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AN INVESTIGATION OF SIZE, AGE, AND SEX OF NORTH CAROLINA STRIPED BASS

by

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CONTENTS

ABSTRACT

During October 1984-December 1985, a total of 813 striped bass were examined in order to determine the size, age and sex composition of fish taken in two major fisheries for striped bass in North Carolina. No striped bass samples were obtained from the ocean during 1985. This fishery was closed in response to interstate management actions along the Atlantic Coast. Those fish taken in Roanoke River during their Spring spawning run comprised the sexually mature segment of the Albemarle Sound stock and, possibly, a few of the Atlantic Ocean migratory stock native to Roanoke River. Spawning males were mostly ages II and III, while females were principally two to five years old. The Albemarle Sound fishery harvested from a declining population, composed mostly of fish one to three years of age.

INTRODUCTION

Striped bass, (Morone saxatilis) have supported significant fisheries in coastal North Carolina since Colonial times. The northern portion of the coast has historically had the most active commercial and recreational fisheries, supporting year-round fisheries in Albemarle Sound and seasonal fisheries elsewhere. Those commercial gears described by Street and Johnson (1977) continue to be the principal types of fishing gear.

The Albemarle Sound-Roanoke River area supports one of the Atlantic Coast's principal spawning populations of striped bass. The oceanic area from Chesapeake Bay entrance to Ocracoke Inlet has been shown to be the principal wintering area for migratory striped bass (Holland and Yelverton 1973). Considerable work has been done on various aspects of striped bass life history throughout the coastal area of North Carolina since the late 1960s. However, only two studies (Trent and Hassler 1968; Harriss et al. 1985) have correlated age and growth with sex. Because of differential growth and age at maturity between sexes, size and age data must be collected by sex in order to be useful in estimating mortality rates, yield-per-recruit, and other population parameters.

In the past decade striped bass populations have declined along the entire Atlantic Coast (Atlantic States Marine Fisheries Commission 1981). Striped bass landings in North Carolina have declined, with the recent catches being the lowest since the 1930s (Table 1). Despite the decline in landings, the pressures on this resource have increased because of its high market value. The recent year classes of striped bass produced in Albemarle Sound area are the poorest on record (Hassler et al. 1981, Hassler and Taylor 1984, Hassler 1984).

The Albemarle-Roanoke stock is below its historic limits and may be in biological danger. This population is probably contributing very little at present to the migratory population, because of the relatively low stock level. The information obtained in this study is critical for the development and implementation of coordinated management actions for striped bass, both in North Carolina and along the Atlantic Coast.

Due to closure of the Atlantic Ocean to the harvest of striped bass by the North Carolina Marine Fisheries Commission (MFC) in response to interstate management needs along the Atlantic Coast, no striped bass samples were obtained from the offshore fishery during the winter of 1984-85.

Table 1. North Carolina striped bass landings (pounds) 1975-1985.*

Year	Albemarle Sound area	Roanoke River	Atlantic Ocean	Other areas	Total
1975	565,538	69,962	585,000	82,700	1,303,200
1976	651,454	25,046	332,400	29,400	1,038,300
1977	432,880	36,620	90,700	11,200	571,400
1978	468,214	56,886	164,600	8,400	698,100
1979	292,807	34,293	240,100	47,100	614,300
1980	368,499	8,001	21,800	74,200	472,500
1981	333,132	1,468	52,000	30,400	417,000
1982	210,588	17,369	92,873	17,480	338,310
1983	279,911	8,861	52,796	19,707	361,275
1984	473,937	1,703	14,501	22,755	512,896
1985	267,103	6,200	183	4,908	278,394

* Data are from the following sources: Roanoke River (1975-81): Hassler, et al. 1981; (1982-84) Hassler and Taylor 1984; (1985) Hassler, pers. comm. All others are from the North Carolina/NMFS cooperative statistics program. Data for 1978-1985 are preliminary and subject to revision.

STUDY AREA

The study areas have been previously described by Street et al. (1975). Project activities were conducted in northeastern North Carolina from the Weldon area on Roanoke River to the Outer Banks (Figure 1).

METHODS

Under this project, a target figure of 900 striped bass was to be sampled annually to obtain size and age data from the Albemarle Sound fishery. Approximately 25 fish were to be sampled monthly at each of three commercial fish houses (Figure 2).

By regulation of the North Carolina Marine Fisheries Commission (MFC), it was unlawful to take, sell or offer for sale striped bass between 1 June-30 September 1985. Also, with the recent striped bass size limit increase (from 12 to 14 in TL) and season adopted by the MFC, it became unlawful to take striped bass by commercial gear, except during the open season (15 November-31 March). These regulations became effective 1 August 1985. Due to these regulations, no striped bass samples were obtained during June-October 1985.

The sizes of fish sampled was in approximate proportion to the sizes of fish present in the fish house. Individual fish were measured (mm, fork length (FL) and weighed (nearest .01 kg), and scales were taken for age determination. Sex was determined for each fish sampled by the Sykes (1958) method.

Scales were read and annuli measured as described by Harriss et al. (1985). Age and year class were assigned according to conventions developed by the Atlantic States Marine Fisheries Commission's Striped Bass Scientific and Statistical Committee. In North Carolina, the time of annulus formation is considered to be January. Age and year class are then assigned in consideration of the date of capture relative to the January birthdate. Thus, fish from a given year class could be assigned two different ages depending on date of capture.

