Variations in Size and Sex Ratio of King Mackerel, *Scomberomorus cavalla*, off Louisiana, 1977-85

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ABSTRACT—Data from over 27,000 king mackerel, Scomberomorus cavalla, *collected from Grand Isle, Louisiana, during 1977-85 were analyzed to evaluate temporal variations in size and sex compositions. The fish were caught by recreational and commercial hook-and-line fishermen.*

Groups of king mackerel from Louisiana were composed of a greater portion of large fish than were populations from other areas in the southeastern United States with the possible exception of South Carolina and Georgia. Large (>120 cm fork length) king mackerel were caught off Louisiana throughout the year. For both males and females, catches were composed of the smallest fish in April through October and the largest fish between November and March. Females dominated catches in most months and comprised a greater portion of the recreational than the commercial landings. Female percentage was usually lower in the warmer than in the colder months. In general, female percentage increased with an increase in fish size.

Introduction

A commercial hook-and-line fishery for king mackerel *Scomberomorus cavalla*, began off Louisiana during the winter of 1981-82. Three fishermen from Florida, along with their crews, began fishing for king mackerel off Grand Isle and landed over 12,000 pounds between 26 December and 15 January. The fishery expanded dramatically the following winter (November 1982-January 1983) when an estimated 30-50 boats landed over 1 million pounds of king mackerel at Grand Isle.

As the fishery expanded, interest in king mackerel off the Louisiana coast increased among fishermen, fishery managers, and fishery scientists. Information about king mackerel off Louisiana, however, was sparse. A newspaper article Marshall, 1983 in *The Times-Picayune*—based on interviews with charterboat captains, commercial fishermen, fish dealers, fishery managers, and fishery scientists—reported on the developing fishery and on many known or hypothesized aspects of king mackerel that occurred off Louisiana. Marshall provided the following: In the mid-1960's, charterboat skippers at Grand Isle became aware that large king mackerel, many in the 40-60 pound range, were available around the oil rigs 10-20 miles southeast of Grand Isle. According to fishermen that Marshall interviewed, the "winter kings" were fish between 35 and 60 pounds, showed up in November, reached peak numbers in January, and stayed on until mid-March; the "summer kings" or "Florida kings," which were 15-25 pounders and small numbers of which were around the whole year, seemed to peak in abundance from early June through August.

Trent et al. (1983) hypothesized that members of the group of large (>90 cm FL) king mackerel that occur off Grand Isle in the winter probably occur adjacent to oil rigs at depths of 10-50 fathoms over a broad area from the Mississippi Delta westward to areas off Texas, and that these fish do not participate in extensive north-south migrations as do smaller king mackerel. This hypothesis was mostly based on evaluation of length data of king mackerel from the southeastern United States (Trent et al., 1981) and on results of tagging studies in south Florida (Williams and Godcharles[1]) and areas of the northern Gulf (Sutherland and Fable, 1980).

This paper compares data on king mackerel length and sex distribution obtained in 1981-85 with those published previously.

Methods

Two data sets reporting lengths and sex ratios of king mackerel caught in Louisiana are published. One set includes weights (lengths were not reported) and sex ratios by season from 623 king mackerel weighed at Grand Isle from December 1977 through 30 November 1978 (Fischer, 1980). Weights from the weight-frequency histograms provided by Fischer were converted to lengths using constants ($a = 0.8464 \times 10^{-5}$ and $b = 2.9881$ for the equation $W = aL^b$, where W = weight in grams and L = fork length in millimeters) provided by Johnson et al. (1983). The length-frequency distributions and numbers of each sex are given in Table 1. The second data set included length and sex information on king mackerel from the southeastern United States (Trent et al., 1981, 1983). Data summaries and analy-

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[1]Williams, R. O., and M. F. Godcharles. 1983. Completion report. King mackerel tagging and stock assessment project 2-341-R. Florida Dep. Nat. Resour. Unpubl. Rep., 45 p.

Table 1.—Length-frequency distributions and numbers of each sex of king mackerel caught by recreational fishermen off Grand Isle, La., from December 1977 through November 1978 (from Fischer, 1980).

Midpoint of weight interval		Fork length	Number of fish			
lb	kg	(cm)	Dec.-Feb.	Mar.-May	June-Aug.	Sept.-Nov.
7.5	34	76		1	1	
12.5	57	90	8	2	24	15
17.5	79	101	17	8	57	40
22.5	102	109	14	14	63	17
27.5	125	117	10	20	33	5
32.5	147	124	14	31	26	1
37.5	170	130	10	32	26	2
42.5	193	135	7	39	7	4
47.5	216	141	8	25	10	3
52.5	238	145	5	12	1	2
57.5	261	150	1	3	1	
62.5	284	154	1	2		
67.5	306	158	1			
		Male	7	6	26	3
		Female	89	183	223	86

Table 2.—Numbers of king mackerel examined from the recreational fisheries in 1977-80 and from commercial fisheries in 1981-85 in Louisiana (M = male, F = female, U = sex unknown, and A = sexes combined).

