SH
351
.B3
H46
1987

Henry, Lynn T.

SH351.B3H46 1987

ALBEMARLE SOUND GILL NET STUDY

By

Lynn T. Henry

North Carolina Department of Natural Resources
and Community Development
Division of Marine Fisheries
Morehead City, NC 28557

Completion Report for Project AFS-23

September 1987

This project was conducted under the Anadromous Fish Conservation Act (PL 89-304, as amended) and funded, in part, by the U.S. Department of the Interior, Fish and Wildlife Service.

TABLE OF CONTENTS

ABSTRACT iii

INTRODUCTION 1

STUDY AREA 2

METHODS AND MATERIAL 3

RESULTS AND DISCUSSION 7

Fall and Summer Striped Mullet Fishery 7

Summer Flounder Fishery 27

Fall Fishery 35

Spring Fishery 43

SUMMARY AND RECOMMENDATIONS 57

ACKNOWLEDGEMENTS 61

LITERATURE CITED 62

ABSTRACT

The Alblemarle Sound area supports the principal striped bass population in North Carolina. Nets were fished during 1984-1986 to characterize and evaluate the Albemarle Sound gill net fishery. Replicate gill nets of 2.5 through 5.5 inches stretched mesh were fished in different locations, to determine impacts on striped bass conservation. Efforts to direct for other species without capturing striped bass were not successful. The summer and fall striped mullet and flounder gill net fisheries, as regulated, should have a minimal impact on striped bass. Recent revisions in the fall fishery for white perch and striped bass have provided for additional striped bass protection without severely reducing the potential harvest of other species. The 3.5 inch net is the predominant gear used by Albemarle Sound fishermen targeting for white perch and striped bass. The 14 inch total length minimum size limit for striped bass and 3.5 inch mesh nets compliment each other. Approximately 70% of the striped bass taken in 3.5 inch mesh are between 14 and 16 inches (TL) and of age groups I+ or II. Catch-per-unit-of-effort (CPUE) data show the continued use of the 3.5 inch net is essential to a multispecies gill net fishery. No changes were recommended for the spring gill net season. A regression equation was developed to determine the striped bass length for which a mesh size is most efficient. Other species captured were enumerated and measured to determine gill net selectivity and efficiency. Other recommendations to the N.C. Marine Fisheries Commission included: (1) conservative use of the October striped bass season proclamation to allow additional growth and reduce spoilage, (2) opening of the striped bass season when the regular gill net season begins to reduce discard, (3) no changes in gill net stretched mesh size, and (4) additional data collection from the late spring gill net fishery is needed to evaluate further protection measures for mature (spawning stock) striped bass.

INTRODUCTION

Declines in the Atlantic coast stocks of striped bass, Morone saxatilis, particularly the Chesapeake stock, began in the early 1970s and have continued into the 1980s. During the same time period, degraded water quality in western Albemarle Sound contributed to the decline of several area fisheries. Reduced harvest, both commercial and recreational, and a perceived decline in production of striped bass (e.g. year class success - juvenile index (Street 1986, ASMFC 1987)) prompted legislative and administrative actions in order to reverse the decline. The Chafee Emergency Striped Bass Amendment (P.L. 96-118), an amendment to The Anadromous Fish Conservation Act (P.L. 89-304), created the Emergency Striped Bass Study program. The objectives of this program were to conduct research to identify factors contributing to the striped bass decline, monitor the stocks, and assess the economic consequences of the decline (ASMFC 1987).

The Striped Bass Fishery Management Plan, prepared in 1981 by the Atlantic State Marine Fisheries Commission (ASMFC) as part of their Interstate Fisheries Management Program (ISFMP), was designed to provide a coordinated framework to speed the recovery of East Coast stocks. Implementation of the "Plan" was mandated by Congress in The Atlantic Striped Bass Conservation Act (PL 98-613) passed in 1985. States not complying with the "Plan" were subject to federal pre-emption and a possible moratorium on striped bass harvest.

The North Carolina Marine Fisheries Commission is responsible for regulating the commercial and recreational harvest of finfish and shellfish in internal coastal waters (joint and coastal waters) and the Territorial Sea of North Carolina. The North Carolina Wildlife Resources Commission is responsible for regulating the recreational harvest of fisheries in joint and inland waters. The two commissions cooperatively manage the fishery resources in joint waters. Meetings and hearings are held annually by the commissions to solicit public input on proposed management actions recommended by their respective agencies. North Carolina instituted the 14 inch total length (TL) minimum size required for internal waters, closed the ocean fishery in 1985, and has been officially found in compliance with the ASMFC Striped Bass Interstate Management Plan.

The commercial fisheries of the Albemarle Sound basin have been extremely important to the economy of the region since colonial times. Gill nets have

been a major gear used in the harvest of North Carolina finfish since the early 1800's. In 1902 the United States Bureau of Fisheries reported that 107,190 gill nets worth $236,255 were used by North Carolina fishermen (Smith 1907).

Over the last decade principal commercial gears for striped bass have been anchor gill nets in the estuaries and rivers, with beach seines, trawls and most recently drop or sink gill nets in the ocean (Street and Johnson 1977).

Gill nets are the predominant gear used in Albemarle Sound and account for the majority of the landings for several species including striped bass. In addition, striped bass are highly prized sport and food fish receiving heavy fishing pressure from the recreational fishing community.

The overall objective of this project was to collect information on the varied and complex gill net fisheries of the Albemarle region and to evaluate the management options available for a continued fishery with striped bass conservation measures. Data collected during the project were used throughout the regulatory process, which led to; (1) the adoption of the 14 inch TL minimum size limit for striped bass and (2) revisions in the summer and fall gill net season regulations for striped bass conservation. Specific objectives of the gill net project were:

(1) to evaluate the size, age, and sex of striped bass taken in the existing Albemarle Sound gill net fisheries,

(2) to evaluate size composition of other commercially important species harvested by gill nets,

(3) to evaluate the potential for directing gill net effort towards species other than striped bass,

(4) to evaluate the management options available with respect to the gill net fishery,

(5) to collect data so that management agencies have a better understanding of the complexity of the Albemarle Sound area gill net fishery.

STUDY AREA

Albemarle Sound, a shallow estuary 60 miles long and 3.5 to 15 miles wide, is characterized by extensive nearshore shoal areas (1.0 to 6.0 feet) which abruptly drop to deeper waters (7.0 to 25.0 feet). The Roanoke and Chowan Rivers are the major tributaries to the Albemarle Sound. These and other tributaries are bordered by extensive gum-cypress swamps. Albemarle Sound and tributaries are further described in Street et al. (1975).

METHODS AND MATERIALS

Replicate 40 and 80 yard anchor gill nets of selected stretched mesh sizes were fished perpendicular to shore in a manner traditional to Albemarle Sound. Fishing was conducted in locations (Figure 1) being utilized by area commercial fishermen.

Both the shoal areas and the deeper channel waters were fished during the study. Nets fished on the shoal areas were classified as; "FIN" = floating inside the shoal area and fishing the entire water column. Nets set outside the shoal areas in deeper water were classified as; (1) "FO" = floating net outside the shoal area, with the net fishing from the surface to the depth of the net in the water column or, (2) "SO" = sink net outside the shoal area, with the lead line resting on the bottom and the net fishing the water column the depth of the net. Replicate nets of specific sizes were fished in different areas (FIN compared to FO or SO) and in different manners in the same areas (FO compared to SO), such that seasonal species utilization of different habitats and different portions of the water column could be documented and used in management decisions.

Areas fished, net placement, stretched mesh sizes, and net length were varied according to seasonal regulations and fisheries. Table 1 contains information on the seasonal fisheries and the gears used during the project. All nets were not fished during the specified times in the plan of work because of purchasing and construction delays. In order to approximate the gears used, area commercial fishermen were contacted relative to net materials and construction techniques. Nets were constructed by two commercial net makers from the Albemarle area. Specifications on twine size, mesh depth, and construction information for gill nets are contained in Table 2. An area commercial fisherman was contracted to fish the nets and collect data with the assistance of Division of Marine Fisheries personnel.

Weather permitting, fishing was conducted for two six-day periods (10 net days) during each month October - May and for two five-day periods (8 net days) each month June - September.

All striped bass collected were counted and, if possible, measured. Some fish could not be measured due to predation by crabs and decomposition. Striped bass were measured fork length (FL) and total length (TL) in millimeters (mm), weighed in kilograms (kg), sexed (Sykes 1958), and scales taken for ageing. Even though measurements of striped bass were taken in

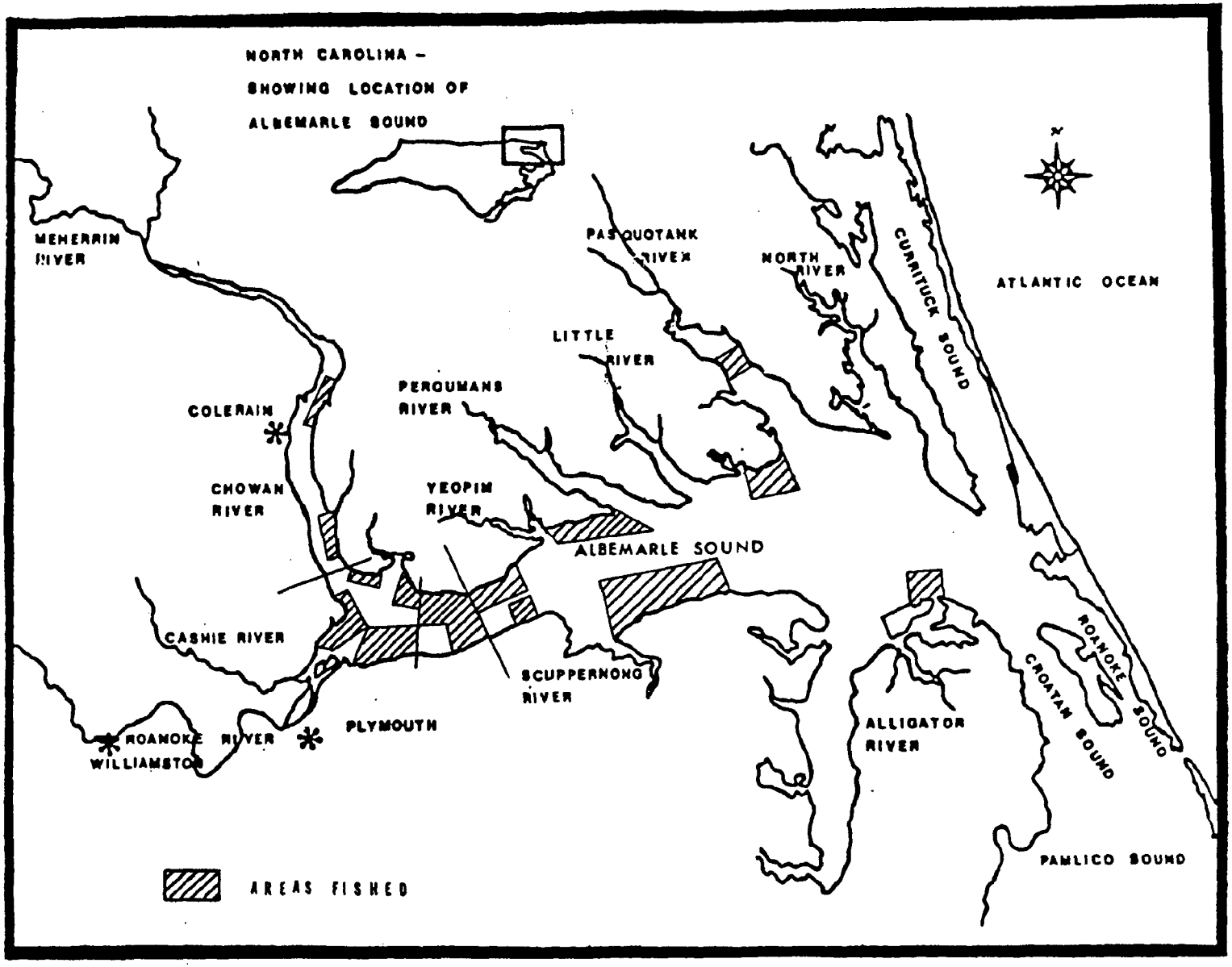

Figure 1. Locations fished during gill net study, Albemarle Sound, N.C.

Table 1. Stretched mesh sizes, net length, and seasons fished during gill net project, Albemarle Sound, N.C.

Season	Fall (October-December)		Spring (January-May)	Summer (June-September)	
Net length	40 yard	80 yard	80 yard	40 yard	80 yard
Stretched mesh size (inches)	2.5*			2.5*	
	3.0*		3.0**	3.0*	
		3.5	3.5		
		3.75	3.75		
		4.0	4.0		
		4.25	4.25		
		4.5	4.5		
					5.0***
					5.5***

* referred to as "mullet net"

** referred to as "river herring net"

*** referred to as "flounder net"

Table 2. Specifications of monofilament gill nets used during gill net project, Albemarle Sound, N.C., 1984-1986.

Gill net* specifications	Stretched mesh (inches)									
	2.5	3.0	3.5	3.75**	3.75	4.0	4.25	4.5	5.0	5.5
Meshes deep	45	40	35	25	25	30	30	35	25	20
Inches/tie*** with 3 meshes/tie	3.75	4.0	4.0	4.25	4.25	4.5	5.0	5.25	6.5	7.5
Hanging coefficient***	.50	.45	.38	.38	.38	.37	.38	.38	.43	.45

* Net webbing was no. 4 (#104) .33 mm dia. monofilament twine size.

** Webbing used in the 3.75 in X 25 net was no. 6 (#139) .40 dia. monofilament twine size.

*** The standard for net construction is to hang the webbing to the float and lead lines on the one-half basis (200 running yards of webbing in every 100 yards of net constructed) resulting in a hanging coefficient of 0.5. Area fishermen normally use more webbing per net than is required by hanging on the one-half basis, thus enhancing the catchability of the nets. Project nets, in order to approximate area gears, were hung less than one-half.

millimeters, for discussion purposes all metric measures are converted to English units (see Figures 2-28 for corresponding lengths in millimeters and inches). Striped bass were not aged by sex because data presented in Harriss et al. (1985) shows little difference in growth rate between sexes for fish age VI or less.

Gizzard shad and crevalle jack were counted and size range recorded by mesh size. Blue crabs captured in the nets were counted, but not measured. Other species collected were identified and important commercial and recreational species were measured (TL or FL). Flounder less than 11 inches (TL), minimum legal size limit, were noted.

Data contained in length-frequency and year-class distribution figures show relative distribution of specific size and age groups of striped bass for each mesh size. Tables show species composition, number of fish, percent of total catch by net type, length range, and means for specific mesh sizes.

RESULTS AND DISCUSSION

Fall and Summer Striped Mullet Fishery

During September 1984 net fishing began in Pasquotank River with 2.5 inch nets which are primarily set for striped or "jumping" mullet (*Mugil cephalus*) in the shoal areas of the sound and rivers.

The small mesh 2.5 and 3.0 inch "mullet nets" had been the topic of considerable controversy regarding their potential impact on striped bass less than 14 inches (TL). The N.C. Marine Fisheries Commission under increased pressure to institute striped bass conservation measures had passed a stringent regulation on the use of mullet nets in the fall 1984. Area fishermen appealed this decision and the Commission repealed the regulation replacing it with a compromise measure which requires that mullet nets be attended [15 NCAC 3B .0401(2)] at all times. The attendance provision allows the live release of striped bass taken in this gear. Current regulations also prohibit the sale of striped bass and the possession of fish which are taken by commercial fishing gear during the summer season (June - September). Data collected during September supported the original intent of the "mullet net" regulation by showing that undersize (less than 14 inches TL, age I+) striped bass were captured in sufficient numbers for concern (Figure 2, 100% <14 in). Data collected on other commercially important species taken during this period are presented in Table 3.

