FISHERIES REPORT

REPORT NO.

WARMWATER STREAM FISHERIES REPORT

REGION IV

1999

Prepared by

Bart D. Carter
Carl E. Williams
and
Rick D. Bivens

Tennessee Wildlife Resources Agency

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TENNESSEE WILDLIFE RESOURCES AGENCY
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Cover: Typical size structure of smallmouth bass collected in east Tennessee rivers (smallmouth in photograph from the Pigeon River).

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

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

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

METHODS

The streams to be sampled and the methods required are outlined in TWRA field request No. 99-4. A total of three rivers were sampled and are included in this report. Stream surveys were conducted from June to August 1999. Sixty-nine catch per unit effort (CPUE) fish samples were collected.

SAMPLE SITE SELECTION

Large river sampling sites 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.

FISH COLLECTIONS

Catch per unit effort samples (CPUE) were conducted in three rivers during 1999. 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 1999 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 survey unit. Otoliths were extracted from black bass and rock bass for age and growth analysis. Efforts were made to collect a representative sample of all age classes of black bass and rock bass in each river.

WATER QUALITY MEASUREMENTS

Basic water quality data were taken at most sites in conjunction with the fish samples. The samples included temperature and conductivity. Data were taken from midstream and mid-depth at each site, using a YSI model 33 S-C-T meter.

DATA ANALYSIS

Catch per unit effort analysis was performed on the three large rivers sampled during 1999. 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. Potential population growth analysis was conducted for selected species according to the models described by Everhart et al. (1975). Annual mortality rates for black bass and rock bass were estimated (when the data met the criteria) according to the procedures described by Van Den Avyle (1993).

RIVER ACCOUNTS

Clinch River

Introduction

The Clinch River represents an important recreational resource for the state both in consumptive and non-consumptive uses. It provides critical habitat for threatened and endangered species and species of special concern. The river supports a diverse fish community and has been documented to host some 43 species of mussels (Ahlstedt 1986). Additionally, it supports one of east Tennessee's better warmwater sport fisheries. The Clinch River has been the focus of numerous surveys and investigations conducted by both state and federal agencies with the major purpose of assessing and monitoring the fish and benthic communities. The Agency has made limited surveys of the river that focused primarily on collecting basic fish, benthic, and water quality data (Bivens 1988,(1992 file data)). Our survey of the Clinch River focused on developing a fish species list and assessing the relative condition of the sport fish populations in the river from the Virginia state line to the Clinch River embayment of Norris Reservoir.

Study Area and Methods

The Clinch River originates in Virginia and flows in a southwesterly direction before emptying into Norris Reservoir near river mile 152. The river has a drainage area of approximately 3,838 kilometers^2 (upstream of reservoir). In Tennessee, all of the Clinch River flows through the Ridge and Valley province of east Tennessee coursing by the town of Sneedville before emptying into Norris Reservoir just northwest of Thorn Hill. Public access along the river is primarily limited to bridge crossings and small "pull-outs" along roads paralleling the river. There are several primitive launching areas for canoes or small boats and two developed launching areas managed by the Tennessee Wildlife Resources Agency (Kyles Ford and Sneedeville).

Between July 13 and July 22 1999, we conducted 32 fish surveys between the Virginia state line and Norris Reservoir (Figure 1). In our survey sites, the riparian habitat consisted primarily of wooded shorelines with interspersed agricultural fields. Submerged woody debri was fairly common in most of our sample areas as were large mats of river weed. The river substrate was predominately boulder/cobble in riffle areas and bedrock with interspersed boulders/cobble in the pool habitat. Measured mean channel widths ranged from 38.5 meters to 71.5 meters, while site lengths fell between 160 meters and 943 meters (Table 1). Water temperatures ranged from 21.5 C to 30.0 C and conductivity varied from 310 to 380 (Table 1).

Fish were collected by boat electrofishing in accordance with the standard large river sampling protocols (TWRA 1998). Fixed-boom electrodes were used to transfer 4-5 amps DC at all sites. This current setting was determined effective in narcotizing all target species (black bass and rock bass). Additionally, 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 standardized to 900 seconds (15 minutes). 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.

Length categorization indices were calculated for target species following Gabelhouse (1984). Potential population growth analyses for length were conducted for smallmouth bass and rock bass according to the models described by Everhart et al. (1975). Annual mortality estimates were derived for target species whose data met the requirements described by Van Den Avyle (1993).

Results

Smallmouth bass (*Micropterus dolomieui*) were present at all 32 surveys sites while rock bass (*Ambloplites rupestris*) were present at all but two of the sampling stations (Table 2). Largemouth bass (*M. salmoides*) and spotted bass (*M. punctulatus*) were encountered less frequently and probably do not contribute significantly to the overall sport fishery. Rock bass, on average, was the most abundant game species at any of the survey sites. CPUE estimates for this species averaged 37.2/hour (SD 32.3). Mean CPUE estimates for black bass were somewhat lower with smallmouth bass averaging 23.5 (SD 16.9), while spotted and largemouth bass estimates averaged 1.6/hour (SD 2.8) and 0.4/hour (SD 1.2), respectively (Table 2). The catch of rock bass and smallmouth bass seemed to be highest at the upper and lower sampling stations, declining somewhat at the intermediate stations. There was no discernable trend in the catch distribution of largemouth bass from downstream to upstream (Table 2). However, Spotted bass seemed to be more abundant in the lower reaches of the river. One muskellunge *(Esox masquinongy)* was collected at site 18 (river mile 175.8) near the town of Sneedeville. This 762 mm (30 inches) specimen was undoubtedly the result of stockings made by the Virginia Game and Fish (VAGF) since stockings of this species have not been made in the Clinch River (including Norris Reservoir) since 1971.

The majority of the smallmouth bass collected in the Clinch River during 1999 fell within the 125 mm to 250 mm length range (Figure 2). 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 $\geq$ 350 mm) was 6.0. RSD for memorable (TL $\geq$430 mm) and trophy (TL $\geq$ 510 mm) size bass were 1.0 and 1.0, respectively. The ratio of quality (TL $\geq$ 280 mm) smallmouth bass to stock size bass (TL $\geq$ 180 mm) was 21.0. Catch per unit effort estimates by RSD category indicated smallmouth bass had relatively high catch rate for the category RSD-Q and a relatively high CPUE value for sub-stock bass indicating good recruitment (Figure 3). Overall, growth rates for smallmouth were very similar to those values reported for the statewide average for age groups represented in the 1999 sample (Figure 4). The von Bertalanffy growth statistics calculated for smallmouth bass predicted a maximum length of 681 mm (~ 26 inches) for the population (Figure 4). Linear length-weight regression analysis indicated steady growth up through the 500 mm length range and yielded a length-weight equation of -4.86 + 2.98x (Figure 5). The annual mortality estimate calculated for smallmouth bass in the Clinch River was about 43% and was similar to other estimates calculated for rivers in the region.

The majority of the spotted bass collected in the Clinch River during 1999 fell within the 125 mm to 175 mm length range (Figure 2). 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 0. 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 20.0. Catch per unit effort estimates by RSD category revealed very few RSD-Q spotted bass (Figure 3). Overall, growth rates for spotted bass were similar to those reported for the statewide average (Figure 4). Because of the relatively low sample size none of the growth or mortality statistics were calculated.

Largemouth bass collected in the Clinch River during 1999 fell within the 125 mm to 175 mm length range (Figure 2). Because the very low sample size collected in the Clinch River, any statistical analysis would be meaningless. Therefore, largemouth bass in the Clinch River are not considered to be an important contributor to the overall sport fish abundance.

Individuals in the 100 mm to 175 mm range represented the majority of rock bass in our sample (Figure 2). Length categorization analysis indicated the RSD for preferred rock bass (TL ≥ 230 mm) was 0. 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 13.1. Annual growth rates for rock bass collected in the 1999 sample approximated those reported for the statewide average (Figure 4). The von Bertalanffy growth statistics calculated for rock bass predicted a potential maximum length of 213 mm (~ 8 inches) for the population (Figure 4). Linear length-weight regression analysis indicated steady growth through the represented length classes and yielded a length-weight equation of -4.69 + 2.99x (Figure 6). The annual mortality estimate calculated for rock bass in the Clinch River was about 42%.

Several other species were collected or observed during our survey of the Clinch River, which included one **In Need of Management Species** (*Percina aurantiaca*). A list of species occurrence by site can be found in Table 3.

Discussion

The Clinch River provides anglers with the opportunity to catch all species of black bass and rock bass (smallmouth bass and rock bass predominant species). Because of the low numbers of spotted and largemouth bass the Clinch River, it should not be considered to contain a sport fishery for these species.

The popularity of this riverine fishery has grown over the last few years and now hosts a good percentage of anglers from Kentucky. 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, public inquiries, and aid in the development of regulations.

The occurrence of musky in the river warrants continued investigations. The consistent stockings made by the VAGF upstream of the state line could lead to the development of a fishery in the Tennessee portion of the Clinch River. According to Tom Hampton (VAGF) their stockings have been quite successful and have resulted in the establishment of a sport fishery.

Surveys on the Clinch River will be conducted on a five-year rotation in order to assess any changes in the fishery. Our return trip in 2004 will in all likelihood not be as intensive as the 1999 survey and will probably be confined to a percentage of sites that are most descriptive of the river.

Figure 1. Site locations for samples conducted on the Clinch River during 1999.

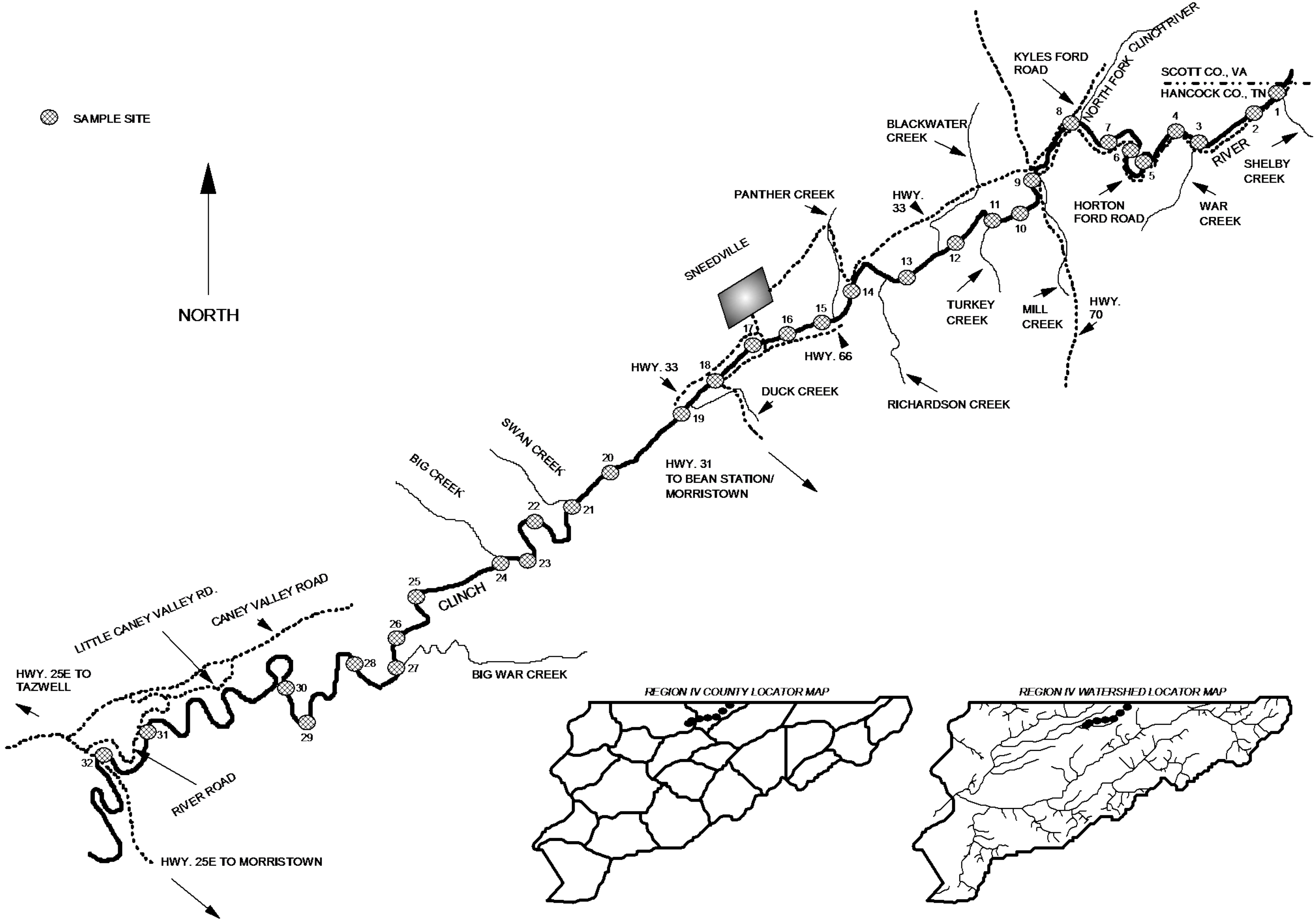


Table 1. Physiochemical and site location data for samples conducted on the Clinch River during 1999.

SITE CODE	DATE	COUNTY	QUADRANGLE	LAT-LONG	RIVER MILE	MEAN WIDTH (m)	LENGTH (m)	SECCHI (m)	TEMP.	COND.
419992501	7/13/99	HANCOCK	LOONEYS GAP	363537N/825322W	202.0	44.6	0376	1.0	21.5	318
419992502	7/13/99	HANCOCK	LOONEYS GAP	363458N/825443W	200.5	57.0	0418	1.0	22.0	310
419992503	7/13/99	HANCOCK	LOONEYS GAP	363436N/825629W	199.0	50.6	0190	1.4	22.5	318
419992504	7/13/99	HANCOCK	LOONEYS GAP	363453N/825716W	197.8	41.6	0381	1.3	23.5	320
419992505	7/13/99	HANCOCK	LOONEYS GAP	363447N/825901W	196.3	63.0	0346	1.3	23.5	320
419992506	7/14/99	HANCOCK	LOONEYS GAP	363359N/825841W	195.1	70.5	0160	1.3	22.5	330
419992507	7/14/99	HANCOCK	LOONEYS GAP	363430N/825958W	193.1	60.3	0445	1.3	23.0	325
419992508	7/14/99	HANCOCK	KYLES FORD 170SE	363505N/830053W	191.8	44.3	0237	1.2	24.0	325
419992509	7/14/99	HANCOCK	KYLES FORD 170SE	363403N/830233W	189.8	62.5	0638	1.2	26.0	325
419992510	7/14/99	HANCOCK	KYLES FORD 170SE	363319N/830303W	188.3	54.3	0452	1.1	24.5	325
419992511	7/14/99	HANCOCK	KYLES FORD 170SE	363311N/830358W	187.5	38.5	0188	1.1	27.0	325
419992512	7/15/99	HANCOCK	KYLES FORD 170SE	363249N/830504W	185.9	57.5	0436	1.1	24.0	335
419992513	7/15/99	HANCOCK	KYLES FORD 170SE	363215N/830741W	183.7	63.5	0781	1.1	24.5	330
419992514	7/15/99	HANCOCK	SNEEDVILLE 170SW	363230N/830846W	182.0	58.5	0943	1.1	26.0	330
419992515	7/15/99	HANCOCK	SNEEDVILLE 170SW	363137N/830940W	180.6	52.0	0517	0.8	27.0	330
419992516	7/15/99	HANCOCK	SNEEDVILLE 170SW	363121N/831119W	178.9	49.0	0459	1.0	28.0	330
419992517	7/15/99	HANCOCK	SNEEDVILLE 170SW	363059N/831257W	177.4	47.5	0191	1.0	28.0	330
419992518	7/15/99	HANCOCK	SNEEDVILLE 170SW	363022N/861429W	175.8	53.5	0547	1.1	28.0	330
419992519	7/19/99	HANCOCK	SWAN ISLAND 162NE	362957N/831525W	174.8	60.0	0493	0.5	28.0	375
419992520	7/19/99	HANCOCK	SWAN ISLAND 162NE	362902N/831643W	173.2	59.0	0353	0.6	28.0	380
419992521	7/19/99	HANCOCK	SWAN ISLAND 162NE	362838N/831721W	172.5	53.0	0718	0.6	28.0	380
419992522	7/19/99	HANCOCK	SWAN ISLAND 162NE	362831N/831811W	170.7	71.5	0480	0.7	29.0	380
419992523	7/20/99	HANCOCK	SWAN ISLAND 162NE	362754N/831803W	169.6	50.0	0217	0.7	28.0	380
419992524	7/20/99	HANCOCK	SWAN ISLAND 162NE	362726N/831903W	168.5	58.5	0328	0.7	27.5	375
419992525	7/20/99	HANCOCK	SWAN ISLAND 162NE	362645N/832057W	166.6	63.0	0890	0.7	28.0	380
419992526	7/20/99	HANCOCK	SWAN ISLAND 162NE	362614N/832106W	165.4	64.0	0473	0.7	30.0	380
419992527	7/21/99	HANCOCK	SWAN ISLAND 162NE	362545N/832128W	164.5	68.5	0520	0.9	27.0	370
419992528	7/21/99	HANCOCK	SWAN ISLAND 162NE	362552N/832225W	163.0	71.5	0430	0.9	28.0	370
419992529	7/21/99	CLAIBORNE	HOWARD QUARTER 162NW	3625.2N/832321W	161.2	64.0	0418	1.3	29.0	370
419992530	7/21/99	CLAIBORNE	HOWARD QUARTER 162NW	362510N/832332W	160.0	75.0	0308	1.3	30.0	380
419992531	7/22/99	CLAIBORNE	HOWARD QUARTER 162NW	362442N/832630W	154.0	62.0	0220	N/A	28.0	365
419992532	7/22/99	CLAIBORNE	HOWARD QUARTER 162NW	362405N/832709W	152.2	71.5	0413	1.6	26.0	370

Table 2. Catch per unit effort and length categorization indices of target species collected at thirty-two sites on the Clinch River during 1999.

SITECODE*	SMALLMOUTH BASS CPUE (#/HOUR)	SPOTTED BASS CPUE (#/HOUR)	LARGEMOUTH BASS CPUE (#/HOUR)	ROCK BASS CPUE (#/HOUR)
419992501	44.0	0.0	0.0	47.9
419992502	12.0	0.0	0.0	40.0
419992503	15.8	0.0	4.0	122.6
419992504	15.9	0.0	0.0	23.9
419992505	4.0	0.0	0.0	108.0
419992506	8.0	0.0	0.0	63.9
419992507	15.9	0.0	0.0	31.9
419992508	4.0	0.0	0.0	87.9
419992509	16.0	0.0	0.0	20.0
419992510	8.0	4.0	0.0	28.0
419992511	8.0	0.0	0.0	83.8
419992512	8.0	0.0	0.0	12.0
419992513	12.0	0.0	0.0	24.0
419992514	19.8	0.0	0.0	15.9
419992515	32.0	8.0	0.0	4.0
419992516	16.0	4.0	0.0	4.0
419992517	4.0	0.0	0.0	39.9
419992518	8.0	4.0	0.0	8.0
419992519	39.9	0.0	4.0	0.0
419992520	4.0	4.0	0.0	15.9
419992521	35.2	0.0	0.0	7.8
419992522	29.9	0.0	0.0	64.9
419992523	27.9	4.0	0.0	59.9
419992524	19.7	0.0	0.0	59.1
419992525	65.8	2.6	0.0	18.4
419992526	27.9	4.0	0.0	8.0
419992527	43.7	0.0	0.0	0.0
419992528	31.8	0.0	0.0	8.0
419992529	23.9	4.0	0.0	39.9
419992530	44.0	0.0	0.0	20.0
419992531	51.8	0.0	4.0	67.8
419992532	55.8	12.0	0.0	55.8
MEAN	**23.5**	**1.6**	**0.4**	**37.2**
STD. DEV.	**16.9**	**2.8**	**1.2**	**32.3**
	LENGTH-CATEGORIZATION ANALYSIS	**LENGTH-CATEGORIZATION ANALYSIS**	**LENGTH-CATEGORIZATION ANALYSIS**	**LENGTH-CATEGORIZATION ANALYSIS**
	PSD = 21.0	PSD = 20.0	PSD = 0	PSD = 13.1
	RSD-PREFERRED = 6.0	RSD-PREFERRED = 0	RSD-PREFERRED = 0	RSD-PREFERRED = 0
	RSD-MEMORABLE = 1.0	RSD-MEMORABLE = 0	RSD-MEMORABLE = 0	RSD-MEMORABLE = 0
	RSD-TROPHY = 1.0	RSD-TROPHY = 0	RSD-TROPHY = 0	RSD-TROPHY = 0

*sitecodes are listed from upstream to downstream

Figure 2. Length frequency distributions for black bass and rock bass collected in the Clinch River during 1999.

