To the Graduate Council:

I am submitting herewith a thesis written by Stephen Carl Nifong entitled "Growth and Food Habits of Adult Striped Bass in Cherokee Reservoir, Tennessee." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Wildlife and Fisheries Science.

J. Larry Wilson, Major Professor

We have read this thesis
and recommend its acceptance:

Accepted for the Council:

Vice Chancellor
Graduate Studies and Research

A

GROWTH AND FOOD HABITS OF ADULT STRIPED BASS IN CHEROKEE RESERVOIR, TENNESSEE

A Thesis

Presented for the

Master of Science

Degree

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Stephen Carl Nifong

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ABSTRACT

One hundred twenty one striped bass were collected on Cherokee Reservoir, Tennessee, from February to December, 1976, to determine food habits and growth characteristics. The study revealed fish in age classes II through VII, with age class IV being the predominant group. Cherokee striped bass grew rapidly in their first three years of life, and then their growth slowed. The condition factor (K) for Cherokee striped bass ranged from 0.74 to 1.72. Stomach analysis done on 98 fish showed that 52.6% contained food items; all food items were fish. Clupeids were the predominant type of fish found in the stomach samples with Lepomis being the next most common group. Other game fish found in the sample included one white crappie.

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CHAPTER I

INTRODUCTION

Striped bass (Morone saxatilis Walbaum) have long been considered one of the premier game fish in coastal areas. With the establishment of a self-sustaining, landlocked population in South Carolina's Santee-Cooper Reservoir in the early 1950's (Stevens 1957), it became apparent that the popular fish could fill an important niche in inland reservoirs and provide many hours of enjoyment for reservoir fishermen. Research and long hours by dedicated hatchery personnel and fisheries biologist subsequently provided the hatchery techniques necessary to provide the fish needed to establish the inland striped bass fisheries in the Southeast as we know them today. For example, Cherokee Reservoir has received a stocking of fry or fingerlings each year since 1964 to build its fishery (Bishop, TWRA, pers. communication).

Along with the tremendous fighting characteristics and trophy status of the striped bass (also called striper), the fisheries biologists soon found it to be an important tool in predator diversification on reservoirs in the attempt to utilize overabundant forage species. However, the use of the striped bass to fill this unexploited niche was not without its problems. At the time of this study in 1976 in Cherokee Reservoir, the diet of striped bass was a matter of large controversy among fishermen. Although most fishermen agree that it was a desirable trophy, many felt that the stocking of striped bass could only be detrimental to other game fish in a reservoir due to

striper's decimation of their populations by predation. One of the purposes of this study was to examine the food habits of striped bass in Cherokee to see if game fish were a major part of their diet. Another facet of the study was the collection of data on age and growth of adult striped bass. Comparisons of data from the Cherokee population with populations in other reservoirs can provide insight into the suitability of Cherokee's aquatic environment for striped bass.

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CHAPTER II

LITERATURE REVIEW

Due to the immense popularity of the striped bass as a game fish and its value as a saltwater commercial fishery, many intensive studies have been done on striped bass. Worth's paper in 1881 on the Weldon Fish Hatchery was the forerunner of others that since have dealt with propagation, age and growth, food habits, physiology, and movements of marine and anadromous fish.

The early twentieth century works on the striped bass primarily concerning marine or estuarine striper populations. Raney (1952) gave a detailed life history of striped bass on both the east and west coast. Hollis (1952) and Vladykov and Wallace (1952) studied the striped bass in the Chesapeake Bay region. Johnson and Calhoun (1952) did a study on the food habits of stripers in San Francisco Bay. Thomas (1967) explored the diet of striped bass in the Sacremento-San Joaquin River System.

Surber (1957) and Stevens (1957) reported on the establishment of the original inland population of striped bass in the Santee-Cooper Reservoirs. This successful, self-sustaining population proved that the striper could complete its life cycle entirely in a fresh-water environment. Tremendous improvements in propagation techniques made it possible for the striper to be stocked across the county in large impoundments. Stevens and Fuller (1962) and Bayless (1972) helped perfect the use of human chorionic gonadotropin (HCG) to

induce spawning in hatchery-held stripers. Bishop (1974) developed the system (which is currently being used in several modern hatcheries) of using circular tanks to spawn HCG injected stripers. In a search for a perhaps more suitable fish for some reservoirs, Bishop (1967) helped develop the striped bass-white bass hybrid. Bishop (1967), Ware (1970) and Williams (1975) reported on various aspects of hybrid populations.

Age and growth characteristics have been studied on several inland striper populations. Stevens (1957) found the average length of striped bass in Santee-Cooper to range from 215.9 mm (8.5 inches) at age I to 767.1 mm (30.2 inches) at age VII. Domrose (1963) reported average lengths at the same ages to be 132.1 mm (5.2 inches) and 723.9 mm (28.5 inches) for Kerr Reservoir. For Tennessee reservoirs, Weaver (1975) found the total lengths to average 215.9 mm (8.5 inches) at age I up to 731.5 mm (28.8 inches) at age VI. Van Den Avyle and Higginbotham (1979) reported that Watts Bar stripers averaged 182.9 mm (7.2 inches) at age I to 993.1 mm (39.1 inches) at age VII.