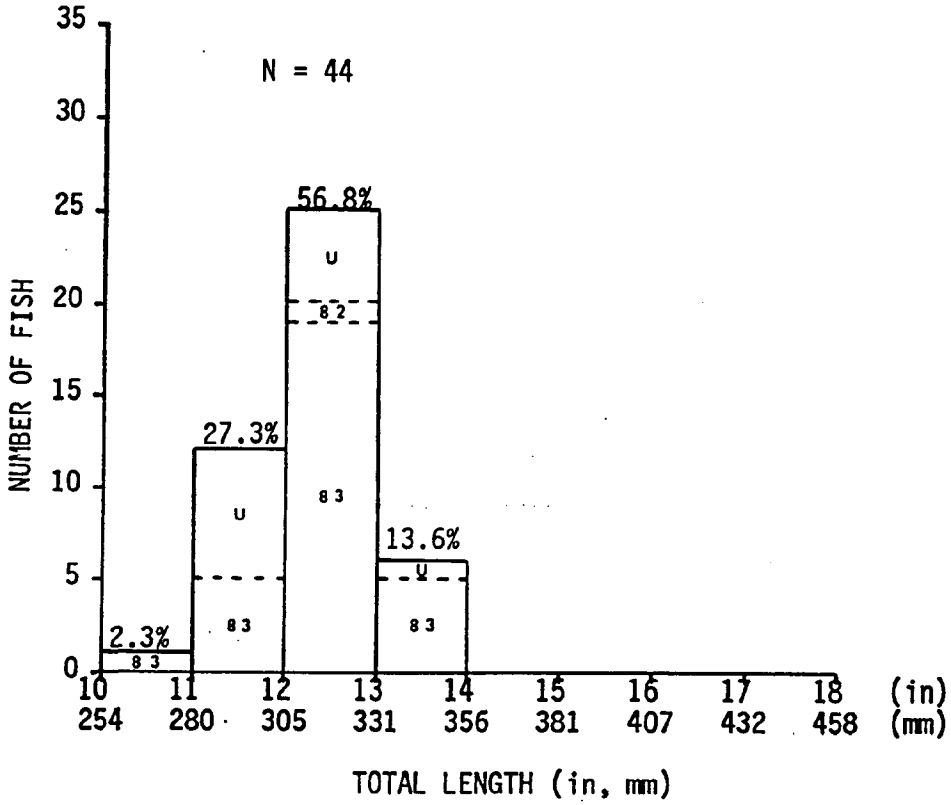

Figure 2. Length-frequency and year class (1982, 1983; U=unknown) distribution of striped bass captured in 80 and 40 yard (combined) 2.5 inch stretched mesh gill nets, by number and percent, during September 1984, Pasquotank River, N.C.

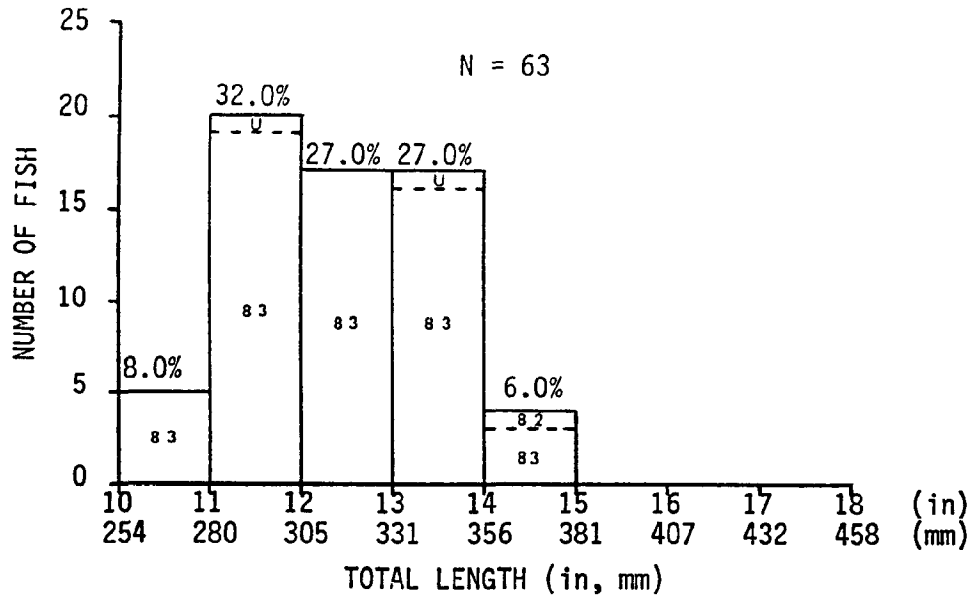

Figure 3. Length-frequency and year class (1982, 1983; U=unknown) distribution of striped bass captured in 40 yard 2.5 inch stretched mesh gill nets, by number and percent, during October-December 1984, Albemarle Sound area, N.C.

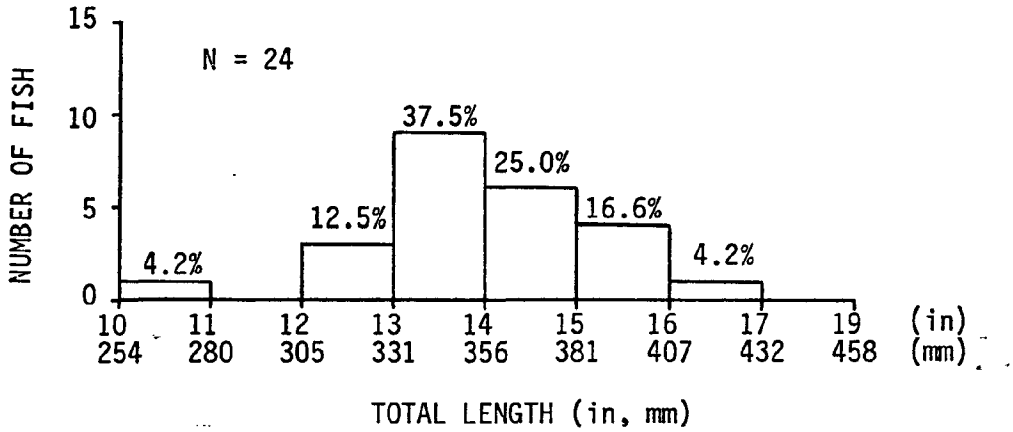

Figure 4. Length-frequency distribution of 1984 year class striped bass captured in 40 yard 2.5 inch stretched mesh gill nets, by number and percent, during October 1985, Albemarle Sound area, N.C.

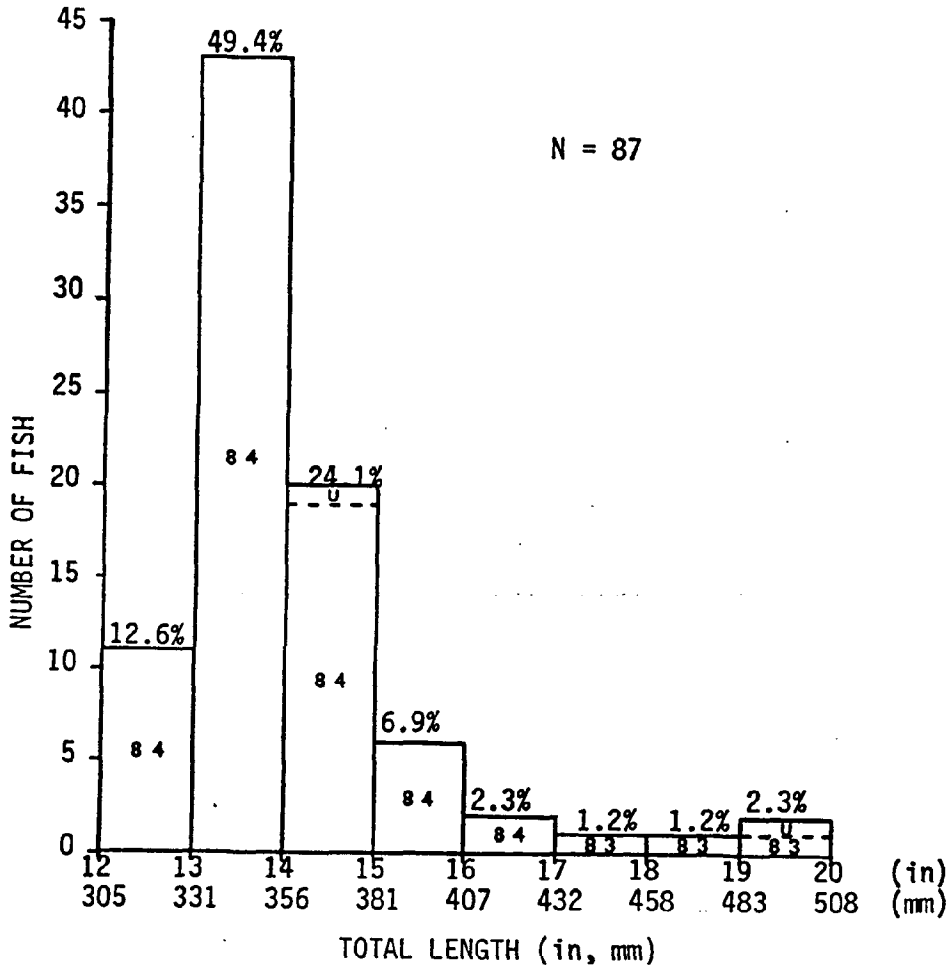

Figure 5. Length-frequency and year class (1983-1985; U=unknown year class) distribution of striped bass captured in 40 yard 3.0 inch stretched mesh gill nets, by number and percent, during October 1985, Albemarle Sound area, N.C.

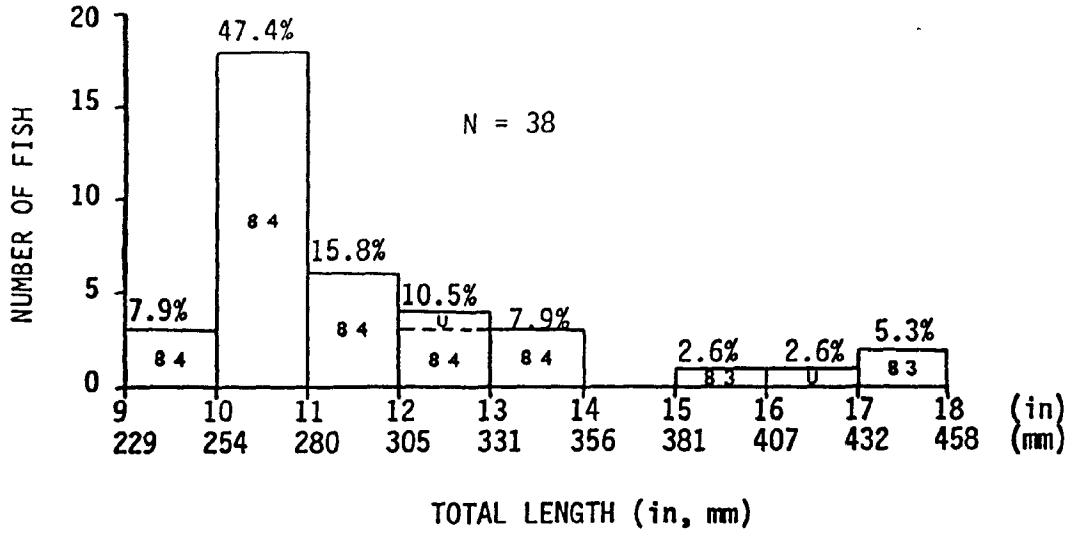

Figure 6. Length-frequency and year class (1983, 1984; U=unknown year class) distribution of striped bass captured in 40 yard 2.5 inch stretched mesh gill nets, by number and percent, during June-September 1985, Albemarle Sound area, N.C.

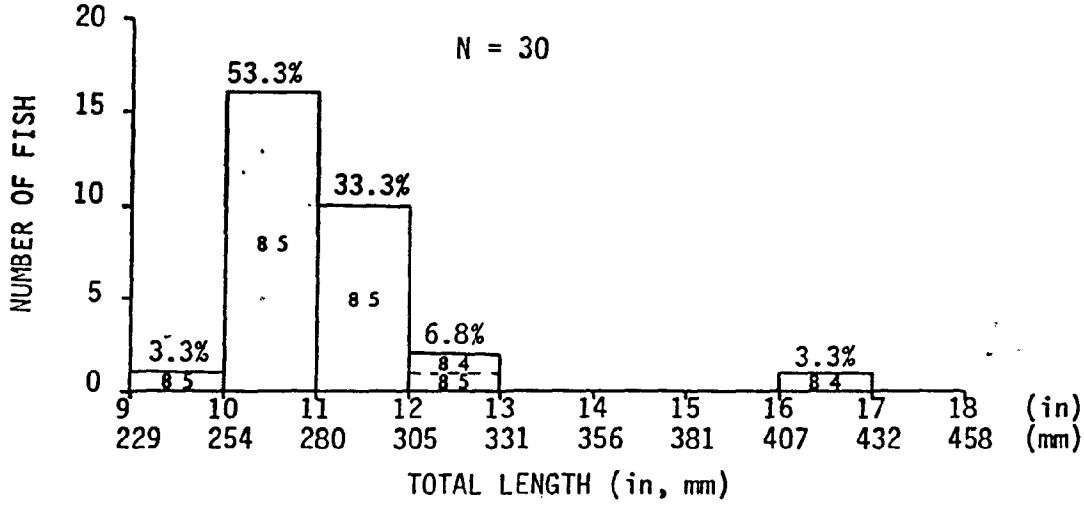

Figure 7. Length-frequency and year class (1984, 1985) distribution of striped bass captured in 40 yard 2.5 inch stretched mesh gill nets, by number and percent, during June 1986, Albemarle Sound area, N.C.

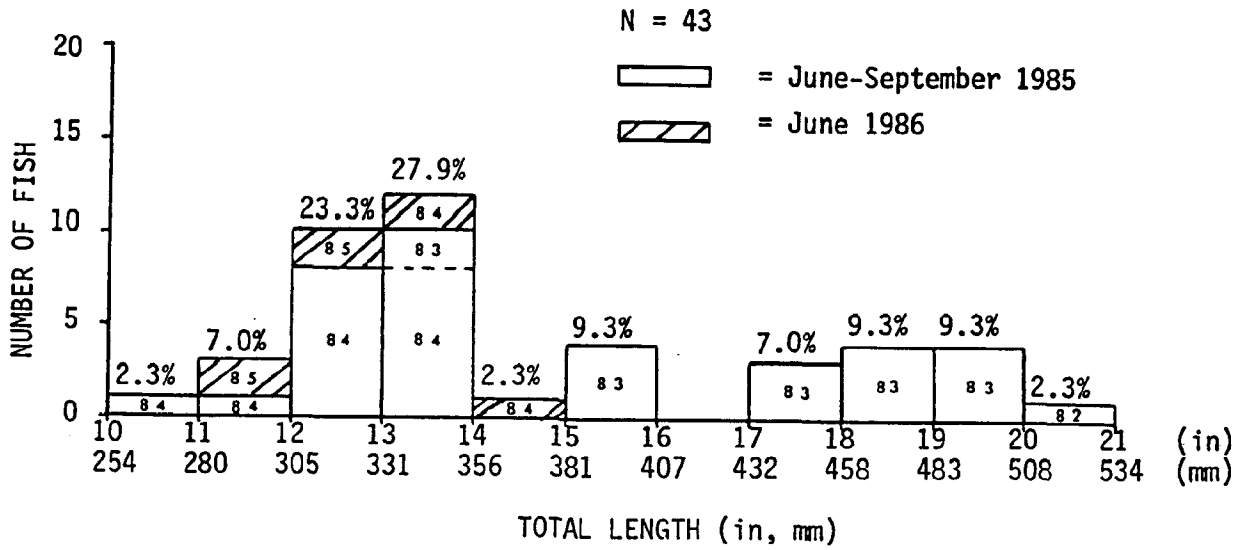

Figure 8. Length-frequency and year class (1982, 1983, 1984, 1985) distribution of striped bass captured in 40 yard 3.0 inch stretched mesh gill nets, by number and percent, during June-September 1985 and June 1986, Albemarle Sound area, N.C.