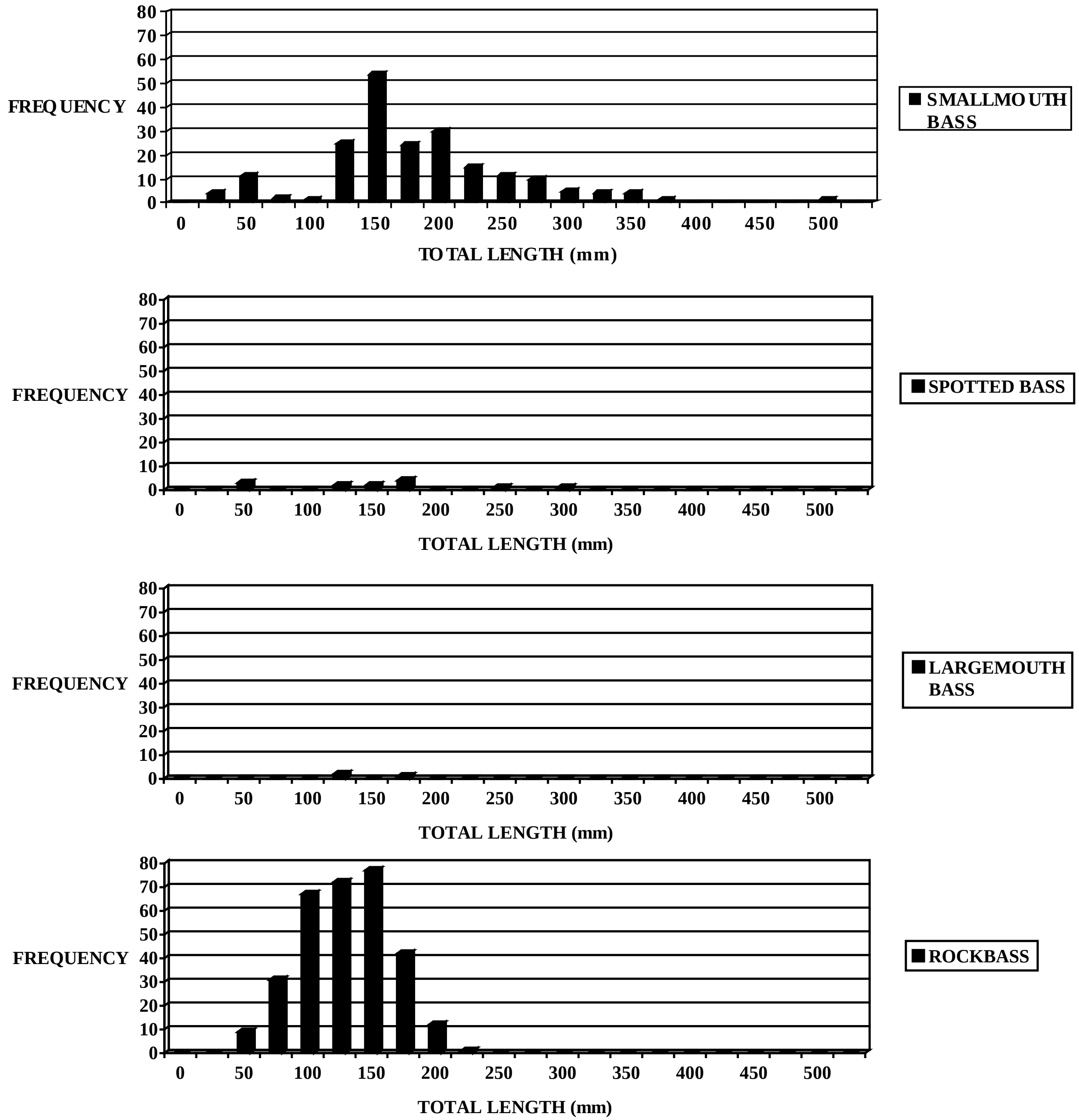
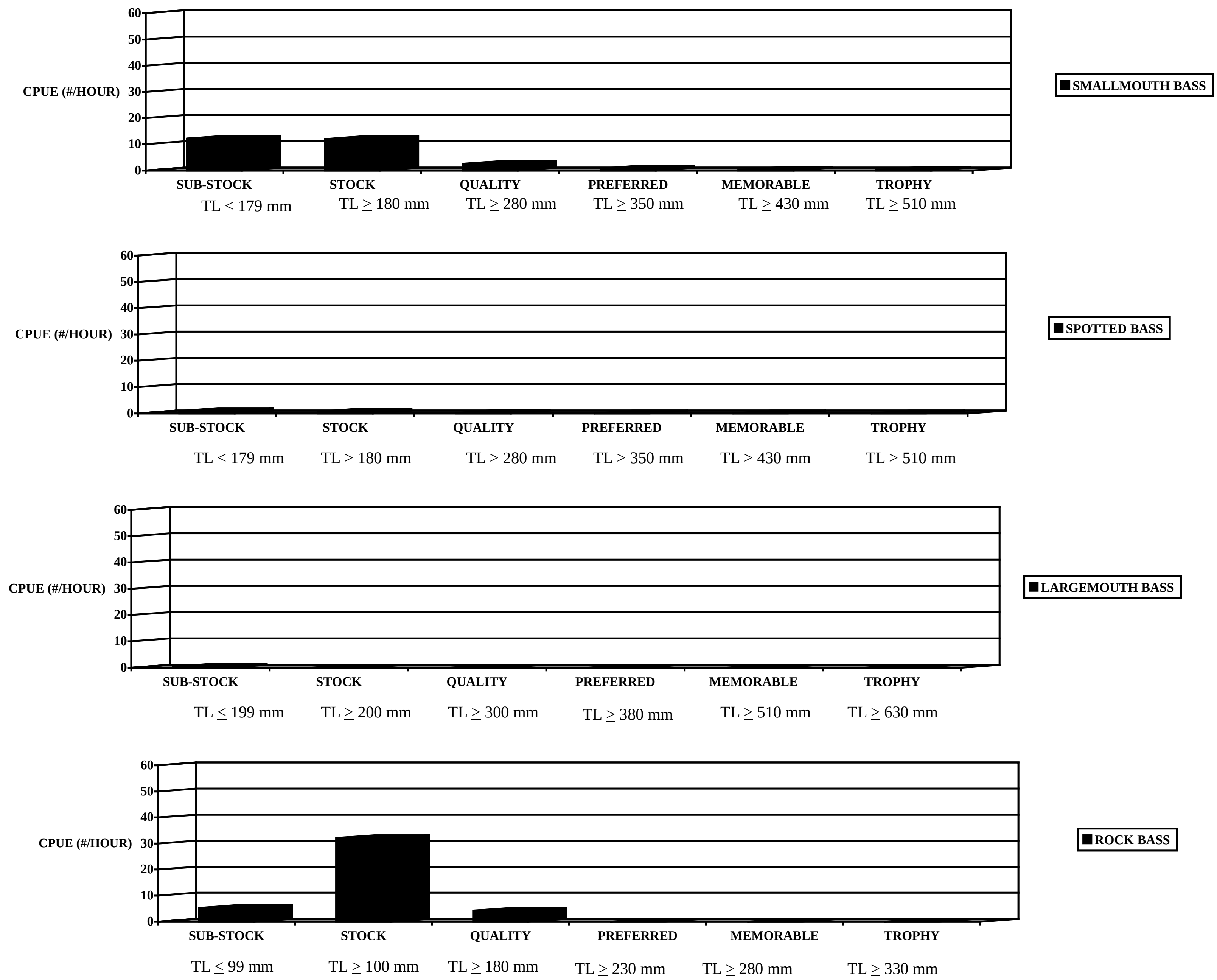


Figure 3. Relative stock density (RSD) catch per unit effort by category* for black bass and rock bass collected in the Clinch River during 1999.



* Length categories after Gabelhouse (1984)

Figure 4. Mean length at age and von Bertalanffy growth statistics for black bass and rock bass collected in the Clinch River during 1999. Statewide mean based on 1995-99 data (TWRA, unpublished data).

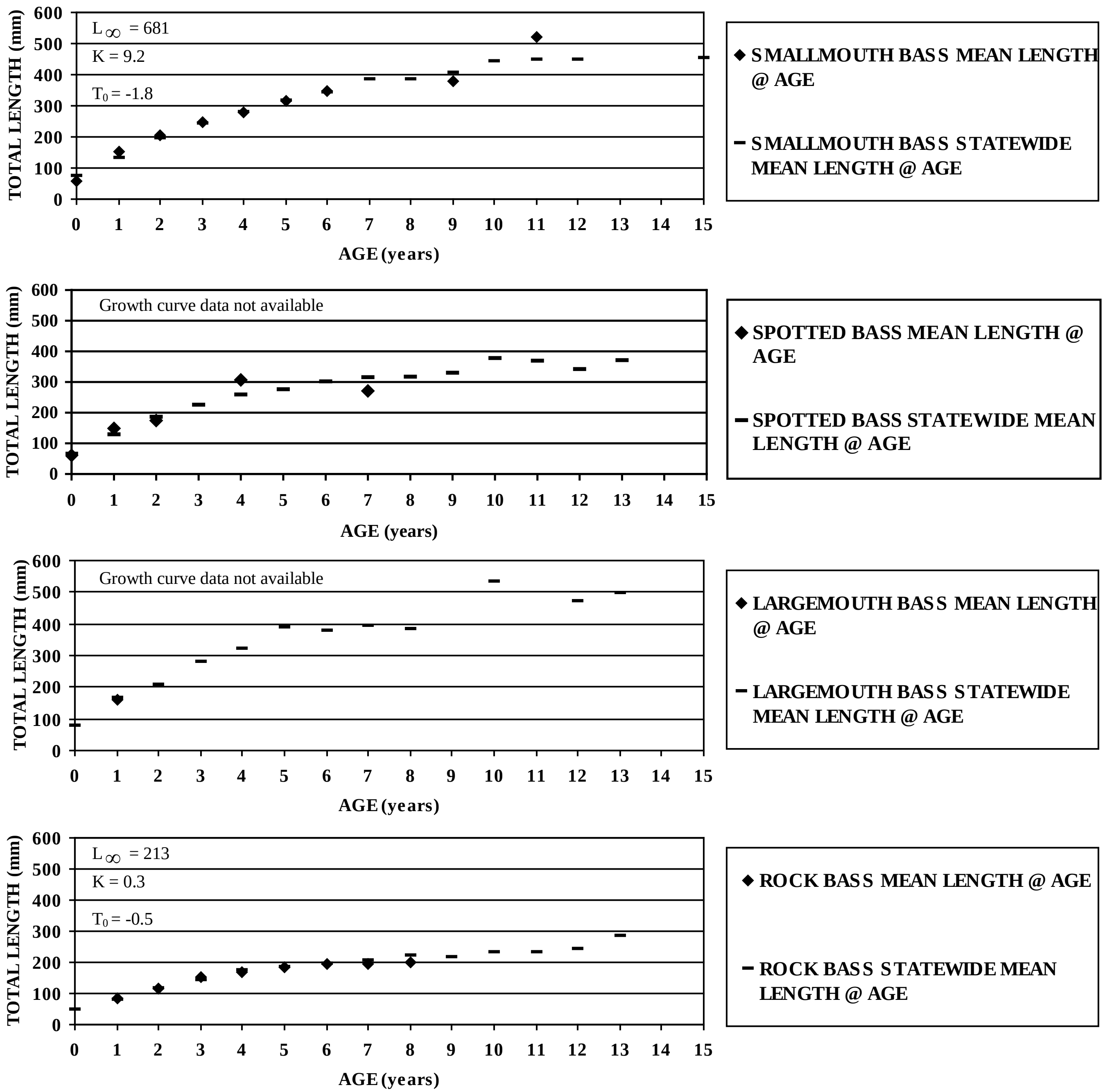
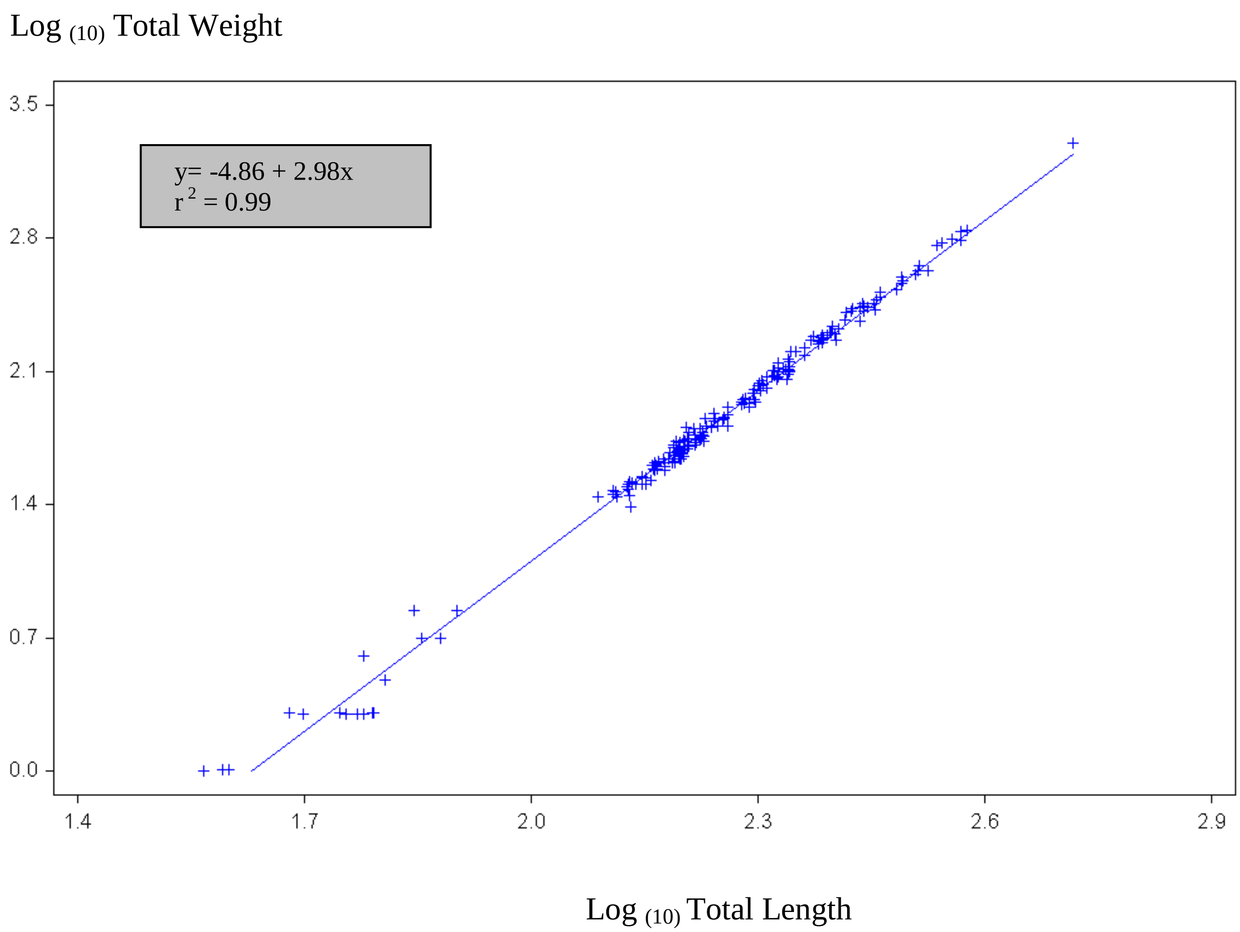


Figure 5. Linear and curvilinear length-weight relationships for smallmouth bass collected in the Clinch River during 1999.



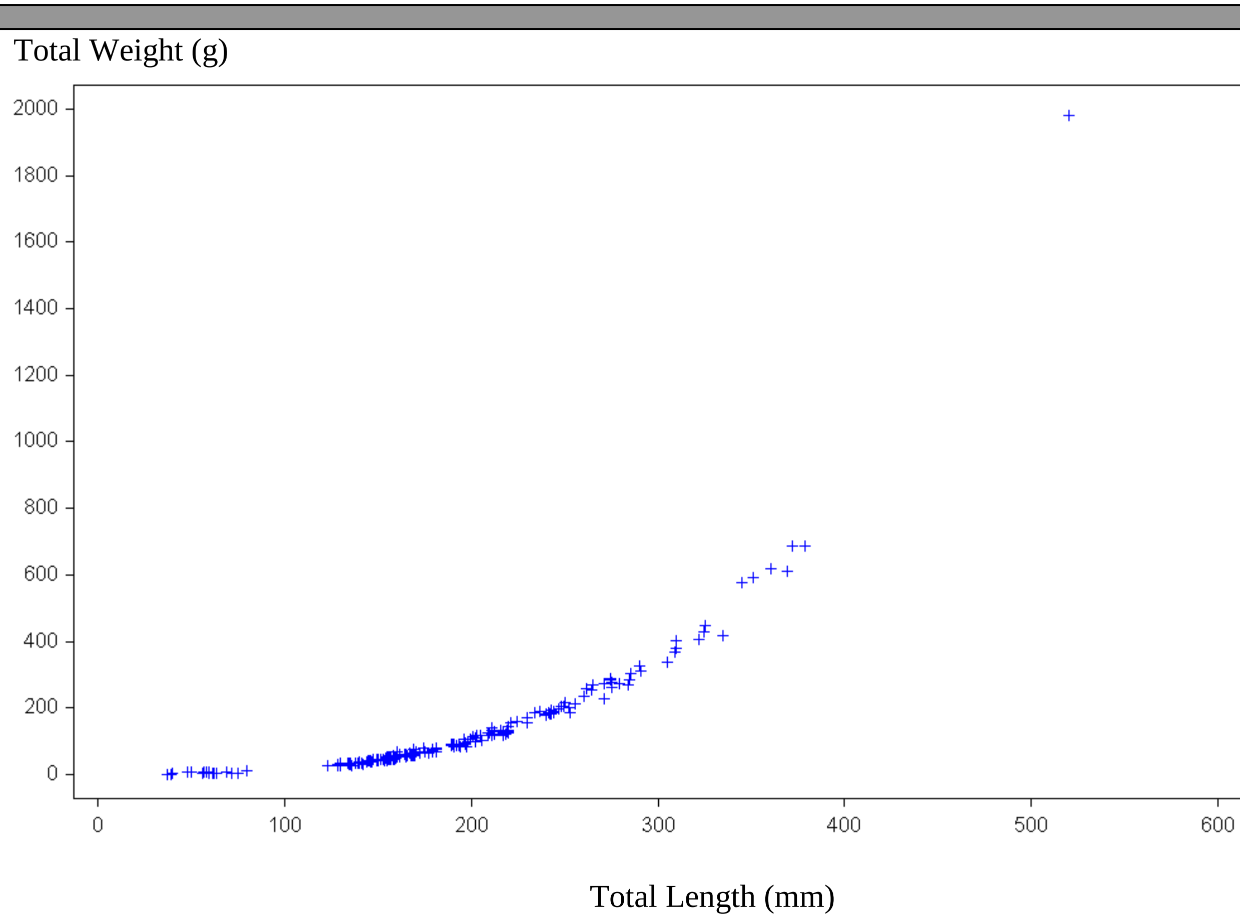
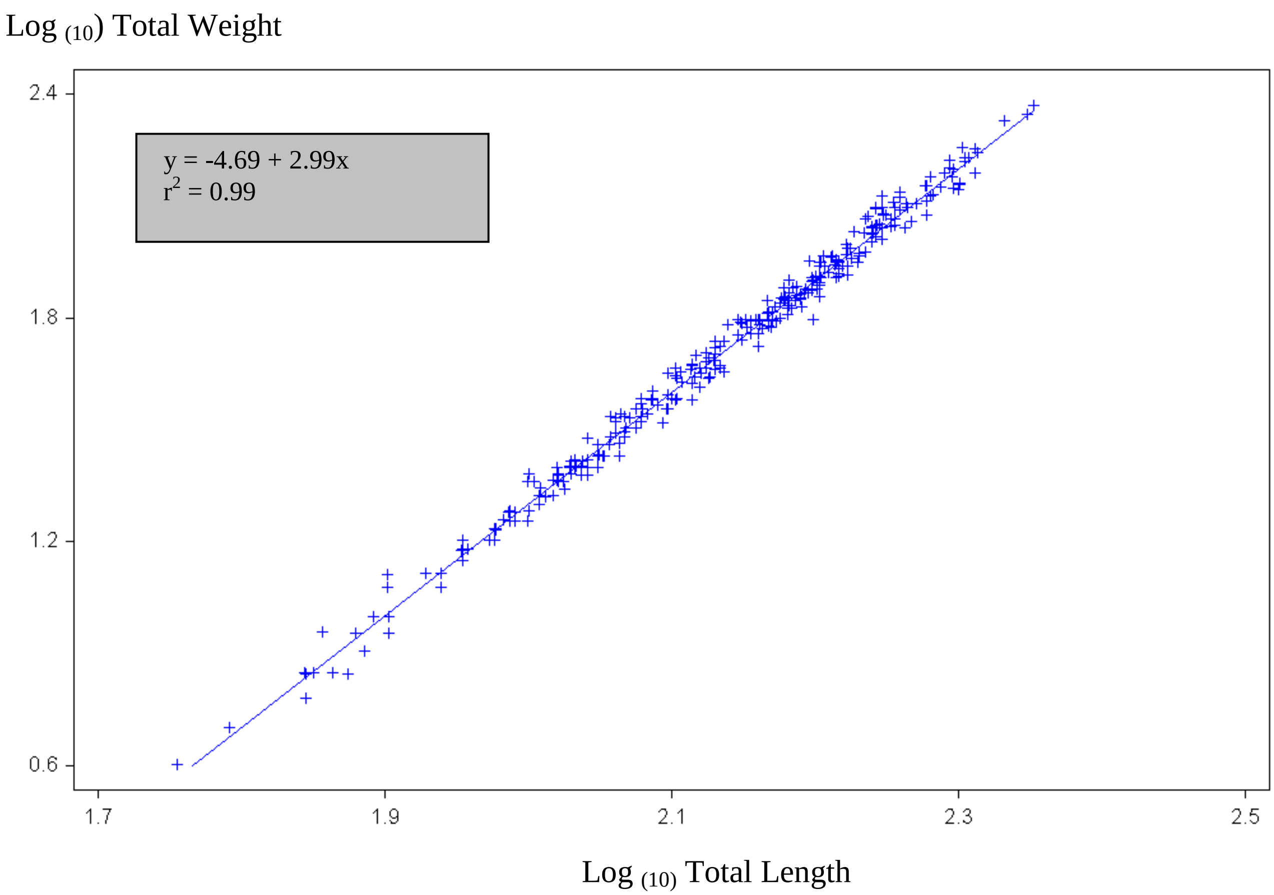
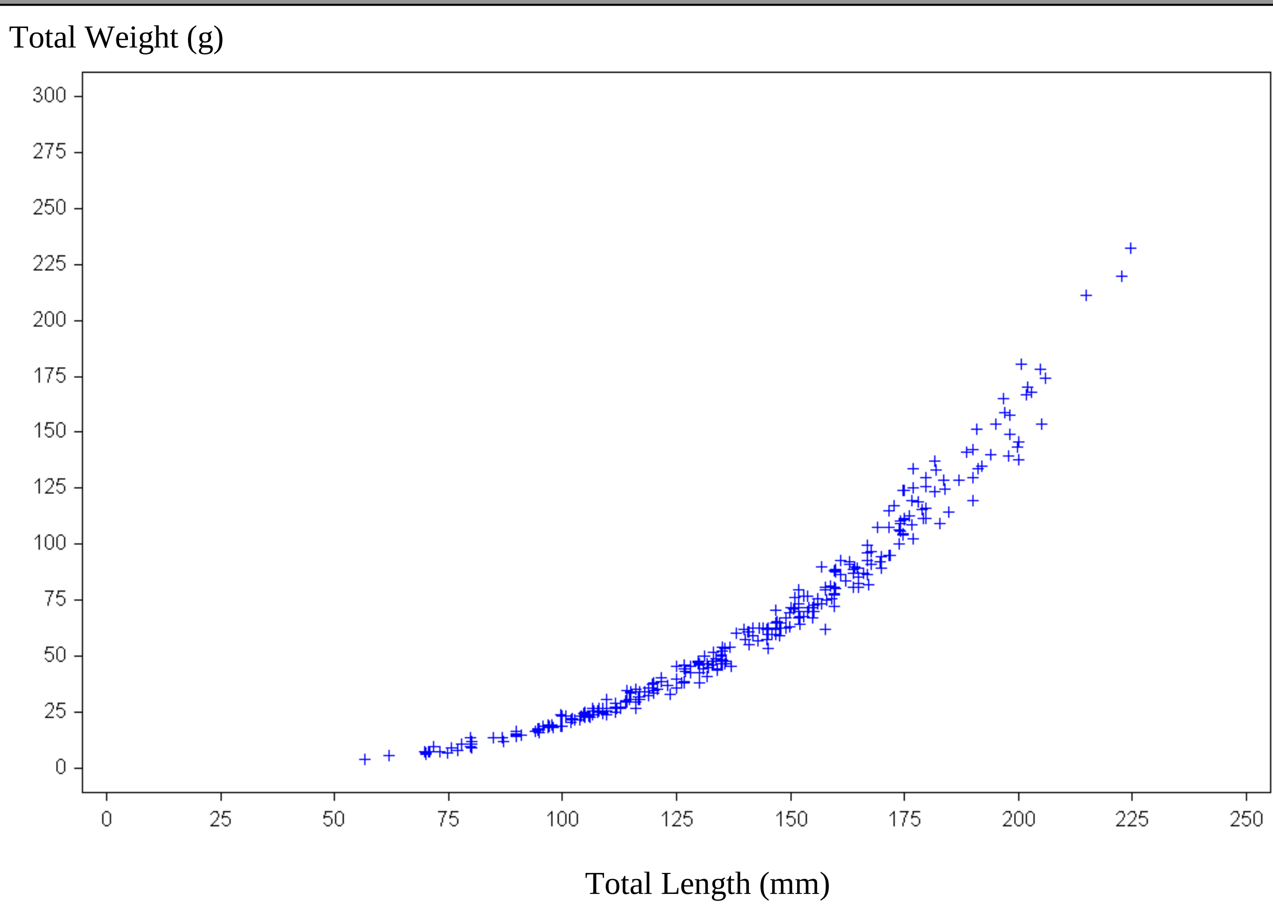