The condition factor (K), or the measure of relative plumpness, has been reported in striper studies. Ware (1970) found the K-factor averaged between 1.83 to 2.30 on some inland Florida striper populations. He gave some generalized classifications of K-values for striped bass between 76.2 mm (3 inches) and 482.6 mm (19 inches) total length in which K-value greater than 2.0 appears plump and healthy, while a K-value less than 1.80 is in poor condition. Weaver (1975) discovered an average of 1.12 to 1.39 for stripers in J. Percy Priest Reservoir.

Wigfall and Barkuloo (1975) indicated that K-factor values ranged from 1.7 to 2.5 for stripers from Choctawhatchee River System of Florida.

Many studies of inland striped bass populations have dealt with various aspects of the food habits of the striper in impoundments or culture ponds. In studies involving culture ponds, Sandoz and Johnson (1956) found that striped bass fingerlings up to 85 mm total length preferred cladocerans. Harper and Jarman (1971) discovered that stripers from 10 to 50 mm preferred copepods and that larger fingerling striped bass and young-of-year (y-o-y) stripers utilized cladocerans and insects heavily. Humphries and Cumming (1971) found similar preferences in Virginia hatchery pond fish.

Some studies have been devoted to young-of-year fish in reservoirs. Gomez (1970) found that striped bass in Canton Reservoir, Oklahoma, preferred dipteran larvae. Higginbotham (1979) discovered that y-o-y striped bass fed heavily on copepods, cladocerans, and dipterans. Saul (1981) stated that Chironomidae larva and pupae were the primary foods for y-o-y stripers in Cherokee Reservoir. Richardson (1982) reported that on Norris Reservoir chironomids and crustaceans were major food items for striped bass up to 15 cm total length. Fish were also utilized by the young-of-year striped bass in Norris Reservoir (Richardson 1982).

Food habits of adult striped bass in reservoirs have been a major portion of several studies. Stevens (1957) sampled 1,573 striped bass on Santee-Cooper Reservoir and found mayfly nymphs to be important food items in the spring months with clupeid fish supporting the

striper population the remainder of the year. Domrose (1963) studied striped bass on Kerr Reservoir, Virginia, and found that shad and white crappie were the principal food items. Ware (1970) stated that the threadfin shad were the dominant food item of inland Florida striper populations. Mensinger (1970) and Combs (1978) reported that studies of Keystone Reservoir, Oklahoma, indicated gizzard shad to be the major food source of striped bass. Weaver (1975) likewise found that striped bass in J. Percy Priest preferred shad, but he also found that threadfin shad were more abundant in the diet than were gizzard shad.

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CHAPTER III

DESCRIPTION OF THE STUDY AREA

The study area for the research on the age, growth, and food habits of the striped bass (Morone saxatilis Walbaum) was Cherokee Reservoir (Figure 1). Formed in 1941 by the damming of the Holston River at Jefferson City, Tennessee, Cherokee Reservoir is a large multi-purpose Tennessee Valley Authority reservoir. Its major functions are to provide flood control, electrical power generation, recreation and navigation (Tennessee Department of Public Health 1978).

Cherokee Reservoir is the largest of the six reservoirs providing storage in the Holston River basin. It is 94.9 Km in length, has 745 Km of shoreline including islands and has a surface area of 12231 hectares. Drainage from the Holston River basin provides the water for Cherokee Reservoir. The Holston River basin in Tennessee, containing 5835.3 Km^2, is located in the northeastern corner of the state and most of the basin is contained in the nine Tennessee counties of Carter, Grainger, Hamblen, Hawkins, Jefferson, Johnson, Knox, Sullivan, and Washington. Peripheral area is contributed by Hancock, Unicoi, and Union counties. Most of the area drained by the North Fork Holston River lies in Virginia, and the drainage area of South Fork Holston River is mostly in Tennessee. Overall, the Holston River watershed is 9779.8 Km^2 with about 60 percent in Tennessee.

