FISHERIES INVESTIGATIONS IN LAKES AND STREAMS DISTRICT IV

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[Creel Survey]

Four sample sites were chosen to conduct the access point creel survey. Two sites were at public boat landings and two were walk-in access areas. During the fall (September - November) and winter seasons (December - February), surveys were conducted six days per season for four hours per day. Three weekdays and three weekend days were sampled per season, with one weekend day and one weekday sampled per month. For the spring (March - May) and summer (June - August) seasons, surveys were conducted eighteen days per season. The same weekday/weekend stratification was employed with nine weekdays and nine weekend days sampled. Sampling days within each season, access point sites, and daily time blocks to be sampled were randomly selected. Access point and time period probabilities for the seasons appear in Table A. Data analysis was performed on an NCR personal computer using S.A.S. programs developed by department biologists Ross Self and Gene Hayes, Dr. Steve Malvestuto, Fisheries Information Management Systems, Auburn, Alabama, and Teresa Wilson of Clemson University.

Results of this study are presented as seasonal averages since the study ran for three winter seasons, three spring seasons, two summer seasons, and two fall seasons. Yearly comparisons were not possible due to the lack of uniformity in starting and ending dates of the creel study.

Species harvested were as follows: white catfish *Ictalurus catus* (Linnaeus); blue catfish, *Ictalurus furcatus* (Lesueur); yellow

bullhead, Ictalurus natalis (Lesueur); flat bullhead, Ictalurus platycephalus (Girrard); channel catfish, Ictalurus punctatus (Rafinesque); white bass, Morone chrysops (Rafinesque); redbreast, Lepomis auritus (Linnaeus); pumpkinseed, Lepomis gibbosus Linnaeus); warmouth, Lepomis gulosus (Curier); bluegill, Lepomis macrochirus (Rafinesque); largemouth bass, white crappie, Pomoxis annularis (Rafinesque); black crappie, Pomoxis nigromaculatus (Lesueur); yellow perch, Perca flavescens (Mitchill).

As reported in the Tables, catfish species refers to white, blue, yellow bullhead, flat bullhead, and channel catfish. Crappie species refers to white crappie and black crappie. The "other" category which appears in the Tables refers to the following species: pumpkinseed, redbreast, redear, warmouth, and yellow perch.

[Cove Rotenone]

During August, three coves totaling 1.84 hectares were sampled in Lake Monticello. All coves were blocked with 9.5 mm mesh netting to prevent the passage of fish to and from the sample area. Uniform applications of 5% emulsifiable rotenone were made at a concentration of 1 mg/l. All fish collected were identified, counted and weighed by 2.54 cm (inch) groups. Second day pick-up weights were acquired from first day weights. All data are presented in English units to facilitate comparison with historic data.

Computer analysis of the cove rotenone data was accomplished

with N.C.R. personal computer using predator-prey software developed by Jenkins and Morais (1976).

Cove sampling was not conducted in either Lake Wateree or Lake Wylie during this project segment.

[Meter Netting]

Threadfin shad, Dorosoma petenense (Gunther) population data were collected from Lake Monticello every two weeks from May through July. An eighteen foot Boston Whaler boat powered by a 150 hp outboard engine was fitted with an aft located aluminum frame and an 8000 pound Warn electric winch. This enabled the net to be released and hauled in with the boat under power. Two stations were located on Lake Monticello with four samples taken per station. All meter netting was done at night on the surface.

A Birge type meter net of 5 m length and .800 mm mesh was used to sample larvel shad (< 30 mm) from a towed distance of 25 m behind the boat. A General Oceanics flow meter was used to calculate the total volume of water sampled. Larval samples were field preserved in 5% unbuffered formalin. The entire sample was then enumerated in the lab with a representative sample of approximately 100 selected for species composition data and measurement. Species determination of specimens less than 20 mm was made by vertebral counts. Threadfin shad possess 42-46 vertebrae while gizzard shad, Dorosoma cepedianum (Lesueur), have 48-52.

Meter net sampling was limited to Lake Monticello during 1989.

the bass population and utilize the available prey base for the larger fish.

