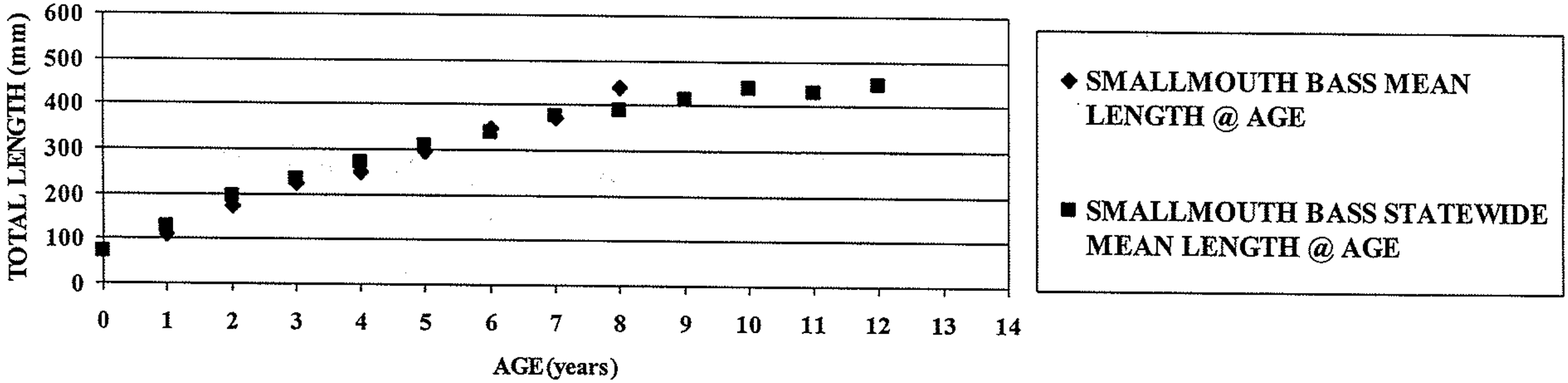
Figure 25. Relative stock density (RSD) catch per unit effort by category* for smallmouth bass and rock bass collected in the North Fork Holston River during 1998.

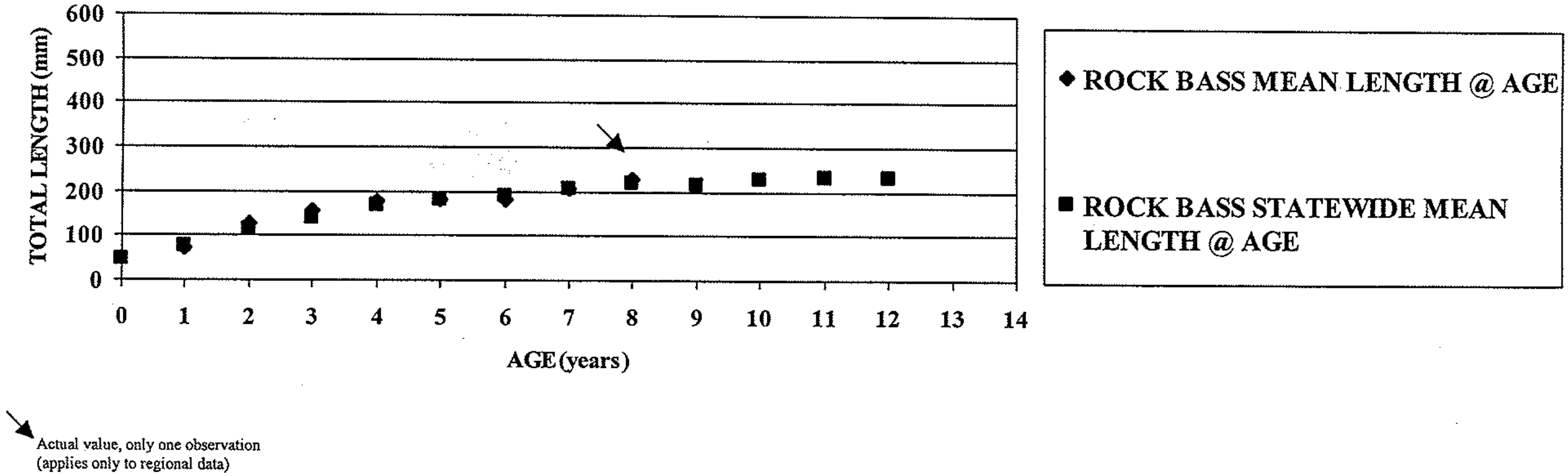




* Length categories after Gabelhouse (1984)

Figure 26. Mean length at age for smallmouth bass and rock bass collected in the North Fork Holston River during 1998. Statewide mean based in 1995-98 data (TWRA, unpublished data).





'igure 27. Percent occurrence of identified food items consumed by various ages of smallmouth bass collected in the North Fork Holston River during 1998.