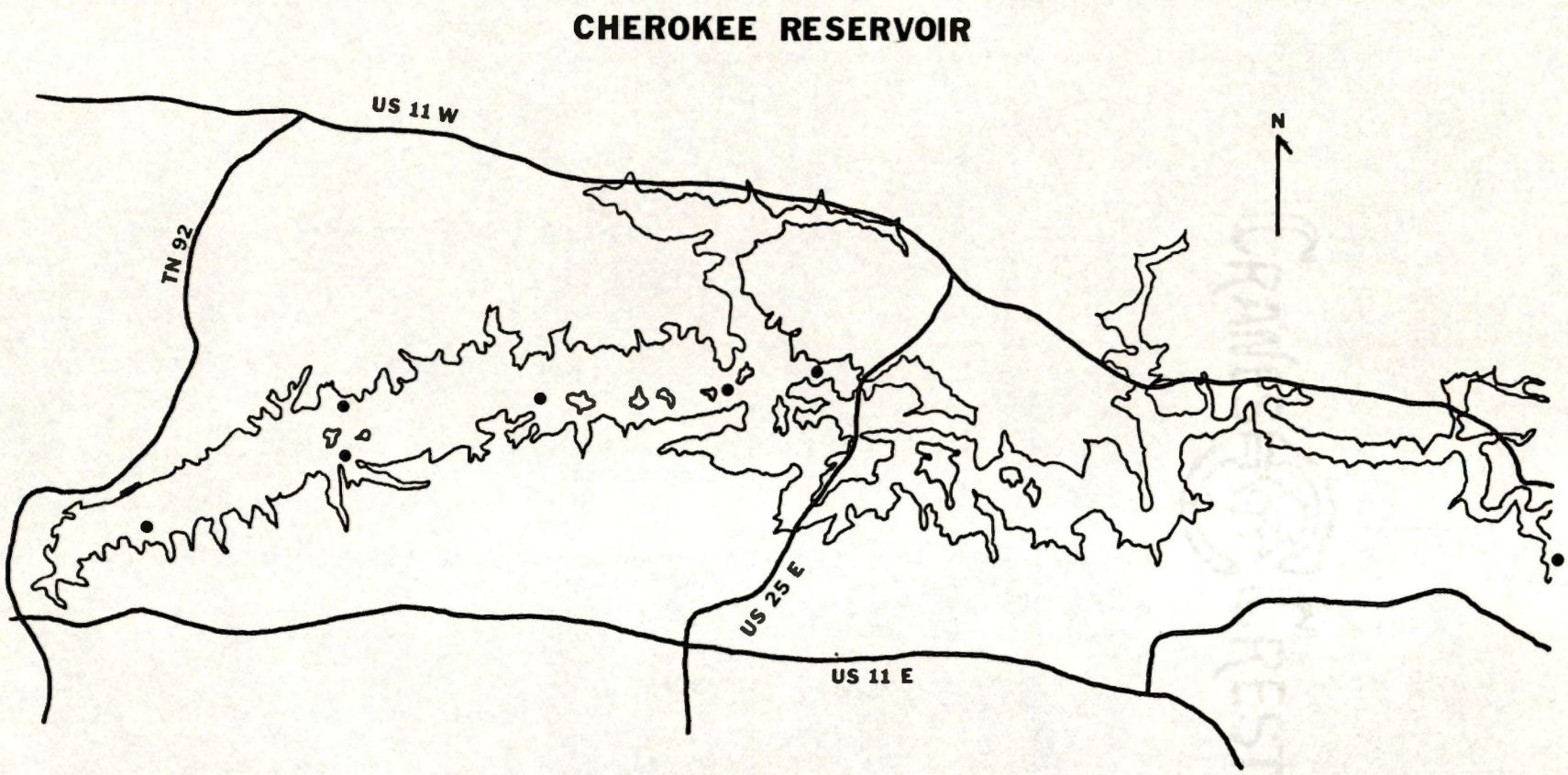


FIGURE 1. Map of Cherokee Reservoir, Tennessee, Showing General Areas (•) Where Adult Striped were Collected

Precipitation in the Holston River basin has varied from a low of 1016 mm per year to a high of 1600.2 mm per year with the average annual precipitation in the basin being about 1168.4 mm. The average monthly precipitation ranges from a low of 66.0 mm in October to a high of about 134.6 mm in July. Although late winter and early summer bring most of the major flooding, isolated storms can cause the problem of local flooding all year-round.

Streamflow is made up of the runoff of percipitation reaching overland or underground streams. The quality of the streamflow reaches its lowest point when low flow periods provide an inadequate quantity of water and lack of dilution. These low flows on the Holston River generally occur during the late summer and fall during extended periods of low rainfall. During these extended periods of low rainfall, a groundwater storage provides most of the streamflow. The resulting poor quality of the water entering Cherokee Reservoir with a high water temperature and low dissolved oxygen content seems to place a great deal of stress on the striped bass (Waddle 1979)

During the study, fish samples were taken from the dam up to Holston River Kilometer 157.8 at Clouds Creek. However, all but one of the fish were taken from the dam to the German Creek section of the lake. This was due primarily to the access points used by the researchers and the data returned from the boat dock operators. Very few, if any, of the fish were taken from thermal refuge areas identified by Waddle (1979).

CHAPTER IV

MATERIALS AND METHODS

All of the striped bass sampled in this study were taken by angling from February to December, 1976. This sampling method was chosen for a number of reasons. At the time of the study, the Tennessee Wildlife Resources Agency, which manages the fisheries resources of the state, did not want stripers taken by nets from Cherokee. This was apparently due to the fact that commercial fishing by nets is banned in Cherokee Reservoir because of the extreme vulnerability of stripers to netting. The sampling method of electro-shocking was also considered and rejected because during a major portion of the year the striped bass inhabits depths that would make them extremely difficult to shock (Waddle 1979). The species' pelagic characteristics made rotenone samples prohibitively expensive. Therefore, sampling by angling was chosen as the method because it was in line with TWRA policy, it could be carried out at all times of the year and in all portions of the reservoir, and it provided stomach samples that most closely approximated the fish that were causing controversy among anglers. By sampling with angling, fish also were selected that were actively feeding rather than existing in a dormant state (Waddle 1979). Thus, these fish might be more likely to provide insight into the food habits of Cherokee Lake's striper population.

All of the fish in the study were weighed, measured, and had scales taken for aging purposes. The weighing was done on portable

Chatillion scales which had been checked for accuracy at the initiation of the study. Measuring was done with a retractable carpenter's type ruler. This data was recorded on numbered coin envelopes. Scales were taken from the fish at the tip of the left pectoral fin and were placed in the numbered envelope on which the data were recorded.

Stomach samples were taken from as many fish as possible. However, since striped bass are avidly sought by anglers as trophies, many anglers did not want the stomach taken in order that they could have the fish mounted. Stomachs were taken by inserting the tip of a knife in the anal vent and opening the belly of the fish to just above the pectoral fins. The entire intestinal tract was removed by severing the tract anteriorally at the esophagus and posteriorly at the anus and removing the tract from the fish carcass. There was no attempt in the field to separate the stomach from intestinal and connective tissues. After the stomach sample was taken from the fish it was wrapped in a piece of cheesecloth. The sample was then tagged with a number corresponding to the scale envelope containing the data on the fish. Stomach samples were placed in a solution of 10% formalin for preservation until the identification of food items could be done later in the laboratory.

