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Catches of king mackerel and cero in the Spanish mackerel gill-net fishery

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ABSTRACT

Between December 1980 and November 1981, Spanish mackerel gill-net catches were sampled in two areas of south Florida and in northwest Florida to determine the proportion by number of king mackerel taken as a bycatch in this fishery. Less than 1,000 king mackerel were observed in over 150,000 mackerels examined from landings totalling over 1.1 million pounds. Weighted estimates of the proportions by number of king mackerel in the catches were less than 1% in all areas (Ft. Pierce-Port Salerno, Marathon-Key West, and Panama City), and the overall weighted estimate for the entire fishery was 0.80%.

Only one cero was seen in the entire study.

INTRODUCTION

Most of the United States commercial landings of Spanish mackerel, Scomberomorus maculatus, and king mackerel, S. cavalla, occur in Florida. Gill nets are the major capture gear for each species. During 1953-1977, gill nets accounted for over 85% of the commercial catch of Spanish mackerel (Trent and Anthony, 1979); some small king mackerel have been caught (by-catch) in the Spanish mackerel nets and have been reported and sold as Spanish mackerel.

The following management measures, considered by the Gulf of Mexico and South Atlantic Fishery Management Councils for king mackerel, are difficult to evaluate unless the amount of small king mackerel caught in the Spanish mackerel gill-net fishery, and sold as Spanish mackerel, is known or estimated.

1. The total allowable catches per year of king mackerel will be 37 million pounds and of Spanish mackerel will be 27 million pounds.

2. Commercial use of king mackerel under 24 inches fork length will by prohibited.

3. The minimum mesh size in the Fishery Conservation Zone for all gill nets used to catch king mackerel shall be 4-3/4 inches stretched mesh (3-1/8 - 3-1/2 inches stretched mesh nets are used in the Spanish mackerel fishery).

The Gulf of Mexico Fishery Management Council (GMFMC) became aware through testimony given at public hearings that the king mackerel by-catch in the Spanish mackerel fishery may be very substantial at certain times. This was especially true in the Ft. Myers-Naples area where the by-catch was reported to be as great as 50% (Connor Davis, GMFMC, personal communication).

The Southeast Fisheries Center's Panama City Laboratory was requested to determine the percentages of king mackerel and cero (S. regalis) caught in the Spanish mackerel gill-net fishery in relation to area and time of year. This study was initially conducted in south Florida between December 1980 and April 1981 and continued in northwest Florida from April into November 1981. This report contains the results obtained in the study.

STUDY AREA AND METHODS

Those Florida counties with historical landings (1966-76) of Spanish mackerel averaging 2% or greater of the total state landings comprised a preliminary survey area (Figure 1). These counties, and percentages of total landings, were: St. Lucie, 9.9; Martin, 10.6; Palm Beach, 9.4; Monroe, 35.9; Collier, 8.1; Lee, 5.2; Gulf, 3.4; and Bay, 4.3. A survey of fish house operators and fishermen during November 1980 revealed that Collier and Lee Counties had almost no landings during the last several years. Table 1 shows the counties and fish house code number that have historically had, or were expected to have, appreciable landings of Spanish mackerel.

We stratified our sampling so that estimates could be obtained by area, month, and boat size. The study areas are shown in Figure 1. The boat sizes were: small = less than 26' in length; medium = 26' to 42'; large = greater than 42'.

Our sampling plan required that a port sampler report to a fish house and take samples from as many boats as possible during the visit. The selection of which fish house to visit on each sampling day was random and was determined by assigning sample selection probabilities (SSP). The SSP, a judgment value associated with a fish house (or group of fish houses, if they were adjacent) was the expected quantity of Spanish mackerel landings as compared to the other fish houses within the same area. For example, a fish house (or group of adjacent houses) with an SSP of four would be expected to have four times the landings of a house with an SSP of one, and would have four times the chance of being sampled. The values were estimated on the basis of the number of vessels using that house, the owner's or manager's statements during interviews regarding anticipated landings, and past landing statistics.