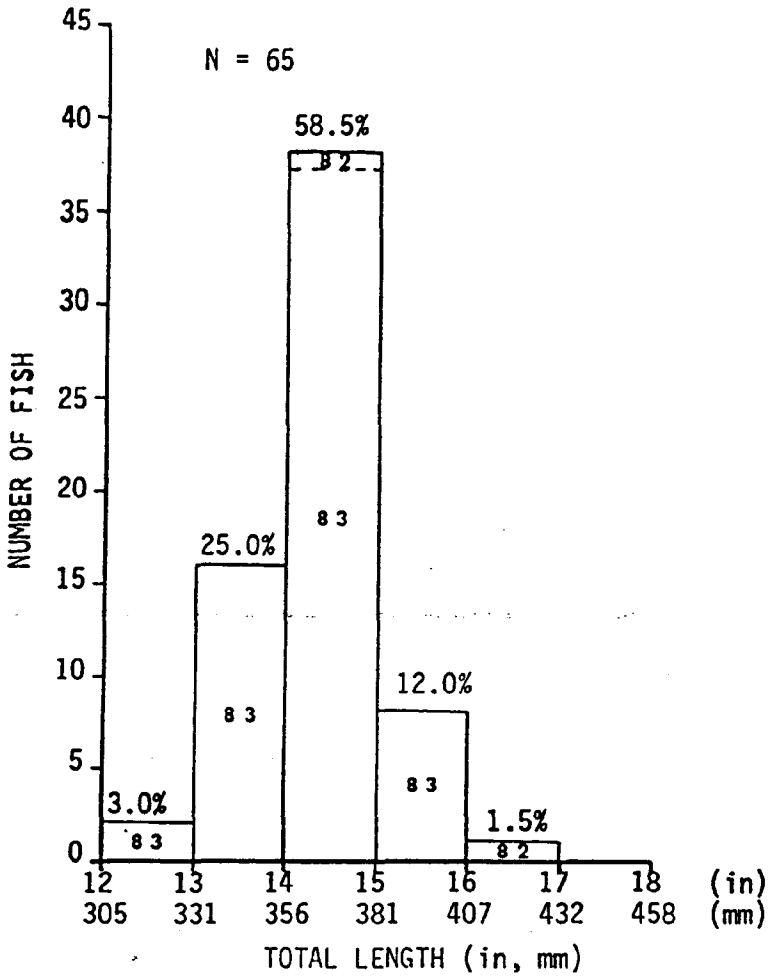

Figure 9. Length-frequency and year class (1982, 1983) distribution of striped bass captured in 80 yard 3.5 inch stretched mesh gill nets, by number and percent, during October-December 1984, Albemarle Sound area, N.C.

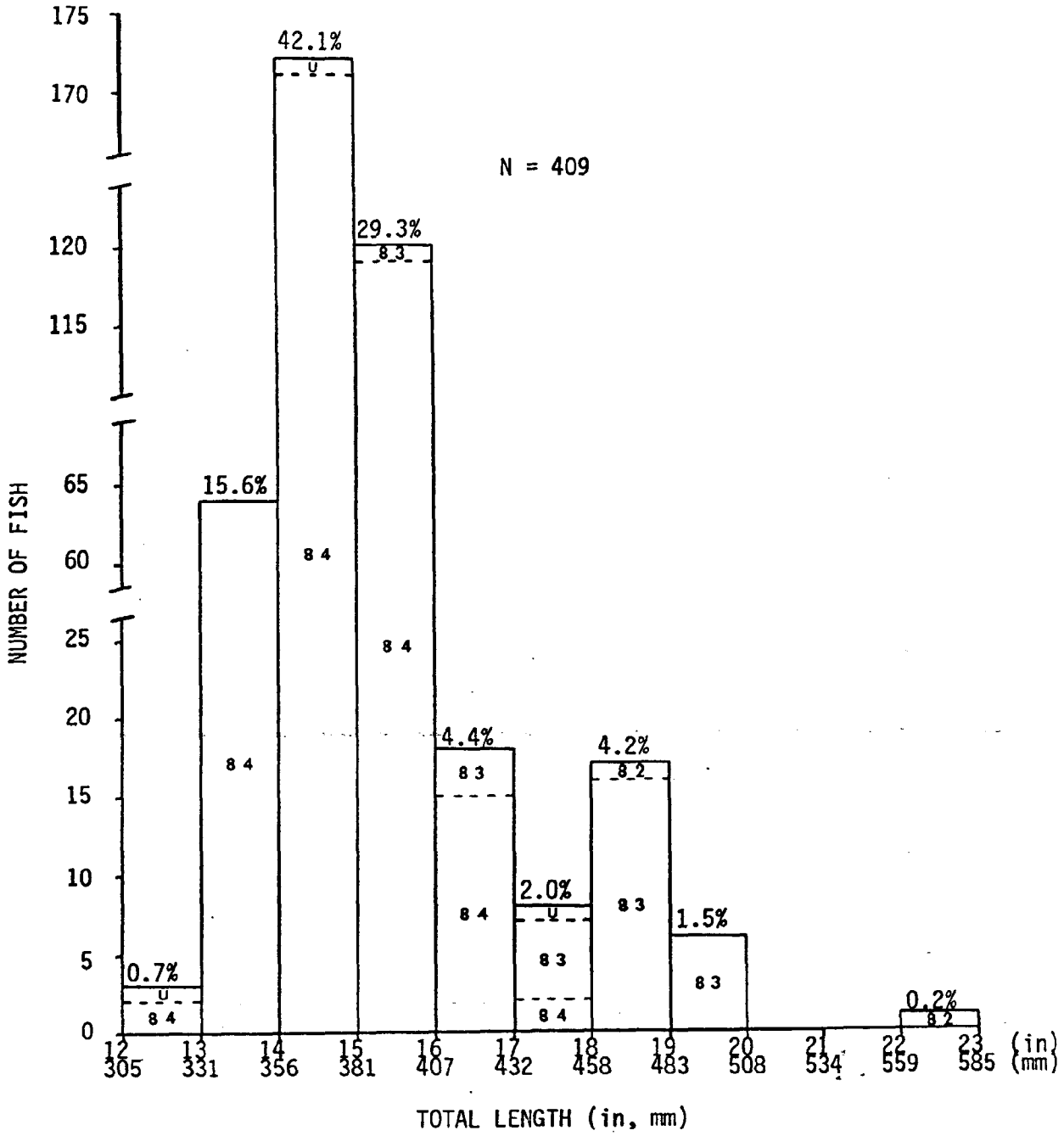

Figure 10. Length-frequency and year class (1982, 1983, 1984; U=unknown year class) distribution of striped bass captured in 80 yard 3.5 inch stretched mesh gill nets, by number and percent, during October-December 1985, Albemarle Sound area, N.C.

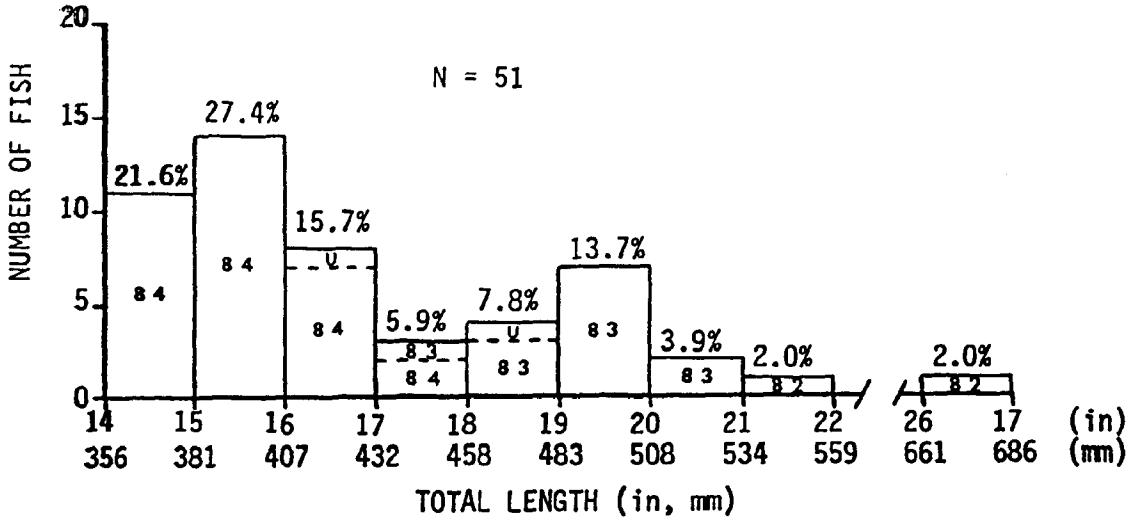

Figure 11. Length-frequency and year class (1982, 1983, 1984; U=unknown year class) distribution of striped bass captured in 80 yard 3.75 inch stretched mesh gill nets, by number and percent, during October-December 1985, Albemarle Sound area, N.C.

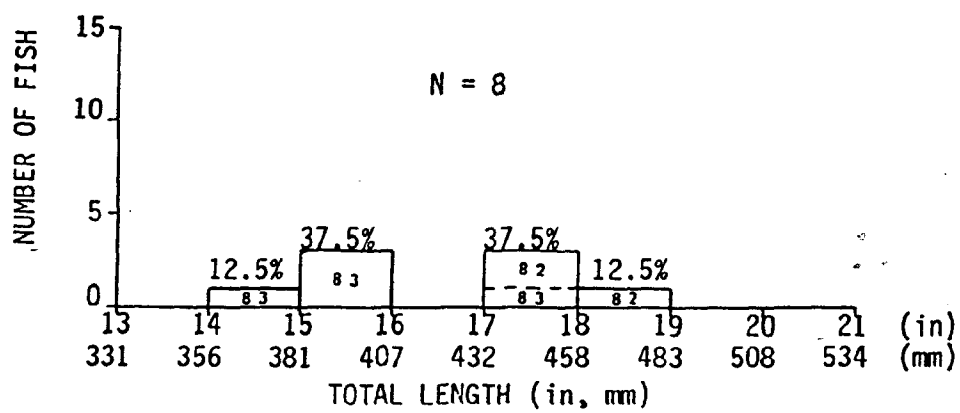

Figure 12. Length-frequency and year class (1982, 1983) distribution of striped bass captured in 80 yard 4.0 inch stretched mesh gill nets, by number and percent, during November-December 1984, Albemarle Sound area, N.C.

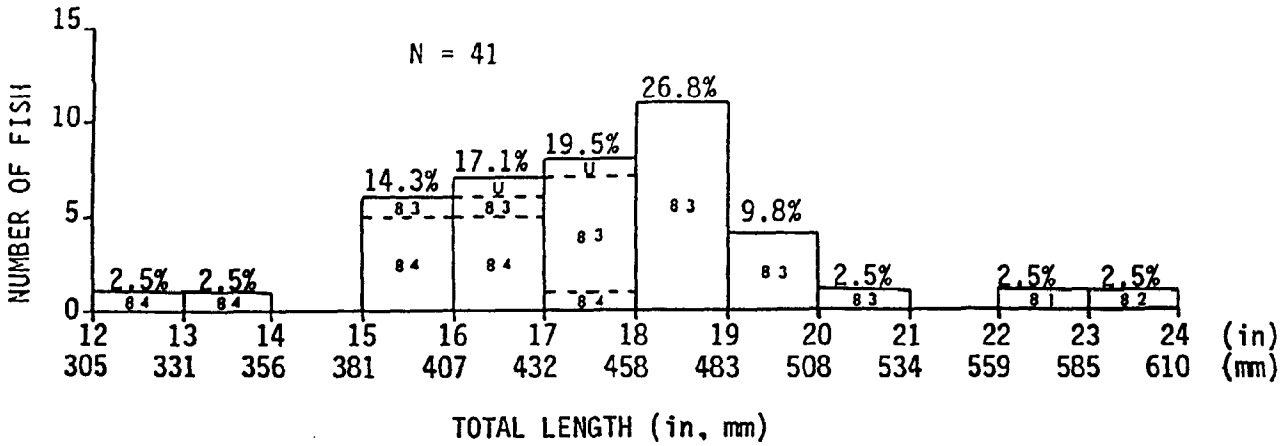

Figure 13. Length-frequency and year class (1981, 1982, 1983, 1984: U=unknown year class) distribution of striped bass captured in 80 yard 4.0 inch stretched mesh gill nets, by number and percent, during October-December 1985, Albemarle Sound area, N.C.

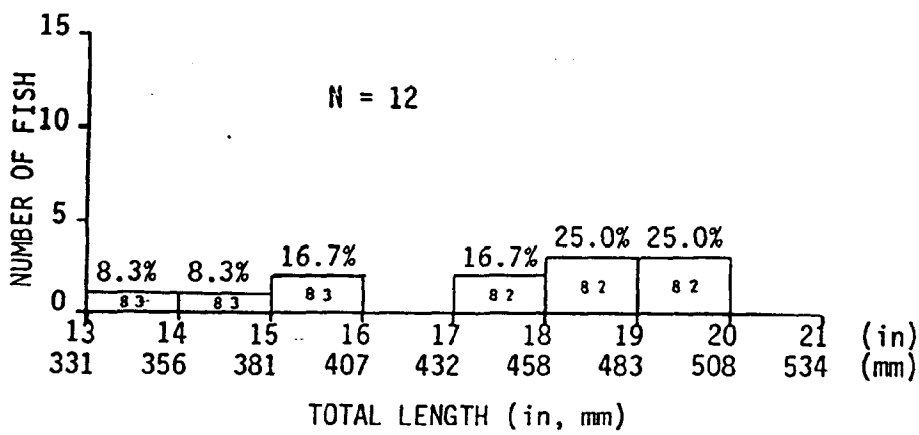

Figure 14. Length-frequency and year class (1982, 1983) distribution of striped bass captured in 80 yard 4.25 inch stretched mesh gill nets, by number and percent, during November and December 1984, Albemarle Sound area, N.C.

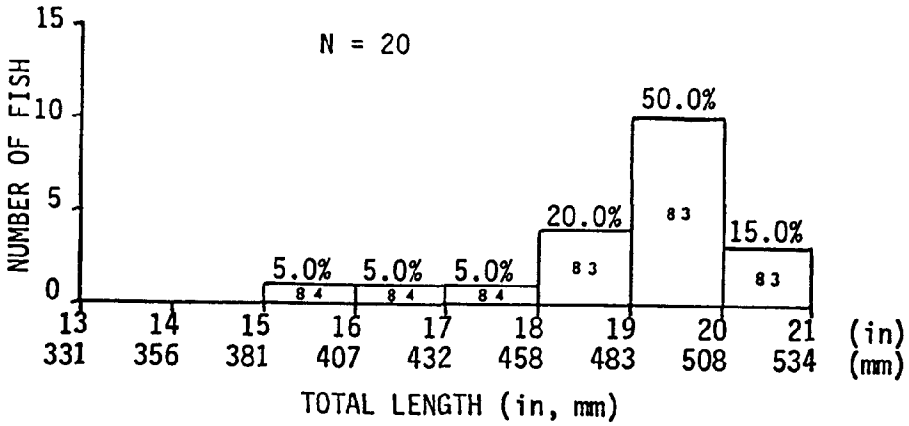

Figure 15. Length-frequency and year class (1983, 1984) distribution of striped bass captured in 80 yard 4.25 inch stretched mesh gill nets, by number and percent, during November and December 1985, Albemarle Sound area, N.C.

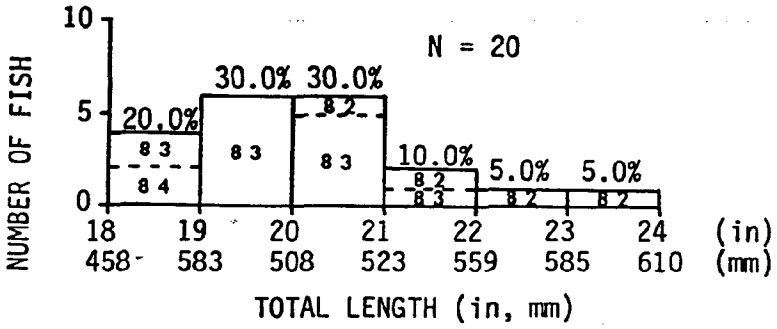

Figure 16. Length-frequency and year class (1982, 1983, 1984) distribution of striped bass captured in 80 yard 4.5 inch stretched mesh gill nets, by number and percent, during November-December 1985, Albemarle Sound area, N.C.

