STATEWIDE RESEARCH – FRESHWATER FISHERIES

ANNUAL PROGRESS REPORT

F63-3

July 1, 2002 through December 31, 2003

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Study Title: FISHERIES INVESTIGATIONS IN LAKES AND STREAMS - STATEWIDE

Job Title: Contribution of South Carolina and Georgia stocked hybrid bass in Lakes Hartwell and Thurmond.

Period Covered July 1, 2002 – December 31, 2003

Results and Discussion

In last years report we examined the contribution of South Carolina Department of Natural Resources (SCDNR) and Georgia Department of Natural Resources (GADNR) stocked hybrid striped bass to the 1999 year class in Lakes Hartwell and Thurmond. Results showed that the proportion of SCDNR hybrids in the catch at age 0+ was greater than the proportion stocked for both lakes. However, analysis of the catch at age 1+ indicated equal survival. We considered two possible explanations for the change in relative frequencies of SCDNR and GADNR hybrids from age 0+ to age 1+. One was differential survival of GA and SC hybrids from the 1999 to the 2000 sampling periods. Another was non-random sampling of SCDNR and GADNR stocked fish at age 0+ possibly due to gear selectivity for larger fish. In an effort to assess the selectivity of the nets, mesh size and total length were noted for each hybrid collected in the 2002/03 sampling season. Fish collected by South Carolina were also aged.

From Thurmond 180 hybrids were collected and 66 were aged. From Hartwell 35 hybrids were collected and 2 were aged. Due to the small sample size from Lake Hartwell, the data and discussion presented here will focus on Lake Thurmond.

The Thurmond data appears to show a representative sample of age 0's. The data is normally distributed, with fish ranging from 150 - 330 mm (Figure 1). More age 1 (n=47) fish were collected

than age 0 (n=8) however (Table 1). That may be showing that age 0's aren't as vulnerable to capture, or may be showing some difference in the 2002 and 2001 year classes.

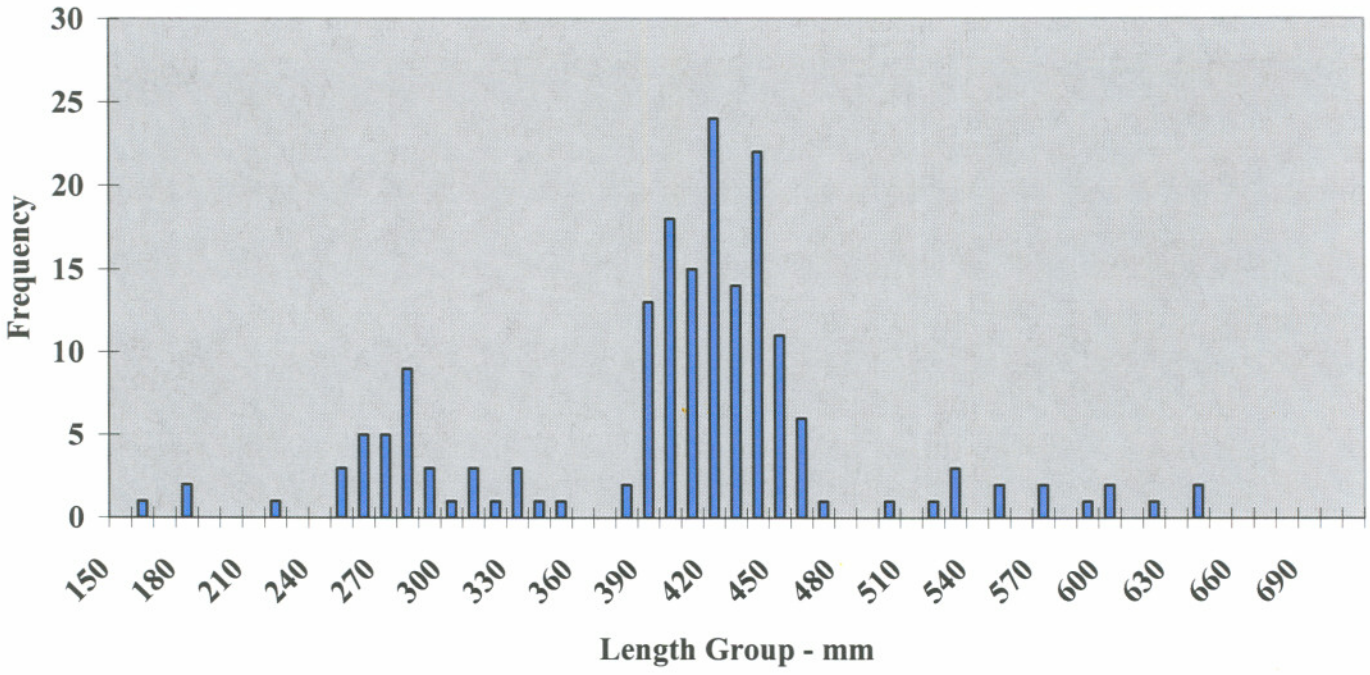

Figure 1. Length frequencies for gill net catch of hybrid striped bass from Lake Thurmond in the 2002-2003 sampling season. Frequencies are shown by 10 mm length group.

Table 1. Gillnet catch and mean total length of aged hybrid striped bass from Lake Thurmond in the 2002/2003 sampling season.

		Total length - mm		
Age	Number collected	Mean	Range	SD
0	8	276	254 – 330	28.3
1	47	409	325 – 454	23.5
2	3	493	437 – 521	48.2
3	5	576	528 – 599	29.1
4	1	612	-	-
5	2	634	633-635	1.41

Of the three meshes, the largest mesh panel was most effective in 2002-2003 at capturing hybrids, while the smallest mesh panel was relatively ineffective (Figure 2). Most of the age-1 fish collected were captured in the largest mesh panel. Only 5% of the total catch on Lake Thurmond came from the smallest mesh. Because gillnets were set offshore, alternating the smaller mesh towards and away from shore, the smaller mesh should have had equal opportunity to ensnare fish. We may better target this population by dropping the small mesh and flanking the 1.75 inch mesh with the 1.25 inch and a larger mesh. This is however based on assessment of one year's data. An increased sample size from multiple years can allow us to run statistics on net selectivity, and in the long run ensure we are capturing our target fish most efficiently. Data from multiple years will also allow us to determine whether subsequent year classes follow the same pattern with respect to relative catch frequencies at age 0 to age 1.

