Abundance of Spanish Mackerel, *Scomberomorus maculatus*, in the Southeastern United States Based on Charterboat CPUE Data, 1982-85

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Introduction

The Spanish mackerel, *Scomberomorus maculatus*, a member of the family Scombridae, is closely related to the king mackerel, *S. cavalla*, the cero, *S. regalis*, and the recently-described Brazilian Spanish mackerel, *S. brasiliensis* (Collette and Russo, 1984). All except *S. brasiliensis* are widely distributed throughout the western U.S. Atlantic with centers of abundance in Florida. The Spanish mackerel supports important commercial and recreational fisheries in the U.S. south Atlantic and Gulf of Mexico (Trent and Anthony, 1979). It is prized as a food item and as a highly desirable recreational fish. The direct economic value of the Spanish mackerel resource is considerable. In 1985, about 4.3 million pounds were landed by commercial fishermen in the United States, and it was estimated that about 2.5 million pounds were landed by recreational fishermen in the mid-Atlantic, south Atlantic, and Gulf of Mexico (Nichols, 1986).

The Spanish mackerel fisheries of the southeast United States are presently being regulated under a joint fishery management plan (FMP) developed by the Gulf of Mexico and South Atlantic Fishery Management Councils (1983, 1985). Basic to the formulation and use of the mackerel FMP are various commercial and recreational fisheries statistics that include estimates of total effort, total catch, and catch per unit effort (CPUE). Detailed CPUE data for Spanish mackerel over broad geographic areas have become available only recently. In 1982, a survey was initiated to obtain daily catch and effort data on fishes commonly caught by charterboats in the southeast United States (Brusher et al., 1984). This survey was continued through 1985 and generated valuable CPUE data on Spanish mackerel. This paper compares the data among fishing methods, fishing zones, areas, seasons, and years with historical data generated by other surveys.

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ABSTRACT—Catch per unit effort (CPUE) data for Spanish mackerel, Scomberomorus maculatus, *over a broad geographic area were obtained from charterboats. In 1982, a survey was initiated to obtain daily catch and effort data on fishes commonly caught by charterboats in the southeast United States. Boat effort and Spanish mackerel CPUE data obtained from this survey during 1982-85 were analyzed. The offshore fishing zone (>10 fathoms) received the highest amount of trolling and "other fishing" efforts; the nearshore fishing zone (≤10 fathoms) received the second highest trolling effort and lowest "other fishing" effort; the estuarine fishing zone received the lowest trolling effort and the second lowest "other fishing" effort. CPUE of Spanish mackerel by "other fishing" was much lower than trolling for most areas and years. CPUE was highest in the estuarine zone when compared with the nearshore and offshore zones. In the southeastern United States from North Carolina to Texas, the highest CPUE occurred in areas within the eastern Gulf of Mexico from Louisiana to southwest Florida each year. Seasonally CPUE of Spanish mackerel was high in the warmer months in Georgia, the Carolinas, and the northern Gulf of Mexico states and in the colder months in the southeastern areas of Florida. Significant differences in CPUE among years were detected only in North Carolina and Louisiana.*

Methods of Obtaining Data

Recreational fishing data were obtained through contract with charterboat captains (Brusher et al., 1984). Data were obtained from 9 charterboats in 5 areas in 1982 (Williams, Brusher, and Trent, 1984; Brusher et al., 1984), from 100 boats in 16 areas in 1983 (Williams et al., 1984; Brusher and Palko, 1985), from 31 boats in 9 areas in 1984 (Williams et al., 1985), and from 43 boats in 16 areas in 1985 (Brusher and Palko, 1986). In 1983, the year of highest coverage, the number of selected captains per area represented about 10 percent of the total number of charterboats fishing in 16 areas (Fig. 1). Data were not reported for the U.S. Caribbean (area 16) because Spanish mackerel do not occur there.

Logbooks containing weekly log forms were provided to the captains, who completed the forms using the following definitions.

1) Fishing zone. Three fishing zones, estuarine, nearshore, and offshore, were identified as defined in Table 1. These and combinations of these zones resulted in the 7 categories for analysis.

2) Fishing method. "Trolling" was defined as fishing with hooks and line at

Table 1.—Fishing zones (1, 2, and 3) and combinations of fishing zones used to record and analyze catch and effort data.

Code	Zone(s)	Definition
1	Estuarine	Bays and sounds
2	Nearshore	0-10 fathoms in ocean or Gulf
3	Offshore	Beyond 10 fathoms in ocean or Gulf
4	Estuarine & nearshore	Combination of 1 & 2
5	Estuarine & offshore	Combination of 1 & 3
6	Nearshore & offshore	Combination of 2 & 3
7	Estuarine, nearshore, & offshore	Combination of 1, 2, & 3

any depth while the boat was moving under its own power. "Other fishing" included all other fishing methods, such as bottom fishing, drift fishing, and flylining.

3) Hours actually fished. This was the total number of hours fished by a single boat on all of its trips for one day using a particular method. Only actual fishing times, rounded to the nearest half-hour, were reported. Running times when hooks were not in the water were specifically excluded.

4) Number caught. The number of each species caught (including releases) was recorded.

Methods of Analyzing Data

Effort was reported in two units, a boat-fishing-day and a boat-fishing-hour. A boat-fishing-day was defined as all fishing that occurred (trolling, other fishing, or both) from a single boat in a single day. Trips were combined if more than 1 trip occurred in a single day. A boat-fishing-day was recorded for each method of fishing on days that both types of fishing occurred. A boat-fishing-hour was defined as the fishing that occurred on one boat in a single hour by a single method of fishing.

Our CPUE estimator was defined as "the number of Spanish mackerel caught per boat-fishing-hour" and was computed for each boat-fishing-day for each method of fishing. The following notations were used in the computations:

$$CPUE = X_i = \frac{No.\ of\ mackerel\ caught}{Hours\ of\ fishing}$$

$$\bar{X} = Mean\ CPUE = \frac{\sum_i X_i}{n_i}$$

$$s^2 = \frac{\sum_i X^2{}_i - \left(\sum_i X_i\right)^2 \Big/ n}{n-1}$$

where

n = Number of boat fishing days and

$s_{\bar{X}}$ = Standard error of the mean

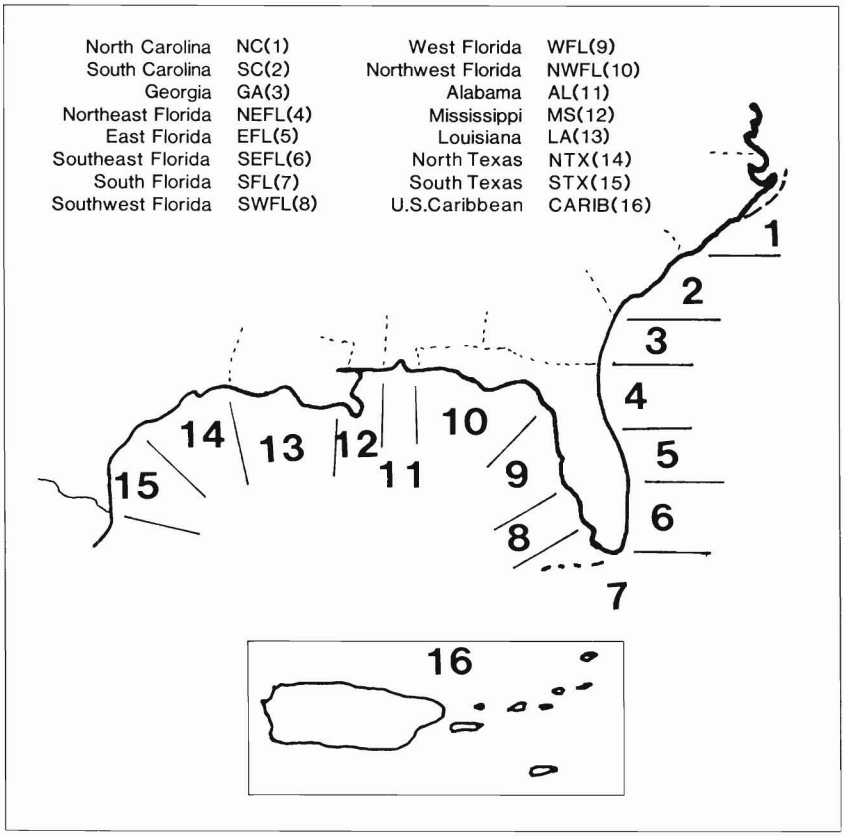

Figure 1.—Geographic areas of the charterboat survey.

$$= \sqrt{\frac{s^2}{n}} = \frac{s}{\sqrt{n}}$$

$CI_{(95\%)}$ = 95% confidence interval

$$= \bar{X} \pm t_{.05} s_{\bar{X}}$$

$$Log\ CPUE = Log_{10}\ (X_i + 1)$$

CPUE and Log CPUE were analyzed graphically (means, ranges, and standard deviations) and Log CPUE was compared among zones, areas, and years using a one-way analysis of variance with unequal replication and Duncan's multiple range test (Steel and Torrie, 1960).