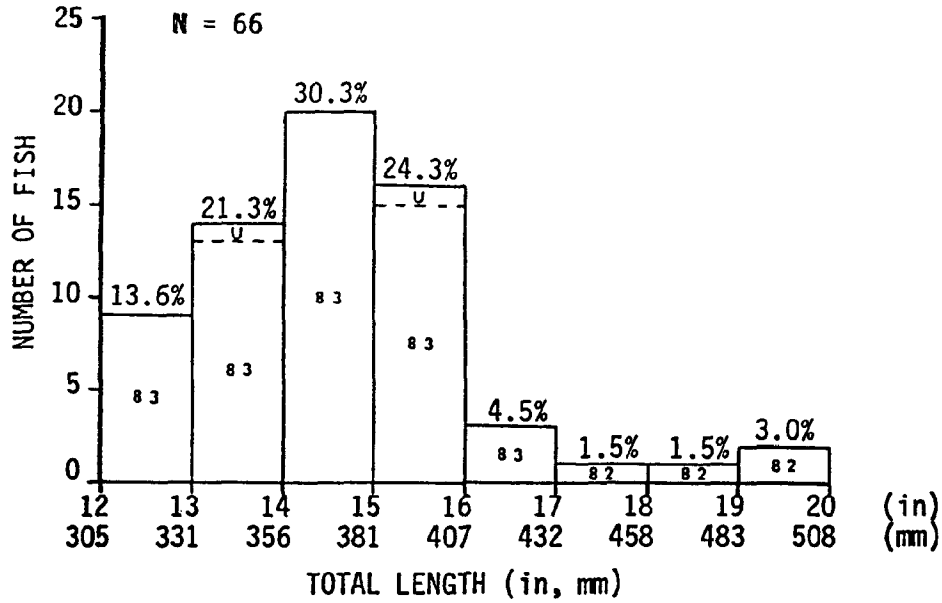

Figure 17. Length-frequency and year class (1982, 1983; U=unknown year class) distribution of striped bass captured in 80 yard 3.0 inch stretched mesh gill nets, by number and percent, during January-May 1985, Albemarle Sound area, N.C.

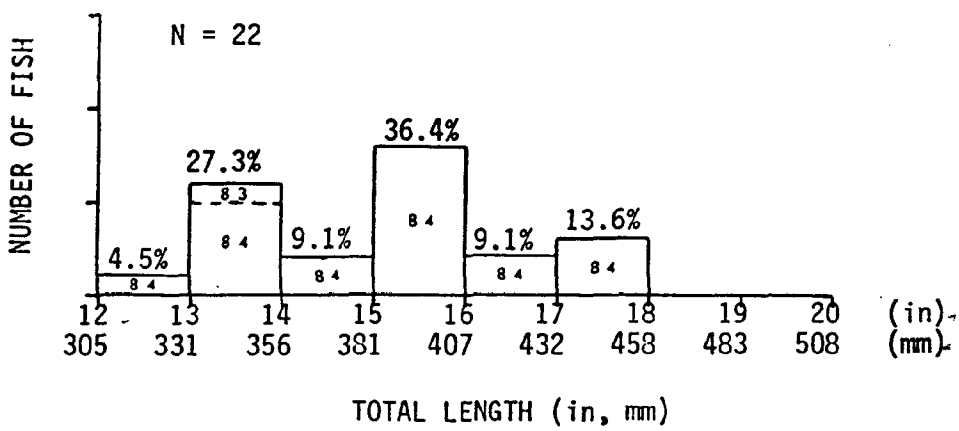

Figure 18. Length-frequency and year class (1983, 1984) distribution of striped bass captured in 80 yard 3.0 inch stretched mesh gill nets, by number and percent, during January-May 1986, Albemarle Sound area, N.C.

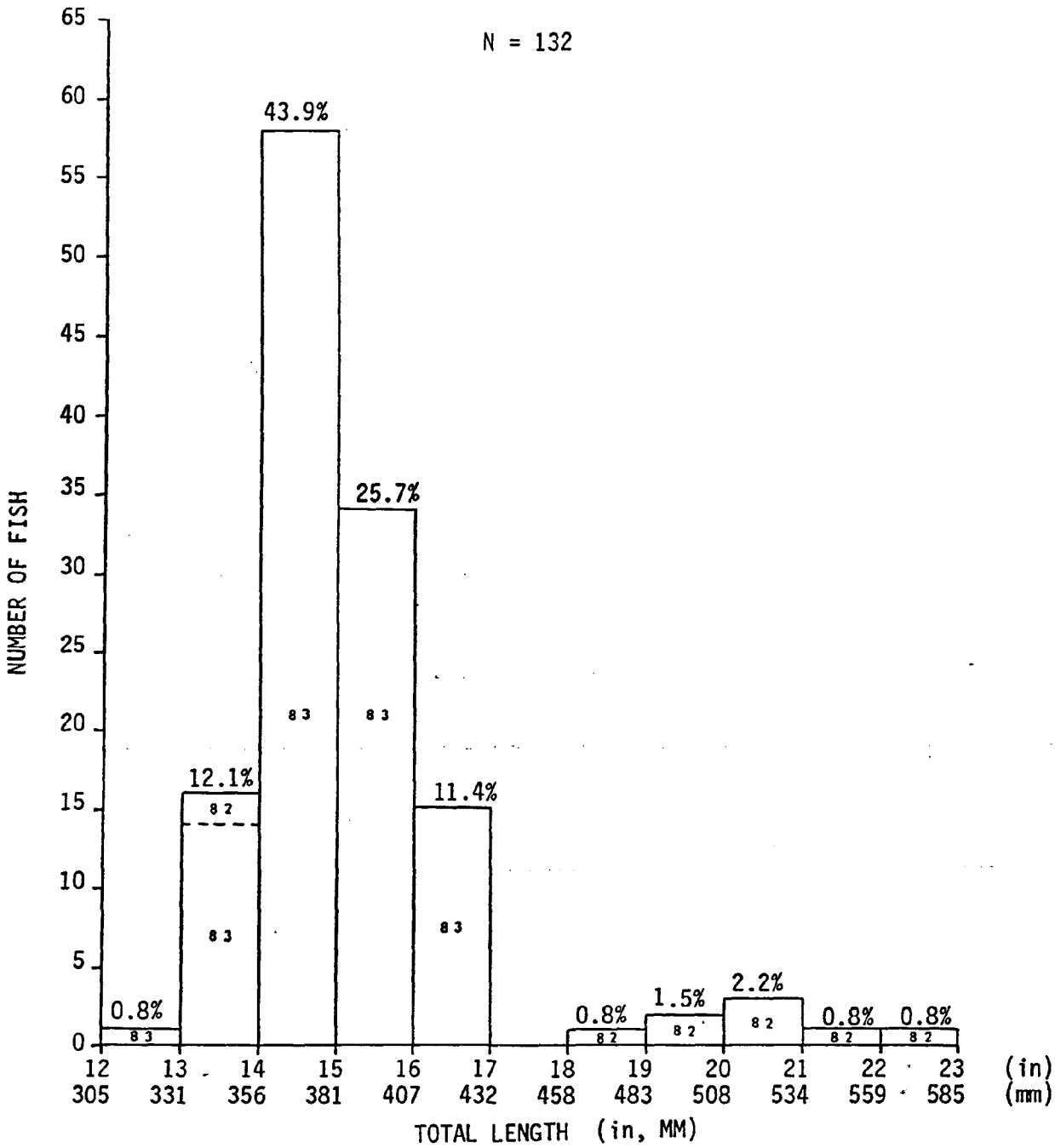

Figure 19. Length-frequency and year class (1982, 1983) distribution of striped bass captured in 80 yard 3.5 inch stretched mesh gill nets, by number and percent, during January-May 1985, Albemarle Sound area, N.C.

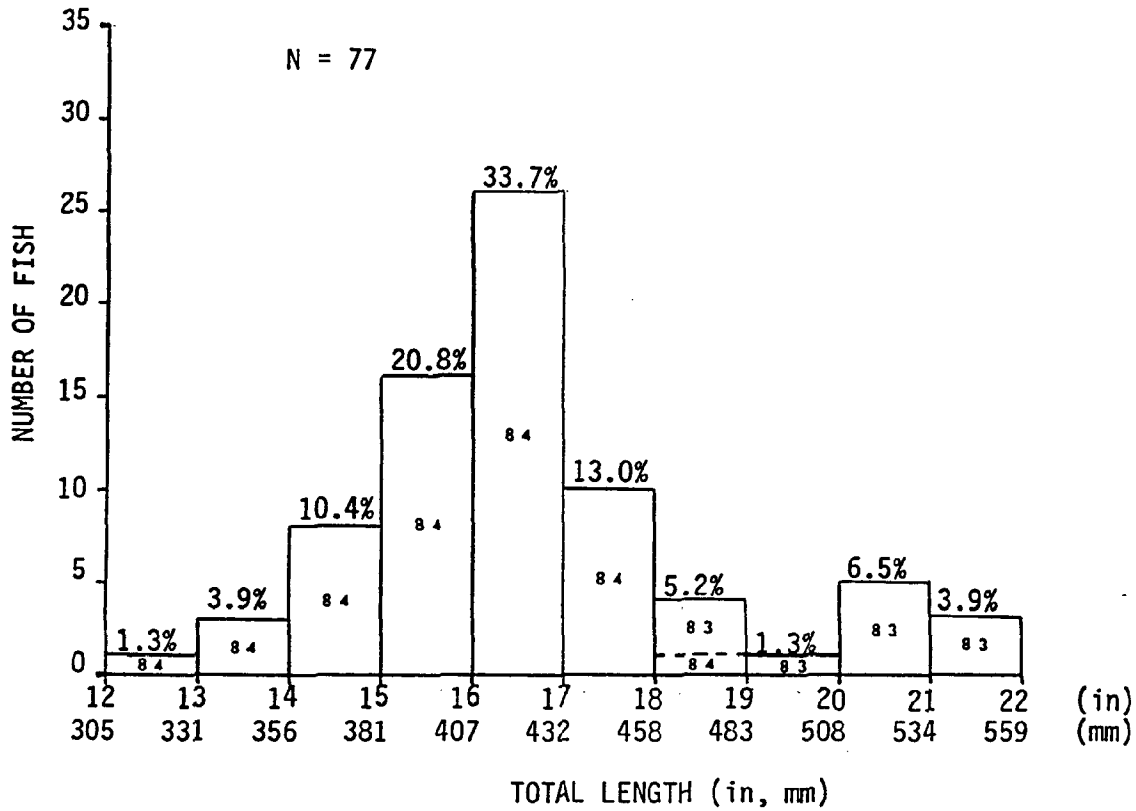

Figure 20. Length-frequency and year class (1983, 1984) distribution of striped bass captured in 80 yard 3.5 inch stretched mesh gill nets, by number and percent, during January-May 1986, Albemarle Sound area, N.C.

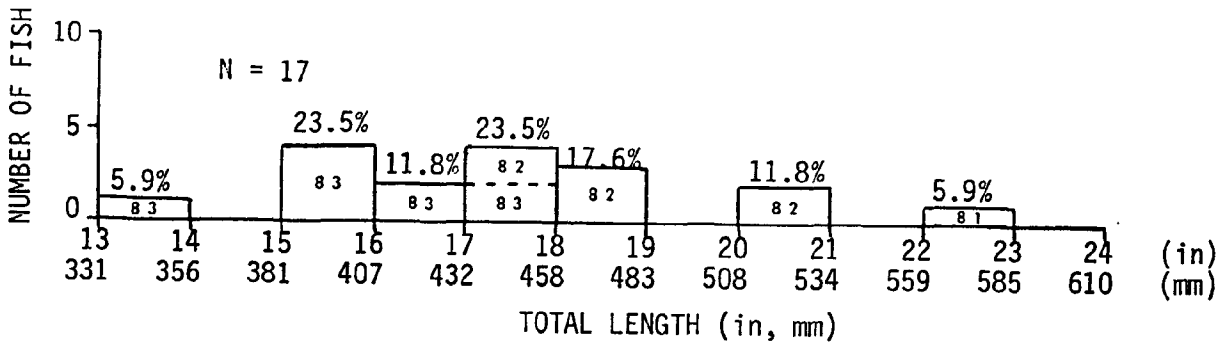

Figure 21. Length-frequency and year class (1981, 1982, 1983) distribution of striped bass captured in 80 yard 3.75 inch stretched mesh gill nets, by number and percent, during February-May 1985, Albemarle Sound area, N.C.

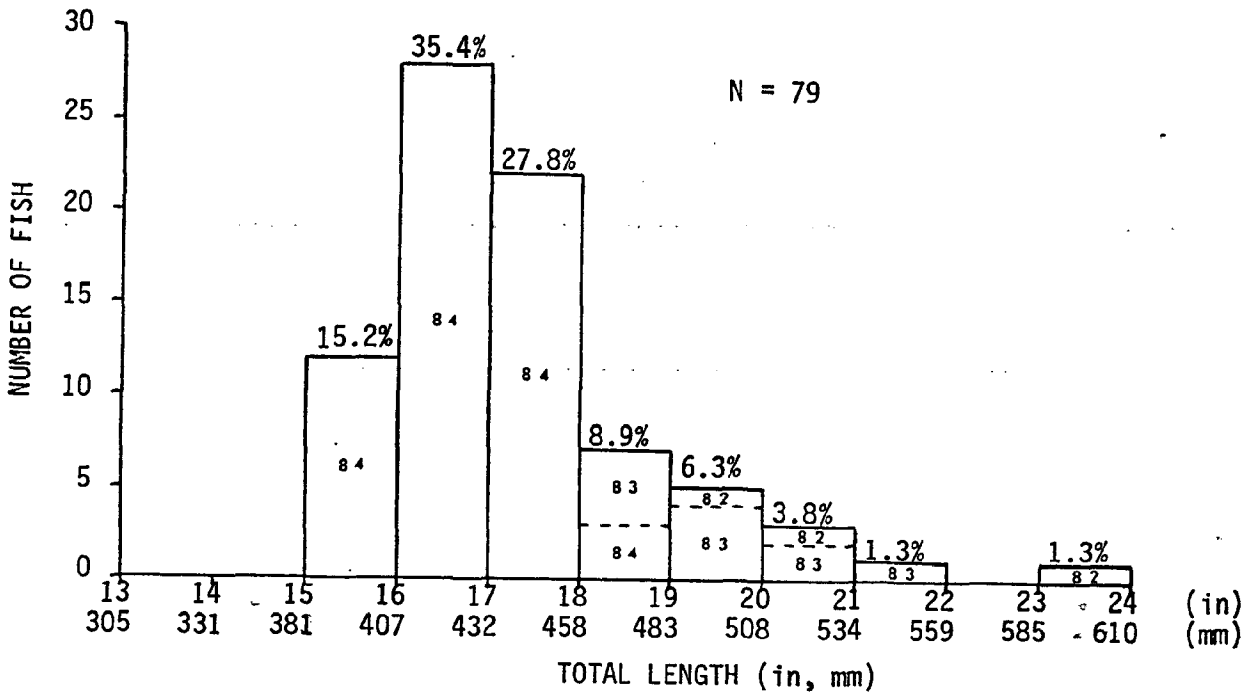

Figure 22. Length-frequency and year class (1982, 1983, 1984) distribution of striped bass captured in 80 yard 3.75 inch stretched mesh gill nets, by number and percent, during January-May 1986, Albemarle Sound area, N.C.

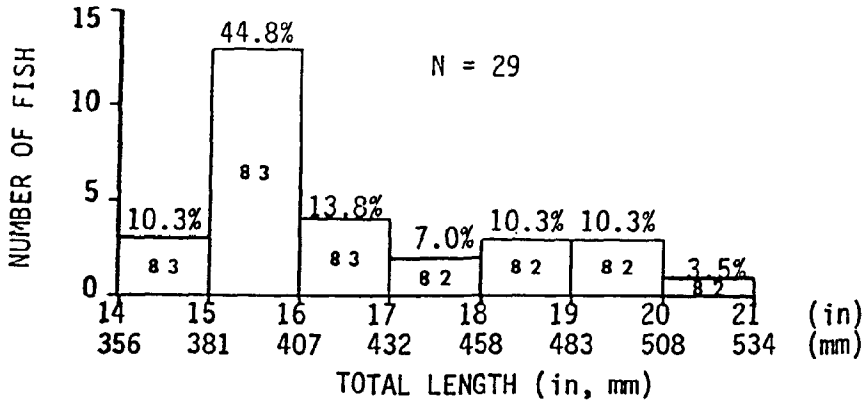

Figure 23. Length-frequency and year class (1982, 1983) distribution of striped bass captured in 80 yard 4.0 inch stretched mesh gill nets, by number and percent, during January-May 1985, Albemarle Sound area, N.C.