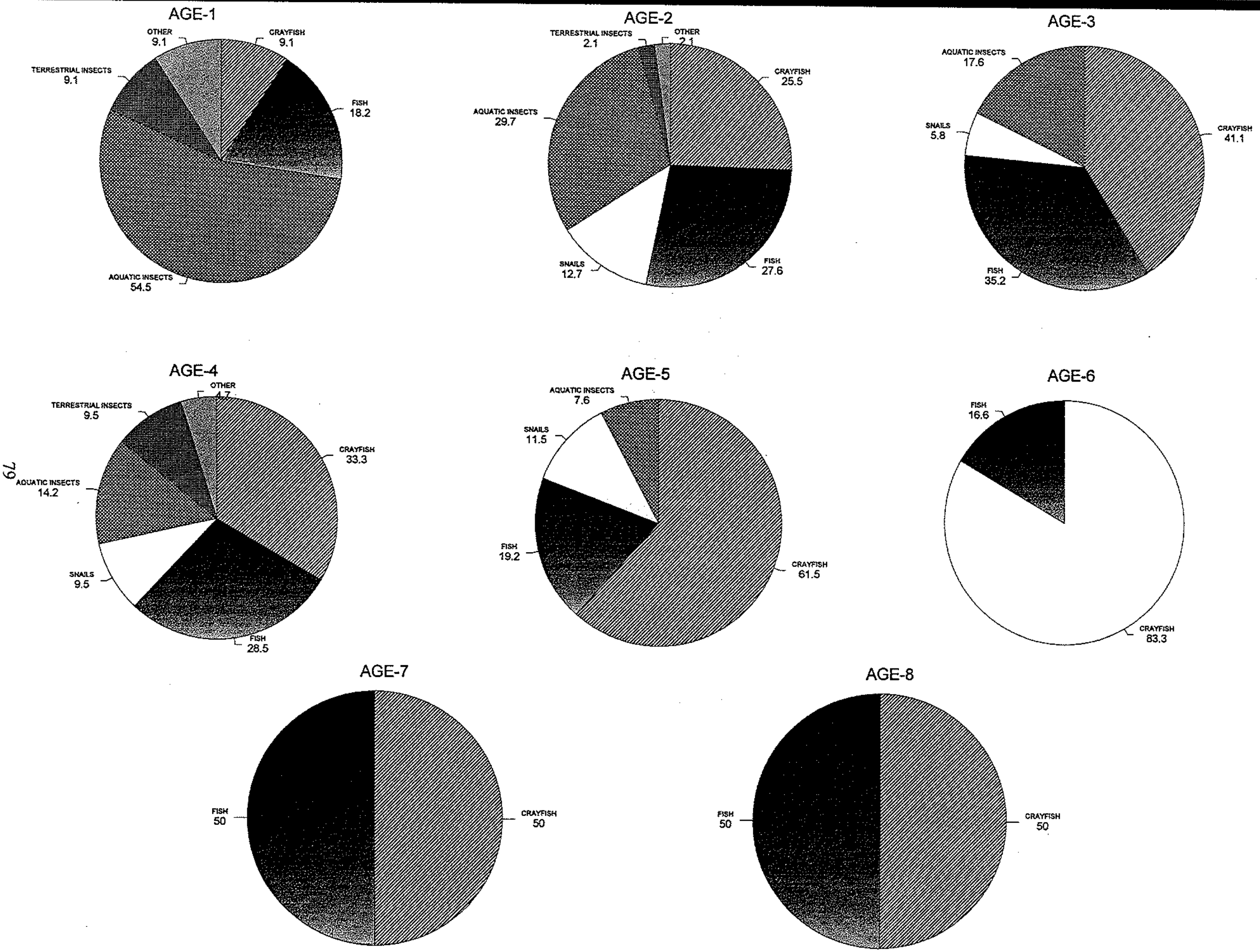


Figure 28. Percent occurrence of identified food items consumed by various ages of rock bass collected in the North Fork Holston River during 1998.

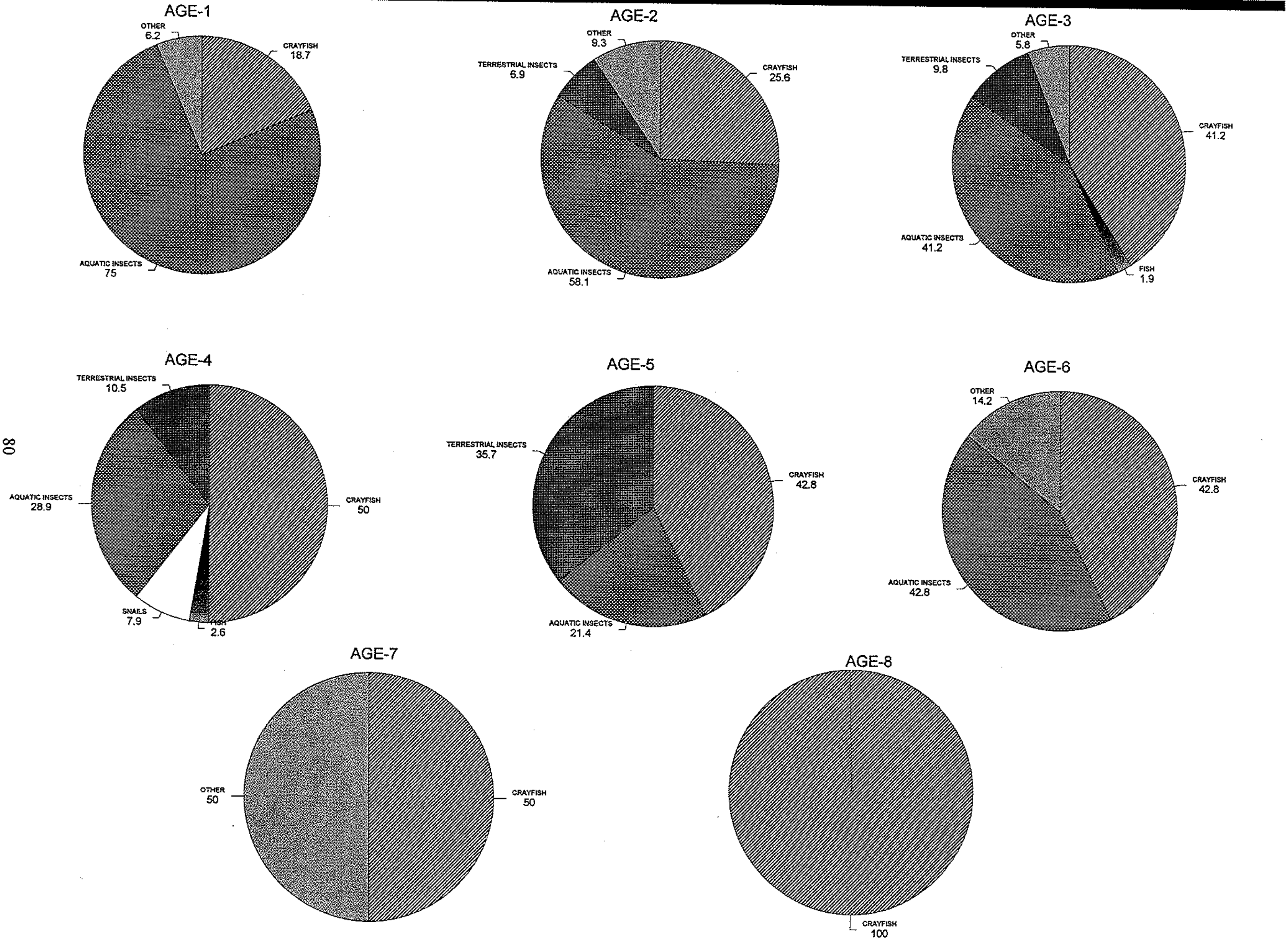


Table 21. Distribution of fish species collected in the North Fork Holston River during 1998.