Port samplers were located in Ft. Pierce, Marathon, and Panama City and were responsible for sampling their particular area (Figure 1). The samplers were on station in south Florida from December 15, 1980 to April 15, 1981 and were on station in northwest Florida from April 1 to November 15, 1981. No port sampler was permanently assigned to the Collier-Lee County area, but the fish houses were monitored weekly by telephone to determine if samples could be obtained.

The sampling design whereby the sampler reported to one fish house during a sampling period (6-10 hours) was efficient in intercepting the sampling units (i.e., a landing by a boat that fished for Spanish mackerel with a gill net). This method of selecting sampling units was not completely random, but we considered it so for purposes of analyses. The probability of selecting a particular fish house on a particular day was based on the selection probabilities shown in Table 1. For example, fish house no. 2 was 12 times as likely to be selected for sampling on a particular day as was fish house no. 1. Sampling was conducted with replacement (selection of a fish house was not influenced by previous selection). Any day in which the weather was suitable and the vessels went out was defined as a sampling day. On each sampling day, samples were taken at the pre-selected fish house until all vessels returned.

During a sampling period, all, or a random subsample of all, available gill-net vessels landing at the selected fish house were sampled. One to three species-composition samples were taken per landing. A sample was defined as at least 100 mackerel per landing, or all that were caught if less than 100. Recorded were the numbers of Spanish mackerel, king mackerel, and cero found in the sample. Other information, including vessel size, net mesh size, total pounds landed, and location of the catch, was also recorded.

Estimates of the proportions (P_{ijk} or $\hat{P}_{ijk}$) by number of king mackerel in Spanish mackerel landings were made using the following equations and notations:

1. $$P_{ijk} = \frac{a_{ijk}}{n_{ijk}}$$

where P_{ijk} = estimate of proportion in the ith area, j^{th} month, and k^{th} boat size

a_{ijk} = number of king mackerel

n_{ijk} = number of mackerels (Spanish and king).

2. $$\hat{P}_{ijk} = \frac{\Sigma\ P_{ijk}\ \omega_{ijk}}{\Sigma\ \omega_{ijk}}$$

where ω_{ijk} = pounds of mackerels landed.

The normal approximation

$$\hat{P} \pm 1.96 \sqrt{\frac{\hat{P}\ (1-\hat{P})}{n_{ijk}}}$$

was used to compute 95% confidence intervals (CI) about the proportions.

BY-CATCH

East coast and Keys

In these areas, which included St. Lucie, Martin, Palm Beach, and Monroe counties, 329 samples were taken from 137 landings; total weight of the landings that were sampled was over 950,000 pounds (Table 2).

The percentages of king mackerel in the Spanish mackerel catch were small. The overall percentage from both these areas was 0.71. Computations from sampling on the east coast (St. Lucie, Martin, and Palm Beach Counties) yielded a percent of 0.91, while in the Keys (Monroe County) only 0.02 was found.

Percentages were low, but they tended to increase as the fishing season progressed. Sampling of medium sized boats provided percentages of 0.03 in December and 0.11 in January on the east coast, and 0.00 in January, 0.11 in February, and 0.20 in March in the Keys (Tables 2-3). Percentages for large boats on the east coast were 0.02 in December, 1.82 in January, and 2.44 in April (this percentage was from a sample of only 41 fish, however). The observed trend was suggested by the fishermen during the preliminary study. They stated that early in a season very few king mackerel were mixed with the Spanish mackerel, but as the season progressed, more were found.

Of the 137 landings that were sampled, three contained relatively large percentages of king mackerel. These three were landings by large boats in January on the east coast. On January 1 a vessel landed 4,500 pounds of mackerels, with an estimated 9.1% king mackerel. On January 19 two vessels landed 4,570 and 5,367 pounds with 13.8 and 16.9% king mackerel, respectively.