Data collected from Lake Wylie represent the first effort in ten years to document the condition, size distribution or age-growth of largemouth bass in the impoundment. Therefore, these data are considered to be a base line of information to develop a trend for selected paramenters. The relative condition of the largemouth bass from Lake Wylie reflects a population in which those fish less than 18 inches (457 mm) are below the mean average condition while those greater than 19 inches (484 mm) are in better than average condition (Figure 5.) The relative abundance establishes that the recruitment of age I fish is at a less than desirable level. These data also indicate a size distribution for the population which has an appropriate number of older fish (Figure 6). Age distribution and growth of largemouth bass collected from Lake Wylie are considered within desirable ranges (Figure 7 and Figure 8).

[Creel Survey]

From winter 1987, through spring 1990, 619 interviews were conducted over 118 sample periods and 1358 fishermen provided information about their fishing trips.

The average estimated annual fishing effort on Lake Monticello was 45,818 fishermen hours, or 6.7 hours per acre (Table B). Seasonal effort was highest during the spring when fishermen expended 17,010 hours, or 2.5 hours/acre. The similar effort and

effort per acre estimates for summer and fall, which were 11,049 hours (1.6 hours/acre) and 10,097 hours (1.5 hours/acre), respectively, was probably due to the lack of any fisherman interviews for fall 1988. Average estimated effort per acre dropped to 1.1 hours/acre (7,662 fisherman hours) during the winter season.

Most (36%) of the average estimated annual effort exerted on Lake Monticello was by catfish fishermen, who expended 16,384 angler hours, or 2.4 hours per acre (Table C). Largemouth bass fishermen and crappie fishermen applied 34% and 24 of effort, Only 3% of the effort was directed at bluegill and 2% for white bass. One percent was expended for "other" species.

Seasonal fishing trends were observed at Lake Monticello (Table D). Most effort exerted by catfish fishermen was during the summer, while most white bass fishermen were found on the lake during the winter. Bluegill fishermen exerted 46% of the effort during summer with less, but almost equal, percentages during spring and fall seasons. Thirty-six percent of the effort directed toward largemouth bass occurred in spring and dropped significantly during during summer. Crappie fishing was practically non-existent during summer, but 63% of the effort exerted on this species was during spring, while 23% occurred during winter. Those fishermen who fished for "other" species exerted 63% of their effort during summer and 37% during spring seasons.

Lake Monticello fishermen caught an estimated average 30,000 fish weighing 20,017 pounds, or 4.4 fish per acre weighing 2.95

lbs/acre (Table E). Highest harvest (numbers and pounds) estimates occurred during the spring when 1.74 fish/acre were caught weighing 1.03 lbs/acre. For the summer season, fishermen harvested 1.57 fish/acre that weighed .91 pounds per acre.

Fish harvest was dominated numerically by catish sp., followed by crappie sp., largemouth bass, bluegill, white bass, and "other" species (Table F). By weight, the harvest was dominated by catfish, largemouth bass, crappie, white bass, bluegill, and "other" species. Harvested fish ranged from a 3 inch bluegill to a 24 inch largemouth bass (Table G).

Estimates of success by season for the creel survey are presented in Table H. Annual CPUE estimates for Lake Monticello are .65 fish/hour and .44 lbs/hour. Greatest fishing success (number and pounds per hour) occurred during the summer when fishermen caught .97 fish and .56 pounds per hour. Seasonally, fishing success was highest in the summer, followed by spring, fall and winter.

Anglers fishing for "other" species were most successful, harvesting 2.2 fish/hour. Bluegill fishermen caught 1.56 fish/hour, white bass fishermen caught 1.23 fish/hour and catfish fishermen caught 1.12 fish/hour. Crappie fishermen caught .39 fish/hour, and largemouth bass fishermen caught .20 fish/hour (Table I).

The results of estimated average seasonal spending over the study period revealed that fishermen spent $123,411.00 at Lake

Monticello (Table J). The greatest seasonal spending occurred during the spring and was attributable to increased crappie and largemouth bass fishing. Approximatly $326,803.00 was spent by Lake Monticello fishermen during this study.