Each striped bass from the Albemarle Sound commercial harvest, for which age, sex, and weight data were available was placed in the appropriate year class for each month sampled during October 1984-December 1985. The number of individuals of each year class was followed monthly through the sampling

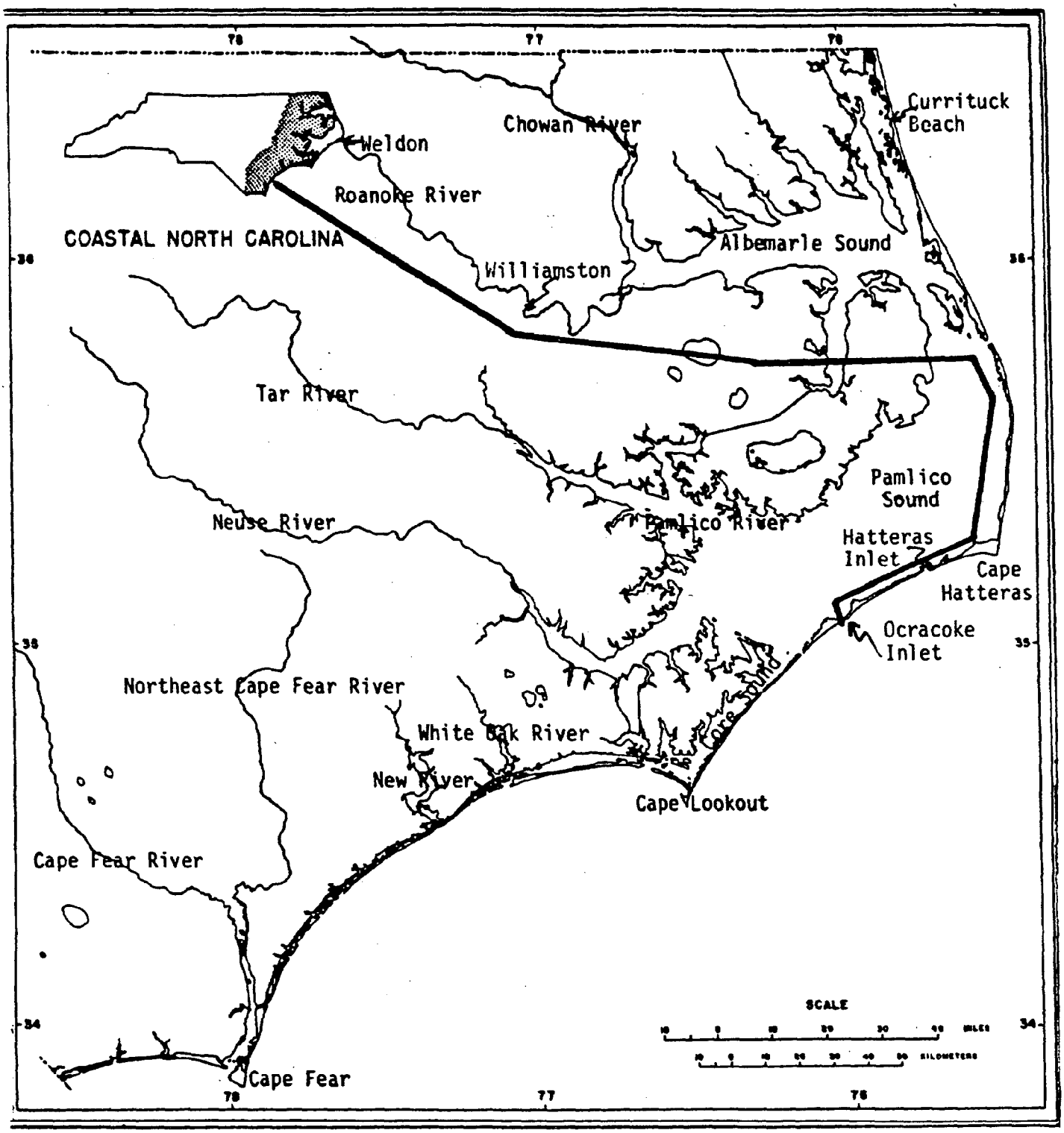

Figure 1. Map of eastern North Carolina showing project study area.