FAMILY	SCIENTIFIC NAME	STATUS*	0.8	2.0	2.7	4.0	4.4	5.0
NORTH FORK HOLSTON RIVER MILE →			0.8	2.0	2.7	4.0	4.4	5.0
SITE CODE →			419980801	419980802	419980803	419980804	419980805	419980806
CATOSTOMIDAE	*Hypentelium nigricans*		●	●	●	●	●	●
	Moxostma anisurum			●				
	Moxostoma duquesnei		●	●	●	●	●	●
	Moxostoma erythrurum		●				●	●
CENTRARCHIDAE	*Ambloplites rupestris*		●	●	●	●	●	●
	Lepomis auritus		●	●	●	●	●	●
	Lepomis macrochirus		●	●				
	Lepomis megalotis			●	●	●	●	●
	Micropterus dolomieu		●	●	●	●	●	●
COTTIDAE	*Cottus carolinae*						●	
CYPRINIDAE	*Campostoma anomalum*						●	
	Cyprinella galactura			●		●	●	●
	Cyprinella monacha	FT		●		●		
	Cyprinella spiloptera						●	●
	Cyprinus carpio			●	●		●	●
	Erimystax dissimilis			●		●		●
	Luxilus chrysocephalus			●	●		●	
	Luxilus coccogenis			●				
	Nocomis micropogon		●	●	●	●	●	●
	Notropis photogenis					●		
	Notropis telescopus		●	●			●	
	Notropis volucellus			●			●	
	Phenacobius uranops					●	●	
ICTALURIDAE	*Ameiurus natalis*				●			
	Ictalurus punctatus		●	●	●	●		●
	Pylodictus olivaris			●		●	●	
PERCIDAE	*Etheostoma blennioides*			●				
	Etheostoma simoterum							●
	Percina aurantiaca	INM		●		●	●	●
	Percina caprodes					●	●	

* FE = FEDERALLY ENDANGERED, FT = FEDERALLY THREATENED, ST = STATE THREATENED, INM = IN NEED OF MANAGEMENT

SUMMARY

We visited nine streams collecting 48 fish samples (6 IBI and 42 CPUE) and six benthic samples during 1998. Index of Biotic Integrity scores for the fish samples ranged from 28 to 50 (poor to good) with an average score of 39. Ratings for the benthic macroinvertebrate samples ranged from 2.5 to 4.5 (fair to good/excellent) with an average rating of 3.4. Of the six IBI fish surveys conducted 50.0% (3) scored "poor to fair" or below, 16.7% (1) scored "fair", 16.7% (1) score "fair to good", and 16.7% (1) scored "good" (Figure 29). Based on the analysis of the benthic macroinvertebrate ratings collected during 1998, 50.0% (3) of the samples were categorized as "fair to fair/good", 33.3% (2) scored "good", and 16.7% (1) was considered to be "good to excellent" (Figure 29). As part of the IBI surveys, stream habitat conditions within each reach were evaluated and scored as to their state of degradation. Scores for the six streams ranged from 100 to 159 (Table 22) and averaged 120.8.

In the three large rivers sampled during 1998, mean CPUE values for smallmouth bass ranged from 10.9/hour in the Nolichucky River to 24.9/hour in the North Fork Holston River (Figure 30). Spotted bass average catch rates ranged from 13.9/hour in the Nolichucky to 2.1/hour in the Pigeon River (none collected in the North Fork), while largemouth bass values ranged from 0.9/hour to 1.6/hour, respectively (none collected in the North Fork). The highest catch rates for smallmouth bass and rock bass were observed in the North Fork Holston River (Table 23, Figure 30). Proportional stock density (PSD) values for smallmouth bass ranged from 32.5 in the Nolichucky River to 60 in the Pigeon River, while spotted bass PSD values ranged from 34.2 to 37.5 (Figure 31). Largemouth bass PSD values ranged from 37.5 in the Nolichucky River to 60 in the Pigeon River (Figure 31). The North Fork Holston River had the highest PSD value for rock bass, followed by the Pigeon and Nolichucky Rivers (Figure 31). PSD values reported from three middle Tennessee rivers sampled in 1996 were generally lower for three species (smallmouth bass, spotted bass, and rock bass) common to both data sets (Cleveland et al. 1997). Relative stock density (RSD) analysis indicated that the Pigeon River had the highest values for black bass and rock bass in the RSD-preferred category (Figure 32). However, only the Nolichucky and North Fork Holston rivers had black bass (smallmouth) large enough to have values associated with the RSD-memorable category (Figure 32). Food habit analysis indicated that crayfish and fish were the most important food items in the diet of black bass and rock bass regardless of the river from which they were taken in 1998 (Figure 33). Aquatic nymphs of Ephemeroptera and Trichoptera were the most common food items found in YOY rock bass, smallmouth bass, and spotted bass. Larger rock bass and smallmouth bass fed predominantly on crayfish, however; *Corydalus cornutus* larvae were particularly important to both. The stomach contents of larger spotted bass were similar to that of rock bass and smallmouth bass, although some unexpected items were identified (e.g. juvenile bird species and a small snake). This possibly indicates a more opportunistic feeding behavior for this species of black bass. Annual mortality rates for smallmouth bass varied from 25% in the North Fork Holston River to 38% in the Nolichucky River. The annual mortality rate for spotted bass collected in the Nolichucky River was 33% (only sample where data met calculation criteria). Mortality rates calculated for rock bass in the North Fork Holston River and Nolichucky River were 45% and 65%, respectively.

Based on the analysis of the three large rivers sampled during 1998, it appears that the Pigeon River has the greatest potential for recruitment (high RSD-preferred value) of smallmouth bass into the memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) categories although none were collected in the 1998 surveys. This may indicate a recruitment problem which could be caused by an above average mortality rate for older age classes of smallmouth bass. It will be interesting to follow the changes (if any) of this smallmouth bass population in response to the regulation being placed on the river in 1999. Unlike the Pigeon River, the Nolichucky and North Fork Holston rivers did have smallmouth bass in RSD-memorable category although the RSD values for preferred smallmouth bass were lower. The 1998 data collected on the rivers was our attempt to begin building the database necessary to formulate sound management plans for the sport fisheries in these rivers. However, without angler use data we will only be able to partially evaluate all factors that influence these fisheries.