CPUE data were compared among years for those areas and zones (1, 2, 3, and 1-7) where sufficient data were available. Sufficient is defined as: 1) Having at least 4 monthly means within each year and at least 3 years of data for a particular area and zone, 2) having exluded months in which all values were zero, and 3) having at least one annual mean (arithmetic) greater than 0.1 within the set to be compared. The monthly mean of log (CPUE + 1) was used as the observation. Arithmetic means are reported even when the statistical comparisons were made on the log values.

Distribution of Fishing Effort Among Habitats and Months

Fishing effort among zones 1-3 (Table 1) was evaluated to determine where most of the charterboat fishing effort occurred by each method of fishing (Table 2). The offshore zone (zone 3) with water depths >10 fm received the highest amount of effort; each year over 48 percent of the effort (trolling or other fishing), in addition to the contributions from

Table 2.—Number of boat fishing days expended by fishing zone, method of fishing, and year.

Year and method of fishing	Variable	Fishing zone 1	2	3	4	5	6	7	Total
1982 Trolling	No. of boat days	15	204	499	22		70		810
	Percent of total	1.8	25.2	61.6	2.7		8.6		
Other	No. of boat days	16	9	199			2		226
	Percent of total	7.1	4.0	88.1			0.9		
	Subtotal	31	213	698	22		72		1,036
	Percent	3.0	20.6	67.4	2.1		6.9		
1983 Trolling	No. of boat days	207	1,367	3,864	66	5	864	3	6,376
	Percent of total	3.2	21.4	60.6	1.0	0.0	13.6	0.0	
Other	No. of boat days	790	701	1,781	87	4	321	1	3,685
	Percent of total	21.4	19.0	48.3	2.4	0.1	8.7	0.0	
	Subtotal	997	2,068	5,645	153	9	1,185	4	10,061
	Percent	9.9	20.6	56.1	1.5	0.0	11.8	0.0	
1984 Trolling	No. of boat days	25	639	1,751	8	1	440	1	2,865
	Percent of total	0.9	22.3	61.1	0.3	0.0	15.4	0.0	
Other	No. of boat days	274	248	1,231	22	1	35		1,811
1984 Other	Percent of total	15.1	13.7	68.0	1.2	0.1	1.9		
	Subtotal	299	887	2,982	30	2	475	1	4,676
	Percent	6.4	19.0	63.8	1.7	0.0	10.2	0.0	
1985 Trolling	No. of boat days	55	901	2,104	14	77	415		3,566
	Percent of total	1.5	25.3	59.0	0.4	2.2	11.6		
Other	No. of boat days	324	514	1,206	19	3	72		2,138
	Percent of total	15.2	24.0	56.4	0.9	0.1	3.4		
	Total	379	1,415	3,310	33	80	487		5,704
	Percent	6.6	24.8	58.0	0.6	1.4	8.5		
1982-85 Trolling	No. of boat days	302	3,111	8,218	110	83	1,789	4	13,617
	Percent of total	2.2	22.8	60.4	0.8	0.6	13.1	0.0	
Other	No. of boat days	1,404	1,472	4,417	128	8	430	1	7,860
	Percent of total	17.9	18.7	56.2	1.6	0.1	5.5	0.0	
	Total	1,706	4,583	12,635	238	91	2,219	5	21,477
	Percent	7.9	21.3	58.8	1.1	0.4	10.3	0.0	

Table 3.—Numbers of hours and days spent fishing by charterboats by month, area, type of fishing, and year (H=hours and D=days).

Area and type of fishing	Year	Jan. H	D	Feb. H	D	Mar. H	D	Apr. H	D	May H	D	June H	D	July H	D	Aug. H	D	Sept. H	D	Oct. H	D	Nov. H	D	Dec. H	D	Total H	D
NC	1982							112.0	22	261.0	40	314.0	43	358.5	51	120.0	20	120.0	20	82.5	13					1368.0	209
Troll	1983							98.0	25	508.5	89	732.0	124	782.0	134	923.0	151	689.0	114	647.0	108	111.0	20	8.0	2	4498.5	767
	1984							53.0	13	158.5	30	287.5	56	309.5	52	327.0	58	214.0	37	289.5	51	138.5	28	0.0	0	1777.5	325
	1985							33.5	7	225.0	42	257.0	46	359.5	60	305.0	49	237.0	40	131.5	29	84.0	18	5.0	2	1637.5	293
Other	1982							0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0					0.0	0
	1983							53.0	10	50.0	10	60.0	12	70.0	15	62.0	14	49.0	10	6.0	2	25.0	4	0.0	0	375.0	77
	1984							6.0	2	5.0	1	21.5	4	24.0	5	20.0	4	8.0	3	6.0	1	0.0	0	6.0	1	96.5	21
	1985							0.0	0	0.0	0	24.5	9	27.5	10	10.5	3	13.0	3	0.0	0	8.0	4	1.0	1	84.5	30
SC	1982																										
Troll	1983							18.5	4	115.5	23	119.0	23	138.5	25	194.0	30	104.0	18	96.0	17	46.0	8			831.5	148
	1984																										
	1985							16.0	3	32.0	5	92.0	20	126.0	29	132.0	24	65.0	14	64.5	19	30.0	8			557.5	122
Other	1982																										
	1983							67.0	8	64.0	14	48.0	12	43.0	9	78.0	16	120.0	13	0.0	0	0.0	0			420.0	72
	1984																										
	1985							0.0	0	0.0	0	18.0	6	7.0	3	3.0	1	6.0	2	6.0	3	0.0	0			40.0	15
GA	1982																										
Troll	1983							0.0	0	25.0	6	36.5	9	37.5	8	74.0	14	7.5	2	0.0	0	0.0	0			180.5	39
	1984																										
	1985					0.0	0	11.5	5	28.0	10	59.0	14	70.0	15	20.0	5	0.0	0	0.0	0	0.0	0			188.5	49
Other	1982																										
	1983							30.0	3	39.0	8	22.5	7	21.0	5	3.0	1	1.5	1	0.0	0	0.0	0			117.0	25
	1984																										
	1985					17.5	4	35.5	7	91.5	20	75.0	20	69.0	16	22.0	5	0.0	0	0.0	0	0.0	0			310.5	72
NEF	1982																										
Troll	1983							43.5	11	112.5	21	87.5	16	76.0	14	103.5	18	32.0	6	57.0	14	21.0	6	7.0	1	540.0	107
	1984																										
	1985					0.0	0	53.0	11	146.0	29	109.5	20	87.5	18	75.5	19	27.0	7	25.5	10	9.0	3	3.0	1	536.0	118
Other	1982																										
	1983							82.0	14	15.5	5	53.0	10	16.0	5	29.0	6	13.5	3	21.5	5	72.0	17	0.0	0	302.5	65
	1984																										
	1985					4.0	1	57.0	14	12.5	3	50.5	12	36.0	10	33.5	10	25.5	8	30.0	9	42.0	12	43.0	12	334.0	91
EF	1982																										
Troll	1983					106.5	21	323.5	86	348.0	89	369.0	97	459.0	116	494.0	120	300.0	73	226.5	63	244.0	63	202.5	43	3073.0	771
	1984	263.5	46	250.0	44	243.0	41	330.5	71	169.5	49	180.0	50	194.0	47	221.0	49	95.0	24	96.5	30	95.5	26	129.5	26	2268.0	503
	1985	183.0	30	203.0	39	273.0	49	124.0	33	159.0	44	148.5	43	172.0	54	130.0	33	56.0	15	71.5	22	80.5	25	30.0	11	1630.5	398

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Table 3.—Continued.