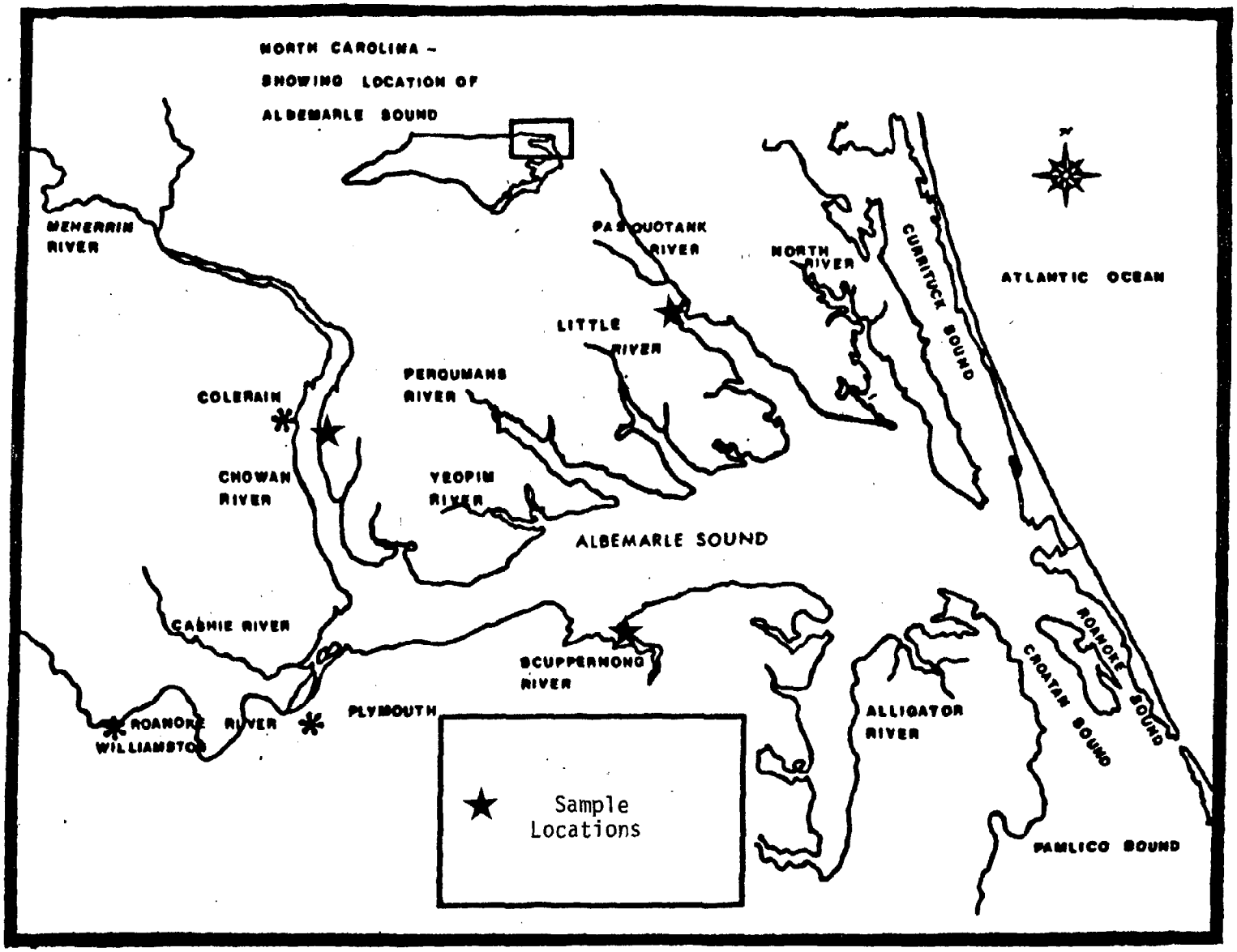

Figure 2. Commercial sampling locations for striped bass, Albemarle Sound area, N.C.

period. Striped bass were separated by sex, and monthly mean weight (kg) by year class were calculated. The total striped bass harvest (kg) for each month was multiplied by the percent weight (kg) of a year class during that month and divided by the mean weight (kg) of individuals of each sex of that year class, resulting in the number of individuals from each year class.

Throughout the Roanoke River area, project personnel obtained size, age, and sex data from striped bass sampled from the commercial and recreational fisheries (a target of 300 fish annually). Procedures were the same as for Albemarle Sound samples. When necessary, fish were purchased and records maintained. This work was conducted during April and May, 1985.

RESULTS AND DISCUSSION

ALBEMARLE SOUND POPULATION

A total of 670 striped bass were sampled from up to three fish dealers monthly in the Albemarle Sound area during October 1984-December 1985. During the legal harvest periods for striped bass, samples of up to 30 fish were taken monthly from each location. As described in the Methods, the MFC modified its regulations on the minimum size and striped bass commercial fishing season. Of the 670 striped bass sampled, 370 were males and 300 females. All fish were aged to derive the year class composition of the sample. The sex ratio for the total sample was 1.23:1, male to female. This ratio was similar to those reported by Harriss et al. (1985).

Table 2 summarizes the age and size data for striped bass, by sex, from Albemarle Sound during October 1984-December 1985. The 1982, 1983, and 1984 year classes (ages I-III) contributed 96.1% (sexes combined) of the total sample, with the 1983 year class (age II) accounting for 63.3%. Only 3.9% of the fish sampled were four years old or greater. Table 3 shows the percentage contribution of each year class from sampling during 1972-1985. During July 1980-July 1984, lower percentages of one to three year old fish (70-90%) and significantly higher percentages of age IV fish or older (11-31%) were reported from the commercial harvest (Table 3) (Harris et al. 1985). The present age data and that reported by Harriss et al. (1985) (sexes combined) differ significantly from that reported by Street et al. (1975) and Johnson et al. (1977) for 1972-1976 (Table 3). The number of year classes making

Table 2. Striped bass number, percent, mean length, mean weight and standard deviation at age, (by sex) from the Albemarle Sound, N.C. commercial catch, October 1984-December 1985.

Year class	Age	Number		Percent of total by sex		Percent sexes combined	Fork length (mm)				Weight (kg)			
							Mean		SD		Mean		SD	
		M	F	M	F		M	F	M	F	M	F	M	F
1984	I	32	29	8.6	9.7	9.1	362	370	22.9	37.2	.71	0.77	0.194	0.269
1983	II	254	170	68.7	56.7	63.3	357	354	33.9	32.6	.65	0.62	0.254	0.220
1982	III	80	79	21.6	26.3	23.7	434	453	47.1	43.9	1.16	1.26	0.396	0.402
1981	IV	2	10	0.5	3.3	1.8	437	514	51.6	62.9	1.26	1.87	0.509	0.751
1980	V	0	6	-	2.0	1.0	-	588	-	53.3	-	3.05	-	0.861
1979	VI	1	3	0.3	1.0	0.6	675	624	-	47.1	5.00	3.87	-	0.808
1978	VII	1	2	0.3	0.7	0.4	640	658	-	124.0	3.81	4.67		2.70
1977	VIII	0	1	-	0.3	0.1	-	768	-	-	-	4.54	-	-
Total		370	300											
		670												

Table 3. Percentage contribution of each year class of striped bass (sexes combined) from sampling the Albemarle Sound, N.C. area commercial harvest 1972-1985.

