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SIZE AND SEX RATIO OF KING MACKEREL, <u>SCOMBEROMORUS</u> CAVALLA, IN THE SOUTHEASTERN UNITED STATES

Lee Trent Roy O. Williams Ronald G. Taylor Carl H. Saloman Charles S. Manooch, III April 1981

U.S. DEPARTMENT OF COMMERCE National Oceanic and Atmospheric Administration National Marine Fisheries Service Southeast Fisheries Center Panama City Laboratory 3500 Delwood Beach Road Panama City, Florida 32407

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ABSTRACT

Data from over 54,000 king mackerel, <u>Scomberomorus cavalla</u>, were analyzed to evaluate temporal variations in size and sex composition in seven areas of the southeastern United States. Data were obtained from recreational hook-and-line fishermen of the coastal states from Texas to North Carolina, and from commercial hook-and-line and gill-net fishermen of south Florida.

Most of the length-frequency distributions derived from king mackerel catches were uni-modal. This distribution is typical of a species that spawns over a long period each year, has highly variable growth rates among individuals, or both.

Size composition in each area varied considerably between months and indicated temporally heterogeneous groups of king mackerel. Seasonal trends in size were at best weakly discernible. In Texas, where data were available from May to August, king mackerel tended to be larger in May and smaller in July; in Louisiana, where large fish were obtained throughout the year, the largest appeared to be more prevalent during the colder months; in northwest Florida, where data were available for the warmer months, fish at the beginning and end of the fishing season (May and September-November) appeared to be larger than those caught during mid-season; in south Florida, where data were available throughout the year, fish tended to be larger during spring and summer and smaller during winter; in North Carolina, where data were available from May to November, the fish appeared to be larger in the fall. There were strong tendencies for fish of similar sizes of each sex to occur together during specific time periods.

Females were dominant in the catches in all areas and years except south Florida in 1978. Annual or ranges of the annual estimates of percentage female by area were: Texas, 60.8 to 62.2%; Louisiana, 91.9 to 92.2%; northwest Florida, 57.1 to 75.1%; south Florida, 40.2 to 75.4%; and North Carolina, 75.8%. No explanation for these deviations from a 1:1 sex ratio was attempted. Distinct seasonal changes in sex ratio were observed only in Texas; females comprised the greatest proportion of the catch in the early months of each fishing season but, by August the sex ratio had approached 1:1.

INTRODUCTION

The king mackerel, <u>Scomberomorus cavalla</u>, is one of the most important species in the coastal pelagic fisheries of the southeastern United States. In spite of its high commercial and recreational value (Wise and Thompson 1977, Deuel and Clark 1968), many details pertaining to king mackerel catches and population structure are not available. We present in this paper information about the size composition and sex ratio of king mackerel in relation to area and time of year.

STUDY AREA AND METHODS

King mackerel were sampled from commercial or recreational landings in seven locations (Figure 1). King mackerel were caught by: recreational hook and line in each area; commercial snapper hook and line off Mississippi; commercial gill net off south Florida; and commercial king mackerel hook and line off south Florida and North Carolina.

Methods used by recreational fishermen to catch king mackerel vary among areas. Off Texas, the Atlantic cutlassfish, Trichiurus lepturus, is usually used as bait and ranges from 30 to 45 cm in length. It is attached to a forward and trailing hook and is trolled or drifted. Off Louisiana a wide assortment of baits and artificial lures are used when trolling but most large king mackerel are caught by drifting live sand seatrout, Cynoscion arenarius, or Atlantic croaker, Micropogonias undulatus, beside or beneath oil rigs located in water depths from 12 to 45 m. The baits are large and usually range from 0.2 to 0.7 kg. Off northwest Florida, round scad, Decapturus punctatus, are almost always used for bait and are attached to single, double, or treble hooks. These baits are from 15 to 25 cm long and are trolled at slow speed or drifted. Several methods are used to capture king mackerel off the coasts of Georgia, South Carolina, and North Carolina by recreational anglers (Manooch 1979). Anglers fish for king mackerel from charter boats, party or headboats, large and small private boats, piers, bridges, and occasionally from the surf. Three basic techniques are used to catch this species. Fishermen aboard boats often troll at or below the surface using spoons and feathered jigs with or without attached strips of mullet, Mugil cephalus. Trolling is usually done in a haphazard fashion until fish are hooked, and then the boats circle until the catch rate diminishes. Another technique is casting at schools of mackerel from a fixed platform or boat and retrieving the baits with a jerking motion. The third technique is float fishing usually done from a drifting or anchored boat; hooks are baited with live fish and are suspended 3.0 to 4.6 m below a float on the surface.

King mackerel from commercial snapper boats were caught incidentally to demersal fishes. Standard bottom rigs with three to six hooks baited with pieces of fish or squid were used. The king mackerel were caught in an area east of the mouth of the Mississippi River where water depths were between 50 and 130 m.

The king mackerel landed by commercial fishermen in south Florida are caught by runaround gill nets and by hook and line (Beaumariage 1973; Austin, Browder, Brugger, and Davis 1978; Manooch 1979). The nets are 120-220 m long, about 22 m (200 meshes) deep, and have a stretched-mesh of 12.1 cm. The nets are fished in water depths as deep as 21 m. Spotter aircraft are frequently used to assist fishermen in locating schools of fish and to direct the setting of nets. In the commercial hook-and-line fishery, lines with spoons or feathered jigs, sometimes with strips of mullet or squid, are trolled behind boats and are retrieved manually or with hydraulic or electric reels. Planers or weights are often used to fish the lures deep (Harris 1974).

Length and sex data on king mackerel were obtained by personnel of the Florida Department of Natural Resources and of the National Marine Fisheries Service. Data were summarized by numbers of fish in relation to sex, location, capture gear, and time (Tables 1 and 2).

Length measurements were taken from uncut, gutted, or filleted fish. Fork length was measured from the tip of the snout (mouth closed) to the fork of the tail to the nearest millimeter or 0.1 in. Measurements in inches were later converted to millimeters.

Length data were grouped into 100 mm intervals and categorized by location, year, month, gear, and sex if determined (Appendix Tables 1-7). All resultant length-frequency distributions representing 25 or more fish were compared between months for each area. Chi-square tests were used to compare homogeneity of frequency distributions and to compare sex ratios to a hypothesized 1:1 ratio (Simpson, Roe, and Lewontin 1960, p 194 and 326).

SEASONAL CHANGES IN SIZE AND SEX RATIO

We assumed that changes through time in the size and sex composition of the fished population or stock in a particular area would be reflected in local catches. On this basis we analyzed length-frequency distributions and sex ratios of catches for each area and for each gear within an area.

<u>Texas</u> - Length distributions of king mackerel caught by recreational fishermen from Texas were uni-modal during each month with greatest modal lengths during May or June (Figure 2). The length composition changed significantly between consecutive months each year except June-July 1977 (Table 3).

Mean lengths of king mackerel of each sex were smallest during July except for females during 1977 (Figure 3). In 1977 the females were similar in size in June-July but smaller than those caught in August.

Sex ratios deviated significantly in favor of females during one of the three months in 1977 and three of four months in 1978 (Table 4). Females comprised the greatest proportion of the catch in the early months of each season, but by August their proportions were similar to those of males (Figure 4).

Sex ratios for each year, when analyzed by size class of fish, showed males dominant in only the smallest size class (500-699 mm FL) during one year (1978) (Table 5). Females comprised over 75% of the catch in size classes above 899 mm FL.

Louisiana - Length distributions of king mackerel show that large (over 1,299 mm FL) fish were caught by recreational fishermen during all seasons in the Louisiana area (Figure 5). The largest fish (over 1,399 mm FL) were caught in highest proportions from November through March. Small fish (less than 700 mm FL) were caught only during one month (June 1977) of the twoyear period. Size composition changed significantly between months (not consecutive months necessarily) in 8 of the 13 comparisons (Table 3).

Mean lengths of king mackerel of each sex showed generally similar trends during each year (Figure 3). especially when considering the small sample sizes for males (Table 6). With the exception of January 1978, mean lengths tended to be highest during colder months and lowest during warmer months.

Females were dominant in the catches during every month that samples were taken (Figure 4) and in every size class for both years (Table 5); sex ratios ranged between 80 and 100% females. The proportions of males in the catch were greatest from May through September.

<u>Mississippi</u> - Samples of king mackerel were obtained off the Mississippi coast from recreational and commercial snapper fishermen, but the number of king mackerel (22) sampled from the recreational fishery was too small for seasonal analysis (Table 6).

The average length of king mackerel that were caught by commercial snapper fishermen was larger in 1977 than in 1978 (Figure 6). In 1978 modal lengths were smaller in June than in July and August. Mean lengths of king mackerel were greatest for males in July and for females in August (Figure 3), except for a single large female caught in September (Table 6). These fish, taken from water depths much greater than those in the other sampling areas, averaged larger during warmer months.

Sex ratios showed a high proportion of females for the recreationally caught fish and during June through August for the commercially caught fish (Figure 4). Females dominated each size class except the 500-699 mm FL class (Table 5) in 1978.

Northwest Florida - Length distributions of king mackerel caught by recreational fishermen from northwest Florida during 1968-69 and 1977-78 indicated that the populations were composed of more large fish in the early part (April-July) of each season (Figures 7-9). In 1978, fish less than 600 mm FL dominated every month except June. The size compositions changed significantly between months in 14 of 21 comparisons (Table 3).