Year and mo.	Recreational				Year and mo.	Commercial			
	M	F	U	A		M	F	U	A
1977					1981				
Feb.	1	24		25	Dec.	3	39		42
June	2	16	40	58					
July			32	32	1982				
Aug.			19	19	Dec.	39	235		274
Sept.	8	59		67					
Oct.	10	135	6	151	1983				
Dec.	3	38		41	Jan.	31	203	376	610
					Feb.	1	46	78	125
1978					Mar.			329	329
Jan.	3	36		39	Apr.	267	74		341
Feb.	8		8	16	Aug.	90	101	41	232
Mar.	4	64		68	Sept.	223	364	26	613
Apr.		3		3	Oct.	105	354	84	543
May	1	4		5	Nov.	24	24	20	68
June	7	60	1	68	Dec.			1,074	1,074
July	13	86	1	100					
Aug.	5	81		86	1984				
Sept.		24	1	25	Jan.	194	307	124	625
Oct.	4	75		79	Feb.	773	1,096	223	2,092
Nov.		34		34	Mar.	965	1,616	222	2,803
Dec.		7		7	Apr.	2		2	4
					May	56	6		62
1980					June	481	321	7	809
May	1			1	July	692	979	27	1,698
June	11	17	1	29	Aug.	81	249	2	332
July	5	30		35	Sept.	142	162	48	352
Aug.		35	4	39	Oct.	233	478	30	741
Sept.	3	43	1	47	Nov.	454	1,299	49	1,802
Oct.	8	50	2	60	Dec.	1,887	3,473	368	5,728
					1985				
					Jan.	124	370	32	526
					Feb.	1	9	0	10
					Mar.	100	119	4	223
					Apr.	0	1	0	1
					May	393	214	20	627
					June	420	264	33	717
					July	608	874	93	1,575
					Aug.	220	376	18	614
					Sept.	6	30	21	57
					Oct.	99	350	4	453
					Nov.	105	241	52	398
					Dec.	119	164	35	318

Table 3.—Number, mean fork length ($\bar{x}$ in centimeters), and sex ratio by month for king mackerel caught off Louisiana, 1977-85.

Gear, year, and mo.	Male		Female		Unknown		Sexes comb.		Percent female
	No.	$\bar{x}$	No.	$\bar{x}$	No.	$\bar{x}$	No.	$\bar{x}$	
Recreational hook and line									
1977									
Feb.	1	107	24	124	0		25	124	96.0
June	2	97	16	102	40	106	58	105	88.9
July					32	107	32	107	
Aug.					19	113	19	113	
Sept.	8	97	59	96	0		67	96	88.1
Oct.	10	89	135	103	6	98	151	102	93.1
Dec.	3	96	38	117	0		41	115	92.7
1978									
Jan.	3	92	36	116	0		39	114	92.3
Feb.	0		8	129	0		8	129	100.0
Mar.	4	124	64	130	0		68	129	94.1
Apr.	0		3	132	0		3	132	100.0
May	1	112	4	112	0		5	112	80.0
June	7	100	60	115	1	97	68	113	89.5
July	13	99	86	112	1	127	100	110	86.9
Aug.	5	93	81	117	0		86	115	94.2
Sept.	0		24	111	1	97	25	110	100.0
Oct.	4	94	75	105	0		79	105	94.9
Nov.	0		34	120	0		34	120	100.0
Dec.	0		7	125	0		7	125	100.0
1980									
May	1	72	0		0		1	72	0.0
June	11	34	17	46	1	37	29	41	60.7
July	5	72	30	97	0		35	95	85.7
Aug.	0		35	75	4	59	39	74	100.0
Sept.	3	85	43	82	1	89	47	83	93.5
Oct.	8	67	50	76	2	59	60	74	86.2
Commercial hook and line									
1981									
Dec.	3	91	39	98	0		42	98	92.9
1982									
Dec.	39	92	235	100	0		274	99	85.8
1983									
Jan.	31	89	203	104	376	102	610	102	86.7
Feb.	1	122	46	117	78	112	125	114	97.9
Mar.					329	103	329	103	
Apr.	267	74	74	75	0		341	74	21.7
Aug.	90	83	101	87	41	84	232	85	52.9
Sept.	223	80	364	77	26	73	613	78	62.0
Oct.	105	86	354	89	84	85	543	88	77.1
Nov.	24	79	24	82	20	88	68	83	50.0
Dec.					1,074	96	1,074	96	
1984									
Jan.	194	92	307	99	124	99	625	96	61.3
Feb.	773	90	1,096	99	223	94	2,092	95	58.6
Mar.	965	91	1,616	97	222	95	2,803	95	62.6
Apr.	2	77	0		2	107	4	92	0.0
May	56	86	6	111	0		62	88	9.7
June	481	81	321	85	7	87	809	83	40.0
July	692	87	979	92	27	95	1,698	90	58.6
Aug.	81	84	249	94	2	65	332	91	75.4
Sept.	142	83	162	86	48	84	352	85	53.3
Oct.	233	88	478	93	30	90	741	91	67.2
Nov.	454	89	1,299	96	49	95	1,802	94	74.1
Dec.	1,887	89	3,473	95	368	92	5,728	93	64.8
1985									
Jan.	124	91	370	99	32	102	526	97	74.9
Feb.	1	107	9	117	0		10	116	90.0
Mar.	100	85	119	85	4	96	223	85	54.3
Apr.	0		1	87	0		1	87	100.0
May	393	82	214	90	20	83	627	85	35.2
June	420	81	264	89	33	86	717	84	62.9
July	608	78	874	82	93	80	1,575	81	59.0
Aug.	220	78	376	87	18	86	614	83	63.1
Sept.	6	78	30	86	21	95	57	89	83.3
Oct.	99	88	350	95	4	80	453	93	77.9
Nov.	105	87	241	95	52	117	398	96	69.6
Dec.	119	87	164	93	35	88	318	90	56.9