To aid in collecting these angling samples, stations were set up at boat docks in various areas of the reservoir. The dock operators were furnished with the verified Chatillion scales and the scale envelopes on which to record data. However, since the participation by the anglers was on a strictly voluntary basis the data yield from the docks was low.

The majority of the samplers were collected by the author and fellow graduate students. Samples were collected by launching ramps from successful anglers and by anglers on the lake. The schooling characteristics of the stripers at times brings forth a large concentration of anglers into a small area. This helped in the search for successful anglers. Student researchers captured a major portion of the fish for the study. Thus, not only were they able to collect striper samples, but they were able to watch for regurgitation of food items which might bias the study.

Laboratory Workup

In the lab, field data was taken from the coin envelopes and transcribed into a data notebook. At this time, the scale sample was placed in a 10 ml bottle with a number corresponding to the fish number from the envelope. Water was placed in the bottle to aid in cleansing the scale and making it pliable for mounting.

Three scales were mounted between two microscope slides with the corresponding fish number. For each fish six scales were mounted. The scale annuli were counted by placing them on an Eberbach Microjector at a magnification of 32X. The scale measurements used for back-calculating length were also done on this machine.

Age and Growth

The age of the 121 striped bass sampled in the study was determined by the number of annuli present. They were placed in age classes according to their number of annuli. The age classes were designated

by Roman numerals. Since all fish in the study had at least two annuli, the age classes started at II.

The scale measurements were taken by measuring from the focus to each annulus and from the focus to the anterior margin. Given in theory that scale growth is directly proportional to body growth, those measurements were used in back-calculating the total length of individual fish by Lea's original formula (Bagenal and Tesch 1978):

$$l_n = \frac{Sn}{S} l$$

where:

l_n = length of fish when annulus n was formed,

l = length of fish when scale sample was obtained,

Sn = radius of annulus C_n (at fish length l_n), and,

S = total scale radius.

Length-Weight Relationship

Length-weight regression lines are useful in calculating the weight of a fish when only the length is known or vice versa. The method described by Ricker (1975) was used to determine length-weight regression lines for both sexes throughout the year. The logarithmic equation used was:

$$\log W = \log a + b \log L$$

where:

W = weight in grams,

L = total length in centimeters

a = intercept, and,

b = slope.

Condition

The condition factor, K, is an index of the relative plumpness and well-being of a fish. It is a useful tool in comparing the suitability of the aquatic environment of various localities for a species of fish; however, populations from various gene pools could influence this relationship. In this study, the K-factor was calculated on the sample of 121 striped bass taken from Cherokee Reservoir by using the cube relationship described by Rounsefell and Everhart (1953):

$$K = \frac{10^5 W}{L^3}$$

where:

K = coefficient of condition,

W = weight of fish in grams, and,

L = total length of fish in centimeters.

The condition factor can be influenced by the age, sex of the fish, spawning season, and environmental conditions.

Food Habits

In the laboratory numbered stomach samples were taken from their cheesecloth wrapping. The stomachs were slip open over 0.64, 1.25, and 2.54 mm mesh circular sifting screens. The stomachs were washed out over the screens in order to capture all possible food items. The food items were counted and identified and the data was recorded

for each individual sample. They key developed by Eddy (1969) was used in identification of food organisms.

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CHAPTER V

RESULTS AND DISCUSSION

Age Determination

Age characteristics of striped bass from Cherokee Reservoir were determined from the 121 specimens collected during the study. Age composition was determined by counting the number of annuli on striped bass scales. Annuli were formed during the spring, most probably in March or April. It was determined that of the 121 striped bass examined, there were six age classes represented (Table 1). These were Age II through Ave VII, inclusive, and were represented by 3, 12, 71, 26, 7, and 2 individuals, respectively. These numbers correspond to age composition by percentage of 2.5, 1.9, 58.7, 21.5, 5.8, and 1.7, for Age II through Ave VII fish, respectively.

A total of 98 fish were sexed by examination of internal organs. The 23 fish left unsexed were those caught by anglers other than the author or fellow graduate students. Of the 98, there were 47 males (48%) and 51 females (52%). The ratio of male striped bass to female striped bass was close to that found by Thomas (1967) in the Sacramento-San Joaquin River system. However, Neal (1973) on Kerr Reservoir and Vladykov and Wallace (1952) on the Chesapeake Bay found a slightly higher percentage of males than females.