Monthly mean lengths of king mackerel of each sex tended to vary similarly. They were lowest during July, August, or September (Table 7 and Figure 3).

Twenty-six monthly estimates of sex ratio were made. Ratios deviated significantly in favor of females in 17 months and in favor of males in two months (October 1977 and August 1978) (Table 7). Highest proportions of

females occurred in July or August of each year except 1978. In 1978 the proportion of females was lowest in August (Figure 4).

Females were dominant in all size classes during each year except for the smallest size group (300-399 mm FL) in 1978 (Table 5).

<u>South Florida</u> - The most extensive sampling among the geographic areas occurred in south Florida. Data were obtained from recreational and commercial hook-and-line and gill-net fisheries. Summary data for these samples are provided in Tables 8 and 9.

Data from recreational fishermen were obtained for three months during 1979. Catches were composed of larger fish in January than in February or March (Figure 10). Large proportions of the fish caught in February and March were less than 700 mm FL. Size composition varied significantly between months (Table 3). Mean lengths decreased from January through March (Table 9). No sex ratio data were available.

Data from commercial hook-and-line catches were available for 1968-69 and 1975-79. Data from at least two months during each of the seven years (Figures 11-16) were obtained. No general seasonal pattern in size composition among all years was apparent. For each year, the greatest monthly modal lengths occurred as follows: 1968 - April and May; 1969 - July, August, and November; 1975 - all months except March; 1976 - April; 1977 - December; 1978 - May; 1979 - March. The frequency distributions changed significantly between months in 23 of the 38 comparisons (Table 3). Mean lengths of each sex tended to increase or decrease between months in a similar fashion except in July-August 1969 (Figure 3). Mean lengths (sexes combined) were plotted by year and for all years combined for the commercial hook-and-line data in an attempt to determine seasonal changes in size. The data indicated that mean lengths averaged less during colder than during warmer months (Figure 17). The averaged monthly means from the commercial hook-and-line data indicated that the average size of the fish increased from late winter, was highest during the spring and summer, and decreased in the fall (Figure 18). Sex ratios deviated significantly in 12 of 21 months (Table 8) but did not change according to any apparent seasonal pattern (Figure 4). Females were dominant in 18 of the 21 months and 10 of the 12 months when differences were significant. Only during May 1969 and September 1978 were males in significantly higher proportions than females. Sex ratios, when analyzed by size class and year, showed males dominant in two of four comparisons in the 500-699 mm FL class and in one of four comparisons in the 700-899 mm FL class (Table 5). In size classes above 899 mm FL, females comprised over 67% of the catch and were dominant in each size class for all four years. Data from gill-net fishing were obtained for various months in 1968-69 and 1976-78. Modal lengths of king mackerel caught in gill nets were the same for all months and years (Figure 19). Fish under 600 mm FL were not caught. Much variation did occur among months, however, in the percents of larger fish caught by the gill nets. Significant differences in size composition between all months resulted (Table 3). Mean lengths were less in April than in January during 1968 and 1977, but much variation occurred in mean lengths in intervening months (Figure 17). Mean lengths of each sex tended to vary similarly during 1968 (Figure 3). Females were in greater proportions than

males during all months and in significantly greater proportions during four of the seven months (Table 8). The proportion of females was greatest in April (Figure 4). Most (75.7%) of the fish that were 500-699 mm FL during 1968 were males, but females predominated in the other size groups (Table 5).

South Carolina - Georgia - Sufficient amounts of data for analysis were available for only three months (Table 10). Catches by recreational fishermen were composed of significantly smaller fish in October than in September (Table 3, Figure 20). Significantly more females than males were landed in October, the only month in which a large number of samples were obtained (Table 10). Overall, females dominated in every size group (Table 5).

North Carolina - Data were available for 1977-78 from catches by recreational fishermen (Table 10). Modal lengths of king mackerel that were caught by recreational fishermen increased from May to June in 1977 and decreased from May to June in 1978 (Figure 20). Modal lengths were the same in three of the four months for which length-frequencies were analyzed in 1978. Length-frequency distributions varied significantly between June and September and between September and October 1978 (Table 3). Mean lengths of each sex varied in a generally similar pattern and were greater in October or November than in May (Figure 3). Females only were caught in November, but they averaged much larger than either sex in previous months. Sex ratios deviated significantly in favor of females during seven of the eight months for which data were available (Table 10), and the ratio varied from 71.3 to 100% female between months (Figure 4). Females were dominant in all size classes in 1978 (Table 5).

Length data from the commercial hook-and-line fishery in North Carolina were available for September and October of 1978 and for May 1979 (Table 10). Modal lengths were the same in September and October 1978 (Figure 20); mean fork length increased from 804 to 836 mm. The distributions did not vary significantly between months (Table 3). Sex data were not available.

DISCUSSION AND SUMMARY

The king mackerel in this study were caught by recreational hook and line, commercial hook and line, and gill net. Among these gears, as they were used, the gill net was the most selective and the recreational hook and line was the least selective toward particular sizes of king mackerel. When all monthly data from south Florida are viewed, the modal lengths varied from 649 to 849 mm FL in commercial hook and line (Figures 11-16) but were always 749 mm in the gill-net catches (Figure 19). Modal lengths from recreational hook-and-line catches varied the most (Figure 10); they ranged from 649 to 949 mm FL within a three-month period.

Size compositions of king mackerel varied considerably between months in each area and indicated temporally heterogeneous groups. Monthly lengthfrequency distributions revealed significant changes in size composition between months in 49 of 92 comparisons. Sizes of males and females tended to increase or decrease similarly from month to month. In areas along the northern Gulf of Mexico, patterns of seasonal change in size of king mackerel were similar. Mean sizes of king mackerel along northwest Florida were highest in spring and fall and lowest during July or August of each year. Mean sizes were also lowest during the warmer months in Louisiana and Texas and, although the data were meager, seasonal changes in size in Texas appeared to be similar to those in northwest Florida.

In south Florida seasonal changes in size based on commercial hook-andline data were at best only weakly discernible. During most years mean lengths tended to be highest during warmer months. When the monthly means from different years were averaged the lengths were: April-June, 808 mm; July-September, 816 mm; October-December, 768 mm; and January-March, 758 mm.

Seasonal changes in size of king mackerel along the south Atlantic coast could not be defined with any certainty because of the paucity of data. In North Carolina mean lengths of recreationally caught fish increased from May (682 mm) to June (735 mm) 1977, decreased from May (809 mm) to June (789 mm) 1978 and increased from September (844 mm) to October (856 mm) 1978. Fish that were caught by commercial hook and line also increased from September (804 mm) to October (836 mm) 1978 in North Carolina. In South Carolina the recreationally caught fish decreased from 895 mm in September to 811 mm in October 1978.

Females were dominant in the catches with few exceptions. In Louisiana annual estimates of percent female were 91.9 in 1977 and 92.9 in 1978. In other parts of the northern gulf and along North Carolina, South Carolina, and Georgia the annual estimates of percent female ranged from 57.1 to 75.8. Only in south Florida did the sex ratio favor males, and this occurred only during 1978 when the annual estimate based on commercial hook-and-line data was 40.2% female.

The degree of dominance by female king mackerel varied in relation to size of fish and type of gear used to capture the fish. Females were always dominant in size classes \geq 700 mm FL except for hook-and-line catches in south Florida in 1978 (females represented only 34.9% of the catch for fish between 700-899 mm FL). In the 500-699 mm FL class, percent females were: 47.1 and 41.8 in 1977-78 in Texas; 100 in 1977 in Louisiana; from 57.0 to 73.3 during 1968-78 in northwest Florida; from 35.6 to 58.2 based on commercial hook-and-line data during 1968-79 and 24.3 based on gill-net data in 1968 in south Florida; 57.8 in 1978 in South Carolina-Georgia; and 61.9 in 1978 in North Carolina. With one exception only small numbers of samples with few individuals per sample were available to evaluate sex ratio in the 300-499 mm FL class. The numbers of males and females respectively, observed in northwest Florida were 1 and 3 in 1968, 0 and 2 in 1969, 0 and 3 in 1977, and 138 and 66 in 1978; in south Florida the numbers were 0 and 1 in 1968, 0 and 1 in 1969, and 0 and 1 in 1979.

In summary, much variation was found in size composition and sex ratio between months and between areas. Seasonal patterns in size variation, however, were similar in the three areas of the northern Gulf of Mexico. Females dominated the catches in all areas and all years except for south Florida in 1978.

ACKNOWLEDGMENTS

Sincere appreciation is extended to the commercial and recreational fishermen and members of sport-fishing organizations who contributed samples, time, and information for this paper. We are especially indebted to Messrs. Raymond Groom, Jinx Martin, Dickie Myers and personnel of the Louisiana Wildlife and Fisheries Commission.

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Figure 1. Sampling locations in the southeastern United States.

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Figure 2. Texas: Length-frequency distributions of king mackerel caught by recreational fishermen in 1977-78.



Figure 3. Mean fork length of king mackerel by month, sex, area, type of gear, and year. Solid circles = females; open circles = males.



Figure 4. Percents of each sex of king mackerel by month, area, type of gear, and year.



Figure 5. Louisiana: Length-frequency distributions of king mackerel caught by recreational fishermen in 1977-78.



Figure 6. Mississippi: Length-frequency distributions of king mackerel caught by commercial snapper fishermen in 1977-78.