Area and type of fishing	Year	Jan. H	Jan. D	Feb. H	Feb. D	Mar. H	Mar. D	Apr. H	Apr. D	May H	May D	June H	June D	July H	July D	Aug. H	Aug. D	Sept. H	Sept. D	Oct. H	Oct. D	Nov. H	Nov. D	Dec. H	Dec. D	Total H	Total D
Other	1982																										
	1983					8.0	2	85.5	36	65.5	34	85.5	40	76.5	30	50.0	23	55.5	15	27.5	11	14.5	11	3.0	4	471.5	206
	1984	1.5	3	24.5	12	28.5	15	47.0	26	56.0	20	49.0	19	30.0	14	27.5	18	22.5	12	36.5	11	26.0	10	27.0	8	376.0	168
	1985	18.0	6	36.0	12	65.5	16	18.5	11	51.0	26	45.5	25	85.0	35	27.0	12	36.5	10	69.0	17	50.0	13	13.0	4	515.0	187
SEF	1982																										
Troll	1983					16.0	3	620.0	146	539.0	128	435.0	93	347.0	74	379.5	101	358.5	77	406.0	97	377.5	94	270.5	64	3749.0	877
	1984	212.0	48	171.0	46	201.0	48																	162.5	40	746.5	182
	1985	152.5	35	123.0	29	199.5	51	140.0	41	132.0	37	125.5	34	106.0	23	53.0	13	62.5	15	61.0	16	90.0	24	99.0	26	1344.0	344
Other	1982																										
	1983					0.0	0	109.0	38	91.5	30	19.5	12	48.5	22	34.5	22	11.5	7	29.5	11	28.0	15	16.5	10	388.5	167
	1984	25.5	16	62.0	20	55.0	19																	34.5	11	177.0	66
	1985	146.5	36	169.5	32	122.0	32	6.5	6	27.0	19	6.0	5	7.0	2	0.0	0	6.5	4	0.0	0	3.0	3	22.0	12	516.0	151
SF	1982					21.5	5	184.0	37	177.0	38	128.5	23	156.0	30	148.0	30	86.5	17	189.5	34	148.0	27	135.0	27	1374.0	268
Troll	1983	102.0	17	17.0	4	15.5	4	599.0	137	924.5	165	906.5	158	799.0	151	614.0	123	422.0	86	544.5	105	591.5	104	403.0	71	5938.5	1125
	1984	159.0	31	248.0	47	247.0	52	335.0	70	268.0	57	321.5	64	248.0	52	235.5	47	155.0	29	158.5	31	274.5	54	134.0	29	2784.0	563
	1985	213.5	42	281.5	55	247.5	52	215.0	46	340.0	60	205.0	35	204.5	38	189.0	34	64.5	12	117.5	20	79.0	15	0.0	0	2157.0	409
Other	1982					1.0	1	19.0	15	9.0	7	2.5	2	5.5	2	4.5	2	16.0	2	0.0	0	0.0	0	0.0	0	57.5	31
	1983	0.0	0	0.0	0	20.0	7	327.5	98	190.5	51	60.5	22	63.5	18	46.0	18	56.5	18	122.5	33	150.5	34	182.0	33	1219.5	332
	1984	80.5	17	48.0	20	75.5	31	28.5	16	34.0	13	0.0	0	12.0	4	0.0	0	7.5	2	0.0	0	22.5	10	1.5	1	310.0	114
	1985	0.0	0	23.0	6	44.5	20	130.5	30	89.0	23	58.0	12	43.0	11	65.5	13	88.5	17	20.5	4	101.0	17	0.0	0	663.5	153
SWF	1982																										
Troll	1983							16.0	3	0.0	0	0.0	0	0.0	0	1.5	2	4.0	1	60.5	16	4.0	1	0.0	0	86.0	23
	1984	0.0	0	0.0	0	0.0	0																	38.5	7	38.5	7
	1985	3.5	1	7.0	4	25.5	11	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0			36.0	16
Other	1982																										
	1983							449.0	90	643.0	126	566.5	107	468.5	100	403.5	97	356.5	82	319.5	74	376.0	84	277.0	62	3859.5	822
	1984	384.0	78	358.5	73	489.0	87																	164.0	37	1395.5	275
	1985	219.5	49	193.0	45	198.0	52	297.5	51	204.0	37	168.5	37	54.5	11	58.5	13	89.0	18	74.5	15	72.5	12			1629.5	340
WF	1982																										
Troll	1983					0.0	0	173.5	47	164.5	47	134.5	32	190.0	36	99.5	22	112.0	29	106.5	25	77.0	21	38.0	13	1095.5	272
	1984	18.5	6	13.5	5	19.5	8	238.0	52	161.5	42	182.0	43	255.5	59	220.0	52	113.0	29	201.5	46	116.0	29	25.0	10	1564.0	381
	1985	4.0	1	2.5	1	124.0	29	174.0	47	133.0	35	172.5	38	140.5	31	106.0	23	57.5	12	87.5	23	55.0	15	16.0	5	1072.5	260
Other	1982																										
	1983					11.0	2	144.5	33	177.5	37	216.5	45	152.5	41	219.5	56	128.5	31	105.0	25	148.5	34	113.0	27	1416.5	331
	1984	146.5	33	223.5	49	278.5	60	38.0	7	37.0	9	43.5	11	32.0	7	65.5	11	18.0	4	14.0	4	45.0	10	146.0	33	1087.5	238
	1985	64.0	15	165.5	31	155.5	34	115.5	26	78.5	20	73.0	20	84.0	23	104.5	20	83.0	16	41.0	11	80.0	16	38.0	10	1082.5	242
NWF	1982							42.5	7	83.5	15	105.5	24	77.0	19	86.5	20	118.5	21	63.0	12					576.5	118
Troll	1983					2.5	1	269.5	71	388.0	101	558.5	150	719.5	178	773.0	151	562.0	106	296.0	67	34.0	10			3603.0	835
	1984							24.0	6	19.0	7	110.0	29	102.5	25	88.5	22	79.0	17	37.0	11	10.5	3			470.5	120
	1985					2.5	1	34.0	7	34.5	9	26.0	8	116.5	28	100.0	23	44.0	7	1.5	1	0.0	0			359.0	84
Other	1982							0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0					0.0	0
	1983					7.5	2	379.0	74	602.5	117	542.0	130	587.5	126	357.5	80	438.0	88	415.0	81	120.0	20			3449.0	718
	1984							102.0	20	181.5	36	193.5	49	100.5	24	128.5	27	178.5	38	159.5	35	10.0	1			1054.0	230
	1985					41.5	9	183.0	38	236.0	50	219.0	48	192.0	38	176.0	33	157.0	36	200.5	45	70.0	15			1475.0	312
AL	1982																										
Troll	1983							55.0	11	151.0	35	231.5	56	299.0	68	253.5	62	139.5	38	130.0	40	22.0	9			1281.5	319
	1984																										
	1985							22.0	8	47 5	18	122.0	33	136.5	35	121.5	28	48.0	13	61.5	23	23.0	13	2.0	1	584.0	172
Other	1982																										
	1983							83.0	13	100.0	27	119.0	35	119.0	36	138.0	41	92.5	25	108.5	28	40.0	9			800.0	214
	1984																										
	1985							52.0	13	68.0	20	66.5	22	73.0	24	49.5	19	40.5	14	62.5	20	40.5	15	4.0	1	456.5	148
MS	1982																										
Troll	1983							16.5	3	133.0	28	126.0	30	172.0	33	163.0	35	112.0	24	26.0	5					748.5	158
	1984																										
	1985							56.0	11	125.0	23	144.0	29	176.0	35	90.5	19	50.5	12	37.5	10	30.0	8			709.5	147
Other	1982																										
	1983							6.0	1	32.0	7	17.0	4	14.0	3	10.5	3	0.0	0	15.0	4					94.5	22
	1984																										
	1985							24.0	5	70.5	9	61.0	13	20.5	7	19.5	4	24.5	6	61.0	11	31.0	7			312.0	62
LA	1982							6.0	3	30.5	14	38.5	11	115.5	21	58.5	19	44.0	11	1.5	1	8.0	3	0.0	0	302.5	83
Troll	1983	36.0	8	47.0	9	0.0	0	0.0	0	16.0	3	78.0	12	139.5	21	122.0	21	104.5	15	76.0	14	31.0	4	0.0	0	650.0	107
	1984	5.0	1	0.0	0	0.0	0	0.0	0	20.0	3	27.0	7	18.5	3	87.5	14	42.0	8	48.0	9	0.0	0	22.5	4	270.5	49
	1985	31.0	6	0.0	0	0.0	0	13.0	2	43.5	7	136.5	22	146.5	20	53.0	9	32.0	6	12.0	2	0.0	0	0.0	0	467.5	74
Other	1982							49.5	11	105.0	25	132.0	30	77.0	18	143.5	32	59.5	14	110.5	22	103.5	21	5.0	1	785.0	174
	1983	21.0	6	31.0	6	55.0	10	21.5	4	104.5	21	303.5	67	337.5	75	306.5	69	152.0	33	277.5	56	215.5	45	97.0	20	1922.5	412
	1984	86.0	19	186.0	37	282.0	52	99.5	21	227.0	40	224.0	51	241.5	54	234.0	50	159.0	36	251.5	58	219.0	50	150.5	36	2360.0	504
	1985	96.0	21	90.0	21	115.0	26	67.0	15	20.5	5	93.5	21	51.0	11	62.5	14	58.5	14	56.0	13	70.5	16	46.5	11	827.0	188
NTX	1982																										
Troll	1983							2.0	1	3'.5	8	145.5	28	106.5	27	146.0	26	55.0	14	14.0	7	2.0	1	0.0	0	502.5	112
	1984																										
	1985							24.0	4	72.5	13	153.5	26	302.5	51	208.5	38	21.5	8	0.0	0	0.0	0			782.5	140