Striped bass of Age Class IV and year class 1972 were by far the dominate group in the sample. This dominance could have resulted from different factors. Stocking data furnished by the Tennessee

TABLE 1. Average Calculated Total Length and Average Length Increments of Both Sexes of Striped Bass taken from Cherokee Reservoir, 1976

Year Class	Age Class	No. of Fish	Average Total Length (mm) at Capture	Size Range	Mean Calculated Total Length (mm) at each Annulus						
					1	2	3	4	5	6	7
1974	II	3	550.3	546.1-558.8	227.9	448.7					
1973	III	12	644.5	584.2-736.6	240.1	460.2	606.1				
1972	IV	71	730.7	635.0-800.1	219.9	462.1	616.1	701.1			
1971	V	26	770.3	660.4-850.9	208.1	425.3	589.0	697.9	738.1		
1970	VI	7	854.5	723.9-939.8	253.8	461.8	619.3	708.3	771.8	820.6	
1969	VII	2	812.8	762-863.6	236.7	409.2	563.0	662.9	720.1	767.5	795.8
Grand Mean Calculated Total Length at Annulus					231.1	444.5	598.7	688.1	743.3	794.1	795.8
Mean Annual Increments of Growth					231.1	213.5	154.9	91.2	59.6	48.1	28.3

Wildlife Resource Agency shows that in 1972 almost 120,000 fingerlings were introduced into Cherokee Reservoir. More fingerlings were stocked this year than in any other year of the study. Although 1971 found a similar number of striped bass stocked in Cherokee Reservoir, 100,000 of the fish were in the fry stage which could be expected to lead to lower survival (Richardson 1982). Bishop (personal communication) also suggested that the fish dominant year class could have resulted from a lower population of white bass (Morone chrysops) in the stocking areas on the Holston River section of Cherokee Reservoir. Saul (1981) and Richardson (1982) found that white bass could possibly impact heavily on striped bass stocking through predation and direct competition.

When age was analyzed by sex, the percent composition was similar (Tables 2 and 3). For males, all ages were represented and had a distribution as follows: Age II, 4.3%; Age III, 10.6%; Ave IV, 53.2%; Age V, 19.1%; Age VI, 8.5%; and, Age VII, 4.3%. For females, there were no Age VII fish. Age composition percentages were 1.9, 9.8, 56.9, 25.5, and 5.9 for Ages II-VI, respectively. These data indicated that there were more males than females at Ages II and III and that females outnumbered males at the older ages. This data may be somewhat biased by the relatively small sample size; however, this general trend is exhibited in other animal populations (Smith 1974).

Growth

The growth rate of 121 striped bass taken from Cherokee Reservoir was calculated from scales. The average total length at capture, the

TABLE 2. Average Calculated Total Length and Average Length Increments of Male Striped Bass taken from Cherokee Reservoir, 1976

Year Class	Age Class	No. of Fish	Average Total Length (mm) at Capture	Size Range	Mean Calculated Total Length (mm) at each Annulus						
					1	2	3	4	5	6	7
1974	II	2	546.1	546.1	227.4	448.3					
1973	III	5	619.8	584.2-660.4	231.7	455.5	588.1				
1972	IV	25	723.4	660.4-800.1	222.9	460.3	605.8	691.8			
1971	V	9	766.2	698.5-838.2	200.9	417.2	569.7	659.6	729.3		
1970	VI	4	882.7	838.2-939.8	238.2	460.1	618.6	720.5	793.9	846.0	
1969	VII	2	812.8	762.0-863.6	236.8	409.2	563.0	669.9	720.1	767.5	795.8
Grand Mean Calculated Total Length at Annulus					226.3	441.8	589.0	685.5	747.8	806.8	795.8
Mean Annual Increments of Growth					226.3	215.5	148.6	96.2	64.4	49.8	28.3

TABLE 3. Average Calculated Total Length and Average Length Increments of Female Striped Bass taken from Cherokee Reservoir, 1976

Year Class	Age Class	Fish	Average Total Length (mm) at Capture	Size Range	Mean Calculated Total Length (mm) at Each Annulus						
					1	2	3	4	5	6	7
1974	IV	1	558.8	558.8	228.9	449.8					
1973	III	5	680.7	635.0-736.6	257.9	470.5	636.6				
1972	IV	29	784.4	635.0-787.4	282.2	467.9	631.1	720.2			
1971	V	13	777.6	711.2-850.9	204.4	422.3	595.8	694.4	747.8		
1970	VI	3	817.0	723.9-863.6	277.6	464.0	620.1	692.1	742.2	786.7	
1969	VII	0									
Grand Mean Calculated Total Length at Annulus					237.6	454.9	620.9	702.2	745.0	786.7	
Mean Annual Increments of Growth					237.6	217.3	164.7	86.6	51.8	44.5	

back-calculated total length at each annulus, and a mean annual increment of growth are shown in Table 1.

Cherokee Reservoir striped bass grew rapidly in their first three years of life and then their growth slowed down. This decrease in growth as age increased is consistent with other fish species. It is probably an example called "Lee's Phenomonon" where there is an apparent decrease in calculated growth when it is determined from successively older groups of individuals (Hile 1936).

Cherokee Reservoir striped bass had a greater growth in their first year than did those of any other study (Tables 4 and 5). After the first year the growth of Cherokee Reservoir stripers were similar to those from other studies. Although Age VII fish exhibited a lower growth rate than stripers from any other study shown in the tables, the data for Age VII fish could easily be biased by the small sample size of two fish.