One cero was seen in the east coast and Keys portions of the study. It was taken on January 13 on the east coast by a large vessel unloading 6,595 pounds of mackerels.

Southwest coast

No samples were obtained on the southwest coast (Collier and Lee Counties) in this study. Between February and April, fish houses in this area were called several times each week to check on landings. In late March a port sampler spent a week there in anticipation of landings, but no Spanish mackerel were observed. Apparently bad weather had forced the fish offshore, and landings for the spring run were negligible.

Northwest coast

On the northwest coast (Bay and Gulf Counties), we obtained 220 samples from 86 landings totalling over 209,000 pounds (Table 2).

As in the east coast and Keys sampling, percentages of king mackerel in the Spanish mackerel catch were very small. The percentage of king mackerel from all months and all boat sizes in this area was 0.47. No trends were noticed in the monthly percentage estimates. Only two large boats were available for sampling and no small boats were observed.

Only one landing sampled on the northwest coast contained an appreciable number of king mackerel. This was a landing of 1,900 pounds of mackerels by a medium-size boat on May 30. The landing was estimated to contain 40.8% king mackerel.

No cero were seen in mackerel landings in northwest Florida. The fishermen say that cero are rare in this area.

LENGTHS

Mean fork lengths of mackerels caught in different mesh sizes ranged from 331 to 570 mm for Spanish mackerel and from 406 to 750 mm for king mackerel (Table 4). The ranges of mesh sizes in this table indicate mixed mesh nets are used commonly in northwest Florida. The sizes of mackerels that were landed were determined not only by the sizes that were available but also by the mesh sizes of nets used to harvest the fish. The lengths of mackerels were related to the mesh size in which they were caught (Figure 2).

CONCLUSION

The results of our study clearly indicated that percentages by number of king mackerel in the Spanish mackerel gill-net catches were very low (less than 1%) in 1980-81. If we assume that the 1980-81 season was a typical year, then we can conclude that king mackerel by-catches in this fishery are insignificant.

LITERATURE CITED

TRENT, LEE, and ERNEST A. ANTHONY. 1979. Commercial and recreational fisheries for Spanish mackerel, Scomberomorus maculatus. In: Colloquium on the Spanish and king mackerel resources of the Gulf of Mexico. Gulf States Marine Fisheries Commission, No. 4, p. 17-32.

Table 1. Sampling areas, counties, fish house code numbers, and sample selection probabilities.

Area	County	Fish house code number	Sample selection probability
East coast	St. Lucie	1	1
		2	12
		3	1
		4	1
	Martin	5	10
	Palm Beach	6	1
Keys	Monroe	7	4
		8	2
		9	2
		10	2
		11	1
		12	1
Southwest coast	Collier	13	1
		14	1
		15	3
		16	2
	Lee	17	10
Northwest coast	Gulf	18	5
	Bay	19	3
		20	5
		21	3
		22	1

Table 2. Estimates of the proportions ($P = P_{ijk}$), in percent, of king mackerel in the Spanish mackerel catch by area, month, and boat size, 1980-81 ($a = a_i$ and $n = n_i$ = numbers of king and Spanish mackerel, respectively; $w = w_i$ = pounds of both species landed).