Figure 7. Northwest Florida: Length-frequency distributions of king mackerel caught by recreational fishermen in 1968.



Figure 8. Northwest Florida: Length-frequency distributions of king mackerel caught by recreational fishermen in 1969.



Figure 9. Northwest Florida: Length-frequency distributions of king mackerel caught by recreational fishermen in 1977-78.



Figure 10. South Florida: Length-frequency distributions of king mackerel caught by recreational fishermen in 1979.



Figure 11. South Florida: Length-frequency distributions of king mackerel caught by commercial hook-and-line fishermen in 1968.







Figure 13. South Florida: Length-frequency distributions of king mackerel caught by commercial hook-and-line fishermen in 1975.



Figure 14. South Florida: Length-frequency distributions of king mackerel caught by commercial hook-and-line fishermen in 1976.



Figure 15. South Florida: Length-frequency distributions of king mackerel caught by commercial hook-and-line fishermen in 1977.







Figure 17. South Florida: Mean lengths (sexes combined) of king mackerel by type of gear and year.







Figure 19. South Florida: Length-frequency distributions of king mackerel caught by commercial gill-net fishermen in 1968 and 1976-77.



Figure 20. South Carolina, Georgia and North Carolina: Length-frequency distributions of king mackerel by type of gear in 1977-78.

Recreation Hook and L					Cc Hool		Gill Net					
Υe	ear	Nort	hwest		South			North				
é M	and	FIO	Fida F	M	Florida	<u> </u>	Ca	rolina	м	Florid	a	
1.14					- Num	ber of	fish					
68	Jan Feb Mar Apr May Jun Jul	22 18 17 11	36 20 55 86	135 182 283 28 40 26	316 457 667 19 24 33		-		361 792 460 5	473 816 578 13		
	Aug Sep Oct Nov Dec	14 21 17	46 39 22	22 27 19 445	38 29 23 4 671	2			2	3		
69	Jan Feb Mar Apr May Jun	4 17 6	16 15 8	709 15 10	1,102 43 31				8 10	12 12		
	Jul Aug Sep Oct	1 5 3 1	32 24 27 8	26 11	34 19							
	Nov Dec	12	18	14 6	44 9							
75	Jan Feb Mar Apr May Jun Aug Oct Dec				·	534 1,343 117 35 373 121 203 3 244						
76	Jan Feb Mar Apr May Jun Aug Oct Dec					304 1,796 2,907 36 1,226 180 166 61 2,266					313	
77	Jan Feb Mar May Jun Aug Dec					1,193 4,106 335 246 227 708					2,777 1,062 306	
78	Jan Feb Mar Apr May Jun Sep Oct					2,475 1,107 2,931 1,305 378 20		72 36				
79	May					809						
TO	TAL	169	452	1,998 3	,563	26,948		917	1,638	1,907	4,458	

Table 1.	Data on king mackerel obtained by the Florida Department of	
	Natural Resources (M = male, F = female, and U = sex unknown	n).

							Re	creatic	onal Ho	ok and	Line								Com	mercia		Ċd	mmer	cial
Year		Texas		Lc	ouisia	na	Missi	ssippi	Nc F	rthwes lorida	t	South Florida	Ca I G	South rolina eorgia	-	Ca	North ro <u>lina</u>		<u>ноок</u> S	outh orida		Hool Miss	and and	Line
Month	М	F	U	M	F	U	M	F	M	F	U	U	M	F	U	M.	E	<u> </u>	<u>M</u>	F	U	<u>M</u>	F	<u> </u>
												Number	of fis	h										
77 Feb May Jun Jul	5 17	18 21	20 106	1 2	24 16	40 32	1	7	9 49 4	26 352 255	6 48 59					2	4	45 28 11						40
Sep Oct Dec	2	2	271	8 10 3	59 135 38	6	I	7	260 180	673 94	23													
78 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov	23 95 193 234	99 281 254 262	13 75 1	3 4 1 7 13 5 4	36 8 64 61 86 81 24 75 34 7	1	2	12	1 5 177 301 417 203	5 23 456 259 472 255	7 16		3 2 156	1 248	7 127 6	13 2 2 3 5 103	41 19 13 48 256 10	4 24 91 82 6	205	138	1	20 4 15 4	29 11 28 1	19 15 31 2
79 Jan Feb Mar Jun					,							371 482 1,052							209 33	346 85	12			
TOTAL	576	944	466	61	755	99	3	19	1,606	2,870	159	1,905	161	249	140	130	407	297	447	569	13	43	69	107

Table 2. Data on king mackerel obtained by the National Marine Fisheries Service (M = male, F = female, and U = sex unknown).

·	Type of		Months	Degrees	Chi-square
Area	Fishermen	Year	Compared	Freedom	Value
			······	<u></u>	
Texas	Recreational	1977	Jun-Jul	3	6.2
	Hook and Line		Jul-Aug	5	31.3*
		1978	Mav-Jun	6	44,5*
			Jun-Jul	7	83.9*
			Jul-Aug	6	77.9*
Louisiana	Recreational	1977	Feb-Jun	5	23.9*
Louisiana	Hook and Line		Jun-Jul	Ĩ4	4.8
			Jul-Sep	i i	20.4*
			Sep-Oct	4	12.1*
			Oct-Dec	6	32.3*
		1977-78	Dec-Jan	4	2.6
		1978	Jan-Mar	5	29.1*
		•••	Mar-Jun	5	44.7*
			Jun-Jul	4	2.2
			Jul-Aug	4	20.0*
			Aug-Sep	4	8.1
			Sep-Oct	4	3.9
			Oct-Nov	5	21.2*
Mississippi	Commercial	1978	Jun-Jul	5	10.3
	Snapper		Jul-Aug	5	1.7
Northwest	Recreational	1968	Ap r-M ay	2	4.3
Florida	Hook and Line		May-Jun	2	4.4
			Jun-Jul	4	33.5*
			Jul-Aug	3	27.5*
			Aug-Sep	3	8.4
			Sep-Oct	2	5.0
		1969	Apr-May	2	11.3*
			May-Jun	2	1.0
			Jun-Jul	3	3.1
			Jul-Aug	3	33.1*
			Aug-Sep	2	13.0*
			Sep-Oct	2	14.0*
			Oct-Nov	2	8.1
		1977	Jun-Jul	6	36.0*
			Jul-Aug	6	62.8*
			Aug-Sep	5	53.4*
			Sep-Oct	5	32.0*
		1978	Jun-Jul	6	155.9*
			Jul-Aug	6	89.3*
			Aug-Sep	5	302.2*
			Sep-Oct	5	382.6*

Table 3. Results of comparisons of length-frequency distributions of king mackerel between months by area, type of gear, and year using a chi-square test of homogeneity.

	Type of		Months	Degrees	Chi-square
Area	Fishermen	Year	Compared	Freedom	Value
A		1070		_	150 01
South	Recreational	1979	Jan-Feb	/	158.0*
Florida	Hook and Line		Feb-Mar	7	26./*
	Commercial	1968	Jan-Feb	5	12.3
	Hook and Line		Feb-Mar	5	30.9*
			Mar-Apr	5	158.4*
			Apr-May	3	18.2*
			Mav-Jun	Ĩ4	9.4
			Jun-Aug	3	9.7
			Aug-Sep	4	5.2
			Sep-Oct	L L	22.6*
			Oct-Dec	5	24.1*
				,	23.1
		1969	Jan-Feb	5	81.5*
			Feb-Mar	4	7.0
			Mar-Jul	4	10.9
			Jul-Aug	3	6.4
			Aug-Nov	5	11.2
		1975	Jan-Feb	5	142.6*
			Feb-Mar	Ĩ4	34.1*
			Mar-Apr	2	25.0*
			Apr-May	2	2 3
			Max-lup	ך וו	2.2
			hay-Jun	4). Z 2 2
			Jun-Aug Aug-Dog	4	2.2 86 7*
			Aug-Dec	4	00.7^
		1976	Jan-Feb	6	32.2*
			Feb-Mar	6	546.3*
			Mar-Apr	4	196.0*
			Apr-May	4	3.7
			Mav-Jun	5	31.6*
			Jun-Aua	5	13.3
			Aug-Oct	Ĩ.	2.5
			Oct-Dec	5	11.2
		1077	lan-Ech	F	64 8*
		1161	Ech-May	5	80.0*
			Mov-lup	5	hh o*
			riay-Juli	2	44.J^ h7 h*
			Jul-Dec	5	7/.7^ 25 14
			Jui-Dec	4	32.1*
		1978	Jan-Feb	7	141.5*
			Feb-Mar	6	100.8*
			Mar-May	5	152.5*
		1979	Jan-Mar	5	22.5*
	Gill Net	1968	Jan-Feb	5	292.2*
	·····		Feb-Mar	Ś	257.6*
				<i>,</i>	

	Type of		Months	Degrees	Chi-square
Area	Fishermen	Year	Compared	Freedom	Value
		1977	Jan-Feb	5	97.4*
			Feb-Mar	6	322.9*
			Mar-Apr	4	643.5*
South Carolina- Georgia	Recreational Hook and Line	1978	Sep-Oct	6	55.8*
North Carolina	Recreational Hook and Line	1977	May-Jun	3	7.0
ou. or ma	HOOK and Erne	1978	Mav-Jun	3	5.9
		.) / 0	Jun-Sep	5	40.4*
			Sep-Oct	5	37.6*
	Commercial Hook and Line	1978	Sep-Oct	5	10.0

*Probability < .05.