Comparison of growth data of male and femals striped bass of Cherokee Reservoir (Tables 2 and 3) shows that femals stripers grew slightly faster than did the males in their first three years of life. This growth pattern correlates with that presented by Nichols (1966). However, Weaver (1975) and Neal (1973) found male striped bass to grow faster than females during the first two years. Starting with their fourth year, male striped bass from Cherokee Reservoir grew faster than did female stripers. These data differs with that of Neal (1973) who found that females outgrew males after the first two

TABLE 4. Comparisons of Total Length of Striped Bass from Cherokee Reservoir to Other Areas

Area	Reference	Mean Calculated Total Length (mm) at Each Annulus						
		1	2	3	4	5	6	7
Cherokee Reservoir	Present study	231.1	445.0	599.4	688.3	744.2	795.0	795.0
Kerr Reservoir	Neal 1973	191.0	487.7	605.0	688.3	706.1	800.1	792.5
Ker Reservoir	Domrose 1963	132.1	307.3	475.0	586.7	657.9	693.7	724.0
Keystone Reservoir	Mensinger 1970		259.1	454.7	541.0	607.1		
J. Percy Priest Reservoir	Weaver 1975	216.0	403.9	528.0	624.8	701.0	732.0	
Watts Bar Reservoir	Van Den Avyle and Higginbotham	182.9	360.7	541.0	688.3	792.5	906.8	993.1
Santee-Cooper Reservoir	Stevens 1957	216.0	398.8	503.0	581.7	655.3	724.0	767.1

TABLE 5. Comparisons of Growth Increments of Striped Bass from Cherokee Reservoir to Other Areas

Area	Reference	Average Increments of Growth (mm) for Each Year						
		1	2	3	4	5	6	7
Cherokee Reservoir	Present Study	231.1	213.4	155.0	91.4	58.4	48.3	28.0
Kerr Reservoir	Neal 1973	191.0	238.8	149.9	96.5	81.3	43.2	30.5
Kerr Reservoir	Domrose 1963	132.1	175.3	167.6	111.8	71.1	35.6	30.5
Keystone Reservoir	Mensinger 1970		259.1	195.6	66.0			
J. Percy Priest Reservoir	Weaver 1975	216.0	188.0	124.5	96.5	73.7	30.5	
Watts Bar Reservoir	Van Den Avyle and Higginbotham	182.9	177.8	180.3	149.9	104.1	88.9	58.4
Santee-Cooper Reservoir	Stevens 1957	216.0	185.4	99.1	81.3	73.7	68.6	43.2

years of growth and it also differs with the study by Weaver (1975) who also found that after Age II, females outgrew males.

Length-Weight Relationship

The length-weight relationship for striped bass from Cherokee Reservoir was calculated using the formula described by Ricker (1975). From this formula it was found that the length-weight regression line of Cherokee Reservoir striped bass is best described as Log W = -4.16 + 2.72 Log L. Weaver (1975) described a length-weight regression line for striped bass from J. Percy Priest Reservoir as Low W = -3.66 + 3.20 Log L. Since $W = -4.16\ L^{2.72}$, the length-weight regression line for Cherokee Reservoir stripers is less than the cube relationship and it is representative of allometric growth (Bagenal and Tesch 1978). This indicates that Cherokee striped bass were longer for their weight than most fish populations which follow the cube relationship.

Condition

Table 6 and Figure 2 show that the average K value was highest in the Age VII fish. This could be influenced by the small sample size of two fish in that age group. The K values for all ages ranged between 1.74 and 1.72. Although this is much lower than the K value range of 1.31 to 2.79 found by Ware (1970) on Florida's inland striper populations, it is difficult to compare the studies because Ware utilized fish of a much smaller size and only of Ages I and II. The range of K values are also lower than those reported by Wigfall and Barkuloo (1975) of 1.65 to 2.54 for the Choctawhatchee River

TABLE 6. Mean Condition Factors (K) of 121 Striped Bass at Various Ages taken from Cherokee Reservoir, Tennessee, during February to December, 1976

Age	No.	Mean	Range
II	3	0.95	0.91-0.98
III	12	1.14	0.90-1.28
IV	71	1.15	0.74-1.72
V	26	1.17	0.85-1.44
VI	7	1.04	0.89-1.29
VII	2	1.20	1.10-1.30

