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APPENDIX I

FISH STOCKED IN LAKE CATHERINE, ARKANSAS, SINCE THE ROUGH FISH REMOVAL OF 1958

Species	*Number of Fish*	*Total*
	Adults	
Crappie	2,000	2,000
	Yearlings	
Smallmouth Bass	1,500	
Largemouth Bass	138,000	
Crappie	205,500	
Channel Catfish	176,500	521,500
	Fingerlings	
Smallmouth Bass	1,500	
Largemouth Bass	378,000	379,500
	Fry	
Walleye (Yellow Pikeperch)	200,000	200,000
GRAND TOTAL		1,103,000

THE WHITE AND CHANNEL CATFISHES OF THE SANTEE-COOPER RESERVOIR AND TAILRACE SANCTUARY

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ABSTRACT

The reservoir has a surface acreage of 160,500 and contains two rather dissimilar lakes, Lake Moultrie and Lake Marion.

Channel catfish (*Ictalurus punctatus*) are virtually unknown in Lake Marion, exist in relatively small numbers in Lake Moultrie, and are abundant in the tailrace sanctuary.

White catfish (*Ictalurus catus*) are present in large numbers in both lakes and the tailrace sanctuary.

The channel catfish of Lake Moultrie and the tailrace sanctuary grow larger and faster, live longer and are in better condition than any channel catfish described in the literature. They, also, differ slightly in morphology.

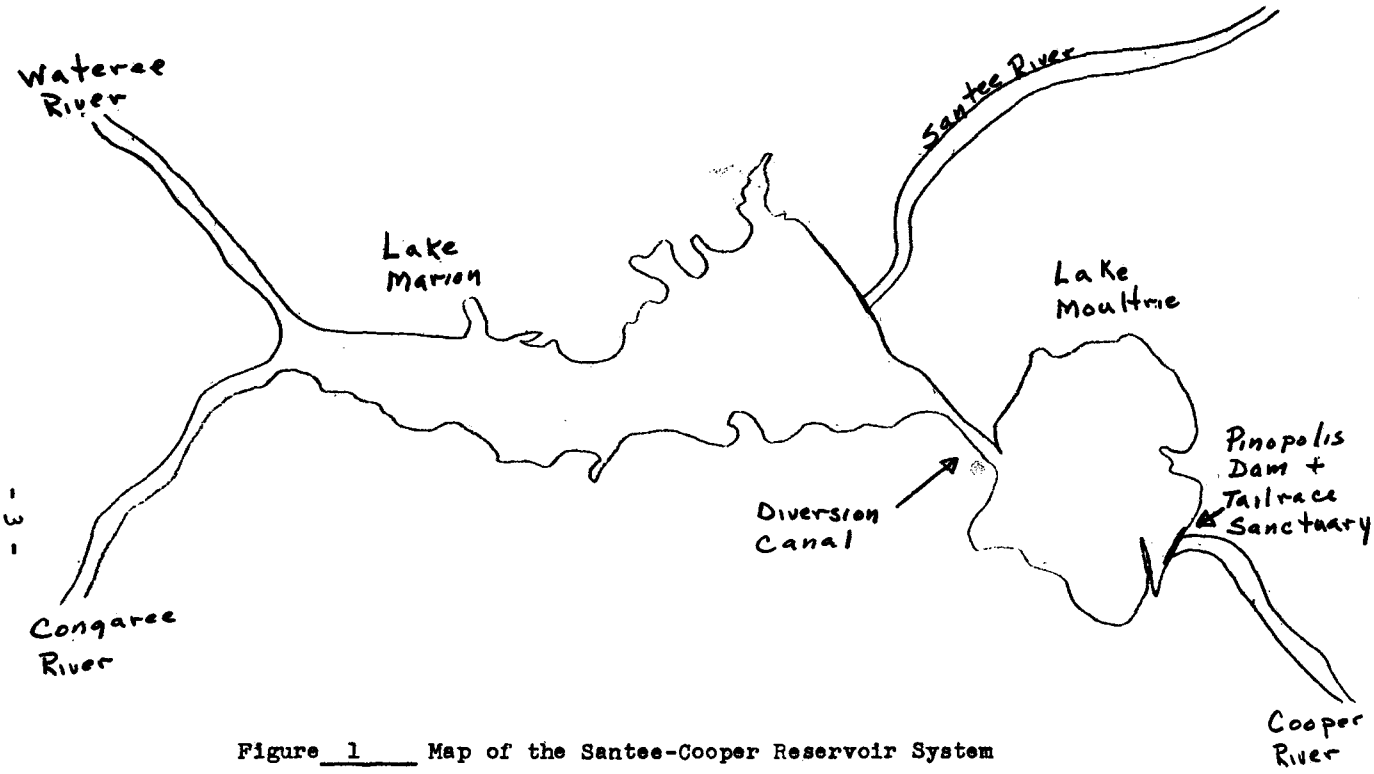


Figure 1 Map of the Santee-Cooper Reservoir System

INTRODUCTION

The Santee-Cooper Reservoir is a very large, shallow reservoir which contains 160,500 acres comprising two dissimilar lakes which are connected by a seven mile canal. The reservoir is 17 years old.

Lake Marion: The upper impoundment is 43 miles long and contains 100,500 acres of water. The upper one-half is a typical river-swampland while the lower half is a shallow lake with most of the original woodlands remaining in the form of a dead forest or sunken logs.

Lake Moultrie: The lower impoundment contains 60,000 acres of water without dead trees.

Dry years greatly reduce the surface acreage of the reservoir, as for example, between 1955 and 1958 it averaged only 108,000 acres. The depth averaged only 14.7 feet during the same period. Of the two, Lake Marion is the shallower. Lake Moultrie contains the deeper water (70 feet) at Pinopolis Dam where power is generated and a navigation lock is maintained.

Tailrace Sanctuary: Immediately below Pinopolis Dam in the boil created by power generation is an area 600 feet wide and 900 feet long which has been set aside as a fish sanctuary.

Sports fishing is not allowed and fish are taken only by Commission personnel for tagging, restocking or for scientific investigations (Stevens, 1957).

This area abounds with fish of several different species and especially striped bass and channel catfish which feed upon stunned fish from the turbines and other fish which are attracted by the current.

The reservoir supports a large population of white catfish and a small population of channel catfish.

Sports fishermen who use the reservoir hold catfish in rather low esteem. In the past five years, catfish have accounted for only 1.8% of the total game fish catch. An occasional large channel catfish serves as a welcome bonus to fishermen using cut bait for striped bass. There are no size or creel limits on catfish in South Carolina.