Figure 6. Linear and curvilinear length-weight relationships for rock bass collected in the Clinch River during 1999.





ution of fish species collected in the Clinch River during 1999.

CLINCH RIVER MILE →		202	201	199	198	196	195	193	192	190	188	187	186	184	182	181	179	177	176	175	173	172	171	170	169	167	165	164	163	161	160	154	152
SITE CODE →		4199925001	4199925002	4199925003	4199925004	4199925005	4199925006	4199925007	4199925008	4199925009	4199925010	4199925011	4199925012	4199925013	4199925014	4199925015	4199925016	4199925017	4199925018	4199925019	4199925020	4199925021	4199925022	4199925023	4199925024	4199925025	4199925026	4199925027	4199925028	4199925029	4199925030	4199925031	4199925032
SCIENTIFIC NAME	**STATUS**																																
Labidesthes sicculus																																●	
Hypentelium nigricans		●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●		●		●	●	●	●	●	●	●	●	●	●	●	
Moxostoma anisurum								●													●												
Moxostoma carinatum		●			●		●	●		●				●	●	●				●			●			●	●	●	●		●		
Moxostoma duquesnei		●	●	●	●			●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
Moxostoma erythrurum			●	●				●	●	●	●	●	●				●	●	●	●	●	●	●	●			●			●			●
Moxostoma macrolepidotum		●	●	●	●	●	●	●	●	●			●	●	●	●	●	●	●			●	●	●	●	●		●	●	●	●	●	●
Ambloplites rupestris		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●		●	●	●	●	●
Lepomis auritus		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●			●	●					●			
Lepomis cyanellus																						●											
Lepomis macrochirus							●				●		●							●					●		●			●		●	●
Lepomis megaloits			●	●	●	●		●	●		●		●			●	●	●	●	●	●	●	●	●	●			●		●	●	●	
Lepomis microlophus		●																															
Lepomis sp. (hybrid)										●																							
Micropterus dolomieu		●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Micropterus punctulatus											●					●	●		●		●			●			●			●			●
Micropterus salmoides				●																●												●	
Pomoxis nigromaculatis																				●													
Dorosoma cepedianum				●		●		●				●		●			●	●		●	●	●	●	●		●	●				●	●	●
Campostoma anomalum		●		●						●	●		●		●		●							●	●			●				●	
Cyprinella galactura		●		●	●		●			●				●	●		●	●				●	●	●	●	●	●					●	●
Cyprinella spiloptera		●		●		●		●	●	●	●	●	●			●		●	●			●	●	●	●							●	●
Cyprinus carpio																									●				●		●	●	
Erimystax dissimilis		●		●		●	●	●		●	●		●	●	●			●		●		●	●			●	●				●		
Hybopsis amblops		●											●										●										
Luxilus chrysocephalus		●											●				●	●		●			●									●	

Powell River

Introduction

The remoteness of the Powell River makes it one of the premier warmwater rivers in east Tennessee. It offers the opportunity to take float trips without seeing another individual during the course of a day. The surroundings are appealing which makes a trip to the Powell well worth the drive. It is an important recreational resource for the state both in consumptive and non-consumptive uses. It provides critical habitat for threatened and endangered species and species of special concern. The river supports a diverse fish community and has been documented to host some 37 species of mussels (Ahlstedt 1986). It is one of only two rivers in the region having reaches designated as mussel sanctuaries. Additionally, it supports one of east Tennessee's better warmwater sport fisheries. The Powell River has been the focus of numerous surveys and investigations conducted by both state and federal agencies with the major purpose of assessing and monitoring the fish and benthic communities. 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 Powell River focused on developing a fish species list and assessing the relative condition of the sport fish populations in the river from the Virginia state line to the Powell River embayment of Norris Reservoir.

Study Area and Methods

The Powell River originates in Virginia and flows in a southwesterly direction before emptying into Norris Reservoir near river mile 54. The river has a drainage area of approximately 1,774 kilometers^2. In Tennessee, all of the Powell River flows through the Ridge and Valley province of east Tennessee coursing by the town of Harrogate before emptying into Norris Reservoir near the community of Authur. Public access along the river is primarily limited to bridge crossings and small "pull-outs" along roads paralleling the river. There are several primitive launching areas for canoes or small boats and one developed launching area managed by the Tennessee Wildlife Resources Agency (Mulberry Creek).

Between August 2 and August 10 1999, we conducted 31 fish surveys between the Virginia state line and Norris Reservoir (Figure 7). In our survey sites, the riparian habitat consisted primarily of wooded shorelines with interspersed agricultural fields. Submerged woody debri was fairly common in most of our sample areas as was water willow. The river substrate was predominately boulder/cobble in riffle areas and bedrock with interspersed boulders/cobble in the pool habitat. Measured mean channel widths ranged from 22.5 meters to 52.0 meters, while site lengths fell between 261 meters and 673 meters (Table 4). Water temperatures ranged from 25.0 C to 29.5 C and conductivity varied from 366 to 388 (Table 4).

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). Additionally, 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 standardized to 900 seconds (15 minutes). 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.

Length categorization indices were calculated for target species following Gabelhouse (1984). Potential population growth analyses for length were conducted for smallmouth bass and rock bass according to the models described by Everhart et al. (1975). Annual mortality estimates were derived for target species whose data met the requirements described by Van Den Avyle (1993).

Results

Smallmouth bass (*Micropterus dolomieui*) and rock bass (*Ambloplites rupestris*) were present at all 31 surveys sites (Table 5). Largemouth bass (*M. salmoides*) and spotted bass (*M. punctulatus*) were encountered less frequently and probably do not contribute significantly to the overall sport fishery. Rock bass, on average, was the most abundant game species at any of the survey sites. CPUE estimates for this species averaged 65.0/hour (SD 44.4). Mean CPUE estimates for black bass were somewhat lower with smallmouth bass averaging 32.9 (SD 17.8), while spotted and largemouth bass estimates averaged 3.2/hour (SD 6.8) and 0.4/hour (SD 1.2), respectively (Table 5). The catch of rock bass and smallmouth bass seemed to be evenly distributed throughout the river with no one area having substantially higher catch rates. The trend in the catch of spotted bass and largemouth bass increased as we approached the reservoir with the highest value for spotted bass being recorded at the most downstream site (31) (Table 5).

The majority of the smallmouth bass collected in the Powell River during 1999 fell within the 125 mm to 250 mm length range (Figure 8). Our data indicated that fish less than 100 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 7.0. RSD for memorable (TL $\geq$430 mm) and trophy (TL $\geq$ 510 mm) size bass were 2.3 and 0, respectively. The ratio of quality (TL $\geq$ 280 mm) smallmouth bass to stock size bass (TL $\geq$ 180 mm) was 27.3. Catch per unit effort estimates by RSD category indicated smallmouth bass had relatively high catch rates for the categories RSD-S and RSD-Q and a relatively high CPUE value for sub-stock bass indicating good recruitment (Figure 9). Overall, growth rates for smallmouth were very similar to those values reported for the statewide average for age groups represented in the 1999 sample (Figure 10). The von Bertalanffy growth statistics calculated for smallmouth bass predicted a maximum length of 523 mm (~ 21 inches) for the population (Figure 10). Curvilinear and linear length-weight regression analysis indicated steady growth up through the 500 mm length range and yielded a length-weight equation of -5.09 + 3.07x (Figure 11). The annual mortality estimate calculated for smallmouth bass in the Powell River was about 40% and was similar to estimates calculated for other rivers in the region.

The majority of the spotted bass collected in the Powell River during 1999 fell within the 150 mm to 175 mm length range (Figure 8). Length categorization analysis indicated the RSD for preferred spotted bass (TL $\geq$ 350 mm) was 0. 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 36.4. Catch per unit effort estimates by RSD category revealed very few RSD-Q and larger spotted bass (Figure 9). Overall, represented growth rates for spotted bass were similar to those reported for the statewide average (Figure 10). Because of the relatively low sample size none of the growth or mortality statistics were calculated.

Largemouth bass collected in the Powell River during 1999 fell within the 150 mm to 225 mm length range (Figure 8). Because of the very low sample size collected in the Powell River, any statistical analysis would be meaningless. Therefore, largemouth bass are not considered to be an important contributor to the overall sport fish abundance in the Powell River.

Individuals in the 75 mm to 175 mm range represented the majority of rock bass in our sample (Figure 8). Length categorization analysis indicated the RSD for preferred rock bass (TL $\geq$ 230 mm) was 0.2. 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 26.4. Annual growth rates for rock bass collected in the 1999 sample approximated those reported for the statewide average through age 8, but were slightly lower for ages 9-11 (Figure 10). The von Bertalanffy growth statistics calculated for rock bass predicted a potential maximum length of 234 mm (~ 9 inches) for the population (Figure 10). Curvilinear and linear length-weight regression analysis indicated steady growth through the represented length classes and yielded a length-weight equation of -4.68 + 2.98x (Figure 12). The annual mortality estimate calculated for rock bass in the Powell River was about 34%, which was within the range of values observed in other rivers in the region.

Several other species were collected or observed during our survey of the Powell River, which included one **In Need of Management Species** *(Percina aurantiaca*). A list of species occurrence by site can be found in Table 6.

Discussion

The Powell River provides anglers with the opportunity to catch all species of black bass and rock bass (smallmouth bass and rock bass predominant species). Because of the low numbers of spotted and largemouth bass the Powell River, it should not be considered to contain a sport fishery for these species.

The popularity of this riverine fishery is continuing to grow as more anglers shift from reservoir habitats to rivers. This trend will undoubtedly continue as the use on reservoirs increases. This type of potential for exploitation of riverine fisheries requires angler use/harvest data collection in order to effectively manage the resource. It is imperative that we obtain this data in order to answer fish management questions, public inquiries, and aid in the development of regulations.

Overall the Powell River represents one of east Tennessee's premier warmwater resources. It provides anglers with the opportunity to catch good numbers of smallmouth bass and rock bass and has the potential of producing memorable catches (both in number and size). The surrounding landscape is as eye appealing as the animals that live in and around the river. It provides an excellent escape for recreationists (consumptive and non-consumptive) who are looking for a river that offers relatively undisturbed surroundings and a diverse community of wildlife.

Surveys on the Powell River will be conducted on a five-year rotation in order to assess any changes in the fishery. Our return trip in 2004 will in all likelihood not be as intensive as the 1999 survey and will probably be confined to a percentage of sites that are most descriptive of the river.

Figure 7. Site locations for samples conducted on the Powell River during 1999.

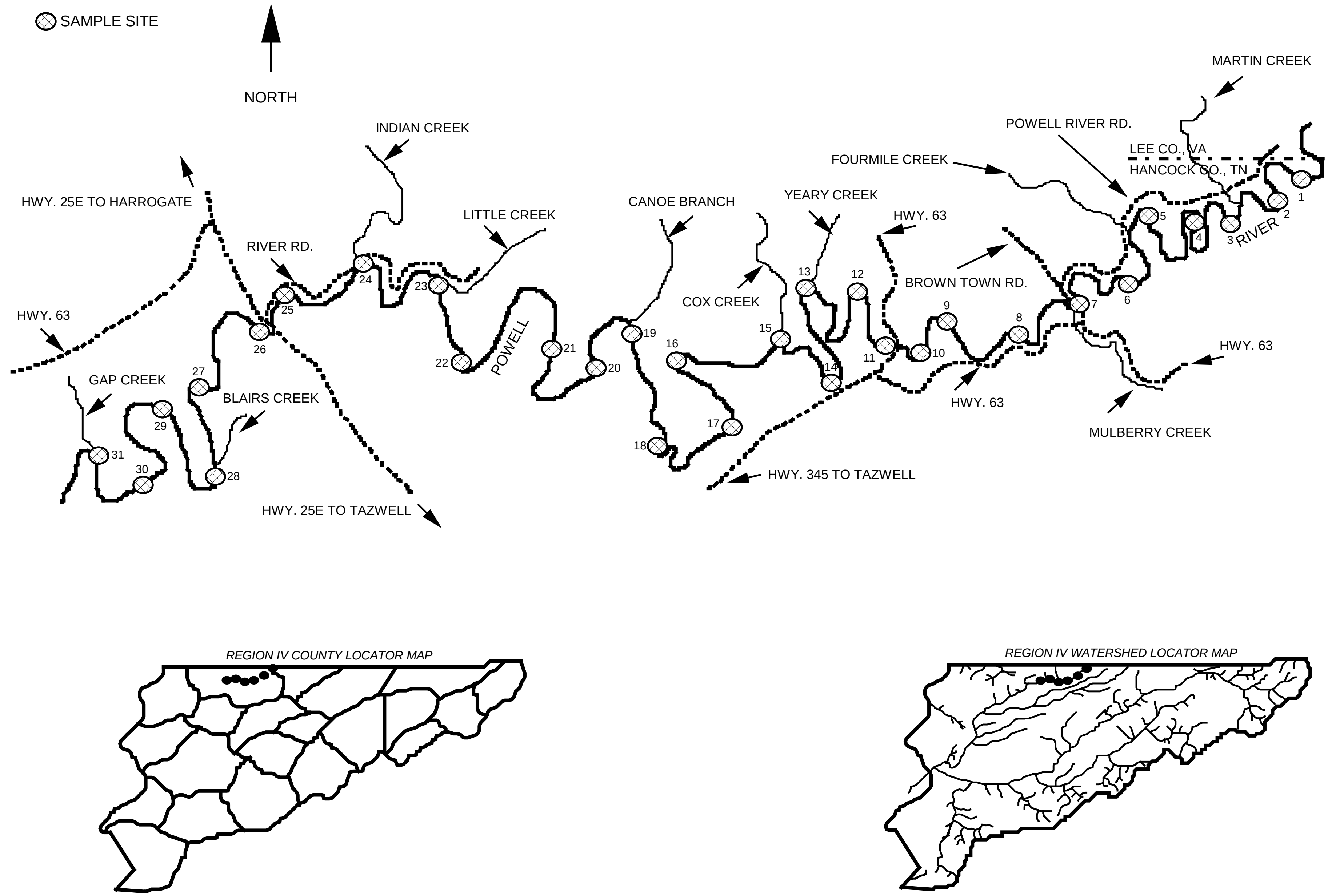


Table 4. Physiochemical and site location data for samples conducted on the Powell River during 1999.

SITE CODE	DATE	COUNTY	QUADRANGLE	LAT-LONG	RIVER MILE	MEAN WIDTH (m)	LENGTH (m)	SECCHI (m)	TEMP. (C)	COND.
419992701	8/2/99	HANCOCK	BACK VALLEY 161SE	363541N/831852W	115.0	29.5	0290	1.0	26.5	379
419992702	8/2/99	HANCOCK	BACK VALLEY 161SE	363538N/831924W	113.5	26.0	0405	1.0	27.5	379
419992703	8/2/99	HANCOCK	BACK VALLEY 161SE	363452N/832005W	112.1	30.0	0577	1.0	28.0	375
419992704	8/2/99	HANCOCK	BACK VALLEY 161SE	363445N/832044W	110.1	22.5	0539	1.5	27.5	379
419992705	8/2/99	HANCOCK	BACK VALLEY 161SE	363455N/832143W	107.6	33.5	0480	1.5	29.5	388
419992706	8/3/99	HANCOCK	BACK VALLEY 161SE	363411N/832142W	105.9	31.0	0261	1.0	25.0	370
419992707	8/3/99	HANCOCK	COLEMAN GAP 161SW	363314N/832242W	103.3	35.5	0414	1.0	26.0	370
419992708	8/3/99	HANCOCK	COLEMAN GAP 161SW	363309N/832411W	101.1	35.5	0377	1.0	27.0	370
419992709	8/3/99	HANCOCK	COLEMAN GAP 161SW	363328N/832520W	99.3	36.0	0447	1.0	28.0	370
419992710	8/3/99	CLAIBORNE	COLEMAN GAP 161SW	363244N/832654W	96.9	36.0	0386	1.0	28.0	380
419992711	8/4/99	CLAIBORNE	COLEMAN GAP 161SW	363206N/832648W	95.0	35.0	0291	1.3	25.5	365
419992712	8/4/99	CLAIBORNE	COLEMAN GAP 161SW	363305N/832720W	93.5	37.0	0407	1.3	27.0	365
419992713	8/4/99	CLAIBORNE	COLEMAN GAP 161SW	363257N/832857W	91.0	38.5	0537	1.3	27.0	360
419992714	8/4/99	CLAIBORNE	COLEMAN GAP 161SW	363136N/832751W	89.0	33.5	0466	1.3	28.5	375
419992715	8/4/99	CLAIBORNE	COLEMAN GAP 161SW	363223N/832849W	87.1	39.0	0649	1.6	28.0	370
419992716	8/6/99	CLAIBRONE	WHEELER 153SE	363126N/833007W	85.0	38.0	0568	1.9	25.0	360
419992717	8/6/99	CLAIBORNE	COLEMAN GAP 161SW	363054N/832941W	83.0	33.5	0323	1.9	26.0	360
419992718	8/6/99	CLAIBORNE	WHEELER 153SE	363054N/833052W	81.0	40.0	0383	1.9	29.0	360
419992719	8/6/99	CLAIBORNE	WHEELER 153SE	363219N/833130W	79.0	44.5	0364	1.9	29.0	370
419992720	8/9/99	CLAIBORNE	WHEELER 153SE	363153N/833202W	77.3	38.0	0570	1.1	25.0	375
419992721	8/9/99	CLAIBORNE	WHEELER 153SE	363218N/833251W	75.0	38.5	0467	1.1	25.0	370
419992722	8/9/99	CLAIBORNE	WHEELER 153SE	363151N/833429W	71.9	40.0	0399	1.1	28.0	370
419992723	8/9/99	CLAIBORNE	WHEELER 153SE	363308N/833503W	70.1	33.0	0367	1.1	28.0	380
419992724	8/9/99	CLAIBORNE	WHEELER 153SE	363327N/833621W	67.6	49.5	0536	1.1	28.0	370
419992725	8/9/99	CLAIBORNE	MIDDLESBORO SOUTH 153SW	363311N/833736W	66.1	34.0	0413	1.1	27.5	370
419992726	8/10/99	CLAIBORNE	MIDDLESBORO SOUTH 153SW	363239N/833830W	64.5	48.0	0407	N/A	25.0	360
419992727	8/10/99	CLAIBORNE	MIDDLESBORO SOUTH 153SW	363137N/833914W	62.6	41.5	0421	N/A	25.5	375
419992728	8/10/99	CLAIBORNE	MIDDLESBORO SOUTH 153SW	363019N/833855W	61.0	52.0	0352	N/A	27.5	370
419992729	8/10/99	CLAIBORNE	MIDDLESBORO SOUTH 153SW	363119N/833927W	59.0	41.5	0479	N/A	28.0	360
419992730	8/10/99	CLAIBORNE	MIDDLESBORO SOUTH 153SW	363029N/833951W	56.3	35.0	0673	N/A	28.5	370
419992731	8/10/99	CLAIBORNE	MIDDLESBORO SOUTH 153SW	363037N/834052W	54.8	42.5	0301	1.4	28.5	370

Table 5. Catch per unit effort and length categorization indices of target species collected at thirty-one sites on the Powell River during 1999.