Continued on next page.

Table 3.—Continued.

Area and type of fishing	Year	Jan. H	Jan. D	Feb. H	Feb. D	Mar. H	Mar. D	Apr H	Apr D	May H	May D	June H	June D	July H	July D	Aug. H	Aug. D	Sept. H	Sept. D	Oct. H	Oct. D	Nov. H	Nov. D	Dec. H	Dec. D	Total H	Total D
Other	1982																										
	1983							39.0	8	62.5	14	91.5	25	167.5	35	52.5	14	86.5	18	63.0	15	37.0	8	13.0	3	612.5	140
	1984																										
	1985							4.0	1	67.0	11	0.0	0	55.0	10	90.0	22	49.5	11	24.0	4	16.5	3			306.0	62
STX	1982							6.0	1	40.5	7	149.5	28	301.0	49	239.0	39	35.0	8	0.0	0					771.0	132
Troll	1983							81.5	17	334.5	57	498.0	79	638.5	95	560.0	81	211.0	35	179.5	33	82.5	15	5.0	1	2590.5	413
	1984							40.5	8	119.0	23	184.0	28	249.5	40	197.0	35	52.0	8	16.0	4	0.0	0			858.0	146
	1985							17.5	4	144.0	29	237.5	49	508.5	102	454.0	92	37.5	9	0.0	0	0.0	0			1399.0	285
Other	1982							9.0	2	18.0	4	9.0	3	0.0	0	4.0	4	12.0	3	24.5	5					76.5	21
	1983							19.0	6	37.5	8	35.5	8	2.0	3	8.0	4	43.0	9	112.0	27	87.0	16	7.0	1	351.0	82
	1984							78.5	16	169.5	27	229.0	32	272.0	32	244.5	35	144.0	19	117.0	20	54.0	14			1308.5	195
	1985							37.5	7	74.0	17	66.0	17	43.5	19	40.0	18	22.0	6	3.5	1	0.0	0			286.5	85
US Carib.	1982																										
Troll	1983					56.0	10	168.5	30	105.0	19	195.5	37	318.0	51	341.5	51	154.5	28	166.0	32	178.5	32	70.0	13	1753.5	303
	1984	330.0	59	322.5	59	379.5	67	241.5	46	192.0	36	110.5	19	388.5	56	352.5	53	271.5	48	285.0	50	259.5	50	216.0	46	3349.0	589
	1985	429.5	78	366.5	63	414.0	71	273.0	51	294.5	54	288.0	50	225.5	35	375.0	59	215.0	40	330.0	60	300.5	56	205.0	38	3716.5	655

Table 4.—Yearly effort and CPUE by area and method of fishing for Spanish mackerel.

	1982				1983				1984				1985			
	Other		Trolling		Other		Trolling		Other		Trolling		Other		Trolling	
Area	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE
North Carolina			1368.0	0.00	375.0	0.00	4498.5	0.10	96.5	0.01	1777.5	1.84	84.5	0.00	1637.5	0.34
South Carolina					420.0	0.00	831.5	0.52					40.0	0.02	557.5	0.44
Georgia					117.0	0.00	180.5	0.16					310.5	0.06	188.5	0.94
NE Florida					302.5	0.01	540.0	0.26					334.0	0.01	536.0	0.41
East Florida					471.5	0.00	3073.0	0.23	376.0	0.02	2268.0	0.07	511.0	0.00	1627.5	0.08
SE Florida					388.5	0.16	3749.0	0.21	177.0	0.00	746.5	0.15	514.0	0.06	1320.0	0.03
South Florida	57.5	0.00	1374.0	0.00	1219.5	0.00	5938.5	0.01	310.0	0.01	2784.0	0.02	663.5	0.00	2157.0	0.01
SW Florida					3859.5	0.05	86.0	1.27	1395.5	0.04	38.5	3.06	1629.5	0.03	36.0	1.94
West Florida					1416.5	0.25	1095.5	1.53	1087.5	0.01	1564.0	1.37	1082.5	0.05	1072.5	1.31
NW Florida			576.5	1.66	3449.0	0.00	3603.0	0.47	1054.0	0.07	470.5	0.21	1475.0	0.01	359.0	1.67
Alabama					800.0	0.00	1281.5	1.41					456.5	0.01	584.0	0.72
Mississippi					94.5	0.01	748.5	8.07					312.0	0.02	709.5	5.72
Louisiana	785.5	0.02	302.5	1.43	1922.5	0.07	650.0	3.13	2360.0	0.05	270.5	2.10	822.5	0.03	467.5	9.61
North Texas					612.5	0.03	502.5	0.45					306.0	0.11	782.5	0.23
South Texas	76.5	0.00	771.0	0.93	351.0	0.00	2590.5	0.08	1308.5	0.01	858.0	0.02	286.5	0.00	1399.0	0.02

Table 5.—Comparisons among fishing zones of yearly CPUE by area for Spanish mackerel caught by trolling. (CPUE values are arithmetic means.)

	1982				1983				1984				1985			
	Zone				Zone				Zone				Zone			
Area	1	2	3	Range test[1]	1	2	3	Range test[1]	1	2	3	Range test[1]	1	2	3	Range test[1]
NC	0.00	0.00	0.00		1.03	0.40	0.01	3 2 1	0.67	3.60	0.05	3 1 2	0.00	2.45	0.04	1 3 2
SC						0.66	0.00						0.67	0.84	0.02	3 2 1
GA						0.26	0.05						3.06	1.02	0.00	3 2 1
NEFL					0.81	0.30	0.17	3 2 1					0.11	0.81	0.19	1 3 2
EFL					0.00	3.87	0.27	1 3 2	0.00	0.00	0.12	1 2 3		1.93	0.10	
SEFL					0.16	2.70	0.03	3 1 2		0.17	0.04			1.07	0.00	
SFL		0.01	0.00		0.00	0.06	0.00	1 3 2		0.08	0.01			0.02	0.00	
SWFL					0.81	1.88				3.06				1.94		
WFL					0.00	1.61	0.18	1 3 2	0.23	1.43	0.07	3 1 2		1.40	0.19	
NWFL	4.92	0.84	0.01	3 2 1	1.63	0.42	0.08	3 2 1	0.69	0.15	0.14	3 2 1	3.99	0.28	0.10	3 2 1
AL					0.08	2.38	0.31	1 3 2					2.00	1.00	0.00	3 2 1
MS						8.02	10.50						3.20	5.80	4.11	3 1 2
LA	4.50	2.36	1.37	3 2 1	12.00	0.40	3.46	2 3 1		6.46	0.13		5.27	11.48	7.05	3 1 2
NTX						0.85	0.31							0.29	0.22	
STX	0.00	1.34	0.02	1 3 2	0.00	0.07	0.10	1 2 3		0.00	0.01		0.00	0.04	0.02	1 3 2

[1]Any two zones not underscored by the same line have significantly different means.