Table 4.—Percentage composition of female king mackerel by type of gear, year, and size class. Ratios in parentheses were determined from samples <10 fish.

Fork length interval (cm)	Rec. hook and line			Comml. hook and line				
	1977	1978	1980	1981	1982	1983	1984	1985
30-49			48.3			(50.0)		(0.0)
50-69	(100.0)		95.6			60.2	29.3	73.1
70-89	85.4	80.0	90.5	(85.7)	64.3	47.4	52.3	48.3
90-109	90.2	86.5	76.5	93.3	88.0	75.7	70.2	70.0
110-129	98.1	97.9	90.0	(100.0)	100.0	97.2	97.4	91.9
130-149	100.0	98.9	100.0		(100.0)	100.0	100.0	97.9
150-169	(100.0)	(100.0)			(100.0)	(100.0)	(100.0)	
30-169	91.9	92.9	86.2	92.9	85.8	61.1	62.6	57.8

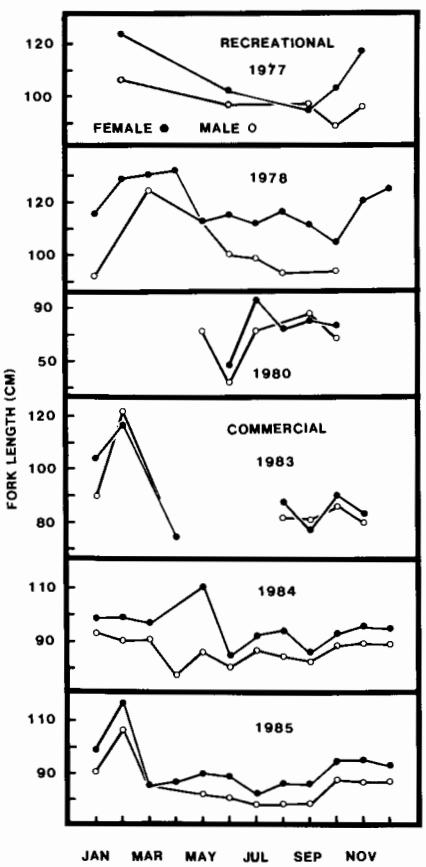

Figure 1.—Monthly mean fork lengths of king mackerel caught off Louisiana by sex, year, and type of fishing.

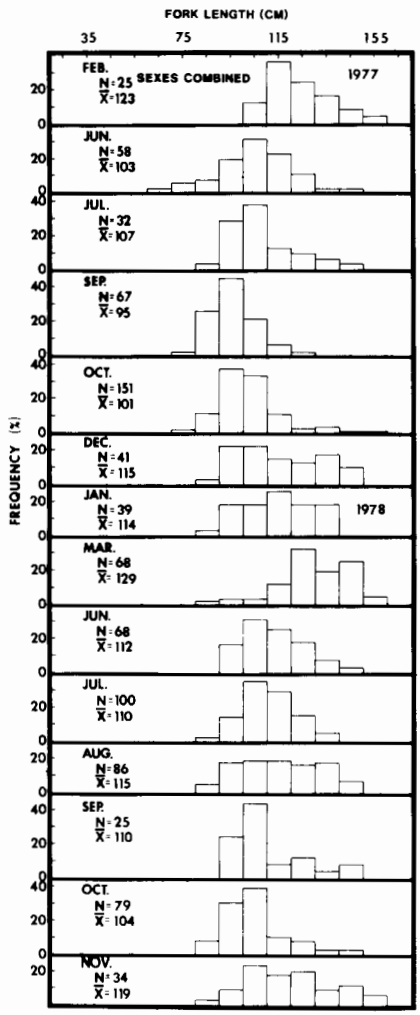

Figure 2.—Length-frequency distribution of both sexes of king mackerel caught by recreational hook and line, 1977-78.

ses that pertain to Louisiana from the published data are assembled with the newly acquired data and are reproduced in this report.