Table 4	ł.	Number, mean fork length $(\overline{x} \text{ in millimeters})$, and sex ratio
		by month for king mackerel caught by recreational fishermen
		in Texas, 1977-78.

Year						Sex			
and	Ma	rle	Fen	nale	Unk	nown	Тс	otal	Percent
Month	No.	X	No.	x	No.	x	No.	X	Female
1977									
Jun	5	809	18	810	20	782	43	812	78.3*
Jul	17	755	21	816	106	80 9	144	804	55.3
Aug	9	782	9	849	251	771	269	774	50.0
1978									
May	23	884	99	993	0	-	122	973	81.1*
Jun	95	835	281	907	13	864	389	888	74.7*
Jul	193	803	254	843	75	793	522	821	56.8*
Aug	234	837	262	921	1	949	497	881	52.8

Table 5. Sex composition of king mackerel by area, type of gear, year, and size class of fish. Ratios in parentheses were determined from samples of < 10 fish.

Fork Length Interval (mm)	Texas Recreat Hook & 1977	ional Line 1978	Loui Recrea Hook 1977	siana tional & Line 1978	Mississippi Commercial Snapper 1978	<u>Recr</u> 1968	Northwes eational 1969	t Florida Hook & I 1977	ine 1978	Comn 1968	Sc nercial H 1969	uth Flor look & L 1978	ida ine 1979	<u>Gill Ne</u> t 1968	<u>S.CGa.</u> Recr. <u>H. & L.</u> 1978	N.C. Recr. <u>H. & L.</u> 1978
		<u> </u>					Pe	rcent Fer	nale						<u></u>	
300- 499						(75.0)	(100.0)	(100.0)	33.3*	(100.0)	(100)		(100.0)			
500- 699	(57.1)	41.8	(100.0)		(0.0)	68.0*	70.7*	73.3*	57.0*	52.7	35.6*	(37.5)	58.2*	24.3*	57.8	61.9
700- 899	56.9	52.3	85.4*	80.0*	58.5	73.5*	72.2*	72.0*	72.7*	69.4*	65.0*	34.9*	63.4*	56.3*	54.6	68.2*
900-1099	(100.0)	78.3*	90.2*	86.5*	61.0	85.0*	100.0*	88.6*	96.5*	78.5*	84.4*	67.9*	94.3*	70.7*	82.4*	94.0*
1100-1299		94.7*	98.1*	97.9*	100.0*	(100.0)	100.0*	(87.5)	100.0*	100.0*	93.3*	(100.0)	(100.0)	100.0*	100.0*	100.0*
1300-1499		(100.0)	100.0*	98.9*		(100.0)								(100.0)	(100.0)	
1500-1699			(100.0)	(100.0)										_		
300-1699	60.8*	62.2*	91.9*	92.9*	63.5*	71.7*	75.1*	73.6*	57.1*	65.4*	61.8*	40.2*	64.0*	53.7*	61.5*	75.8*

Area, Type Of Gear, and Year

Area, Year,	Туре		<u> </u>			S	ex			
and Month	Of Fichorman	No	Male	<u> </u>	<u>male</u>	<u>Unk</u>	nown	<u> </u>	tal	Percent
MOTICI	FISHERINAN	NO.	<u> </u>	140.	X	<u>NU.</u>	X	<u>NO.</u>	<u> </u>	rellidie
<u>Louisia</u>	na									
1977	Recreational									
Feb	Hook & Line	1	1,049	24	1,241	0		25	1,233	96.0*
ู่ มูมา		2	999	10	1,018	40	1,004	20 32	1,032	00.9"
Διια		-				32 19	1,077	19	1 1 3 3	
Sep		8	974	59	956	0		67	958	88.1*
0ct		10	899	135	1.025	ő	999	151	1,016	93.1*
Dec		3	982	38	1,165	Ō		41	1,152	92.7*
1978									**	
Jan		3	916	36	1,160	0		39	1,141	92.3*
Feb		0		8	1,287	0		8	1,287	100.0*
Mar		4	1,249	64	1,302	0		68	1,299	94.1*
Apr		0		3	1,316	0		3	1,316	100.0*
May		1	1,149	4	1,124	0		5	1,132	80.0*
Jun		7	1,006	61	1,140	0		68	1,126	89.7*
JUI		13	995	86	1,119	1	1,249	100	1,104	86.9*
Aug		5	909	81	1,169	0	010	80 25	1,154	94.2*
Jep Oct		1	040	24 75	1,10/	1	949	20	1,101	0/ 0*
Nov		4	949	70	1,002	0		79	1 106	100 0*
Dec		0		7	1,249	0		7	1,249	100.0*
Mississ	ippi									
	Recreational									
1077	Hook & Line									
Δυσ		1	1 049	7	1.092	0		8	1.087	87.5*
1978		·	19045	'	1,052	Ŭ		Ŭ	1,007	0,10
Jun		2	449	12	1,032	0		14	949	85.7*
1977	Commercial Snappor									
Jun	Hook & Line	-				40	1,064	40	1,064	
1978									_	
Jun		20	854	29	911	19	928	68	899	59.2
ปนไ		4	924	11	922	15	1,002	30	962	73.3*
Aug		15	882	28	981	31	943	/4	945	65.1*
Sep	<u></u>	4	899	<u> </u>	1,249	2	/99	/	920	20.0

Table 6.	Number, mean fork length (\overline{x} in millimeters), and sex ratio by month for	۶r
	king mackerel caught off Louisiana and Mississippi, 1977-78.	

-

Year					Se	x			
and	<u>Mal</u>	e	Fem	<u>ale</u>	Unkn	own	<u>Tot</u>	<u>al</u>	Percent
Month	No.	x	No.	x	No.	X	No.	x	Female
1968									
1900	22	717	26	780	0	_	۲Q	757	62 1
Apr	18	677	20	700	0		20	/2/	52.1
riay	10	0// 7/2	20	7/4	0		יי סכ	729	52.0 76 h∻
Jun	17	/4) EE8	22	670	0	_	72	740	70.4^ 88 7÷
Jui	11	220 728	00 1/2	710	0	-	97	715	76 74
Aug	21	672	20	705	0		60	/15 60E	/0./^ 6E 0*
Sep	21	721	22	705	0		20	035 794	55.0A
001	17	121	22	/22	0		22	/24	50.4
1969									
Apr	4	724	16	1,005	0	-	20	950	80.0*
May	17	737	15	756	0	-	32	747	46.9
Jun	6	682	8	824	0	-	14	764	57.1
Jul	1	649	32	802	0	-	33	798	97.0*
Aug	5	589	24	595	0	-	29	595	82.8*
Sep	3	582	27	716	0		30	703	90.0*
0ct	1	849	8	912	0		9	906	88.9*
Nov	12	774	18	799	0	-	30	790	60.0
1977									
Jun	9	805	26	857	6	849	41	844	74.3*
Jul	49	790	352	747	48	764	449	753	87.8*
Aug	4	649	255	694	59	705	317	697	98.4*
Sep	260	694	673	729	0		933	720	72.1*
0ct	180	710	94	722	23	692	297	713	34.3*
1078									
May	1	649	5	809	0	_	6	782	83.3*
ridy	5	689	23	862	Ő	_	28	831	82.1*
Jui Lul	177	556	456	625	7	620	640	606	72.0*
Δυσ	301	530	259	612	Ó	-	560	568	42.2*
Sen	417	556	472	583	Õ	-	889	570	53.1
Oct	203	634	255	624	16	630	474	628	55.7*
							•		

Table 7. Number, mean fork length (\overline{x} in millimeters), and sex ratio by month for king mackerel caught by recreational fishermen from northwest Florida, 1968-69 and 1977-78.

Table 8. Number, mean fork length (\overline{x} in millimeters), and sex ratio by month for king mackerel caught by commercial hook-and-line and gill-net fishermen off south Florida, 1968-69 and 1978-79.

Year				<u> </u>		S	ex			
and	Type of	<u> Ma</u>	le	Fem	ale	Unk	nown	To	tal	Percent
Month	Fishermen	No.	x	No.	x	No.	x	No.	x	Female
1968										
Jan	Commercial	135	728	316	764	0	-	451	754	70.1*
Feb	Hook and Line	182	723	457	754	0	-	639	746	71.5*
Mar		283	746	667	764	0	-	950	759	87.9*
Apr		28	878	19	933	0	-	47	901	40.4
May		40	824	24	878	0	-	63	832	38.1*
Jun		26	791	33	791	0	-	59	792	55.9
Aug		22	799	38	854	0	-	60	835	63.3*
Sep		27	768	29	849	0	-	56	811	51.8
0ct		19	712	23	758	2	399	44	722	54.8
Nov		0	-	4	1,074	0		4	1,075	100.0
Dec		445	707	671	748	0	-	1,116	732	60.1
1969					- 0	_				
Jan		709	741	1,102	789	0	-	1,811	771	60.8*
Feb		15	742	43	821	0	-	58	802	/4.1*
Mar		10	719	31	797	0	-	41	///	/5.6*
Jul		26	799	34	873	0	-	60	842	56./
Aug			840	19	854	0	-	30	850	63.3
Nov		14	/99	44	931	0	-	58	900	/5.9*
Dec		6	649	9	638	0	-	15	643	60.0
1978		205	90F	120	0-0	,	71.0	21.1.	906	10 24
Sep		205	005	130	050	1	/49	344	020	40.24
1979		200	710	246	757	10	716	567	740	69 24
Jan		209	710	540 85	722	12	/10	118	740	
mar 1068))	740	05	700	0	-	110	115	/2.0^
lan	Gill Net	361	790	472	820	0	-	834	819	56 7*
Jan Ech		707	750	816	770	0	-	1 608	758	50.7
Mar		460	776	578	830	0	_	1,000	7 J0 807	55 7*
Anr		400 Γ	709	13	734	0		18	728	72 2*
Nov		2	799	י גי ג	882	0	-	5	849	60.0
1969		-	155	,	002	Ŭ		-		
Mar		8	837	12	857	0	-	20	849	60.0*
Anr		10	749	12	857	õ	-	22	807	54.5
		• •		• =	- 21				/	- · · ·