SITECODE*	SMALLMOUTH BASS CPUE (#/HOUR)	SPOTTED BASS CPUE (#/HOUR)	LARGEMOUTH BASS CPUE (#/HOUR)	ROCK BASS CPUE (#/HOUR)
419992701	44.0	4.0	0.0	123.9
419992702	31.9	0.0	0.0	27.9
419992703	35.5	3.9	0.0	19.7
419992704	23.9	0.0	0.0	47.8
419992705	40.0	0.0	0.0	147.8
419992706	8.0	0.0	0.0	15.9
41999207	31.8	0.0	0.0	23.9
419992708	39.8	0.0	0.0	15.9
419992709	27.3	0.0	0.0	19.5
419992710	32.0	12.0	0.0	87.9
419992711	11.8	3.9	0.0	94.6
419992712	39.6	3.6	0.0	100.8
419992713	91.5	0.0	4.0	47.7
419992714	19.9	0.0	0.0	95.7
419992715	55.9	0.0	0.0	63.9
419992716	31.9	0.0	0.0	31.9
419992717	20.0	0.0	0.0	76.0
419992718	51.8	4.0	0.0	27.9
419992719	11.7	3.9	0.0	7.8
419992720	51.2	0.0	0.0	70.9
419992721	51.9	0.0	0.0	67.9
419992722	27.8	0.0	0.0	187.0
419992723	16.0	4.0	0.0	27.9
419992724	23.9	0.0	0.0	16.0
419992725	16.0	12.0	0.0	87.8
419992726	19.9	0.0	0.0	83.6
419992727	24.0	4.0	0.0	103.9
419992728	27.9	4.0	4.0	111.6
419992729	66.3	0.0	0.0	70.2
419992730	27.9	4.0	0.0	95.8
419992731	19.8	35.6	4.0	15.8
MEAN	**32.9**	**3.2**	**0.4**	**65.0**
STD. DEV.	**17.8**	**6.8**	**1.2**	**44.4**
	LENGTH-CATEGORIZATION ANALYSIS PSD = 27.3 RSD-PREFERRED = 7.0 RSD-MEMORABLE = 2.3 RSD-TROPHY = 0	**LENGTH-CATEGORIZATION ANALYSIS** PSD = 36.4 RSD-PREFERRED = 0 RSD-MEMORABLE = 0 RSD-TROPHY = 0	**LENGTH-CATEGORIZATION ANALYSIS** PSD = 0 RSD-PREFERRED = 0 RSD-MEMORABLE = 0 RSD-TROPHY = 0	**LENGTH-CATEGORIZATION ANALYSIS** PSD = 26.4 RSD-PREFERRED = 0.2 RSD-MEMORABLE = 0 RSD-TROPHY = 0

*sitesodes are listed from upstream to downstream

Figure 8. Length frequency distributions for black bass and rock bass collected in the Powell River during 1999.

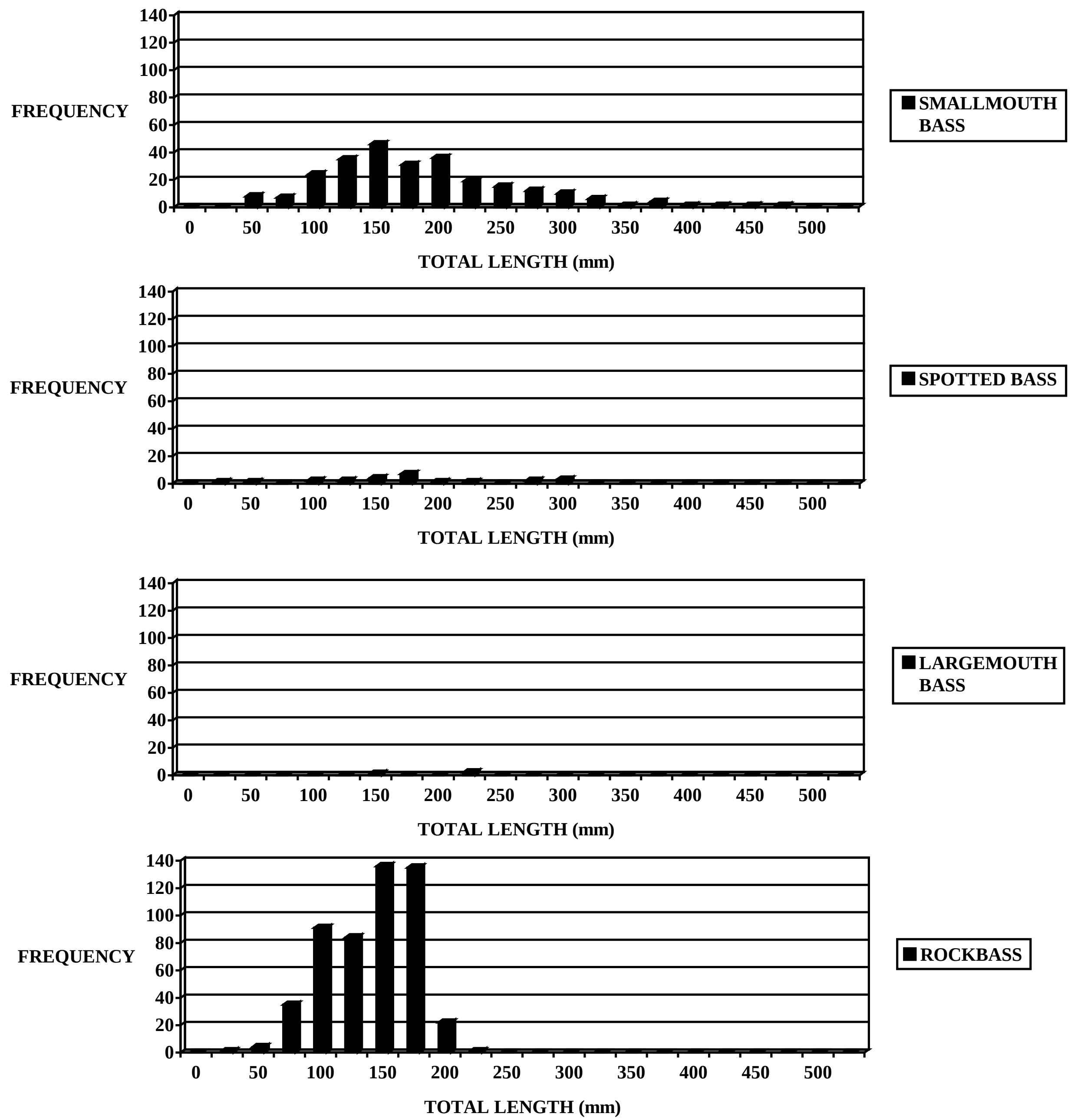
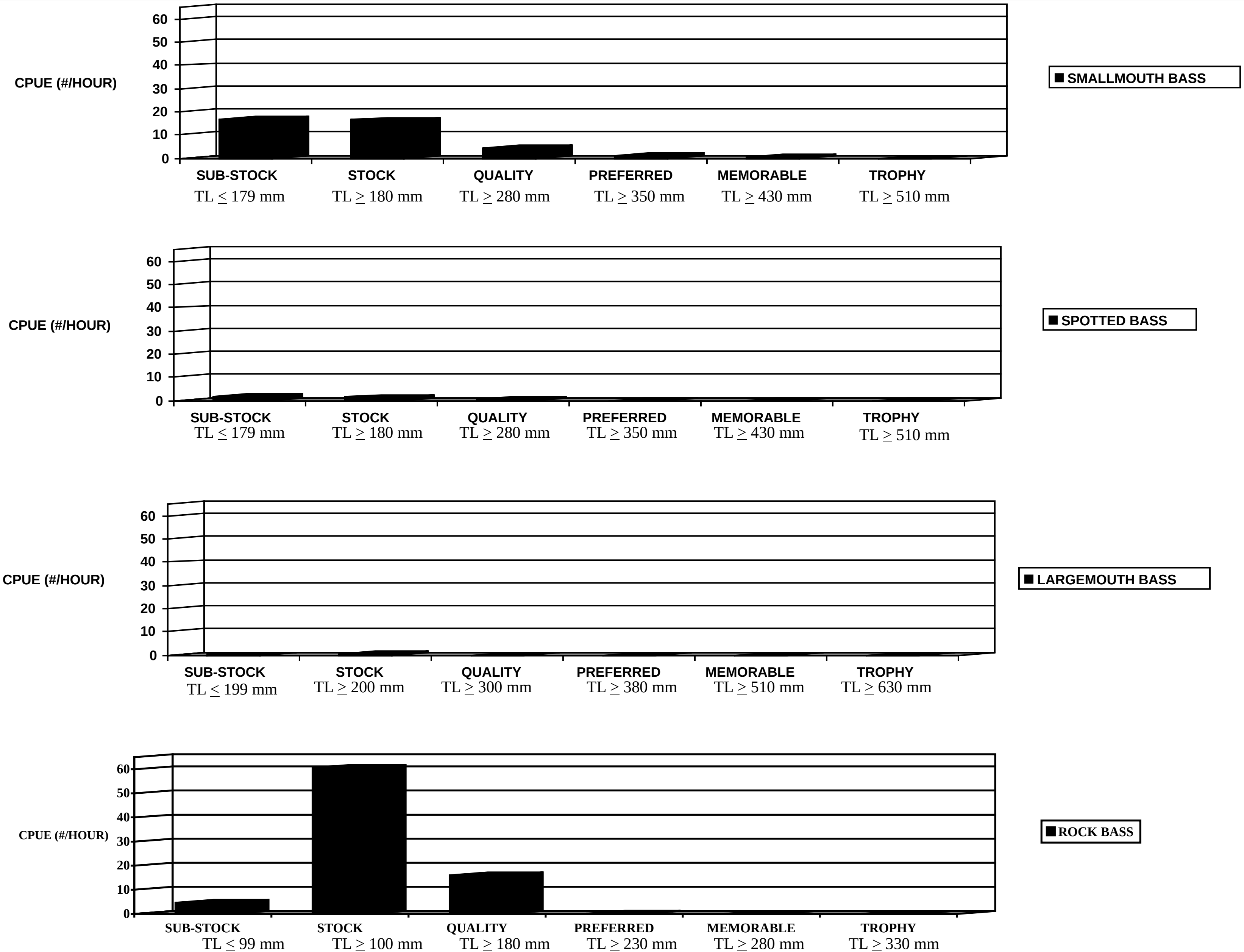


Figure 9. Relative stock density (RSD) catch per unit effort by category* for black bass and rock bass collected in the Powell River during 1999.



* Length categories after Gabelhouse (1984)

Figure 10. Mean length at age and von Bertalanffy growth statistics for black bass and rock bass collected in the Powell River during 1999. Statewide mean based on 1995-99 data (TWRA, unpublished data).

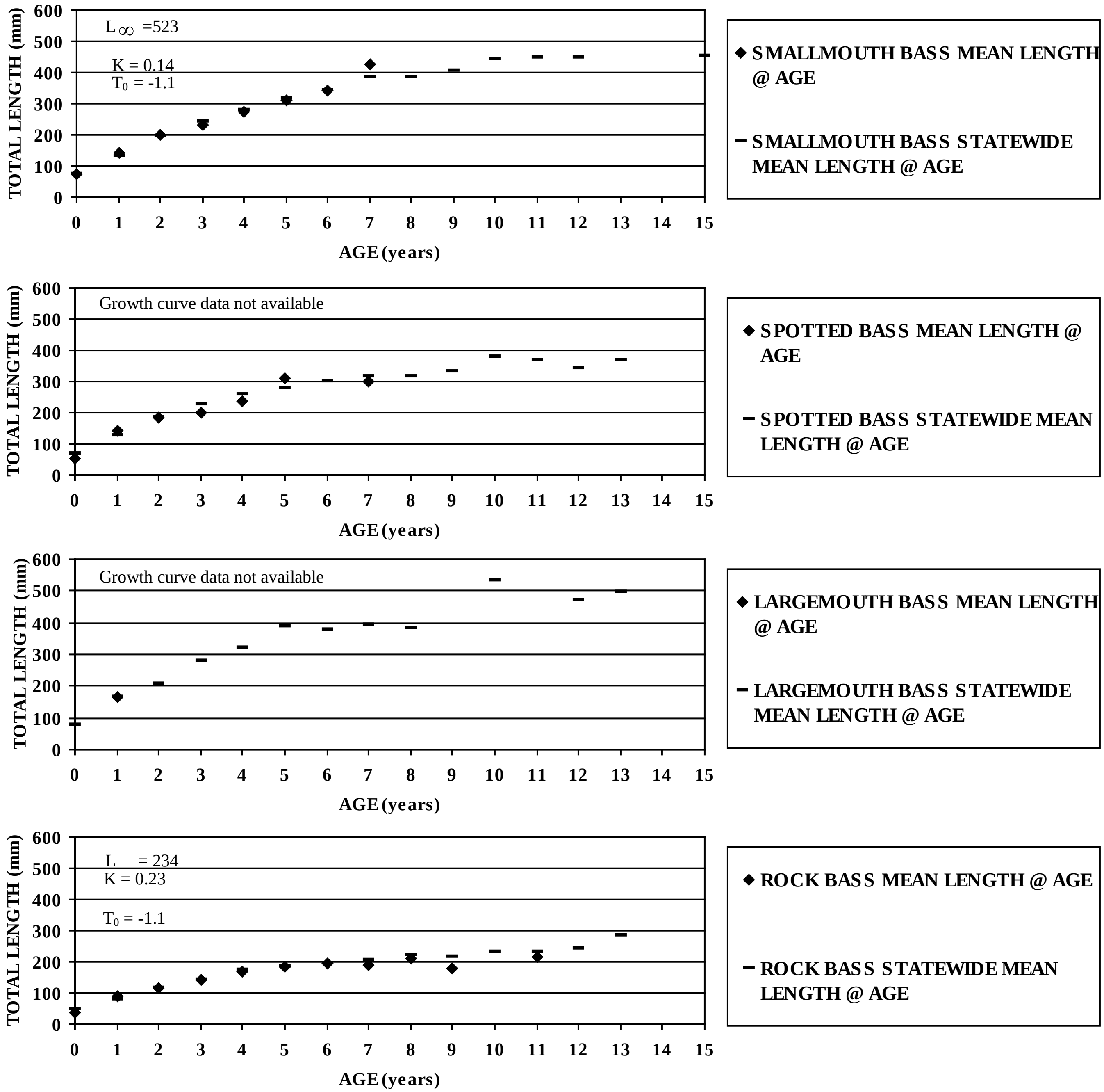
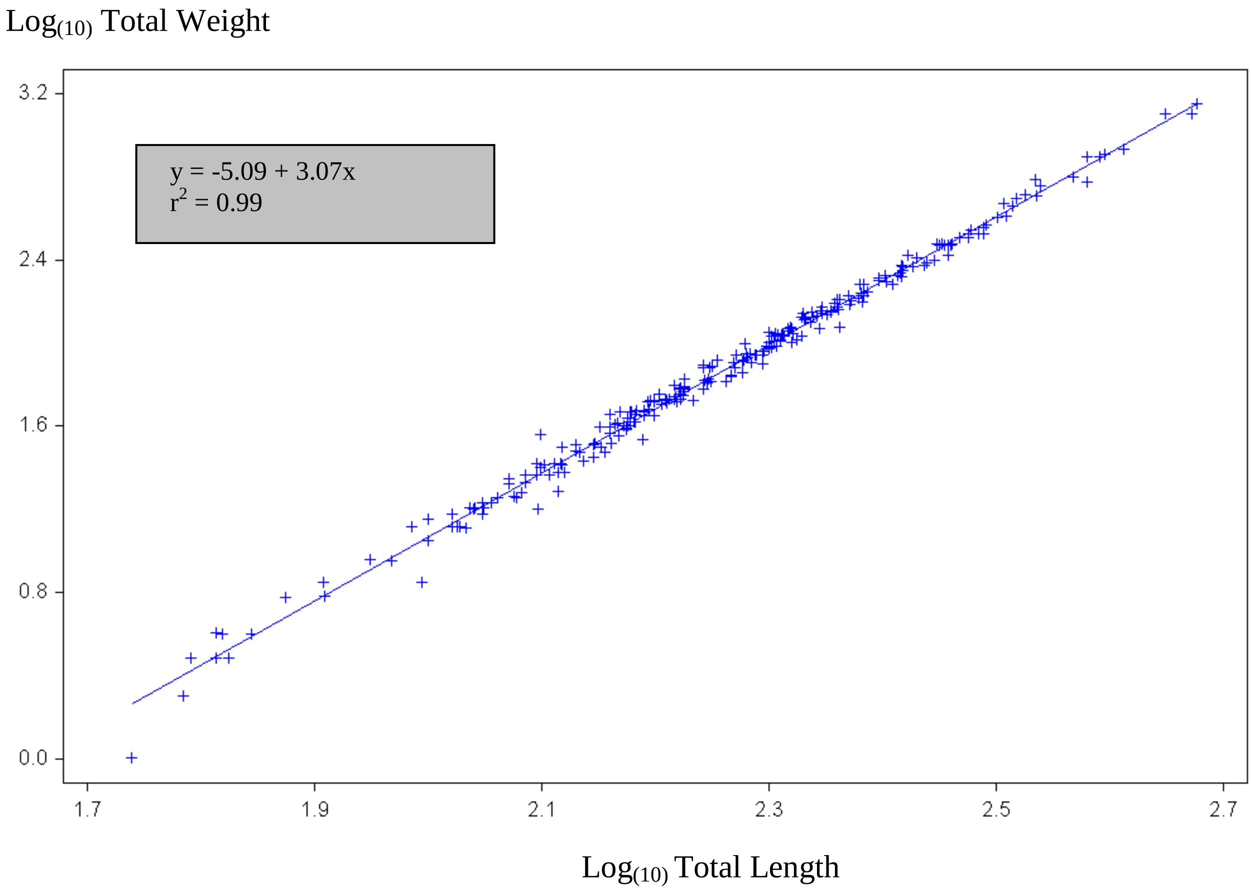


Figure 11. Linear and curvilinear length-weight relationships for smallmouth bass collected in the Powell River during 1999.



