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Relative Abundance and Size Composition of Sablefish (*Anoplopoma fimbria*) in the Coastal Waters of California and Southern Oregon, 1984-1991

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N. B. Parks and F. R. Shaw

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Fisheries Science Center

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ABSTRACT

Trap survey results indicate that the relative abundance of sablefish (Anoplonoma fimbria) off the coasts of California and southernmost Oregon decreased by 66% in numbers and 64% in kilograms per trap between 1988 and 1991. Catch rates decreased at all nine sites sampled. The largest decreases in catch per unit of effort were in the central part of the survey area; declines of between 70% and 84% were observed at the Pt. Arena, Half Moon Bay, Cannel Bay, and Morro Bay sites. Smaller declines in catch rate (24% to 57%) were observed at the northern (Cape Sebastian, Pt. St. George, and Cape Mendocino) and southern (Cortes Bank) sites. Small and undersized sablefish made up 83% of the catch, down from 90% in 1988, whereas medium and large sablefish comprised 14% and 3% of the catch, respectively. Highest catch rates (number/trap) occurred at the depths of 225 and 300 fathoms'. Mean length increased with depth and generally decreased from north to south within the sampling area.+

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INTRODUCTION

The sablefish (Anoplonoma fimbria) has been the most valuable commercial groundfish species landed on the West Coast in most years from 1985 to 1990 with an estimated ex-vessel value averaging $11.5 million.[1] High demand and relatively high prices have resulted in heavy fishing pressure on the stocks. The 1989 optimum yield was set at 10,400 metric tons (t) and was reduced to 8,900 t in 1990 and 1991 (Methot and Hightower 1990). Methot (1991) estimated the long-term potential yield to be 6,900 t.

Alaska Fisheries Science Center (AFSC) trap surveys to measure changes in sablefish relative abundance were begun in Oregon and Washington waters in 1979 and extended to waters off California in 1980 (Parks and Hughes 1981; Parks 1982, 1984; and Parks and Shaw 1983, 1985, 1987, 1988a, 1988b, 1989, 1990). These surveys measure catch per unit effort (CPUE) at standard sites to use as indices of sablefish abundance for assessing the condition of the stock. Collecting biological data such as the state of maturity and the weight, length, and age composition of the stock are other important objectives of these surveys. All fish released alive were tagged as part of an age validation study in which 75% were injected with oxytetracycline -(OTC) to mark the bony structures used to age the fish (otoliths), while

[1] Pacific Coast Fisheries Information Network (PacFin) as of 30 December 1991. Pacific Marine Fisheries Commission, Metro Center - Suite 170, 2000 S.W. First Ave., Portland, Oregon 97201-5346.

25% were not injected to be used as controls. This report presents results of the 1991 survey off California and southernmost Oregon and compares them with results of previous trap surveys and other assessments of the condition of the West Coast sablefish stock(s).

SURVEY METHODS AND GEAR

The 1991 survey methods were identical to the 1984 survey methods (Parks and Shaw 1985) except that conical traps have been used exclusively since 1986. Methods and trap gear used in earlier surveys are described in Parks and Shaw (1983).

The conical traps employed in this study were constructed with a 137 cm-diameter bottom ring and an 65 cm diameter top ring (Fig. 1). The traps were 71 cm high with a tunnel entrance on the side: The framework was covered with 5.7 cm 42-thread nylon webbing,. Tunnels were constructed of 5.1 cm nylon knotless web and rigged with a 'noose arrangement which closed by a magnesium alloy time-release device 24 (+ 1) hours after setting. Ten traps were attached with C-hooks to gangions at 50 fathom (fm) (91 m) intervals on a 550 fm groundline of 1.59 cm synthetic line (Fig. 2). A perforated plastic bait jar containing approximately 2 lb of chopped herring was hung in each trap.