Area and Month	Boat Size: Small					Medium					Large					Combined				
	No. of Samples	Sums a	Sums n	Sums w	P	No. of Samples	Sums a	Sums n	Sums w	P	No. of Samples	Sums a	Sums n	Sums w	P	No. of Samples	Sums a	Sums n	Sums w	P
East Coast																				
Dec	37	29	7,648	37,150	0.38	12	1	3,449	25,500	0.03	94	5	24,742	365,522	0.02	143	35	35,839	428,172	0.10
Jan	--	--	--	--		3	1	899	4,100	0.11	112	597	32,185	425,597	1.82	113	598	33,084	429,697	1.78
Apr	--	--	--	--		--	--	--	--		1	1	40	187	2.44	1	1	40	187	2.44
Total or Mean	37	29	7,648	37,150	0.38	15	2	4,348	29,600	0.05	207	603	56,967	791,306	1.05	259	634	68,963	858,056	0.91
Keys																				
Jan	2	0	400	600	0.00	39	0	11,436	48,512	0.00	18	0	5,150	45,582	0.00	59	0	16,986	94,694	0.00
Feb	--	--	--	--		7	2	1,898	4,707	0.11	--	--	--	--		7	2	1,898	4,707	0.11
Mar	--	--	--	--		4	2	998	1,570	0.20	--	--	--	--		4	2	998	1,570	0.20
Total or Mean	2	0	400	600	0.00	50	4	14,332	54,789	0.03	18	0	5,150	45,582	0.00	70	4	19,882	100,971	0.02
Northwest Coast																				
Apr	--	--	--	--		98	2	28,998	99,561	0.01	13	0	3,900	12,200	0.00	111	2	32,898	111,761	0.01
May	--	--	--	--		12	276	3,100	12,800	8.18	--	--	--	--		12	276	3,100	12,800	8.18
Jul	--	--	--	--		3	0	650	850	0.00	--	--	--	--		3	0	650	850	0.00
Aug	--	--	--	--		12	2	3,598	20,900	0.06	--	--	--	--		12	2	3,598	20,900	0.06
Sep	--	--	--	--		77	28	23,072	51,950	0.12	3	0	900	10,000	0.00	80	28	23,972	61,950	0.12
Nov	--	--	--	--		2	0	600	800	0.00	--	--	--	--		2	0	600	800	0.00
Total or Mean	--	--	--	--		204	308	60,018	186,861	0.51	6	0	4,800	22,200	0.00	220	308	64,818	209,061	0.47
Grand Total or Mean	39	29	8,048	37,750	0.36	269	314	78,698	271,250	0.40	241	603	66,917	859,088	0.89	549	946	153,663	1,168,088	0.61

Table 3. Estimates of the proportions ($\hat{P}_{ijk}$) of king mackerel in the Spanish mackerel catch by area and boat size, 1980-81. The estimates were weighted on the basis of pounds that were landed (data from Table 2).

Area and Month	Boat Size			
	Small	Medium	Large	Combined
East Coast				
Dec	0.38	0.03	0.02	0.05
Jan	--	0.11	1.82	1.80
Apr	--	--	2.44	2.44
Mean ($\hat{P}_{ijk}$)	0.38	0.04	0.99	0.93
95% CI	0.3691-0.3909	0.0342-0.0458	0.9892-0.9908	0.9281-0.9319
Keys				
Jan	0.00	0.00	0.00	0.00
Feb	--	0.11	--	0.11
Mar	--	0.20	--	0.20
Mean ($\hat{P}_{ijk}$)	0.00	0.01	0.00	0.01
95% CI	--	0.0084-0.0116	--	0.0086-0.0114
Northwest Coast				
Apr	--	0.01	0.00	0.01
May	--	8.18	--	8.18
Jul	--	0.00	--	0.00
Aug	--	0.06	--	0.06
Sep	--	0.12	0.00	0.12
Nov	--	0.00	--	0.00
Mean ($\hat{P}_{ijk}$)	--	0.57	0.00	0.55
95% CI	--	0.5660-0.5740	--	0.5461-0.5539
Area Combined				
Mean ($\hat{P}_{ijk}$)	0.37	0.40	0.91	0.78
95% CI	0.3595-0.3805	0.3966-0.4034	0.9078-0.9122	0.7779-0.7821

Table 4. Length-frequency distributions by species, area, month, and stretched mesh size in inches.