Concerning capture and release of largemouth bass over the entire study period, 204 fishermen (15%) released a total of 668 largemouth bass back into Lake Monticello. Eighty-two percent (1113) of the fishermen did not catch and release any largemouth, while 13% of fishermen did not respond to the question.

In response to the question, "Do you think there should be a length limit on largemouth bass in Lake Monticello?", 86% (1170) of the fishermen said yes, only 6% (85) responded negatively. Eight percent (103) gave no response. The majority of fishermen interviewed (58%), favor a twelve inch minimum size limit, 22% want a fourteen inch size limit and 5% would set the limit at eight inches (Table K). Fishermen who favored the fourteen inch and above size limit were avid largemouth bass fishermen, while those favoring less than a twelve inch limit usually fished for other species.

The results of fishermen perception of fishing quality at Lake Monticello for the study period are as follows: 12% rated the fishing excellent; 43% rated fishing as good; 24% rated fishing as fair; 17% rated the fishing at Lake Monticello as poor. Four percent of fishermen did not respond to the question.

Approximately 96.2% of fishermen interviewed at Lake Monticello during the study period originated their trip in South Carolina.

Twenty-three of South Carolina's forty-six counties were represented by fishermen visiting the lake. The highest percentage of fishermen represented at Lake Monticello were from Union, Richland, Spartanburg, Newberry, and Lexington counties. Approximately 3.7% of fishermen interviewed at Lake Monticello were from North Carolina. These fishermen originated their trips from Gaston, Iredell, Rutherford, Davidson, Polk, Cabarrus, Henderson, Hyde, Mecklenburg, and Rowan counties. Two fishermen, representing .1% of those at Lake Monticello, were from Tennessee.

[Cove Rotenone]

Cove rotenone sampling in Lake Monticllo collected 24 species of fish with a total average standing stock of 183 pounds per acre during this project segment (Table L). Of those species collected, gizzard shad, channel catfish, Ictalurus punctatus (Rafinesque), bluegill, Lepomis macrochirus (Rafinesque), and white catfish, Ictalurus catus (Linnaeus), dominated the stock with average E values of 12.3, 15.4, and 34.7, respectively. Threadfin shad, largemouth bass, yellow perch Perca flavescens (Mitchill) and black crappie, had a three year (1987 - 1989) mean E value of 4.8, 1.9, 3.9 and 1.8, respectively (Table M).

The average available prey-predator ratio for Lake Monticello indicates an availability of prey for all size groups of predators (Figure 9).

From those data collected during 1989 and those collected in 1987 and 1988, it is evident that the major prey species are

bluegill, threadfin shad and yellow perch. Bluegill dominated the prey base by providing a three year average of 54.8 pounds per acre of standing stock with an abundance of these fish being 2 to 5 inches in length (Figure 13). The yellow perch collected during this period represented 10.6 pound per acre and consisted primarily of 2 and 3 inch fish (Figure 15).

The major pelagic prey species was the threadfin shad. Although gizzard shad represented the species with the highest E values, their numbers were concentrated in size groups available only to the largest predators, thereby reducing their impact as a prey species (Figure 10). The numbers and weights of threadfin shad are judged to be adequate for maintaining the lake's native fishery. but data collected during 1989 are consistent with those collected 1987 and 1988 in that the surplus available for exploitation is limited. The threadfin shad which are avaiable should assist in maintaining the largemouth bass, black crappie, larger catfish and a limited white bass fishery.

[Meter Netting]

Meter netting results from Lake Monticello during 1989 continue to demonstrate an age 0 Clupeid prey base which is dominated by threadfin shad (Table 0). Although gear selectivity may account for a portion of the late season domination, previous samples taken in 1987 and 1988 demonstrate a definite trend toward pelagic control of the Clupeid prey base by threadfin shad (Nash, Self and Stroud

1989).

