ABUNDANCE AND SIZE COMPOSITION OF SABLEFISH (*Anoplopoma fimbria*) IN THE COASTAL WATERS OF CALIFORNIA AND SOUTHERN OREGON, 1984-86

by

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ABSTRACT

Survey results indicate sablefish (Anoplopoma fimbria) relative abundance off southernmost Oregon and California decreased 53% in numbers and 49% in pounds per trap between 1984 and 1986. Catch rates were down at all nine index sites. Highest catches occurred at the 225- and 300-fathom depths. The proportion of small sablefish decreased from 81% of the catch in 1984 to 75% of the catch in **1986**, resulting in the mean length increasing slightly from 53.1 to 53.7 cm in **1984** and **1986**, respectively. Mean length in **1986** was 51.8 cm for males and 57.0 cm for females. Mean length increased with depth and much larger fish were taken in the 650- to 780-fathom depth range. Mean length decreased from north to south within the sampling area.

CONTENTS

INTRODUCTION

The economic importance of the sablefish (Anoplopoma fimbria) fishery (Korson 1986) and the need for information on the status of stocks resulted in the Northwest and Alaska Fishery Center (NWAFC) conducting surveys to periodically measure relative changes in sablefish abundance. These surveys began in waters off Oregon and Washington in 1979, and in waters off California in 1980. The results of the sablefish surveys during 1979-85 in the Washington-California region have been reported by Parks and Hughes (1981), Parks (1982, 1984), and Parks and Shaw (1983, 1985, 1987). This report updates these results, and includes the results of the 1986 survey off California and southernmost Oregon (Fig. 1).

The original sample sites at Bodega Canyon and Patton Escarpment fished in 1980, 1981, and 1982 had to be abandoned in 1984 because intensive trawling and drift gillnet fishing precluded working in those areas. Alternate sites were established in 1984 approximately 35 to 45 nautical miles southeast of the original sites (Fig. 1), but continuity and the ability to compare results with the first three survey years have been lost. As a result, the 1984 survey data will be used as the baseline for comparative studies of present and future California surveys.

Data on sablefish mean length by depth and by latitude are presented; a length-weight relationship and length at 50% maturity data are presented and compared to Oregon and Washington data collected in 1985.

Trap gear comparisons were made in 1983, 1984, and 1985 (Parks and Shaw 1985, 1987). In 1984, conical traps fished off California were 1.265 times more efficient than rectangular traps. Thus, all rectangular trap catches in this survey area are adjusted upward by that factor.

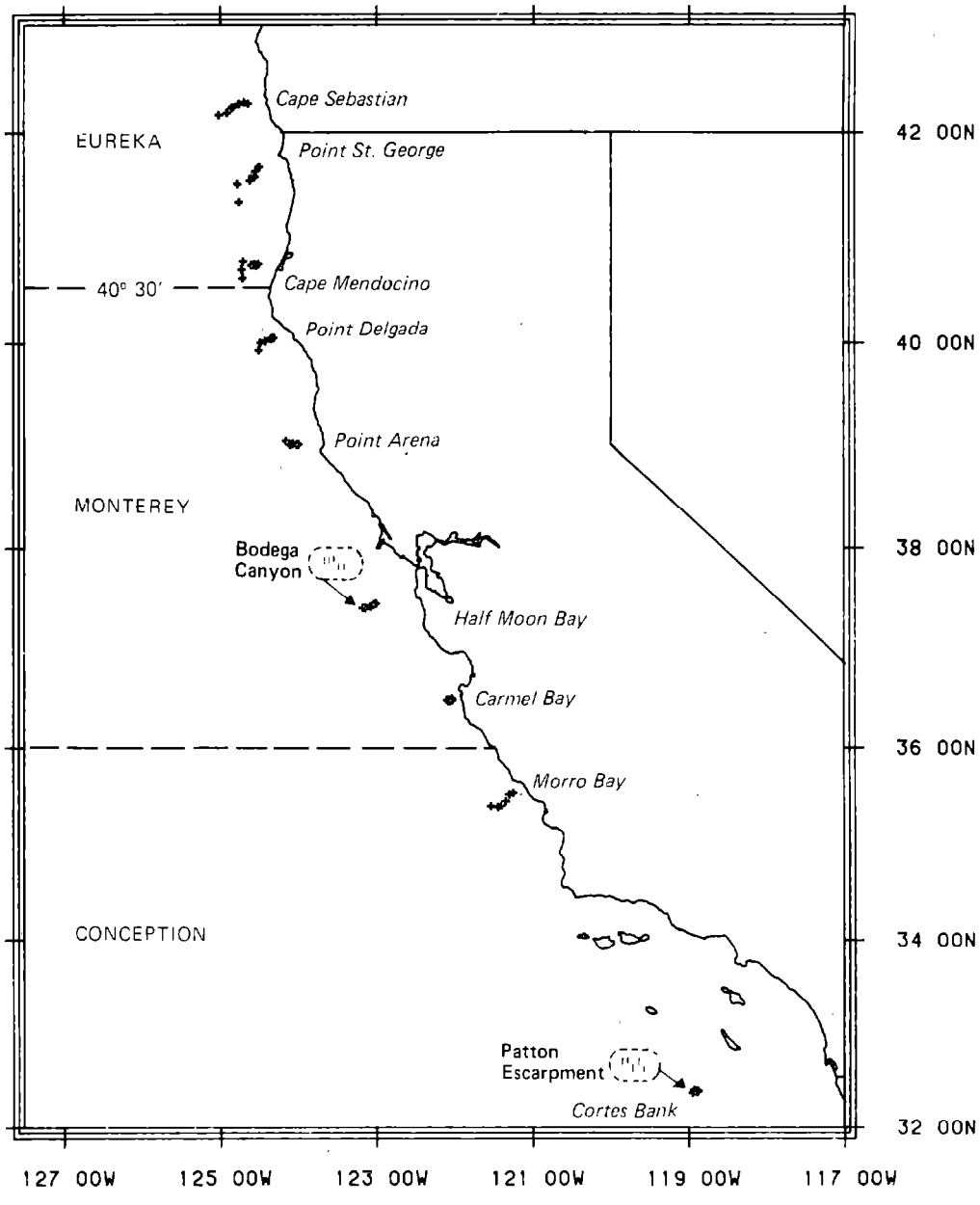


Figure 1.--Sites fished off California and southern Oregon (International North Pacific Fisheries Commission areas Eureka, Monterey, and Conception) during the 1986 sablefish abundance indexing survey. Curved arrows denote relocation of Bodega Canyon and Patton Escarpment sites in 1984 (old sites in dotted lines).

SURVEY METHODS AND GEAR

Methods used in earlier surveys and trap gear employed through 1982 are described in detail by Parks and Shaw (1983); methods and gear used in the 1984 survey are described by Parks and Shaw (1985). The 1986 survey methods were identical to the 1984 survey methods except conical traps were used exclusively in 1986.

The conical traps have a bottom ring of 54 inches (outside diameter), a top ring of 33.5 inches (outside diameter), a height of 28 inches, and a tunnel entrance on the side. The traps were attached to 5/8-inch groundlines 550 fathoms in length, and were spaced at intervals of 50 fathoms. Trap bridles were attached to the groundline by means of gangions using brummel hooks or "C" hooks.

In 1986, a string of 10 conical traps was fished twice at each site at each of five depths (225, 300, 375, 450, and 525 fathoms). An additional string was set in 150 fathoms at the three northernmost sites, the three southernmost sites, and between 650 and 780 fathoms at the four northernmost sites. Fishing time for each set was standardized to 24 hours. Loran C and depth sounders were used to position replicate sets near locations of the first sets.

Data collected during the surveys included:

1) Number and weight of sablefish and other species captured in each trap.

2) Fork lengths of all sablefish.

3) Biological information to determine age, sex ratios, and maturity.

4) Each of the 1,486 sablefish from which otoliths were taken (both a

random sample and a stratified sample of larger sablefish) were weighed to the nearest gram using a high resolution triple beam balance.

Sablefish not required for biological samples were double tagged and released in support of ongoing coastwide migration and tag loss studies.

Sampling was conducted from north to south during September-November 1986. Because the primary objective was to establish the relative stock size for the entire survey area, individual site data (Appendix) are not discussed in detail.