Sampling was conducted during 7 September to 7,October 1991; from north to south at nine index sites off California and southern Oregon (Fig. 3). These sites were also sampled in 1984, 1986, and 1988. Ten-trap groundlines were fished along the 225,

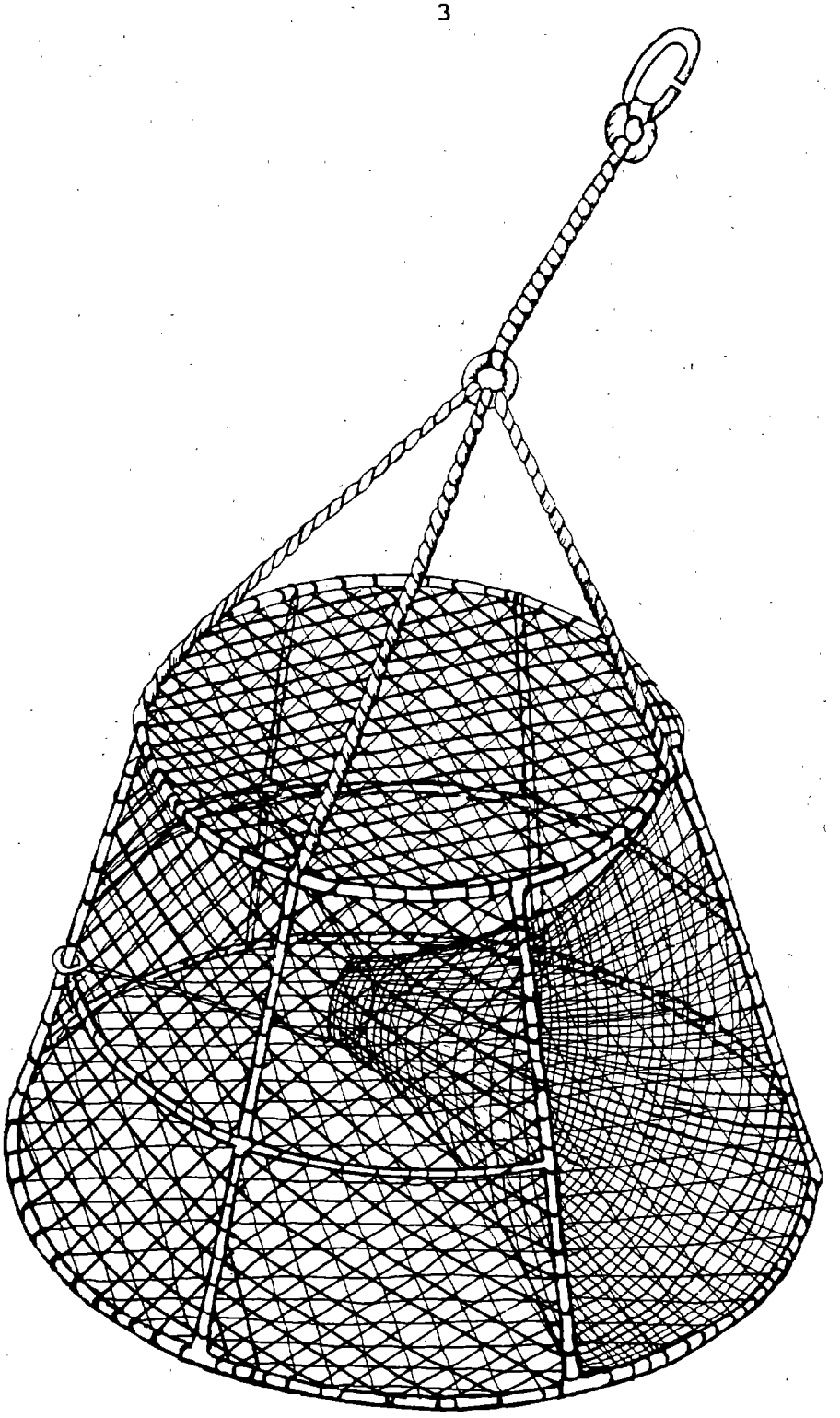

Figure 1.--Conical trap used in recent sablefish abundance indexing surveys.