	Spanish Mackerel									
	East Coast					Keys				
Length	Dec 1980			Jan 1981		Jan 1981				
Mid-point	3.125	3.25	3.375	3.25	3.375	3.375	3.625	3.75	3.875	4.625
300	8	15	1	0	10	15	1	0	0	0
350	299	395	78	0	239	142	3	0	0	0
400	360	328	1,195	36	629	473	35	1	5	2
450	101	156	757	151	386	188	120	22	5	14
500	16	54	145	70	135	64	259	52	24	84
550	0	22	26	11	34	13	125	35	28	182
600	0	4	2	0	2	4	47	23	11	217
650	0	2	0	0	3	1	9	16	2	49
700	0	0	0	0	0	0	1	1	1	8
Mean	388	396	424	460	418	411	504	536	530	570

	Spanish Mackerel							
	Keys							
Length	Feb 1981				Mar 1981			Apr 1981
Mid-point	2.0 1/	3.5	3.75	4.625	3.75	4.625	4.75	3.375
350	1	0	0	3	0	0	0	1
400	2	2	1	0	0	1	6	6
450	3	10	28	1	0	13	26	8
500	14	34	36	23	9	32	52	4
550	27	39	55	44	19	31	49	3
600	14	12	25	25	6	18	12	6
650	3	3	3	4	1	3	5	9
700	1	0	1	0	0	0	0	3
Mean	545	529	529	548	549	531	517	539

1/ Used as a seine

Table 4. Continued

Length Mid-point	Spanish Mackerel Northwest Coast									
	Apr 1981						May 1981		Jul 1981	Aug 1981
	1.125-2.5 1/	2.375-2.75	2.75-3.0	3.0	3.125	3.125-3.25	1.125-2.5 1/	3.0	1.125-2.5 1/	1.125-2.5 1/
200	0	0	0	0	0	0	1	0	0	1
250	0	0	0	0	1	0	1	1	0	12
300	5	14	2	44	2	6	52	6	1	101
350	61	50	30	677	96	174	158	57	50	43
400	83	14	80	730	98	194	144	136	43	36
450	41	0	60	280	3	17	31	125	6	7
500	9	0	19	100	0	6	12	67	0	0
550	1	0	5	25	0	3	1	8	0	0
600	0	0	2	1	0	0	0	0	0	0
650	0	0	1	1	0	0	0	0	0	0
700	0	0	1	0	0	0	0	0	0	0
Mean	398	350	425	395	375	382	374	437	377	331

1/ Used as a seine

Table 4. Continued

Length Mid-point	Spanish Mackerel Northwest Coast Aug 1981 3.0	Sep 1981 1.125-2.5 1/	Sep 1981 2.375-2.75	Sep 1981 3.0	Nov 1981 1.125-2.5 1/
100	0	0	0	1	0
250	1	1	0	3	0
300	6	11	6	219	1
350	24	80	43	527	91
400	257	76	108	1,439	87
450	125	21	33	566	17
500	75	8	9	189	4
550	12	2	1	23	0
600	0	1	0	0	0
750	0	0	0	1	0
1000	0	0	0	1	0
Mean	427	386	400	401	383

Length Mid-point	King Mackerel East Coast Dec 1980 3.125	Dec 1980 3.25	Dec 1980 3.375	Jan 1981 3.375	Keys Feb 1981 3.75	Keys Mar 1981 4.625	Northwest Coast Sep 1981 3.0
350	0	2	0	8	0	0	3
400	0	3	0	98	0	0	16
450	0	5	0	21	0	0	2
500	0	0	0	1	0	0	2
550	0	1	0	0	1	0	3
600	1	2	2	0	0	0	1
650	0	3	0	0	0	0	0
700	0	1	0	0	0	0	0
750	0	0	1	0	0	2	0
800	0	0	0	0	0	0	1
Mean	600	503	650	406	550	750	443