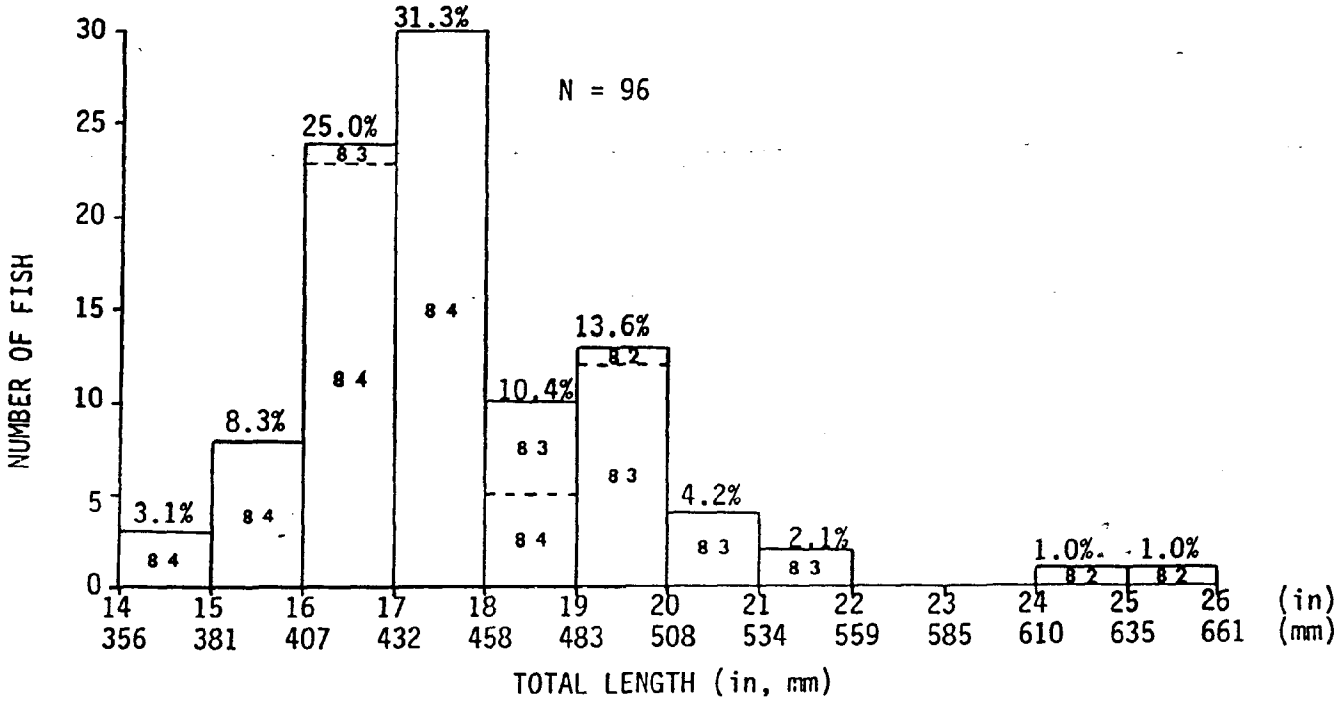

Figure 24. Length-frequency and year class (1982, 1983, 1984) distribution of striped bass captured in 80 yard 4.0 inch stretched mesh gill nets, by number and percent, during January-May 1986, Albemarle Sound area, N.C.

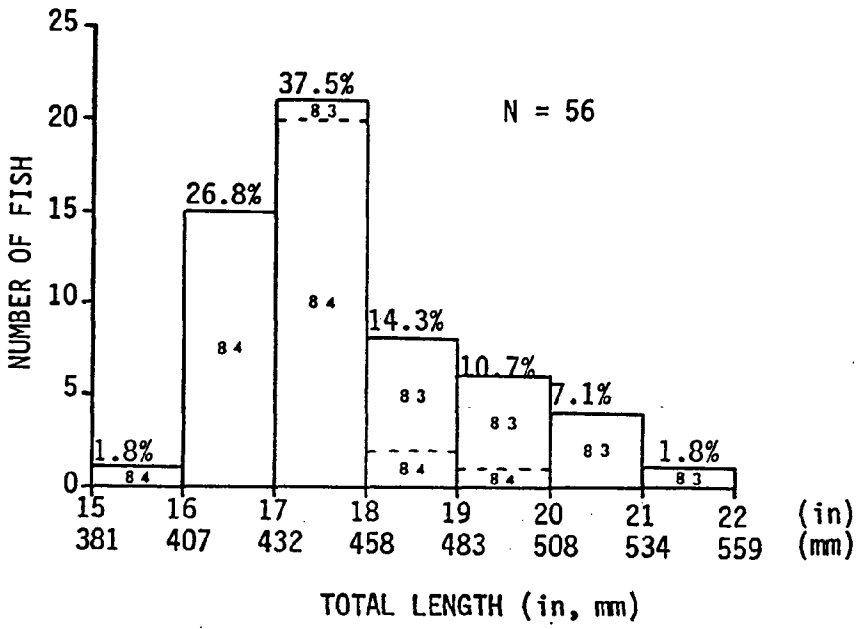

Figure 25. Length-frequency and year class (1983, 1984) distribution of striped bass captured in 80 yard 4.25 inch stretched mesh gill nets, by number and percent, during January-May 1986, Albemarle Sound area, N.C.

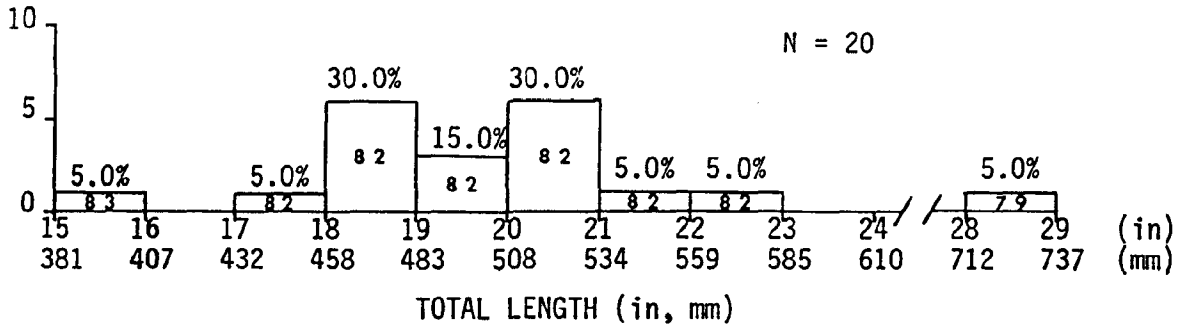

Figure 26. Length-frequency and year class (1979, 1982, 1983) distribution of striped bass captured in 80 yard 4.5 inch stretched mesh gill nets, by number and percent, during January-May 1985, Albemarle Sound area, N.C.

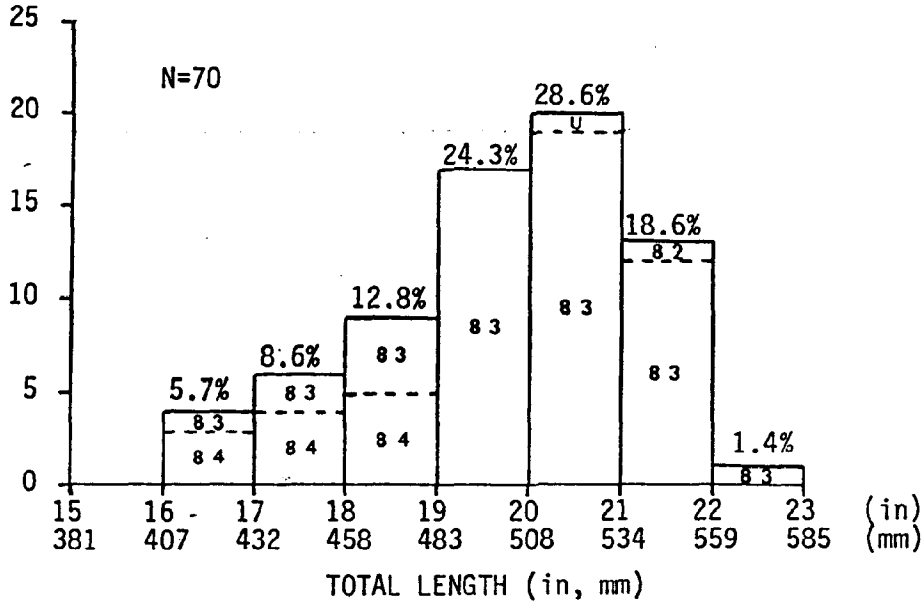

Figure 27. Length-frequency and year class (1982, 1983, 1984) distribution of striped bass captured in 80 yard 4.5 inch stretched mesh gill nets, by number and percent, during February-May 1986, Albemarle Sound area, N.C.

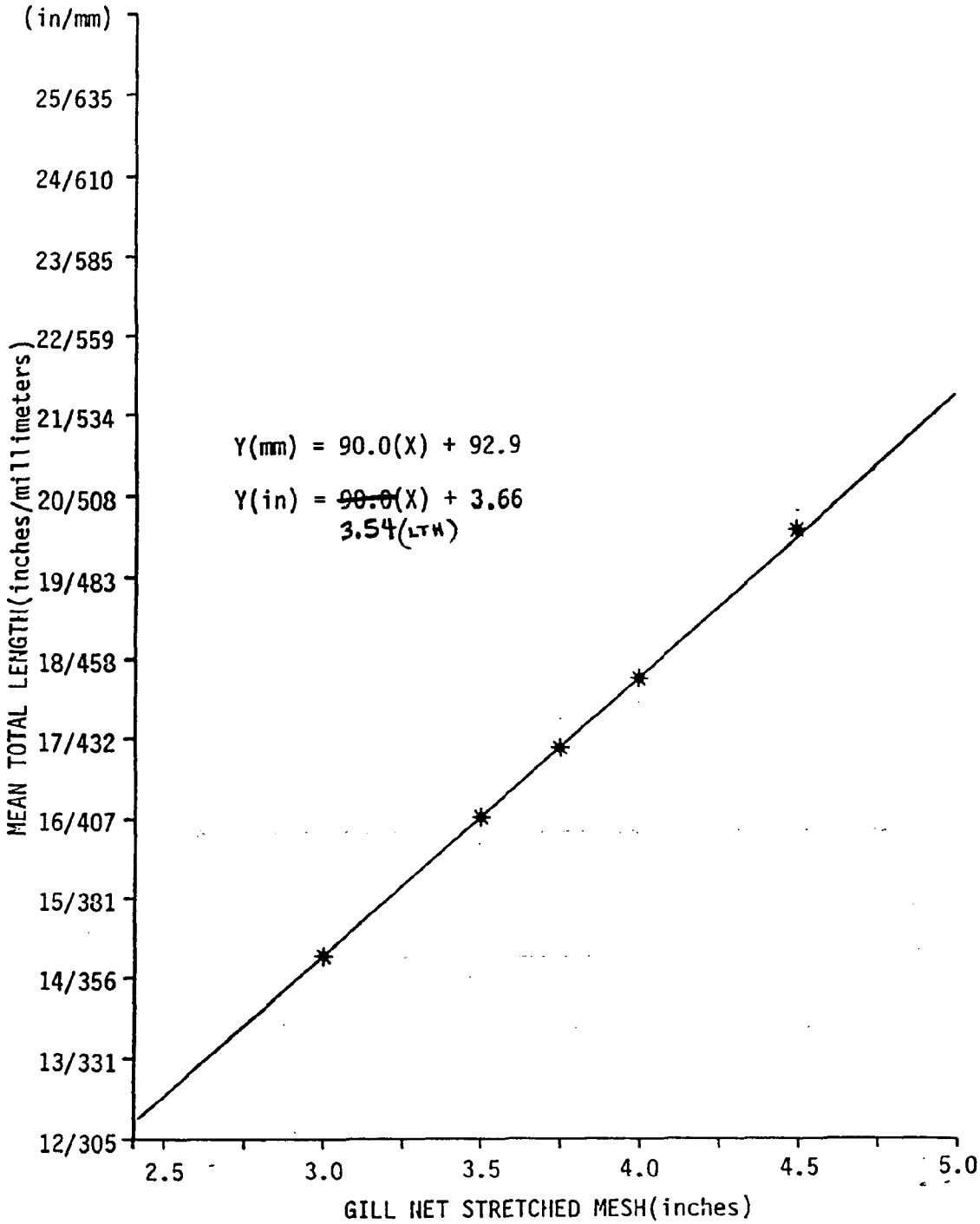

Figure 28. Regression equation for the relationship between gill net stretched mesh size (X) and mean total length (Y) of capture for striped bass taken during January-May 1985 and 1986 Albemarle Sound area, N.C.

Table 3. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by an 80 yard/2.5 inch stretched mesh "mullet" gill net set for 3 net days and a 40 yard/2.5 inch gill net fished for 8 net days during September 1984, Pasquotank River, N.C. (Striped bass and flounder measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish		Percent of catch	Length range (mm)	Mean length (mm)
Striped bass	(44)*	48	21.2	254-340	300
White perch	(48)	81	35.7	185-278	210
Striped mullet	(88)	89	39.2	218-300	253
Catfish	(3)	3	1.3	230-390	285
Yellow perch	(0)	1	0.4	-	-
Spot	(1)	1	0.4	167	167
Flounder	(2)	2**	0.9	270-275	273
Gizzard shad	(1)	2	0.9	205	205
Total fish	(187)	227	100.0		

* ( ) denotes number of measurable fish
** 2 flounder less than 11 inches (legal limit).

Mullet nets of 2.5 inch stretched mesh were also fished during October - December, 1984. One mullet net was set in a traditional manner floating in the shallow shoal waters nearshore (FIN net). Another net was fished on the bottom in deep water outside the shoal area in a non-traditional manner for mullet nets (SO net). Nets were set in this manner to determine which species utilize the two different habitats and the effectiveness of traditional mullet nets on striped mullet, striped bass and other species. Traditional mullet (FIN) nets were very effective in capturing striped mullet, white perch (Morone americana), striped bass, and spot (Leiostomus xanthurus) (Table 4). Sink (SO) nets were most effective in capturing white perch, spot, and gizzard shad (Dorosoma cepedianum).

Mullet nets of 2.5 and 3.0 inch were fished during October 1985. These nets were set to determine if a difference existed between a floating net set for mullet in shoal waters (FIN) and a floating net set in the deeper outside waters (FO). Floating outside (FO) nets are not effective in capturing mullet, but are efficient in the capture of striped bass Tables 5 and 6. Figures 3, 4 and 5 contain the respective length-frequencies and year classes for striped bass caught in mullet nets during the falls of 1984 and 1985. Most of the striped bass were less than 14 inches total length and were age I+ (18 to 20 months old).

Tables 7 and 8 contain data collected from "mullet nets", 2.5 and 3.0 inch, fished during June - September 1985 and June 1986. These data continue to support the effectiveness of "FIN" nets on striped mullet and the potential impacts on undersize striped bass, therefore regulations which require full-time attendance at these nets does contribute to striped bass conservation efforts. Striped bass year class and length-frequency data for the summer season are contained in Figures 6, 7 and 8. The majority of striped bass captured during the summer were age I+ (14 - 17 months old) and less than 14 inches (TL).

Summer Flounder Fishery

Nets of 5.0 and 5.5 inch stretched mesh, which are primarily set floating inside (FIN) for flounder (Paralichthys sp.), were evaluated to determine impacts on large striped bass during the summer season. Six striped bass were taken in 5.0 inch nets (Table 9) and no striped bass were taken in the 5.5 inch nets (Table 10). These nets did well on flounder, channel catfish (Ictalurus punctatus), and white catfish (Ictalurus catus).

Table 4. Number of fish, percent of total catch, length range, and mean length for commercially important species, caught by 40 yard/2.5 inch stretched mesh "mullet" gill nets (floating inside = FIN, sink outside = SO) fished for 38 net days during October-December 1984, Albemarle Sound, N. C. (Striped bass, flounder and croaker measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month						Total fish	Percent of catch	Total fish	Percent of catch	Length range	Mean length
	October		November		December							
	FIN	SO	FIN	SO	FIN	SO	FIN	FIN	SO	SO	(mm)	(mm)
Striped bass	25	8	27	7	1	0	53	11.2	15	6.7	257-374	(63)* 315
White perch	21	12	49	88	0	0	70	14.8	100	44.4	165-290	(168) 199
Striped mullet	171	2	24	8	48	8	243	51.3	18	8.0	227-332	(219) 259
Catfish	6	15	3	2	3	3	12	2.5	20	9.0	215-393	(32) 305
Spot	41	23	8	5	0	0	49	10.3	28	12.4	160-212	(77) 190
Yellow perch	1	9	0	7	1	0	2	0.4	16	7.1	195-265	(17) 229
Flounder	4	0	2	0	0	0	6**	1.3	0	0	170-235	(6) 186
Atlantic sturgeon	2	0	0	0	0	0	2	0.4	0	0	390-410	(2) 400
Atlantic croaker	1	0	0	0	0	0	1	0.2	0	0	225	(1) 225
Weakfish	0	0	2	0	0	0	2	0.4	0	0	256-265	(2) 261
Gizzard shad	30	5	3	3	1	2	34	7.2	28	12.4	185-243	- -
Total fish	302	74	118	120	54	31	474	100.0	225	100.0		

* ( ) denotes number of measurable fish
** 6 flounder less than 11 inches (legal limit).