A relatively large commercial catfish fishery is maintained with wire baskets in both lakes. Limited data shows this fishery to be supported 90% by white catfish and the remaining 10% by channel catfish and yellow bullhead combined.

Channel catfish are almost unknown in Lake Marion, the upper impoundment. During an intensive gill net operation since 1956 only nine channel catfish have been taken in Lake Marion while 173 were taken in Lake Moultrie. In addition, all nine channel catfish caught in Lake Marion were taken within one mile of the canal between the lakes. Likewise, trotlines set in both lakes took 53 channel catfish in the lower lake and none in the upper lake. During the same period, nets and trotlines took a total of 934 white catfish from both lakes.

I have no idea why Lake Marion is unacceptable to channel catfish while being readily acceptable to white catfish.

MORPHOLOGY

For several years large specimens of channel catfish in the reservoir were thought to be white catfish. Preserved specimens were sent to several Universities and also to the Smithsonian Institution. For a while there was little agreement as to the identification and it was variously identified as white catfish, channel catfish and blue catfish (*Ictalurus furcatus*).

There are several good reasons for the confusion as will be seen below. My authority, however, for the identification is Dr. Reeve Bailey, Dr. Carl Hubbs, Dr. Milton Trautman and Dr. William Taylor, and also the meristic measurements and descriptions below.

Table I summarizes measurements taken on the head of each species. Due to the fact that body proportions vary a great deal with the size of the catfish, it is difficult to state these proportions except in terms of size. For this reason, the data have been placed in several size groups. It can be seen that for a given size the meristic measurements differ significantly. Also, that for each species

the four head measurements considered increase proportionately with an increase in the size of the fish. So then, the head of an older catfish is longer and wider in proportion to the body than is the case with younger catfish. This is also true of the gape of mouth.

Table I also summarizes the fin ray count for each species. Most taxonomic keys use the anal ray count as a prime character for separating the several species of *Ictaluridae*. As can be seen in Table I, this count overlaps in range between species but on the average is a good character for separating the two—if other characters are used as well.

Pectoral ray counts were found to be I-10 in channel catfish and I-9 in white catfish with but rare exception. An examination of five channel catfish from Catawba Lake on the same watershed, however, showed all to have a pectoral ray count of I-9, so this character probably is not useable elsewhere. One other character which is used in most keys is the fact that there is a break in the bony ridge between the head and the dorsal spine in white catfish and no break in channel catfish. This is an excellent character for small catfish of either species but has probably been the major cause of the misidentification of the larger channel catfish here. The larger channel catfish have a definite break in this predorsal ridge which, while not as distinct and large as in the white catfish, is nevertheless present and confusing to one trying to make an identification in the field.

TABLE I

A COMPARISON OF SEVERAL HEAD AND FIN RAY CHARACTERISTICS OF WHITE AND CHANNEL CATFISHES OF THE SANTEE-COOPER RESERVOIR AND TAILRACE SANCTUARY

Channel Catfish

		Head Measurements *							
		Head Length in St. Length		*Head Width in St. Length*		*Gape in Head Length*		*Interorbital Width in Head Length*	
Total Length	*No.*	*Avg.*	*Range*	*Avg.*	*Range*	*Avg.*	*Range*	*Avg.*	*Range*
3.0-10.9	36	4.1	3.9-4.5	6.2	5.7-6.7	3.2	2.7-4.2	3.1	2.6-3.5
11.0-20.9	9	3.9	3.6-4.2	5.4	4.9-5.9	2.4	2.2-3.4	2.1	1.8-2.5
21.0-30.9	42	3.6	3.1-4.0	4.7	3.7-5.6	2.1	1.6-2.4	1.8	1.4-2.2
31.0-42.9	34	3.3	3.1-3.8	4.3	3.6-5.0	2.1	1.8-2.4	1.8	1.6-2.0
TOTALS	121	. .	3.1-4.5	. .	3.6-6.7	. .	1.8-4.2	. .	1.6-3.5
White Catfish									
4.0-10.9	16	3.9	3.6-4.1	5.0	4.2-5.5	2.0	1.7-2.4	1.9	1.6-2.0
11.0-17.9	47	3.4	3.1-3.9	4.0	3.6-5.0	1.6	1.3-1.9	1.5	1.4-1.8
18.0-22.9	26	3.2	2.9-3.5	3.7	3.1-4.0	1.3	1.1-1.6	1.4	1.3-1.6
TOTALS	89	. .	2.9-4.1	. .	3.1-5.5	. .	1.1-2.4	. .	1.3-2.0

Fin Ray Count *

	Number	*Anal Avg.*	*Pectoral*	*Pelvic*	*Dorsal*	*Caudal*
Channel Cat	85	24-27 (26)	I-10	8	6	15-18
White Cat	77	21-26 (23)	I- 9	8	6	15-18

* Measurements and counts made as outlined by Hubbs & Lagler (1949).

Another good field character is the fact that channel catfish have spots on the body while white catfish have none.

Finally, and by way of hindsight, I will always be suspicious of white catfish over 10 pounds. Of 934 white catfish taken since 1956, the two largest specimens weighed 7.8 pounds each. One was a 22.0 inch male and the other a 22.3 inch female.

FOOD HABITS

Table II lists the food items found while examining 521 white catfish and 179 channel catfish between January 1, 1959 and June 30, 1959. Of these totals, only 34.2% of the white catfish and 48.6% of the channel catfish contained food items. A stomach not entirely empty was classified as full.

Digestion seems to be much more rapid than is the case with striped bass, especially during the warmer months when almost no food could be found in the catfish stomachs. This rapid digestion is also reflected in the fact that 28.7% of the white catfish stomachs and 18.9% of the channel catfish stomachs contained unidentifiable fish remains.

Channel Catfish: Fish in both species comprised the bulk of the diet. Channel catfish seem to be very fond of catfish (15.3%). Herring (10.8%) proved to be the next most important fish while bream were close behind, occurring 9.0% of the time.