As is the case in many areas of east Tennessee, streams are suffering primarily from residential/commercial development and agricultural practices. The primary product of these activities that is ultimately regulating the full potential of many streams is sedimentation. This component of habitat degradation had the most consistent negative influence on our instream habitat analysis for the streams we surveyed in 1998.

Figure 29. Trends in IBI fish scores and biotic index values calculated for benthic macroinvertebrates collected during 1998.

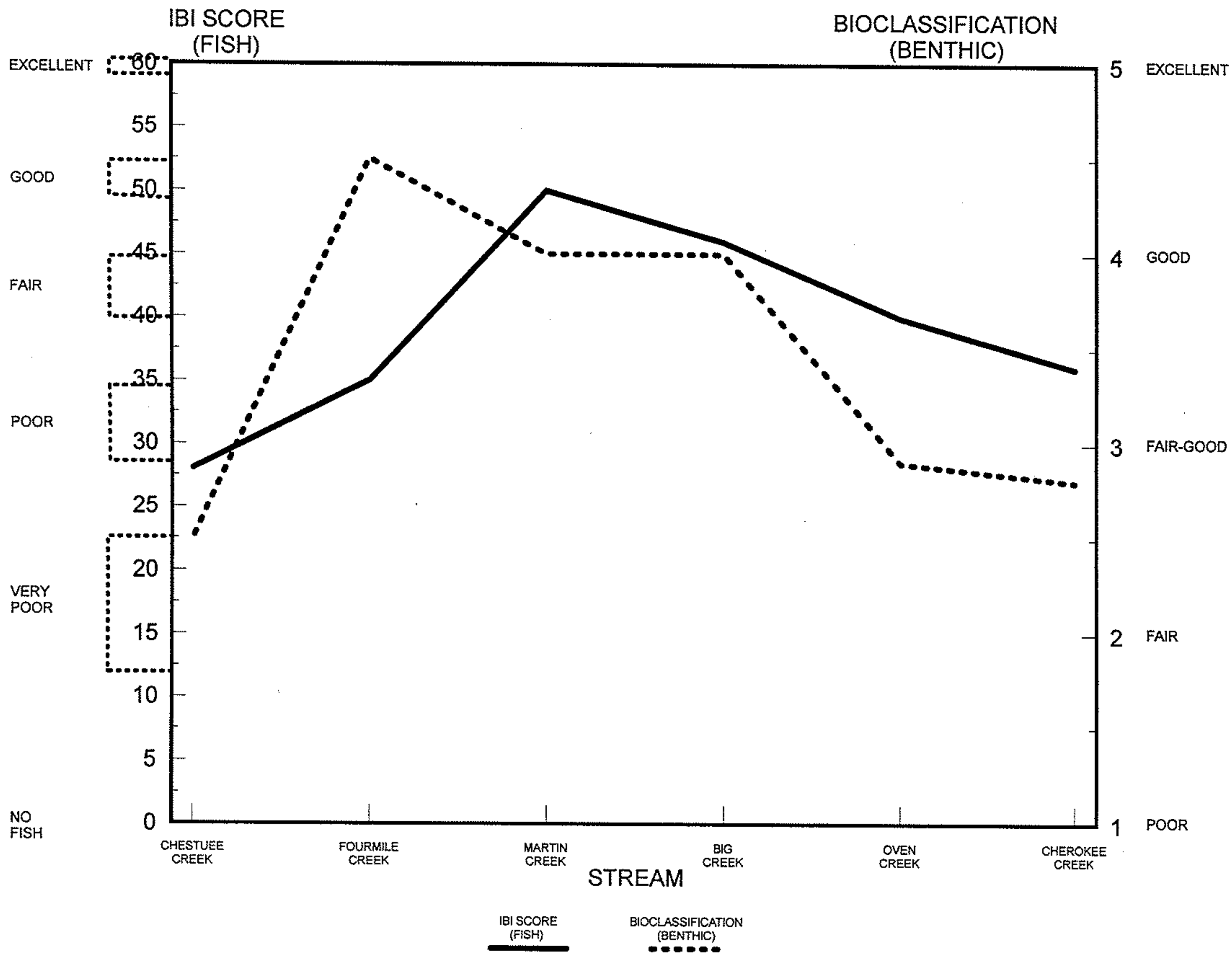


Table 22. Mean habitat scores for six streams surveyed during 1998.

	PREVALENT HABITAT TYPE	HABITAT PARAMETER 1	HABITAT PARAMETER 2	HABITAT PARAMETER 3	HABITAT PARAMETER 4	HABITAT PARAMETER 5	HABITAT PARAMETER 6	HABITAT PARAMETER 7	HABITAT PARAMETER 8	HABITAT PARAMETER 9	HABITAT PARAMETER 10	
	RIFFLE/RUN	Instream Cover	Epifaunal Substrate	Embeddedness	Channel Alteration	Sediment Deposition	Freq. of Riffles	Channel Flow Status	Bank Vegetative Cover	Bank Stability	Riparian Vegetative Zone Width	
	GLIDE/POOL	Bottom Substrate	Pool Substrate	Pool Variability	Channel Alteration	Sediment Deposition	Channel Sinuosity	Channel Flow Status	Bank Vegetative Cover	Bank Stability	Riparian Vegetative Zone Width	
												MEAN TOTAL
STREAM	* DESIGNATION	SCORE	SCORE	SCORE	SCORE	SCORE	SCORE	SCORE	SCORE	SCORE	SCORE	SCORE
CHESTUEE CREEK	GLIDE/POOL	7	10	14	14	8	12	14	8	5	8	100
FOURMILE CREEK	RIFFLE/RUN	10	10	18	18	17	18	17	11	12	9	140
MARTIN CREEK	RIFFLE/RUN	14	14	18	16	17	16	16	16	18	14	159
BIG CREEK	RIFFLE/RUN	14	14	10	11	9	17	16	6	9	6	112
OVEN CREEK	RIFFLE/RUN	9	10	9	14	7	12	16	14	13	10	114
CHEROKEE CREEK	RIFFLE/RUN	7	10	8	16	7	12	16	9	9	6	100

* Streams designated as riffle/run or glide/pool were evaluated based on the specific criteria for that habitat type.