	Recreat	ional Lline			Commer	cial He	ook and L	ine					Gill	Net		
	197	<u>79</u>	197	/5	1976		197	7	197	78	197	6	197	7	19	78
Month	No,	X	No.	X	No.	x	No.	x	No.	x	No.	x	No.	X	No.	x
Jan	371	861	534	780	304	735	1,193	754	2,475	742			2,777	803		
Feb	482	743	1,343	732	1,796	770	4,106	750	1,107	779	313	750	1,062	803		
Mar	1,052	729	117	689	2,907	712			2,931	789			306	903		
Apr			35	763	36	807							1,305	772	1,305	772
May			373	774	1,226	800	335	797	378	842						
Jun			121	767	180	768	246	751	20	854						
Aug			203	782	166	776	227	802								
0ct			3	716	61	783										
Dec			244	704	2,266	757	708	825								

Table 9. Numbers and mean fork lengths (\overline{x} in millimeters) of king mackerel of undetermined sex caught by recreational and commercial fishermen off south Florida 1975-79

Table 10.	Number, mean fork length (\overline{x} in millimeters), and sex ratio by month for king mackerel by type of gear off South Carolina-Georgia and North Carolina, 1977-79.

	Туре	Year					S	Sex			·····
	of	and	Mal	e	Fen	nale	Unk	nown	Tot	al	Percent
Area	Fishermen	Month	No.	X	No.	<u> </u>	No.	<u> </u>	No.	<u> </u>	Female
South Carolina- Georgia	Recreation Hook and Line	a1 1978									
		Aug	0		3	849	7	920	10	899	100.0*
		Sep	2	649	1	949	127	899	130	895	33.3
		0ct	156	775	248	839	6	616	410	811	61.4*
North Carolina		1977									
		Мау					45	682	45	682	
		Jun					28	735	28	735	
		Jul	2	799	4	724	11	804	17	784	66.3
		1978									
		Мау	13	726	41	842	4	749	58	809	75.9*
		Jun	2	699	19	781	24	803	45	789	90.5*
		Jul	2	849	13	841	4	874	19	849	86.7*
		Aug	3	749	16	912	2	949	21	892	84.2*
		Sep	5	829	48	907	91	812	144	844	90.6*
		0ct	103	824	256	876	82	836	441	856	71.3*
		Nov	0		10	1,069	6	799	16	968	100.0*
	Commercial Hook and Line	1978									
		Sep					72	804	72	804	
		Oct					36	836	36	836	
		1 979 .									
		May					809	867	809	867	

Appendix Table I.	
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•	Length-frequency distributions of king mackerel caught
	off Texas, 1977-78 (M = male, F = female, U = sex
	unknown).

				Recro	eatic	onal	Hook	and	Lin	e		
offork	<u></u>				197	17				<u></u> ,,,,	1	978
length		Jun			Ju				Aug			1ay_
interval (mm)	M	F	U	M	F	U		М	F	U	М	F
····					- Nun	nber	of f	ish				
549										13		
649		1	1	3	2	4			1	34		3
749	2	6	6	10	7	48		6	2	132	5	4
849	3	10	12	4	9	41		3	3	43	8	22
949		1	1		2	12			2	15	7	28
1049					1	1			1	14	3	18
1149												13
1249												6
1349												4
1449												ł
Total	5	18	20	17	21	106		9	9	251	23	99
			<u></u>								<u> </u>	
mean Length	809	810	782	755	816	809		782	849	771	884	993
								<u></u>				
					_							
				Rec	reat	iona	I Hoo	<u>k</u> ar	nd Li	ne		
		. <u> </u>		Rec	reat	ional	I Hoo 1978	ok ar	nd Li	ne		
			Jun	Rec	reat	ional	I Hoo 1978 Ju1	ok ar		<u>ne</u>	Aug	
		M	Jun F	Rec U	reat	M	I Hoo 1978 Jul F	k ar	J	ne M	Aug F	<u> </u>
		 M	Jun F 	Rec		ional M Numbe	I Hoo 1978 Jul F er of	k ar l l fis	J J Sh -	ne M	Aug F	<u> </u>
449		 	Jun F	Rec	<u>reat</u>	ional M Numbe	I Hoo 1978 Jul F er of	k ar l	nd Li J sh -	<u>ne</u> <u>M</u>	Aug F	<u> </u>
449 549	<u> </u>	 	Jun F	Rec U	I	ional M Numbe 2	I Hoo 1978 Jul F er of I	ik ar	nd Li J sh -	<u>me</u> <u>M</u> 	Aug F 	<u>U</u>
449 549 649		M 	Jun F 	Rec U	I	ional M Numbe 2 20	I Hoo 1978 Jul F er of 1 17	t fis	12	<u>ne</u> <u>M</u> 2 11	Aug F 1 3	<u> </u>
449 549 649 749		M 1 3 31	Jun F 3 35	Rec U 	<u> </u>	<u>M</u> Numbe 2 20 70	I Hoc 1978 Jul F er of 1 17 66	fis	12 30	ne M 11 65	Aug F 1 3 28	<u> </u>
449 549 649 749 849		M 1 3 31 39	Jun F 3 35 109	Rec U U 1 3 4	<u> 1</u>	<u>M</u> Numbe 2 20 70 76	I Hoo 1978 Jul F er of 1 17 66 100	fis	I 2 30 25	<u>M</u> 2 11 65 106	Aug F 1 3 28 75	<u> </u>
449 549 649 749 849 949		M 1 31 39 16	Jun F 3 35 109 88	Rec U 	I	<u>M</u> Numbe 2 20 70 76 21	I Hoo 1978 Jul F er of 1 17 66 100 50	fis fis	nd Li J sh - 12 30 25 4	ne M 11 65 106 37	Aug F 1 3 28 75 100	
449 549 649 749 849 949 1049		M 1 3 31 39 16 4	Jun F 3 35 109 88 26	Rec U 1 3 4 4		ional M Numbe 20 70 76 21 4	I Hoo 1978 Jul F er of 1 17 66 100 50 100	fis	nd Li J sh - 12 30 25 4 4	ne M 11 65 106 37 11	Aug F 1 3 28 75 100 43	
449 549 649 749 849 949 1049 1149 1249		M 1 3 3 1 39 16 4	Jun F 3 35 109 88 26 15 5	Rec U 1 3 4 4 1	I	1 ona 1 	I Hoo 1978 Jul F P r of 1 1 17 66 100 50 16 3	fis	12 30 25 4 4	 	Aug F 1 3 28 75 100 43 9 3	
449 549 649 749 849 949 1049 1149 1249		M 1 3 3 1 39 16 4 1	Jun F 3 35 109 88 26 15 5	Rec U 1 3 4 4 1		ional M Numbe 20 70 76 21 4	I Hoo 1978 Jul F er of 1 1 17 66 100 50 16 3	fis	12 30 25 4 4	M 2 11 65 106 37 11 2	Aug F 1 3 28 75 100 43 9 3	1
449 549 649 749 849 949 1049 1149 1249 Total		M 1 3 3 1 39 16 4 1 9	Jun F 3 35 109 88 26 15 5 281	Rec U U 1 3 4 4 1 1 3	I	193	I Hoo 1978 Jul F er of 1 1 17 66 100 50 16 3 3	k ar	12 30 25 4 4 75	ne M 11 65 106 37 11 2 234	Aug F 1 3 28 75 100 43 9 3 262	1
449 549 649 749 849 949 1049 1149 1249 Total Mean		M 1 31 39 16 4 1	Jun F 3 35 109 88 26 15 5 281	Rec U 1 3 4 4 1 1 3		ional M Numbe 2 20 70 76 21 4 193	I Hoo 1978 Jul F er of 1 17 66 100 50 16 3 25 ¹	k ar	nd Li J sh - 12 30 25 4 4 75	 	Aug F 1 3 28 75 100 43 9 3 262	1

		unknown	/•							
Midpoint	t			Recreat	iona	1 Hool	< and	Line		
of for	k					1977				
lengtł	h	Feb			Jun			Jul		Aug
interval	(mm)	M	F	M	F	U	-	U		U
				Ni	umbe	r of	fish			
649						1				1
749						1 2	2			
849						2 2	2	1		
949				1		3 -	7	9		4
1049		1	2	1		<u> </u>	3	12		6
1149		•	9			3 10	5	4		-
1249			6		-	í í	5	3		
1349			ŭ			•	í	2		8
1449			2			1		ĩ		Ŭ
1549			1			•		•		
			•							
T. 4. 1		,	01	<u> </u>	1	· 1.0	<u> </u>			10
lotar		ſ	24	Z	10	5 40)	32		19
Mean										
Length		1049 1	241	999	1019	8 106/		1077		1122
Lengen		1049 1	271	222	1010	5 100-	T	10//		(())
		-		Recreat	ona	l Hool	< and	Line		
				<u> ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~</u>		1977				
		<u> </u>	ер	_		Oct			De	ec
		<u> </u>	F		<u></u>	F	U		<u>M</u>	<u>F</u>
				Nu	Impei	r of t	ish ·			
74.0			•			,				
749		•	1		1	1				
849		2	15		3	14	-			<u> </u>
949		3	2/		6	4/	3		2	/
1049		- 2	12			47	3		1	8
1149		1	3			16				6
1249			1			3				5
1349						5				7
1449						1				4
1549						1				
Total		8	59		10	135	6		3	38
					. <u></u>				· · · · · · · · · · · · · · · · · · ·	
Mean										
Length		97L	956		899	1025	gaa		982	1165
					- 1 5	1025	1.00		202	

Appendix Table 2.	Length-frequency distributions of king mackerel caught
	off Louisiana,1977-78 (M = male, F = female, U = sex unknown).