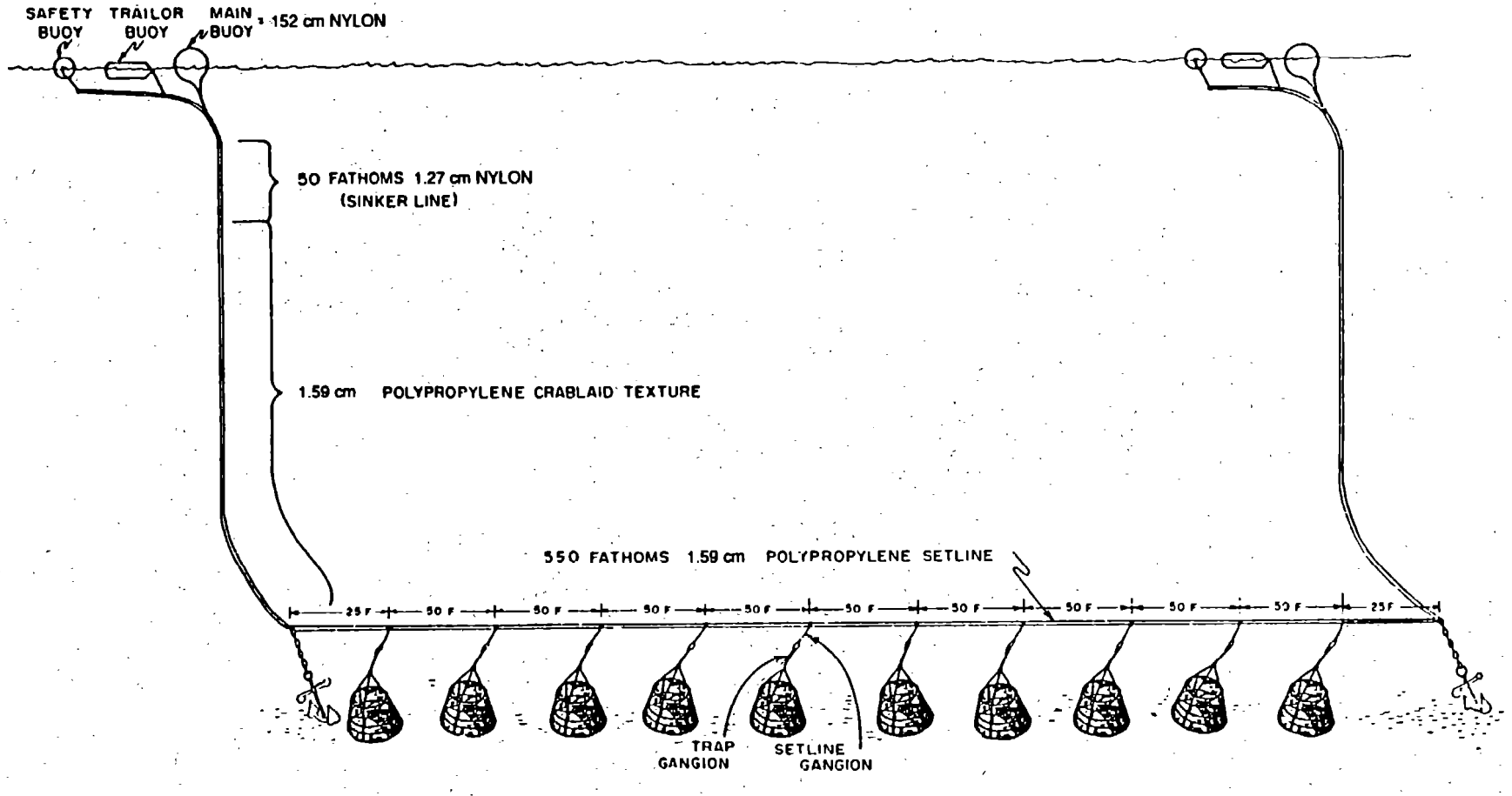

Figure 2. --A pictorial view of a string of conical trap gear used in. sablefish indexing surveys.