RESULTS

Catch Rates and Size Composition

Catch rates for sablefish declined 53% from 1984 to 1986 based on numbers of fish per trap at standard depths (225-525 fathoms) for the nine abundance index sites combined. This decline, from 9.8 fish per trap in 1984 to 4.6 in 1986 (Fig. 2), is significant at the 99.9% level based on Rubin's method (Knechtel 1986); the coefficients of variation of these catch rates per trap were 7.6% and 7.5%, respectively (se = 0.750 and se = 0.345, respectively). Catch rates of small (<4.25 lb) sablefish declined from an average of 7.9 fish per trap in 1984 to 3.4 fish per trap in 1986 (Fig. 2). Catch rates of medium-size (4.25-7.0 lb) sablefish declined from 1.7 fish per trap in 1984 to 1.0 in 1986, and catch rates of large (>7.0 lb) sablefish remained low and unchanged at 0.2 sablefish per trap (Fig. 2 and Table 1). Catch rates shown for 1980-82, although not directly comparable with those from 1984 and 1986 because the stations were different, exhibit similar trends to catch rates of sablefish from surveys off Oregon and Washington in 1979-82 (Parks 1984). Average catch rates of sablefish expressed in lb per trap at the standard

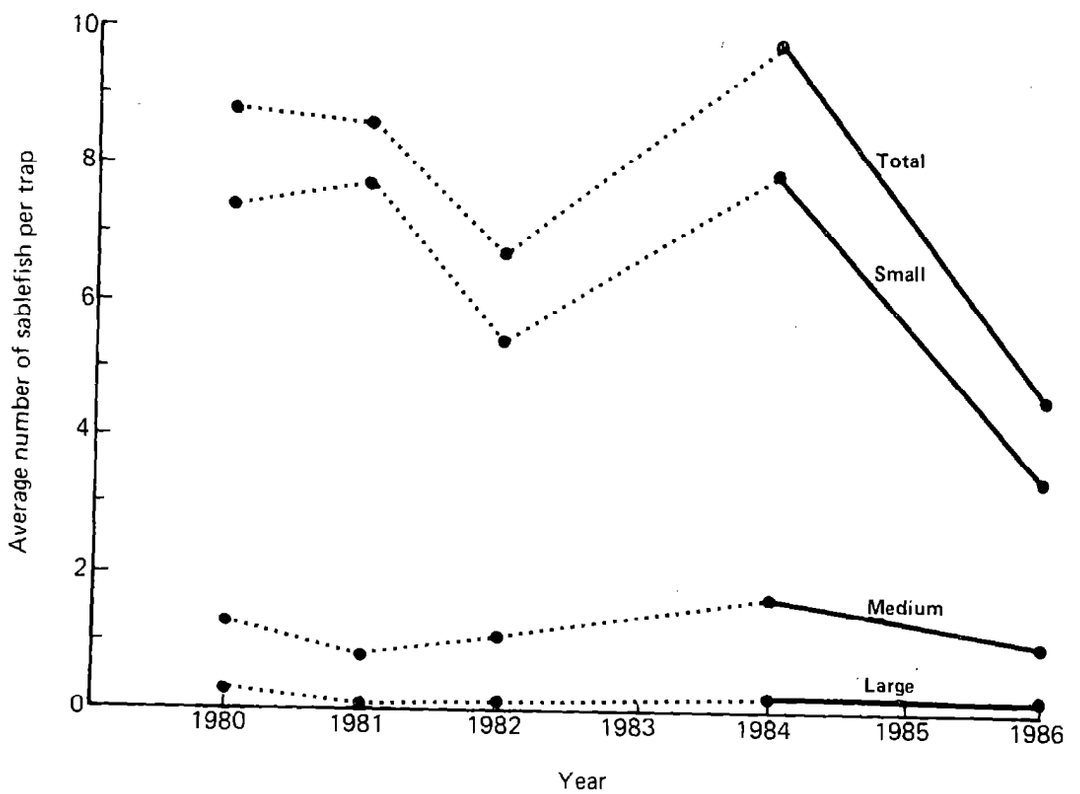


Figure 2.--Mean catch rates of total, small, medium, and large sablefish captured in standard depths (225-525 fathoms) at two index sites off California in 1980-82 (dotted lines) and nine index sites fished off California and southern Oregon in 1984 and 1986. No surveys were conducted in this area in 1983 and 1985.

Table 1. --Numbers sablefish, average numbers and weight by trap, and percentage of sablefish by size[a] captured at southernmost Oregon and California sites by depth in 1984[b] and 1986.

Depth fathoms (fm)	Year	Total no. sablefish	Avg. no. sablefish per trap	Avg. wt. (lb) per trap	% Large sablefish	% Medium sablefish	% Small sablefish
150	1984[d]	420	5.2	16.1	1	11	88
	1986[e]	286[c]	2.4	6.8	3	9	88
225	1984	2,736	15.2	51.0	2	16	82
	1986	1,262[c]	7.0	23.4	2	18	80
300	1984	2,571	14.3	48.9	2	14	84
	1986	1,105[c]	6.1	23.2	4	20	76
375	1984	1,499	8.3	28.5	3	16	81
	1986	689	3.8	16.3	7	20	73
450	1984	1,263[c]	7.0	25.6	2	17	81
	1986	595[c]	3.3	13.0	3	19	78
525	1984	757	4.2	18.8	5	34	61
	1986	479	2.7	12.0	4	33	63
650-780	1986[f]	189	2.4	18.5	47	49	4
All depths combined	1984	9,246	9.4	33.1	2	17	81
	1986	4,605	4.2	16.5	6	21	73
Standard depths combined	1984	8,826	9.8[g]	34.6	2	17	81
	1986	4,130	4.6[g]	17.6	4	21	75

[a]Large = over 7.0 lb round weight (rd. wt.); medium = 4.25-7.0 lb rd. wt.; and small = less than 4.25 lb rd. wt.

[b]The 1984 numbers are the result of adjustment (x 1.265) on rectangular trap catches plus conical trap catches.

[c]Adjusted upward for missing string(s) of gear based on the average decline of catch from the first set to the second set.

[d]150-fm depth fished at the four southern sites only.

[e]150-fm depth fished at the three northern and three southern sites only.

[f]650- to 780-fm depth fished at the four northern sites only in 1986 and not fished in 1984.

[g]Standard error = 0.750 for 1984 and 0.345 for 1986.

depths declined 49% from 34.6 lb to 17.6 lb between 1984 and 1986 (Table 1). Catch rates (number per trap) were down at all sites, with the largest declines at Half Moon Bay (-85%), Cortes Bank (-67%), and Point Arena (-66%) (Appendix Table 1; Appendix Fig. 1). Smallest declines occurred at the Morro Bay (-6%) and Cape Sebastian (-19%) sites. Catch rates were highest at Morro Bay (6.2 per trap), Cape Sebastian (6.1 per trap), and Carmel Bay (5.8 per trap), and were lowest at Half Moon Bay (2.3 per trap) and Point Arena (3.2 per trap).

Highest catches within the standard sampling depths (225-525 fathoms) occurred at 225 and 300 fathoms (Table 1). Traps were fished at depths greater than 600 fathoms only at the four northernmost sites and produced catch rates that were slightly lower than traps fished at 375, 450, and 525 fathoms, and were equal to the catch rates at 150 fathoms (Table 1).

Size compositions for 1984 and 1986 are compared in Figure 3. Mean length increased slightly from 53.1 to 53.7 cm between 1984 and 1986, reflecting a lower proportion of small fish at the standard depths. The proportion of small sablefish decreased from 81% of the catch in 1984 to 75% in 1986, whereas the proportion of medium- and large-size sablefish increased from 17 to 21% and 2 to 4% (Table 1). The sex-specific size composition for sablefish captured at the standard depths during the 1986 survey is illustrated in Figure 4.

Mean Length by Depth and by Latitude

Length compositions by depth are shown for both 1984 and 1986 surveys in Figure 5. Mean lengths were generally found to increase with depth in both years (Fig. 6). The largest change within the standard sampling depths occurred between 450 and 525 fathoms where mean lengths increased approximately 3 cm in both survey years, and between 150 and 225 fathoms in 1986 where mean