Midpoint			Recreationa	1 Hook a	nd Li	ne		
OF FORK				19/0	Mar			A
interval (mm)	Jan M		<u> </u>			-	-	F
			Numbe	r of fis	h			
849	1					1		
949	2	5				2		
1049		7	1			2		
1149		10	1		1	7		
1249		7	2		2 2	20		1
1349		7	2		1	12		2
1449			2			17		
1549						3		
Total	3	36	8		4 (54		3
·····		<u></u>			<u> </u>			
Mean			1007	101	A 13/	~ ^		
Mean Length	916 1	160	1287	124	9 130)2 	 	316
Mean Length	916 1	160	1287 Recreationa	124 1 Hook a	9 130 nd L	02 ine		
Mean Length	916 1	160	1287 Recreationa	124 1 Hook a 1978	9 13(nd L	02 ine		
Mean Length	916 1	160 	1287 Recreationa Ju	124 1 Hook a 1978 n	9 13(02 ine	Jul	
Mean Length	916 1 	160 	1287 Recreationa Ju M 7 Numbe	124 1 Hook a 1978 n F r of fis	9 13(nd L	02 ine 	Ju1 F	U
Mean Length 	916 1 	160 <u></u>	1287 Recreationa Ju M Numbe	124 <u>1 Hook a</u> 1978 n F r of fis	9 13(nd L 	02 ine M	Ju1 F 	U
Mean Length 849 949	916 1 	160 <u></u>	1287 Recreationa Ju M Numbe	124 1 Hook a 1978 n F r of fis 8	9 13(nd L 	02 ine M 7	Ju1 F 2 7	U
Mean Length 849 949 1049	916 1 	160 <u>ay</u> F 2	1287 Recreationa Ju M Numbe 3 4	124 <u>1 Hook a</u> 1978 <u>n</u> F r of fis 8 17	9 13(nd L h - ·	02 ine M 7 6	Jul F 2 7 29	U
Mean Length 849 949 1049 1149	916 1	160 <u>Ty</u> F 2	1287 Recreationa Ju M Numbe 3 4	124 <u>1 Hook a</u> 1978 n F r of fis 8 17 17	9 130	02 ine M 7 6	Jul F 2 7 29 29	U
Mean Length 849 949 1049 1149 1249	916 1 1	160 <u></u>	1287 Recreationa Ju M Numbe 3 4	124 <u>1 Hook a</u> 1978 n F r of fis 8 17 17 12	9 13(nd L h - ·	02 ine M 7 6	Jul F 2 7 29 29 14	U 1316
Mean Length 949 949 1049 1149 1249 1349	916 1 	160 <u>ay</u> F 2 1 1	1287 Recreationa Ju M Numbe 3 4	124 1 Hook a 1978 n F r of fis 8 17 17 12 5	9 13(nd L h - ·	02 ine M 7 6	Jul F 2 7 29 29 14 5	U 1316
Mean Length 849 949 1049 1149 1249 1349 1449	916 1 1	160 <u>ay</u> F 2 1 1	1287 Recreationa Ju M Numbe 3 4	124 1 Hook a 1978 n F r of fis 8 17 17 12 5 2	9 130	02 ine M 7 6	Jul F 2 7 29 29 14 5	U 1316
Mean Length 849 949 1049 1149 1249 1349 1349 1449 Total	916 1 1	160 <u>Ay</u> F 2 1 1 1 4	1287 Recreationa Ju M Numbe 3 4	124 <u>1 Hook a</u> <u>1978</u> <u>r</u> of fis 8 17 17 12 5 2 61	9 130	02 ine M 7 6	Jul F 2 7 29 29 14 5 86	U 1 1

Midpoint			Reci	eatio	onal Hook 1978	and L	.ine	
length interval (mm)	A	ig F	Se F	ер]	0	ct F	Nov F	Dec
				- Nun	nber of f	ish -		
849 949 1049 1149 1249 1349 1449 1549	2 3	2 12 16 14 15 6	5 11 2 3 1 2	1	4	6 20 31 8 6 2 2	1 3 6 7 3 4 2	4 2 1
Total	5	81	24	1	4	75	34	7
Mean Length	909	1169	1107	949	949	1052	1196	1249

.

Appendix Table 2. Continued

	unkno	wn).								
		Reci	reatio	nal			Co	mmercial	Snappe	er
Midpoint		Hook	and L	ine				Hook and	<u>Line</u>	
of fork	197	7		197	78		<u>1977</u>		1978	
length	Au	<u>g</u>		Ju	in		<u>Jun</u>		Jun	
interval (mm)	<u>M</u>	F		<u> </u>	F		U	M	F	<u> </u>
				1	lumber	of	fish -			
449				2	2					
549										
649									I	1
749							2	1	5 11	- 3
849							2	-	76	6
949		3			2		7	(53	3
1049	1	2			1		13	·	3	I
1149					4		10		4	5
1249					1		5		2	
1349		2			2		1			
Total	1	7	4 <u>5, 5, 5 , ,</u>	2	12		40	20) 29	19
Mean					<u> </u>					
Length	1049	1092		449	1032		1064	854	+ 911	928
	<u> </u>		Comm	ercia	al Sna	pper	Hook	and Line		
						1978	}			
		Ju1				Aug			Sep	
	M	F	U		М	F	U	M	F	U
					Numbe	r of	fish			
749		1			1	1	5		l	1
849	1	4	5		8	8	8			1
949	. 3	4	3		6	7	8		3	
1049		1	3			7	5			
1149		1	3			3	4			
1249						2	2 1		1	
1349			1							
Total	4	11	15		15	28	31		4 1	2
Mean Length	92L	922	1002	<u></u>	882	981	943	89	9 1249	799
	<u> </u>	,				201		÷ • J.		, , , ,

Appendix Table 3. Length-frequency distributions of king mackerel caught off Mississippi, 1977-78 (M = male, F = female, U = sex unknown).

	femal	e, U	= sex unk	nown).						
Midpoint			Recre	ationa	1 Hook	<pre>c and</pre>	Line	_		
of fork					1968					
length	Ap	r	Ma	ау	_	Ju	n		Ju	1
interval (mm)	M	F	M	F		M	F	M		F
			~ _ ~	Number	r of f	ish			-	
449									1	3
549	1						4		ģ	23
649		6	13	4		6	10			29
749	11	22	5	13		7	31		1	17
849	1	3	-			3	6		•	10
949	1	2		Ì		í	3			4
1049		2		•			ĩ			·
1149		1					•			
1249										
1349				1						
Total	22	36	18	20		17	55	1	1	86
Mean Length	717	780	677	774		743	744	55	8	672
			Recrea	ational	l Hook	and	Line			
				00		0.			905	<u>,</u>
	<u>Au</u>	<u>g</u>	<u> </u>			<u>UC</u>		<u>M</u>	۹pr	
	<u>M</u>			Number	of f	n ish	<u> </u>			- <u>-</u> -
549	1	2	Ĩ	2						
649	1	21	14	22		8	9		1	
749	12	17	6	8		6	11	•	3	4
849		5		5		2	1			
949		1		2			1			3
1049						Ĩ				3
1149										4
1249										2
Total	.14	46	21	39		17	22	:	4	16
Mean	<u> </u>		<u></u>	<u></u>						<u>, ;,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</u>
Length	728	710	673	705		731	722	72	41	005

Appendix Table 4. Length-frequency distributions of king mackerel caught off northwest Florida, 1968-69 and 1977-79 (M = male, F =