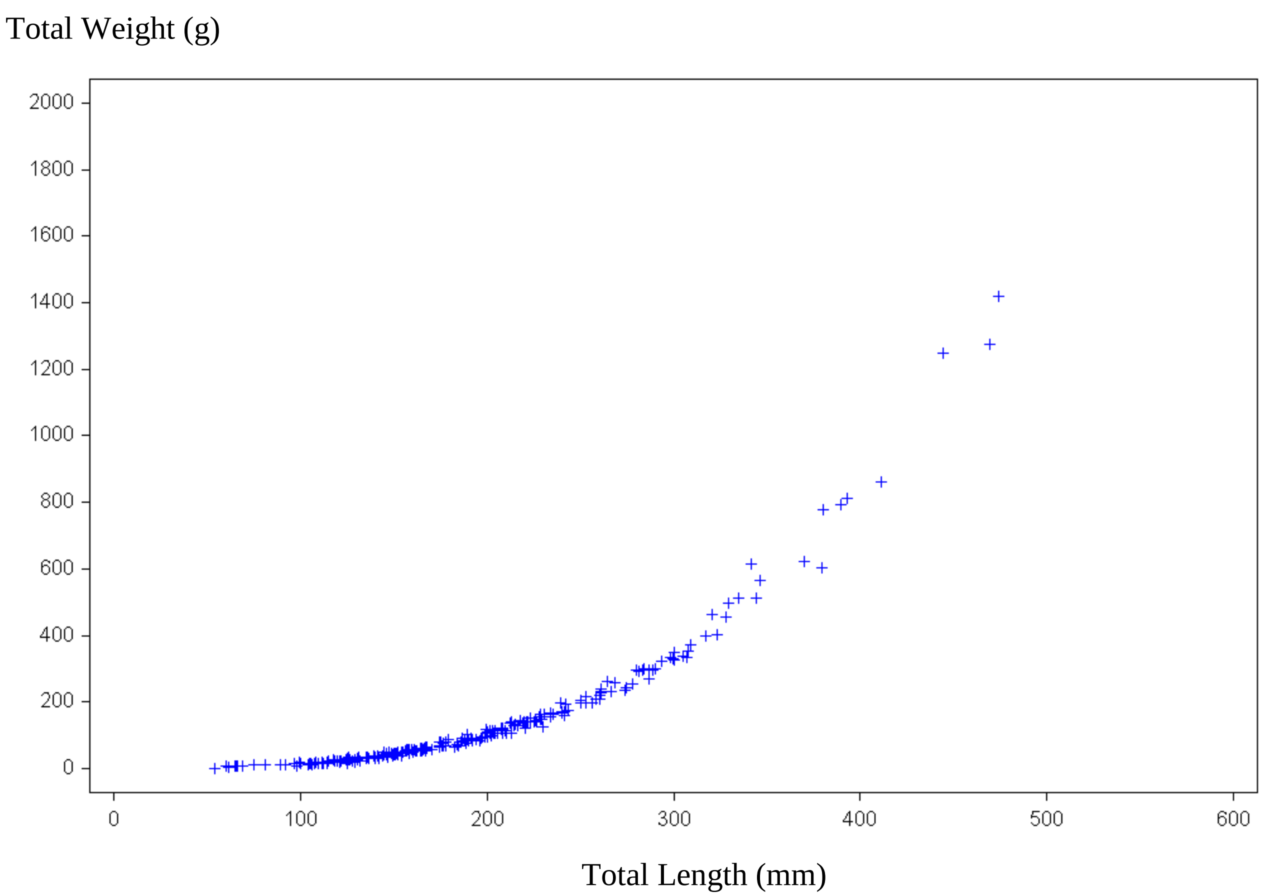
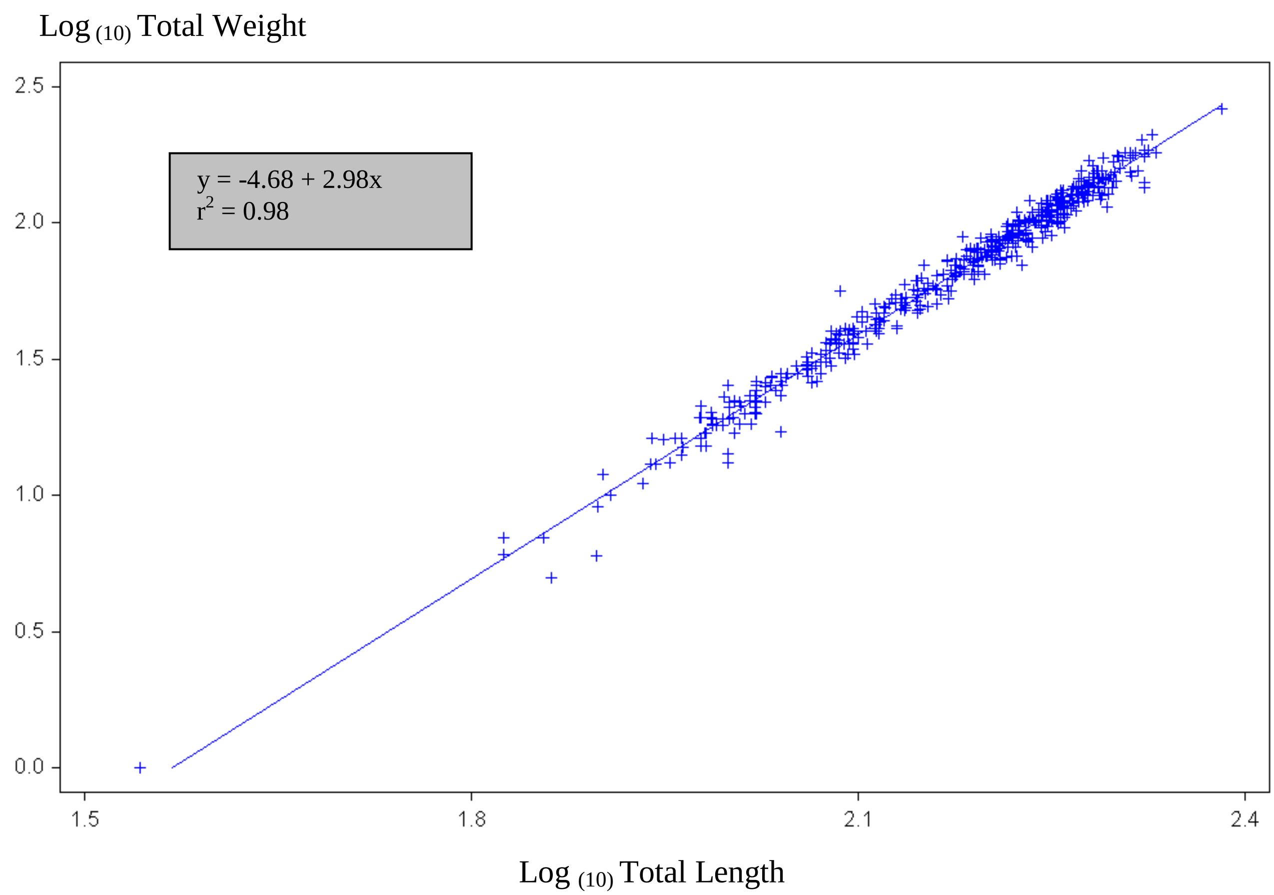


Figure 12. Linear and curvilinear length-weight relationships for rock bass collected in the Powell River during 1999.



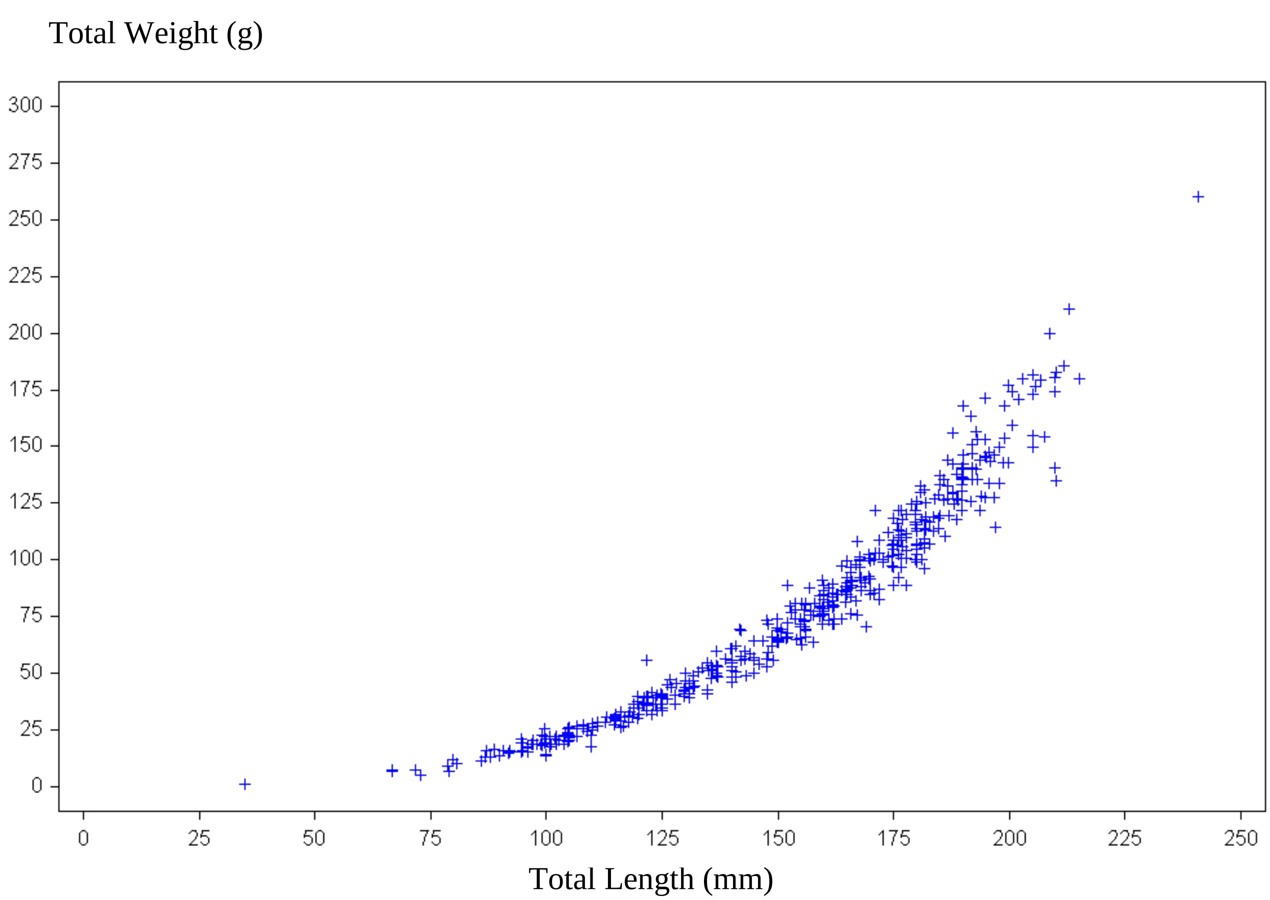


Table 6. Distribution of fish species collected in the Powell River during 1999.

FAMILY	SCIENTIFIC NAME	STATUS	115	114	112	110	108	106	106	101	99	97	95	94	91	89	87	85	83	81	79	77	75	72	70	68	66	65	63	61	59	56	55
	SITE CODE		419992701	419992702	419992703	419992704	419992705	419992706	419992707	419992708	419992709	419992710	419992711	419992712	419992713	419992714	419992715	419992716	419992717	419992718	419992719	419992720	419992721	419992722	419992723	419992724	419992725	419992726	419992727	419992728	419992729	419992730	419992731
CATOSTOMIDAE	*Hypentelium nigricans*		●	●	●	●		●	●		●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
	Moxostoma anisurum				●	●										●			●	●								●					
	Moxostoma carinatum		●	●	●	●		●	●	●	●		●	●	●	●	●	●	●	●		●		●	●		●	●	●		●	●	●
	Moxostoma duquesnei		●	●	●		●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●		●
	Moxostoma erythrurum		●		●	●		●	●	●	●		●					●	●		●	●	●			●				●		●	
	Moxostoma macrolepidotum		●	●		●	●		●	●	●	●		●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
CENTRARCHIDAE	*Ambloplites rupestris*		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Lepomis auritus		●	●	●	●	●	●	●	●		●	●								●	●											
	Lepomis macrochirus											●				●		●	●				●		●	●	●		●	●	●	●	●
	Lepomis megaloits		●		●	●	●	●	●	●	●	●	●	●	●	●		●	●		●		●	●	●	●		●	●	●			●
	Micropterus dolomieu		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Micropterus punctulatus		●		●							●	●	●							●				●		●		●	●		●	●
	Micropterus salmoides														●															●			●
	Pomoxis annularis																													●			
CLUPEIDAE	*Dorosoma cepedianum*			●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
COTTIDAE	*Cottus carolinae*			●																			●										●
CYPRINIDAE	*Campostoma anomalum*				●					●				●												●	●	●		●			
	Cyprinella galactura		●	●	●				●	●	●			●	●	●	●	●		●	●	●	●	●	●	●		●	●	●		●	
	Cyprinella spiloptera		●	●			●		●			●	●					●					●		●				●		●		
	Cyprinus carpio							●	●																								
	Erimystax dissimilis				●	●	●		●											●	●				●			●		●			
	Hybopsis amblops			●						●					●																		
	Luxilus chrysocephalus			●			●		●		●			●	●			●			●		●			●	●			●			
	Luxilus coccogenis		●	●										●								●			●					●			
	Nocomis micropogon		●		●	●	●				●			●		●	●	●	●			●	●	●		●	●	●	●	●	●		
	Notropis ariommus		●	●			●		●															●									
	Notropis leuciodus																●											●					
	Notropis photogenis						●			●						●		●		●		●	●	●				●					●
	Notropis rubellus		●	●	●	●								●			●						●			●						●	
	Notropis sp. (sawfin shiner)		●											●																			
	Notropis telescopus		●	●		●												●				●	●							●		●	
	Notropis volucellus				●				●	●				●	●			●				●				●							
	Phenacobius uranops			●			●		●		●			●										●				●					
	Pimephales notatus									●				●																			
	Rhinichthys atratulus		●																														
ICTALURIDAE	*Ameiurus natalis*		●																														
	Ictalurus punctatus					●		●			●		●	●	●		●		●						●		●	●		●	●		●
	Pylodictus olivaris			●		●									●	●	●	●	●							●		●	●				●
LEPISOSTEIDAE	*Lepisosteus osseus*								●		●			●	●	●	●	●		●		●						●					
PERCIDAE	*Ehteostoma camurum*																											●					
	Etheostoma blenniodes																●	●				●				●			●				
	Etheostoma ruflineatun																			●													
	Etheostoma vulneratum															●																	
	Etheostoma zonale																							●				●					
	Percina aurantiaca	INM	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●		●	●	●
	Percina caprodes		●							●						●		●	●	●	●		●	●	●	●	●	●	●	●	●	●	●
	Percina evides																									●							
	Stizostedion canadense													●	●													●					
PETROMYZONTIDAE	*Ichthyomyzon sp.*					●							●							●													
SCIAENIDAE	*Aplodinotus grunniens*				●									●	●					●		●						●				●	

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

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 developed its full potential. In terms of the fishery, consumption of all fish was prohibited up until 1996 when the ordinance was downgraded, limiting consumption of carp, catfish, and redbreast sunfish (TDEC 1996). Despite the continued posting of consumption advisories, the river draws a substantial amount of angling pressure. Since 1988, cooperative Index of Biotic Integrity samples have been conducted at two localities near river mile 8.2 (Tannery Island) and river mile 16.6 (Denton).

Our 1999 surveys focused on continuing our collection of catch effort data for black bass and rock bass. We returned to our established sampling areas in 1999, and added one additional site near river mile 3.6. This addition allowed us to encompass approximately 27.9 km 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) and five sites in 1998 (Carter et al. 1999). 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 was 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. The river has a drainage area of approximately 1,784 km^2 at its confluence with the French Broad River. In Tennessee, approximately 35 kilometers of the Pigeon River flows through mountainous terrain with interspersed communities and small farms before joining the French Broad River near 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 July 1 and July 23 1999, we conducted six fish surveys between Newport and the community of Hartford (Figure 13). 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 36.6 m to 61.3 m, while site lengths fell between 80 m and 869 m (Table 7). Water temperatures ranged from 20 C to 23 C and conductivity varied from 75 to 165 (Table 7).

Fish were collected by boat electrofishing in accordance with the standard large river sampling protocols (TWRA 1998). Fixed-boom electrodes were used to transfer 4-5 amps DC at all sites. This current setting was determined effective in narcotizing all target species (black bass and rock bass). Additionally, efforts were made to identify non-target species encountered at each survey site. All sites were sampled during daylight hours and had survey durations ranging from 1000 to 5368 seconds. Catch-per-unit-effort (CPUE) values were calculated for each target species at each site. Length categorization indices were calculated for target species following Gabelhouse (1984).

Results

All species of black bass and rock bass were collected from sites 1,2,3,5 and 6. Spotted bass and largemouth bass were not collected at site 4. Smallmouth bass were the most abundant black bass species at any of the survey sites. CPUE estimates for this species averaged 35.6/hour (SD 23.5), while the spotted bass and largemouth bass estimates were 3.4/hour (SD 2.4) and 3.2/hour (SD 3.8), respectively (Table 8). There was a general trend of increasing catch rates for smallmouth bass in the intermediate reaches (sites 3-5) of the river (Table 8). Largemouth and spotted bass appeared to be most abundant in the lower reaches of the river due to the close proximity of Douglas Reservoir. Rock bass CPUE was highest in the downstream sample sites (2 and 3) and averaged 8.3/hour (SD 7.7). The highest catch rate for this species was recorded at site 3 (21.5/hour), which was 61% above the five-site average.

The majority of the smallmouth bass collected in the Pigeon River during 1998 fell within the 75 mm to 200 mm length range (Figure 14). Our data indicated that bass less than 75 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 14.7. RSD for memorable (TL $\geq$ 430 mm) and trophy (TL $\geq$ 510 mm) size bass were 8.8 and 0, respectively. The ratio of quality (TL $\geq$ 280 mm) smallmouth bass to stock size bass (TL $\geq$ 180 mm) was 35.5. 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 15). The catch of sub-stock smallmouth was quite high which indicated good recruitment (Figure 15). Linear and curvilinear length-weight regression analysis indicated steady growth through the 500 mm length range and yielded a length-weight equation of $-5.08 + 3.07x$ (Figure 16). Because no otolith samples were collected, age and growth characteristics were not evaluated during the 1999 field season. It is assumed that growth characteristics were similar to those reported from the 1998 sample (Carter et al. 1999).

The majority of spotted bass collected in the Pigeon River during 1999 fell within the 150 mm to 275 mm length range (Figure 14). Our data indicated that fish less than 150mm, were for the most part, not effectively sampled. Length categorization analysis indicated the RSD for preferred spotted bass (TL $\geq$ 350 mm) was 21.1. 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 31.6. Catch per unit effort estimates by RSD category revealed very few spotted bass above the RSD-S category, indicating a relative lack of larger fish available to anglers (Figure 15). Additionally, the catch rate for sub-stock spotted bass was low indicating poor recruitment. Because no otolith samples were collected, age and growth characteristics were not evaluated during the 1999 field season. It is assumed that growth characteristics were similar to those reported from the 1998 sample (Carter et al. 1999).

Largemouth bass collected during 1999 fell within the 50 mm to 425 mm length range (Figure 14). Length categorization analysis indicated the RSD for preferred largemouth bass (TL $\geq$ 380 mm) was 5. 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 20. The catch rate for largemouth bass in RSD-Q and above were very similar to the values observed for spotted bass (Figure 15). Poor recruitment was also evident by the relative lack of sub-stock largemouth bass. Age and Growth characteristics were not evaluated during 1999, but are assumed to be similar to the values recorded in 1998 (Carter et al. 1999).

Individuals in the 100 mm to 200 mm range represented the majority of rock bass in our sample (Figure 14). Length categorization analysis indicated the RSD for preferred rock bass (TL $\geq$ 230 mm) was 1.9. 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 24.1. Catch per unit effort estimates by RSD category indicated the majority of our catch was stock size fish with few quality size rock bass represented in the sample (Figure 15). The sub-stock catch of rock bass was low, but probably does not indicate poor recruitment due to the fact that sampling efficiency is usually lower with this size group. Curvilinear and linear length-weight analysis indicated consistent growth through the represented length classes and yielded a length-weight equation of - 4.18 + 3.05x (Figure 17). It is assumed that growth characteristics were similar to those reported from the 1998 sample (Carter et al. 1999).

Several other species were collected or observed (47) during our survey of the Pigeon River. None of the fish collected in the 1999 sample were listed by the U.S. Fish and Wildlife Service or the TWRA. A list of species occurrence by site can be found in Table 9.

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 rivers "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 (Carter et al. 1999), 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.

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

Over the last 10 years the IBI scores at two stations on the Pigeon River have been steadily increasing (Figure 18). This has primarily been the result of improved wastewater treatment at the Champion Paper Mill in Canton, North Carolina. The improved water quality has undoubtedly had an affect on the amount of recreation that is currently taking place, particularly whitewater rafting. The continuation of improvements to the water quality of the Pigeon River will in all likelihood have dramatic impacts on the use of the river in the future.

Surveys on the Pigeon River will be conducted on an annual basis in order to assess any changes in the fishery that may result from the new regulation. We added an additional downstream site to our sampling regime to increase our sample size and evaluate the 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 13. Site locations for samples conducted on the Pigeon River during 1999.