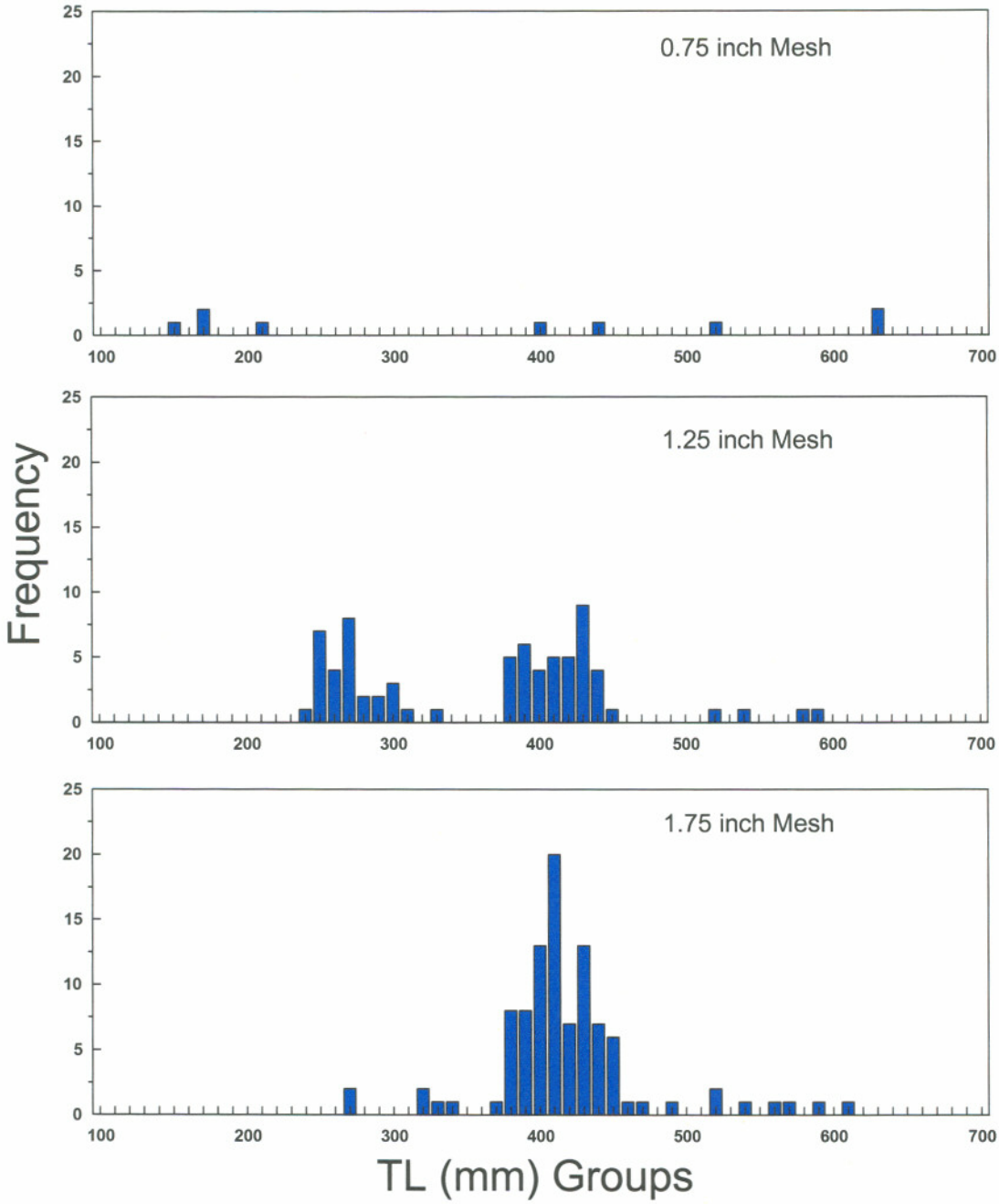

Figure 2. Length frequencies mesh size for gill net catch of hybrid striped bass from Lake Thurmond in the 2002-2003 sampling season. Frequencies are shown by 10 mm length group

Recommendations

In 2003-2004 continue to note mesh size for each hybrid striped bass collected. Additionally, all fish collected should be aged. This should provide a larger sample size for analysis. After analysis consider what net structure will most effectively capture our target fish.

Assess the contribution of SCDNR and GADNR stocked hybrids to another year class in Lakes Thurmond and Hartwell. This has not been possible recently due to difficulty in discerning marks on known marked fish. Work with personnel at Bayless hatchery to assess effectiveness of the current marking protocol.

Prepared By: Jean K. Leitner

Title: Fisheries Biologist

Job Title: Zoogeography of Centrarchidae of the South Atlantic Slope

Period Covered July 1, 2002 – December 31, 2003

Results and Discussion

We evaluated levels of within and among population diversity for six species from the family Centrarchidae collected from the Savannah, Edisto, Santee, and Pee Dee drainages. Species collected were redbreast sunfish *Lepomis auritus*, redear sunfish *L. microlophus*, warmouth *L. gulosus*, dollar sunfish *L. marginatus*, spotted sunfish *L. punctatus*, and mud sunfish *Acantharchus pomotis*. For most species we collected 10 individuals per drainage, with those fish coming from two sites within a drainage. Mud sunfish were not collected from Savannah drainage. A total of 223 fish were collected (Table 1.).

Sequences of the ND2 gene were generated for 184 of 223 individuals. The sequences generated did not show any variation in mud sunfish and only a single variant, restricted to a single individual, in dollar sunfish. Variation was shown for redbreast, redear, warmouth and spotted sunfish. A measure of the proportion of variation present within and among drainages, Φ_{st},, was calculated for each species and is shown in Table 2.

Table 1. Sunfish collected in 2002 by species and drainage.