Table 6.—Statistical comparisons among areas of Log (CPUE + 1) of Spanish mackerel (analysis of variance and multiple range test). Any two logarithmic means not underscored by the same line are significantly different.

1982	NC	SFL	STX	LA	NWFL
Log (CPUE + 1)	0.00	0.00	0.06	0.20	0.20
CPUE	0.00	0.00	0.93	1.43	1.66

1983	SFL	NC	SEFL	STX	GA	EFL	NEFL	NWFL	NTX	SC	AL	LA	SWFL	WFL	MS
Log (CPUE + 1)	0.00	0.02	0.02	0.03	0.05	0.05	0.08	0.09	0.10	0.11	0.23	0.27	0.32	0.33	0.76
CPUE	0.01	0.10	0.21	0.08	0.16	0.23	0.26	0.47	0.45	0.52	1.41	3.13	1.27	1.53	8.07

1984	STX	SFL	EFL	SEFL	NWFL	NC	LA	WFL	SWFL
Log (CPUE + 1)	0.01	0.01	0.02	0.03	0.04	0.19	0.28	0.29	0.56
CPUE	0.02	0.02	0.07	0.15	0.21	1.84	2.10	1.37	3.06

1985	SFL	SEFL	STX	EFL	NC	NTX	SC	NEFL	AL	GA	NWFL	WFL	SWFL	MS	LA
Log (CPUE + 1)	0.00	0.01	0.01	0.02	0.03	0.07	0.08	0.10	0.17	0.18	0.15	0.25	0.43	0.71	0.77
CPUE	0.01	0.03	0.02	0.08	0.34	0.23	0.44	0.41	0.72	0.94	1.67	1.31	1.94	5.72	9.61

Table 7.—Comparison among areas of CPUE by year and zone for Spanish mackerel caught while trolling.

Year and zone	Mean CPUE by area															Area in order of increasing CPUE and results of range test[1]
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1982																
1	0.00									4.92			4.50		0.00	1 15 10 13
2	0.00						0.01			0.84			2.36		1.34	1 7 15 10 13
3	0.00						0.00			0.01			1.37		0.02	1 7 10 15 13
1983																
1	1.03			0.81	0.00	0.16	0.00	0.81	0.00	1.63	0.08		12.00		0.00	5 7 9 15 11 6 4 1 8 10 13
2	0.40	0.66	0.26	0.30	3.87	2.70	0.06	1.88	1.61	0.42	2.38	8.02	0.40	0.85	0.07	7 15 1 3 10 4 13 2 14 6 5 9 11 8 12
3	0.01	0.00	0.05	0.17	0.27	0.03	0.00		0.18	0.08	0.31	10.50	3.46	0.31	0.10	2 7 1 6 3 10 15 9 4 11 14 5 13 12
1984																
1	0.67				0.00				0.23	0.69						5 9 10 1
2	3.60				0.00	0.17	0.08	3.06	1.43	0.15			6.46		0.00	5 15 7 10 6 9 1 8 13
3	0.05				0.12	0.04	0.01		0.07	0.14			0.13		0.01	7 15 6 1 9 10 5 13
1985																
1	0.00	0.67	3.06	0.11						3.99	2.00	3.20	5.27		0.00	1 15 4 2 10 11 3 12 13
2	2.45	0.84	1.02	0.81	1.93	1.07	0.02	1.94	1.40	0.28	1.00	5.80	11.48	0.29	0.04	7 15 10 14 2 4 1 6 3 11 9 5 8 12 13
3	0.04	0.02	0.00	0.19	0.10	0.00	0.00		0.19	0.10	0.00	4.11	7.05	0.22	0.02	3 11 7 6 15 1 2 10 5 4 9 14 12 13

[1]Any two areas not underscored by the same line have significantly different means.

zones 5, 6, and 7, occurred in this zone. The second most important zone in terms of trolling effort was the nearshore zone (zone 2); over 21 percent of the trolling effort each year, in addition to the contributions from zones 4, 6, and 7, occurred in this zone. The second most important zone for other fishing was in the estuarine zone; percentages of effort expended (not including the contributions from zones 4, 5, and 7) in this zone were 7.1 percent in 1982, 21.4 percent in 1983, 15.1 percent in 1984, and 15.2 percent in 1985.

Much more other-fishing effort occurred in the estuarine zone (17.9 percent) than did trolling effort (2.2 percent) based on data combined for all years (Table 2). Percentages of total effort were similar between methods for zones 2 and 3.

Fishing effort was not monitored

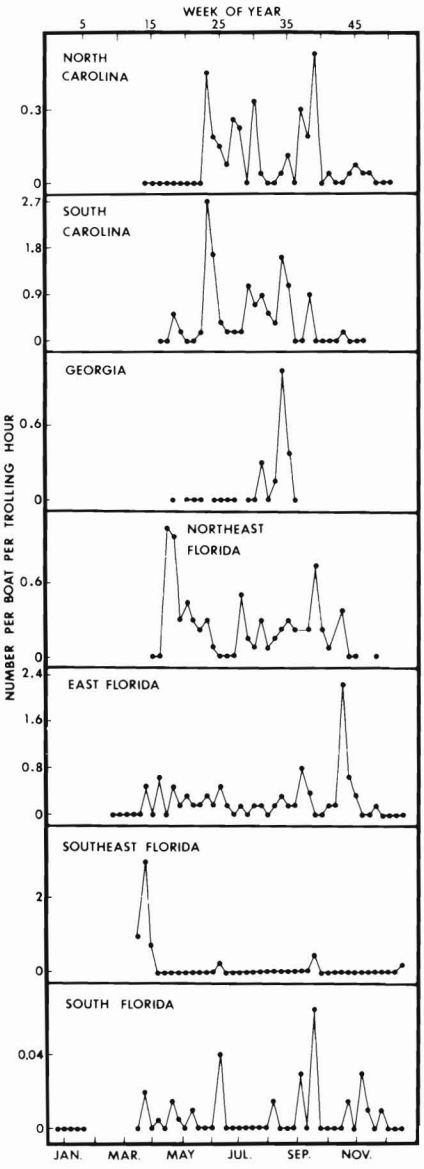

Figure 2.—CPUE for Spanish mackerel caught by trolling on the southeastern U.S. coast in 1983.

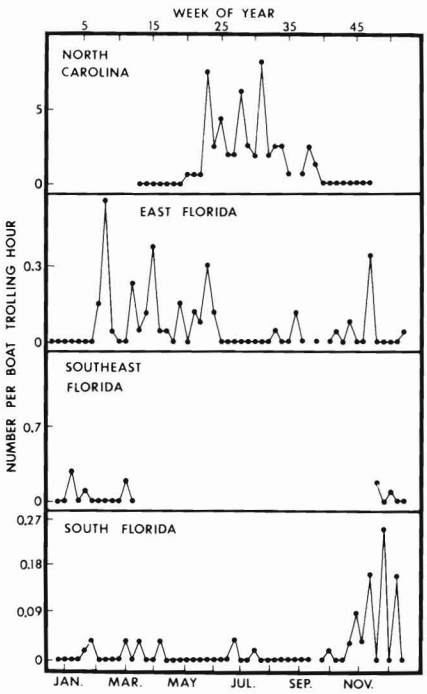

Figure 3.—CPUE for Spanish mackerel caught by trolling on the southeastern U.S. coast in 1984.