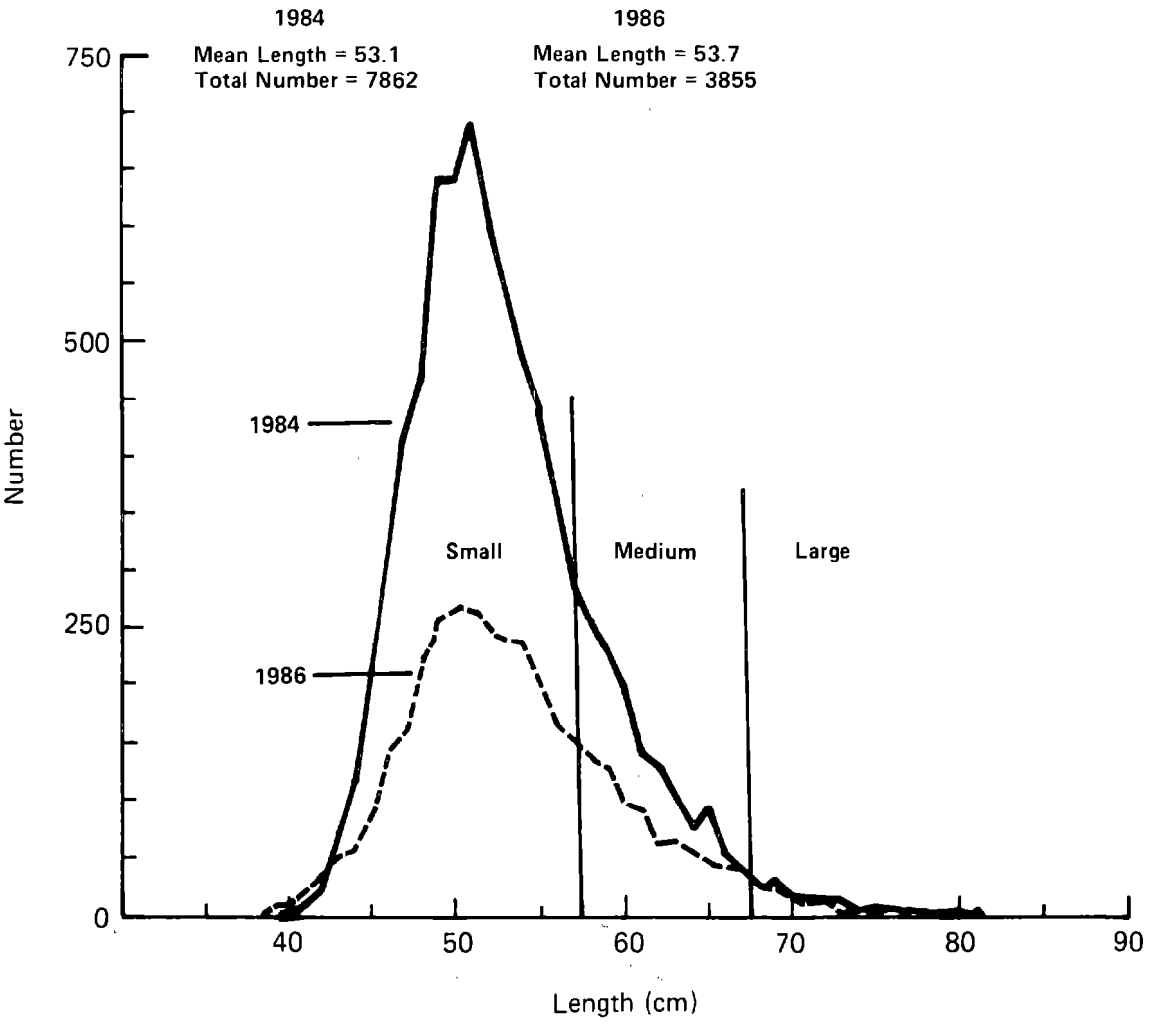


Figure 3. --Sablefish length composition for all southern Oregon and California index sites combined at standard depths (225-525 fathoms) for 1984 and 1986.

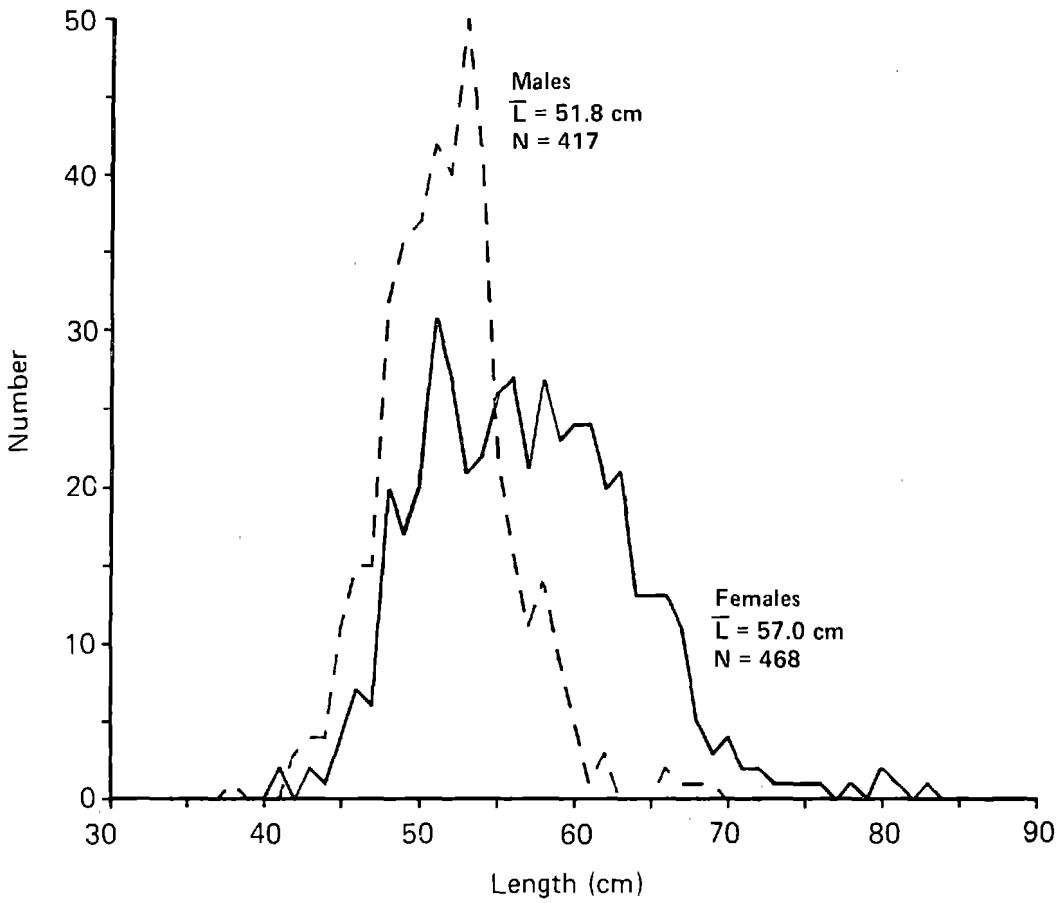


Figure 4. --Sablefish length compositions and mean length by sex based on random samples at the standard depths (225-525 fathoms) during the 1986 abundance index survey.