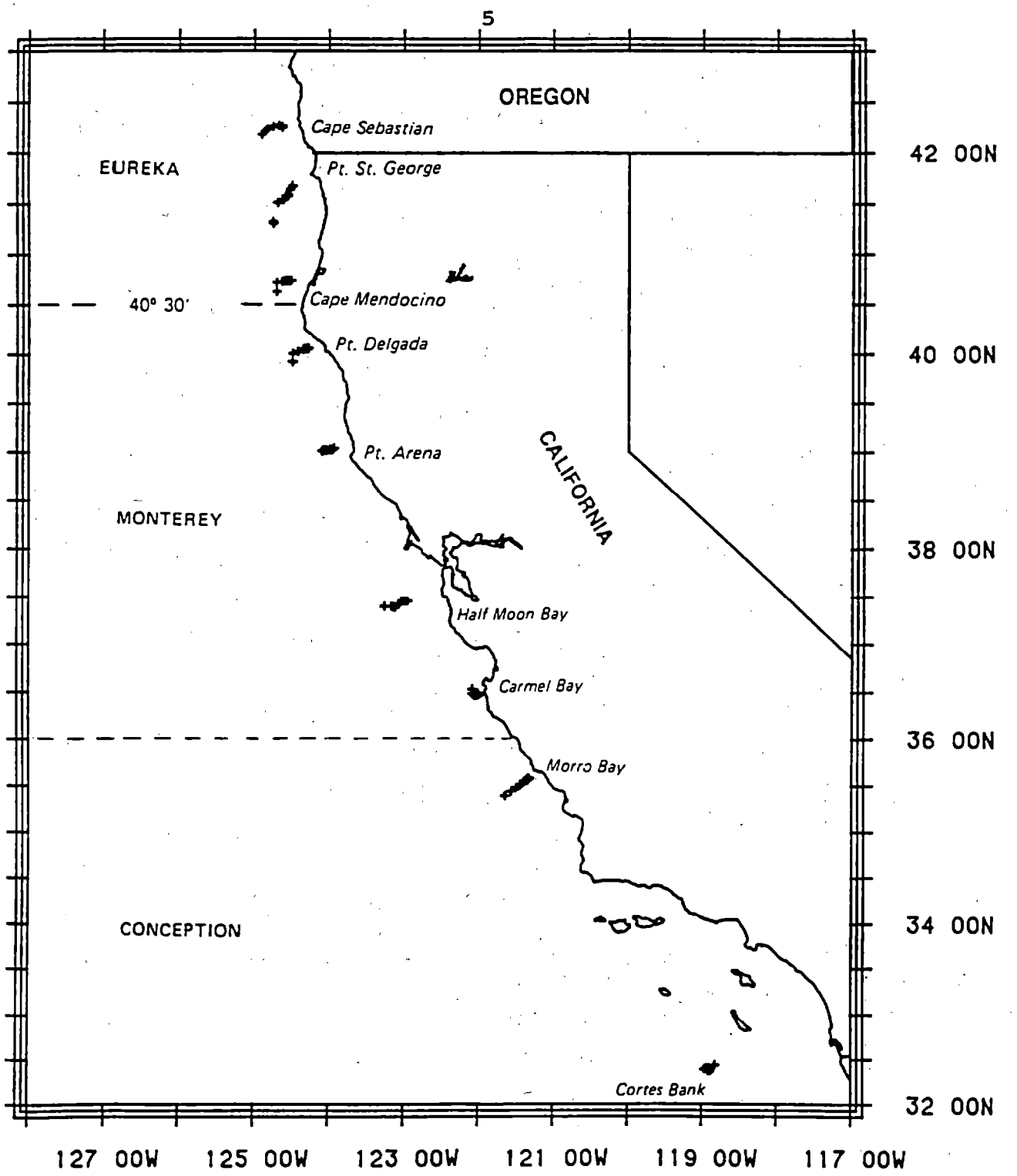

Figure 3.--Sites sampled off California and southern Oregon (International North Pacific Fisheries Commission areas Eureka, Monterey, and Conception) during the 1991 sablefish abundance indexing survey.

300, 375; 450, and 525.fm isobaths (standard depths) at all sites. Additional strings were set opportunistically at 150 fm' and between 600 and 900 fm to obtain information on the portions of the population in depths shallower and deeper than those routinely sampled. Two sets were made at each depth at most sites. Loran C, Global Positioning System (GPS), and depth sounders were used to position replicate sets as near as possible to the locations of the original sets.

At each site, we collected data on the number and weight of each species captured in each trap, lengths of all sablefish, and sablefish biological specimens. and data including otoliths, individual weight, sex, and sexual maturity from a random sample of the first 20 fish taken at each depth at each site.