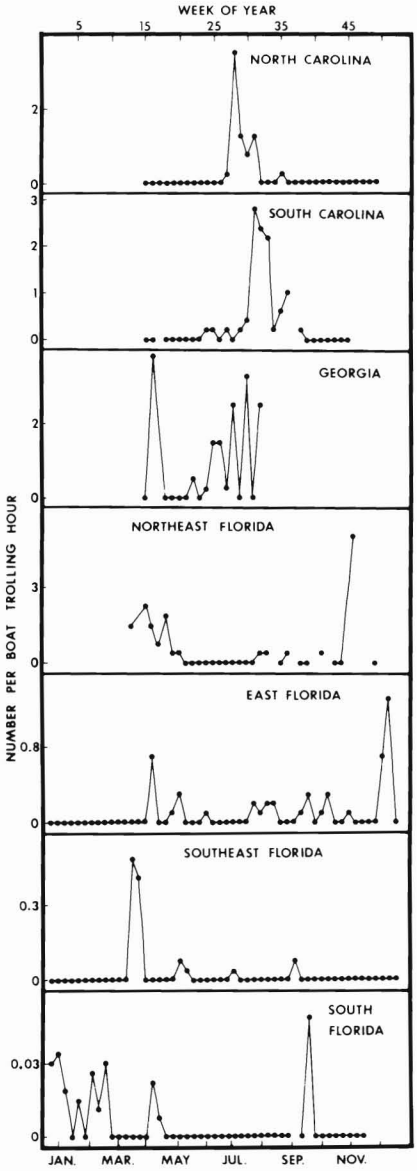

Figure 4.—CPUE for Spanish mackerel caught by trolling on the southeastern U.S. coast in 1985.

throughout the year in most areas and years (Table 3). The months of January, February, and March were not surveyed for the most part north of the east and west Florida areas (Fig. 1) except in Louisiana.

Data in Table 3 are useful to evaluate the seasonality of fishing effort because the numbers of boats in the survey remained relatively constant within an area and year with one exception. In North Carolina in 1982, during the pilot survey, two boats reported in April through July with only one boat reporting the remainder of the survey.

CPUE Comparisons

Between Fishing Methods

CPUE of Spanish mackerel by other fishing was much lower than by trolling for most areas and years (Table 4). Area-year combinations where other-fishing CPUE was at least one-fourth of trolling CPUE were southeast Florida in 1983; east, south, and northwest Florida, and south Texas in 1984; and southeast Florida and north Texas in 1985.

Among Fishing Zones

CPUE was highest in the estuarine zone in most areas and years. CPUE in each zone and area and results of comparisons among zones are provided in Table 5. Mean values of zone CPUE significantly greater than all other zone means within area and year were:

1982: Zone 1 in northwest Florida.

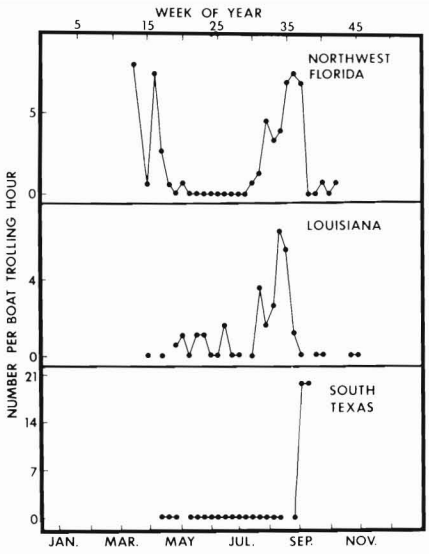

Figure 5.—CPUE for Spanish mackerel caught by trolling on the U.S. Gulf coast in 1982.

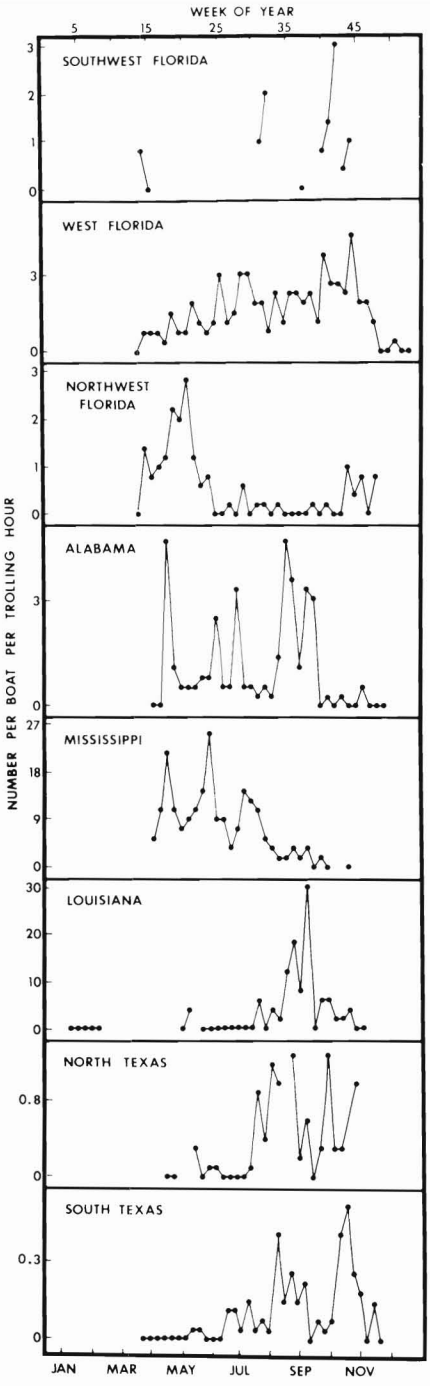

Figure 6.—CPUE for Spanish mackerel caught by trolling on the U.S. Gulf coast in 1983.

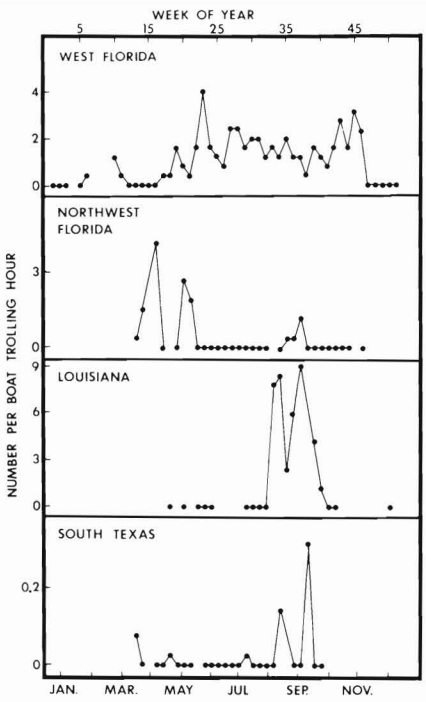

Figure 7.—CPUE for Spanish mackerel caught by trolling on the U.S. Gulf coast in 1984.

1983: Zone 1 in North Carolina and northwest Florida; zone 2 in east, southeast, south, and west Florida.

1984: Zone 1 in northwest Florida.

1985: Zone 1 in Georgia and northwest Florida.

Significant differences among any set of means within area and year can be read from Table 5. For example, in North Carolina in 1983 CPUE in zone 1 was significantly greater than in zones 2 and 3 and CPUE in zone 2 was significantly greater than in zone 3.

Among Areas

When data from all zones and all months within each year were combined, highest catch rates of Spanish mackerel occurred in the areas within the eastern Gulf of Mexico from Louisiana to southwest Florida each year (Table 6). In 1982 CPUE from Louisiana and northwest Florida were significantly higher than in the other three areas. In 1983 through 1985 CPUE was significantly higher in Mississippi (1983), in southwest Florida (1984), and in Louisiana (1985) than in the other areas.

CPUE was also compared among areas within each zone (Table 7). Area mean values of CPUE determined to be significantly greater than all other area means within zone and year were:

Zone 1: Louisiana in 1983.