TABLE II

A LIST OF FOOD ITEMS FOUND IN 178 FULL WHITE CATFISH STOMACHS AND 111 FULL CHANNEL CATFISH STOMACHS TAKEN IN LAKE MOULTRIE, LAKE MARION AND THE TAILRACE SANCTUARY BETWEEN JANUARY 1, 1958 AND JUNE 30, 1959

	White Catfish Frequency		*Channel Catfish Frequency*	
Species	*Number*	*Percent*	*Number*	*Percent*
Shad *	17	9.6	1	0.9
Gizzard Shad	8	4.5	5	4.5
Threadfin Shad	8	4.5	–	. .
Herring	5	2.8	12	10.8
Hickory Shad	–	. .	1	0.9
Unidentified Clupeoids	7	3.9	3	2.7
Bream	4	2.2	10	9.0
Crappie	–	. .	2	1.8
Yellow Perch	–	. .	1	0.9
Catfish	5	2.8	17	15.3
Needlefish	1	0.6	–	. .
Mullet	–	. .	2	1.8
Eel	–	. .	7	6.3
Unidentified Fish	51	28.7	21	18.9
Fish Scales	7	3.9	2	1.8
Fish Eggs	1	0.6	–	. .
Mussel	2	1.1	2	1.8
Crawfish	–	. .	–	. .
Freshwater Shrimp	3	1.7	–	. .
Mayfly Larvae	28	15.7	16	14.4
Dragonfly Larvae	1	0.6	1	0.9
Adult Beetles	1	0.6	2	1.8
Diptera	3	1.7	1	0.9
Hemiptera	1	0.6	–	. .
Hymenoptera	1	0.6	–	. .
Unidentified Insects	5	2.8	2	1.8
Annelid Worm	1	0.6	–	. .
Filamentous Algae	3	1.7	–	. .
Potamogeton	41	23.0	1	1.8
Seeds	2	1.7	–	. .
Debris	5	2.8	–	. .

Species	*Total Stomachs*	*Full Stomachs*	*Percent*	*Empty Stomachs*	*Percent*
White Catfish	521	178	34.2	343	65.8
Channel Catfish	179	87	48.6	92	51.4
	700	265	. . .	435	. . .

* Includes undifferentiated threadfin and gizzard shad.

In all, game fish occurred in 11.8% of the full channel catfish stomachs and this is much more frequent than in the reservoir population of striped bass (Stevens, 1957).

Total fish life occurred in 75.7% of the full channel catfish.

The only other food item important to channel catfish was mayfly nymphs which occurrred in 14.4% of the time. This item made up very little volume however. The largest food items taken from channel catfish were a 12-inch crappie and a nine-inch bream.

The channel catfish used in the food habit study averaged 5.0 pounds.

White Catfish: Fish occurred 64.4% of the time in full white catfish with clupeoid fish accounting for most of this total. Catfish were found in 2.8% and bream in 2.2% of the stomachs. Non-fish items included mayfly nymphs (15.7%) and pondweed (Potamogeton sp.) (23%). Most of the pondweed was taken during the cold months.

The average white catfish taken during the study was 13.0 inches in total length and weighed 1.5 pounds.

The remainder of the paper will be devoted to each species separately.

CHANNEL CATFISH

The channel catfish of the Santee-Cooper Reservoir and tributary streams grow larger and faster, are in better condition and live longer than any other population described in the literature.

Most keys and references state that channel catfish grow to 20 or 25 pounds (Bailey, 1951; Forbes and Richardson, 1909 and 1920; Troutman, 1957; and Eddy, 1957). Carlander (1950) lists only one channel catfish above 20 pounds; namely, a 55-pound individual from South Dakota which also holds the world's record for this species.

For the past five years a creel census has been maintained continuously on the reservoir. Since 1956, the creel census checkers have reported the following giant catfish: 78.0 pounds, 75.0, 62.0 pounds, 60.0 pounds, 55.0 pounds, 52.0 pounds. I examined a snapshot of the 78.0 pound catfish which was taken in the canal between the lakes on July 4, 1956, weighed on cotton scales and witnessed by many Fourth of July fishermen. I couldn't positively identify the fish from the snapshot but it appeared to be a typical example of the large channel catfish in the reservoir. Since I have not yet encountered blue catfish or flathead catfish (*Pylodictus olivaris*) in the watershed, I tentatively assume that this large catfish and the others reported by the creel checkers were, indeed, channel catfish.

I have personally examined a 49.0 pound channel catfish from Lake Moultrie and seven channel catfish above 40 pounds from the Tailrace sanctuary as follows: 40.8, 41.3, 44.0, 46.1, 47.5, 48.0, and 48.5 pounds. Channel catfish in the 30-40 pound range are not uncommon in either location, and channel catfish 20-30 pounds are common. For example, Table III lists the stocking data of 720 channel catfish taken in the tailrace sanctuary by Commission personnel between February 2, 1958 and August 6, 1959. On March 13, 1959, 18 were caught which averaged 21.7 pounds.

In April and May of 1958 in Lake Moultrie near Pinopolis Dam, many large channel catfish were taken by striped bass fishermen using cut and live herring as bait. A sample of 44 of these large channel catfish averaged 27.6 pounds each. Few of these large catfish were taken this year, however, although the striped bass fishery was intensive and very productive.

TABLE III

STOCKING DATA FOR CHANNEL CATFISH FROM THE PINOPOLIS DAM TAILRACE SANCTUARY

Date	*No.*	*Wt. Lbs.*	*Avg. Wt. Lbs.*	*Destination*
2/ 5/58	24	369.4	15.4	Oak Grove Lake, Greenville Co., S. C.
2/11/58	25	465.0	18.6	Oak Grove Lake, Greenville Co., S. C.
2/17/58	7	75.2	10.7	Orangeburg Federal Fish Hatchery, S. C.
3/31/58	45	436.5	9.7	Orangeburg Federal Fish Hatchery, S. C.
4/ 1/58	50	452.3	9.0	Hoffman Federal Fish Hatchery, N. C.

TABLE III—*Continued*

STOCKING DATA FOR CHANNEL CATFISH FROM THE PINOPOLIS DAM TAILRACE SANCTUARY

Date	*No.*	*Wt. Lbs.*	*Avg. Wt. Lbs.*	*Destination*
4/ 2/58	50	459.6	9.1	Millen Federal Fish Hatchery, Ga.
4/ 3/58	50	428.3	8.6	Cheraw Federal Fish Hatchery, S. C.
6/ 6/58	23	315.3	13.7	Oak Grove Lake, Greenville Co., S. C.
7/24/58	20	316.4	15.8	Broad River, Cherokee Co., S. C.
7/24/58	26	361.0	13.9	Oak Grove Lake, Greenville Co., S. C.
8/ 7/58	23	296.8	12.9	Burnside Pond, Richland Co., S. C.
9/ 9/58	22	209.1	9.5	Hoffman Federal Fish Hatchery, S. C.
9/ 9/58	20	175.2	8.8	Millen Federal Fish Hatchery, Ga.
9/ 9/58	15	171.5	11.4	Orangeburg Federal Fish Hatchery, S. C.
3/11/59	36	582.8	16.2	Oak Grove Lake, Greenville Co., S. C.
3/30/59	33	600.8	18.2	Saluda River, Greenville Co., S. C.
4/ 3/59	18	390.8	21.7	Saluda River, Greenville Co., S. C.
4/ 4/59	23	298.0	13.0	Saluda River, Greenville Co., S. C.
4/13/59	35	620.8	17.7	Keowee River, Pickens River, S. C.
4/27/59	22	399.2	18.2	Oak Grove Lake, Greenville Co., S. C.
5/22/59	38	485.5	12.8	Oak Grove Lake, Greenville Co., S. C.
6/19/59	32	415.3	13.0	Edisto River, Bamberg Co., S. C.
6/23/59	17	255.3	15.0	Oak Grove Lake, Greenville Co., S. C.
6/23/59	14	212.0	15.1	Burnside Pond, Richland Co., S. C.
8/ 3/59	37	542.0	14.7	Broad River, Spartanburg Co., S. C.
8/ 6/59	15	163.0	10.9	Oak Grove Lake, Greenville Co., S. C.
TOTALS	720	9,497.1	13.2	

These fish and the other channel catfish taken between April 1, 1956 and September 30, 1959 are listed in Table IV.