Year class	FISHING YEAR													
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1961	0.2	0.2												
1962	0.1	0.2												
1963	0.2	0.2	0.3											
1964	0.7	0.4	1.6	0.3										
1965	1.8	0.6	1.0	-		0.3								
1966	2.8	2.4	1.0	0.6	0.1	0.7								
1967	11.5	4.1	-	1.7	0.1	1.0								
1968	22.5	7.7	0.3	2.9	1.5	2.0								
1969	28.2	19.9	7.8	5.2	1.9	3.0								
1970	32.0	40.5	25.0	25.2	9.4	3.5								
1971		23.8	48.4	25.5	23.7	4.0								
1972			14.6	21.2	16.0	4.5	1.3	0.7						
1973				17.4	43.2	10.0	8.3	5.0	0.6		0.3	0.3	0.3	
1974					4.1	50.0	25.1	13.4	2.7	0.3	-	0.3	-	
1975						21.0	36.2	15.1	3.8	2.3	0.3	1.1	0.6	
1976							29.1	37.1	5.9	4.0	1.8	2.3	-	
1977								28.7	7.4	3.7	4.9	3.1	1.5	0.1
1978									31.4	9.4	9.5	5.6	1.8	0.4
1979									48.2	45.1	34.9	16.4	11.8	0.6
1980										35.2	48.3	38.1	15.0	1.0
1981												32.8	3.8	1.8
1982													65.2	23.7
1983														63.3
1984														9.1

significant contributions to the annual harvest has changed from four or five during the 1972-1979 period to two or three in recent years. It is evident from examining the data in Table 3 that fewer and fewer striped bass are in or remain in the population long enough to reach sexual maturity. This situation results from poor reproduction, probably due to degraded water quality. Very heavy fishing pressure applied to one to three year old fish has probably also contributed to stock reduction, especially in recent years of environmental stress.

Male striped bass ranged in age from one to seven years old during this project. The 1982-84 year classes (age I-III) accounted for 98.9% of the sample. During this sampling period, only 1.1% of the males sampled were four years old or more (Table 2). This is significantly lower than that found by Harriss et al. (1985) for 1980-1984 (8.1-13.4%). Since virtually all male striped bass in the Albemarle Sound area are sexually mature by age III (Trent and Hassler 1968), the majority of these fish probably contributed only once to the spawning population.

During this project, female striped bass were found to range in age from one to eight years old. The 1980-1984 year classes (ages I-V) comprised 98% of the females sampled. As with the males, 1983 year class (age II) females accounted for the majority of the sample (56.7%) (Table 2). The percentage of one to five year old females was higher than that reported by Harriss et al. (1985). Trent and Hassler (1968) reported that almost all female striped bass were sexually mature by age five. The 1984-1985 data show a decrease of five year old females, compared to that found by Harriss et al.(1985).

The length-frequency distributions for male and female striped bass are presented in Figure 3. During this project, male striped bass ranged in length from 295 mm to 615 mm FL, and in weight from 0.33 kg to 5.0 kg. Females ranged in length from 304 mm to 768 mm FL, and in weight from 0.32 kg to 6.58 kg. The length-frequency distribution for males is somewhat similar to that reported by Harriss et al. (1985) for 1980-1984. That is, male striped bass dominated the 300-350, 351-400 mm size groups, while females dominated the larger size groups. The frequency of larger fish, both male and female, continued to decline from that shown by Harriss et al. (1985).