King mackerel were sampled from recreational landings during 1977-80 (Fischer, 1980; Trent et al., 1983) and from commercial landings during 1981-85 from Louisiana. The fish were caught by recreational fishermen using a wide assortment of baits and artificial lures while trolling and by drifting live sand seatrout, *Cynoscion arenarius*, Atlantic croaker, *Micropogonias undulatus*, or other species near oil rigs located in water depths from 12 to 45 m. The baits for drift fishing were large and usually ranged in weight from 0.2 to 0.7 kg. In the commercial hook-and-line fishery, lines with spoons, nylon filament jigs (often with strips of fish), and baits such as the cigar minnow, *Decapterus punctatus*, were trolled behind boats and retrieved manually or with hydraulic or electric reels (Harris, 1974; Marshall, 1983). Planers or weights were often used to fish the lures deep.

Length measurements were taken from both whole and gutted fish. Fork lengths were measured from the tip of the snout (mouth closed) to the fork of the tail to the nearest millimeter, centimeter, or 0.1 inch. All measurements were later converted to millimeters or centimeters. Data were summarized in relation to sex, capture gear, and month. Length data were grouped into 1, 2.5, and 10 cm intervals during preliminary analysis. In this report, length data are presented in 5 or 10 cm intervals.

The numbers of king mackerel that were measured and sexed are in Table 2; sex ratios by month and mean length by sex and month are in Table 3; and sex ratios by year and length interval are in Table 4. The third set of length measurements of king mackerel were taken from December 1981 through December 1985 from the newly developed commercial hook-and-line fishery out of Grand Isle and from biologists obtaining fish for tagging. These data have been summarized and are included in Tables 2-4.

Results

Size

King mackerel caught in Louisiana ranged in fork length from 30 to 155 cm; monthly mean fork lengths (sexes combined) ranged from 41 to 132 cm (Table 3). Mean lengths of females were greater than those for males in 40 of 45 months, and were the same for the two sexes in 2 months, when comparative data (lengths for each sex) were available (Fig. 1).

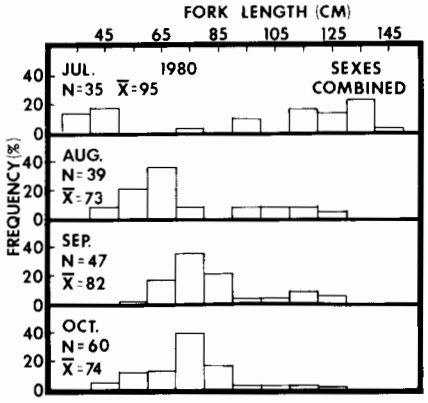

Figure 3.—Length-frequency distributions of both sexes of king mackerel caught by recreational hook and line, 1980.

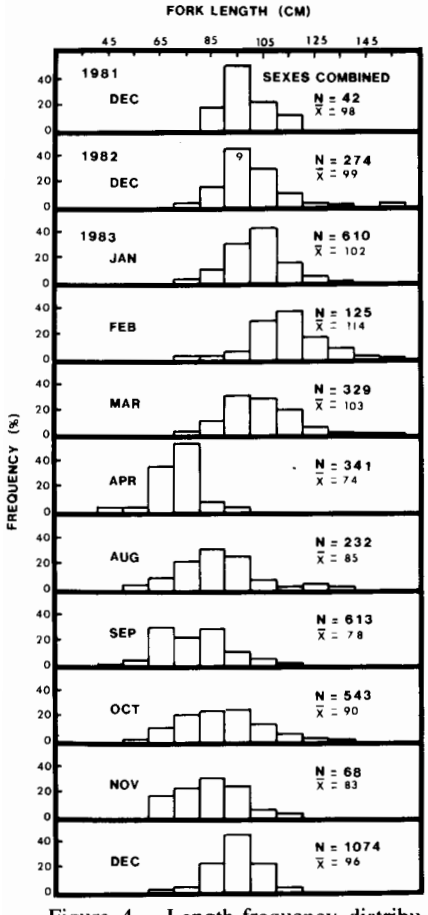

Figure 4.—Length-frequency distributions of both sexes of king mackerel caught by commercial hook and line, 1981-83.