Species	Drainage	Total collected	No. of sites
Redbreast	Pee Dee	10	2
	Santee	10	2
	Edisto	10	2
	Savannah	10	2
Redear	Pee Dee	10	1
	Santee	10	2
	Edisto	10	2
	Savannah	5	1
Warmouth	Pee Dee	10	2
	Santee	10	2
	Edisto	10	2
	Savannah	10	2
Dollar	Pee Dee	10	2
	Santee	10	2
	Edisto	10	2
	Savannah	10	2
Spotted	Pee Dee	9	2
	Santee	10	2
	Edisto	10	2
	Savannah	10	2
Mud	Pee Dee	9	2
	Santee	10	2
	Edisto	10	2

Table 2. Percentage of genetic variation present within and among drainages for sunfish species collected in 2002.

	Φ_{st} values	
Species	Within drainages	Among drainages
Dollar	---	---
Mud	---	---
Spotted	1.00	0.00
Warmouth	0.66	0.34
Redbreast	0.78	0.22
Redear	0.90	0.10

For those species that showed variation at ND2 the amount of genetic diversity within drainages was relatively high, indicating relatively moderate to high effective population sizes. For redear, redbreast and warmouth, the proportion of variation between drainages indicates moderate genetic divergence among drainages. This seems reasonable since these are the three species studied that are most likely to inhabit main river channels. Redear and redbreast are also the two species most likely to have been affected by human intervention through stocking or population transfer. In comparison, the measure of genetic divergence between major drainages for pygmy sunfish *Elassoma boehlkei* and *E. okatie* is around 0.96. For shortnose sturgeon *Acipenser brevirostrum* it is around 0.04. Results for spotted sunfish indicate a high level of gene flow between drainages. This is a surprising result for a species that typically inhabits slow moving streams, and is usually uncommon.

The current data is showing frequency differences among the populations studied. To have confidence in the variance components we want to extract for all six species however, it important that we increase the data available for calculating genetic variance. Plans are to increase the number of bases sequenced for each individual, and the number of individuals per drainage. Efforts are also

underway to amplify viral DNA isolated from the tissues collected. This may show more population structure in the spotted, dollar and mud sunfish studied.

Recommendations

Continuing this study for another year. To increase our ability to detect variation, the number of individuals per drainage and the number of base pairs sequenced should be increased. Viral DNA should be extracted to determine if it is useful in determining population structure for these species. More in depth statistical analysis will be performed on the expanded data set.

Prepared By: Jean K. Leitner

Title: Fisheries Biologist

Study Title: SURVEY AND INVENTORY

Job Title: Development of Reservoir-Specific Management Models

Period Covered July 2002 – December 2003

Results and Discussion

Largemouth bass otoliths were obtained from District 1 (Hartwell 2002 and 2003), District 3 (Boyd Mill Pond 2002, Parr Shoals 2002, and Greenwood 2003), and District 4 (Wateree 2001, Stumpy Pond 2003, and Wylie 2002 and 2003) for verification of ages. Percentage of otoliths read by Eastover ranged from 13% (Wylie 2002) to 100% (Wylie 2003), and averaged 50% across reservoirs and districts. Agreement with district-determined ages varied from 78% for Parr 2002 to 93% for Boyd Mill Pond 2002, and averaged 89%. Most disagreements (89%) were ±1 yr and resulted from differences in the interpretation of the margin in whole mounts. Otoliths broken through the core and examined in cross section usually provided better resolution of the margin than whole mounts, especially for older fish.

A Microsoft Access™ program to facilitate standardized input and output of spring electrofishing data was developed and distributed to the districts prior to the 2003 sampling season. Few problems with it were reported, none serious. Spring electrofishing data for 2002 and 2003 were received from Districts 1, 3, 4 and 5 following each sampling season. A SAS program developed to automate data compilation, summary, and reporting was tested using 2003 data. The program has been modified for individual districts or regions but it is not yet ready for distribution. Selected population parameters for the reservoirs for which data were available in 2002 and 2003 are summarized in Tables 1a-d and 2a-d, respectively.

Table 1a-d. Largemouth bass population parameters in selected South Carolina reservoirs, 2002. Parameters in 1a and 1b were computed from age frequency tables based on single- or multi-year age-length keys, as appropriate.

1a. Mean total length (std. error) in cm, by age.

Age	Hartwell	Boyd Mill	Parr Shoals	Wylie	Marion	Moultrie
1	18.4 (0.48)	17.9 (0.47)		19.1 (0.67)	18.8 (0.59)	20.6 (0.56)
2	27.9 (0.34)	25.5 (0.96)		27.4 (0.35)	31.8 (0.55)	31.9 (0.80)
3	34.7 (0.51)	32.2 (0.97)		34.3 (0.21)	38.1 (0.61)	37.6 (0.58)
4	37.6 (0.57)	35.9 (1.69)		37.2 (0.26)	40.6 (1.02)	40.9 (0.62)
5	40.0 (1.09)			39.6 (0.77)	45.9 (0.97)	44.2 (0.75)

1b. Catch per unit effort (no./hr) by age. Total includes all ages.

Age	Hartwell	Boyd Mill	Parr Shoals	Wylie	Marion	Moultrie
1	9.1	11.0		3.0	16.8	20.4
2	12.4	11.0		9.5	8.3	7.3
3	8.1	9.4		19.8	5.2	6.9
4	4.1	4.7		15.0	4.5	5.8
5	2.0			4.5	3.8	5.3
Total	38.1	45.9	11.7	62.2	51.7	60.4

1c. Catch per unit effort (no/hr) by length category. TL range (mm) for each category in parentheses.

Length Category	Hartwell	Boyd Mill	Parr Shoals	Wylie	Marion	Moultrie
Prestock (<200)	5.3	11.0	0.7	1.7	9.5	7.8
Stock (200 - 299)	14.5	13.0	2.0	9.0	11.2	14.4
Quality (300 - 379)	10.9	10.4	4.0	33.9	7.8	9.8
Preferred (380 - 509)	6.8	10.4	4.7	16.4	18.0	21.8
Memorable (510 - 629)	0.5	1.0	0.3	1.1	5.0	6.7
Trophy (≥630)	0.0	0.0	0.0	0.0	0.2	0.0

1d. Stock density indices.