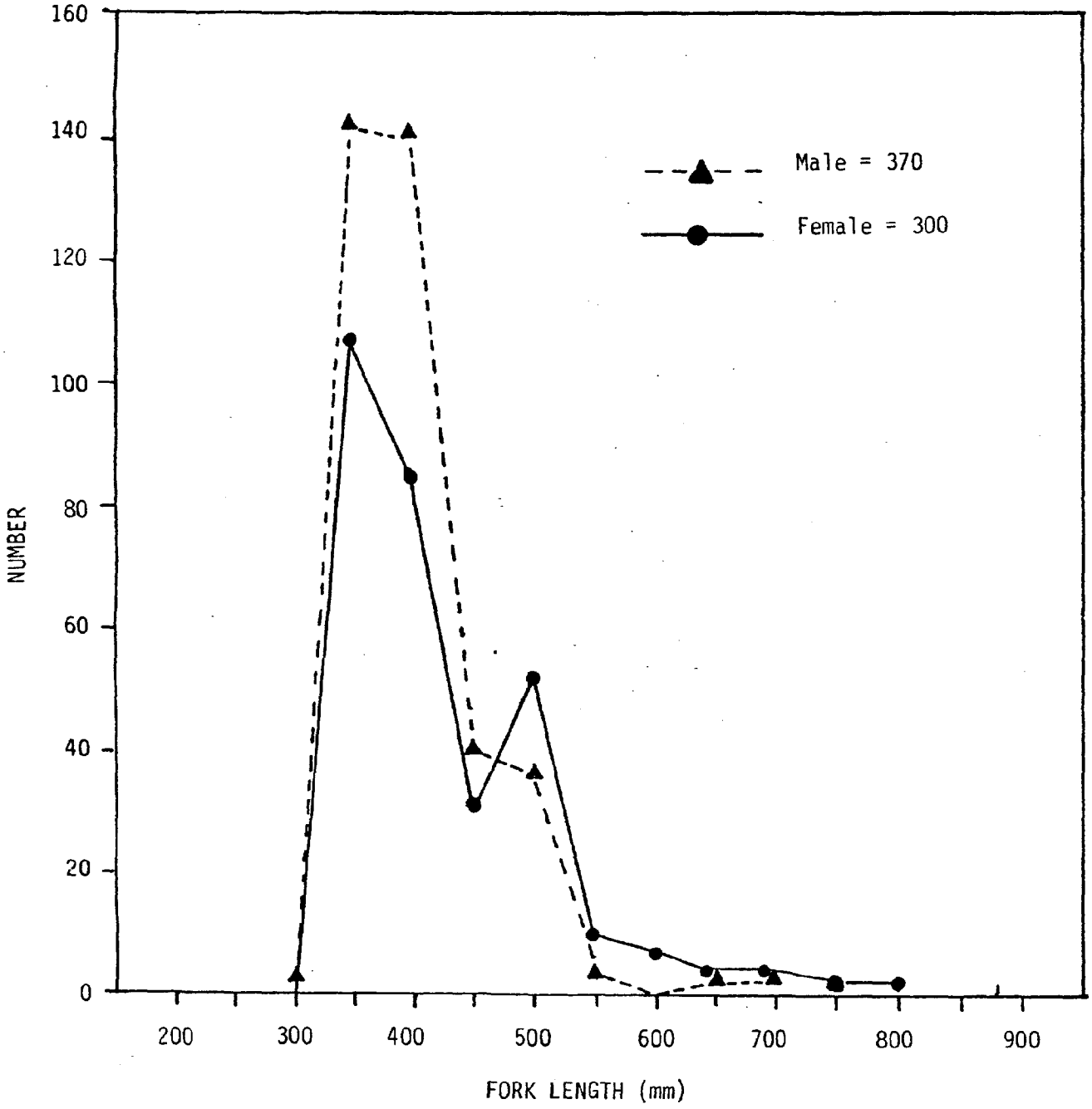

Figure 3. Length-frequency distributions for striped bass in 50 mm size groups, captured by commercial fishermen in Albemarle Sound, N.C., October 1984-December 1985.

YEAR CLASS COMPOSITION OF THE COMMERCIAL HARVEST

The Albemarle Sound striped bass age data for October 1984-December 1985 were used to estimate the number of individuals in the commercial harvest from each year class by month. The estimated contribution of each year class to the striped bass harvest from the Albemarle Sound area fishery by sex and month are shown in Table 4. These data show that the 1983 and 1982 year classes (ages II and III) dominated the striped bass harvest, contributing 88.1% of the total. The 1981 and older year classes contributed very little to the commercial harvest (Table 5). The percentages found from the estimation of individuals by year class to the commercial harvest are very similar to those found by year class from aging data. This method should be continued in the future so that better comparisons may be made.

ROANOKE RIVER SPAWNING POPULATION

During April-May 1985, a total of 143 striped bass were examined for determination of sex, size and age composition of the Roanoke River spawning population. All fish were aged. All of the fish sampled came from commercial pound nets set in the mouth of Roanoke and Cashie rivers, below the N.C. Highway 45 bridge. (North Carolina State University personnel did not conduct tagging studies as in previous years, resulting in no samples from the upper river). Of these fish, 79 were males and 64 were females for a sex ratio of 1.23:1 (males to females). This ratio generally agrees with that for 1982 and 1983, when males outnumbered females. However, these ratios continue to disagree sharply with previous work on striped bass in Roanoke River. Trent and Hassler (1968) found that males comprised from 69.7% to 85.1% of the samples during 1963-1965.

Table 6 presents data from the 1985 spawning run. The 1981-1983 year classes (ages II-IV) accounted for all of the male samples. Pound net data from previous years, 1981-1984, (Table 7) show that some males (5.4-12.0%), except for 1981, have exceeded four years of age each year. All of the pound net data in 1981 were obtained in mid-March, probably biasing the data because young male striped bass enter the river early in the season. During the other years the samples were spread out over the spawning season.

Table 4. Esimated contribution of each year class to the striped bass harvest from the Albemarle Sound N.C. commercial fishery by sex, by month, October 1984-December 1985.

Year and month	Year class	Male		Female		Total number of individuals
		Percent	Number of individuals	Percent	Number of individuals	
1984						
October	1983	64.7	40,366	51.8	30,871	71,237
	1982	35.3	21,931	48.2	28,299	50,230
November	1983	72.7	60,352	57.1	39,767	100,119
	1982	27.3	22,697	42.9	29,666	52,363
December	1983	71.4	18,834	68.0	19,734	38,568
	1982	25.7	6,820	38.0	8,155	14,975
	1981	0	0	4.0	1,164	1,164
	1978	2.9	756	0	0	756
1985						
January	1983	72.7	26,758	63.2	19,181	45,939
	1982	27.3	9,902	31.6	9,639	19,541
	1981	0	0	5.2	1,603	1,603
February	1983	82.2	13,675	75.6	10,791	24,466
	1982	17.8	2,927	24.4	3,495	6,422
March	1983	80.9	15,968	72.7	12,363	28,331
	1982	19.1	3,721	20.4	3,469	7,190
	1981	0	0	4.6	771	771
	1980	0	0	2.3	388	388
April	1983	83.3	15,306	38.9	3,255	18,561
	1982	11.1	2,029	25.0	2,074	4,103
	1981	3.7	680	5.6	461	1,141
	1980	0	0	13.9	1,154	1,154
	1979	1.9	340	8.3	689	1,029
	1978	0	0	5.6	460	460
	1977	0	0	2.7	227	227
May	1983	70.4	8,697	64.5	7,310	16,007
	1982	29.6	3,651	22.6	2,555	6,206
	1981	0	0	12.9	1,467	1,467
June - October 1985 - Fishery closed, no samples taken						
November	1984	66.7	8,137	83.3	10,790	18,927
	1983	8.3	1,020	11.1	1,440	2,460
	1982	25.0	3,055	5.6	719	3,774

Table 4. (continued)

Year and month	Year class	Male		Female		Total number of individuals
		Percent	Number of individuals	Percent	Number of individuals	
December	1984	61.5	19,447	70.0	23,506	42.953
	1983	33.3	10,554	25.0	8.373	18,927
	1982	5.1	1,614	5.0	1,678	3,292
	TOTAL		319,237		285,514	604,751

Table 5. Estimated contribution of each year class to the striped bass harvest from the Albemarle Sound N.C. commercial fishery, by sex, October 1984-December 1985.