The population density of threadfin shad from Lake Monticello is judged to be relatively low, particularly when compared to the Catawba-Wateree populations (Nash et al., 1986). Of the two sample stations used on Lake Monticello, the station nearest the dam (station A) produced the lowest densities of threadfin shad and the higher percntages of gizzard shad (Tables N and O). Despite major differences in water source and exchange rates, this trend is similar to that found in lakes Wateree and Wylie (Nash 1980). Population densities of age 0 threadfin shad are greatest at the 10-19 mm size group with mortalities being their highest between 19 and 30 mm (Figure 16). Figure 16 also indicates that the population density of the 1989 threadfin shad was higher than 1988 or 1987; however, statistical comparisons (analysis of covariance) suggest that there are no significant differences betweeen three years sampled (95% level of confidence).

The survey and inventory of the Lake Monticello sport and prey fisheries describes a reservoir which is of medium productivity. The physical configuration of the impoundment suggests the main component of its fertility is allochthonous in nature. The relatively low gizzard shad E values and their size distribution are possibly attributed to this evaluation.

Due to the gizzard shad size distribution, its importance as a prey species is diminished allowing bluegill, threadfin shad and yellow perch to become the major elements of the prey base. Their

length-frequency distribution and their E values support these suggestions. The availability of these prey species is adequate for all size groups of predators; however, relative condition factor data suggest a higher level of competition among largemouth bass from 290 mm - 320 mm.

Despite Lake Monticello's adequate prey base, there appears to be a lack of surplus pelagic prey. When compred to the highly fertile Catawba-Wateree reservoirs, the Lake Monticello threadfin shad population density and growth rate appear significantly lower. With limitations on nutrient intake, the potential of improving the standing stock of threadfin shad is not anticipated. The present threadfin shad population densities are judged to be inadequate to absorb the impact of an additional predator.

Recommendations

1. Continue this job as written.

2. Continue the statistical analysis to allow reasonable comparisons of estimates of Kn base on each technique.

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Table A. Seasonal probabilities and time blocks for the Lake Monticello creel survey.

I. Fall (September - November) / Winter (December - February)

a. Access Points:	Public Landing 1	(PL1)	.25
	Public Landing 2	(PL2)	.25
	Walk-In 1	(WI1)	.25
	Walk-In 2	(WI2)	.25

b. Time Periods:	6:00 a.m. - 10:00 a.m.	(A.M.)	.20
	10:00 a.m. - 2:00 p.m.	(NOON)	.40
	2:00 p.m. - 6:00 p.m.	(P.M.)	.40

II. Spring (March - May) / Summer (June - August)

a. Access Points:	Public Landing 1	(PL1)	.55
	Public Landing 2	(PL2)	.35
	Walk-In 1	(WI1)	.05
	Walk-In 2	(WI2)	.05

b. Time Periods: Eastern Daylight Savings Time

7:00 a.m. - 11:00 a.m.	(A.M.)	.30
11:00 a.m. - 3:00 p.m.	(Noon)	.30
3:00 p.m. - 8:00 p.m.	(P.M.)	.40

Table B. Average estimated seasonal and annual fishing effort and effort per acre for winter 1987 - spring 1990, Lake Monticello, S.C. Number in () equals number of seasons sampled.

Season	Effort	Effort/Acre
Winter (3)	7,662	1.1
Spring (3)	17,010	2.5
Summer (2)	11,049	1.6
Fall (2)	10,097	1.5
Annual	45,818	6.7

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Annual	45,818	6.7

Table D. Seasonal estimates of percent of average effort by species from Lake Monticello, S.C., winter 1987 - spring, 1990.

	Percent of Average Hours by Season			
	Winter	Spring	Summer	Fall
Catfish (sp.)	6	23	44	27
White bass	70	22	8	0
Bluegill	3	27	46	23
Largemouth bass	21	36	18	25
Crappie (sp.)	23	63	1	13
Other	0	37	63	0

Table E. Estimated average seasonal and annual sportfish harvest (number and weight (lbs.) and numbers and pounds of fish per acre for winter 1987 - spring 1990, Lake Monticello, S.C.