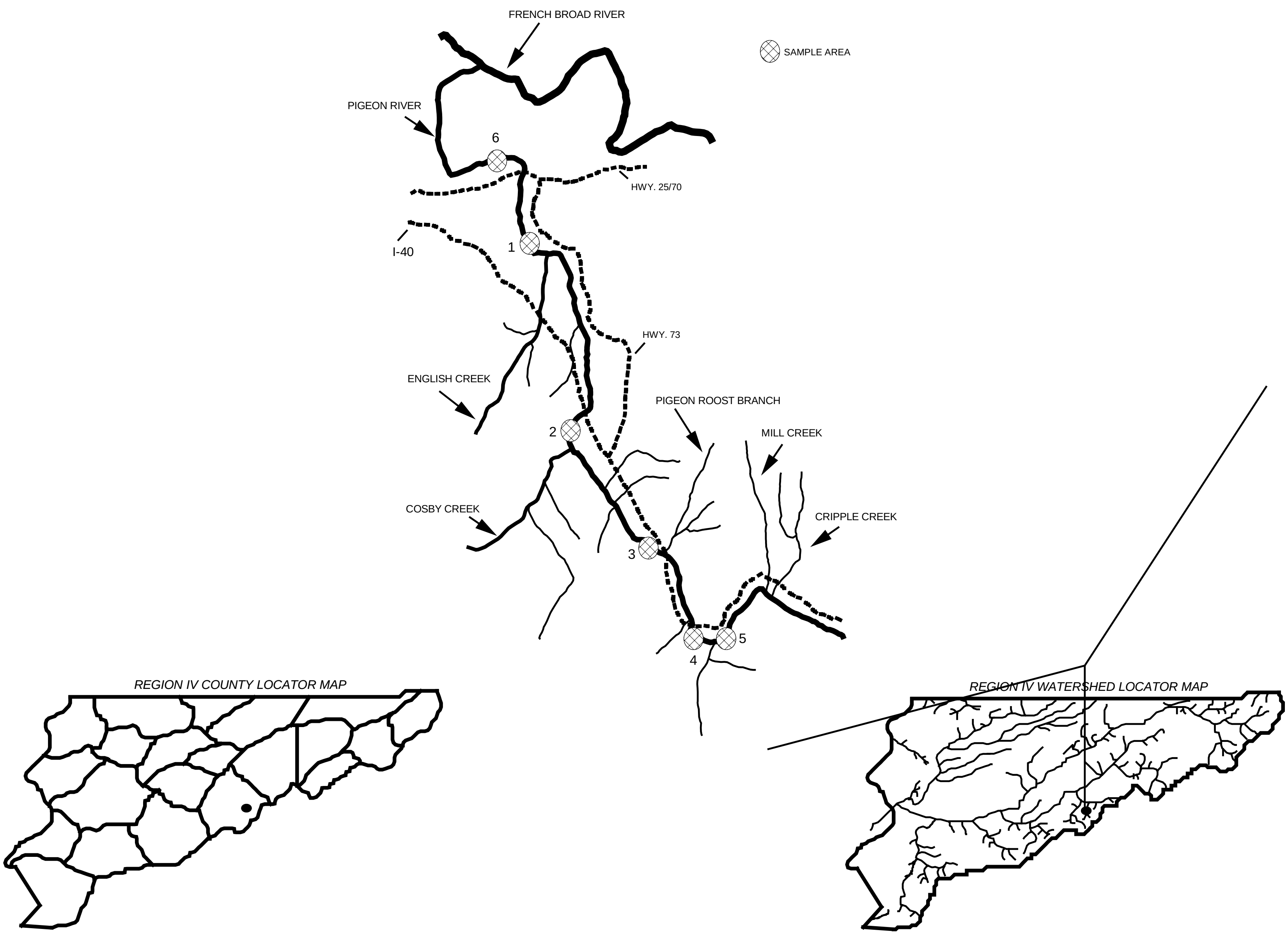


Table 7. Physiochemical and site location data for samples conducted on the Pigeon River during 1999.

SITE CODE	DATE	COUNTY	QUADRANGLE	LAT-LONG	RIVER MILE	MEAN WIDTH (m)	LENGTH (m)	SECCHI (m)	TEMP.	COND.
419992401	6/23/99	COCKE	NEWPORT 173NW	355633N/831043W	8.1	53.6	0392	0.6	23.0	160
419992402	7/1/99	COCKE	NEWPORT 173NW	355322N/831147W	13.0	61.3	0869	2.0	22.0	138
419992403	7/7/99	COCKE	HARTFORD 173SW	355039N/831104W	16.6	N/A	0414	1.2	21.0	075
419992404	7/1/99	COCKE	HARTFORD 173SW	354847N/831041W	19.0	36.6	0080	1.9	20.0	135
419992405	6/30/99	COCKE	HARTFORD 173SW	354849N/830945W	20.5	50.6	0839	2.0	21.0	103
419992406	7/1/99	COCKE	NEWPORT 173NW	355857N/831156W	3.6	54.0	0193	1.5	21.0	165

Table 8. Catch per unit effort and length-categorization indices of target species collected at six sites on the Pigeon River during 1999.

SITECODE*	SMALLMOUTH BASS CPUE (#/HOUR)	SPOTTED BASS CPUE (#/HOUR)	LARGEMOUTH BASS CPUE (#/HOUR)	ROCK BASS CPUE (#/HOUR)
419992701	14.6	3.4	1.7	6.9
419992702	25.4	5.3	10.0	13.4
419992703	39.6	5.4	0.7	21.5
419992704	79.2	0.0	0.0	3.6
419992705	36.4	1.0	5.1	1.0
419992706	18.5	5.5	1.8	3.7
MEAN	**35.6**	**3.4**	**3.2**	**8.3**
STD. DEV.	**23.5**	**2.4**	**3.8**	**7.7**
	LENGTH-CATEGORIZATION ANALYSIS	**LENGTH-CATEGORIZATION ANALYSIS**	**LENGTH-CATEGORIZATION ANALYSIS**	**LENGTH-CATEGORIZATION ANALYSIS**
	PSD = 35.3	PSD = 31.6	PSD = 20	PSD = 24.1
	RSD-PREFERRED = 14.7	RSD-PREFERRED = 21.1	RSD-PREFERRED = 5	RSD-PREFERRED = 1.9
	RSD-MEMORABLE = 8.8	RSD-MEMORABLE = 0	RSD-MEMORABLE = 0	RSD-MEMORABLE = 0
	RSD-TROPHY = 0	RSD-TROPHY = 0	RSD-TROPHY = 0	RSD-TROPHY = 0

* sitecodes are listed from downstream to upstream
(with the exception of site six)

Figure 14. Length frequency distributions for black bass and rock bass collected in the Pigeon River during 1999.

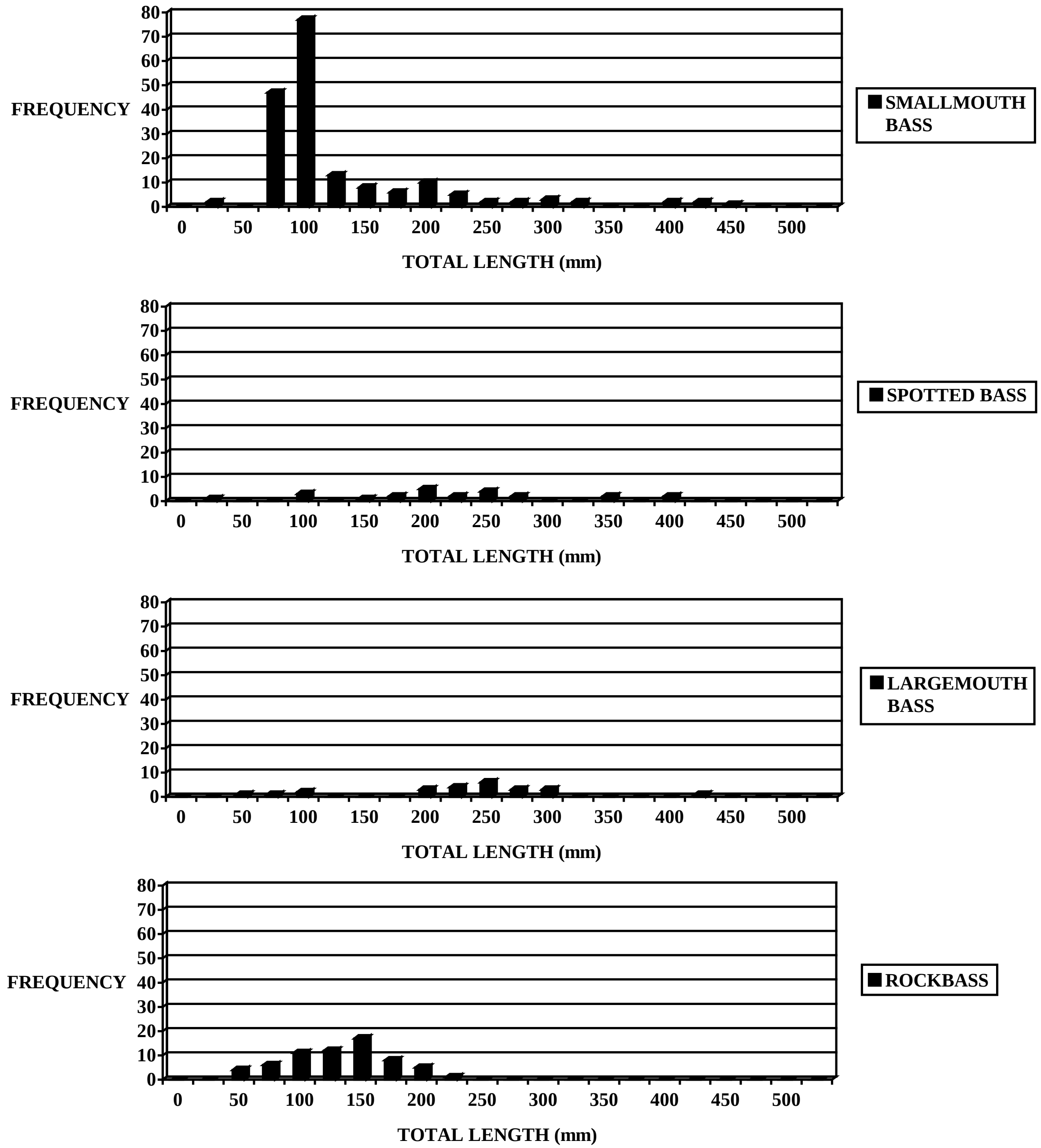
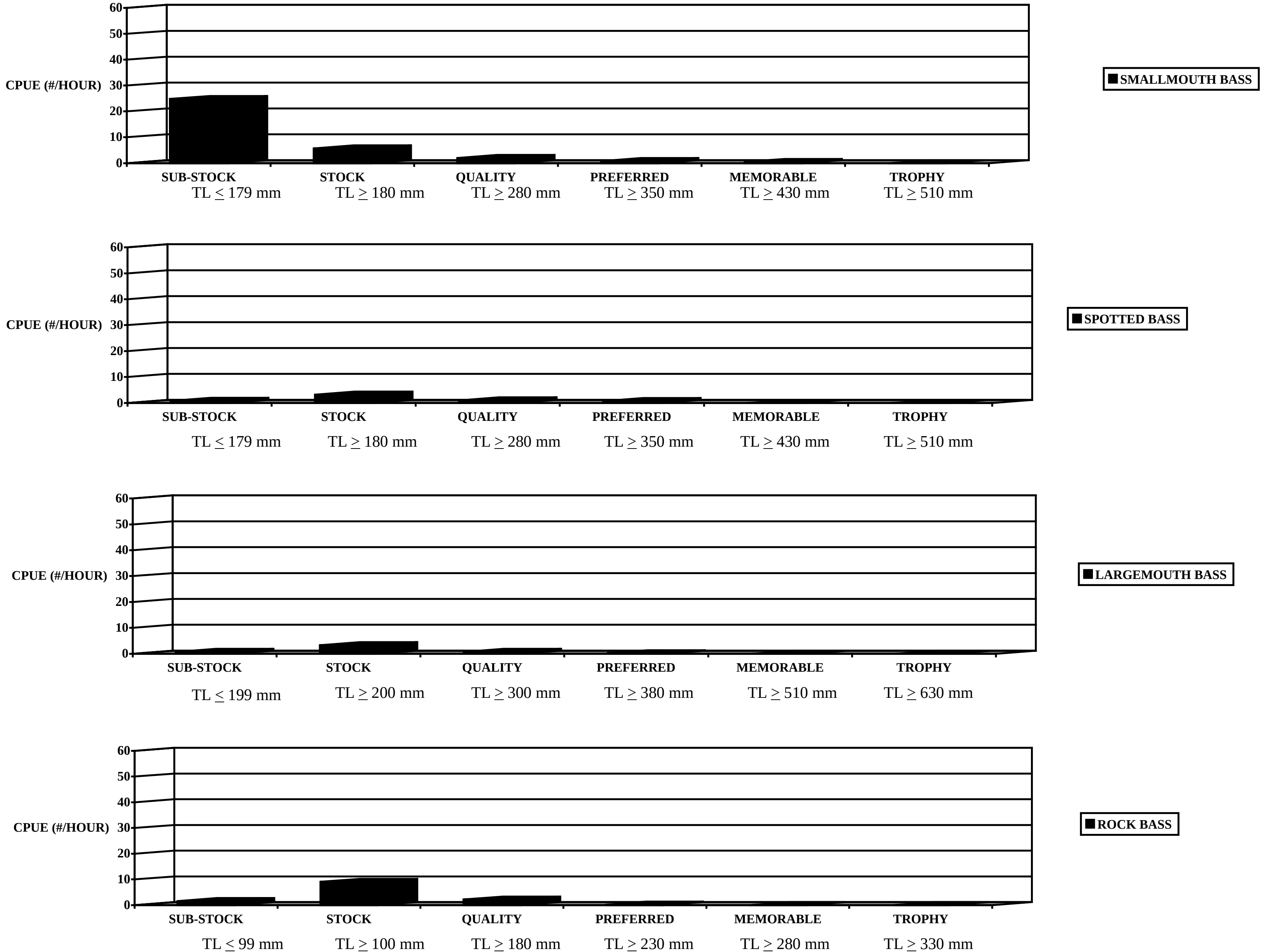
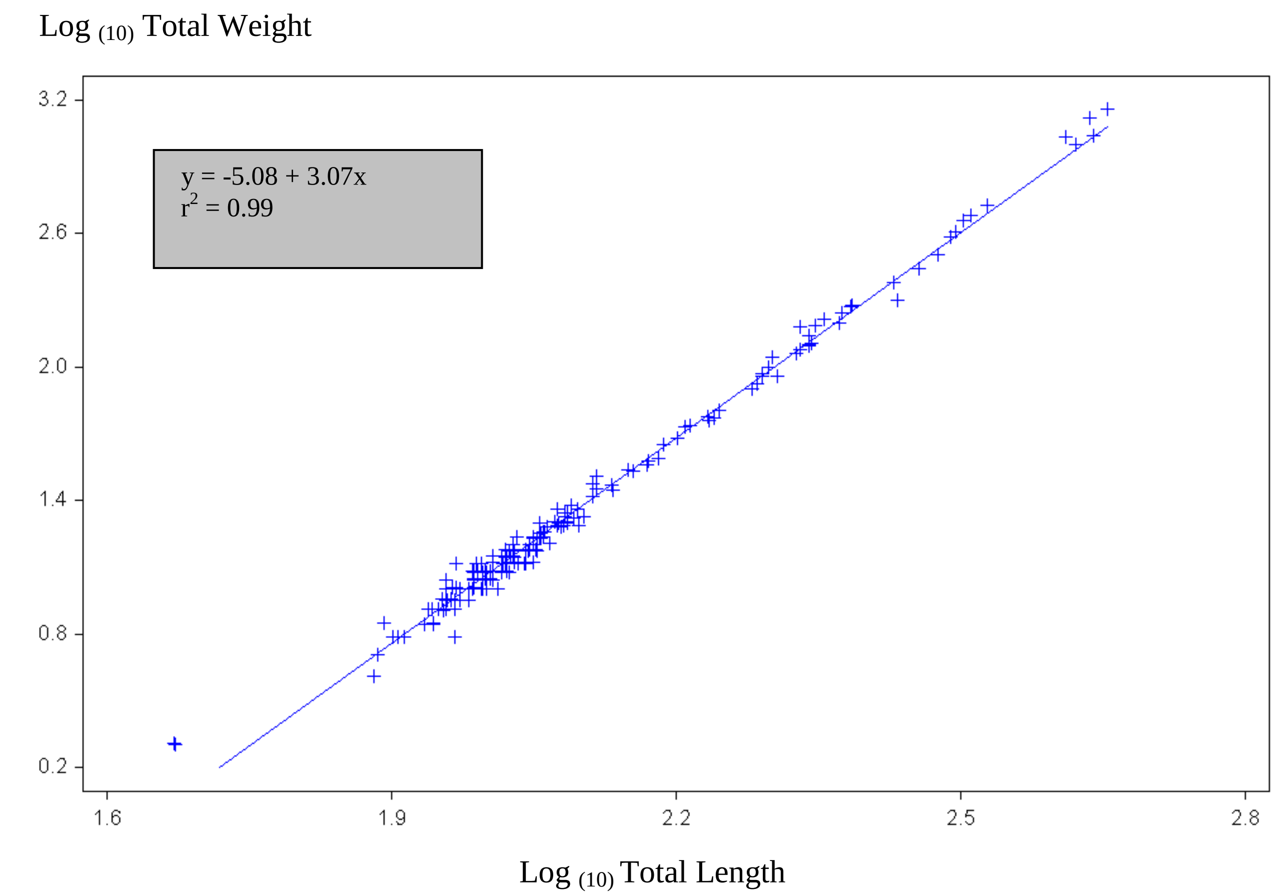


Figure 15. Relative stock density (RSD) catch per unit effort by category* for black bass and rock bass collected in the Pigeon River during 1999.



* Length categories after Gabelhouse (1984)

Figure 16. Linear and curvilinear length-weight relationships for smallmouth bass collected in the Pigeon River during 1999.



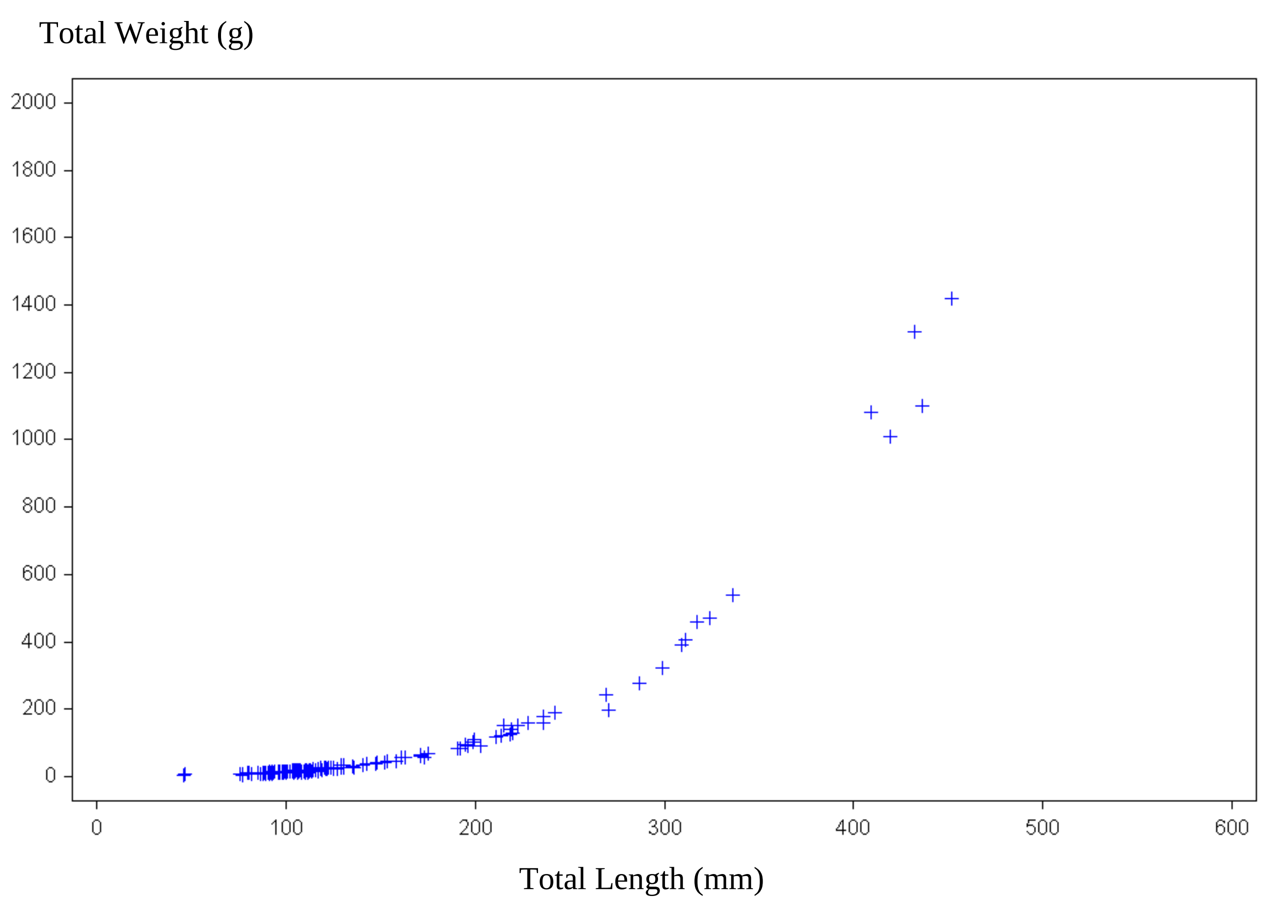
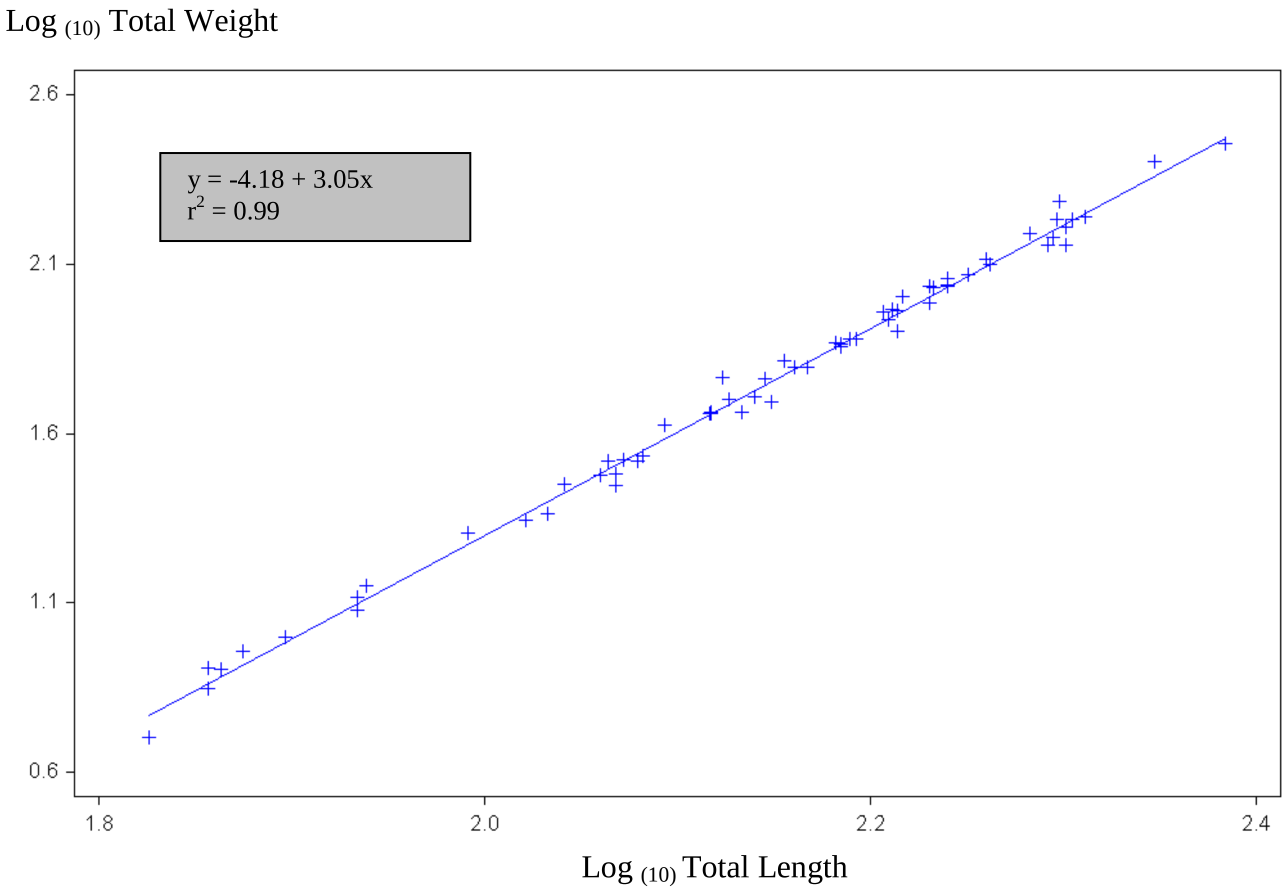


Figure 17. Linear and curvilinear length-weight relationships for rock bass collected in the Pigeon River during 1999.