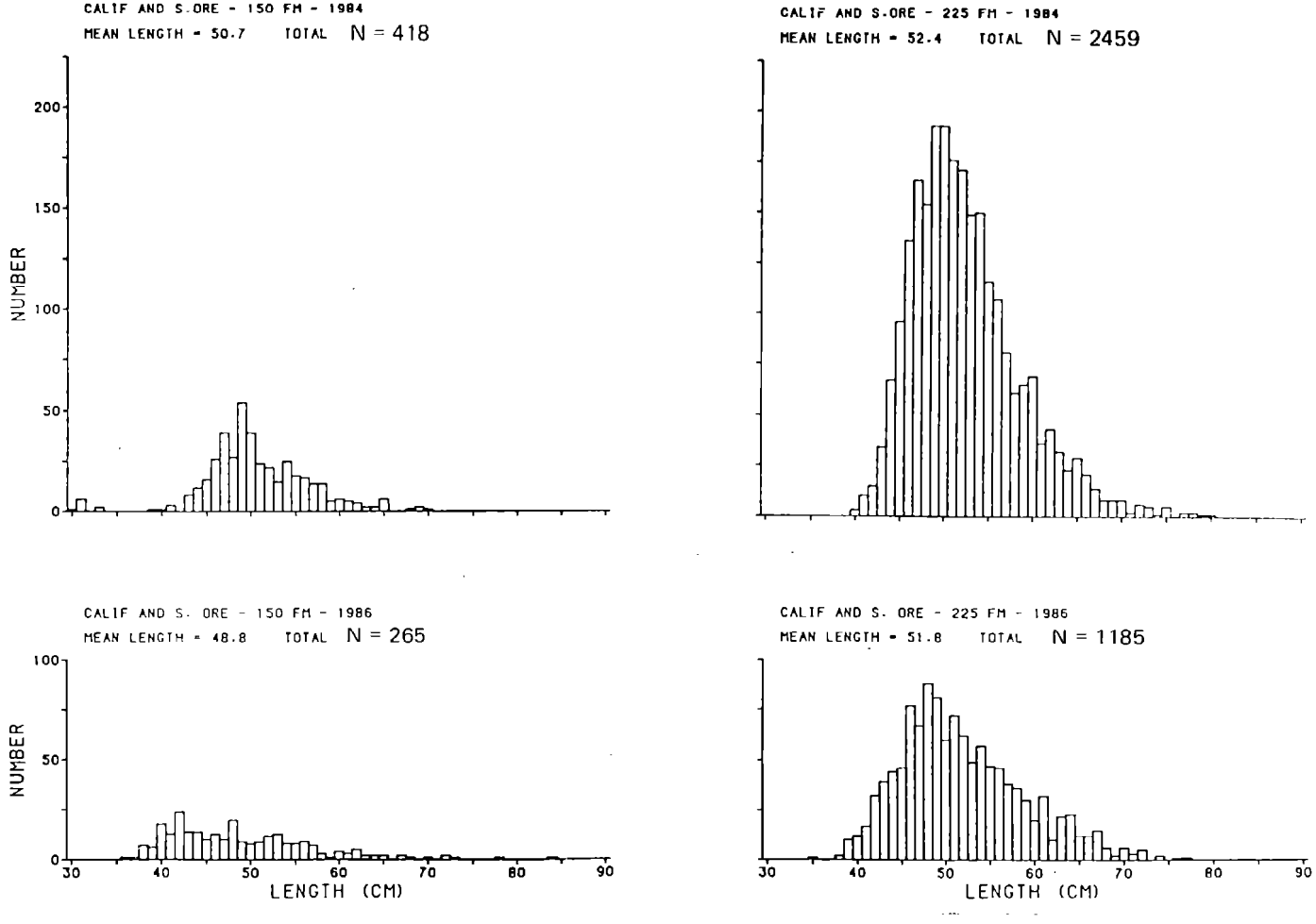
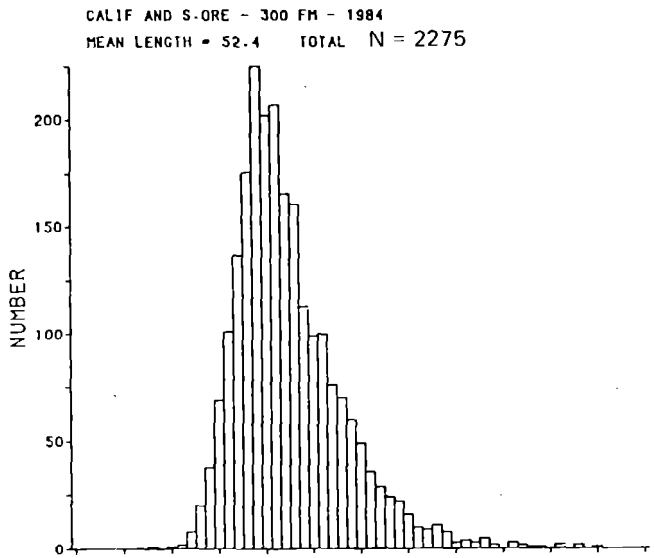
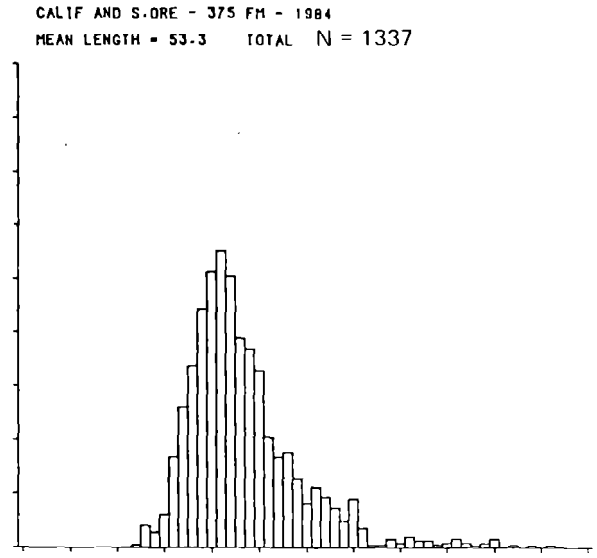
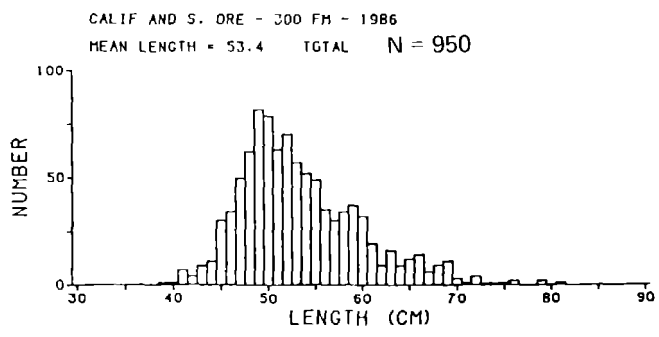
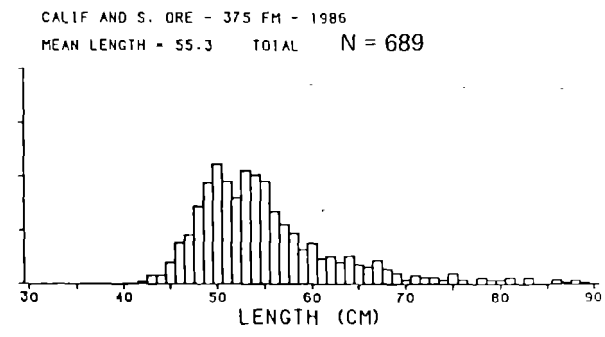


Figure 5.--Sablefish length compositions by depth for all sites combined for 1984 and 1986 (150 fathoms fished only at four southern sites in 1984 and at the three northernmost and three southernmost sites in 1986, >600 fathoms were fished only at the four northern sites in 1986).









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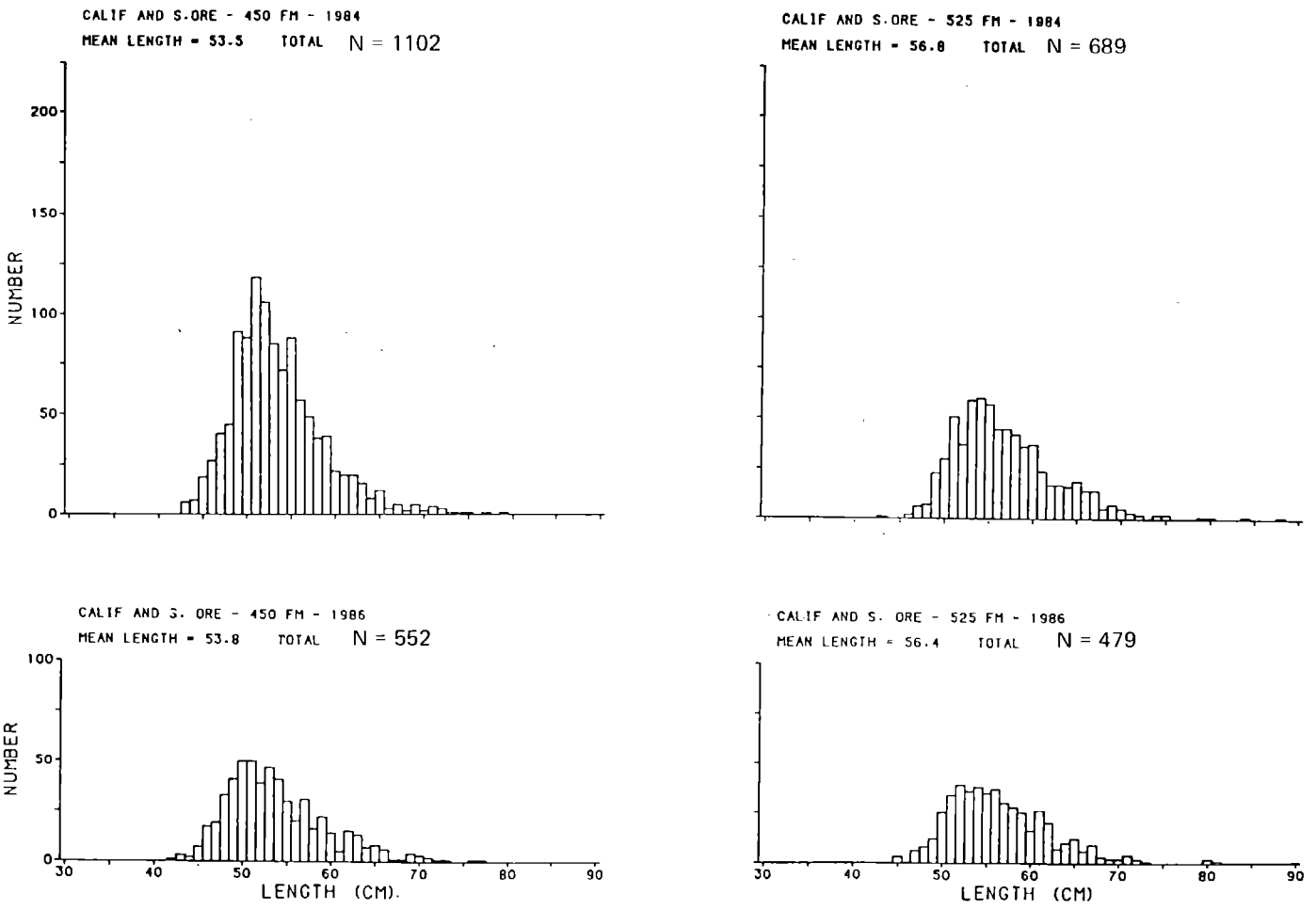