Midpoint	Recreational Hook and Line												
of fork					1	969							
length	<u> </u>	У		Jun			Ju	<u> </u>		<u> </u>	ug _		
interval (mm)	M	<u> </u>	M		-		<u>M</u>	<u>۲</u>		M	<u> </u>		
			~ , ~ ~	- Nur	nber	of f	ISh						
lulio								1			1		
449 Elo								1		2	1 1		
573 6/10	2	2		Ь			1	1		נ פ	6		
7/0	ر 12	2 Q		7	E		1	10		2	2		
849	1	С 4		2	2			13			J		
o 4 9 o 4 o	1	т			2			15					
1049			-										
1149					1			2					
1249					•			1					
	· · · · · · · · · · · · · · · · · · ·							·					
Total	17	15		6	8		1	32		5	24		
	· ,				<u> </u>		·						
Mean													
Length	737	756	68	2 83	24		649	802		589	595		
-				<u></u>		<u></u>							
			Recr	eatio	onal	Hook	and	Line					
	<u> </u>		196	9						1977			
	Se	<u>р</u>	<u>0c</u>	<u>t</u>		No	V			Jun			
· · · · · · · · · · · · · · · · · · ·	<u>M</u>	F	<u> </u>	<u> </u>		<u>M</u>	F		M	<u> </u>	<u> </u>		
				– Nur	mber	of f	ish						
549	2	6											
649	1	5					2						
749		9		1		9	7		5	. 8			
849		6	1	4		3	7		3	9	6		
949		1		Ī			2		1	8			
1049				1						1			
1149				1									
Total	3	27	1	8		12	18		9	26	6		
Moon													
Length	582	716	849	912		774	799		805	857	849		
	-	-		-					-		-		

Midpoint			Recr	eational	Hook	and Li	ne		
of fork				1	977				
length			<u> </u>		Aug			Se	р
interval (mm)	<u>M</u>	F	<u> </u>	M	+	U		M	<u>+</u>
349 449 549 649 749 849 949 1049	3 11 1 11 1 14 8 1	31 07 09 69 21 11	 5 14 14 7 3	- Number 4	of f 1 27 142 44 28 8 3	5 31 15 5 1 1		22 113 112 11 2	2 34 249 247 100 33 7
1249 1249 Total	 49 3	3 1 	1 48	4	255	1			673
Mean Length	790 7	47	764	649	694	705	(594	729
		1077	Recr	eational	Hook	and Li	ne		
		$\frac{19/7}{0ct}$		-	Max	l	9/8	<u>l</u> i	
	M	<u> </u>		-	M M	/ F	-	M	<u>лі</u> F
				- Number	of	fish -			
549 649 749 849 949 1049 1149	6 69 94 11	1 34 49 9 1	1 11 11		1	 2 		1 2 1 1	1 6 8 6 1
Total	180	94	23		I	5		5	23
Mean Length	710	722	.692		649	809		689	862

Midpoint		Recreational Hook and Line												
of fork		<u> </u>	Jul		/ <u>//</u>	Id		Se	D					
interval (m	nm)	М	F	U	M	F		M	F					
*************************************					- Number of	fish								
349			2	٦										
449		22	7	1	101	22		3						
549		126	223	2	164	90		380	356					
649		26	171	1	30	130		34	85					
749		. 1	10		4	6			22					
849		1	21	1	2	7			8					
949		1	12	1										
1049			5			2			_					
1149			3			1			1					
1249			2			1			1					
Total		177	456	7	301	259		417	472					
Mean Length		556	625	620	530	612		556	583					

				Recre	ationa	1 Hook	and L	ine		
		1978					1979			
<i>i</i>		0ct		Apr	May	Jun	Jul	Aug	Sep	0ct
	М	F	U	U	U	U	U	U	U	U
				N	umber	of fisl	n – –			
349 449 549 649 749 849 949 1049 1149 1249	12 68 70 45 8	36 100 39 57 20 1 1	1 6 2 4 1 2	2 8 1 5	15 35 12 5	32 138 64 6 6	1 43 85 33 8 7 2 1	4 178 202 20 3 2 3	2 50 94 17 1 1 2	6 9 8 9 2
Total	203	255	16	16	68	247	180	412	167	34
Mean Length	634	624	630	908	772	679	675	619	639	725

	temale,	U = sex u	nknown).				
	Re	ecreationa	1		Comme	rcial	
Midpoint	Ho	ook and Li	ne		Hook a	nd Line	
of fork		1979			19	68	
length	Jan	Feb	Mar	Ja	in	Fe	b
interval (mm)	U	U		М	F	M	F
			- Number	of fish			
349		2	4				
449		12	30				
549	14	48	175	1		2	6
649	30	136	254	40	45	75	89
749	63	118	281	82	208	81	283
849	108	113	171	11	43	17	50
949	115	32	90	1	12	7	17
1049	30	16	43		6		7
1149	10	5	4		2		4
1249	1						1
Total	371	482	1052	135	316	182	457
		102					
Mean							
Length	861	743	729	728	764	723	754

Appendix Table 5.	Length-frequency distributions of king mackerel caught
	off south Florida, $1968-69$ and $1975-79$ (M = male, F =
	female. U = sex unknown).

	Commercial Hook and Line										
				1	<u>968</u>						
	M	ar	A	\pr	Ma	ay	<u> </u>	in			
	<u> </u>	F	M	F	M	F	M	F			
				Number	of fish						
449				1							
549	4	10			1		1				
649	83	108		1	1		2	4			
749	126	377	-	3 2	10	10	10	19			
849	58	127	15	5 1	25	7	11	7			
949	12	37	Ċ) 7	1	4	2	1			
1049		7	1	5	2	1					
1149				Ì		1		1			
1249		1		1				I			
1349											
1449								x			
1549											
1649			-			1					
Total	283	667	28	3 19	40	24	26	33			
		<u></u>									
Mean Length	746	764	878	3 933	824	878	791	791			

Midpoint	···· ·································		Co	mmerc	ial	Hook	and	d Lin	e		
of fork	<u></u>	·····			1	968					
length	Au	ig			Se	p				0ct	
interval (mm)	M	F			М	F			М	F	U
· · · · · · · · · · · · · · · · · · ·				- No	umber	of f	is	n – –			
349											1
449											1
549										1	
649	1				5	1			12	10	
749	11	15			14	11			4	5	
849	8	10			/	0 4			1	4	
949 1049	Z	9 1			1	2			Z	1	
1149		7			1	1				1	
1249						•				1	
Total	22	38			27	29			19	23	2
Maan						<u> </u>					
Length	799	854			768	849			712	758	399
······································			 0 J	mmerc		Hook	an	d lin	e		
		1968							1969		
	Nov		De	C			Jai	n		Fe	b
	F		M	F	or o	M F fis	l h	F			F
				num		1 113	• • •				
449			_	,							1
549	,		5	4 225		- 1	1	100		-	-
649 749	I		164	235		21	3 (0	109 50h		くて	16
849			104 11	174		10	פי 11	278		2	6
949			2	26		2		92		ī	ŭ
1049	1		ī	3			3	27			4
1149							1	2			3
1249	2										1
Total	4	~	445	671		70	9	1102		15	43
Mean	1070		707	748		 74	.1	789		742	821
Longth	L L L L		, .,	770		ר,		103		, 74	ΨZ Ι

Midpoint			Commer	cial	Hook and	Line		
OF TOPK				1	969	·		
rengtn	<u>~~~</u>		<u>JL</u>	<u> </u>	AL		NC	<u></u>
Interval (mm)		۲ ۲	M	r lumbor	of fich		<u> </u>	<u> </u>
			r	umber	01 TISH			
649	5	2	1			1	3	1
749	Ĺ	16	13	10	1	4	3	5
849		10	10	15	10	ní	7	15
949	1	2	2	2		1	,	'n
1049		ī		5		1	1	7
1149		-		2		·	·	2
1249				_		1		3
	· · · · · · · · · · · · · · · · · · ·							
Total	10	31	26	34	11	19	14	44
		<u> </u>						
Mean								
Length	719	797	799	873	840	854	799	931
	1060		Commerc	ial Ho	ook and L	.ine		
	Dec	F	Jan U	horot	197 <u>Feb</u> U	'5 <u>Mar</u> U		Apr U
	 M	F	<u>Jan</u> U Num	iber of	197 <u>Feb</u> U f fish -	<u>Mar</u> U		Apr U
	 	F 	Jan U Num	iber of	<u>197</u> <u>Feb</u> U fish -	<u>Mar</u> U 		Apr U
 449 549	 	F 	<u>Jan</u> U Num 2	iber of	<u>197</u> Feb U fish - 1 37	<u>Mar</u> U 1 8		Apr U
 449 549 649	Dec M 1 1	F 3 5	<u>Jan</u> U Num 2 73	iber of	197 Feb U fish - 1 37 420	<u>Mar</u> U 1 8 61		Apr U
449 549 649 749	Dec M 1 1 1	F 3 5	<u>Jan</u> U Num 2 73 245	iber of	<u>197</u> Feb U fish - 1 37 420 652	<u>Mar</u> U 1 8 61 38		Apr U 5 20
449 549 649 749 849	 M 1 4 1	F 3 5 1	<u>Jan</u> U Num 2 73 245 184	iber of	<u>197</u> <u>Feb</u> J fish - 1 37 420 652 201	<u>Mar</u> U 1 8 61 38 8		Apr U 5 20 10
449 549 649 749 849 949	<u>Dec</u> 	F 3 5 1	<u>Jan</u> U Num 2 73 245 184 29	iber of	197 Feb U fish - 1 37 420 652 201 27	<u>Mar</u> U 1 8 61 38 8 1		Apr U 5 20 10
449 549 649 749 849 949 1049	Dec M 1 1 1 1	F 3 5 1	<u>Jan</u> U Num 2 73 245 184 29 1	iber of	197 Feb U fish - 1 37 420 652 201 27 5	<u>Mar</u> U 1 8 61 38 8 1		Apr U 5 20 10
449 549 649 749 849 949 1049	1909 Dec M 1 4 1	F 3 5 1	<u>Jan</u> U Num 2 73 245 184 29 1	iber of	197 Feb U fish - 1 37 420 652 201 27 5	<u>Mar</u> U 1 8 61 38 8 1		Apr U 5 20 10
449 549 649 749 849 949 1049 Total	 M 1 4 1	F 3 5 1 9	<u>Jan</u> U Num 2 73 245 184 29 1 1 534	iber of	197 Feb U f fish - 1 37 420 652 201 27 5 1343	<u>Mar</u> U 1 8 61 38 8 1 1 117		Apr U 5 20 10 35
449 549 649 749 849 949 1049 Total	 M 1 4 1 6	F 3 5 1 9	<u>Jan</u> U Num 2 73 245 184 29 1 1 534	iber of	197 Feb U f fish - 1 37 420 652 201 27 5 1343	<u>Mar</u> U 1 8 61 38 8 1 1 117		<u>Apr</u> U 5 20 10 35
449 549 649 749 849 949 1049 Total Total Mean Length	 M 1 4 1 1 6 6	F 3 5 1 9 638	<u>Jan</u> U Num 2 73 245 184 29 1 1 534 780	iber of	197 Feb U fish - 1 37 420 652 201 27 5 1343 732	<u>Mar</u> U 1 8 61 38 8 1 1 117 689		Apr U 5 20 10 35 763