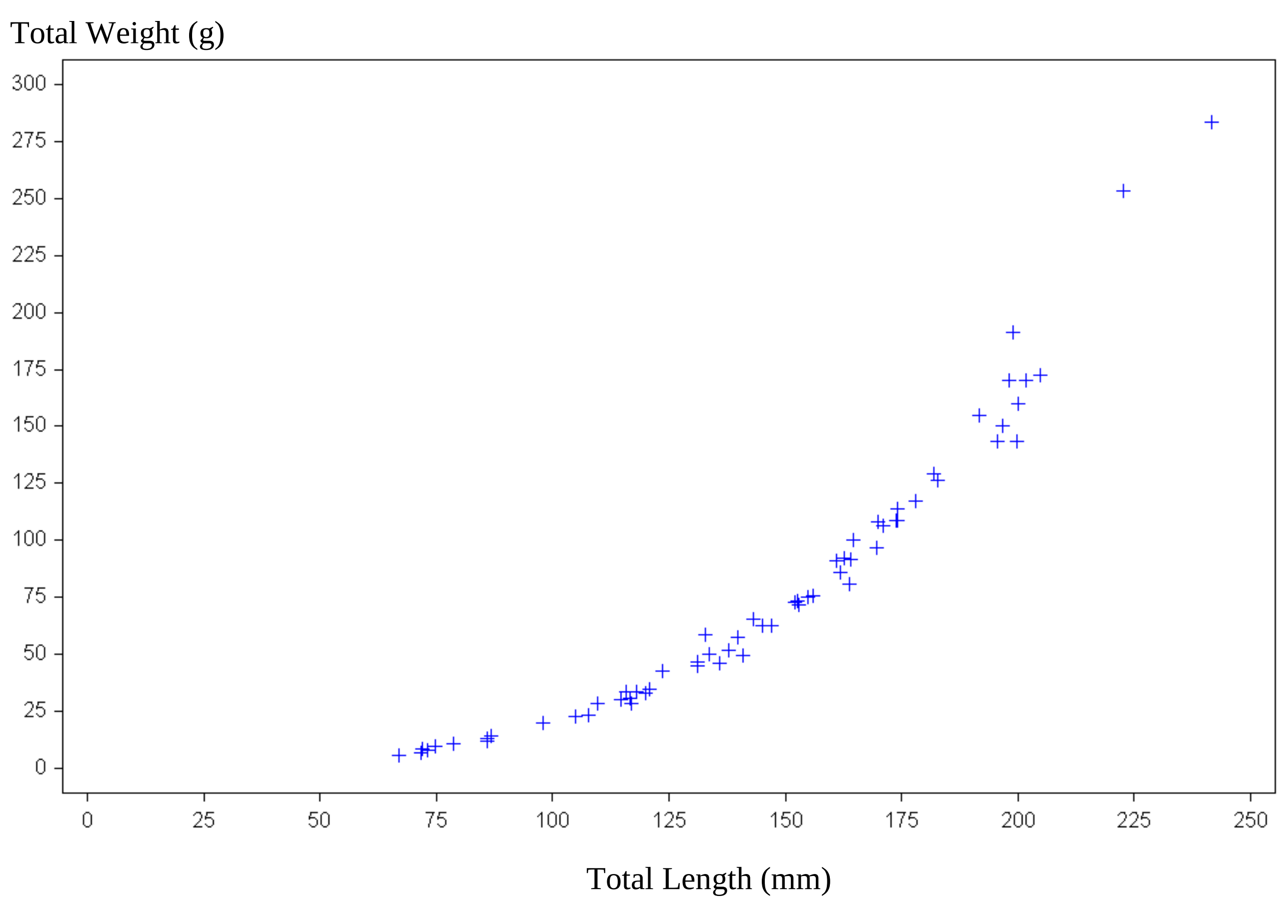
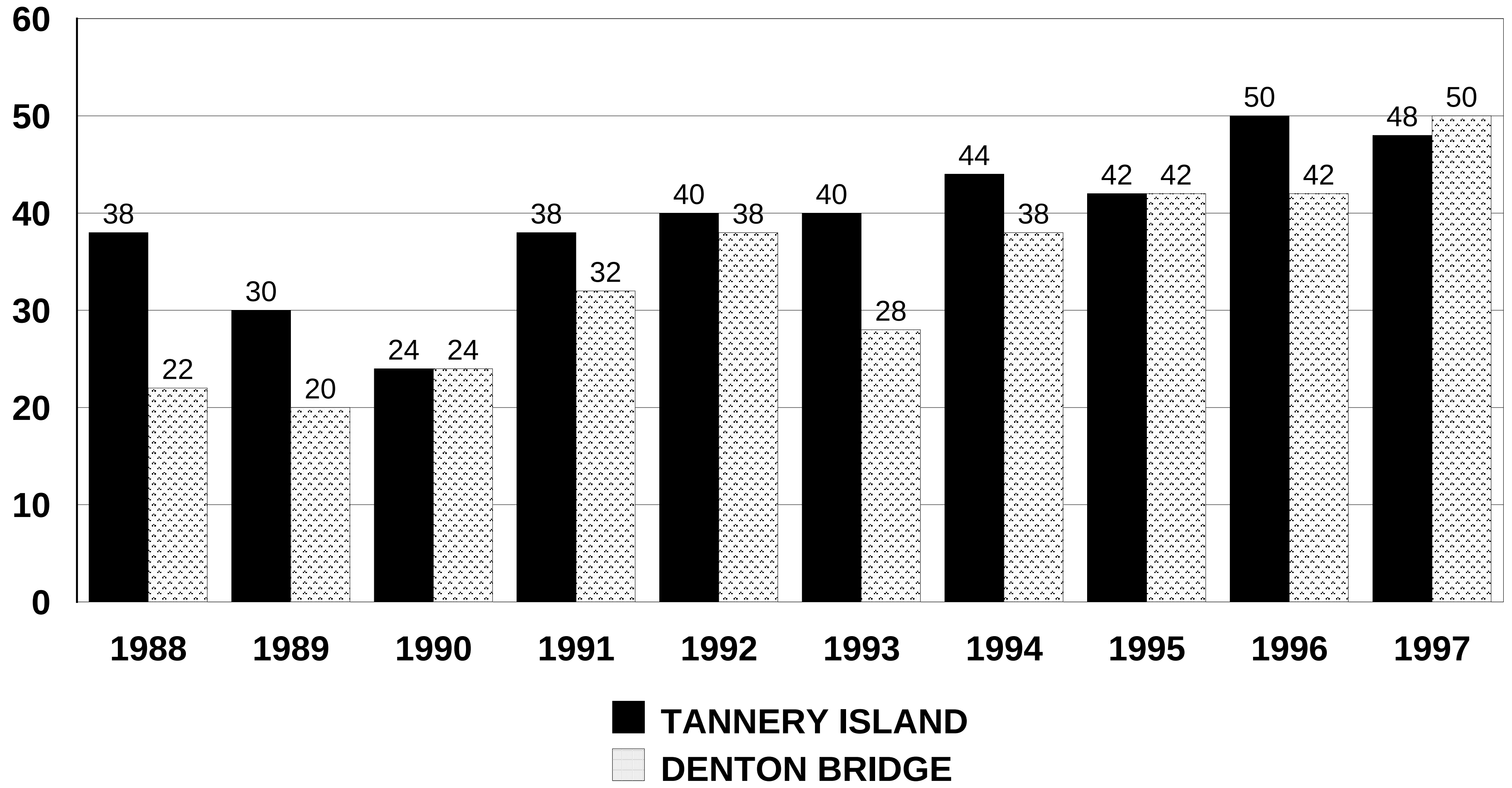


Table 9. Distribution of fish species collected in the Pigeon River during 1999.

FAMILY	SCIENTIFIC NAME	STATUS*	8.2	13.0	16.6	19.0	20.5	3.6
	PIGEON RIVER MILE →		8.2	13.0	16.6	19.0	20.5	3.6
	SAMPLE TYPE →		IBI/CPUE SURVEY	CPUE SURVEY	IBI/CPUE SURVEY	CPUE SURVEY	CPUE SURVEY	CPUE SURVEY
	SITE CODE →		419992401	419992402	419992403	419992404	419992405	419992406
CATOSTOMIDAE	*Carpiodes carpio*		●					
	Hypentelium nigricans		●	●	●	●	●	●
	Ictiobus bubalus		●	●	●	●	●	●
	Ictiobus niger		●		●			
	Moxostoma anisurum		●				●	
	Moxostoma carinatum		●					●
	Moxostoma duquesnei		●	●	●	●	●	●
	Moxostoma erythrurum		●	●		●	●	●
	Moxostoma macrolepidotum		●					●
CENTRARCHIDAE	*Ambloplites rupestris*		●	●	●	●	●	●
	Lepomis auritus		●	●	●		●	●
	Lepomis sp. (red x green)			●				
	Lepomis cyanellus				●			
	Lepomis macrochirus		●	●	●	●	●	●
	Micropterus dolomieu		●	●	●	●	●	●
	Micropterus punctulatus		●	●	●		●	●
	Micropterus salmoides		●	●			●	●
	Pomoxis annularis					●		
	Pomoxis nigromaculatis			●	●			
CLUPEIDAE	*Dorosoma cepedianum*		●	●	●	●	●	●
	Dorosoma petenense		●					
COTTIDAE	*Cottus carolinae*		●		●	●	●	
CYPRINIDAE	*Campostoma anomalum*		●		●	●		
	Cyprinella galactura		●	●	●	●	●	●
	Cyprinella spiloptera		●					●
	Cyprinus carpio		●	●		●	●	●
	Hybopsis amblops		●		●		●	●
	Nocomis micropogon							●
	Notemigonus crysoleucas		●					
	Notropis photogenis		●	●	●	●	●	
	Notropis rubellus		●					●
	Notropis telescopus		●	●	●	●		
	Rhinichthys cataractae		●					
ICTALURIDAE	*Ameiurus natalis*		●				●	
	Ictalurus punctatus		●	●				●
LEPISOSTEIDAE	*Lepisosteus osseus*							●
MORINIDAE	*Morone chrysops*							●
PERCIDAE	*Etheostoma blennioides*		●		●			●
	Etheostoma rufilineatum		●	●	●			
	Etheostoma simoterum		●		●			
	Etheostoma swannanoa							
	Etheostoma zonale		●					
	Percina caprodes		●	●		●	●	●
	Stizostedion canadense			●				
	Stizostedion vitreum		●					●
PETROMYZONTIDAE	*Ichthyomyzon cataneus*							
	Ichthyomyzon sp.				●			
SCIAENIDAE	*Aplodinotus grunniens*		●		●	●	●	●

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

Figure 18. Trends in Index of Biotic Integrity (IBI) at two stations on the Pigeon River (1988-97).



SUMMARY

We visited three rivers collecting 69 fish samples and encompassing approximately 126 river miles during 1999. In the three large rivers sampled during 1999, mean CPUE values for smallmouth bass ranged from 23.5/hour in the Clinch River to 35.6/hour in the Pigeon River (Figure 19). Spotted bass average catch rates ranged from 1.6/hour in the Clinch to 3.4/hour in the Pigeon River, while largemouth bass values ranged from 0.4/hour to 3.2/hour, respectively. During the 1999 surveys, the highest catch rate for smallmouth bass was observed in the Pigeon River while rock bass were most abundant in the Powell River (Table 10, Figure 19). Proportional stock density (PSD) values for smallmouth bass ranged from 21 in the Clinch River to 35.3 in the Pigeon River during 1999. Spotted bass PSD values ranged from 20 to 36.4, while largemouth bass values ranged from 0 in the Clinch and Powell rivers to 20 in the Pigeon River (Figure 20). The Powell River had the highest PSD value for rock bass, followed by the Pigeon and Clinch rivers (Figure 20). Relative stock density (RSD) analysis indicated the Pigeon River had the highest values for black bass and rock bass in the preferred category (Figure 21). However, only the Clinch River had black bass (smallmouth) large enough to have a value associated with the trophy category (Figure 21). Overall, age and growth analysis for the three rivers sampled during 1999 indicated similar growth characteristics for the ages represented in each river and were very similar to the statewide means (Figure 22). Length and weight characteristics for smallmouth bass and rock bass indicated steady growth for the represented size classes (Figures 23-24).

Over the last two years five major rivers (Nolichucky, Pigeon, North Fork Holston, Clinch, and Powell) have been surveyed within the region. These surveys have focused on gathering quantitative data on the sport fishery in these rivers as well as developing fish species lists. These efforts represent the first intensive efforts to gather this type of data. The focus of these surveys has been primarily on smallmouth bass and rock bass as these two species are the "staple" sport species found in these rivers. Overall, The Pigeon River has produced the highest catch rates for smallmouth bass followed by the Powell and North Fork Holston rivers. The Nolichucky River produced an overall smallmouth catch rate that was 54% lower than the mean catch for the five rivers surveyed between 1998 and 1999. Catch rates for rock bass were highest in the Powell River (109% higher than the five river mean), followed by the Clinch and North Fork Holston rivers.

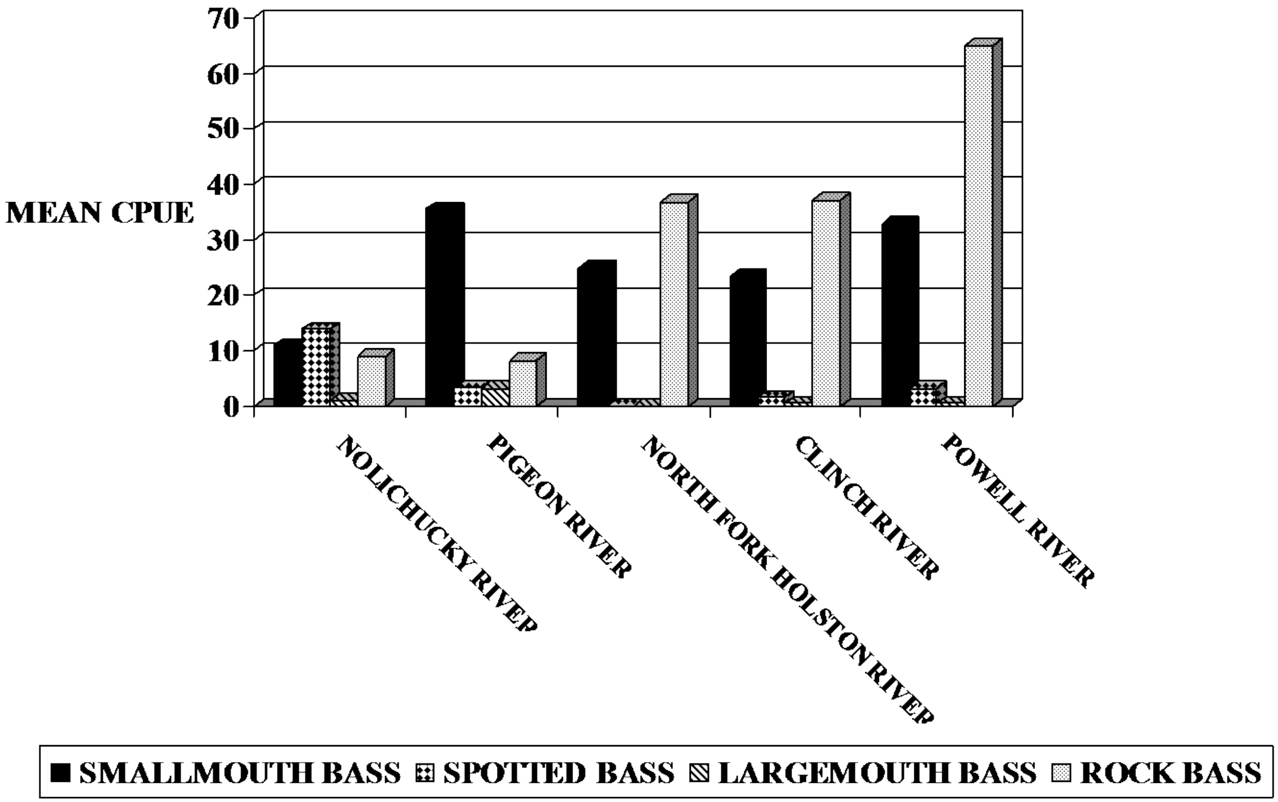
Growth of all black bass species and rock bass was very consistent among the five rivers surveyed between 1989 and 1999. The mean length at age values generated for each river also compare quite well with the overall statewide length at age data. This indicates that the black bass and rock bass growth within the region is consistent with populations across the state.

Based on the analysis of the five large rivers sampled between 1998 and 1999, it appears that the Pigeon River has the greatest potential for recruitment (high RSD-preferred and memorable values) of smallmouth bass into the trophy (TL $\geq$ 510 mm) category although none were collected in the 1999 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 Clinch River did have smallmouth bass in RSD-trophy category although the RSD values for preferred and memorable smallmouth bass were lower. The 1999 survey data along with the 1998 data were our attempts 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 poor 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 was the most consistently observed in our 1999 surveys.

Figure 19 . Mean CPUE values calculated for black bass and rock bass collected in the Nolichucky, Pigeon, North Fork Holston, Clinch, and Powell rivers between 1998 and 1999.

[redacted]



NOTE: Nolichucky River and North Fork Holston River data collected in 1998.