Year class	Number of males	Number of females	Total number	Percent of total
1984	27,584	34,296	61,880	10.23
1983	211,530	153,085	364,615	60.29
1982	78,347	89,749	168,096	27.80
1981	680	5,466	6,146	1.02
1980	0	1,542	1,542	0.25
1979	340	689	1,029	0.17
1978	756	460	1,216	0.20
1977	0	227	227	0.04
TOTAL	319,227	285,514	604,751	

Table 6. Number, percent, mean length, mean weight, and standard deviation at age, by sex, for striped bass sampled from the Roanoke River spawning run during April and May 1985.

Year class	Age	Number		Percent of total by sex		Percent sexes combined	Fork length (mm)				Weight (kg)			
							Mean		SD		Mean		SD	
		M	F	M	F		M	F	M	F	M	F	M	F
1983	II	58	18	73.4	28.1	53.1	368	368	16.1	0.106	0.62	0.59	0.092	23.8
1982	III	20	27	25.3	42.2	32.9	442	462	0.267	0.219	1.06	1.24	29.3	20.8
1981	IV	1	4	1.3	6.3	3.5	450	525	-	0.598	1.04	1.82	-	59.6
1980	V	0	12	-	18.6	8.4	-	603	-	0.610	-	2.91	-	35.9
1979	VI	0	0	-	-	-	-	-	-	-	-	-	-	-
1978	VII	0	3	-	4.8	2.1	-	724	-	1.67	-	4.80	-	64.8
TOTAL		79	64											
		143												

Table 7. Striped bass number, percent, and age (by sex) sampled from the pound nets in lower Roanoke River during the spawning run 1981-1985.

Age	1981					1982					1983					1984					1985				
	Number		Percent of total by sex		Percent sexes combined	Number		Percent of total by sex		Percent sexes combined	Number		Percent of total by sex		Percent sexes combined	Number		Percent of total by sex		Percent sexes combined	Number		Percent of total by sex		Percent sexes combined
	M	F	M	F		M	F	M	F		M	F	M	F		M	F	M	F		M	F	M	F	
I	1	-	3.4	-	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
II	26	2	89.8	4.8	39.5	73	11	40.1	12.9	31.5	7	1	8.4	1.2	4.8	40	7	71.4	19.0	50.5	58	18	73.4	28.1	53.1
III	1	-	3.4	-	1.4	59	2	32.4	2.3	22.8	45	3	54.2	3.5	28.6	3	1	5.3	2.7	4.3	20	27	25.3	42.2	32.9
IV	1	10	3.4	23.8	15.5	38	10	20.9	11.8	17.9	21	16	25.3	18.8	22.0	10	6	17.9	16.2	17.2	1	4	1.3	6.3	3.5
V	-	11	-	26.2	15.5	9	20	5.0	23.5	10.9	8	27	9.7	31.8	20.8	3	11	5.4	29.7	15.0	0	12	-	18.6	8.4
VI	-	9	-	21.4	12.7	2	29	1.1	34.1	11.6	1	17	1.2	20.0	10.7	-	6	-	16.2	6.5	0	0	-	-	-
VII	-	2	-	4.8	2.8	1	7	0.5	8.2	3.0	1	13	1.2	15.3	8.3	-	2	-	5.4	2.2	0	3	-	4.8	2.1
VIII	-	3	-	7.1	4.2	-	5	-	5.9	1.9	-	5	-	5.9	3.0	-	3	-	8.1	3.2	-	-	-	-	-
IX	-	3	-	7.1	4.2	-	1	-	1.2	0.4	-	-	-	-	-	-	1	-	2.7	1.1	-	-	-	-	-
X	-	2	-	4.8	2.8	-	-	-	-	-	-	2	-	2.3	1.2	-	-	-	-	-	-	-	-	-	-
XI	-	-	-	-	-	-	-	-	-	-	-	1	-	1.2	0.6	-	-	-	-	-	-	-	-	-	-
Total	29	42				182	85				83	85				56	37				79	64			
	71					267					168					93					143				

Female striped bass sampled from the pound nets ranged from two to seven years old. The 1980-1983 year classes (ages II-V), comprised 95.2% of the females sampled (Table 6). The percentage of two to five year olds in 1985 is significantly higher than that for 1981-1984 (50.6-67.6%) (Table 7). Only 4.8% of the females in 1985 were more than five years old, much lower than in previous years (32-49%, Table 7). Trent and Hassler (1968) found males exceeding four years of age and a much higher proportion of females older than five years. The 1981-1984 Roanoke River spawning run data, as reported by Harriss et al. (1985) for the entire river, are shown in Table 8. This information agrees with that found for the Albemarle Sound commercial fishery (Table 3); there is a continuing decline of older fish in the striped bass population.

In 1985, male striped bass ranged in length from 318 mm to 501 mm (FL), and in weight from 0.38 kg to 1.76 kg. The mean length was 387 mm FL, and the mean weight was 0.74 kg. Female striped bass ranged in length from 327 mm to 797 mm FL, and the weight range was 0.42 kg to 6.71 kg. Mean length for females was 478 mm FL, and mean weight was 1.57 kg. The mean lengths and weight for males and females in 1984 was considerably higher (Harris et al. 1985).