Table 5. Number of fish, percent of total catch, length range and mean length for commercially important species caught by 40 yard/2.5 inch stretched mesh "mullet" gill nets (floating inside = FIN, floating outside = FO) fished for 8 net days during October 1985, Albermarle Sound, N.C. (Striped bass measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish October FIN	FO	Percent of catch FIN	Percent of catch FO	Length range (mm)	Mean length (mm)
Striped bass	10	14	14.7	51.9	265-408	353
White perch	8	6	11.8	22.2	198-234	209
Striped mullet	30	2	44.1	7.4	272-315	292
Bluefish	1	0	1.5	0	311	311
Hickory shad	0	1	0	3.7	249	249
Atlantic needlefish	1	0	1.5	0	607	607
Gizzard shad	3	0	4.4	0	184-194	-
Blue crab	15	4	22.0	14.8	-	-
Total Fish	68	27	100.0	100.0		

Table 6. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 40 yard/3.0 inch stretched mesh "mullet" gill nets (floating inside = FIN, floating outside = FO) fished for 8 net days during October 1985, Albemarle Sound, N.C. (Striped bass and flounder measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish October FIN	Number of fish October FO	Percent of catch FIN	Percent of catch FO	Length range (mm)	Mean length (mm)
Striped bass	28	59	24.0	61.4	312-486	357
White perch	13	9	11.1	9.4	218-331	243
Striped mullet	49	9	41.8	9.4	286-352	315
Catfish	2	0	1.7	0	356-433	395
Bluefish	2	4	1.7	4.2	252-400	344
Flounder	1	0	0.9	0	361	361
Gizzard shad	9	13	7.7	13.5	212-262	-
Blue crab	13	2	11.1	2.1	-	-
Total Fish	117	96	100.0	100.0		

Table 7. Number of fish, percent of total catch, length range, and mean length for important species caught by 40 yard/2.5 inch stretched mesh "mullet" gill nets (floating inside = FIN, floating outside = FO) fished for 80 net days during June - September, 1985 and June, 1986, Albemarle Sound, N.C. (Striped bass, croaker, flounder, weakfish and silver perch measurements in total length (TL), all other species in fork length (FL).)

	1985															
	June		July		August		September		June 1986		Total fish	Percent of catch	Total fish	Percent of catch	Length range	Mean length
Species	FIN	FO	FIN	FO	FIN	FO	FIN	FO	FIN	FO	FIN	FIN	FO	FO	(mm)	(mm)
Striped bass	2	9	5	5	2	1	8	6	26	4	43	3.0	25	3.4	230-447	290
White perch	38	120	41	5	31	0	79	174	116	32	305	20.9	331	45.4	165-245	*(594) 196
Striped mullet	39	2	65	1	49	1	138	0	87	0	378	25.9	4	0.5	222-350	265
Catfish	11	5	5	1	6	2	5	21	14	0	41	2.8	29	4.0	182-577	274
Yellow perch	2	0	1	0	0	0	1	0	2	0	6	0.4	0	0.0	128-227	204
Pumpkinseed	1	0	0	0	0	0	0	0	0	0	1	0.1	0	0.0	136	136
Bluefish	0	10	12	6	19	13	25	9	0	4	56	3.8	42	5.8	154-375	259
Spot	19	1	48	38	38	1	52	9	82	97	239	16.4	146	20.0	120-240	188
Atlantic croaker	2	1	4	21	7	0	15	3	12	0	40	2.7	25	3.4	155-320	239
Flounder	1	0	3	0	0	0	2	0	0	0	6**	0.4	0	0.0	183-364	289
Weakfish	0	0	0	0	0	0	6	10	0	1	6	0.4	11	1.5	194-310	282
Spanish mackerel	0	0	1	0	0	18	0	0	0	0	1	0.1	18	2.5	170-278	250
Crevalle jack	0	0	0	0	10	9	23	1	0	0	33	2.3	10	1.4	105-162	-
Silver perch	0	0	0	0	0	0	2	0	0	0	2	0.2	0	0.0	210-210	210
Atlantic sturgeon	0	0	0	0	0	0	2	0	0	0	2	0.2	0	0.0	385-630	508
Hickory shad	0	19	0	0	0	0	0	0	0	0	0	0.0	19	2.6	218-240	230
Pinfish	0	0	0	0	0	0	0	0	1	0	1	0.0	0	0	160	160
Gizzard shad	8	2	42	0	61	3	21	3	13	0	145	9.9	8	1.1	177-305	-
Blue crab	31	21	18	8	44	12	61	20	0	0	154	10.5	61	8.4	-	-
Total Fish	154	190	245	85	267	60	440	256	353	138	1459	100.0	729	100.0		

* ( ) denotes number of measurable fish, if less than total catch was measured.
** 3 flounder less than 11 inches (legal limit).

Table 8. Number of fish, percent of total catch, length range, and mean length for important species caught by 40 yard/3.0 inch stretched mesh "mullet" gill nets (floating inside = FIN, floating outside = FO) fished for 80 net days during June - September 1985 and June 1986, Albemarle Sound, N.C. (Striped bass, croaker, flounder, weakfish, spotted sea trout and bowfin measurements in total length (TL), all other species in fork length (FL).)

	1985								1986							
	June		July		August		September		June		Total fish	Percent of catch	Total fish	Percent of catch	Length range	Mean length
Species	FIN	FO	FIN	FO	FIN	FO	FIN	FO	FIN	FO	FIN	FIN	FO	FO	(mm)	(mm)
Striped bass	1	6	0	0	2	1	6	23	4	3	13	1.0	33	5.8	277-533	(43)* 392
White perch	10	47	11	6	3	0	10	105	41	13	75	6.0	171	30.0	171-270	(226)* 230
Striped mullet	99	8	87	0	36	0	81	0	197	4	500	39.9	12	2.1	252-377	298
Catfish	7	4	2	1	2	2	6	35	8	0	25	2.0	42	7.3	165-577	297
Yellow perch	1	1	1	0	0	0	0	0	2	0	4	0.3	1	0.2	254-284	265
Pumpkinseed	0	0	0	0	0	0	0	0	2	0	2	0.2	0	0.0	180-265	222
Bluefish	1	30	7	18	23	11	16	2	0	0	47	3.8	61	10.7	165-405	301
Spot	3	1	10	9	31	0	33	0	24	22	101	8.1	32	5.6	120-244	213
Atlantic croaker	7	1	28	32	6	4	7	3	6	4	54	4.3	44	7.7	151-415	273
Flounder	1	0	4	0	6	0	2	0	0	0	13**	1.0	0	0.0	201-390	278
Weakfish	0	0	0	0	0	0	1	5	0	0	1	0.1	5	0.9	160-394	222
Spanish mackerel	0	0	0	0	0	2	0	0	0	0	0	0.0	2	0.4	242-264	253
Crevalle jack	0	0	0	0	0	2	0	0	0	0	0	0.0	2	0.4	143-148	-
Spotted sea trout	0	0	0	0	1	0	0	0	0	0	1	0.1	0	0.0	390	390
Longnose Gar	0	0	0	0	0	1	0	0	0	0	0	0.0	1	0.2	780	780
Bowfin	0	0	0	0	1	0	0	0	0	0	1	0.1	0	0.0	462	462
Gizzard shad	14	15	67	40	104	21	83	17	25	7	293	23.4	100	17.5	212-363	-
Blue crab	28	24	15	7	38	17	41	16	0	0	122	9.7	64	11.2	-	-
Total Fish	172	137	232	113	253	61	286	206	206	53	1252	100.0	570	100.0		

* ( ) denotes number of measurable fish, if less than total catch was measured.

** 6 flounder less than 11 inches (legal limit)

Table 9. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 80 yard/5.0 inch stretched mesh "flounder" gill nets (floating inside = FIN, sink outside = SO), for 80 net days during June - September 1985 and June 1986, Albemarle Sound, N.C. (Striped bass, flounder and croaker measurements in total length (TL), all other species in fork length (FL).)

	1985								1986							
	June		July		August		September		June		Total fish	Percent of catch	Total fish	Percent of catch	Length range	Mean length
Species	FIN	SO	FIN	SO	FIN	SO	FIN	SO	FIN	SO	FIN	FIN	SO	SO	(mm)	(mm)
Striped bass	0	0	0	0	0	0	1	4	1	0	2	0.7	4	2.1	480-587	544
Flounder	1	0	14*	2	11	0	16	2	4	8	46	15.6	12	6.4	270-474	351
Catfish	11	15	8	9	3	2	24	8	11	5	57	19.3	39	20.7	228-618	448
Bluefish	0	1	0	1	2	2	15	0	0	0	17	5.7	4	2.1	200-400	263
Atlantic croaker	0	0	1	3	0	1	2	0	6	2	9	3.0	6	3.2	172-338	261
Spot	0	0	1	0	0	0	0	0	0	0	1	0.3	0	0	212	212
Spanish mackerel	0	0	0	2	0	5	0	0	0	0	0	0	7	3.7	176-281	231
Sheepshead	0	0	0	0	0	0	0	0	1	0	1	0.3	0	0	392	392
Gizzard shad	0	0	26	21	16	16	44	34	0	10	86	29.1	81	43.2	290-407	-
Blue crab	7	8	9	5	21	10	40	12	0	0	77	26.0	35	18.6	-	-
Total Fish	19	24	59	43	53	36	142	60	23	25	296	100.0	188	100.0		

* One flounder less than 11 inches (legal limit).

Table 10. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 80 yard/5.5 inch stretched mesh "flounder" gill nets (floating inside = FIN, sink outside = SO), for 64 net days during July - September 1985 and June 1986, Albemarle Sound, N.C. (Flounder and croaker measurements in total length (TL), all other species in fork length (FL).)

	1985						1986							
	July		August		September		June		Total fish	Percent of catch	Total fish	Percent of catch	Length range	Mean length
Species	FIN	SO	FIN	SO	FIN	SO	FIN	SO	FIN	FIN	SO	SO	(mm)	(mm)
Flounder	13	2	5	0	12	0	5	1	35	16.2	3	5.3	307-450	382
Catfish	7	4	2	0	13	3	28	3	50	23.1	10	17.5	212-625	483
Bluefish	0	0	4	2	15	1	0	0	19	8.8	3	5.3	200-405	278
Atlantic croaker	2	2	3	0	2	1	2	1	9	4.1	4	7.0	255-443	312
Spot	0	0	0	0	0	0	1	0	1	0.5	0	0	188	188
Spanish mackerel	0	2	0	3	0	0	0	0	0	0	5	8.8	170-255	222
White perch	0	0	0	0	0	1	1	0	1	0.5	1	1.7	195-202	199
Striped mullet	0	0	0	0	1	0	0	0	1	0.5	0	0	257	257
Sheepshead	0	0	0	0	1	0	0	0	1	0.5	0	0	393	393
Carp	0	0	0	0	0	0	4	0	4	1.8	0	0	470-725	611
Gizzard shad	8	5	1	5	13	3	3	1	25	11.6	14	24.6	201-420	-
Blue crab	14	4	18	7	38	6	0	0	70	32.4	17	29.8	-	-
Total Fish	44	19	33	17	95	15	44	6	216	100.0	57	100.0		

Fall Fishery

The minimum legal mesh size for Albemarle Sound during the fall fishing season (October-December) is 3.5 inch. This is the predominant mesh size utilized by area fishermen because it is selective for large to medium white perch and pan size (12-16 inch, age I+) striped bass. Striped bass dominated the catch during the fall of 1984 (Table 11) and was second to gizzard shad (Table 12) in 1985. Figures 9 and 10 contain length-frequency and year class distribution for striped bass taken in 3.5 inch nets during the fall. Due to the large number of striped bass taken in the 12 to 16 inch size range, a portion of the catch was separated by sex and subsampled for age (year class) determination. Subsampling procedures were based on the method of Ketchen (1950) and Harriss et al. (1985). Fish between 14 and 16 inches (TL) comprised 70.5% and 71.4%, respectively, of the fall 1984 and 1985, 3.5 inch net catch. The majority of the striped bass taken during the fall season by 3.5 inch gear are age I+ (18 to 20 months old).

Data presented in Table 12 support area fishermen's efforts, through regulation, to decrease the harvest of striped bass during the fall season and concentrate on white perch by restricting nets from 3.5 inch up to 4.25 inches to sink nets, only, to be used in water depths 10 feet or more. Floating nets (FIN and FO) captured 33% of the striped bass and 29% of the white perch taken during the fall 1985. Therefore, the elimination of the FIN and FO nets will provide some conservation of striped bass and will allow for the harvest of the more bottom oriented white perch by SO nets.

Length-frequency and year class distribution of striped bass captured in 3.75 inch nets fished during the fall 1985 are shown in Figure 11. Approximately sixty-five percent of these fish were between 14 and 17 inches (TL) and 67% were age I+. Comparing Tables 12, 13, 14, and 15 for 3.5, 3.75, 4.0, and 4.25 inch nets, respectively, the white perch catch drops significantly in the nets larger than 3.5 inches. Further, comparison of these tables for the fall 1985 season reinforces efforts directed at striped bass conservation by elimination of the FIN and FO nets. Striped bass length frequency and year class distribution for 4.0 and 4.25 inch nets fished during the fall 1984 and 1985 are presented in Figures 12, 13, 14, and 15. Few fish were captured in these nets during fall 1984 (Tables 16 and 17) and no comparisons could be made because inside and outside net replicates were not fished.

Table 11. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 80 yard/3.5 inch stretched mesh gill nets fished for 42 net days during October-December 1984, Albemarle Sound, N. C. (Striped bass, flounder and croaker measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month			Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	October	November	December				
Striped bass	6	87	23	(65)* 116	40.85	324-424	365
White perch	1	4	0	5	1.76	245-320	272
Striped mullet	42	4	18	64	22.54	226-375	324
Catfish	14	2	13	29	10.21	265-450	332
Flounder	2	0	0	2**	0.70	240-275	258
Yellow perch	1	0	0	1	0.35	275	275
Atlantic croaker	0	1	0	1	0.35	240	240
Gizzard shad	26	8	32	66	23.24	237-335	-
Total fish	92	106	86	284	100.0		

* ( ) denotes number of measurable fish, if less than total catch was measured.
** 2 flounder less than 11 inches (legal limits).

Table 12. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 80 yard/3.5 inch stretched mesh gill nets (floating inside = FIN, floating outside = FO and sink outside = SO) fished for 56 net days during October - December 1985, Albemarle Sound, N.C. (Striped bass, flounder, croaker and weakfish are measured in total length (TL), all other species in fork length (FL).)

	Number of fish per month						Total fish	Percent of catch	Total fish	Percent of catch	Length range	Mean length
	October		November		December							
Species	FIN	SO	FO	SO	FO	SO	FIN & FO	FIN & FO	SO	SO	(mm)	(mm)
Striped bass	106	270	26	3	4	0	136	20.5	273	34.3	326-583	381
White perch	8	50	13	10	13	25	34	5.1	85	10.7	214-306	253
Striped mullet	96	2	1	0	0	0	97	14.5	2	0.3	297-391	363
Catfish	3	26	23	6	13	13	39	5.8	45	5.7	202-526	368
Yellow perch	0	2	0	0	0	0	0	0	2	0.3	288-295	292
Bluefish	25	12	0	0	0	0	25	3.8	12	1.5	247-427	323
Spot	3	0	0	0	0	0	3	0.5	0	0	218-233	226
Atlantic croaker	1	14	0	0	0	0	1	0.2	14	1.7	187-343	286
Flounder	12	6	0	0	0	0	12*	1.8	6**	0.8	233-378	297
Weakfish	1	11	3	0	0	0	4	0.6	11	1.4	170-250	209
Gizzard shad	199	268	31	2	73	70	303	45.5	340	42.7	224-372	-
Blue crab	11	5	0	0	0	0	11	1.7	5	0.6	-	-
Total Fish	465	666	97	21	103	108	665	100.0	795	100.0		

* 4 flounder less than 11 inches (legal limit).