TABLE IV

CHANNEL CATFISH CAPTURE DATA

Location	*Method*	*No.*	*Total Wt. Lbs.*	*Avg. Wt. Lbs.*	*Purpose*
Lake Moultrie	Gill Net	182	339.0	1.9	Study
Lake Moultrie	Trotline	53	832.2	15.7	Study
Tailrace Sanctuary	Hook and Line ..	52	738.4	14.2	Study
Tailrace Sanctuary	Hook and Line ..	720	9,497.1	13.2	Stocking
		1,007	11,406.7	11.3	

During this period, 1,007 channel catfish weighing 11,406.7 pounds were taken in Lake Moultrie and the tailrace sanctuary. These fish averaged 11.3 pounds which reflects in part the methods used for capture. Large hooks and large pieces of cut bait were used in both hook and line and trotline fishing. However, channel catfish between 10 and 21 inches are scarce in both Lake Moultrie and the tailrace canal. Of 354 channel catfish used in Table IX for length-weight analysis only 20 (5.6%) were between 10 and 20 inches in total length.

AGE GROWTH

Methods: The pectoral spines of 210 channel catfish from Lake Moultrie and the tailrace sanctuary were aged in a manner similar to that described by Snead (1951). A small cross section was cut at the distal end of the basal groove of each spine. The sections were then placed on an Eberbach projector using a 300-watt bulb and the annuli counted and measured from the image. A 200-watt bulb did not give adequate illumination. A zero intercept was assumed and the sexes were not separated.

On approximately one-half of the specimens, the dorsal spine and vertebrae were also prepared and read. These bones gave satisfactory results for the smaller catfish but were not satisfactory for larger individuals. The vertebrae from the large channel catfish showed distinct marks but the first several were obscure and there appeared to be false annuli or spawning checks. I could establish no criterion for separating true annuli from false annuli. In general, however, there was agreement within one or two annuli with the pectoral spine count. The count usually being larger on the vertebrae.

Dorsal spine sections from large fish in many cases agreed well with the corresponding pectoral spine section, but in others, contained fewer annuli. The growth pattern on pectoral spine sections appeared more logical and was in better agreement with other emperical data.

In the center of both spines there occurs a lumen which increases with age by eroding away the adjacent bony material. In the larger catfish this obliterates the first and sometimes presumably two or three annuli. The pectoral spine is preferable in this respect because the lumen is not as large as in the dorsal spines and erosion is not as extensive.

In either case, however, it presents a difficulty in determining the first year or more growth for the larger catfish. This early growth, therefore, was assumed for large fish on the basis of the current growth of the younger fish.

This will introduce an error if this early growth rate has changed in recent years, which is likely, or if a given large catfish happens to have been a fast grower in early life. In such case, a large catfish, say in year class XIII, could be as much as two years younger than indicated.

Another difficulty is presented by the edge of the section in that it almost always appears to be an annulus. Since the annulus forms in April, May and June in the Santee-Cooper Reservoir, the edge was considered the annulus in adult catfish taken between January 1 and June 30 if the last annulus was not obviously formed. A series of 25 channel catfish with an average total length of 7.9 inches appeared to have formed the last annulus in December. Small fish were treated, therefore, as an exception to the rule above. The last annulus for small catfish, however, was in most cases, obviously formed or not.

Marzolf (1955) and Appelget and Smith (1951) used vertebrae satisfactorily in aging channel catfish, while Hall and Jenkins (1952) preferred dorsal spines to pectoral spines. As will be shown below, however, the average size of the catfish in each instance was much smaller than those aged here. In smaller catfish the lumen erosion is not as much a problem nor are the vertebrae as difficult to read.

Rate of Growth: Table V presents the average calculated growth and growth increments for 210 channel catfish taken from Lake Moultrie and the tailrace sanctuary. The study includes catfish in age groups 0 through XIV but heavily emphasizes age groups VII-XI. This is one fact which distinguishes the study from similar studies elsewhere.

"live longer"

In this study 60% of the catfish were eight years or over. Fennell and Jenkins (1954) aged 7,717 channel catfish in Oklahoma, only 3% of which were eight or more years old. Appelget and Smith (1951) in Iowa lists 39 (7.3%) of 535 channel catfish as being eight or more years old, while Marzolf (1955) in Missouri found only 16 (3.7%) of 434 channel catfish to be eight years old and none older.

Fennell and Jenkins (1954) also found channel catfish reaching fourteen years of age in Oklahoma although of 7,717 channel catfish they found only 16 (0.2%) twelve, thirteen and fourteen year olds, while I found 14 (6.7%) of 210 channel catfish in this range.

"grow faster"

Table VI compares this age-growth study with similar work in Oklahoma, Iowa and Missouri. These appear to be the major works of this nature to be found in print. When this study is compared with the Oklahoma State average, it can be seen that the growth for the first four years is very similar but

that the Santee-Cooper channel catfish grow much faster in subsequent years. It should be pointed out that the Oklahoma sample is much larger and covers all habitats within the state.