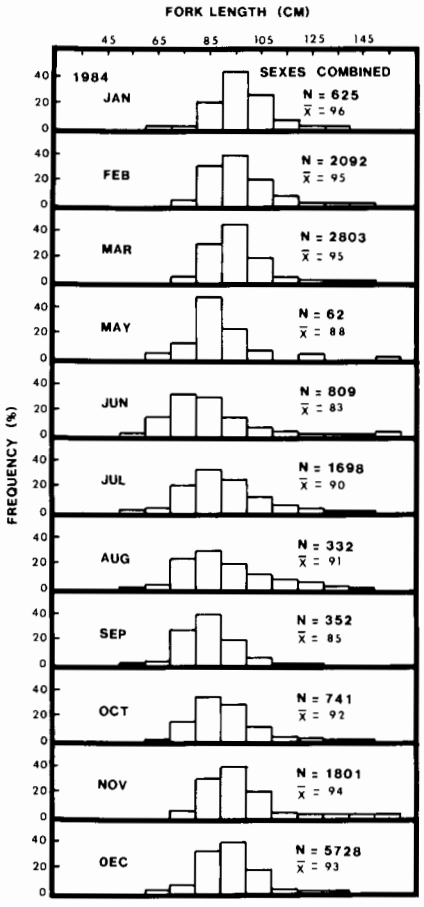

Figure 5.—Length-frequency distributions of both sexes of king mackerel caught by commercial hook and line, 1984.

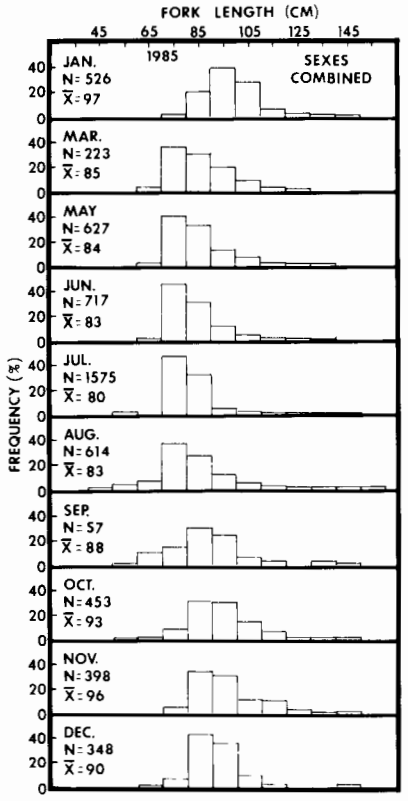

Figure 6.—Length-frequency distributions of both sexes of king mackerel caught by commercial hook and line, 1985.

Data from both recreational and commercial fisheries showed that large (>90 cm FL) king mackerel are available throughout the year and that greater portions of large fish occur during the colder months (Fig. 1-6). King mackerel caught in the recreational fishery in 1977-80 (Fig. 2-3) averaged larger and the catches were composed of more large fish than those caught in the commercial fishery in 1983-85 (Fig. 4-6).

In general, mean lengths of members of each sex were closely correlated through time (Fig. 1). For both females and males the catches were composed of the smallest fish during April through October of each year (Fig. 7-14).

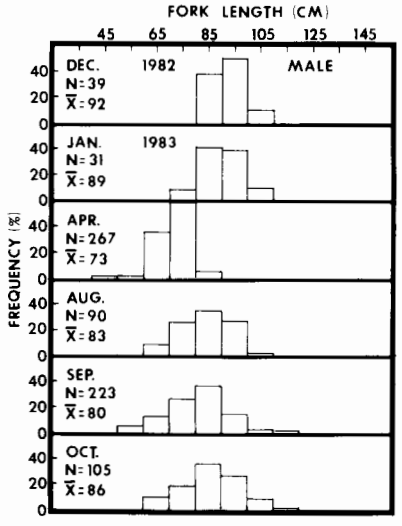

Figure 7.—Length-frequency distributions of male king mackerel caught by commercial hook and line, 1982-83.

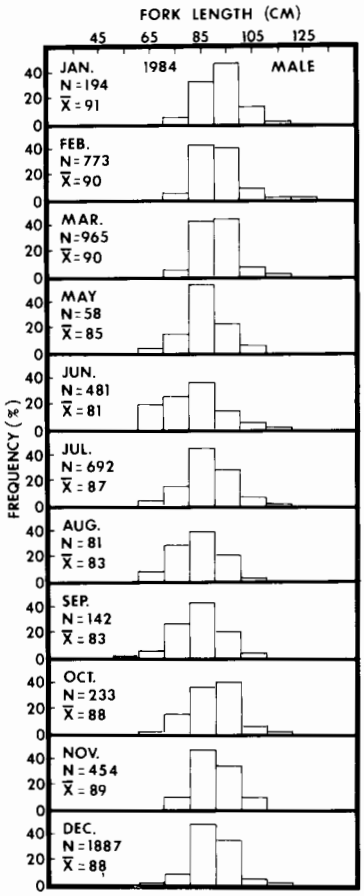

Figure 8.—Length-frequency distributions of male king mackerel caught by commercial hook and line, 1984.