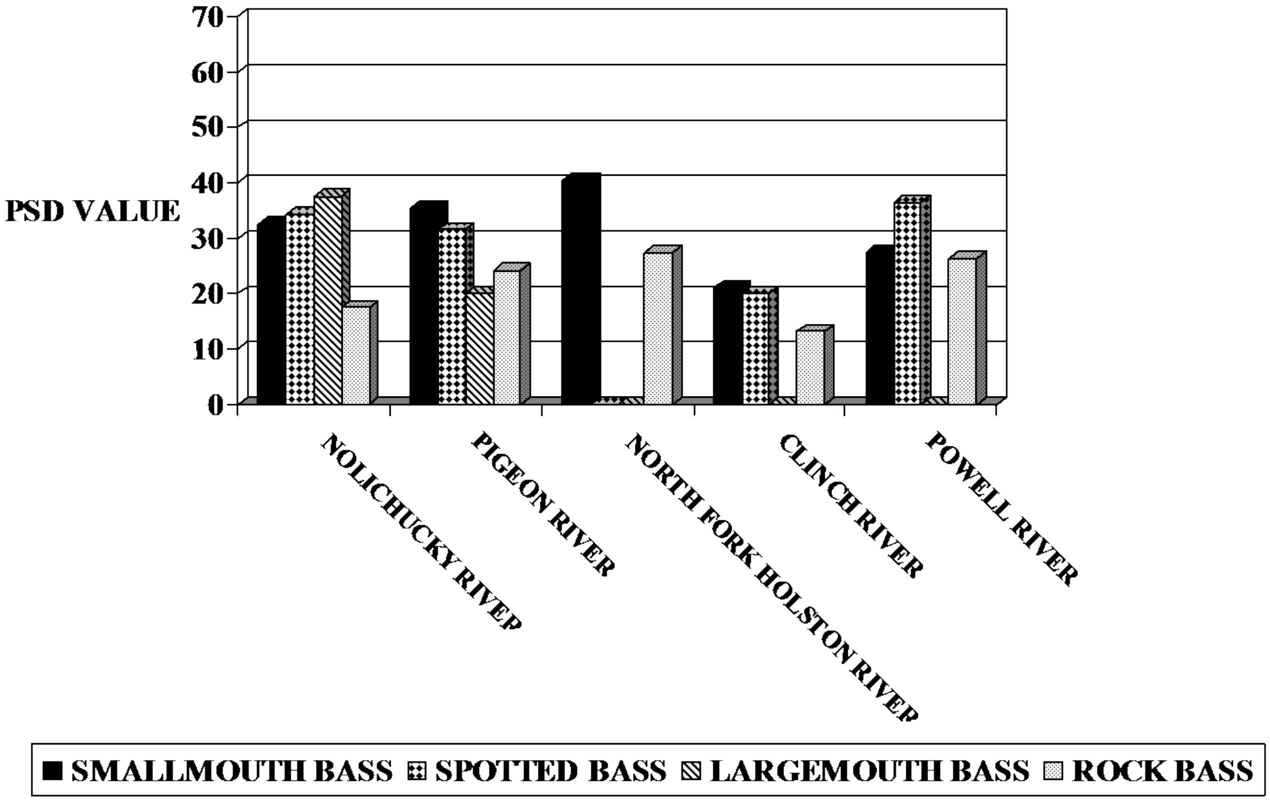
Table 10. Summary population statistics for smallmouth bass and rock bass collected in the Nolichucky, Pigeon, North Fork Holston, Clinch, and Powell rivers between 1998 and 1999.

	SMALLMOUTH BASS					ROCK BASS			
RIVER	**MEAN CPUE**	**PSD**	**RSD-PREFERRED (TL ≥ 350 mm)**	**RSD-MEMORABLE (TL ≥ 430 mm)**	**RSD-TROPHY (TL ≥ 510 mm)**	**MEAN CPUE**	**PSD**	**RSD-PREFERRED (TL ≥ 230 mm)**	**RSD-MEMORABLE (TL ≥ 280 mm)**
NOLICHUCKY RIVER 1998 data	10.9	32.5	11.7	1.3	0	9	17.4	0	0
PIGEON RIVER 1998 data	16.8	60	20	0	0	6.7	22.2	2.8	0
NORTH FORK HOLSTON RIVER 1998 data	24.9	40.5	9.5	1.4	0	36.8	27.3	1.4	0
PIGEON RIVER 1999 data	35.6	35.3	14.7	8.8	0	8.3	24.1	1.9	0
CLINCH RIVER 1999 data	23.5	21	6	1	1	37.2	13.1	0	0
POWELL RIVER 1999 data	32.9	27.3	7	2.3	0	65	26.4	0.2	0

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

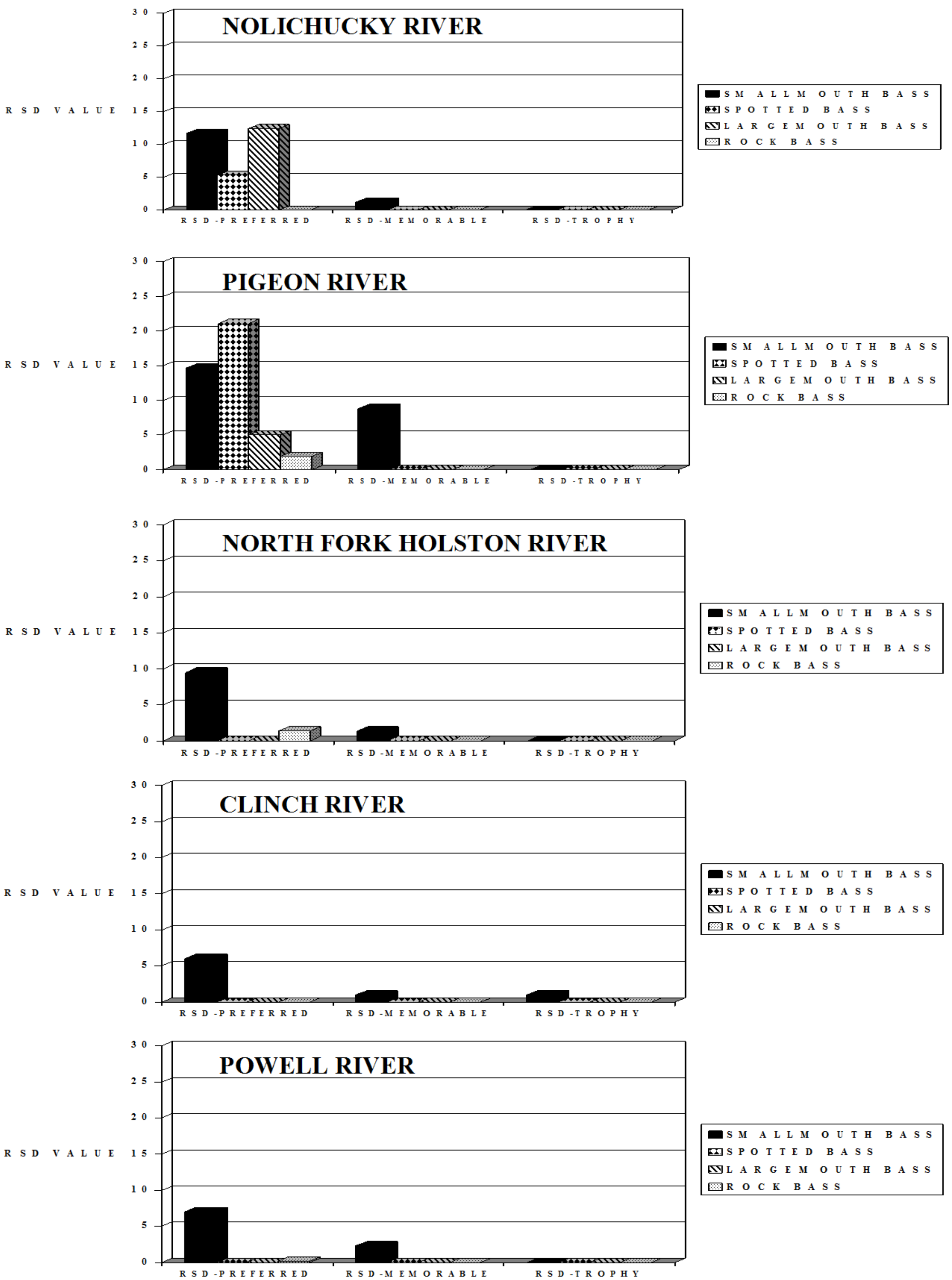
Figure 20. Proportional stock density values calculated for black bass and rock bass collected in the Nolichucky, Pigeon, North Fork Holston, Clinch, and Powell rivers between 1998 and 1999.

[redacted]



NOTE: Nolichucky River and North Fork Holston River data collected in 1998.

Figure 21. Selected relative stock density values calculated for black bass and rock bass collected in the Nolichucky, Pigeon, North Fork Holston, Clinch, and Powell rivers between 1998 and 1999.



NOTE: Nolichucky River and North Fork Holston River data collected in 1998.

Figure 22. Mean length at age for black bass and rock bass collected in the Nolichucky, Pigeon, North Fork Holston, Clinch, and Powell rivers between 1998-1999. Statewide mean based on 1995-99 data (TWRA, unpublished data).

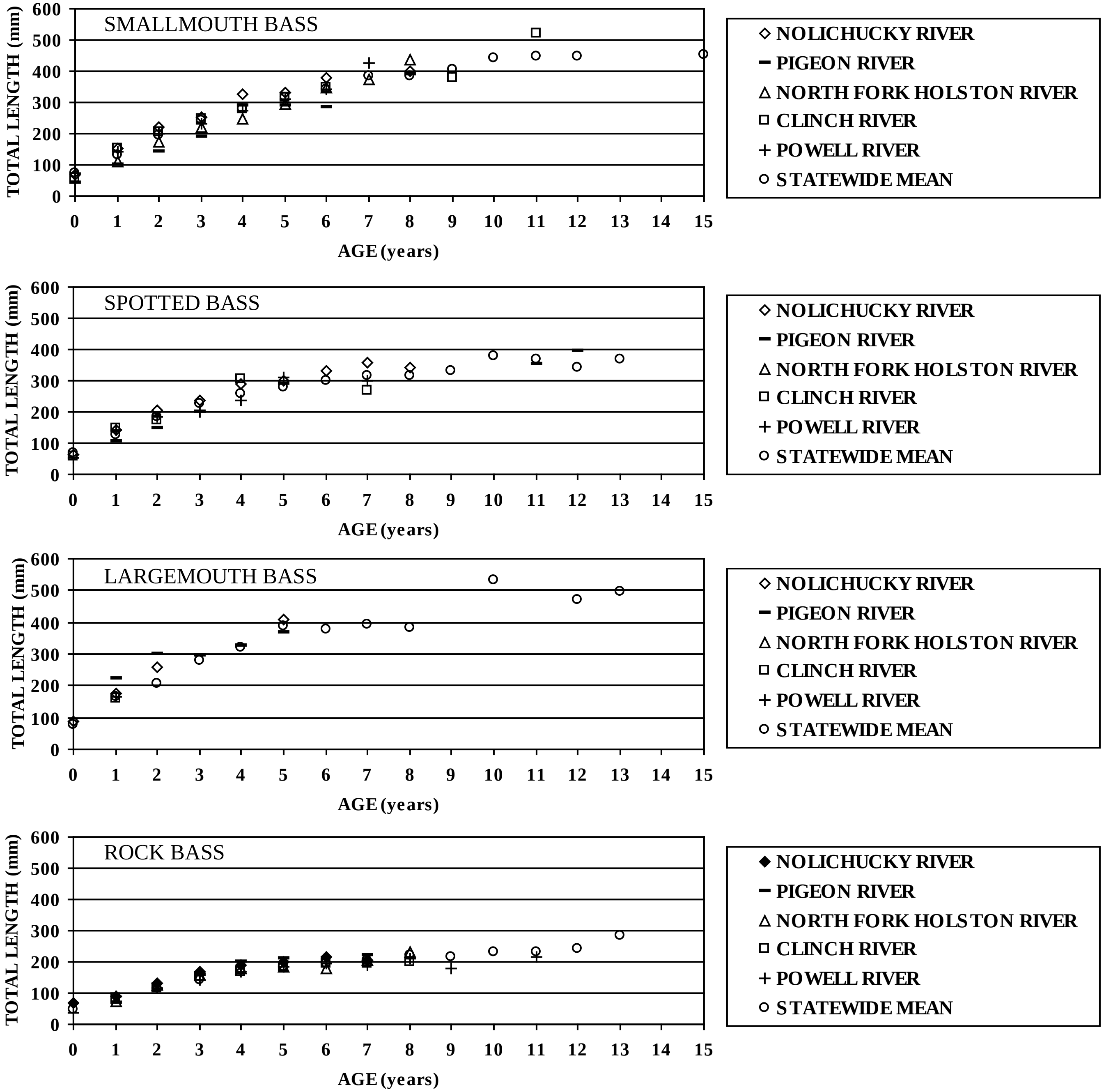
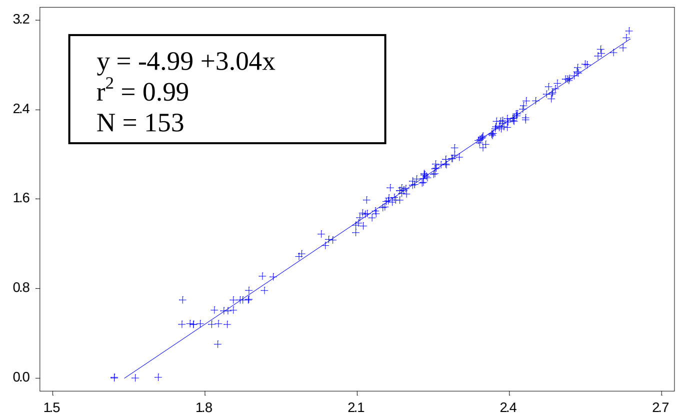
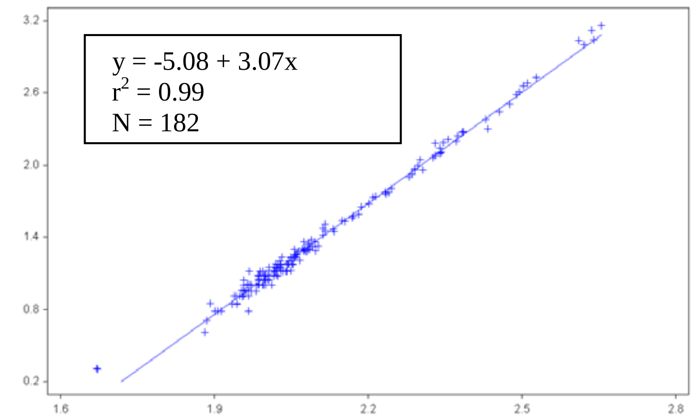


Figure 23. Linear length-weight relationships for smallmouth bass collected in the Nolichucky, Pigeon, North Fork Holston, Clinch, and Powell rivers between 1998 and 1999 (length [x] and weight [y] data were $\log_{(10)}$ transformed).

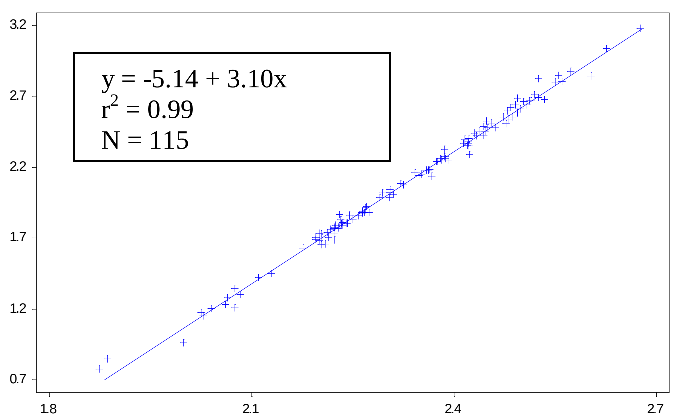
Nolichucky River



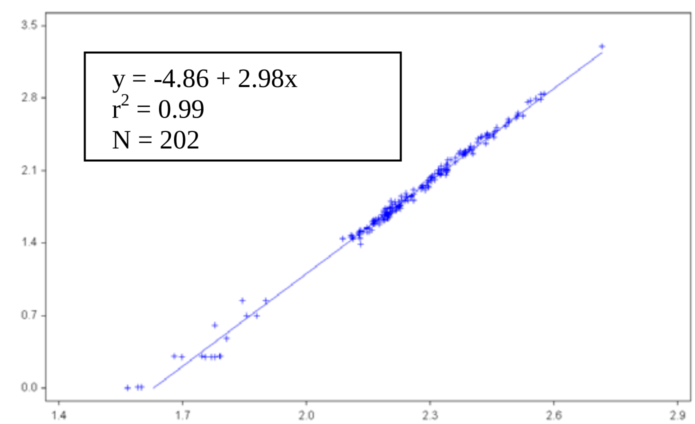
Pigeon River



North Fork Holston River



Clinch River



Powell River

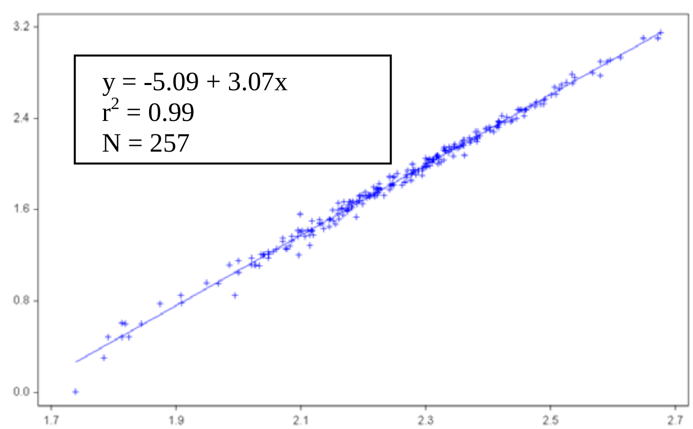
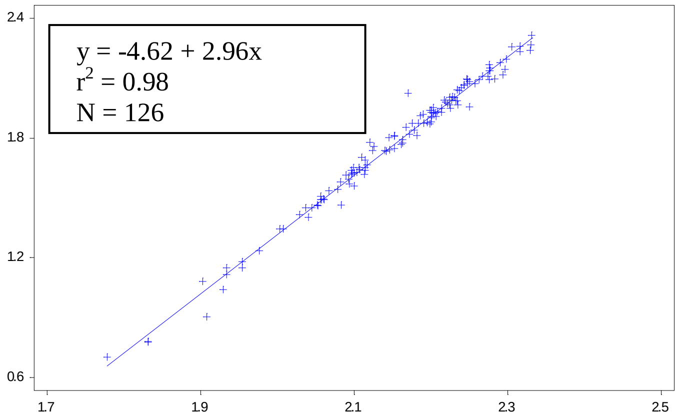
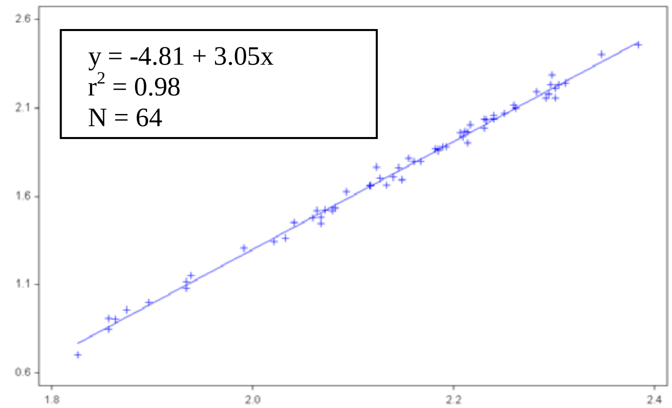


Figure 24. Linear length-weight relationships for rock bass collected in the Nolichucky, North Fork Holston, Clinch, and Powell rivers between 1998 and 1999 (length [x] and weight [y] data were log $_{(10)}$ transformed).

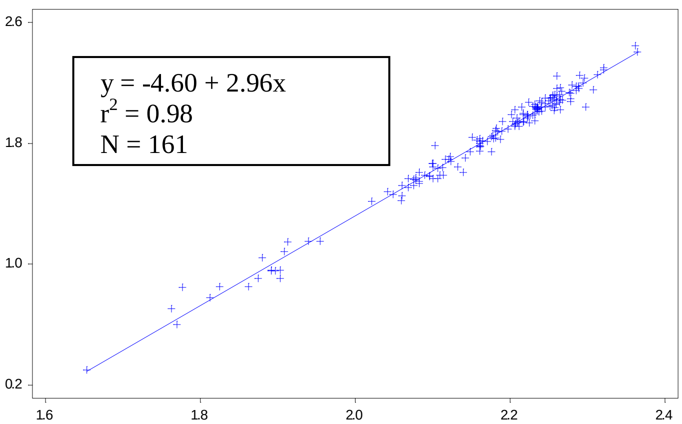
Nolichucky River



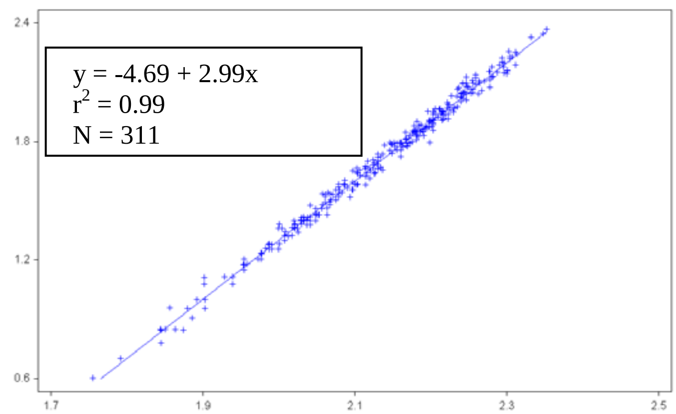
Pigeon River



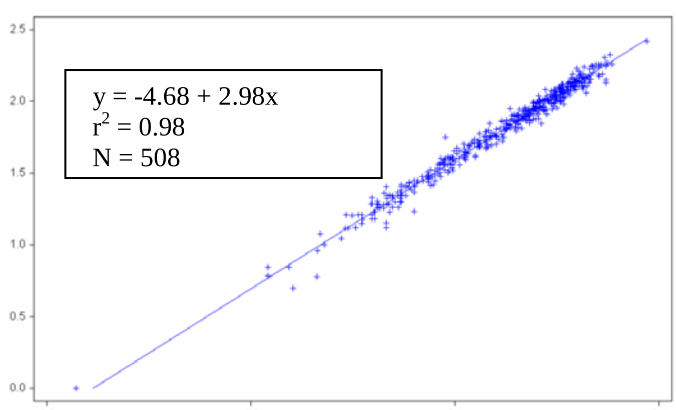
North Fork Holston River



Clinch River



Powell River



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APPENDIX A

1999 Summary of Strategic Plan Activites

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	3
Implemented a creel and/or user survey (II-3)	NO	
Identification of stream fishing access sites for purchase and/or lease (III-1)	YES	1
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	20
Locations for potential land purchases or leases: **CLINCH RIVER**	YES	1