TABLE V

AVERAGE CALCULATED TOTAL LENGTHS IN INCHES AND ANNUAL LENGTH INCREMENTS OF 210 CHANNEL CATFISH FROM LAKE MOULTRIE AND THE TAILRACE SANCTUARY

Age Group	*No.*	*Avg. Total Length*	*Calculated Total Length at End of Year of Life*													
			1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
0	3	4.1														
I	20	6.9	3.3													
II	25	7.9	3.3	7.2												
III	4	12.3	4.0	6.3	11.5											
IV	4	15.4	3.2	6.0	10.2	14.3										
V	4	20.5	3.1	6.4	10.8	14.9	19.5									
VI	7	23.3	3.6	8.1	11.7	15.1	18.5	21.7								
VII	18	26.7	5.2	7.8	11.5	15.5	19.1	22.9	25.8							
VIII	34	28.1		6.8	10.6	14.1	17.0	21.1	24.4	27.0						
IX	34	30.3		7.6	11.6	15.0	17.7	21.2	24.0	26.8	29.4					
X	24	32.2		7.4	11.1	14.3	17.4	20.7	23.5	26.2	28.9	31.2				
XI	19	33.5		8.4	11.1	13.7	16.5	19.6	22.8	25.8	28.4	30.7	32.4			
XII	3	33.9		6.2	10.4	14.1	17.3	19.5	21.2	23.4	26.3	29.1	31.2	32.7		
XIII	8	37.6		7.6	11.9	14.3	16.3	18.4	20.2	24.5	27.4	29.5	32.0	34.7	36.9	
XIV	3	36.6		7.8	10.7	12.2	13.9	15.9	17.9	20.0	23.5	26.2	29.2	31.7	34.0	35.6
(†)	210		3.4	7.3	11.2	14.5	17.4	20.9	23.7	26.2	28.6	30.4	31.8	33.6	36.1	35.6
(‡)			3.4	3.9	3.9	3.3	2.9	3.5	2.8	2.5	2.4	1.8	1.4	1.8	2.5	

† Grand Average and Total. ‡ Increments of Growth.

TABLE VI

A COMPARISON OF THE GROWTH RATE OF CHANNEL CATFISH FROM SEVERAL STATES

Location	*No.*	*Average Calculated Total Length at Each Annulus*													
		I	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*	*XIII*	*XIV*
Santee-Cooper... Stevens (1959)	210	3.4	7.3	11.2	14.5	17.4	20.9	23.7	26.2	28.6	30.4	31.9	33.6	36.1	35.6
Okla. State Avg. Fennell & Jenkins (1954)	7,717	4.0	8.5	11.9	14.5	16.1	17.8	19.9	21.9	23.9	24.8	25.4	25.5	25.8	28.8
Iowa ..... Appelget & Smith (1951)	535	3.0	6.3	9.1	11.7	14.2	16.6	19.1	21.1	24.0	26.6	25.9	28.0		
Missouri ..... Marzolf (1955)	434	2.1	4.3	6.1	7.7	9.2	10.4	11.5	13.0						

Fennell and Jenkins (1954) found the growth of channel catfish in Oklahoma to vary with many environmental factors such as age and size of the body of water, turbidity and the presence or absence of channel catfish reproduction.

The growth rate in the Santee-Cooper Reservoir which is 17 years old far exceeds the growth rate of old reservoirs in Oklahoma. New Oklahoma reservoirs and small lakes produce a growth rate which exceeds the Santee-Cooper growth through the sixth year, and small lakes equal the Santee-Cooper growth in years seven, eight and nine, after which, the Oklahoma sample becomes too small for comparison.

The Iowa study using Mississippi River channel catfish, shows a growth rate less than here at all times. The Missouri study on Lake-of-the-Ozarks was evidently made on a very stunted population since the average calculated total length at age group VIII is only 13.0 inches—as compared with 26.2 inches for this State.

These data demonstrate the extreme plasticity of channel catfish when confronted with different physical and biological conditions. In terms of total

length, the eight-year old Santee-Cooper channel catfish were twice as long as Lake-of-the-Ozarks channel catfish of like age. In terms of weight, however, the difference is between a 0.5 pounds and 9.4 pounds or a 19-fold difference.

Table VII takes this plasticity concept one step further and compares the slowest and fastest growing individuals in each age group from the Santee-Cooper Reservoir.

TABLE VII

SLOWEST AND FASTEST GROWING INDIVIDUAL CHANNEL CATFISH IN EACH YEAR CLASS *

	Length		*Weight*	
Year Class	*Slowest*	*Fastest*	*Slowest*	*Fastest*
I	2.2	4.8	0.1	0.2
II	5.7	8.7	0.1	0.6
III	8.9	17.6	0.8	2.3
IV	10.2	21.4	0.8	3.4
V	16.5	23.1	2.4	7.8
VI	19.0	29.3	3.6	15.0
VII	23.6	30.5	5.6	15.8
VIII	23.0	33.5	7.0	22.5
IX	24.3	39.4	7.3	36.5
X	25.6	38.5	8.8	41.0
XI	26.9	38.8	9.1	34.5
XII	31.0	35.6	16.6	34.2
XIII	30.5	40.9	21.4	43.5
XIV	33.5	38.4	19.1	38.0

* The length and weights are not necessarily from the same catfish.

Maximum growth presented in Table VII was achieved by a 36.5 pound and a 41.0 pound individual which grew at an average rate of about four pounds per year.

Because Lake Moultrie and the tailrace sanctuary present very different physical and biological conditions, the growth of channel catfish in each location is compared in Table VIII.

The tailrace sanctuary almost always has a current which varies from slight to very strong as power needs are met. Large numbers of many species of fish congregate in this current to spawn in the spring months and to eat stunned fish which are drawn through the turbines in great numbers. Table IV leaves no doubt that channel catfish congregate in the tailrace sanctuary during the entire year.

Lake Moultrie, on the other hand, has no preceptable current, a relatively small population of channel catfish and no windfall of food such as occurs in the tailrace sanctuary.

Table VIII. A Comparison of the Growth Rate of Channel Catfish in Lake Moultrie and the Tailrace Sanctuary.

TABLE VIII

A COMPARISON OF THE GROWTH RATE OF CHANNEL CATFISH IN LAKE MOULTRIE AND THE TAILRACE SANCTUARY

Location	*No.*	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*
Lake Moultrie	127	3.4	7.2	11.4	14.9	18.0	21.9	24.9	27.4	30.0
Tailrace Sanctuary	83	3.8	7.5	11.0	14.9	16.9	19.9	22.6	25.2	27.5

Table VIII shows the growth to be very similar until year V when the Lake Moultrie catfish began growing faster. The superiority increases to a difference of 2.5 inches in year IX, after which it diminishes. Apparently the effect of the abundance of food in the tailrace sanctuary is minimized by the competition and swift current.

The growth rate in each situation becomes greatly accelerated after year IV. This is not as apparent in terms of total length as in terms of weight (Figure 2). Once channel catfish have grown beyond the competition of the much smaller and abundant white catfish, the growth greatly increases.

Figure 2 compares the growth in terms of weight of channel catfish from this study against channel, blue and flathead catfishes from Oklahoma. The average calculated lengths were plotted against length-weight relationship data in each paper and then plotted in Figure 2. The Oklahoma publications were Fennell and Jenkins (1954), Jenkins (1956) and McCoy (1953).