An age-validation study was initiated on the 1991 survey in which sablefish were injected with OTC to mark the age structure at the point in time that the fish was tagged. Approximately 75% of all sablefish tagged were injected with an intraperitoneal dose of 30 mg of OTC per kilogram of weight. The remaining 25% constituted the control group to determine to what extent the OTC injection affects survival. Sablefish not required for biological samples were placed into live tanks supplied with fresh running seawater immediately upon capture. Usually within 15 minutes of the completion of each haul, all viable sablefish were measured to the nearest centimeter in a padded tagging

cradle, injected, and tagged with a single blue Floy[2] anchor tag implanted just below the first dorsal fin. Anesthetic was not used.

RESULTS AND DISCUSSION

All nine index sites were sampled at the 150, 225, 300, 375, 450, and 525 fm depths. 'The 600-900 fm depth interval was sampled at all sites except those off Cape Sebastian and Pt. 'Arena. Adverse weather prevented fishing at these depths and also prevented the second replicate of the 375, 450, and 525 fm sets off Cape Sebastian.

Same data standardization was necessary at sites where. traps, were lost or conditions precluded replicating a set. If some traps on a string were lost, the observed catch for the string was adjusted by assigning the average catch in the remaining traps to lost traps. Occasionally, due to weather, gear conflict, or time constraints, the replicate set at a site could not be completed. In those cases, the catch in the replicate set (needed because the index is based on the average of both sets) was estimated by calculating the rate of decline in CPUE between the first and second sets at all other sites and-depths and applying that rate to the catch from the single set; in 1991, the catch on the second set averaged 0.701 of the catch on the first

[2] Reference to trade name does not imply endorsement by the National Marine Fisheries Service, NOAA.

set,, Catch and size data from individual sampling sites are given in the Appendix.

Catch Rates and Size Composition

Catch rates (average number of fish per trap), based on data from standard survey depths (225-525 fm) at the nine abundance index sites, decreased 66% from 1988 to 1991. The mean catch rate of 3.6 sablefish. per trap also represents a decrease of 22% from 1986 and 63% from 1984 (Fig. 4). Standard errors and coefficients of variation associated with 1984, 1986, 1988, and 1991. mean catches per trap are shown in Table 1. Pair-wise comparisons between the catch rates (average number of sablefish,' per trap). among survey years were tested at a level of significance of c = 0.05. The, Bonferroni joint' testing procedure (Neter et al. 1985) was used to adjust for the multiple between-.' year comparisons. Only two of the six possible between-year comparisons were not significantly different (1984-88 and 1986-91, Table 2).

The mean catch rate of small sablefish (<1.93 kg) in 1991 decreased by 69% since 1988; The CPUE of large fish (>3.18 kg) held relatively steady at just under 0.1 per trap, while the CPUE of medium-sized sablefish (1.93 to 3.18 kg) declined 48%. The 1991 catch rates for all size groups are lower than in any of the‘ previous surveys., Catch rates in 1991 were lower at all sites with the largest decreases occurring at Pt. Arena, Half Moon Bay,