1/ Used as a seine

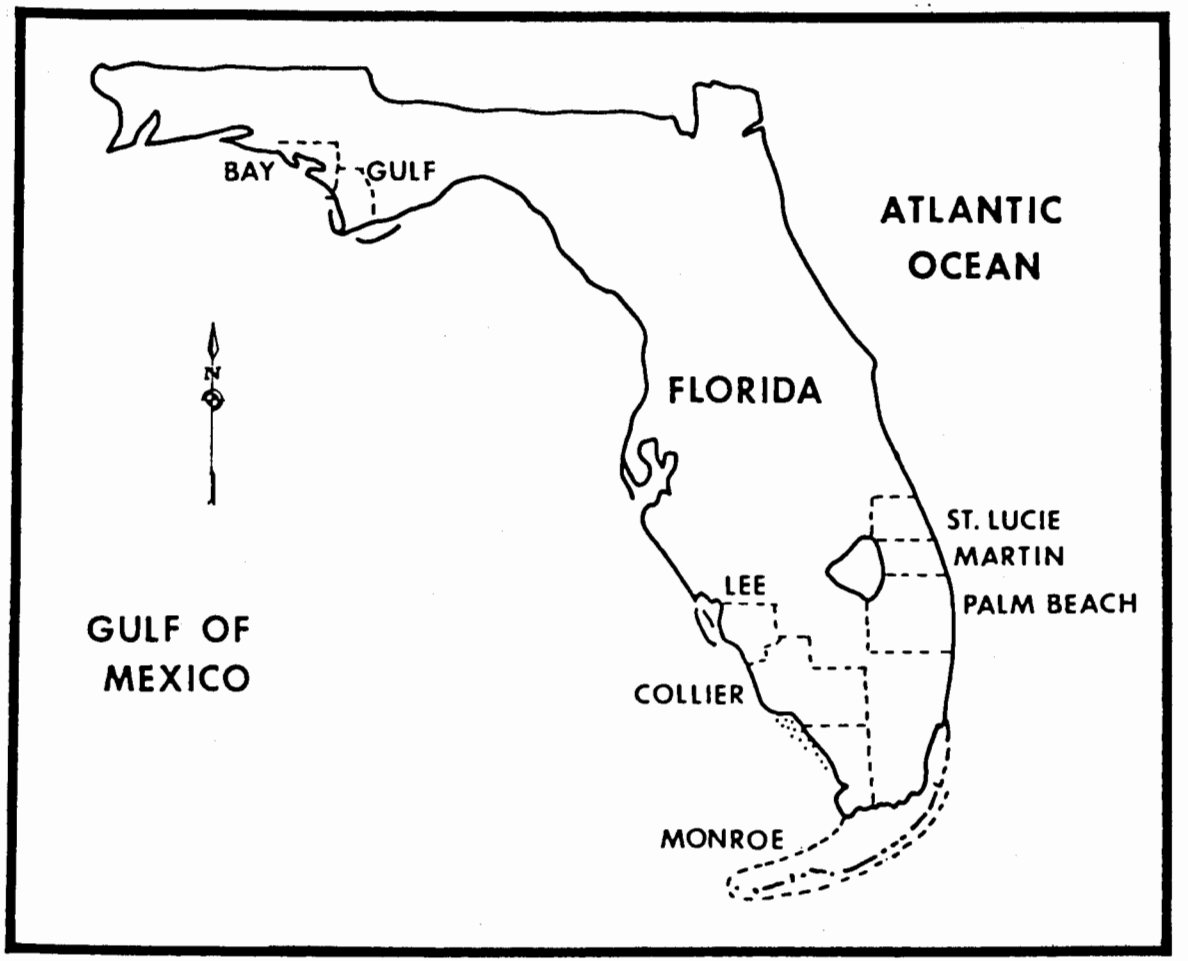

Figure 1. East coast (St. Lucie, Martin, and Palm Beach Counties), Keys (Monroe County), Southwest (Collier and Lee Counties), and Northwest Florida (Bay and Gulf Counties) sampling areas.