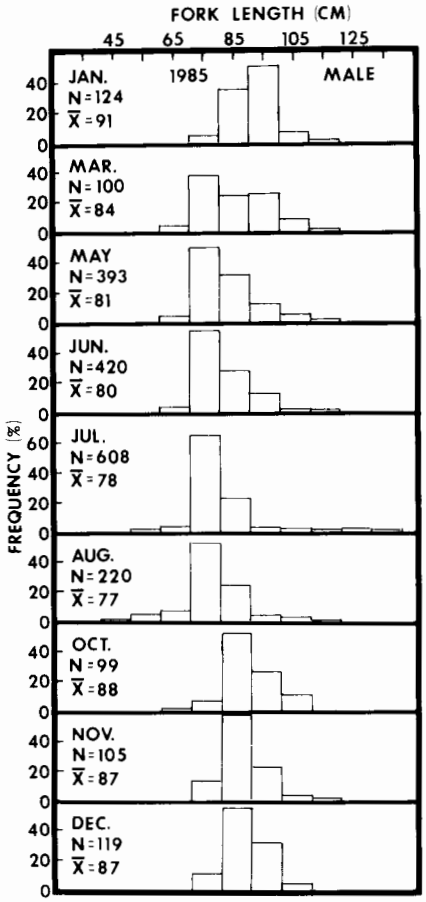

Figure 9.—Length-frequency distributions of male king mackerel caught by commercial hook and line, 1985.

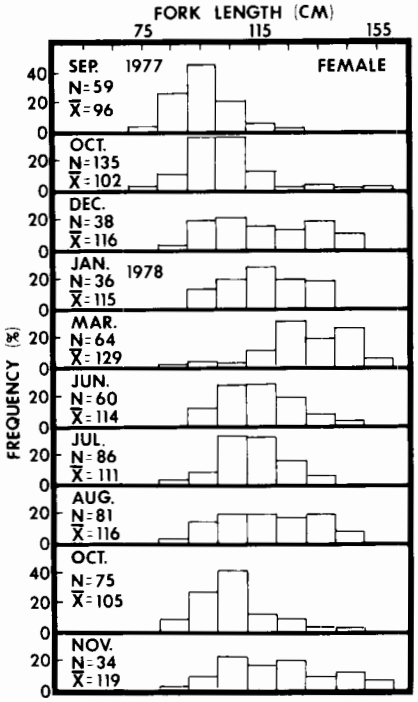

Figure 10.—Length-frequency distributions of female king mackerel caught by recreational hook and line, 1977-78.

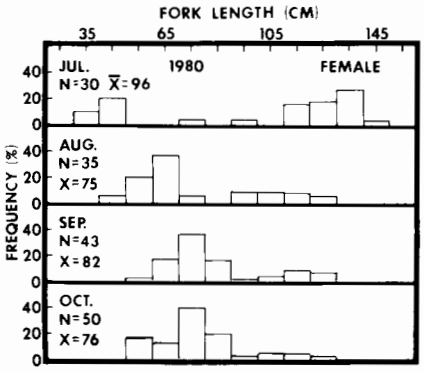

Figure 11.—Length-frequency distributions of female king mackerel caught by recreational hook and line, 1980.

Sex Ratio

Females dominated catches in most months (Table 3, Fig. 15). Females comprised a greater portion of the recreational than of the commercial landings. Annual sex ratios (female percentage) by gear type for those years with sample sizes of 100+ fish were: Recreational 1977, 91.9 percent; 1978, 92.9 percent; 1980, 86.2 percent. Commercial 1982, 85.8 percent; 1983, 61.1 percent; 1984, 62.6 percent; and 1985, 57.8 percent. Female percentage was below 70 percent in the recreational fishery only in 1 of 21 months, whereas in the commercial fishery the value was below 70 percent in 19 of 29 months (Fig. 15). When all years were evaluated, female percentage was always lowest in May or June in the recreational landings and in April or May in the commercial landings (Fig. 15).