CATEGORIES AND SCORING RANGES USED TO DERIVE OVERALL STREAM HABITAT CLASSIFICATIONS:

CATEGORY	SCORE RANGE
OPTIMAL	200-160
SUBOPTIMAL	159-110
MARGINAL	109-60
POOR	59-0

Table 23. Summary population statistics for smallmouth bass and rock bass collected in the Nolichucky, Pigeon, and North Fork Holston rivers during 1998.

RIVER	SMALLMOUTH BASS MEAN CPUE	PSD	RSD-PREFERRED (TL ≥ 350 mm)	RSD-MEMORABLE (TL ≥ 430 mm)	RSD-TROPHY (TL ≥ 510 mm)	ROCK BASS MEAN CPUE	PSD	RSD-PREFERRED (TL ≥ 230 mm)	RSD-MEMORABLE (TL ≥ 280 mm)	RSD-TROPHY (TL ≥ 330 mm)
NOLICHUCKY RIVER	10.9	32.5	11.7	1.3	0	9	17.4	0	0	0
PIGEON RIVER	16.8	60	20	0	0	6.7	22.2	2.8	0	0
NORTH FORK HOLSTON RIVER	24.9	40.5	9.5	1.4	0	36.8	27.3	1.4	0	0

CPUE = CATCH PER UNIT EFFORT
PSD = PROPORTIONAL STOCK DENSITY
RSD = RELATIVE STOCK DENSITY

Figure 30. Mean CPUE values calculated for black bass and rock bass collected in the Nolichucky, North Fork Holston, and Pigeon Rivers during 1998.

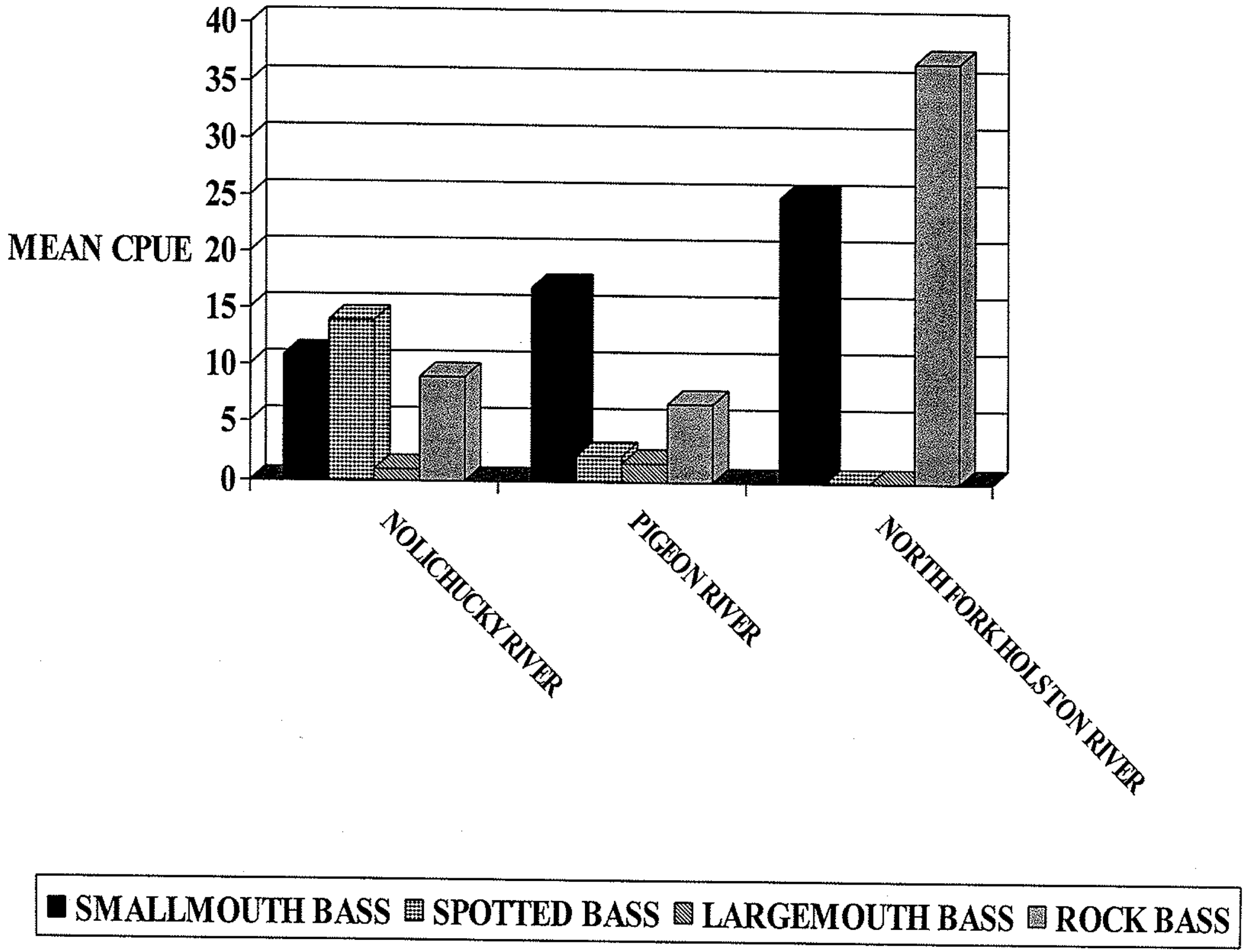


Figure 31. Proportional stock density values calculated for black bass and rock bass collected in the Nolichucky, North Fork Holston, and Pigeon Rivers during 1998.