Index	Hartwell	Boyd Mill	Parr Shoals	Wylie	Marion	Moultrie
PSD	56	63	82	85	74	73
RSD-15	23	33	45	29	55	54
RSD-20	2	3	3	2	12	13

Table 2a-d. Largemouth bass population parameters in selected South Carolina reservoirs, 2003. Parameters in 1a and 1b were computed from age frequency tables based on single- or multi-year age-length keys, as appropriate.

2a. Mean total length (std. error) in cm, by age.

Age	Hartwell	Greenwood	Stumpy Pond	Wylie	Marion	Moultrie
1	17.9 (0.57)	14.3 (0.49)	17.5 (0.84)	16.7 (0.47)	18.2 (1.15)	16.3 (0.74)
2	29.6 (0.48)	28.1 (0.47)	29.1 (0.67)	27.5 (0.72)	33.0 (0.67)	33.5 (0.49)
3	35.3 (0.39)	35.4 (0.56)	37.1 (1.08)	35.3 (0.35)	37.6 (0.54)	37.5 (0.43)
4	38.5 (0.61)	37.4 (0.77)	40.1 (0.84)	38.0 (0.36)	40.5 (0.86)	40.5 (0.67)
5	41.9 (0.74)	42.0 (0.67)	43.2 (0.84)	41.5 (0.59)	44.1 (1.33)	44.1 (0.95)

2b. Catch per unit effort (no./hr) by age. Total includes all ages.

Age	Hartwell	Greenwood	Stumpy Pond	Wylie	Marion	Moultrie
1	4.6	7.5	6.0	8.9	4.5	14.0
2	8.4	10.8	10.5	5.1	3.5	8.9
3	10.0	7.5	5.5	13.8	4.0	9.6
4	6.7	6.5	10.0	15.6	2.5	6.7
5	4.9	2.1	7.0	8.2	2.0	5.6
Total	39.9	38.4	47.0	66.4	23.3	60.2

2c. Catch per unit effort (no/hr) by length category. TL range (mm) for each category in parentheses.

Length Category	Hartwell	Greenwood	Stumpy Pond	Wylie	Marion	Moultrie
Prestock (<200)	3.6	7.3	4.5	7.3	2.7	9.6
Stock (200 - 299)	5.7	8.9	9.0	5.8	2.7	5.6
Quality (300 - 379)	15.7	10.5	9.5	25.1	6.2	15.1
Preferred (380 - 509)	14.1	10.1	22.0	26.9	8.7	24.2
Memorable (510 - 629)	0.7	1.5	2.0	1.3	3.2	5.8
Trophy (≥630)	0.0	0.0	0.0	0.0	0.0	0.0

2d. Stock density indices.

Index	Hartwell	Greenwood	Stumpy Pond	Wylie	Marion	Moultrie
PSD	84	71	79	90	87	89
RSD-15	41	37	56	48	57	59
RSD-20	2	5	5	2	15	11

Recommendations

1. Compile 1997-2003 data, defining best-available model parameters (i.e. growth, mortality, and recruitment).
2. Transfer largemouth bass management model results to the fisheries districts, making reservoir-specific management recommendations when sufficient data are available.
3. Define an optimal statewide regulation for largemouth bass.
4. Continue to provide verification of otolith aging at Eastover.
5. Evaluate zonal differences in largemouth bass population parameters.

Prepared By: John S. Crane

Title: Fisheries Biologist

Study Title: SURVEY AND INVENTORY

Job Title: Piedmont Stream Survey – Broad River basin

Period Covered April 1, 2003 – December 31, 2003

Results and Discussion

The objectives of the Broad River tributary study are to conduct a comprehensive fish community inventory of the wadeable streams of the upper Broad (U.S. Geological Survey hydrologic unit 3050105) and lower Broad (hydrologic unit 3050106) basins, develop a list of species having the greatest conservation need, and, ultimately, identify opportunities for conducting habitat conservation and/or restoration activities expected to have a beneficial effect on aquatic communities.

A GIS database for the two Broad River basins was constructed to aid in the selection of least impacted sites and to ensure that sites were selected proportionally among ecoregions and basins. The database included information on land use, point-source discharge sites, stream order, ecoregions, drainage basins, and roads.

During fall 2003 eighteen streams were sampled following South Carolina Department of Natural Resources (SCDNR) protocols for sampling fish in wadeable streams (Table 1, Figure 1). At least one site was sampled in each of the five ecoregions present within the two study basins.

A total of 7,487 fish, comprising 38 species and seven families (Table 2), was collected. Bluehead chub and yellowfin shiner were the most abundant species, comprising more than 41% of the total number of fish collected. Highback chub, redbreast sunfish, rosyside dace, spottail shiner, and creek chub each comprised more than 5% of the total number of fish collected. Dusky shiner,

pumpkinseed sunfish, chain pickerel and flier were rare; only one individual of each species was collected.

No federally-listed threatened or endangered species were collected. However, three species on the South Carolina Heritage Trust list of fishes of special concern were collected (Table 2).

Physical and chemical habitat data were collected at each site, including, turbidity, temperature, dissolved oxygen, conductivity, and pH. A visual habitat inventory was also conducted at each site. Those data have not been processed.

Table 1. Sites sampled within the Broad River drainage during fall 2003.