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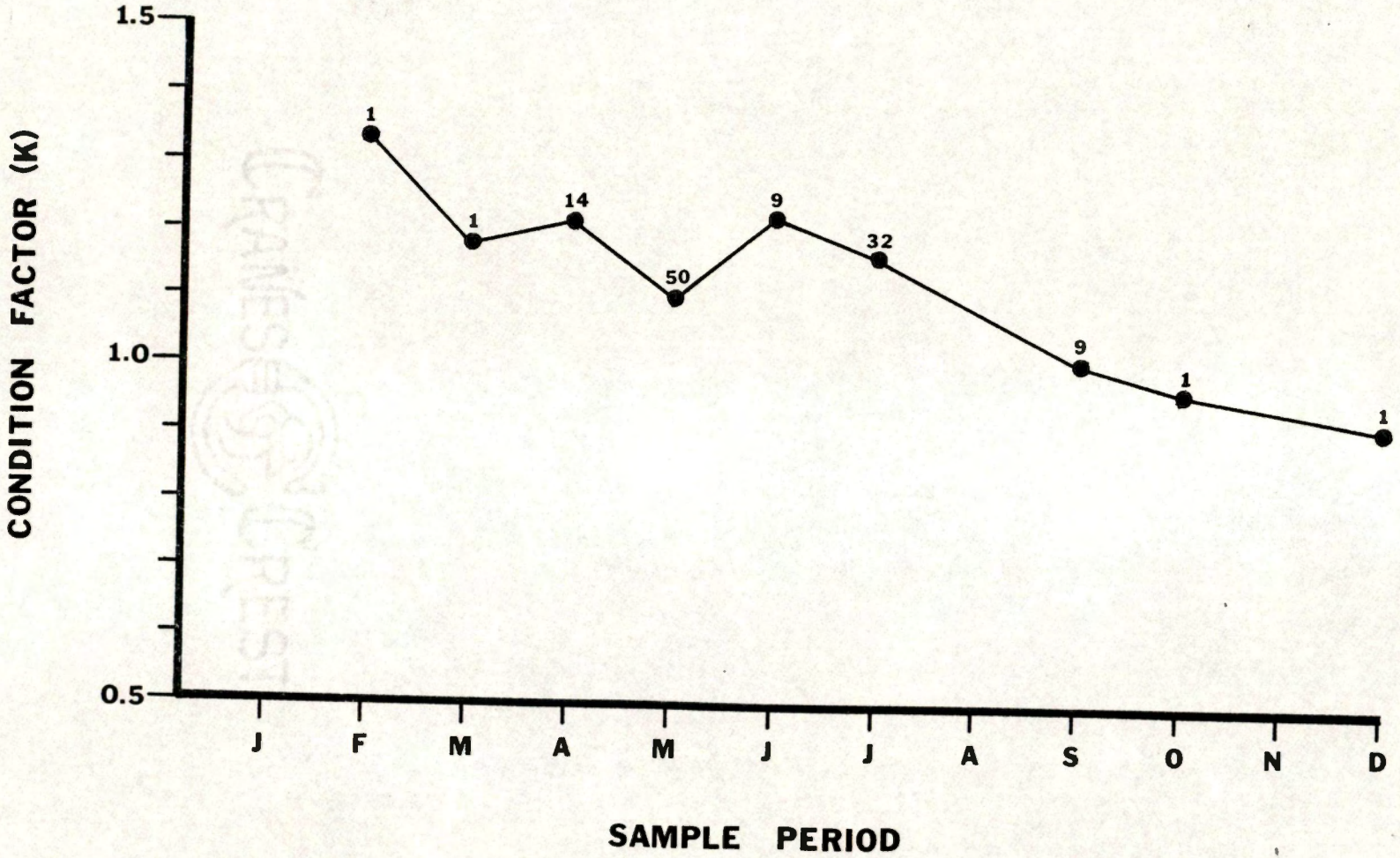


FIGURE 2. Mean Condition Factors (K) of 47 Male Striped Bass and 51 Female Striped Bass of Ages II-VII taken from Cherokee Reservoir, Tennessee, 1976. Numbers above line represent monthly sample size.

System, Florida. However, with only fish up to 3.5 years of age being sampled, a direct comparison is difficult. Both the Ware study and the Wigfall and Barkuloo study utilized striped bass from Florida. Genetic differences in the Florida and Tennessee population study could result in the large difference in K values. Differences in length of growing season, food supply, or water quality could also help explain the wide divergence. The range of K values for Cherokee stripers are similar to the range of 0.77 to 1.71 found by Weaver (1975) in J. Perry Priest.

Table 7 shows the average K value of Cherokee stripers as determined by age and sex. Although there are some minor differences of K values between male and females at various ages, the averaging of all age groups gives the same K value of 1.09 for both sexes.

Figure 2 shows a graph of the average condition of both sexes by months of the year. The K values range from a high of 1.33 in February to a low of 0.90 in December. The decline from February through May is probably due to stresses associated with the spawning season. The peak in June is possibly associated with recovery from spawning stresses, an abundance of forage, and a dissolved oxygen and temperature profile (Waddle 1979) that is conducive to optimum feeding. After the June peak, a steady decline in condition is noted. This decline probably is associated with the temperature-dissolved oxygen "squeeze" where the striped bass seeks its final preferendum of 21 to 22^{o}C (Coutant 1978) only to possibly find an inadequate amount of dissolved oxygen. Even if the dissolved oxygen is sufficient

TABLE 7. Mean Condition Factors (K) of 47 Male Striped Bass and 51 Female Striped Bass of Various Ages Taken from Cherokee Reservoir, Tennessee, 1976

	MALE		FEMALE	
Age	No.	Mean	No.	Mean
II	2	0.98	1	0.91
III	5	1.14	5	1.13
IV	25	1.09	29	1.14
V	9	1.17	13	1.17
VI	4	1.01	3	1.08
VII	2	1.20		
Overall Mean		1.09		1.09

at the depth where the striper finds its final preferendum, it is possible that its primary food source of clupeids will not be found at that level. Some authors feel shad normally inhabits warmer temperatures near the surface. Thus, to feed, the stripers must rise to depths where the temperature is uncomfortable, grab its prey, and return to the depth of its thermal preferendum (Coutant 1978). This process puts great stress on the striped bass and leads to deterioration of its condition.

Food Habits

Stomach samples were taken from 97 striped bass from Cherokee Reservoir. Examination showed that 51 stomachs (52.6%) contained food items and 46 stomachs (47.49%) were empty. This ratio of stomachs with food to empty stomachs of food holds consistently with some other studies. Weaver (1975) found 47% of stomachs from J. Percy Priest stripers to contain food. Ware (1970) found in an examination of 422 striped bass that 55.9% contained food and Hollis (1952) found 56% in an examination of 1736 Chesapeake Bay striped bass. However, some studies have found a higher percentage of stomachs with food items. Combs (1978) and Mensinger (1970) found about 64% of Keystone Lake striped bass had food items. Stevens (1957) examined 1,573 Santee-Cooper striped bass and found 69.5% had food items. In a study of 122 Choctawhatchee River striped bass, Wigfall and Barkuloo (1975) found a high 76.2% to contain food items.