** 2 flounder less than 11 inches (legal limit).

Table 13. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 80 yard/3.75 inch stretched mesh gill nets (floating inside = FIN, floating outside = FO, and sink outside = SO) fished for 48 net days during October - December 1985, Albemarle Sound, N.C. (Striped bass, flounder, croaker, weakfish and spotted sea trout measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month						Total fish FIN & FO	Percent of catch FIN & FO	Total fish SO	Percent of catch SO	Length range (mm)	Mean length (mm)
	October		November		December							
	FIN	SO	FO	SO	FO	SO						
Striped bass	21	12	12	1	2	3	35	14.8	16	7.2	317-663	425
White perch	0	2	0	1	1	2	1	0.4	5	2.2	246-302	275
Striped mullet	18	0	1	0	0	0	19	8.1	0	0	343-403	369
Catfish	4	13	10	8	5	22	19	8.1	43	19.4	232-590	397
Bluefish	6	1	0	0	0	0	6	2.5	1	0.5	251-370	311
Atlantic croaker	1	2	0	0	0	0	1	0.4	2	0.9	275-339	311
Flounder	1	0	1	0	0	0	2*	0.9	0	0	268-332	300
Weakfish	1	4	0	0	0	0	1	0.4	4	1.8	188-221	200
Spotted sea trout	1	0	0	0	0	0	1	0.4	0	0	370	370
Ladyfish	1	0	0	0	0	0	1	0.4	0	0	271	271
Gizzard shad	105	151	13	0	32	0	150	63.6	151	68.0	261-350	-
Total Fish	159	185	37	10	40	27	236	100.0	222	100.0		

* 1 flounder less than 11 inches (legal limit).

Table 14. Number of fish, percent of total catch, length range, and mean length for commercially important species caught in 80 yard/4.0 inch stretched mesh gill nets (floating inside = FIN, floating outside = FO, and sink outside = SO) fished for 48 net days during October - December 1985, Albemarle Sound, N.C. (Striped bass, flounder, croaker, weakfish and silver perch measurements in total length (TL), all other species in fork length (FL).)

	Number of fish per month						Total fish	Percent of catch	Total fish	Percent of catch	Length range	Mean length
	October		November		December		FIN	FIN				
Species	FIN	SO	FO	SO	FO	SO	& FO	& FO	SO	SO	(mm)	(mm)
Striped bass	12	14	9	1	3	2	24	10.1	17	5.3	320-606	448
White perch	2	5	1	0	3	3	6	2.5	8	2.5	162-310	286
Striped mullet	8	0	0	0	0	0	8	3.4	0	0	366-406	380
Catfish	2	12	26	27	15	26	43	18.1	65	20.3	192-571	385
Bluefish	2	3	0	0	0	0	2	0.8	3	0.9	280-415	350
Atlantic croaker	1	1	0	0	0	0	1	0.4	1	0.3	322-330	326
Flounder	4	1	0	2*	0	1	4	1.7	4	1.3	276-394	320
Weakfish	0	8	0	0	0	0	0	0	8	2.5	190-240	211
Silver perch	0	1	0	0	0	0	0	0	1	0.3	207	207
Gizzard shad	73	110	23	10	54	93	150	63.0	213	66.6	245-373	-
Total Fish	104	155	59	40	75	125	238	100.0	320	100.0		

* 2 flounder less than 11 inches (legal limit).

Table 15. Number of fish, percent of total catch, length range, and mean length for commercially important species caught in 80 yard/4.25 inch stretched mesh gill nets (floating outside = FO and sink outside = SO) fished for 40 net days during November - December 1985, Albemarle Sound, N.C. (Striped bass and flounder measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month November FO	November SO	December FO	December SO	Total fish FIN & FO	Percent of catch FIN & FO	Total fish SO	Percent of catch SO	Length range (mm)	Mean length (mm)
Striped bass	13	1	4	2	17	16.3	3	4.3	400-526	482
Catfish	6	13	28	14	34	32.7	27	38.6	213-532	394
Flounder	0	4	1	1	1	1.0	5	7.1	284-395	332
Gizzard shad	14	8	38	27	52	50.0	35	50.0	212-364	-
Total Fish	33	26	71	44	104	100.0	70	100.0		

Table 16. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 80 yard/4.0 inch stretched mesh gill nets fished for 17 net days during November-December 1984, Albemarle Sound, N. C. (Striped bass, flounder and croaker measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month		Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	November	December				
Striped bass	3	5	8	16.33	380-459	417
Catfish	7	17	24	48.98	284-529	378
Flounder	3	0	3*	6.12	262-290	277
Gizzard shad	0	14	14	28.57	233-324	-
Total fish	13	36	49	100.0		

* 1 flounder less than 11 inches (legal limit).

Table 17. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 80 yard/4.25 inch stretched mesh gill nets fished for 14 net days during November-December 1984, Albemarle Sound, N. C. (Striped bass, flounder and croaker measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month		Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	November	December				
Striped bass	6	6	12	29.27	346-491	439
White perch	2	0	2	4.88	145-165	155
Catfish	3	9	12	29.27	300-480	375
Flounder	2	0	2*	4.88	258-385	322
Yellow perch	0	1	1	2.43	204	204
Gizzard shad	4	8	12	29.27	282-350	-
Total fish	17	24	41	100.00		

* 1 flounder less than 11 inches (legal limit).

The majority of the striped bass captured during the fall 1984 and 1985 in 4.0, 4.25 and 4.5 inch nets (Figures 12, 13, 14, 15, and 16) were greater than 17 inches (TL) and age II+ (approximately 30 to 32 months old). Table 18 contains information on fish collected from 4.5 inch nets November - December 1985.

Spring Fishery

The spring season (January - May) is a period characterized by extensive spawning migrations into the Albemarle Sound estuary by anadromous fishes; river herring (alewife, *Alosa pseudoharengus* and blueback herring, *Alosa aestivalis*), hickory shad (*Alosa mediocris*), and American shad, (*Alosa sapidissima*). White perch, striped bass, and catfish also migrate within the estuary to spawning areas. These migrations make all these species extremely susceptible to harvest by gill nets and other commercial gear.

Stretched mesh gill nets floating outside (FO) and sink outside (SO) of 3.0, 3.5, 3.75, 4.0 and 4.5 inch were fished during the spring season 1985 and 1986. Nets of 4.25 inch were fished only during spring 1986. The minimum mesh size allowed during the spring season is 3.0 inch webbing. River herring, which are abundant during the spring, are the target species for these nets. River herring accounted for over 73% of the fish taken in the 3.0 inch mesh (Tables 19 and 20). White perch were second in abundance. When comparing data for striped bass, white perch, and river herring for 1985 and 1986 mean lengths varied less than .4 inches. Figures 17 and 18 contain the striped bass length-frequency and year class distribution for 3.0 inch mesh during the two spring seasons. Striped bass less than 16 inches (TL) of age group II (21-25 months old) comprised the majority of the catch.

Catch and length data for 3.5 inch mesh nets fished during the spring seasons are contained in Tables 21 and 22. River herring, white perch, catfish, gizzard shad, striped mullet, and striped bass dominated the catch. Comparing 1985 and 1986 data, mean lengths for white perch and river herring varied less than .3 inch (FL). The 3.5 inch nets accounted for the majority of the striped bass (N=209) captured during the spring seasons. Length frequency and year class distributions for these fish are presented in Figure 19 and 20. Striped bass between 14 and 17 inches (TL), of age group II dominated the catch. Year class 1984 (age II) fish taken during 1986 appeared to be faster growers, and covered a broader size range than the 1983 year class (age II) fish taken in 1985.

Table 18. Number of fish, percent of total catch, length range, and mean length for important species caught in 80 yard/4.5 inch stretched mesh gill nets (floating outside = FO and sink outside = SO) fished for 40 net days during November - December 1985, Albemarle Sound, N.C. (Striped bass and flounder measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month				Total fish FIN & FO	Percent of catch FIN & FO	Total fish SO	Percent of catch SO	Length range (mm)	Mean length (mm)
	November		December							
	FO	SO	FO	SO						
Striped bass	7	6	3	4	10	9.4	10	9.8	458-595	511
White perch	0	0	1	1	1	0.9	1	1.0	312-326	319
Catfish	5	12	41	35	46	43.0	47	46.0	184-697	462
Flounder	3	5	0	1	3	2.8	6	5.9	304-402	349
Hickory shad	1	0	0	0	1	0.9	0	0	275	275
Largemouth bass	1	1	0	0	1	0.9	1	1.0	398-402	400
Black crappie	0	1	0	0	0	0	1	1.0	289	289
Gizzard shad	15	6	30	30	45	42.1	36	35.3	225-371	-
Total Fish	32	31	75	71	107	100.0	102	100.0		

Table 19. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 80 yard/3.0 inch stretched mesh "river herring" gill nets fished for 88 net days during January-May 1985, Albemarle Sound, N. C. (Striped bass, flounder and croaker measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month					Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	January	February	March	April	May				
Striped bass	19	0	11	20	16	66	1.11	311-487	370
White perch	3	4	36	397	120	560	9.43	172-277	222
Striped mullet	0	38	0	2	90	130	2.19	212-358	295
Catfish	1	6	28	7	143	185	3.11	169-451	318
Yellow perch	0	3	0	0	2	5	0.08	245-276	256
River herring*	5	1,394	702	2,404	3	4,508	75.90	226-299	254
Hickory shad	0	0	3	13	0	16	0.27	287-347	328
Atlantic croaker	0	0	0	1	6	7	0.12	286-321	295
Flounder	0	0	1	1	0	2**	0.03	241-291	266
Spot	0	0	0	0	2	2	0.03	204-232	218
Gizzard shad	3	72	25	20	339	459	7.73	190-331	-
Total fish	31	1,517	806	2,865	721	5,940	100.00		

* River herring subsample of lengths.
** 1 flounder less than 11 inches (legal limit).

Table 20. Number of fish, percent of total catch, length range, and mean length for commercially important species caught in 80 yard/3.0 inch stretched mesh "river herring" gill nets fished for 90 net days during January - May 1986, Albemarle Sound, N.C. (Striped bass and flounder measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month					Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	January	February	March	April	May				
Striped bass	7	0	1	4	10	22	0.4	322-456	361
White perch	73	11	206	511	116	917	16.4	128-307	224
Striped mullet	86	0	0	17	93	196	3.5	225-378	310
Catfish	0	5	40	29	28	102	1.8	198-668	296
Yellow perch	2	4	1	2	0	9	0.2	251-310	274
River herring*	135	690	1483	1766	2	4076	73.1	229-299	258
Hickory shad	0	1	2	0	0	3	0.1	272-294	286
American shad	1	0	0	0	0	1	0.0	345	345
Flounder	2	7**	0	0	0	9	0.2	143-441	230
Gizzard shad	0	160	27	24	28	239	4.3	202-314	-
Total Fish	306	878	1760	2353	277	5574	100.0		

* River herring subsample of lengths.

** 7 flounder less than 11 inches (legal limit).

Table 21. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 80 yard/3.5 inch stretched mesh gill nets fished for 100 net days during January-May 1985, Albemarle Sound, N. C. (Striped bass, flounder and croaker measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month					Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	January	February	March	April	May				
Striped bass	44	1	25	41	21	132	7.87	324-565	385
White perch	0	6	21	188	17	232	13.84	212-293	243
Striped mullet	108	8	1	1	28	146	8.71	286-361	320
Catfish	9	2	35	16	208	270	16.11	180-582	350
Yellow perch	0	0	0	0	4	4	0.24	287-302	293
River herring*	1	85	159	213	0	458	27.33	229-305	274
Hickory shad	0	1	14	49	0	64	3.82	232-380	333
Atlantic croaker	0	0	0	0	4	4	0.24	263-328	301
Flounder	0	0	0	1	0	1**	0.06	247	247
Gizzard shad	2	48	29	33	253	365	21.78	224-340	-
Total fish	164	151	284	542	535	1,676	100.00		

* River herring subsample of lengths.
** One flounder less than 11 inches (legal limit).

Table 22. Number of fish, percent of total catch, length range, and mean length for commerically important species caught in 80 yard/3.5 inch stretched mesh gill nets fished for 100 net days during January - May 1986, Albemarle Sound, N.C. (Striped bass, flounder, and croaker measurements in total length (TL), all other species in fork length FL).

Species	Number of fish per month					Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	January	February	March	April	May				
Striped bass	15	2	27	10	23	77	5.9	311-555	423
White perch	26	3	40	158	20	247	18.8	149-344	249
Striped mullet	16	0	0	9	25	50	3.8	242-400	335
Catfish	1	14	34	86	57	192	14.6	176-549	323
Yellow perch	2	0	1	0	4	7	0.5	181-306	276
River herring	14	17	47	10	0	88	6.7	219-301	272
Hickory shad	1	2	24	1	1	29	2.2	254-361	321
American shad	0	1	2	2	0	5	0.4	360-544	412
Atlantic croaker	0	0	0	0	14	14	1.1	294-387	325
Flounder	1	2	0	0	1	4	0.3	293-390	329
American eel	0	0	0	0	1	1	0.1	885	885
Gizzard shad	8	203	180	73	136	600	45.6	239-360	-
Total Fish	84	244	355	349	282	1314	100.0		

Tables 23 and 24 contain data on fish collected by 3.75 inch nets during this season. Catfish and gizzard shad were the most abundant species captured in this size gear. White perch constituted a sizeable portion of the catch during 1986. Striped bass of age II, between 15 and 18 inches (TL) comprised the major portion of the catch (Figures 21 and 22).

Information compiled on fish taken in the 4.0 inch nets are presented in Tables 25 and 26. Catfish and gizzard shad dominated the catch. The 4.0 inch nets were second only to the 3.5 inch net in numbers of striped bass taken during the spring season (N=125). The majority of these age II fish were between 15 and 18 inches (Figures 23 and 24). Four in webbing was the smallest mesh to effectively capture striped bass of two different age groups or year classes (71% = age II and 26% = age III).

Nets of 4.25 inch were fished only during the spring of 1986. The majority of the fish taken by these nets were catfish and gizzard shad (Table 27). American shad and striped bass also made up an economically important portion of the catch. Figure 25 illustrates that the majority of the striped bass captured by the 4.25 inch webbing were 16 to 18 inches (TL) and age II. This mesh size was similar to the 4.0 mesh in capturing more than one age group.

Tables 28 and 29 contain harvest data for species from the 4.5 inch nets. Catfish and gizzard shad continued to be the most prevalent species taken by the larger mesh nets. Catches of American shad, as would be expected, increased as mesh size went up. A significant number of striped bass between 18 and 22 inches were taken (Figures 26 and 27) in this mesh size. These fish were from the 1982 and 1983 year classes (age III) captured in 1985 and 1986, respectively. The 4.5 inch was the only mesh which selected fish predominantly of age group III (approximately 33-37 months old).

Data collected during the spring seasons (1985 and 1986) are the most consistent, due to the numbers of fish collected and effort expended; when comparing mesh size selection by species, catch-per-unit of effort (CPUE) and relative percent of catch by mesh size. The spring season data for striped bass collected in 3.0, 3.5, 3.75, 4.0 and 4.5 inch nets were used to estimate the relationship between mesh size and mean total length. Figure 28 shows the regression equation and the closeness of fit of the regression line to the points representing mean total length and mesh size. This regression equation may be used to determine the length for which a mesh size is most efficient. Mean length per mesh in this study was 0.7 to 0.9 inch greater than

Table 23. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 80 yard/3.75 inch stretched mesh gill nets fished for 80 net days during February-May 1985, Albemarle Sound, N. C. (Striped bass, flounder, and croaker measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month				Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	February	March	April	May				
Striped bass	0	3	10	4	17	5.12	331-564	444
White perch	0	2	5	2	9	2.71	221-228	259
Catfish	1	35	8	104	148	44.59	167-490	363
Yellow perch	1	0	0	0	1	0.30	283	283
River herring	1	2	6	0	9	2.71	240-286	258
Hickory shad	1	13	6	0	20	6.02	332-393	361
American shad	0	3	0	0	3	0.90	352-368	358
Atlantic croaker	0	0	0	1	1	0.30	306	306
Flounder	0	0	2	0	2	0.60	251-284*	268
Gizzard shad	6	11	16	89	122	36.75	205-372	-
Total fish	10	69	53	200	332	100.00		

* one flounder less than 11 inches (legal limit).