Date	Site No.	Stream Name	Lat	Long	Ecoregion
9/9/2003	1	Crim's Creek	-81.36741	34.26054	Southern Outer Piedmont
9/23/2003	2	Site's Creek	-81.27060	34.18304	Carolina Slate Belt
9/24/2003	3	Harmon Creek	-81.09771	34.16443	Carolina Slate Belt
9/24/2003	4	Crooked Creek	-81.31626	34.16533	Carolina Slate Belt
9/29/2003	5	Obed Creek	-81.99581	35.12230	Southern Outer Piedmont
9/29/2003	6	Tributary to N. Pacolet River	-82.07775	35.17409	Southern Outer Piedmont
9/30/2003	7	Vaughn's Creek	-82.25029	35.18253	Southern Inner Piedmont
9/30/2003	8	Tributary to Vaughn's Creek	-82.27225	35.19487	Blue ridge
10/2/2003	9	Weir Creek	-81.26623	34.55870	Southern Outer Piedmont
10/9/2003	10	Rocky Creek	-81.37221	34.43065	Southern Outer Piedmont
10/9/2003	11	John's Creek	-81.38306	34.58356	Southern Outer Piedmont
10/13/2003	12	Blue Branch	-81.35578	34.86001	Southern Outer Piedmont
10/14/2003	13	Guyon-Moore Creek	-81.44655	34.99677	Southern Outer Piedmont
10/15/2003	14	Wolf Creek	-81.46135	35.04183	Kings Mountain
10/15/2003	15	Garner Branch	-81.41938	35.10064	Kings Mountain
10/20/2003	16	Big Cedar Creek	-81.05711	34.24005	Carolina Slate Belt
10/22/2003	17	Long Branch	-81.35746	35.13609	Kings Mountain
10/22/2003	18	Rocky Branch	-81.33467	35.04678	Southern Outer Piedmont

Table 2. Fish species collected from Broad River tributaries, their status according to South Carolina Heritage Trust (SC = state concern and E = endemic) and their relative abundance (RA) during fall, 2003.

Family	Scientific Name	Common Name	Status	RA (%)
Esocidae	*Esox americanus*	Redfin pickerel		0.03
Esocidae	*Esox niger*	Chain pickerel		0.01
Cyprinidae	*Clinostomus funduloides*	Rosyside dace		7.23
Cyprinidae	*Cyprinella chloristia*	Greenfin shiner		0.60
Cyprinidae	*Cyprinella nivea*	Whitefin shiner	SC	0.33
Cyprinidae	*Cyprinella pyrrhomelas*	Fieryblack shiner		0.76
Cyprinidae	*Hybognathus regius*	Eastern silvery minnow		2.82
Cyprinidae	*Hybopsis hypsinotus*	Highback chub		7.73
Cyprinidae	*Hybopsis zanema*	Santee chub		0.03
Cyprinidae	*Nocomis leptocephalus*	Bluehead chub		28.54
Cyprinidae	*Notropis cummingsae*	Dusky shiner		0.01
Cyprinidae	*Notropis hudsonius*	Spottail shiner		5.20
Cyprinidae	*Notropis lutipinnis*	Yellowfin shiner		13.06
Cyprinidae	*Notropis scepticus*	Sandbar shiner		3.45
Cyprinidae	*Semotilus atromaculatus*	Creek chub		5.10
Catostomidae	*Catostomus commersoni*	White sucker		0.03
Catostomidae	*Erimyzon oblongus*	Creek chubsucker		1.52
Catostomidae	*Hypentelium nigricans*	Northern hogsucker	SC	0.11
Catostomidae	*Moxostoma anisurum*	Silver redhorse		0.03
Catostomidae	*Scartomyzon rupiscartes*	Striped jumprock		1.55
Ictaluridae	*Ameiurus brunneus*	Snail bullhead		0.07
Ictaluridae	*Ameiurus natalis*	Yellow bullhead		0.03
Ictaluridae	*Ameiurus platycephalus*	Flat bullhead		0.80
Ictaluridae	*Noturus insignis*	Margined madtom		3.17
Aphredoderidae	*Aphredoderus sayanus*	Pirate perch		0.53
Centrarchidae	*Centrarchus macropterus*	Flier		0.01
Centrarchidae	*Lepomis auritus*	Redbreast sunfish		7.25
Centrarchidae	*Lepomis cyanellus*	Green sunfish		0.12
Centrarchidae	*Lepomis gibbosus*	Pumpkinseed sunfish		0.01
Centrarchidae	*Lepomis gulosus*	Warmouth		0.15
Centrarchidae	*Lepomis macrochirus*	Bluegill		3.26
Centrarchidae	*Lepomis microlophus*	Redear sunfish		0.03
Centrarchidae	*Micropterus salmoides*	Largemouth bass		1.10
Centrarchidae	*Pomoxis nigromaculatus*	Black crappie		0.03
Percidae	*Etheostoma flabellare*	Fantail darter	SC	0.47
Percidae	*Etheostoma olmstedi*	Tessellated darter		3.41
Percidae	*Etheostoma thalassinum*	Seagreen darter		1.23
Percidae	*Percina crassa*	Piedmont darter		0.17