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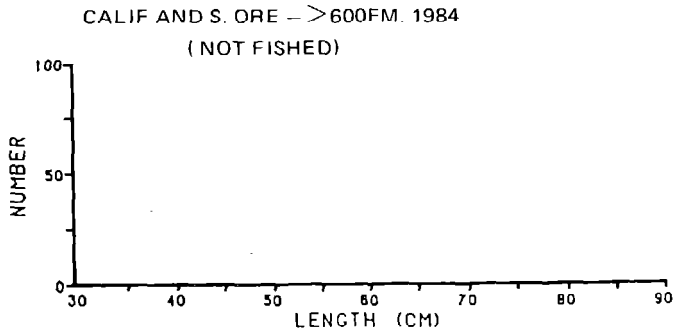

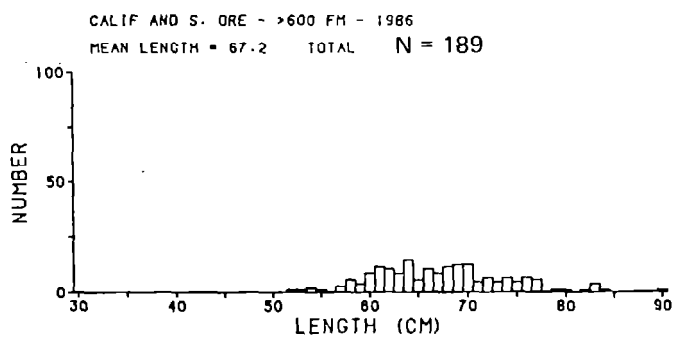

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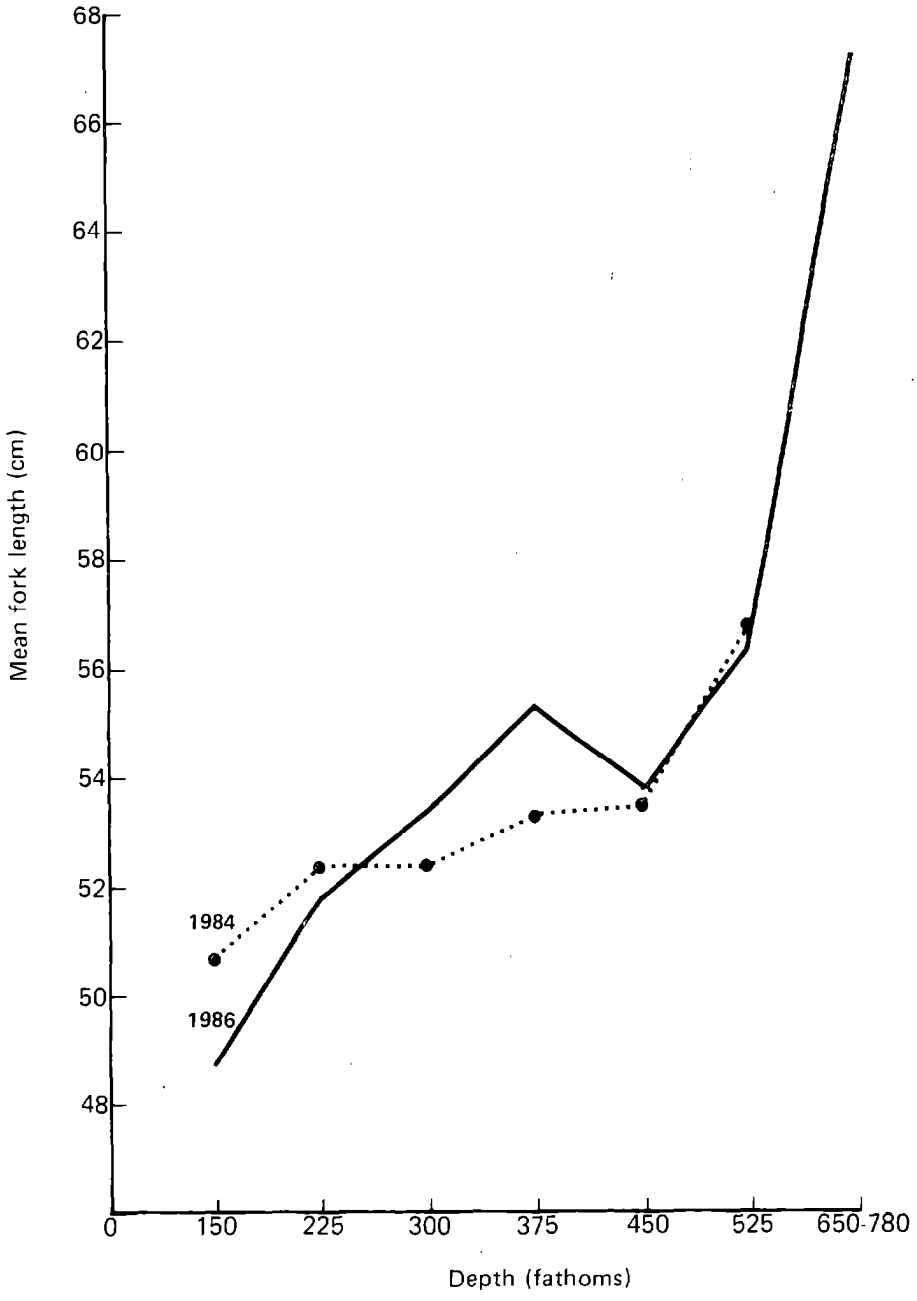

Figure 6. --Mean fork length (cm) of sablefish by depth from southern Oregon and California abundance index surveys in 1984 and 1986.

length also increased approximately 3 cm. The only decrease with increasing depth occurred in 1986 between 375 and 450 fathoms where mean length decreased 1.5 cm. Sablefish in the 650- to 780-fathom depth interval (sampled only at the four northernmost sites in 1986) were larger with a mean length of 67.2 cm (Fig. 6). In this depth range only 4% of the catch was small (<4.25 lb), compared to 63-88% in the standard depths (Table 1).

Sablefish mean length generally decreased from north to south during both survey years (Fig. 7). The decrease in mean length from the Cape Sebastian, Oregon site to the Cortes Bank site was 3.2 and 2.2 cm in 1984 and 1986, respectively. The magnitude of decreases in length with latitude were greatest south of Point Arena.

Length-Weight Relationship

When the length-weight relationships were calculated, the regression lines for males and females (total sample size = 1,486) could not be distinguished graphically; therefore, the data was lumped (Fig. 8). The resultant relationship is $W = .0023314 \times L^{3.3639}$, where W = weight in grams and L = length in centimeters. The predicted weights by l-cm intervals are shown in Table 2. The 1985 sablefish length-weight relationship for Oregon and Washington was considerably different (Parks and Shaw 1987). Sablefish less than 42 cm weighed slightly more off Oregon and Washington, while sablefish at 50, 60, 70, 80, 90, and 100 cm off California were 2, 4, 6, 8, 10, and 11% heavier, respectively. Some of this difference may be the result of more advanced maturation in the California sablefish which were sampled closer to the winter spawning period than were the Oregon-Washington fish.