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Midpoint	· · · · · ·	C	ommercia	1 Hook a	nd Line		
of fork			1975			19	76
length	May	Jun	Aug	Oct	Dec	<u>Jan</u>	Feb
interval (mm)	U	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
			Numb	er of fi	sh		
549	5	2			13	6	15
649	35	18	27	1	104	104	465
749	214	66	105	2	106	135	704
849	99	28	54		21	47	409
949	19	6	12			10	157
1049	Ī		5			2	34
1149		1					9
1249							2
1349							1
Total	373	121	203	3	244	304	1796
			······································				
Mean	771.	767	780	716	704	725	770
Length	//4	/0/	/02	710	,,,,		//0
		· .	Commerci	al Hook	and Line	1	
				1976	· · · · · · · · · · · · · · · · · · ·		
	Mar	Apr	May	Jun	Aug	Oct	Dec
	<u> </u>	<u> </u>	<u> </u>	<u>U</u>	<u> </u>	U	<u> </u>
			NUMC	ber of fi	sn		
449	10						
549	33		4	1	4		75
649	1284	5	132	21	27	14	467
749	1301	11	520	113	73	24	1085
849	267	14	407	34	47	14	509
949	12	6	133	9	12	7	104
1049			26	2	3	(25
1149			5			1	1
1249		· ·					
Total	2907	36	1226	180	166	61	2266
Mean	· <u></u>	<u> </u>					
Length	712	807	800	768	776	783	757
<u></u>					<u></u>		

Midpoint		Commercial Hook and Line										
of fork				19// May	lun	Δ~		Dec				
length	<u>_Jan</u>	<u>- rep</u>			<u> </u>	Aug	-					
			N	umber of	fish -							
			·									
549	23	164		4	2							
649	214	990		33	48	15		76				
749	670	1873		152	144	111		200				
849	252	841		100	48	70		281				
949	32	202		37	4	28		122				
1049	2	27		8		3		27				
1149		9		I								
1249								l				
Total	1193	4106		335	246	227		708				
Mean Length	754	750		797	751	802		825				
			Commer	cial Hoo	k and Lin	ne						
				1978								
	<u>Jan</u>	<u>Feb</u>	<u></u>	<u>May</u>	Jun	M	Sep					
			N	lumber of	fish - ·							
				_		_						
549	14	4	2	1		1	_					
649 740	/46	186	256	4	-	4	3					
/49 840	1201	525	1410	100	5	98	2/	I				
049	435	20/	1003	100 E6	11	05 15	20					
1049	5	12	26	16	2	21	50					
1149	3	5	20	2	4	2	1					
1249	2	Ĩ	Ī	-			•					
Total	2475	1107	2931	378	20	205	138	1				
							· · ·	<u></u>				
Mean												

`

Midpoint		Commercial Hook and Line								Gill 196	Net
length			lan		119	Ma	r	-		دل	<u>n</u>
interval (mm)	-	M	F			M	F	-		<u></u> M	F
					- Num	ber of	fisl	ı			
349 449			1								
549 649		16	18	1		10	11	Ę		54	14
749		84	94	2		16	30)		151	192
849		30	80	3		7	3:	3		116	163
949		2	36	2		,	Ĩ	5		34	54
1049		1	7							6	32
1149			•								16
1249			1								1
1349											1
Total		209	346	12		33	8	5		361	473
Mean											
Length		715	757	716		740	788	3		790	839
					Gi	11 Net					
						1968					
	Fe	<u>eb</u>		Ma	ar		Ap	<u> </u>		<u>Nc</u>	<u>v –</u>
	M	F		<u> </u>	F		<u>M</u>	F		M	F
					Numbe	r of fi	sh ·				
549	2			1				2			
649	199	66		94	29		2	2			
749	438	540		198	230		3	6		1	
849	148	184		119	197			2		1	2
949	5	24		41	75			1			ľ
1049		2		7	36						
1149					11.						
Total	792	816		460	578		5	13		2	3
Mean Length	743	770		776	830		709	734		799	882
				.,-		,					

Midpoint			·		Gill	11 Net				
of fork		196	69		1976		1977		1978	
length	M	lar	Ap	r	Feb	Jan	Feb	Mar	Apr	
interval (mm)	M	F	М	F	UU		U	U	U	
					Number	of fish				
549 649 749 849 949 1049 1149 1249 1349	3 3 2	1 2 6 2 1	3 4 3	4 4 3 1	40 230 42 1	3 370 1134 807 347 96 12 8	58 502 393 98 7 3 1	17 82 61 55 57 26 7 1	83 849 364 9	
Total	8	12	10	12	313	2777	1062	306	1305	
Mean Length	837	857	749	857	750	803	803	903	772	

.

		female,	U =	sex unkn	own)						
Midpoir	nt			Recrea	tio	nal H	ook a	nd Line				
of forl	k					197	8					
length		Au	Aug		Sep				Oct			
interval	(mm)	F	U		Μ	F	U		Μ	F	U	
<u></u>		~			Num	ber o	ffis	h				
549					1		4		21	21	4	
649			1				1		5	16		
749			1		1		9		59	52	2	
849		3					53		58	87		
949		-	2			1	39		10	37		
1049			3				16		3	23		
1149			-				5			9		
1249							-			2		
1349										1		
Total		3	7		2	1	127		156	248	6	
Mean Length		849	920	6	49	949	899		775	839	616	

Appendix Table 6. Length-frequency distributions of king mackerel caught off South Carolina and Georgia, 1978 (M = male, F = female, U = sex unknown).

	Sex	unkno	W(I) •			· · · · · · · · · · · · · · · · · · ·				
Midpoint		·	Recre	ational	Hook	and Li	ne			
of fork		·	<u> 197</u>	7					<u>1978</u>	
length	<u>May</u>		Jun	M			M		May	
Interval (mm)				Number	of f			-		
549 649 749 849 949	6 21 15 3		10 13 4 1	1	3	3 2 3 3		5 6 2	3 8 19 11	1 2 1
Total	45		28	2	4	11	1	3	41	4
Mean Length	682		735	799	724	804	72	.6	842	749
			Recr	eationa	1 Нос 1978	ok and L	ine			
		Jun			Jul				Aug	
· · · · · · · · · · · · · · · · · · ·	M	F	<u> </u>	M	F	U	M		F	U
Eho				- Numbe	ror	tish -		-		
649	1	6	6					1	ı	
749	1	5	9		3				•	1
849		4	4	2	8	3		2	5	
949		4	2		2	1			8	
1149			2				•		2	1
Total	2	19	24	2	13	4		3	16	2
Mean Length	699	781	803	849	841	874	74	9	912	949

Appendix Table 7. Length-frequency distributions of king mackerel caught off North Carolina, 1977-78 (M = male, F = female, U = sex unknown).

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Midpoin	t	Recreational Hook and Line										
of fork					19	78		·				
length			Sep		· · · · · · · · · · · · · · · · · · ·	Oct			No	V		
interval (mm)	<u>M</u>	<u>F</u>	<u> </u>	<u> </u>	F	<u> </u>		F	<u> </u>		
					- Number	of fis	:h					
549		1	1	8		1						
649				4		1	2			1		
749			I	24	34	48	24			1		
849		2	21	37	62	117	47			4		
949		2	18	14	6	62	3		2			
1049			7	4	1	21	4		4			
1149						5	2		4			
1249						i						
Total		5	48	91	103	256	82		10	6		
Mean												
Length		829	907	812	824	876	836		1069	799		
					Commercial	Hook	and L	.ine				
				19	78				1979			
			Sep		0ct	•			May			
			U		U	•		<u>1</u> /	<u>u2/</u>	<u>u3/</u>		
					Number	of fi	sh -	~				
549			7									
649			4		2			21	5			
749			19		10			9	55	42		
849			29		19			4	24	389		
949			11		2			1	7	201		
1049			2		2					39		
1149					1					10		
1249										2		
Total	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	72		36			35	91	683		
Mean Length			804	<u></u>	836			703	784	887		
-					-				-	•		

 $\frac{1}{2}$ 10-11 Fathoms $\frac{2}{2}$ 12-17 Fathoms $\frac{3}{2}$ 18-30 Fathoms