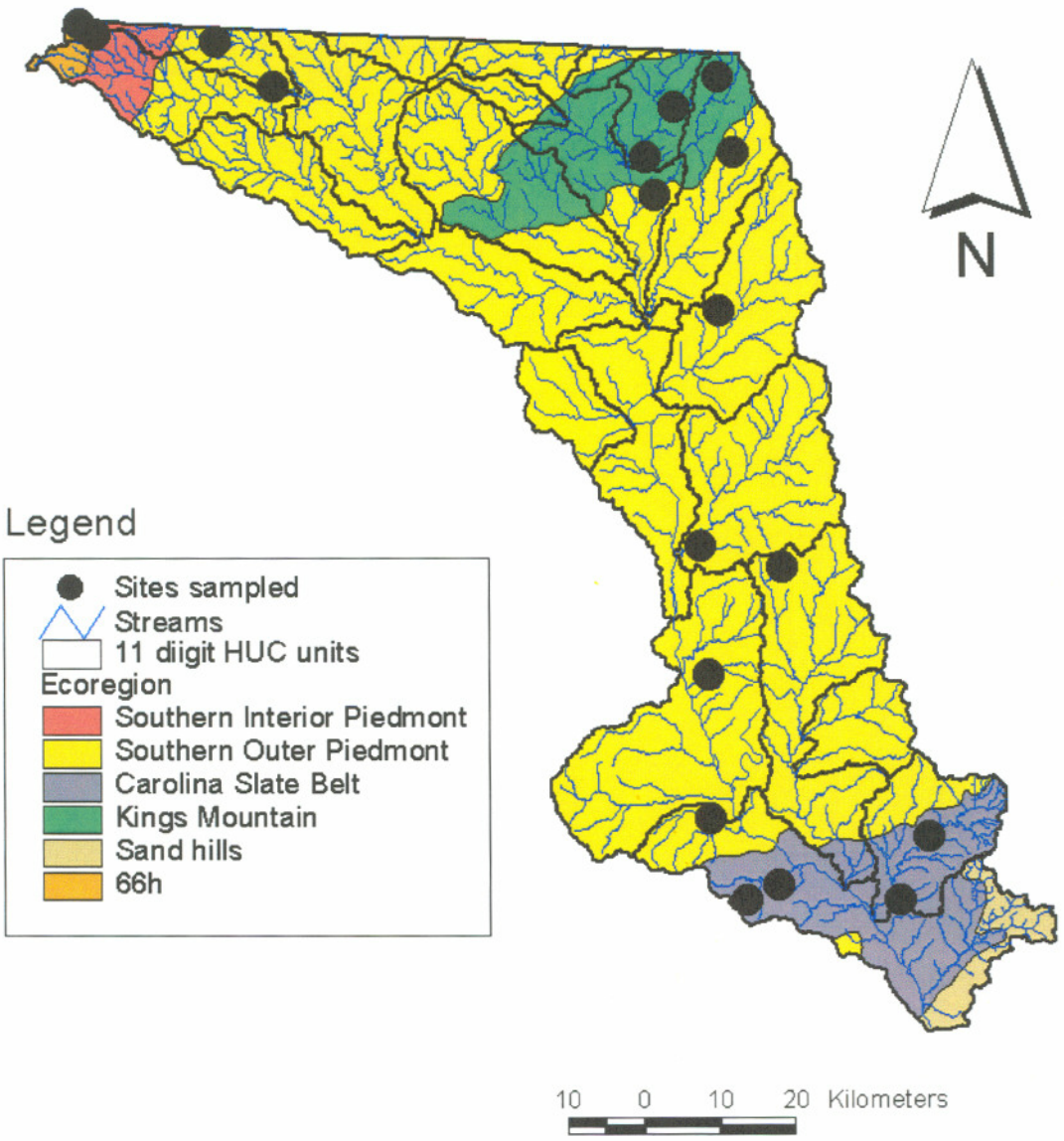

Figure 1. Sites sampled in the Broad River Drainage during fall, 2003.

Recommendations

- Continue study as planned, sampling up to 30 sites in 2004.
- Inspect data to see what was gained from repetitive sampling.
- Merge this data with other 2003 stream survey data to obtain initial look at fish distribution.

Prepared By: Jason Bettinger

Title: Fisheries Biologist

Study Title: SURVEY AND INVENTORY

Job Title: Evaluation of hooking mortality and recovery of striped bass held in flow-through live-release tubes

Period Covered January 1, 2003 – December 31, 2003

Results and Discussion

This project had two objectives. The first objective was to use sonic transmitters to determine if striped bass held in tubes exhibited differential survival from fish caught and immediately released. The second objective was to inspect blood chemistry to determine if fish held in tubes recovered from the stress of capture and handling.

Sample sizes were much lower than anticipated. During the winter (12 February - 3 April) we planned to include up to 96 fish in the study. Approximately half were to be used for blood chemistry analysis and half were to be fitted with sonic transmitters and tracked. Difficulties collecting fish with angling gear limited our sample size to 42 fish, of which 28 were used for blood work (Table 1) and 14 were fitted with transmitters (Table 2). During the summer (30 June – 6 August) 91 fish were collected with angling gear. Thirty-five fish were used for blood work (Table 1) and 45 fish were fitted with sonic transmitters (Table 2).

During the winter all fish placed in tubes were released alive. Of the 14 fish fitted with temperature sensing transmitters, two were never located and 12 were located at least once. Twelve fish survived for at least 3 days while 10 of 12 were re-located and alive after seven days (Table 2). One fish was known to expire 7 days post tagging. During the summer 11 fish died while being held in the tubes. Of the 45 fish tracked during the summer, 36 fish were known to expire, 4 fish were never located and 5 fish were assumed to be alive at the conclusion of the study (Table 2).

Survival of striped bass, with known fates, caught during the winter was good (92%), but survival of striped bass caught during the summer was poor (12%). It appears that tube residence time during the winter does not effect survival. However, during the summer none of the fish held in tubes for more than 2 hours survived.

Dr. Joe Tomasso at Clemson University is currently analyzing blood samples to determine if striped bass recovered from capture after being held in tubes. The results of the blood work will be available next year.

Table 1. Striped bass collected with angling gear from Lake Murray, South Carolina, during winter and summer 2003, and used for the blood component of the evaluation of live-release tubes. Depth indicates the depth of the fish at capture ("Free" indicates angling depth was not controlled). Time in represents the time the fish was placed in a tube and time out represents the release time. Residence time is the amount of time, in hours, a fish spent in the tube. Fish with no residence time were not placed in tubes before having blood drawn.