Season	Harvest #	# Fish/Acre	Harvest (lbs)	lbs Fish/Acre
Winter (3)	2,324	.34	2,313	.34
Spring (3)	11,844	1.74	7,004	1.03
Summer (2)	10,668	1.57	6,173	.91
Fall (2)	5,164	.76	4,527	.67
Annual	30,000	4.41	20,017	2.95

Table F. Average estimated annual harvest (numbers and pounds) of sportfish creeled from Lake Monticello, S.C., winter 1987 - spring 1990.

Species	Harvest	
	Number	Pounds
Catfish (sp.)	18,277	11,864
White bass	1,206	986
Bluegill	2,198	373
Largemouth bass	3,183	4,753
Crappie (sp.)	4,256	1,842
Other	877	198

Table G. Size range, mean length (inches), and mean weight (pounds) of species harvested by year from Lake Monticello, S.C., winter 1987 - spring 1990.

Year	Species	Size Range (Inches)	$\overline{X}$L (Inches)	$\overline{X}$ Weight (Pounds)
1987-1988	White catfish	5-18	9.4	.42
1988-1989		5-18	9.7	.45
1989-1990		5-22	9.7	.46
1987-1988	Blue catfish	10-11	10.5	2.3
1988-1989		8-21	12.7	2.4
1989-1990		13-21	18.0	2.9
1987-1988	Yellow bullhead	no harvest	-	-
1988-1989		7-11	8.8	.31
1989-1990		6-15	8.5	.37
1987-1988	Flat bullhead	8-10	8.7	.25
1988-1989		no harvest	-	-
1989-1990		no harvest	-	-
1987-1988	Channel catfish	5-19	11.3	.72
1988-1989		5-24	12.3	.86
1989-1990		6-22	13.3	1.0
1987-1988	White bass	8-16	12.6	1.3
1988-1989		6-14	9.8	.51
1989-1990		6-15	11.0	.71
1987-1988	Redbreast	no harvest	-	-
1988-1989		9	9.0	.16
1989-1990		6	6.0	.15
1987-1988	Pumpkinseed	no harvest	-	-
1988-1989		4-6	5.0	.08
1989-1990		4-6	5.0	.09
1987-1988	Warmouth	no harvest	-	-
1988-1989		5-7	6.0	.16
1989-1990		6-7	6.5	.19

Table G (continued). Size range, mean length (inches) and mean weight (pounds) of species harvested by year from Lake Monticello, S.C., winter 1987 - spring 1990.

Year	Species	Size Range (Inches)	$\bar{X}$L (Inches)	$\bar{X}$ Weight (Pounds)
1987-1988	Bluegill	4-8	5.8	.14
1988-1989		3-15	6.6	.25
1989-1990		5-7	6.7	.20
1987-1988	Redear	5-10	8.0	.36
1988-1989		6-11	8.9	.46
1989-1990		7	7.0	.20
1987-1988	Largemouth bass	10-22	14.5	1.6
1988-1989		9-24	14.9	1.9
1989-1990		12-23	14.9	1.8
1987-1988	White crappie	no harvest	-	-
1988-1989		6-17	9.8	.53
1989-1990		11-14	12.3	.98
1987-1988	Black crappie	5-15	9.2	.53
1988-1989		6-13	9.7	.62
1989-1990		7-13	10.6	.78
1987-1988	Yellow perch	5-10	7.8	.19
1988-1989		6-14	8.5	.26
1989-1990		5-11	7.9	.19

Table H. Seasonal and annual catch per unit of effort, numbers and pounds of fish harvested per hour from Lake Monticello, S.C. winter 1987 - spring 1990.

	CPUE	
Season	Number/hour	Pounds/hour
Winter (3)	.30	.30
Spring (3)	.70	.41
Summer (2)	.97	.56
Fall (2)	.51	.45
Annual	.65	.44

Table I. Estimates of average annual CPUE (number and pounds/hour) for sportfish creeled from Lake Monticello, S.C. winter 1987 - spring 1990.