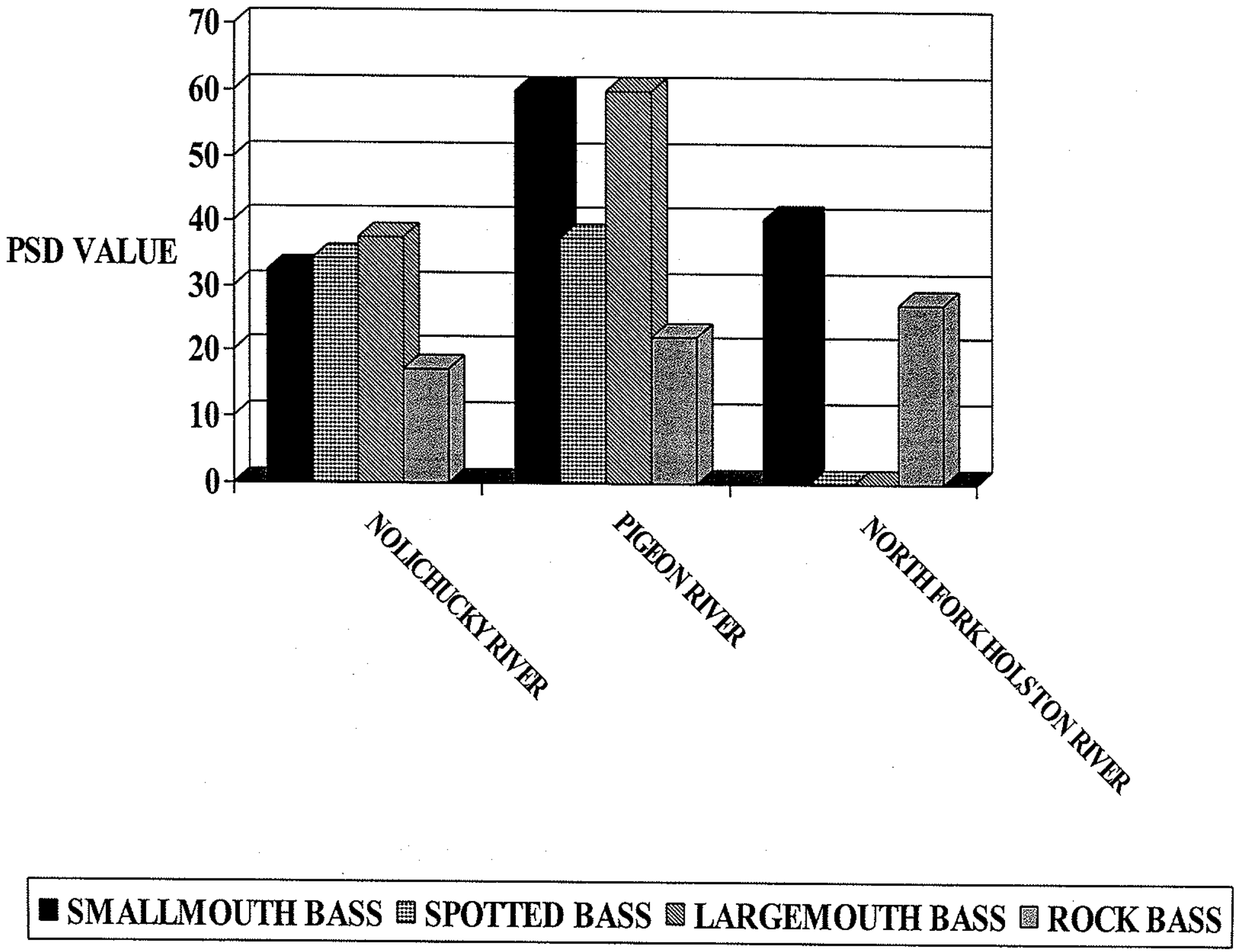


Figure 32. Selected relative stock density values calculated for black bass and rock bass collected in the Nolichucky, North Fork Holston, and Pigeon Rivers during 1998.