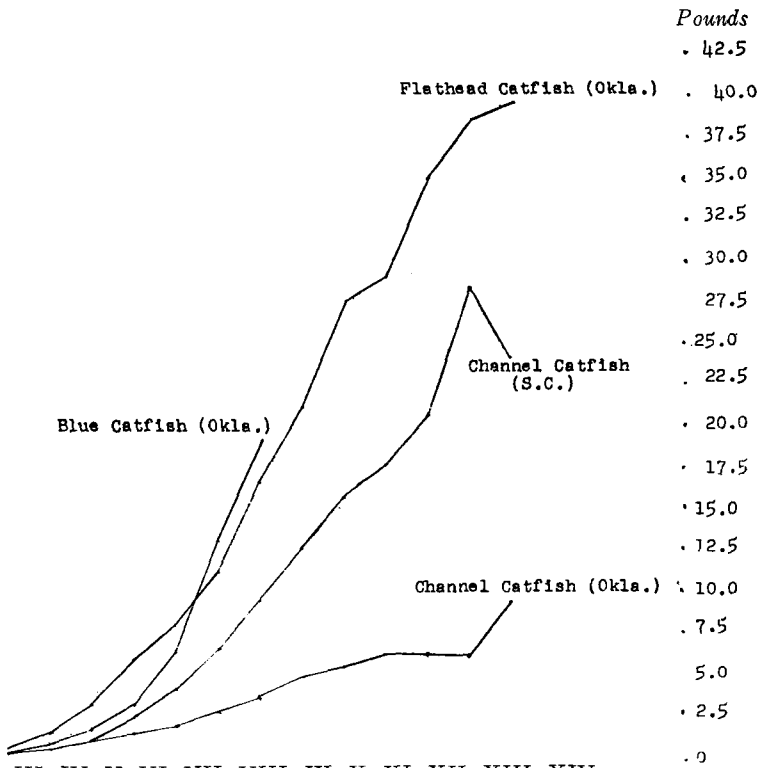


Figure 2 A Comparison of the Weight at each Annulus of Channel Catfish from South Caroline and Channel, Blue and Flathead Catfishes from Oklahoma.

It can be seen that Santee-Cooper channel catfish greatly exceed the growth of Oklahoma channel catfish but are, in turn, greatly exceeded by Oklahoma blue and flathead catfishes. For example, at year class X Oklahoma channel catfish are about five pounds; South Carolina channel catfish are three times as large at 15.0 pounds and Oklahoma flathead catfish almost double that figure with a 27.4 pound average at ten years of age. The blue catfish growth is similar to that of flathead catfish.

Lenth-Weight Relationships: Table IX presents the length-weight relationship of 354 channel catfish taken both from Lake Moultrie and the tailrace canal. It also includes the weight range in each inch group which again emphasizes the great variation in the growth and form among the channel catfish in this study.

TABLE IX

LENGTH-WEIGHT RELATIONSHIP OF CHANNEL CATFISH OF THE SANTEE-COOPER RESERVOIR

Length Inches	*Number of Fish*	*Average Total Length*	*Avg. Weight Pounds*	*Weight Range Pounds*
6.0– 7.9	2	6.3	0.10	....
7.0– 7.9	22	7.4	0.13	0.10–0.20
8.0– 8.9	12	8.4	0.18	0.21–0.31
9.0– 9.9	7	9.2	0.31	0.23–0.81
10.0–10.9	1	10.4	0.30	0.30
11.0–11.9	2	11.6	0.50	0.50
12.0–12.9	3	12.5	0.57	0.51–0.62
13.0–13.9	–	....	....	....
14.0–14.9	1	14.3	0.81	0.81
15.0–15.9	–	....	....	....
16.0–16.9	1	16.5	1.8	1.8
17.0–17.9	3	17.6	2.2	2.0– 2.4
18.0–18.9	4	18.6	3.3	2.4– 4.3
19.0–19.9	2	19.6	3.1	2.8– 3.3
20.0–20.9	3	20.5	4.0	3.1– 5.1
21.0–21.9	7	21.6	4.1	3.3– 6.2
22.0–22.9	7	22.5	4.9	4.4– 6.3
23.0–23.9	6	23.5	6.5	5.3– 7.5
24.0–24.9	15	24.4	7.1	5.4– 8.3
25.0–25.9	21	25.5	8.5	7.0–10.0
26.0–26.9	14	26.3	9.4	7.9–11.0
27.0–27.9	26	27.3	10.9	8.8–13.0
28.0–28.9	29	28.2	12.5	9.8–15.0
29.0–29.9	23	29.5	13.7	11.5–16.3
30.0–30.9	22	30.4	15.6	13.0–18.0
31.0–31.9	24	31.4	17.5	14.0–21.3
32.0–32.9	20	32.5	19.2	17.1–22.0
33.0–33.9	22	33.4	20.5	18.4–24.0
34.0–34.9	10	34.5	22.8	21.2–25.0
35.0–35.9	12	35.4	24.5	22.0–26.6
36.0–36.9	4	36.3	28.1	26.0–29.5
37.0–37.9	9	37.3	32.9	30.0–39.0
38.0–38.9	9	38.4	35.2	30.4–38.6
39.0–39.9	2	39.0	34.2	33.8–34.6
40.0–40.9	6	40.4	40.7	36.5–48.3
41.0–41.9	2	41.0	46.6	46.1–47.0
42.0–42.9	1	42.3	43.5	43.5
TOTAL	354			