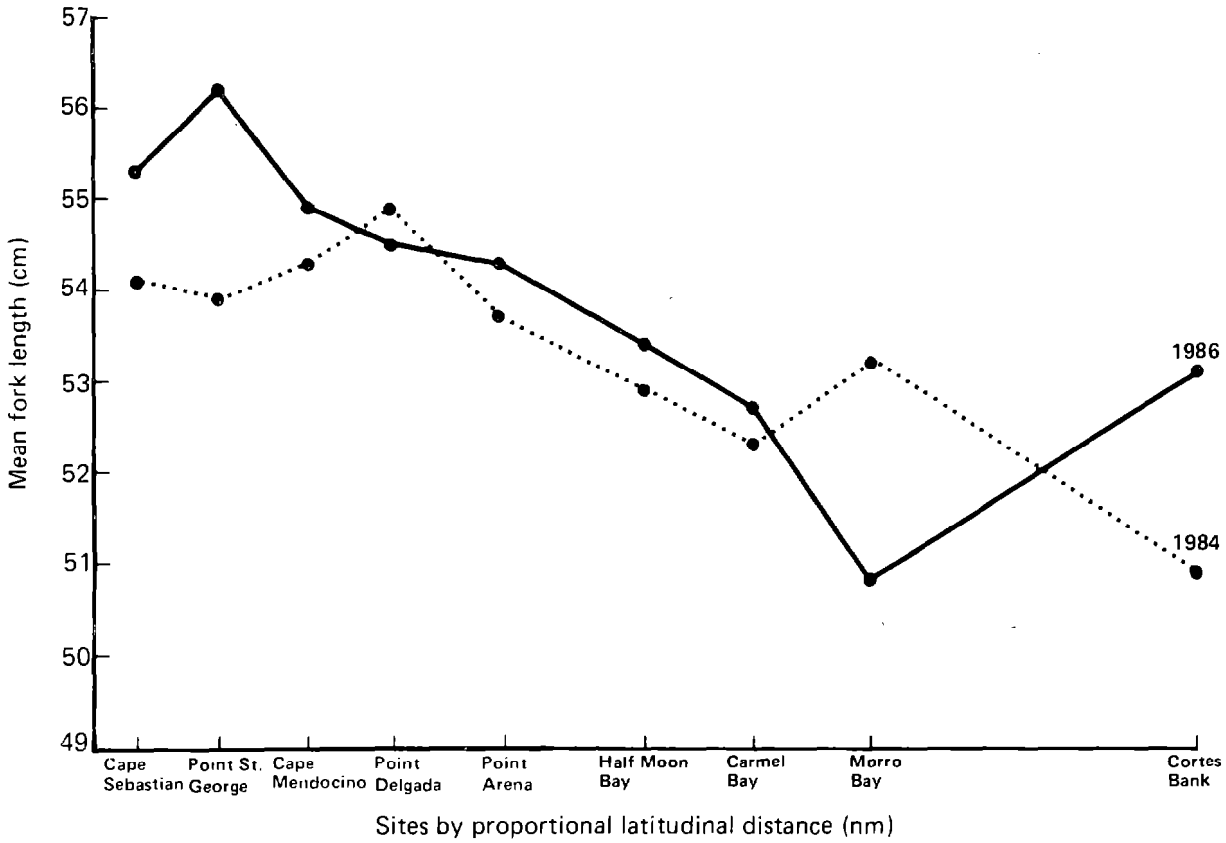

Figure 7.--Mean fork lengths (cm) of sablefish by site from southern Oregon and California abundance index surveys 1984 and 1986.

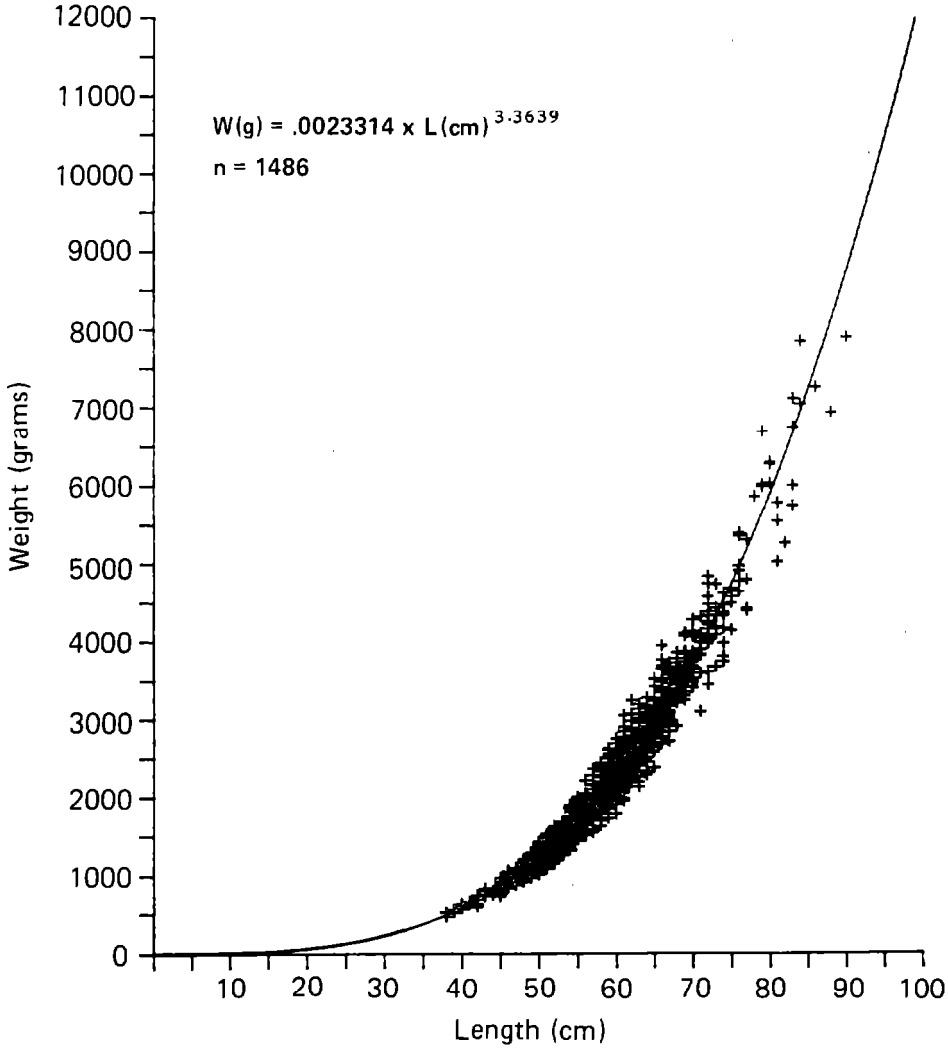

Figure 8.--Length-weight relationship derived from sablefish collected off California and southern Oregon in September-October-November 1986.

Table 2.--Predicted mean weights by l-cm length intervals for sablefish (sexes combined) captured off southern Oregon and California in September-October-November 1986.

Length (cm)	Mean weight (g)	Mean weight (lb)	Length (cm)	Mean weight (g)	Mean weight (lb)
30	217.1	0.48	66	3,079.8	6.79
31	242.4	0.53	67	3,239.6	7.14
32	269.7	0.59	68	3,405.2	7.51
33	299.1	0.66	69	3,576.6	7.88
34	330.7	0.73	70	3,753.9	8.28
35	364.6	0.80	71	3,937.4	8.68
36	400.8	0.88	72	4,127.1	9.10
37	439.6	0.97	73	4,323.1	9.53
38	480.8	1.06	74	4,525.6	9.98
39	524.7	1.16	75	4,734.6	10.44
40	571.4	1.26	76	4,950.3	10.91
41	620.9	1.37	77	5,172.9	11.40
42	673.3	1.48	78	5,402.3	11.91
43	728.7	1.61	79	5,638.9	12.43
44	787.3	1.74	80	5,882.6	12.97
45	849.2	1.87	81	6,133.6	13.52
46	914.3	2.02	82	6,392.1	14.09
47	982.9	2.17	83	6,658.1	14.68
48	1,055.1	2.33	84	6,931.9	15.28
49	1,130.8	2.49	85	7,213.4	15.90
50	1,210.4	2.67	86	7,502.9	16.54
51	1,293.7	2.85	87	7,800.4	17.20
52	1,381.1	3.04	88	8,106.1	17.87
53	1,472.5	3.25	89	8,420.2	18.56
54	1,568.0	3.46	90	8,742.7	19.27
55	1,667.9	3.68	91	9,073.6	20.00
56	1,772.1	3.91	92	9,413.4	20.75
57	1,880.8	4.15	93	9,762.1	21.52
58	1,994.1	4.40	94	10,119.7	22.31
59	2,112.1	4.66	95	10,486.4	23.12
60	2,235.0	4.93	96	10,862.4	23.95
61	2,362.8	5.21	97	11,247.7	24.80
62	2,495.6	5.50	98	11,642.6	25.67
63	2,633.7	5.81	99	12,047.1	26.56
64	2,776.9	6.12	100	12,461.3	27.47
65	2,925.6	6.45			

Length at 50% Maturity

A probit analysis (Finney 1971) was used to calculate length at 50% maturity for the 519 male and 1,032 female sablefish sampled in 1986. Results indicate that 50% maturity is reached at 51.9 cm for males and 57.9 cm for females. These lengths are similar to those calculated for sablefish captured off California between 1980 and 1982 (Parks and Shaw 1983). They are also similar to the 50.8 cm and 55.3 cm lengths at 50% maturity calculated for males and females, respectively, captured off Oregon and Washington in 1985 (Parks and Shaw 1987). Mason et al (1983) reported that length at 50% maturity was approximately 52 cm for males and 58 cm for females off the west coast of Canada.

SUMMARY AND CONCLUSIONS

Survey catch rates of sablefish off California and southern Oregon decreased by about 50% in terms of numbers and weight between 1984 and 1986. Catch rates were down at all sites with the largest declines at the Half Moon Bay, Cortes Bank, and Point Arena sites (Appendix Fig. 1; Appendix Table 1). Smallest decreases in catch rates were observed at the Morro Bay and Cape Sebastian sites.

Although catch rates declined, the mean length increased slightly from 53.1 cm in 1984 to 53.7 cm in 1986 (Fig. 3). The proportion of small sablefish (<4.25 lb) decreased from 81% of the catch in 1984 to 75% of the catch in 1986 (Table 1). Sablefish size generally increased with depth and those captured at 650-780 fathoms were much larger than those captured at the standard depths. Mean length of male sablefish was 51.8 cm whereas females averaged 57.0 cm (Fig. 4).