Table 24. Number of fish, percent of total catch, length range, and mean length for commercially important species caught in 80 yard/3.75 inch stretched mesh gill nets fished for 100 net days during January - May 1986, Albemarle Sound, N.C. (Striped bass, flounder, and croaker measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month					Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	January	February	March	April	May				
Striped bass	4	0	38	7	30	79	6.7	359-599	436
White perch	6	2	28	101	18	155	13.2	217-333	253
Striped mullet	3	0	0	0	6	9	0.8	332-392	356
Catfish	1	14	41	109	56	221	18.8	184-522	325
Yellow perch	0	3	0	0	1	4	0.3	284-308	300
River herring	0	2	11	4	0	17	1.5	251-308	279
Hickory shad	0	1	26	0	0	27	2.3	317-378	344
American shad	0	2	2	1	6	11	0.9	279-428	363
Atlantic croaker	0	0	0	0	13	13	1.1	286-377	326
Flounder	1	3	0	0	0	4*	0.3	210-332	273
Spot	0	0	0	0	1	1	0.1	150	150
Atlantic sturgeon	0	0	0	0	1	1	0.1	295	295
Gizzard shad	3	113	313	59	145	633	53.9	250-372	-
Total Fish	18	140	459	281	277	1175	100.0		

* 2 flounder less than 11 inches (legal limit).

Table 25. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 80 yard/4.0 inch stretched mesh gill nets fished for 90 net days during January-May 1985, Albemarle Sound, N. C. (Striped bass, flounder, and croaker measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month					Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	January	February	March	April	May				
Striped bass	16	2	2	6	3	29	5.20	377-519	423
White perch	0	2	2	14	5	23	4.13	188-310	264
Striped mullet	2	3	0	0	1	6	10.7	350-404	373
Catfish	21	9	64	21	177	292	52.33	197-520	363
Yellow perch	0	5	0	0	0	5	0.90	284-290	287
River herring	0	1	1	4	0	6	1.07	234-295	253
Hickory shad	0	1	6	1	0	8	1.43	331-370	351
American shad	0	0	5	0	1	6	1.07	380-514	423
Atlantic croaker	0	0	0	0	2	2	0.36	342-396	369
Gizzard shad	2	26	28	25	100	181	32.44	222-370	-
Total fish	41	49	108	71	289	558	100.00		

Table 26. Number of fish, percent of total catch, length range, and mean length for important species caught in 80 yard/4.0 inch stretched mesh gill nets fished for 100 net days during January - May 1986, Albemarle Sound, N.C. (Striped bass, flounder, and croaker measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month					Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	January	February	March	April	May				
Striped bass	9	0	41	12	34	96	10.0	363-640	451
White perch	9	0	9	17	3	38	4.0	205-323	267
Striped mullet	4	0	0	2	2	8	0.8	351-417	376
Catfish	2	15	58	198	64	337	34.8	152-586	341
Yellow perch	1	0	0	0	0	1	0.1	292	292
River herring	0	1	2	3	0	6	0.6	244-278	260
Hickory shad	0	0	15	0	0	15	1.5	330-410	358
American shad	0	1	5	2	2	10	1.0	346-528	401
Atlantic croaker	0	0	0	0	3	3	0.3	317-371	350
Flounder	6	1	0	0	0	7*	0.7	262-359	325
Largemouth bass	0	0	1	0	0	1	0.1	382	382
Gizzard shad	7	74	192	76	97	446	46.1	267-378	-
Total Fish	38	92	323	310	205	968	100.0		

* One flounder less than 11 inches (legal limit).

Table 27. Number of fish, percent of total catch, length range, and mean length for important species caught in 80 yard/4.25 inch stretched mesh gill nets fished for 100 net days during January - May 1986, Albemarle Sound, N.C. (Striped bass, flounder, and croaker measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month					Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	January	February	March	April	May				
Striped bass	9	0	24	11	12	56	8.7	393-541	455
White perch	3	0	4	1	1	9	1.4	172-294	263
Striped mullet	1	0	0	0	0	1	0.2	388	388
Catfish	0	11	46	71	49	177	27.6	182-655	362
Yellow perch	0	0	1	0	0	1	0.2	186	186
River herring	0	0	0	4	1	5	0.8	235-266	251
Hickory shad	0	1	12	0	0	13	2.0	349-386	373
American shad	4	2	11	5	11	33	5.1	326-528	414
Atlantic croaker	0	0	0	0	1	1	0.2	357	357
Flounder	7	2	0	2	1	12*	1.8	233-386	304
Largemouth bass	0	0	1	0	0	1	0.2	393	393
Gizzard shad	7	62	186	31	47	333	51.8	222-400	-
Total Fish	31	78	285	125	123	642	100.0		

* 2 flounder less than 11 inches (legal limit).

Table 28. Number of fish, percent of total catch, length range, and mean length for commercially important species caught by 80 yard/4.5 inch stretched mesh gill nets fished for 100 net days during January-May 1985, Albemarle Sound, N. C. (Striped bass, flounder, and croaker measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month					Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	January	February	March	April	May				
Striped bass	8	1	2	4	5	20	5.80	396-733	506
White perch	0	1	0	0	1	2	0.58	185-300	243
Catfish	29	9	32	14	90	174	50.43	200-645	400
Hickory shad	0	0	1	0	0	1	0.29	411	411
American shad	0	0	18	9	4	31	8.99	375-510	420
Atlantic croaker	0	0	0	0	1	1	0.29	378	378
Gizzard shad	1	36	26	13	40	116	33.62	233-405	-
Total fish	38	47	79	40	141	345	100.00		

Table 29. Number of fish, percent of total catch, length range, and mean length for important species caught in 80 yard/4.5 inch stretched mesh gill nets fished for 80 net days during February - May 1986, Albemarle Sound, N.C. (Striped bass and flounder measurements in total length (TL), all other species in fork length (FL).)

Species	Number of fish per month				Total fish	Percent of catch	Length range (mm)	Mean length (mm)
	February	March	April	May				
Striped bass	1	21	12	36	70	13.9	420-563	502
White perch	0	1	0	3	4	0.8	143-213	185
Catfish	13	43	73	68	197	39.0	178-565	376
River herring	0	0	2	0	2	0.4	226-236	231
Hickory shad	0	3	0	0	3	0.6	382-401	392
American shad	8	13	12	8	41	8.1	365-537	424
Flounder	2	0	3	2	7*	1.4	220-325	290
Crappie**	0	1	0	0	1	0.2	330	330
Gizzard shad	31	99	17	33	180	35.6	273-396	
Total Fish	55	181	119	150	505	100.0		

* 3 flounder less than 11 inches (legal limit).

calculations made by Trent and Hassler (1968) for male striped bass collected in the Roanoke River. The difference in lengths may be attributable to the hanging coefficients used and/or hydrological conditions and the effect it has on fishing and capture efficiency of gill nets (e.g. fast flowing Roanoke River compared to the slow moving tidally influenced Albemarle Sound.)

Catch-per-unit of effort (CPUE) data by net sizes with similar effort are presented in Table 30. The 3.0 inch net is indeed a "river herring net" with almost one-half the catch being comprised of these fish. White perch and striped mullet were also very important catch components in the 3.0 inch net. The importance of the 3.5 inch net to a multispecies fishery is evident when comparing the CPUE data with other mesh sizes.

SUMMARY AND RECOMMENDATIONS

Approximately thirty percent of the striped bass taken in 3.0 inch nets during the spring season (January - May) were less than 14 inches total length. Many of the undersize striped bass taken January - May could probably be released alive due to the cooler water temperatures. The 3.0 inch herring nets are an economically important part of the early river herring fishery. Therefore, no changes in gill net mesh size are recommended for the spring season.

Data collected during the summer season support the intent of the new summer gill net regulations. The intent of these regulations, which is to allow the harvest of striped mullet and flounder with little or no impact on striped bass, has been accomplished. Striped bass less than 14 inches (TL) are captured on the shoal areas of Albemarle Sound and its tributaries by the 2.5 inch and 3.0 inch "mullet nets" during this period. However, the attendance at all times provision of the "mullet net" regulation allows for the release of these young fish. Additionally, this provision should restrict the majority of this gear use to daylight periods. Young striped bass appear to utilize these shoal areas mainly at night and during the low light periods of dawn and dusk. Strict enforcement of the "mullet net regulation" will further enhance striped bass conservation. "Flounder nets" (5.0 and 5.5 inch) do not appear to be of concern with the present size ranges of striped bass prevalent in Albemarle Sound. Also, larger striped bass of age III and older appear to avoid if possible, the warmer shoal waters where "flounder nets" are

Table 30. Catch per unit of effort (CPUE) for frequently captured commercial species by specific gill net stretched mesh during January-May 1985 and 1986, Albemarle Sound, N.C. (unit of effort = one net day)

	Mesh size (inches)			
Species	3.0 CPUE	3.5 CPUE	4.0 CPUE	4.5 CPUE
Striped bass	0.49	1.05	0.66	0.50
White perch	8.29	2.40	0.32	0.03
Striped mullet	1.83	0.98	0.07	0.00
Catfish	1.61	2.31	3.31	2.06
River herring	48.22	2.73	0.06	0.01
Hickory shad	0.01	0.47	0.12	0.02
American shad	0.01	0.03	0.08	0.40
Gizzard shad	3.92	4.83	3.30	1.64

most productive. Preliminary data on preferred temperatures of striped bass in Chesapeake Bay further support this behavior (Coutant and Benson 1986).

Fall season (October - December) gill net regulations were revised in 1986 as a result of local efforts to extend the striped bass season earlier into the fall. Revisions were intended to direct effort away from schooling striped bass and towards other species, such as white perch and catfish, by fishing the deeper water areas of the sound. These regulations were recommended by the Albemarle Fishermens Association (AFA) and are supported by data collected during this project. The new regulation [15 NCAC 3B .0401(3)] reads as follows: "From October 1 through December 31, no gill net shall be used which has a mesh length less than three and one-half inches in Albemarle Sound and tributaries. Gill nets which have a mesh length three and one-half inches and greater and less than four and one-quarter inches must be sunk to the bottom, set in no less than eight feet of water in the tributaries, ten feet of water in the Sound, and be no more than 35 meshes deep." This regulation allows for conservation of age I+ striped bass throughout the fall season when they are concentrated in surface feeding schools, without severely restricting the harvest of the more bottom oriented white perch, yellow perch (Perca flavescens), croaker (Micropogonias undulatus), weakfish (Cynoscion regalis) and catfish.

The fourteen inch (TL) size limit for striped bass and 3.5 inch minimum mesh size compliment each other well. Approximately 70% of the striped bass taken in 3.5 inch nets during the fall were between 14 and 16 inches (TL). This is also the largest mesh size which will allow the efficient and economical harvest of white perch. Comparing catches of 3.5 inch nets to the other nets fished during the project, it is evident that total gill net landings would be drastically reduced for many commercially important species if further restrictions were placed on the use of this net.

Conservative use of the newly enacted "October striped bass season" proclamation authority would be beneficial for both the fishermen and the fishery. Spoilage rate for striped bass taken in October 1985, with water temperatures near 21.0°C (70°F), was approximately sixteen percent. Reviewing Division of Marine Fisheries data since the mid-seventies it appears that striped bass growth has increased with fish achieving 12 and 14 inches TL at an earlier age (Street and Johnson 1977 and 1981). Therefore, another month of growth will allow more fish to reach the 14 inch TL minimum size and gain additional weight (Street and Johnson 1981).

Area fishermen are concerned by the discard of striped bass which is occurring by allowing the fall gill net season to begin prior to the opening of striped bass season. Approximately 93% of the striped bass taken in 3.5 inch project nets during October 1985 were dead when taken from the nets, therefore, would have been a wasted by-catch of the fishery. Area citizens do not view this as conservation, when one species is destroyed to allow the harvest of others. Many fishermen are requesting that the opening of the fall striped bass season and the gill net season should coincide.

Changing the minimum size limit on striped bass would not conserve these stocks, without a change in the gill net mesh sizes which are allowed in the Albemarle Sound fishery. An increase in gill net mesh size would eliminate the gill net fishery for all species except striped bass, catfish, and American shad.

Data collected during this project support recently adopted regulations by the North Carolina Marine Fisheries Commission which provide for a continued multi-species gill net fishery with striped bass conservation in the Albemarle Sound.

Additionally, a change to a larger mesh size would direct more effort at the larger size classes of striped bass (mature fish) and American shad, stocks of which are also extremely low from a historical perspective (Winslow et al. 1983, and ASMFC 1985). Gill net mesh sizes of 4.5 inches and greater would be utilized in the harvest of sexually mature striped bass. Male striped bass are sexually mature by age III (>18 inches TL), while almost all females mature by age V (>24 inches TL) (Trent and Hassler 1968 and Harriss et al. 1985). Additional information on the late spring gill net fishery for striped bass and American shad is needed to evaluate future protective measures for mature (spawning stock) striped bass.

ACKNOWLEDGMENTS

The completion of this project involved the assistance and advice of many individuals. Special thanks are expressed to: Maggie Harrell and Beth White, gill net construction; Rodney L. Cross, a local commercial fisherman contracted to fish project nets and assist in data collection; Richard Morcum, Gary B. Davis, and Lawrence Hanford, data collection and analysis; Robert C. Harriss, Jr., striped bass aging technique; Harrel Johnson, Sara Winslow, James Kornegay, and Michael W. Street, technical assistance and guidance. Harrel Johnson, Sara Winslow, Michael W. Street, Maury Wolff, and Mike Byerly reviewed the manuscript and provided valuable comments. Diana D. Willis and Suzanne Russell typed the report. Sincere appreciation is expressed to the Albemarle area commercial net suppliers, commercial fishermen, and Marine Fisheries Enforcement Officers inspectors who contributed their time and knowledge.

LITERATURE CITED

Atlantic States Marine Fisheries Commission.
1985. Fishery management plan for the anadromous alosid stocks of the Eastern United States: American shad, hickory shad, alewife, and blueback herring: Phase II in interstate management planning for migratory alosids of the Atlantic Coast. Washington, D.C. XVIII + 347 pp.

Atlantic States Marine Fisheries Commission.
1987. Interstate fisheries management plan for the striped bass of the Atlantic Coast from Maine to North Carolina. Revised source document and management plan framework. Washington, D.C.

Coutant, C. and D.L. Benson.
1986. Linking estuarine water quality and impacts on living resources: shrinking striped bass habitat in Chesapeake Bay. Oak Ridge National Laboratory. Oak Ridge, Tennessee. 17 pp.

Harriss, R.C., Jr., B.L. Burns, H.B. Johnson, and R.A. Rulifson.
1985. An investigation of size, age and sex of North Carolina striped bass. N.C. Dept. Nat. Res. and Comm. Develop., Div. Mar. Fish. Morehead City, N.C. 136 p.

Ketchen, J.S.
1950. Stratified subsampling for determining age distribution. Trans. Am. Fish. Soc. 79:205-212.

N.C. Dept. Nat. Resources Comm. Devel.
1987. North Carolina fisheries regulations for coastal waters, 1987. N.C. Dept. Nat. Resources Comm. Devel., 175 p.

Smith, H.M.
1907. The fishes of North Carolina. N.C. Geological and Economic Survey, Raleigh, N.C. 453 p.

Street, M.W.
1986. Trends in North Carolina commercial fisheries, 1965-1985. N.C. Dept. Nat. Res. and Comm. Develop., Div. Mar. Fish., Morehead City, N.C. 14 p.

Street, M.W. and H.B. Johnson.
1977. Striped bass in North Carolina-1977. N.C. Dept. Nat. Res. and Comm. Develop., Div. Mar. Fish., Morehead City, N.C. 12 p.

Street, M.W. and H.B. Johnson.
1981. Management options for the Albemarle Sound striped bass fishery. N.C. Dept. Nat. Res. and Comm. Develop., Div. Mar. Fish., Morehead City, N.C. 9 p.

Street, M.W., P.P. Pate, Jr., B.F. Holland, Jr., and A.B. Powell.
1975. Anadromous fisheries research program northern coastal region. Compl. Rep., Proj. AFCS-8, N.C. Dept. Nat. & Econ. Res., Div. Mar. Fish. 173+62+Append.

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, W.L. and W.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.

Winslow, S.E., N.S. Sanderlin, G.W. Judy, J.H. Hawkins, B.F. Holland, Jr., C.A. Fischer, and R.A. Rulifson.
1983. North Carolina anadromous fisheries management program. Compl. Rep., Proj. AFCS-16, N.C. Dept. Nat. Res. and Comm. Develop., Div. Mar. Fish., Morehead City, N.C., 402 p.