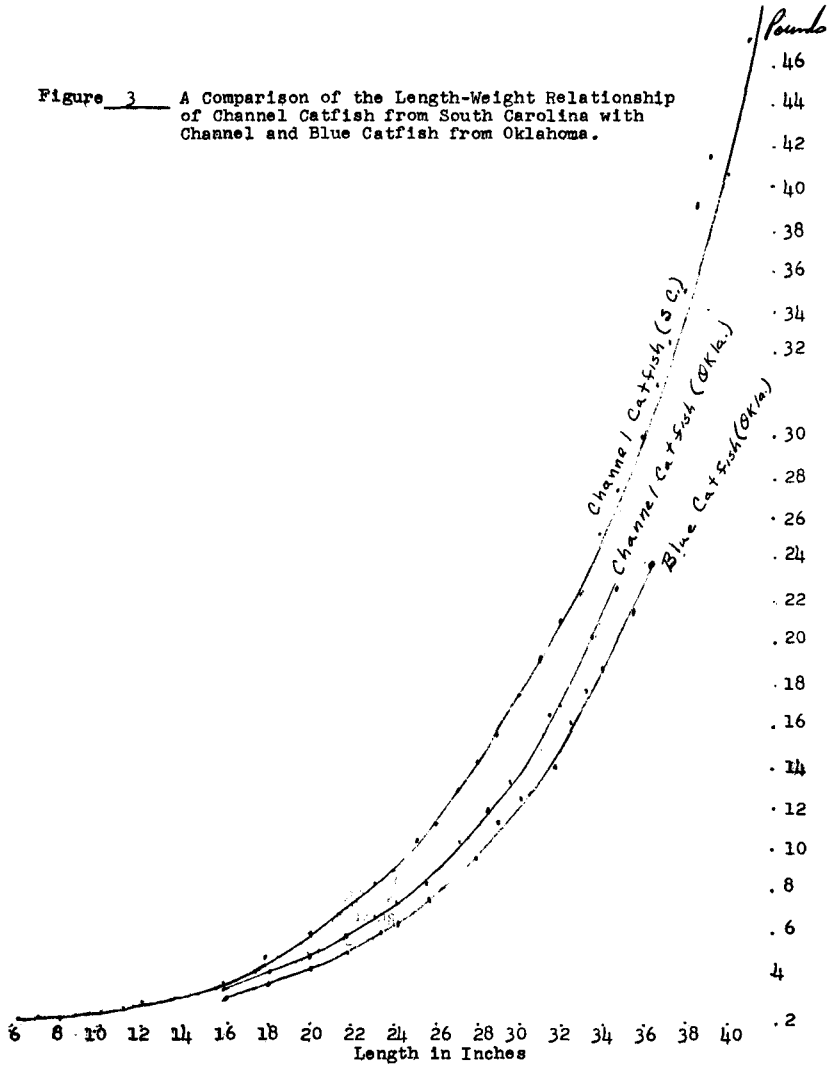
"better condition"

Figure 3 plots the length-weight relationship of South Carolina channel catfish against similar data from channel catfish and blue catfish from Oklahoma. Up to a total length of about 14 inches the relationship is similar. From 14 on through 42 inches, channel catfish here are more robust than either of the *Ictaluridae* in Oklahoma. The length-weight relationship of Oklahoma flathead catfish is similar to that of Oklahoma blue and channel catfish and consequently are also less robust than Santee-Cooper channel catfish.

Channel catfish from the tailrace canal are more robust than those from Lake Moultrie in most inch groups between 20 and 40 inches. A comparison of 68 from the tailrace sanctuary and 65 from Lake Moultrie showed that from 21.0-30.9 inches total length, the tailrace channel catfish average 0.7 pounds heavier and from 31.0-40.9 inches total length, averaged 3.1 pounds heavier.

This superior condition in the tailrace catfish helps offset in part the above-mentioned superiority of Lake Moultrie channel catfish as it pertains to total length. Even so, Lake Moultrie channel catfish attained a greater weight than the tailrace channel catfish from five years of age on.

Figure 3 A Comparison of the Length-Weight Relationship of Channel Catfish from South Carolina with Channel and Blue Catfish from Oklahoma.



SEX AND MATURITY

It became obvious early in 1956 that many of the large male channel catfish had rudimentary testicles.

This phenomenon was persued to see whether this deficiency in the primary sex character would be accompanied by differences in secondary sex characteristics.

Table X compares 22 mature male channel catfish with 14 male channel catfish with small inactive testicles.

A large mature male has testicles which have both length and width and are well fringed. He is generally black or blue-black and has black lips—especially the upper lip. His external genitalia is usually well formed and from 11 to 16 mm. in length.

A large sexually immature male has testicles which are almost invisible. The external genitalia is soft and usually less than five mm. in length. The lips are white and the body color is grey to light grey as indicated in Table X.

TABLE X

A COMPARSON OF SEVERAL PRIMARY AND SECONDARY SEX CHARACTERISTICS OF 22 MATURE AND 14 IMMATURE MALE CHANNEL CATFISH FROM LAKE MOULTRIE AND THE TAILRACE SANCTUARY

	Testicles		*External Genitalia*	
Maturity	*Length*	*Width*	*Length*	*Condition*
Mature	10–16 mm.	2–5 mm.	11–16 mm.	Well Formed
Immature	2– 7 mm.	½ mm.	2– 7 mm.	Soft

	Color		
Lips	*Head*	*Back*	*Sides*
Mottled to Black	Grey to Blue Back	Light Grey to Blue Black	Light to Blue Back
White	Light Grey to Dark Grey	Light Grey to Dark Grey	Light to Light Grey

			Total Length Range	*Wt. Range*	*Avg. Wt.*
	Number	*Percent*	*Inches*	*Pounds*	*Pounds*
Mature	22	61.1	28.3–42.3	11.0–48.5	23.4
Immature	14	38.9	25.9–35.5	9.1–24.6	15.3
TOTAL	36	100.0			

In addition, a mature male has a longer and wider head and wider gape of mouth. To demonstrate this I took 16 mature male and 16 immature male channel catfish and separated them into three length groups to eliminate the natural difference in proportions between channel catfish of different sizes. From these data I computed a weighted average expressed in percent as follows:

The mature males had heads which averaged 8.2% longer, 13.7% wider and gapes which averaged 13.4% wider than immature males of corresponding sizes. The maximum difference however was 20.8%, 28.5% and 25.4% respectively for each of the above three measurements.

Mature males had heads 3.1% longer, 8.1% wider and gapes 3.9% wider than mature females of equal length and maximum differences of 9.8%, 28.2%, and 11.0% respectively.

Therefore, immature males had smaller heads and gapes than either of the mature sexes.

A small number of immature males were aged and compared with the growth of mature males and females but no significant difference was discernible.

There were individual males which seemed intermediate between the two; having mottled lips, lighter body color and narrower heads, etc. Invariably, however, if a male had well formed testicles, he was black, had large well-formed external genitalia and a broad head. On the other hand, a male with rudimentary testicles in all cases was shaped and colored similar to mature females and had small, soft external genitalia.

Mature females generally have lighter lips and body than mature males. However, females between 20 and 30 pounds are usually black, blue black or a very dull grey, and have mottled to black lips.

Very little information is available which makes it possible to delimit with accuracy the spawning season or the minimum size of spawning females. Several large females were found in March and April had large flaccid ovaries which appeared spawned out. The only other spawned females were found in the first and third weeks of June. Ripe females were taken throughout June so

it is assumed that the most active spawning period is probably June and July for channel catfish here.

The small numbers of channel catfish taken between 10-20 inches make it impossible to establish the minimum size of spawning females. The smallest mature female encountered was 24.2 inches in total length and weighed 5.6 pounds. Three females between 7.0 and 7.5 pounds were found which had very little ovarian development. These individuals may well have been suffering from the same hormone deficiency as the large immature male channel catfish. The data are too meager for development, however.