Since the catch rates declined at every site and decreased over 50% when samples from all nine sites were combined, we can only conclude that there was a substantial decline in sablefish abundance off southern Oregon and California between 1984 and 1986. These results are in line with survey results off Oregon and Washington which indicated a decrease of about 33% in sablefish abundance between 1983 and 1985 (Parks and Shaw 1987).

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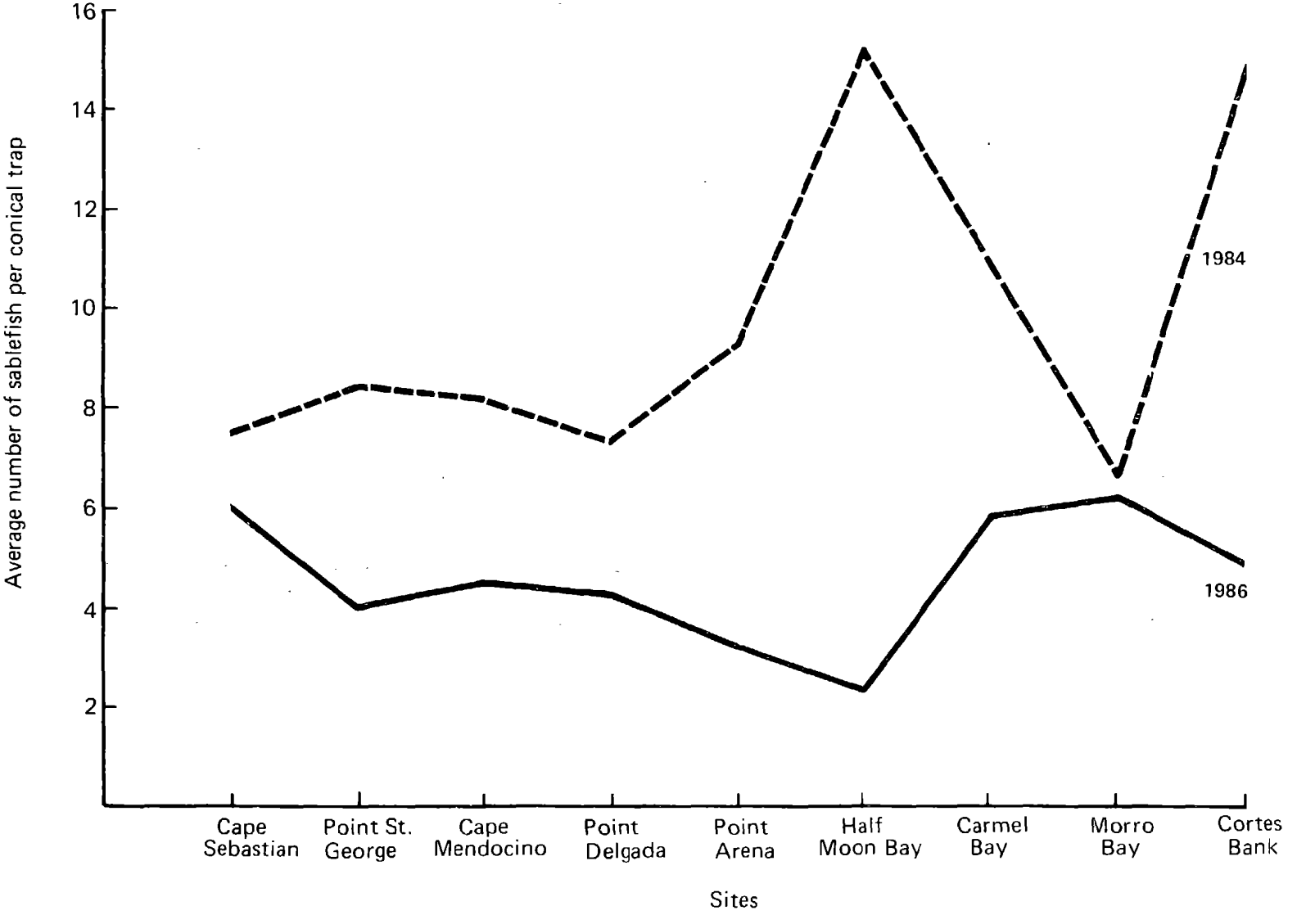
APPENDIX

Individual Index Site Data

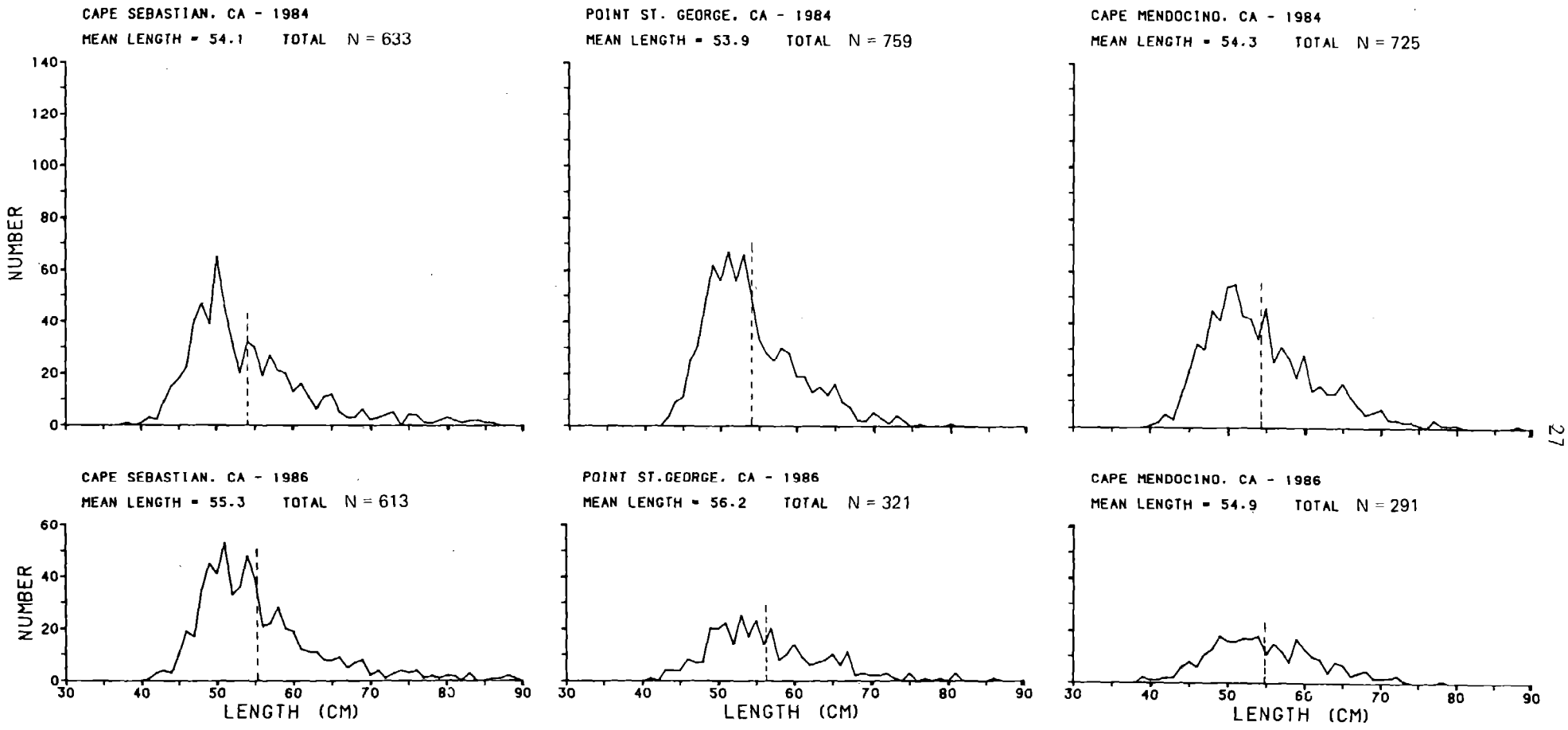
Appendix Table 1. --Sablefish catches by site and by year in the southern Oregon-California region in 1984 and 1986.