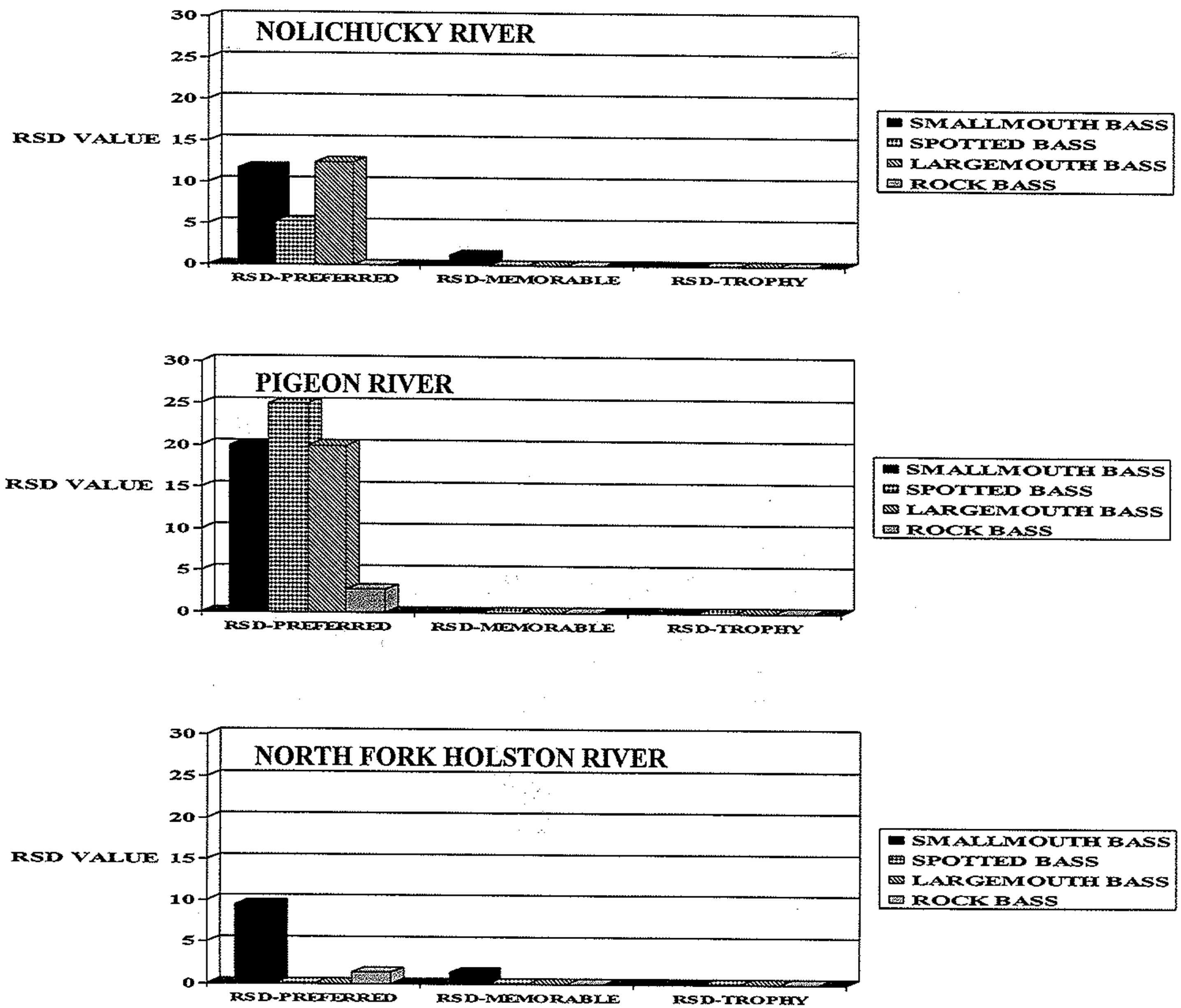
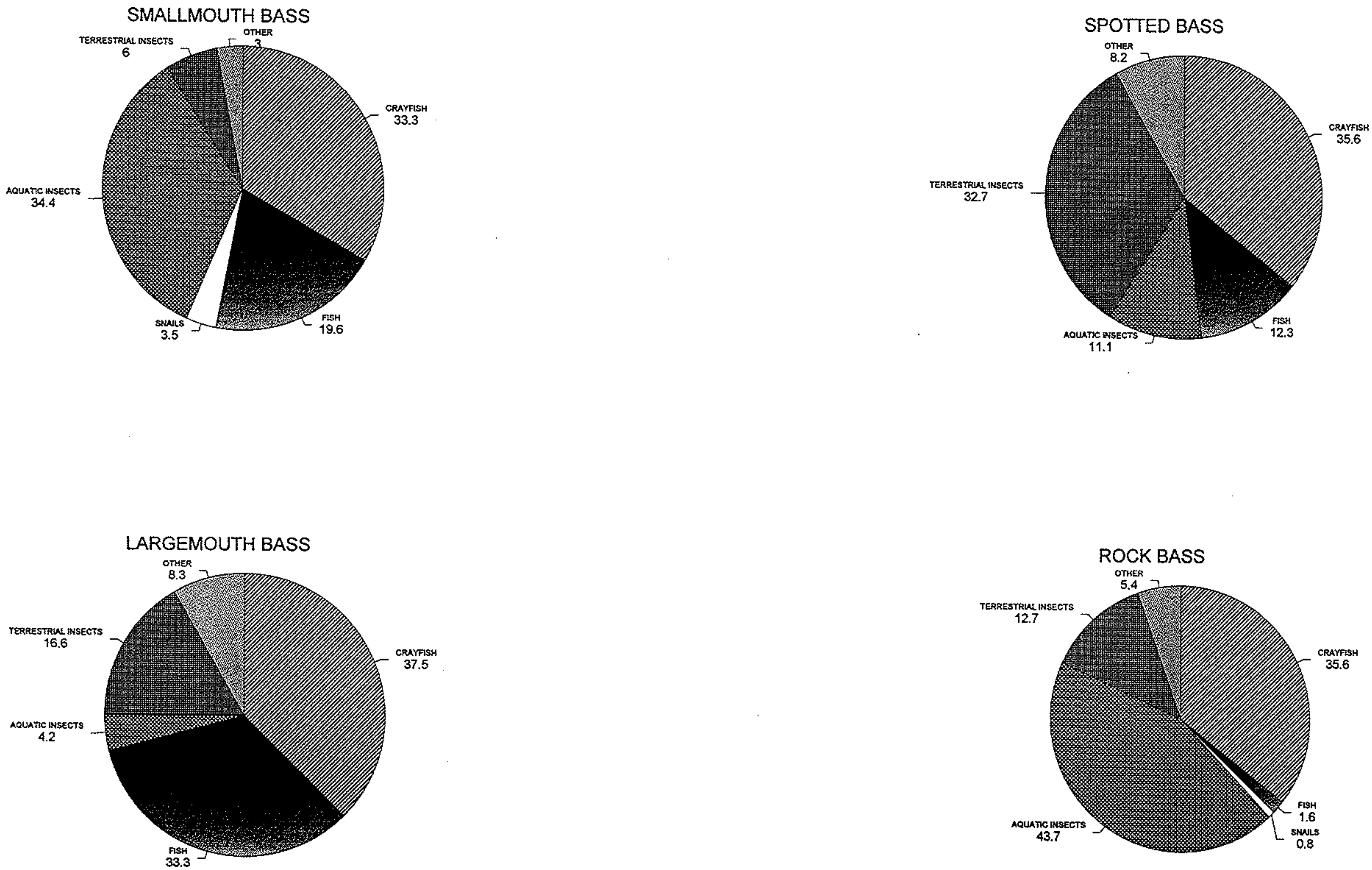


Figure 33. Percent occurrence of identified food items consumed by black bass and rock bass collected in 1998 (composite of the Nolichucky, North Fork Holston, and Pigeon Rivers).



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APPENDIX A

Fish Species with Designations for Tolerance, Trophic Guild, Reproductive Guild, and Headwater Habitat