	Number/hour	Pounds/hour
Catfish (sp.)	1.12	.72
White bass	1.23	1.00
Bluegill	1.56	.26
Largemouth bass	.20	.30
Crappie (sp.)	.39	.17
Other	2.22	.54

Table J. Estimated average seasonal spending by fishermen at Lake Monticello, S.C., winter 1987 - spring 1990.

Season	Average spending	
Winter (3)	$ 28,664.19	$ 85.922.57
Spring (3)	$ 51,316.16	$153.948.78
Summer (2)	$ 20,168.83	$ 40,337.66
Fall (2)	$ 23,262.02	$ 46,524.04
Annual	$123,411.30	$326,803.05

Table K. Angler responses (as percent and number ()) to being asked to set a minimum length limit for largemouth bass at Lake Monticello, S.C., winter 1987 - spring 1990.

Minimum Size Limit		
Limit	Percent	Number
5"	.3	(4)
6"	1.4	(16)
7"	.3	(4)
8"	5.0	(57)
9"	.3	(4)
10"	3.6	(42)
12"	58.5	(688)
13"	.3	(4)
14"	22.0	(259)
15"	2.5	(29)
16"	3.0	(35)
17"	.2	(2)
18"	2.0	(24)
22"	.2	(2)

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Minimum Size Limit		
Limit	Percent	Number
5"	.3	(4)
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10"	3.6	(42)
12"	58.5	(688)
13"	.3	(4)
14"	22.0	(259)
15"	2.5	(29)
16"	3.0	(35)
17"	.2	(2)
18"	2.0	(24)
22"	.2	(2)

Table L: Standing stock from cove rotenone studies, Lake Monticello, August 1987, 1988, 1989.

	1987	1988	1989
Longnose gar			TR
Gizzard Shad	75.4	33.0	22.5
Threadfin shad	14.7	9.5	9.3
Silvery minnow		.3	.1
Golden shiner		TR	.3
Whitefin shiner	.5	.1	.9
River Carpsucker	11.6	1.6	2.5
Silver redhorse	13.0	6.0	.1
Shorthead redhorse			1.5
Snail bullhead		.1	
White catfish	22.9	49.6	27.2
Blue catfish			4.4
Flat bullhead	.3	TR	
Channel catfish	56.0	67.8	28.1
Gambusia		TR	.1
White bass	.6	.3	.9
Redbreast sunfish	.3	.1	TR
Pumpkinseed	3.1	4.9	4.1
Warmouth	1.3	.8	.9
Bluegill	51.2	49.9	63.3
Redear sunfish	.9	1.9	3.8
Largemouth bass	4.1	5.7	3.5
White crappie		1.0	
Black crappie	7.8	5.5	.3
Tessellated darter	TR	TR	TR
Yellow perch	9.8	13.2	8.7
Total standing stock	273.5	251.1 lb/acre	182.6

TR = trace value

Table M: E values from cove rotenone studies, Lake Monticello August 1987, 1988, 1989.

	1987	1988	1989
Longnose gar			TR
Gizzard Shad	27.5	13.1	12.3
Threadfin shad	5.4	3.8	5.0
Silvery minnow		.1	TR
Golden shiner		TR	.2
Whitefin shiner	.2	TR	.5
River Carpsucker	4.2	.6	1.4
Silver redhorse	4.8	2.4	.1
Shorthead redhorse			.8
Snail bullhead		TR	TR
White catfish	8.4	19.7	14.9
Blue catfish			2.4
Flat bullhead	.1	TR	
Channel catfish	20.5	27.0	15.4
Gambusia			TR
White bass	.2	.1	.5
Redbreast sunfish	.1	TR	TR
Pumpkinseed	1.1	2.0	2.3
Warmouth	.5	.3	.5
Bluegill	18.7	19.9	34.7
Redear sunfish	.3	.8	2.1
Largemouth bass	1.5	2.3	1.9
White crappie			.4
Black crappie	2.9	2.2	.2
Tessellated darter	TR	TR	TR
Yellow perch	3.6	5.3	4.8
Total standing stock	100.0%	100.0%	100.0%

TR = trace value