Zone 2: Louisiana in 1982 and 1985; Mississippi in 1983.

Zone 3: Louisiana in 1982 and 1985; Mississippi in 1983.

Significant differences among any set of means within zone and year can be read from Table 7. For example, in zone 2 in 1984, CPUE in Louisiana was signifi-

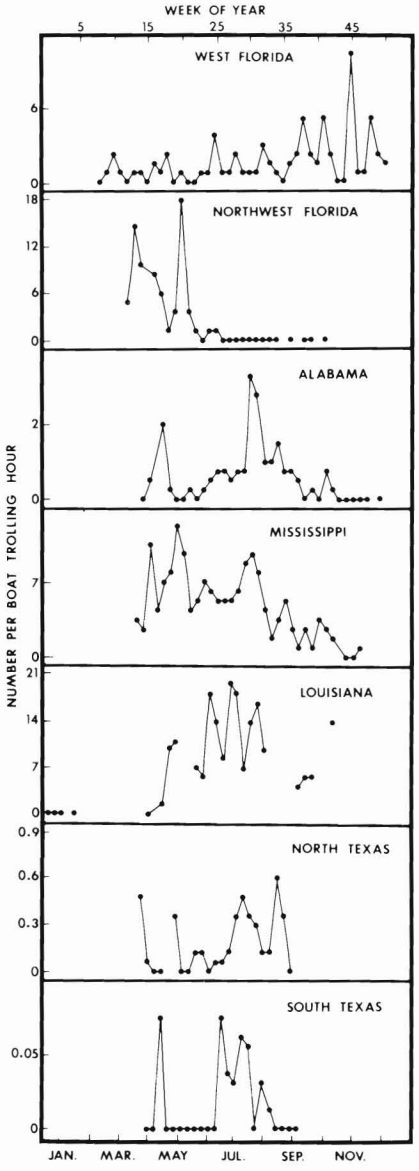

Figure 8.—CPUE for Spanish mackerel caught by trolling on the U.S. Gulf coast in 1985.

Table 8.—Monthly mean CPUE by area and year for Spanish mackerel caught by trolling.

Area	Year	Monthly mean CPUE												Annual CPUE
		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
NC	1982				0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
	1983				0.00	0.00	0.19	0.20	0.01	0.21	0.02	0.03	0.00	0.10
	1984				0.04	0.32	3.07	2.92	3.41	1.48	0.27	0.00		1.84
	1985				0.00	0.01	0.01	1.18	0.44	0.13	0.01	0.00	0.00	0.34
SC	1983				0.00	0.16	1.20	0.51	0.73	0.54	0.07	0.00		0.52
	1985				0.00	0.00	0.08	0.16	1.62	0.54	0.05	0.00		0.44
GA	1983					0.00	0.00	0.00	0.44	0.00				0.16
	1985				1.50	0.00	0.45	1.49	1.95					0.94
NEF	1983				0.57	0.46	0.08	0.10	0.21	0.47	0.19	0.00	0.00	0.26
	1985				1.61	0.57	0.07	0.08	0.22	0.19	0.09	1.67	0.00	0.41
EF	1983			0.00	0.34	0.25	0.25	0.10	0.17	0.36	0.53	0.20	0.00	0.23
	1984	0.00	0.16	0.03	0.14	0.06	0.13	0.00	0.01	0.04	0.12	0.12	0.01	0.07
	1985	0.00	0.01	0.00	0.29	0.07	0.03	0.01	0.13	0.01	0.15	0.06	0.55	0.08
SEF	1983			1.60	1.10	0.00	0.03	0.00	0.01	0.11	0.01	0.02	0.05	0.21
	1984	0.41	0.03	0.06									0.10	0.15
	1985	0.00	0.00	0.00	0.18	0.02	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.03
SF	1982			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
	1983	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.02	0.00	0.01	0.00	0.01
	1984	0.00	0.01	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.01	0.08	0.09	0.02
	1985	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00		0.01
SWF	1983				0.50				1.50	0.00	1.48	1.00		1.27
	1984												3.06	3.06
	1985	4.86	2.13	1.60										1.94
WF	1983				0.61	1.22	1.47	2.22	1.60	1.87	2.57	2.32	0.03	1.53
	1984	0.00	0.30	0.40	0.11	0.75	2.48	1.87	1.64	1.34	1.56	2.36	0.00	1.37
	1985	0.00	0.00	0.89	0.86	0.65	1.43	1.13	1.25	1.78	2.81	1.94	3.50	1.31
NWF	1982				2.90	0.42	0.03	0.26	2.53	5.26	0.26			1.66
	1983			0.00	1.06	1.78	0.32	0.28	0.08	0.07	0.18	0.48		0.47
	1984				1.33	1.50	0.00	0.00	0.00	0.40	0.05	0.00		0.21
	1985			4.80	11.10	5.10	1.25	0.06	0.00	0.00	0.00			1.67
AL	1983				2.80	0.94	1.20	1.26	1.76	2.91	0.23	0.33		1.41
	1985				0.58	0.14	0.42	1.20	1.70	0.51	0.31	0.00	0.00	0.72
MS	1983				12.20	9.69	14.97	10.67	3.25	2.15	0.08			8.07
	1985				6.20	8.62	5.92	6.80	5.99	2.17	2.25	0.30		5.72
LA	1982				0.00	0.54	1.16	0.00	4.02	2.04	0.00	0.00		1.43
	1983	0.00	0.00			1.40	0.04	1.86	5.40	8.04	4.01	0.25		3.13
	1984	0.00				0.00	0.00	0.00	2.50	5.72	2.45		0.00	2.10
	1985	0.00			0.00	8.16	10.93	11.12	15.72	4.97	9.83			9.61
NTX	1983				0.00	0.14	0.05	0.41	0.98	0.46	0.50	1.00		0.45
	1985				0.17	0.08	0.10	0.30	0.29	0.19				0.23
STX	1982				0.00	0.00	0.00	0.00	0.05	15.04				0.93
	1983				0.00	0.00	0.03	0.09	0.10	0.15	0.22	0.18	0.00	0.08
	1984				0.03	0.01	0.00	0.01	0.00	0.23	0.00			0.02
	1985				0.00	0.01	0.00	0.05	0.02	0.00				0.02

cantly greater than all other areas except southwest Florida. CPUE in southwest Florida and North Carolina were significantly greater than in northwest Florida, south Florida, south Texas, and east Florida.

Seasonality

Weekly estimates of CPUE were plotted to analyze abundance of Spanish mackerel through seasons in relation to area. Along the Atlantic coast the fish were abundant in the warmer months in the northerly areas (northeast Florida to North Carolina), and abundant in the colder months, or sporadically throughout the year, in the southeast areas of Florida (Fig. 2-4). In general, low CPUE in east Florida coincided with high CPUE in Georgia and the Carolinas, possibly indicating migration from the southerly to the northerly areas.

In the Gulf of Mexico, sufficient data for evaluation were obtained only from the west Florida to the south Texas area (Fig. 5-8). Spanish mackerel were abundant, as reflected by CPUE data, from May through November in west Florida; in April-May, or August-October, or both in northwest Florida, Alabama, Louisiana, and Texas; and during May-July in Mississippi.

Variation in mean CPUE among months within an area and year can be observed in Table 8. For example, mean CPUE in North Carolina in 1983 ranged

Table 9.—Yearly effort and CPUE by zone and area for Spanish mackerel caught while trolling.