There are several reasons why almost half of the stomachs of Cherokee Reservoir striped bass were empty. Raney (1952) reports

that although the striped bass is a voracious and carnivorous fish, it is not a steady feeder. Very gregarious in nature, members of a school normally feed at about the same time. Thus, since the Cherokee Reservoir stripers were taken by angling, it is possible that they were caught just as the school began to feed. The angler's bait or lure could have been the first food item during that feeding period and may have triggered feeding in the school. Another problem associated with sampling by angling is the regurgitation of food items during the stress of the fish's fight. This was observed several times during the study when stripers regurgitated partially digested fish in the vicinity of the boat. A potential reason for empty stomachs in fish taken during the warmer months of the summer and early fall is the seeking of the final preferendum by striped bass (Coutant 1978). Depths having the proper temperatures for the striper may not also hold its preferred or most abundant species of prey (Coutant 1978).

As in the study by Combs (1978) on Keystone Reservoir, all of the food items found in the stomachs of Cherokee Reservoir striped bass were fish. Shad, found in 58.8% of the stomachs containing food, was the predominant type of fish (Table 8). For the purpose of the study, gizzard shad, Dorosoma cepedianum, and threadin shad, D. petenense, were grouped together. This grouping was done due to the fact that in many cases the rapid digestion of the striped bass (Raney 1952) had obscured the differentiating characteristics necessary to tell the two species apart, but the prey could still be identified as Dorosoma.

TABLE 8. Food Items Found in Stomach Samples of Striped Bass from Cherokee Reservoir, Tennessee, 1976

Food Item	No. of stomachs with food item	Percentage of total stomachs c food	Mean number of fish in stomach
Shad	30	58.8%	1.43
Bluegill	13	25.5%	1.38
White crappie	1	2.0%	1.00
Unidentified fish	7	13.7%	1.43

This high percentage of shad closely follows the findings of other studies. Ware (1970) found 46.6% of inland Florida stripers stomachs contained threadfin shad. Domrose (1963) found a 59% level of shad in Kerr Reservoir stripers. Both Stevens (1957) and Wigfall and Barkuloo (1975) found clupeids to be the major source of prey for striped bass. Combs (1978) and Mensinger (1970) found 77% and 83% of stripers stomachs from Keystone Lake contained shad. A very high percentage of 89% shad in occurrence in striped bass stomachs was also found by Weaver (1975) on J. Percy Priest Reservoir.

The next most common food item for Cherokee Reservoir striped bass was bluegill, Lepomis macrochirus, or similar fish of the genus Lepomis. Lepomis were found in 25.5% of the striper stomachs containing food. This percentage was much higher than the 5.9% reported by Ware (1970), or the 0.5% found by Weaver (1975). A reason for this high percentage undoubtedly is the fact that Lepomis are some of the most popular baits for striped bass on Cherokee Reservoir. Examination in the lab revealed hook marks behind the dorsal fin of approximately half the Lepomis; however, not all Lepomis had hook marks. As many as three Lepomis were found in some stomachs. Thus, I followed the theory put forth by Hollis (1952) that in sampling done by angling no distinction can be made between stomachs containing bait or natural food since the fish was actively feeding in either case.

The only other game fish found in a Cherokee Reservoir striped bass was one small white crappie, Pomoxis annularis, which represented only 2% of the food items found. This crappie was found in a striper

stomach also containing three shad. Combs (1978) found a similar 3.6% occurrence of crappie in Keystone Reservoir striped bass. Stevens (1957) found only two crappie in 1,093 striper stomachs containing food. However, Domrose (1963) found a relatively high 27% level of crappie in Kerr Reservoir. This crappie predation occurred in early spring when shad were scarce. Thus, it appears that in most cases crappie contribute a very low percentage of forage for striped bass.

CHAPTER VI

SUMMARY

1. A study of growth and food habits of adult striped bass was conducted on Cherokee Reservoir, Tennessee, with 121 adult striped bass collected from February to December, 1976.

2. Age characteristics of Cherokee Reservoir striped bass were determined from the 121 specimens collected during the study. Six age classes, Age II through Age VII conclusive, were represented with age class IV (1972 stock) the dominant group in the sample. Of 98 fish sexed by examination of internal organs, 48% were males and 52% were females.

3. The growth rate of 121 striped bass from Cherokee Reservoir was calculated from scale analysis. Cherokee Reservoir striped bass grew rapidly in their first three years of life and then slowed. Females grew slightly faster than males for their first three years, after which males outgrew the females. Compared with other studies of striped bass populations, Cherokee Reservoir fish grew faster in their first year of life and had similar growth rates after that.

4. The length-weight regression line for Cherokee Reservoir striped bass was determined to be: $W = -4.16 + 2.72 \log L$. Condition factors for Cherokee Reservoir striped bass ranged between 0.74 and 1.72. These values were lower than those found in inland Florida striped bass but similar to those found from J. Percy Priest Reservoir, Tennessee.

5. Of 98 stomachs taken from Cherokee Reservoir striped bass, 52.5% contained food items and 41.5% were empty. All of the food items found in the stomachs were fish. Shad, found in 58.8% of the stomachs containing food, was the predominant type of fish. Fish of the genus Lepomis was the next most common food item and were found in 25.5% of the stomachs containing food. The only other game fish found in Cherokee Reservoir stripers was one white crappie.

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VITA

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Steve was married to the former Rose Marie Cowden of Petersburg, Tennessee, in June 1975.

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