MORPHOLOGY

In order to compare the Santee-Cooper channel catfish with channel catfish from another location, several body measurements have been taken from Forbes and Richardson (1903 and 1920) and compared as follows:

	Forbes and Richardson	*Santee-Cooper*	
		Adults	*Sub-Adults*
		25.4–42.3*	4.0–12.0*
Body Depth	4.2–5.0	4.0–4.9	5.1–6.2
Head Length	3.6–4.0	3.1–4.0	3.9–4.5
Head Depth	4.9–5.2	5.2–5.8	6.1–6.7
Dorsal to Snout	2.5–2.7	2.4–2.7	2.8–3.0
Anal Fin Base	3.4–3.7	3.6–4.5	3.8–4.2

* Total Length in Inches.

Forbes and Richardson were undoubtedly dealing with smaller adult fish and this would account for the fact that channel catfish in South Carolina appear to range deeper in body and longer in head. The head depth comparison is in complete disagreement, however, and the anal fin base of the Santee-Cooper channel catfish are definitely less in proportion to the body than channel catfish, not only in Illinois but also Ohio and Iowa since Bailey (1951) and Trautman (1957) also quote 3.4-3.7 for anal fin base length.

One other obvious difference is that these channel catfish retain their spots throughout life although the spots tend to become obscured in the mature black individuals and are, of course, less obvious on the larger channel catfish than on sub-adults. Almost all other keys and descriptions state that channel catfish lose their spots after seven to ten pounds.

WHITE CATFISH

Age-Growth: Table XI presents an age-growth study of 179 white catfish from the Santee-Cooper Reservoir in terms of total calculated length at each annulus. The growth in each lake was approximately the same and these data were combined for this reason. A zero intercept was assumed and the sexes were not separated for consideration.

The same methods were used for preparing and reading spine sections as with channel catfish, although dorsal spines were used except in a few cases. As mentioned before, dorsal spines proved to be satisfactory for smaller catfishes. Lumen erosion was again encountered and the first year's growth of some of the older white catfish was assumed.

The maximum age attained was represented by two individuals which were 11 years old. The only other available growth study on white catfish was done in California. Growth data on white catfish from the Sacramento River in 1954 and 1955 and on Clear Lake in 1955 were reported by J. B. Kimsey in a quarterly progress report. These data were in terms of fork length but simple comparisons with similar data here indicate that Sacramento River white catfish grow at about the same rate as Santee-Cooper white catfish, while those in Clear Lake generally exceeded slightly the growth of the Santee-Cooper white catfish.

TABLE XI

AVERAGE CALCULATED LENGTHS AND ANNUAL LENGTH INCREMENTS OF 179 WHITE CATFISH FROM THE SANTEE-COOPER RESERVOIR

Age Group	*No.*	*Avg. Total Length (In.)*	*Calculated Total Length at End of Year of Life* 1	2	3	4	5	6	7	8	9	10	11
0	11	2.6											
I	6	4.9	3.0										
II	15	6.6	2.7	5.3									
III	13	9.5	2.8	4.7	7.7								
IV	30	12.2	3.3	5.6	8.5	10.9							
V	24	14.9	3.4	5.9	9.0	11.3	13.3						
VI	27	16.3	3.5	5.3	8.1	10.8	13.2	15.0					
VII	34	17.1	3.5	5.3	7.6	10.3	12.3	14.1	15.7				
VIII	12	18.9	4.0	5.4	7.7	10.4	12.9	14.4	15.9	17.3			
IX	5	19.7		5.3	7.6	10.4	12.3	14.2	16.0	17.6	18.9		
X	1	18.2		5.8	6.4	10.6	13.1	13.6	14.6	15.2	16.4	17.6	22.0
XI	1	*22.0*			*7.7*	10.5	11.8	13.3	14.6	15.8	18.3	19.5	*22.0*
GRAND AVG. AND TOTAL	179		3.2	5.4	8.1	10.7	12.8	14.4	15.7	17.2	18.5	18.6	22.0
INCREMENT OF GROWTH			3.2	2.2	2.7	2.6	2.1	1.6	1.3	1.5	1.3	0.1	3.4

Table XII presents the length-weight relationship of 459 white catfish from the Santee-Cooper Reservoir. These data compare closely with a study on white catfish in Virginia (Menzel, 1945) and a study on Clear Lake in California by Murphy in 1951.

TABLE XII

LENGTH-WEIGHT RELATIONSHIP OF WHITE CATFISH OF THE SANTEE-COOPER RESERVOIR

Length Inches	*Number of Fish*	*Average Total Length*	*Avg. Weight Pounds*	*Weight Range Pounds*
6.0– 6.9	13	6.2	0.14	0.11–0.31
7.0– 7.9	23	7.4	0.16	0.14–0.21
8.0– 9.9	19	8.3	0.21	0.15–0.30
9.0– 9.9	24	9.3	0.30	0.20–0.40
10.0–10.9	34	10.5	0.47	0.40–0.71
11.0–11.9	65	11.3	0.65	0.51–1.00
12.0–12.9	43	12.5	0.82	0.53–1.70
13.0–13.9	49	13.3	1.1	0.6–1.5
14.0–14.9	40	14.4	1.5	0.8–2.1
15.0–15.9	37	15.4	1.9	1.4–2.7
16.0–16.9	40	16.4	2.4	1.9–3.3
17.0–17.9	18	17.5	3.0	2.3–3.8
18.0–18.9	19	18.4	3.5	2.3–4.8
19.0–19.9	11	19.5	3.8	3.1–7.8
20.0–20.9	6	20.2	4.9	4.1–5.8
21.0–21.9	11	21.3	5.4	4.1–7.0
22.0–22.9	4	22.0	6.8	5.5–7.8
23.0–23.9	2	23.3	6.1	5.3–5.8
24.0–24.9	1	24.5	5.3	5.3
TOTAL	459			

Spawning: Six of seven females taken in between July 2 and July 16 were spawned and it is assumed the spawning season peaks in June. The smallest ripe female encountered was 8.2 inches in total length.

EDITOR'S NOTE: On March 8, 1960 a 57.0 pound channel catfish was caught in Lake Moultrie by C. B. Dennis and accepted by *Field and Stream* Magazine as the world record.

RECOMMENDATIONS

Since channel catfish do not take advantage of the 100,500 acres of water provided by Lake Marion and since channel catfish do not fully fill the niche provided by the 60,000 acres in Lake Moultrie, I recommend that flathead catfish and blue catfish be introduced into the Santee-Cooper Reservoir.

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