The length-frequency distributions for male and female striped bass, in 50 mm size groups, are presented in Figure 4 for the Roanoke River spawning run in 1985.

Male striped bass showed a peak at the 400-450 mm size interval, while female fish showed a peak at the 450-500 mm size interval. The male length frequency distribution peaks during 1981 and 1984 were similar to that found in 1985, while the female peaks during 1981-1984 were at a larger size interval (Harriss et al. 1985).

CONCLUSIONS

The Albemarle Sound striped bass population has shown a continued decline since the 1970s. It is probable that deteriorating water quality, poor year class production, and heavy fishing pressure applied on immature fish have taken their toll on the population. The current Phase II striped bass stocking program may help sustain a population during these low levels of abundance, but probably cannot be used to restore the population to

Table 8. Striped bass number, percent, and age, (by sex) sampled from the Roanoke River during the spawning run 1981-1984.

Age	1981					1982					1983					1984				
	Number		Percent of total by sex		Percent sexes combined	Number		Percent of total by sex		Percent sexes combined	Number		Percent of total by sex		Percent sexes combined	Number		Percent of total by sex		Percent sexes combined
	M	F	M	F		M	F	M	F		M	F	M	F		M	F	M	F	
I	1	0	0.9	-	0.4	-	-	-	-	-	-	-		-	-	-	-	-	-	-
II	72	3	63.2	2.0	28.7	106	15	37.2	12.7	30.0	10	1	5.4	0.6	3.2	53	6	53.6	4.0	23.8
III	31	0	27.2	-	12.0	100	4	35.1	3.4	25.8	100	4	53.8	2.6	30.4	11	2	11.1	1.3	5.2
IV	9	37	7.8	25.2	17.6	60	16	21.0	13.6	18.9	59	45	31.7	28.8	30.4	24	45	24.2	30.2	27.9
V	0	45	-	30.6	17.2	15	33	5.3	28.0	11.9	12	52	6.4	33.3	18.7	9	64	9.1	43.1	29.4
VI	1	32	0.9	21.8	12.6	3	37	1.1	31.3	10.0	4	29	2.2	18.7	9.6	1	14	1.0	9.4	6.1
VII	0	11	-	7.5	4.2	1	7	0.3	6.0	2.0	1	17	0.5	11.0	5.3	1	9	1.0	6.0	4.0
VIII	0	9	-	6.1	3.4	0	5	-	4.2	1.2	0	5	-	3.2	1.5	0	6	-	4.0	2.4
IX	0	7	-	4.8	2.8	0	1	-	0.8	0.2	0	1	-	0.6	0.3	0	2	-	1.3	0.8
X	0	3	-	2.0	1.1	-	-	-	-	-	0	1	-	0.6	0.3	0	1	-	0.7	0.4
X	-	-	-	-	-	-	-	-	-	-	0	1	-	0.6	0.3	-	-	-	-	-
Total,	114	147				285	118				186	156				99	149			
	261					405					342					248				