The degree of dominance of female king mackerel varied in relation to size of fish and in relation to capture gear, year, or both (Table 4). For the recreational

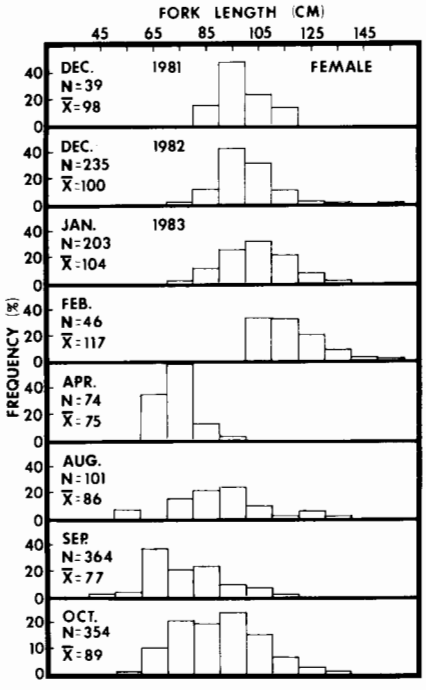

Figure 12.—Length-frequency distributions of female king mackerel caught by commercial hook and line, 1981-83.

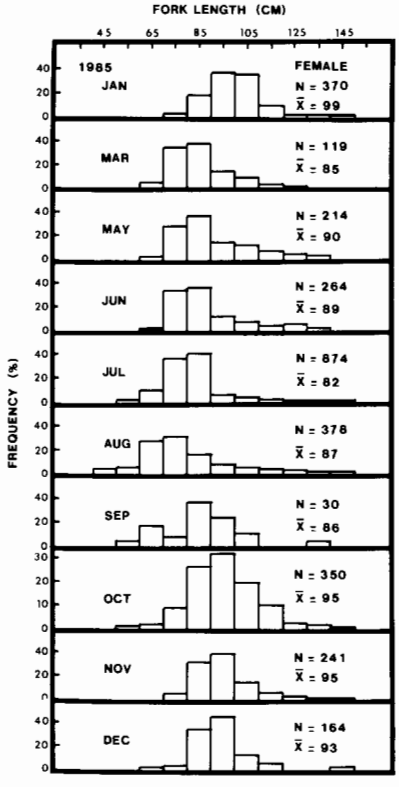

Figure 14.—Length-frequency distributions of female king mackerel caught by commercial hook and line, 1985.

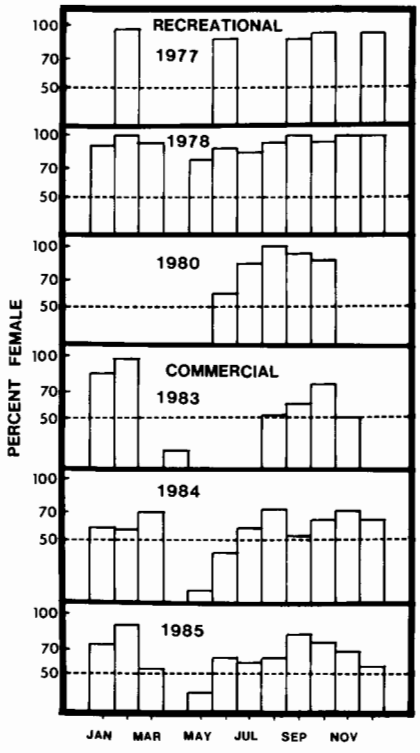

Figure 15.—Percentage of female king mackerel caught off Louisiana by month, year, and fishery.

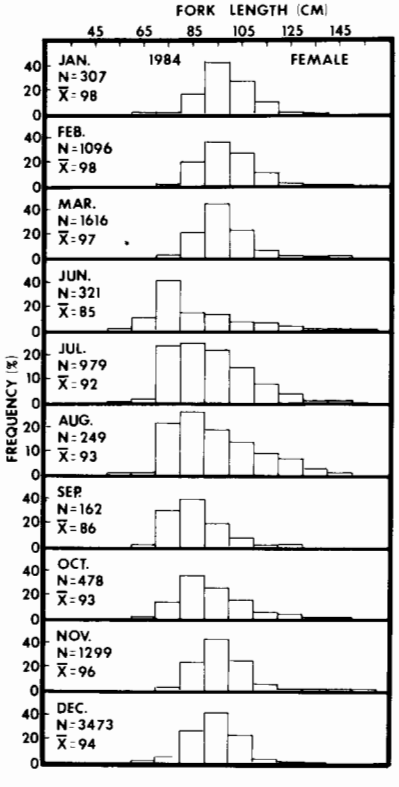

Figure 13.—Length-frequency distributions of female king mackerel caught by commercial hook and line, 1984.

fishery in the years 1977-80, female percentage increased with an increase in fish size in every case except for the 70-89 and 90-109 cm size classes in 1980. The same general trend of increasing female percentage with increasing fish size was reflected in the commercial data, but the female percentage was much lower in fish <90 cm in the commercial than in the recreational landings.