					Time		Temperature (C°)		Dissolved Oxygen (mg/L)		
Date	Fish #	TL (mm)	Depth (ft)	Angling(s)	In	Out	In	Out	In	Out	Residence (h)
2/12/2003	1	550	22	30	9:48	16:58	8.2	15.5	8.9	6.5	7:10
2/12/2003	2	540	26		10:15	14:23	8.5	12.9	9.7	7.5	4:08
2/12/2003	3	617	30	34	11:16	15:07	8.3	12.2	9.5	7.5	3:51
2/12/2003	4	471	30	57	11:24	14:52	8.3	12.5	9.5	7.5	3:28
2/12/2003	5	578	30	62	12:11	16:30	8.4	12.8	8.9	7.2	4:19
2/12/2003	6	583	26	105	12:17	17:12	8.4	13.7	8.9	7.2	4:55
2/12/2003	7	582	27	42	13:16	13:16					0:00
3/2/2003	8	490	22	38	12:28	14:38	9.7	12.4	9.0	7.4	2:10
3/2/2003	9	494	22	29	12:55	14:53	9.7	12.4	9.0	7.8	1:58
3/2/2003	10	456	24	30	13:30	17:12	9.7	13.5	9.0	7.6	3:42
3/2/2003	11	565	37	62	15:09	15:09					0:00
3/2/2003	12	582	37	36	15:18	16:24	9.7	12.2	9.0	7.6	1:06
3/5/2003	13	696	24	37	13:06	18:35	12.8	15.7	7.5	6.1	5:29
3/5/2003	14	685	8	80	15:46	17:35	13.3	14.4	6.9	6.5	1:49
3/5/2003	15	514	8	185	15:51	16:55	11.6	12.6	8.1	7.3	1:04
3/5/2003	16	490	8	52	16:32	17:10	12.2	12.6	7.4	7.5	0:38
3/5/2003	17	624	8	121	17:41	18:21	12.4	12.6	7.7	6.7	0:40
3/5/2003	18	545	8	80	18:00	18:00					0:00
3/12/2003	20	--	Free	80	9:50	16:23	13.3	20.1	7.3	2.8	6:33
3/12/2003	21	512	Free	70	13:37	16:06	17.0	20.9	6.4	5.6	2:29
3/12/2003	22	--	Free	70	12:08	16:32	13.1	19.9	8.2	1.6	4:24
3/25/2003	23	390	Free	75	13:15	13:15					0:00
3/25/2003	24	555	Free	109	14:00	16:03	20.8	22.3	8.9	7.0	2:03
3/25/2003	25	523	Free	81	9:48	16:39	16.8	24.3	8.5	6.8	6:51

Table 1. Continued.

Date	Fish #	TL (mm)	Depth (ft)	Angling(s)	Time		Temperature (C°)		Dissolved Oxygen (mg/L)		Residence (h)
					In	Out	In	Out	In	Out	
3/25/2003	26	535	Free	75	11:46	16:48	16.3	23.0	9.0	7.1	5:02
3/25/2003	27	530	Free	101	13:04	17:20	16.9	21.7	8.5	7.6	4:16
3/25/2003	28	610	Free	158	18:01	18:01					0:00
6/30/2003	29	628	30	82	8:18	14:12	24.0	23.3	6.0	5.7	5:54
6/30/2003	30	505	38	53	9:53	13:55	24.2	6.2	6.3	6.6	4:02
6/30/2003	31	497	30	43	12:53	12:53					0:00
7/1/2003	32	719	30	135	10:55	16:35	23.0	22.6	5.6	7.4	
7/1/2003	33	524	30	59	11:00	16:30	23.0	22.6	6.7	5.9	5:30
7/9/2003	34	692	36	150	8:41	15:01	25.7	18.6	6.7	6.8	6:20
7/9/2003	35	558	37	53	10:42	14:36	22.3	23.9	8.1	6.3	3:54
7/9/2003	36	605	36	56	10:48	14:51	23.0	22.5	6.9	6.5	4:03
7/9/2003	37	701	32	73	11:06		24.4		7.5		
7/9/2003	38	561	36	39	11:23	13:55	23.2	21.0	8.4	7.7	2:32
7/9/2003	39	--	36	38	11:28	13:30	27.5	27.1	6.4	7.1	
7/9/2003	40	554	36	39	12:15	12:15					0:00
7/16/2003	41	535	40		7:54	13:51	25.1	22.9	6.7	7.8	5:57
7/16/2003	42	532	25	32	8:23	14:20	22.1		7.1	7.4	5:57
7/16/2003	43	536	40		8:25	13:22	22.0	22.8	7.1	8.1	4:57
7/16/2003	44	547	40	45	8:33	13:33	23.2	21.9	7.9	7.8	5:00
7/16/2003	45	554	36	65	12:04	16:05	23.1	25.7	6.3	7.5	4:01
7/16/2003	46	608	24	34	18:25	18:25					0:00
7/24/2003	47	492	34	60	9:54	12:13	24.3	22.2	5.9	6.9	2:19
7/24/2003	48	589	34	65	9:47	12:28	24.6	23.3	5.2	6.6	2:41
7/24/2003	49	542	34	88	9:30	13:38	24.3	23.7	5.7	6.3	4:08
7/24/2003	50	642	34		8:15	14:08	22.2	25.6	6.9	5.6	5:53
7/24/2003	51	520	34		8:20	14:18	22.8	25.5	6.7	5.9	5:58
7/24/2003	52	610	34		8:20	14:33	22.0	25.2	6.3	6.8	6:13
7/24/2003	53	665	34	117	16:48	16:48					0:00

Table 1. Continued.

Date	Fish #	TL (mm)	Depth (ft)	Angling(s)	Time		Temperature (C°)		Dissolved Oxygen (mg/L)		Residence (h)
					In	Out	In	Out	In	Out	
7/24/200	54	535	Free	127	17:26	17:26					0:00
7/24/200	55	570	36	80	18:02	18:02					0:00
7/24/200	56	505	Free	35	18:30	18:30					0:00
7/24/200	57	605	Free	95	18:50	18:50					0:00
7/31/200	58	535	34		11:27	13:44	25.7	23.5	6.3	6.2	2:17
7/31/200	59	528	34		11:30	13:49	25.5	23.6	6.4	6.7	2:19
7/31/200	60	670	Free		11:30	13:58	25.5	24.0	5.7	5.7	2:28
7/31/200	61	580	34		10:28	14:16	25.4	22.6	6.0	5.4	3:48
7/31/200	62	562	Free		10:30	14:27	22.9	25.0	5.8	5.9	3:57
7/31/200	63	520	24	39	12:36	14:47	26.2	23.9	6.4	5.8	2:11

Table 2. Striped bass collected with angling gear from Lake Murray, South Carolina, during winter and summer 2003, and fitted with transmitters. Depth indicates the depth of the fish at capture ("Free" indicates angling depth was not controlled). Residence time is the amount of time, in hours, a fish spent in the tube. Fish with no residence time were not placed in tubes. "Locs" is the number of times a fish was located and "MDA" is the minimum days alive. Fate codes are: A = assume fish was alive at end of study, U = unknown, and D = fish died during the study.