	Zones, 1982								Zones, 1983							
	1		2		3		1-7		1		2		3		1-7	
Area	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE
North Carolina	4.0	0.00	64.5	0.00	1280.0	0.00	1368.0	0.00	270.5	1.03	245.5	0.40	3896.5	0.01	4498.5	0.10
South Carolina											638.5	0.66	144.5	0.00	831.5	0.52
Georgia											100.5	0.26	69.5	0.05	180.5	0.16
Northeast Florida									20.0	0.81	166.0	0.30	105.0	0.17	540.0	0.26
East Florida									7.0	0.00	35.0	3.87	1833.0	0.27	3073.0	0.23
Southeast Florida									86.0	0.16	115.0	2.70	3258.5	0.03	3749.0	0.21
South Florida			95.0	0.01	1039.5	0.00	1374.0	0.00	34.5	0.00	232.0	0.06	5111.0	0.00	5938.5	0.01
Southwest Florida									53.0	0.81	33.0	1.88			86.0	1.27
West Florida									5.5	0.00	801.0	1.61	113.5	0.18	1095.5	1.53
Northwest Florida	59.5	4.92	289.5	0.84	60.5	0.01	576.5	1 66	323.5	1.63	1210.0	0.42	1148.0	0.08	3603.0	0.47
Alabama									12.0	0.08	701.0	2.38	69.0	0.31	1281.5	1.41
Mississippi											733.5	8.02	12.0	10.5	748.5	8.07
Louisiana	2.0	4.50	7.5	2.36	282.0	1.37	302.5	1.43	5.0	12.00	23.0	0.40	518.5	3.46	650.0	3.13
North Texas											164.0	0.85	331.5	0.31	502.5	0.45
South Texas	6.0	0.00	550.0	1.34	129.5	0.02	771.0	0.93	9.0	0.00	820.0	0.07	1638.0	0.10	2590.5	0.08

Table 9.—Continued.

	Zones, 1984								Zones, 1985							
	1		2		3		1-7		1		2		3		1-7	
Area	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE	Hours	CPUE
North Carolina	23.0	0.67	811.0	3.60	904.5	0.05	1777.5	1.84	7.5	0.00	134.5	2.45	1491.0	0.04	1637.5	0.34
South Carolina									14.5	0.67	172.5	0.84	339.5	0.02	557.5	0.44
Georgia									16.0	3.06	114.5	1.02	58.0	0.00	188.5	0.94
Northeast Florida									9.0	0.11	152.5	0.81	186.0	0.19	536.0	0.41
East Florida	2.0	0.00	24.0	0.00	764.5	0.12	2268.0	0.07			13.0	1.93	663.5	0.10	1627.5	0.08
Southeast Florida			6.0	0.17	646.5	0.04	746.5	0.15			18.0	1.07	1261.0	0.00	1320 0	0.03
South Florida			271.5	0.08	2064.0	0.01	2784.0	0.02			283.5	0 02	1457.5	0.00	2157.0	0.01
Southwest Florida			38.5	3.06			38.5	3 06			36.0	1.94			36 0	1.94
West Florida	13.5	0.23	1156.5	1.43	73.0	0.07	1546.0	1.37			912.0	1 40	143.5	0.19	1072.5	1.31
Northwest Florida	65.0	0.69	245.5	0.15	156.0	0.14	470.5	0 21	125.5	3.99	56.5	0.28	167.0	0.10	359.0	1.67
Alabama									2 0	2.00	148.0	1.00	75.0	0.00	584.0	0.72
Mississippi									5.0	3.20	678.0	5.80	26.5	4.11	709.5	5.72
Louisiana			75.5	6.46	184.0	0.13	270.5	2.10	11.0	5.27	222.5	11.48	199.5	7.05	467.5	9.61
North Texas											118.0	0 29	328.5	0.22	782.5	0.23
South Texas			24.0	0.00	810.0	0.01	858.0	0.02	19.0	0.00	600.0	0.04	688.0	0.02	1399.0	0.02

from zero in April, May, and December to 0.21 in September.

Among Years

The mean CPUE and associated effort data are given in Table 9, and results of the statistical comparisons among years are given in Table 10. Only in North Carolina and Louisiana were significant differences detected among years. In North Carolina, for all zones combined, CPUE was significantly higher in 1984 than in the other 3 years. In Louisiana, both in zone 3 and for all zones combined, CPUE was significantly higher in 1983 and 1985 than in 1982 and 1984.

Discussion

Charterboats account for only a small percentage of the total recreational fishing effort that is exerted in salt water in the southeastern United States. According to Marine Recreational Fisheries Statistics Surveys (MRFSS) conducted in 1979-85, the average percentages of effort, in fisherman trips by mode of fishing, were: Man-made (piers, jetties, bridges, etc.), 30 percent; beach/bank, 20 percent; party boat/charterboat, 11 percent and private boat (rental boat), 39 percent (NMFS, 1984-86).

Of the four modes of fishing, the private boat/rental boat mode produced greatest landings of Spanish mackerel. The average percentages of total landings for the 7 years by mode of fishing were: Man-made, 18 percent; beach/bank, 2 percent; party boat/charterboat, 25 percent and prviate boat (rental boat), 56 percent.

Based on the MRFSS 1979-85 data, Spanish mackerel were landed in greatest amounts from the ocean $\leq$3 miles from shore. The average percentages of landings in relation to area were: Inland, 9 percent; ocean $\leq$3 miles, 55 percent; and ocean $>$3 miles, 36 percent. Our data indicate that for charterboats the highest CPUE of Spanish mackerel usually occurred in the estuarine zone where the lowest landings were reported by the MRFSS, assuming that the "inland" category is the same or similar to our estuarine zone.

Greatest landings of Spanish mackerel occurred in west Florida, Alabama, and Mississippi areas when states and areas of states were compared. The average percentages of landings by area for 1979-85 were: North Carolina, 14 percent; South Carolina, 5 percent; Georgia, 1 percent; east Florida, 11 percent; west Florida, 25 percent; Alabama, 18 percent; Mississippi, 19 percent; Louisiana,

Table 10.—Comparison for Spanish mackerel of log (CPUE+1) among years for those areas, zones, and years with sufficient data.

Area	Zone	Year	Mean: Arithmetic	Mean: Log (CPUE+1)	F	d.f.	$F_{.10}$	Area	Zone	Year	Mean: Arithmetic	Mean: Log (CPUE+1)	F	d.f.	$F_{.10}$	Area	Zone	Year	Mean: Arithmetic	Mean: Log (CPUE+1)	F	d.f.	$F_{.10}$
NC	2	1983	1.04	0.26	0.61	2,12	2.8		1-7	1983	0.29	0.09	1.68	2,24	2.5		1-7	1982	1.67	0.33	1.11	3,24	2.5
		1984	3.79	0.55						1984	0.09	0.03						1983	0.54	0.16			
		1985	3.35	0.40						1985	0.02	0.01						1984	0.30	0.10			
	1-7	1982	0.00	0.00	*2.67	3,28	2.3											1985	2.50	0.32			
		1983	0.08	0.16				WF	2	1983	1.60	0.36	0.61	2,24	2.5								
		1984	1.11	**0.31						1984	1.39	0.34				LA	3	1982	1.30	0.31	*3.10	3,19	2.4
		1985	0.22	0.07						1985	1.86	0.43						1983	4.70	**0.60			
									1-7	1983	1.55	0.41	0.46	2,24	2.5			1984	0.18	0.05			
EF	3	1983	0.26	0.10	1.13	2,24	2.5			1984	1.35	0.34						1985	8.46	**0.66			
		1984	0.16	0.06						1985	1.71	0.41					1-7	1982	1.11	0.29	*4.26	3,20	2.4
		1985	0.15	0.06														1983	3.00	**0.56			
	1-7	1983	0.22	0.08	1.25	2,27	2.5	NWF	1	1982	5.80	0.79	2.02	3,10	2.7			1984	1.52	0.32			
		1984	0.10	0.05						1983	1.42	0.37						1985	8.68	**0.90			
		1985	0.13	0.05						1984	0.82	0.20											
										1985	5.42	0.64				STX	1-7	1982	2.52	0.21	0.89	3,20	2.4
SEF	3	1983	0.03	0.01	2.54	2,21	2.6		2	1982	0.95	0.23	2.04	3,20	2.4			1983	0.06	0.03			
		1984	0.10	0.04						1983	0.42	0.13						1984	0.04	0.02			
		1985	0.00	0.00						1984	0.40	0.13						1985	0.01	0.01			
										1985	0.01	0.01											

*Significant at the $F_{.10}$ level.
**Significantly higher than during other years based on Duncan's multiple range test.

4 percent; and Texas, 4 percent. MRFSS landings data were concordant with the results of this study where highest catch rates of Spanish mackerel occurred in the areas within the eastern Gulf of Mexico from Louisiana to southwest Florida.

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