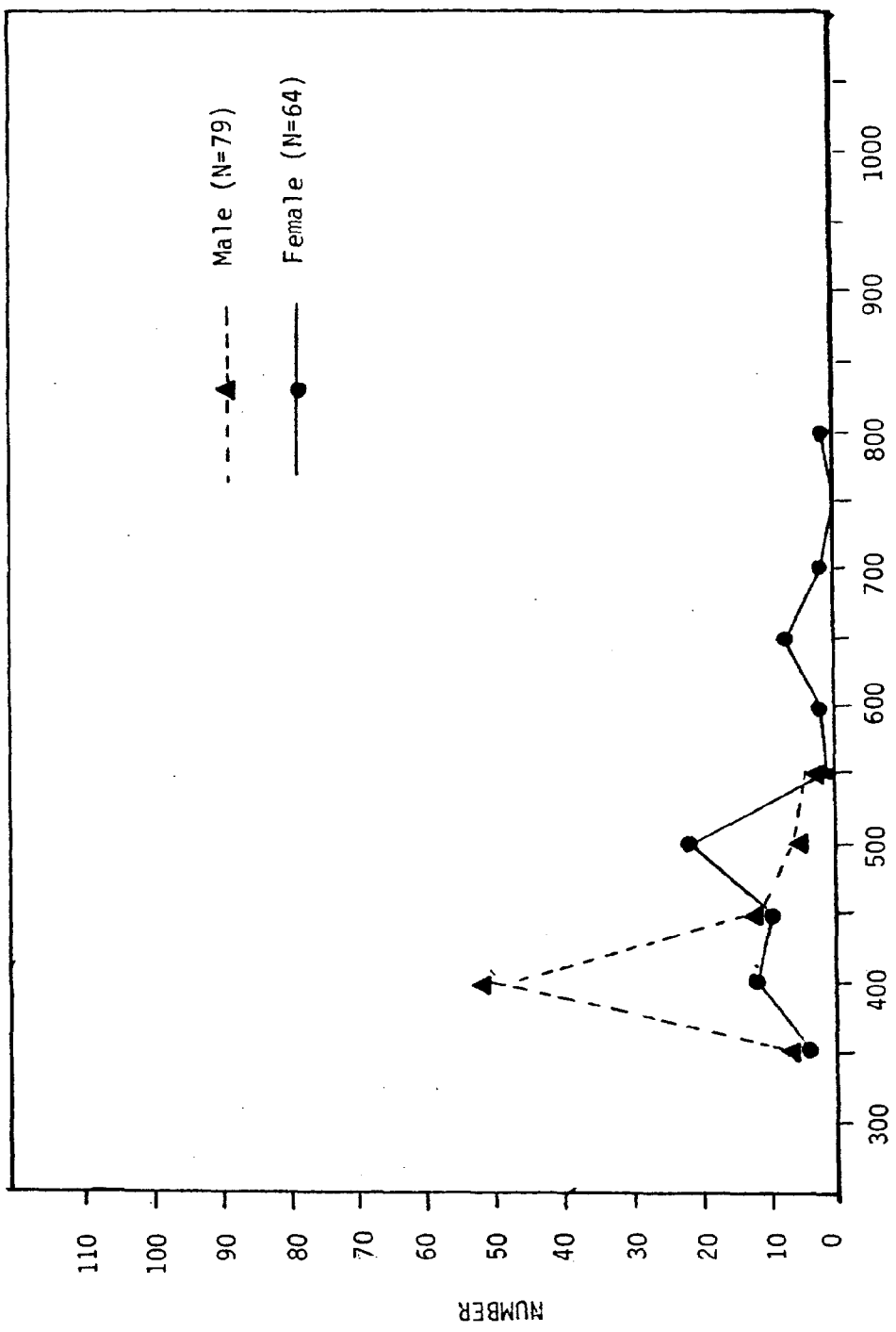

Figure 4. Length-frequency distributions for male and female striped bass in 50 mm size groups, captured in Roanoke River, N.C. during the 1985 spring spawning run.

self-sustaining levels, especially when heavy fishing pressure continues on these fish prior to sexual maturity.

The recent regulations adopted by the MFC, an increase in the minimum size limit and a shorter commercial fishing season, will probably allow more fish to reach sexual maturity and contribute to the spawning population, at least once. If the striped bass population continues to decline even further, stricter regulations may be inevitable.

LITERATURE CITED

Atlantic States Marine Fisheries Commission (ASMFC).
1981. Interstate fisheries management plan for the striped bass. Fish. Mgmt. Rep. No. 1, ASMFC, Washington, D.C.

Harriss, Robert C., Jr., Beth L. Burns, Harrel B. Johnson, and Roger Rulifson.
1985. An investigation of size, age, and sex of North Carolina striped bass., Compl. Rep., Proj. AFC-18, N.C. Dept. Nat. Res. & Community Develop., Div. Mar. Fish., 136 p.

Hassler, W. W.
1984. The status and abundance of striped bass, Morone saxatilis, in the Roanoke River and Albemarle Sound, North Carolina 1977-1981. N.C. Dept. Nat. Res. & Community Develop., Div. Mar. Fish., Compl. Rep., Proj. AFS-14, 40 p.

Hassler, William W., Norman L. Hill, and James T. Brown.
1981. The status and abundance of striped bass, Morone saxatilis, in the Roanoke River and Albemarle Sound, North Carolina, 1956-1980. N.C. Dept. Nat. Res. & Community Develop., Div. Mar. Fish., Spec. Sci. Rep. No. 38, 156 p.

Hassler, W. W. and S. D. Taylor.
1984. The status, abundance, and exploitation of striped bass in the Roanoke River and Albemarle Sound, North Carolina, 1982, 1983. Compl. Rep., Proj. AFC-19, N.C. Dept. Nat. Res. & Community Develop., Div. Mar. Fish., 67 p. + App.

Holland, B. F. Jr., and George F. Yelverton.
1973. Distribution and biological studies of anadromous fishes offshore North Carolina. N.C. Dept. Nat. & Econ. Res., Div. Comm. and Sports Fish. Spec. Sci. Rep. No. 24., 132 p.

Johnson, Harrel B. and William W. Hassler.
1980. Cooperative management for Albemarle Sound-Roanoke River striped bass. Progress Rep., Project AFS-14-3., N.C. Dept. Nat. Res. & Community Develop., Div. Mar. Fish., 21 p.

Johnson, H. B., B. F. Holland, Jr., and S. G. Keefe.
1977. Anadromous fisheries research program, northern coastal area. Completion rep., Project AFCS-11, N.C. Dept. Nat. and Econ. Res., Div. Mar. Fish. 97 + 40 p.

Johnson, Harrel B., Henry W. Stevens, and William W. Hassler.
1979. Cooperative management program for Albemarle Sound-Roanoke River striped bass. N.C. Dept. Nat. Res. & Community Develop., Div. Mar. Fish., Ann. Rep., Proj. AFS-14-2, 63 p.

Keefe, S. G. and W. W. Hassler.
1981. Cooperative management program for Albemarle Sound-Roanoke River striped bass. N.C. Dept. Nat. Res. and Community Develop., Div. Mar. Fish., Ann. Rep., Proj. AFS 14-4, 28 p.

Street, M. W., P. P. Pate, Jr., B. F. Holland, Jr., and A. B. Powell.
1974. Anadromous fisheries research program, northern coastal region. Completion rep., Project AFCS-8. N.C. Dept. Nat. and Econ. Res., Div. Mar. Fish., 193 + 62 p. + App.

Street, M. W. and H. B. Johnson.
1977. Striped bass in North Carolina. Unpub. rep., N.C. Dept. Nat. Res. and Community Develop., Div. Mar. Fish., 12 p.

Sykes, J. F.
1958. A method of determining the sex of the striped bass (Roccus saxatilis) (Walbaum). Trans. Am. Fish., Soc. 87:104-107.

Trent, Lee and William W. Hassler.
1968. Gill net selection, migration, size and age composition, sex ratio, harvest efficiency, and management of striped bass in the Roanoke River, North Carolina. Chesapeake Sci. 9(4):217-232.