					Temperature (C°)		Dissolved Oxygen (mg/L)					
Date	Fish #	TL (mm)	Depth (ft)	Angling (s)	In	Out	In	Out	Residence (h)	Locs	MDA	Fate
3/18/2003	1	650	free	42	13.6	17.5	9.3	6.5	5:50	1	9	A
3/18/2003	2	>533	free	85	13.6	17.1	9.3	7.3	5:54	5	17	A
3/18/2003	3	555	free	42	13.6	15.9	9.3	7.5	4:00	3	17	A
3/18/2003	4	575	free	48	14.4	15.9	9.4	7.8	1:55	3	9	A
3/18/2003	5	605	free	77	14.5	15.8	9.0	7.5	2:00	5	27	A
3/18/2003	6	600	free	59					2:00	7	21	A
3/18/2003	7	545	free	104					0:00	0		U
3/19/2003	8	580	free	62	14.8	15.8	8.3	7.7	3:52	2	16	A
3/19/2003	9	600	free	54	14.8	15.9	8.3	6.4	4:00	3	3	A
3/19/2003	10	605	free	105					0:00	0		U
4/2/2003	11	675	free	156	15.9	22.0	7.2	6.5	6:01	3	15	A
4/2/2003	12	633	free	120	14.7	21.1	8.2	6.1	5:54	2	7	A
4/2/2003	13	540	free	86					0:00	2	4	A
4/3/2003	14	655	7	180	16.4	23.9	8.2	5.6	6:12	3	7	D
7/10/2003	15	540	37	70	23.0	23.2	7.1	6.5	5:57	5	4	D
7/10/2003	16	615	33	120	23.0	24.1	7.1	7.2	6:01	2	1	D
7/10/2003	17	700	32	117	21.2	23.4		7.3	4:09	4	4	D
7/10/2003	18	630	34	78		22.6		7.3	4:07	8	0	D
7/10/2003	19	585	36	168	23.5	23.2	7.0	6.9	1:48	3	1	D
7/10/2003	20	>533	36	83	23.4	22.2	7.0	6.9	1:50	5	5	A
7/14/2003	21	553	38	30	21.4	22.9	7.9	5.9	6:03	1	0	D
7/14/2003	22	700	37		22.1	22.9	7.3		5:51	0	0	D
7/14/2003	23	527	28	70	22.1	22.9	7.3		5:58	3	1	D

Table 2. Continued.

Date	Fish #	TL (mm)	Depth (ft)	Angling (s)	Temperature (C°)		Dissolved Oxygen (mg/L)		Residence (h)	Locs	MDA	Fate
					In	Out	In	Out				
7/14/2003	24	540	37	82	23.2	23.2	7.2	6.4	4:12	5	4	D
7/14/2003	25	652	38	150	19.1	23.2	7.5	6.8	4:11	6	0	D
7/14/2003	26	620	38	61	23.2	22.5	7.8	7.6	1:56	3	4	A
7/14/2003	27	562	38	45	25.0	24.4	5.8	6.8	1:54	0	0	D
7/14/2003	28	610	38	67	24.8	22.9	5.9	8.8	2:14	8	0	D
7/14/2003	29	526	26	52					0:00	0	0	D
7/14/2003	30	595	28	52					0:00	2	4	A
7/14/2003	31	548	28	26					0:00	2	1	D
7/22/2003	32	580	30		24.1	25.2	6.3	6.5	6:00	8	0	D
7/22/2003	33	721	30		24.7	23.7	6.8	7.3	4:00	0	0	D
7/22/2003	34	585	28	48	22.1	25.4	7.9	6.4	4:00	1	0	D
7/22/2003	35	532	30	40	25.3	25.0	7.0	6.7	3:54	5	2	D
7/22/2003	36	510	36		24.1	23.9	6.6	7.1	2:03	2	3	A
7/22/2003	37	630	36	41	25.2	24.5	6.1	6.5	2:00	7	2	D
7/22/2003	38	455	36	73					0:00	2	2	D
7/29/2003	39	535	free	127	26.8	25.8	5.3	5.3	6:15	4	1	D
7/29/2003	40	565	36		22.6	25.2	5.4	5.5	4:05	3	1	D
7/29/2003	41	620	30	94	23.4	24.8	6.0	5.6	3:58	2	1	D
8/5/2003	42	525	26		25.9		6.1		2:23	0	0	D
8/5/2003	43	580	free		26.5	27.6	5.7	5.5	2:00	0		U
8/5/2003	44	573	22		25.5	26.9	5.9	6.4	0:00	0	0	D
8/5/2003	45	535	free		25.0	26.0	5.9	6.4	4:00	0		U
8/5/2003	46	611	free		25.8	26.3	5.9	6.1	1:40	0	0	D
8/5/2003	47	545	free	61					0:00	0		U
8/5/2003	48	570	free	110					0:00	2	3	A
8/6/2003	49	550	free		25.9	27.1	6.5	6.5	2:00	2	1	D
8/6/2003	50	>533	free		23.3	27.4	5.8	6.0	4:27	0	0	D
8/6/2003	51	562	free	89					0:00	0	0	D

Table 2. Continued.

Date	Fish #	TL (mm)	Depth (ft)	Angling (s)	Temperature (C°)		Dissolved Oxygen (mg/L)		Residence (h)	Locs	MDA	Fate
					In	Out	In	Out				
8/6/2003	52	585	free	93					0:00	1	0	D
8/6/2003	53	592	26						0:00	0	0	D
8/6/2003	54	590	free	71					0:00	0		D
8/6/2003	55	590	22	35					0:00	0	0	D
8/6/2003	56	540	24	30	25.1	26.1	6.5	6.6	1:18	2	0	D
8/6/2003	57	540	24	75					0:00	0		D
8/6/2003	58	640	free	87					0:00	0		U
8/6/2003	59	592	free	60					0:00	0	0	D

Recommendations

Continue study as planned. The fieldwork for this project has been completed. We are awaiting the blood analysis so a completion report can be drafted. Preliminary analysis indicates that the evaluated tubes may offer tournament anglers the opportunity to conduct catch and release tournaments during the cooler months, but not the warmer months. Additional work on tube design and survival during the spring and fall transitional periods is needed.

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