Site	Year	Total no. sablefish	Avg. no. sablefish per trap	Avg. wt. (lb) per trap	% Large sablefish[b]	% Medium sablefish[c]	% Small sablefish[d]
Cape Sebastian, OR	1984	748[f]	7.5	31.5	7	19	74
	1986	613	6.1	25.8	9	21	70
Pt. St. George, CA	1984	843	8.4	31.7	3	22	75
	1986	405[e f]	4.0	16.7	7	28	65
Cape Mendocino, CA	1984	819	8.2	32.8	5	23	72
	1986	448[e g]	4.5	18.0	5	29	66
Pt. Delgada, CA	1984	735	7.4	29.1	4	23	73
	1986	427[f]	4.3	18.2	5	26	69
Pt. Arena, CA	1984	928	9.3	33.9	1	20	79
	1986	325	3.2	13.3	4	25	71
Half Moon Bay, CA	1984	1,525	15.2	51.5	<1	15	84
	1986	226	2.3	8.6	1	20	79
Carmel Bay, CA	1984	1,094	10.9	36.7	<1	14	85
	1986	580	5.8	20.7	1	17	82
Morro Bay, CA	1984	664	6.6	24.5	2	17	81
	1986	619	6.2	20.0	<1	13	86
Cortes Bank, CA	1984	1,470	14.7	44.0	<1	10	89
	1986	487	4.9	17.0	1	19	80
All sites combined	1984	8,826	9.8	35.1	2	17	81
	1986	4,130	4.6	17.5	4	21	75

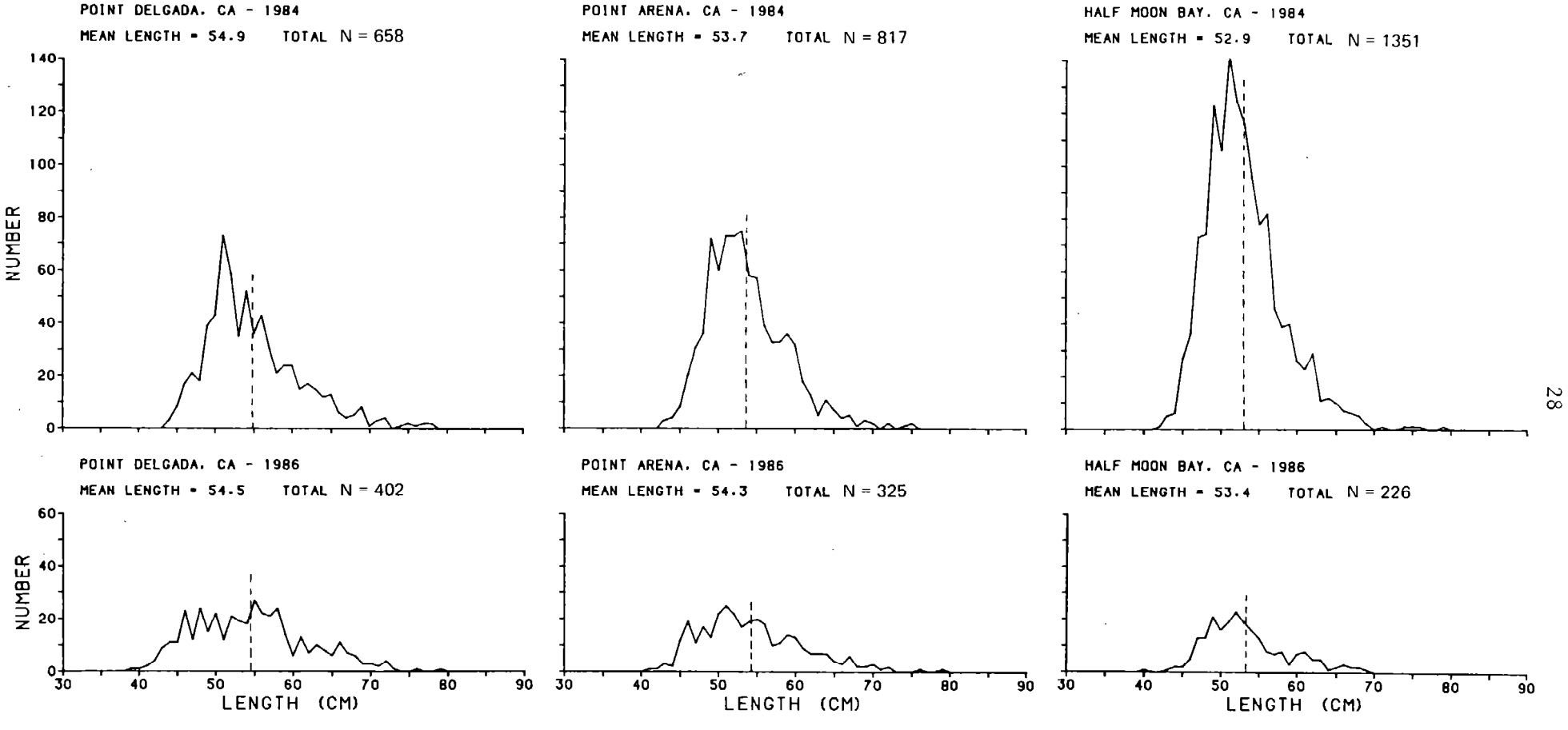
[a] These numbers are the result of upward adjustment on rectangular trap catches by 1.265 plus conical trap catches.
[b] Over 7.0 lb round weight.
c 4.25-7.0 lb round weight.
[d] Less than 4.25 lb round weight.
[e] Adjusted upward for lost string of gear on first set.
[f] Adjusted upward for lost string of gear on second set.
g Adjusted upward for second repetition which was not made.



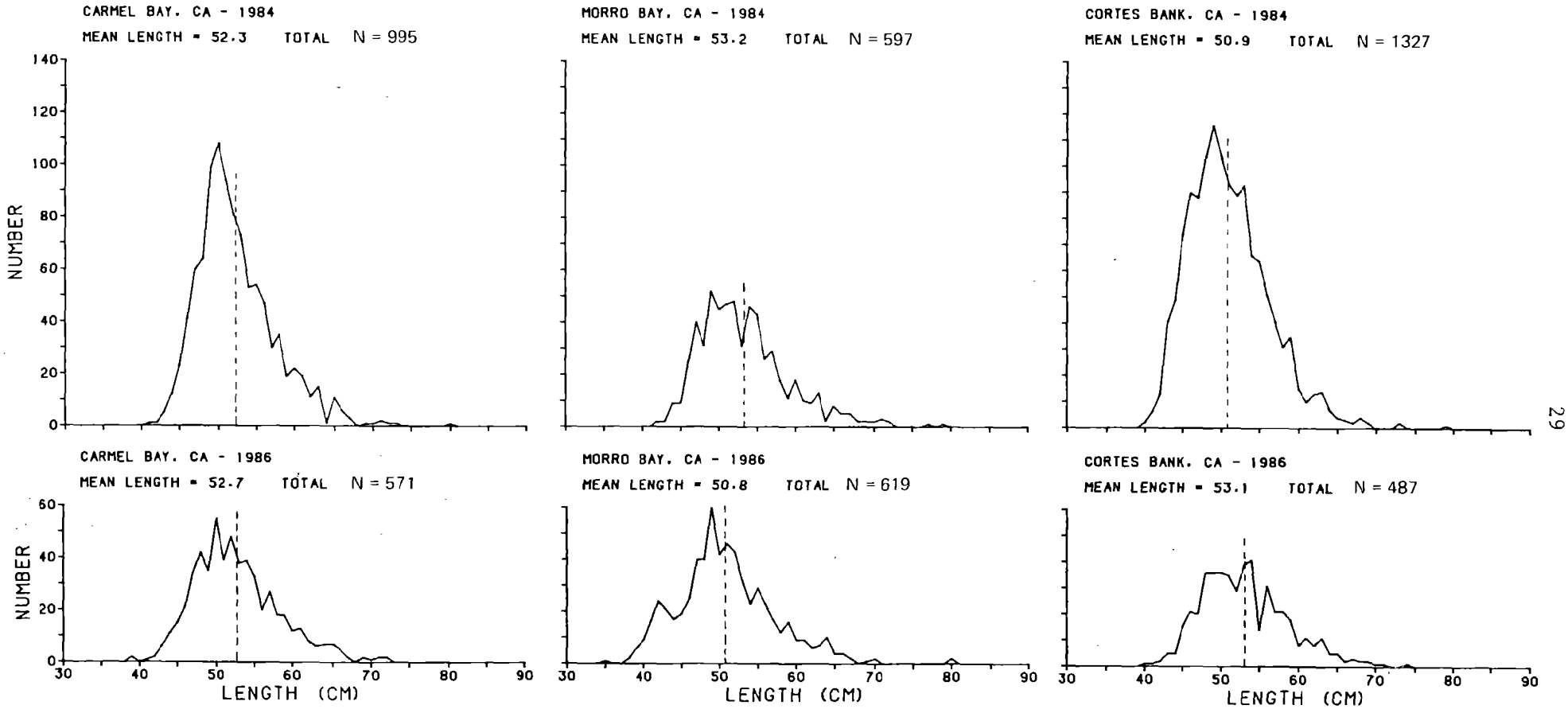
Appendix Figure 1.--Mean catch rates at nine index sites fished off California and southern Oregon in 1984 and 1986.



Appendix Figure 2.--Sablefish length compositions and mean lengths by abundance indexing site for the standard sampling depths (225-525 fathoms) based on data from the 1984 and 1986 abundance index surveys.



Appendix Figure 2.-- Continued.



Appendix Figure 2.--Continued.