Family	Species	Tolerance	Trophic Guild	Reproductive Guild	Headwater Habitat
CATOSTOMIDAE	*Carpiodes cyprinus*		OM		
	Catostomus commersoni	TOL	OM	L	P
	Hypentelium nigricans			L	
	Ictiobus bubalus		OM		
	Minytrema melanops			L	
	Moxostoma carinatum			L	
	Moxostoma duquesnei	INT		L	P
	Moxostoma erythrurum			L	P
	Moxostoma macrolepidotum			L	
CENTRARCHIDAE	*Ambloplites rupestris*	INT	TC		P
	Lepomis auritus				
	Lepomis cyanellus	TOL			P
	Lepomis macrochirus				
	Lepomis megalotis	HI			P
	Lepomis gulosus				P
	Lepomis sp. (hybrid)				
	Micropterus dolomieu	TC			P
	Micropterus punctulatus	TC			P
	Micropterus salmoides	TC			P
CLUPEIDAE	*Dorosoma cepedianum*	TOL	OM		
COTTIDAE	*Cottus carolinae*				R
CYPRINIDAE	*Campostoma anomalum*	OM			
	Cyprinella galactura				P
	Cyprinella spiloptera	TOL			P
	Cyprinus carpio	TOL	OM		
	Erimystax insignis		OM	L	R
	Hybopsis amblops	HI	SP	L	P
	Luxilus chrysocephalus	TOL	OM	L	P
	Luxilus coccogenis	HI	SP	L	P
	Lythrurus fasciolaris		SP	L	P
	Nocomis micropogon		OM		P
	Notemigonus crysoleucus	TOL	OM		
	Notropis leuciodus	HI	SP	L	P
	Notropis photogenis		SP	L	P
	Notropis rubellus		SP	L	
	Notropis rubricroceus	HI	SP	L	P
	Notropis spectrunculus		SP	L	P
	Notropis stramineus		SP	L	P
	Notropis telescopus	INT	SP	L	P
	Notropis volucellus		SP	L	
	Pimephales notatus		OM		P
	Pimephales promelas		OM		
	Phenacobius uranops		SP	L	R
	Rhinichthys atratulus			L	
	Rhinichthys cataractae	HI	SP	L	R
	Semotilus atromaculatus	TOL			P
FUNDULIDAE	*Fundulus catenatus*	HI	SP	L	R
	Fundulus notatus				
ICTALURIDAE	*Ameiurus natalis*	TOL	OM		P
	Ictalurus punctatus		OM		
	Pylodictus olivaris		TC		
LEPISOSTEIDAE	*Lepisosteus osseus*	TOL	TC		
MORONIDAE	*Morone chrysops*		TC	L	
PERCIDAE	*Etheostoma blennioides*		SP	L	R
	Etheostoma flabellare	INT	SP		R
	Etheostoma jessiae	INT	SP	L	P
	Etheostoma kennicotti		SP	L	P
	Etheostoma rufilineatum		SP	L	R
	Etheostoma simoterum		SP	L	R
	Etheostoma zonale		SP	L	R
	Perca flavescens				
	Percina caprodes		SP	L	P
	Percina evides	INT	SP	L	R
	Stizostedion canadense		TC	L	
PETROMYZONTIDAE	*Ichthyomyzon bdellium*				
	Ichthyomyzon sp.				
	Lampetra appendix				
POECILIIDAE	*Gambusia sp.*				
SALMONIDAE	*Oncorhynchus mykiss*				
	Salmo trutta		TC		
SCIAENIDAE	*Aplodinotus grunniens*				

INT = INTOLERANT HI = HEADWATER INTOLERANT ONLY SP = SPECIALIST L = SIMPLE LITHOPHIL R = RIFFLE
TOL = TOLERANT OM = OMNIVORE TC = TOP CARNIVORE P = POOL

APPENDIX B

HABITAT ASSESSMENT FIELD DATA SHEET

RIFFLE/RUN PREVALENT STREAMS

STREAM ____________ DATE ____________

SITE ____________ INVESTIGATOR ____________

Riffle/Run Prevalent Streams are those in moderate to high gradient landscapes that sustain water velocities of approximately 1 ft/sec or greater. Natural streams have substrates primarily composed of coarse sediment particles (i.e., gravel or larger) or frequent coarse particulate aggregations along stream reaches.

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1. Instream Cover (Fish)	Greater than 50% mix of snags, submerged logs, undercut banks, or other stable habitat.	30-50% mix of stable habitat; adequate habitat for maintenance of populations.	10-30% mix of stable habitat; habitat availability less than desirable.	Less than 10% mix of stable habitat; lack of habitat is obvious.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Epifaunal Substrate	Well-developed riffle and run; riffle is as wide as stream and length extends two times the width of stream; abundance of cobble.	Riffle is as wide as stream but length is less than two times width; abundance of cobble; boulders and gravel common.	Run area may be lacking; riffle not as wide as stream and its length is less than 2 times the stream width; gravel or large boulders and bedrock prevalent; some cobble present.	Riffles or runs virtually nonexistent; large boulders and bedrock prevalent; cobble lacking.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	New embankments present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from coarse gravel; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, coarse sand on old and new bars; 30-50% of the bottom affected; sediment deposits at obstruction, constriction, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
6. Frequency of Riffles	Occurrence of riffles relatively frequent; distance between riffles divided by the width of the stream equals 5 to 7; variety of habitat is key. In the highest gradient streams (e.g., headwaters), riffles are continuous, and placement of boulders or other large, natural obstruction is evaluated as providing habitat diversity.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream equals 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is between ratio >25.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption, through grazing or mowing, minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.
SCORE ____ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ____ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ____ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ____ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ____ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ____ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ____

STREAM ____________________ DATE ____________________

SITE ____________________ INVESTIGATOR ____________________

Glide/Pool Prevalent Streams are those in low to moderate gradient landscapes that have velocities rarely greater than 1 ft/sec, except during storm events. Natural streams have substrates of fine sediment or infrequent aggregations of coarser (gravel or larger) sediment particles along stream reaches.

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
1. Bottom Substrate/ Available Cover	Greater than 50% mix of snags, submerged logs, undercut banks, rubble or other stable habitat and at stage to allow full colonization potential (i.e., logs/ snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Channel Alteration	Channelization or dredging absent or minimal; stream with normal, sinuous pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yrs) may be present, but recent channelization is not present.	New embankments present on both banks; channelization may be extensive, usually in urban areas or drainage areas of agriculture lands; and >80% of stream reach channelized and disrupted.	Extensive channelization; banks shored with gabion or cement; heavily urbanized areas; instream habitat greatly altered or removed entirely.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation.	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Channelized; mud, silt, and/or sand in braided or nonbraided channels; pools almost absent due to deposition.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Habitat Parameter	Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note -- channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 2 to 1 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE ____	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces covered by native vegetation, including trees, understory shrubs, or non-woody macrophytes; vegetative disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of stream-bank vegetation is very high; vegetation has been removed to 2 inches or less in average stubble height.
SCORE ____ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ____ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ____ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ____ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
SCORE ____ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ____ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score ____

APPENDIX C

1998 Summary of Strategic Plan Activities

ACTIVITY	COMPLETED	NUMBER
Identified land for purchase and/or lease of stream easements from landowners for habitat protection (I-1)	NO	0
Participation in stream restoration projects (I-4)	YES	2
Development of a watershed management plan (II-1)	NO	
Stream surveys (II-2)	YES	9
Implemented a creel and/or user survey (II-3)	NO	
Identification of stream fishing access sites for purchase and/or lease (III-1)	YES	2
Cooperation with organized groups for stream habitat development and cleanup (III-3)	NO	
Design and implementation of stream habitat enhancement programs (IV-1)	NO	
Evaluation of stream habitat enhancement (IV-2)	NO	
Public education about stream fishing (VI-1)	YES	25
Locations for potential land purchases or leases: **TELLICO RIVER** **LITTLE RIVER**	YES	2