Discussion

Seasonal changes in size and sex ratio were not as apparent in the recreational landings as in the commercial landings. Recreational fishermen seek the largest fish and use techniques such as drifting live fish around oil rigs to increase their probability of catching the largest fish (Trend et al., 1983). Commercial fishermen are interested in large landings in pounds and dollars and their fishing strategy varies depending on fish availability

Table 5.—Monthly mean fork lengths of king mackerel caught by commercial hook and line in the southeastern United States, 1981-85 (for sample sizes ≥25 fish).

Year and mo.	Mean fork length (cm)						
	LA	NC	SC	GA	EFL[1]	SFL[2]	NWFL[3]
1981							
Jan.					73	81	
Feb.					71	73	
Mar.					69	71	
Apr.					75		
May					80		
June					84		
July					78		
Nov.						77	
Dec.	98				83	75	
1982							
Jan.					79		
Feb.					79		
Mar.					76		
Apr.					74		
Dec.	99				86		
1983							
Jan.	102				82		
Feb.	114				72		
Mar.	103				77		
Apr.	74						
May					91		
Aug.	85						62
Sept.	78						
Oct.	88	85					
Nov.	83	86					
Dec.	96						
1984							
Jan.	96	86			66		
Feb.	95	77			72		
Mar.	95				70		
Apr.				94	74		
May	88		94				
June	83		92	90			
July	90		91	87			
Aug.	91		92		82		
Sept.	85		86		87		73
Oct.	91	82	82				73
Nov.	94	84	88				
Dec.	93	89	88				
1985							
Jan.	97						
Mar.	85						
May	85						
June	84						
July	81						
Aug.	83						
Sept.	89						
Oct.	93						
Nov.	96						
Dec.	90						
Non-weighted mean	90.7	84.1	89.1	90.3	77.4	75.4	69.3

[1]East Florida from Holly Hill to Boca Raton.
[2]South Florida from Key Largo to Key West.
[3]Northwest Florida from Yankee Town to Alabama-Florida line.

and price paid per pound for each size of fish. In the king mackerel fishery off Grand Isle in 1983-85, the price paid per pound for fish under 10-15 pounds was often much more than that paid for fish above this size; occasionally a market did not exist for the large fish. During times of depressed prices for large fish, and times of the year when small fish comprise greater portions of the population, the commercial fishermen land mostly smaller fish with males comprising a greater portion of the landings.

Groups of king mackerel off Grand Isle are composed of greater portions of large fish than in most areas of the southeastern coast of the United States and Gulf of Mexico based on recreational and commercial landings. Mean fork lengths of recreationally caught king mackerel in 1978-79 were: Texas, 87 cm; Louisiana, 114 cm; northwest Florida, 59 cm; south Florida, 76 cm; and North Carolina, 85 cm (Trent et al., 1983). Mean lengths of king mackerel caught in commercial hook-and-line fisheries in the southeastern United States were generally larger in Louisiana than other areas except South Carolina and Georgia (Table 5). Much less is known about size composition of the king mackerel off South Carolina and Georgia than off the Louisiana coast; the possibility of congregations of larger fish in more offshore areas of South Carolina was suggested by Williams and Godcharles[1] who caught larger fish in offshore than in inshore areas.

Literature Cited

Fischer, M. 1980. Size distribution, length-weight relationships, sex ratios, and seasonal occurrence of king mackerel (*Scomberomorus cavalla*) off the southeast Louisiana coast. La. Dep. Wildl. Fish. Tech. Bull. 31:1-21.

Harris, A. R. 1974. Commercial kingfishing off Florida requires special gear, techniques. Natl. Fisherman, July, p. 16-26.

Johnson, A. G., W. A. Fable, Jr., M. L. Williams, and L. E. Barger. 1983. Age, growth, and mortality of king mackerel, *Scomberomorus cavalla*, from the southeastern United States. Fish. Bull. (U.S.) 81:97-106.

Marshall, B. 1983. King mackerel fishing goes commercial. The Times-Picayune, 5 Jan., Sect 4, p. 1, 7.

Sutherland, D. F., and W. A. Fable, Jr. 1980. Results of a king mackerel (*Scomberomorus cavalla*) and Atlantic Spanish mackerel (*Scomberomorus maculatus*) migration study, 1975-79. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFC-12, 18 p.

Trent, L., R. O. Williams, R. G. Taylor, C. H. Saloman, and C. S. Manooch III. 1981. Size and sex ratio of king mackerel, *Scomberomorus cavalla*, in the southeastern United States. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFC-62, 59 p.

———, ———, ———, ———, and ———. 1983. Size, sex ratio, and recruitment in various fisheries of king mackerel, *Scomberomorus cavalla*, in the southeastern United States. Fish. Bull. (U.S.) 81:709-721.