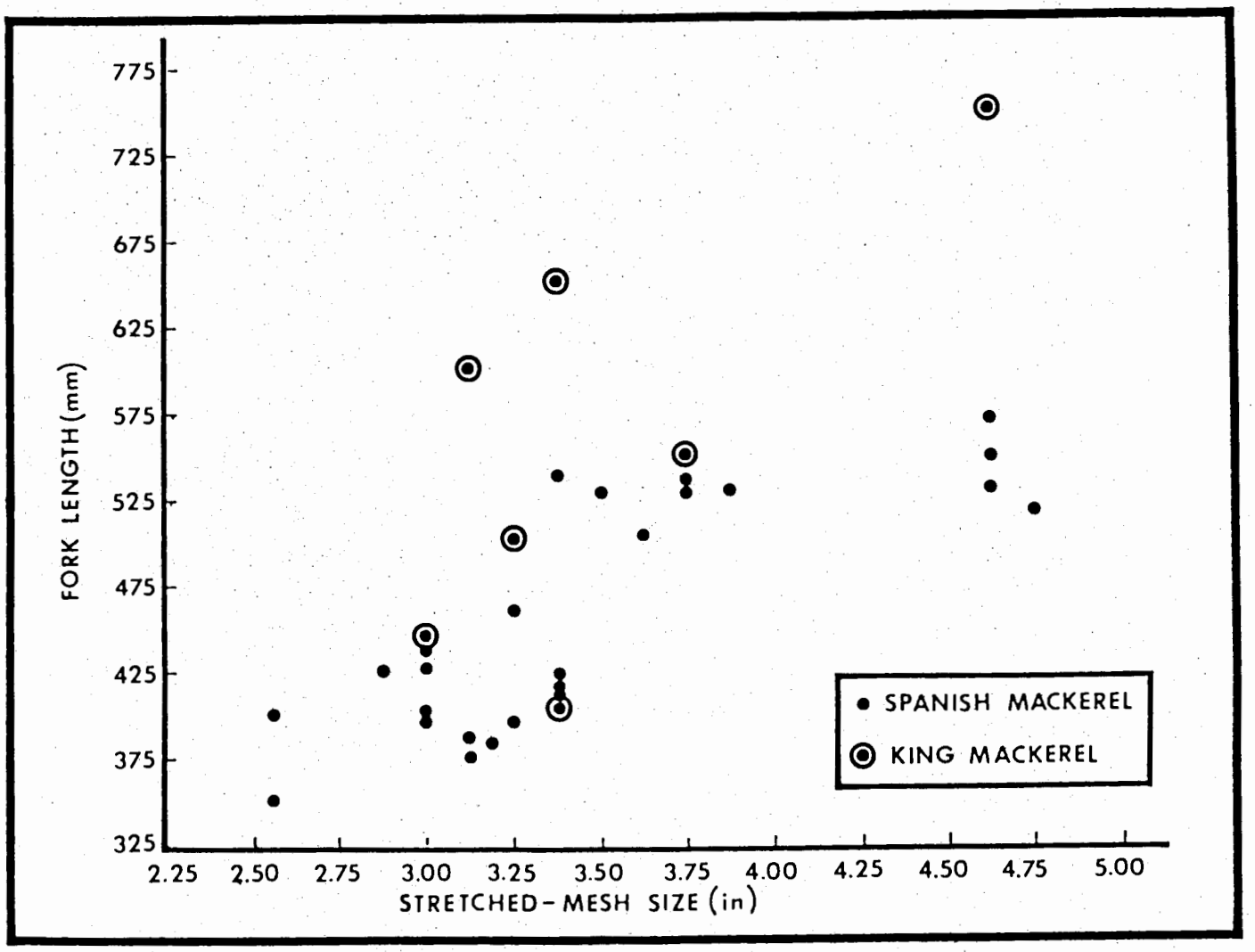

Figure 2. Mean fork lengths of king and Spanish mackerel sampled from gill-nets having various mesh sizes.