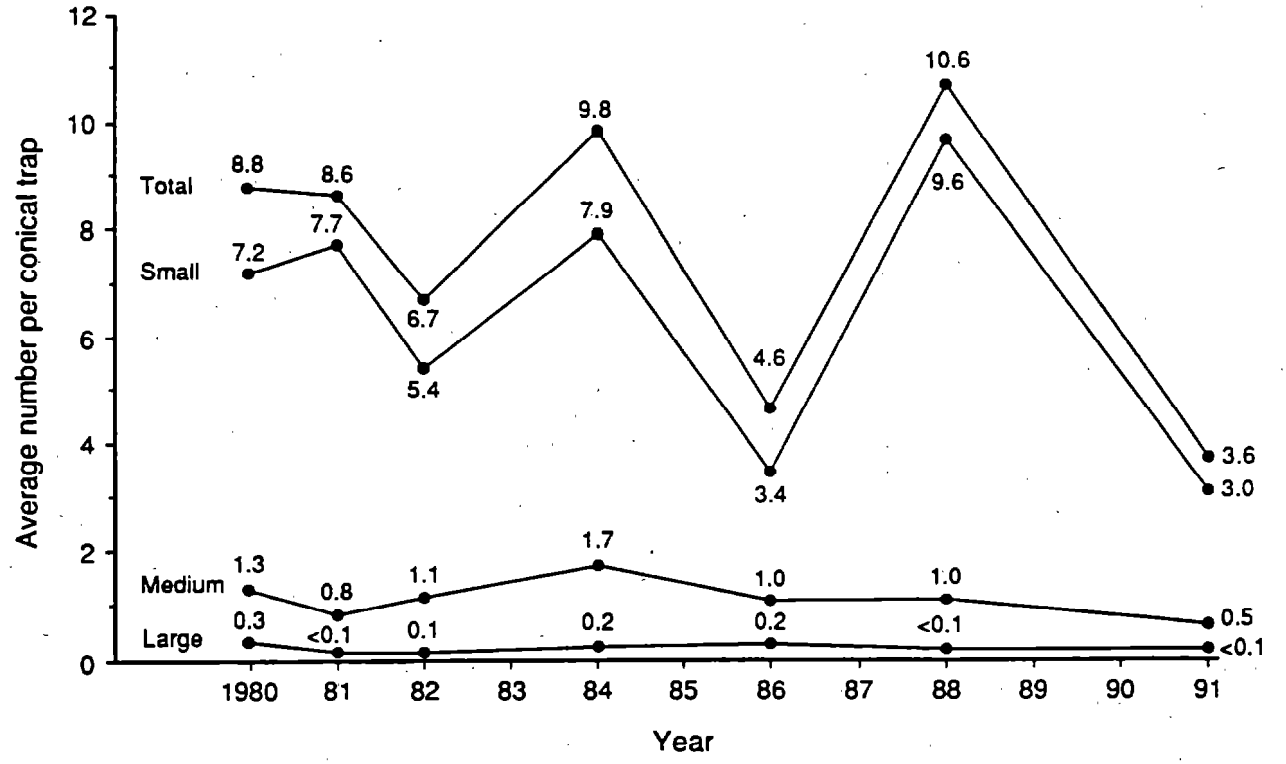

Figure 4. --Mean catch rates of sablefish (number/trap) by size category at standard depths (225-525 fathoms) at two index sites off California in 1980-82 and nine index sites off California and southern Oregon in later years.

Table 1. --Mean catch rates, standard errors, and coefficients of variation for sablefish at index sites off California and southern Oregon from 1984 to 1991 (standard depths 225-525 fathoms).

Year	Mean catch rate	Standard error	Coefficients of variation
1984	8.8	0.663	7.5
1986	4.6	0.345	7.5
1988	10.6	1.164	11.0
1991	3.6	0.481	13.4

Table 2 .--Pair-wise -comparisons between the catch rates (average numbers of sablefish/trap) from various survey years. Significance judged at 0.05% probability level.

Year	Difference between average catch rates,	Standard error of difference	95%. confidence interval	Statistically significant
1984-86.	4.2	0.658	(1.46, 6.94)	Yes
1984-88	-1.8	1.340	(-0.94, 4.54)	no
1984-91	5.2	0.819	(2.46, 7.94)	yes
1986-88	-6.0	1.214	(3.26, 8.74)	yes
1986-91	1.0	0.592	(-1.74,.3.74)	no'
1980-91	7.0	1.260	(4.26, 9.74)	yes

Carmel Bay, Morro Bay, and Cape Mendocino (-84%, -83%, -76%,-75%, and -7O%, respectively). Catch rates declined less at Cape Sebastian, Cortes Bank, and Pt. St. George (-24%;-46%, and -57%, respectively). Average sablefish catch rates in weight (kilograms per trap) from the standard depths decreased 64% between 1988 and 1991 (Fig. 5). The 1991 value (5.4 kg/trap) was down 33% from the previous low in 1986 (8.0 kg/trap).

In 1991, the highest mean catch rates (number/trap) within the standard sampling depths (225-525 fm) occurred at 225 and 300 fm (Table 3). Catch rates were lowest at 450, 525, and >600 fm at 1.3, 1.2, and 1.5 fish/trap, respectively.

The sablefish size composition from the 1991 survey was unimodal, peaking at 48 cm (Fig. 6). Mean length declined from 53.1 and 53.7 cm in 1984, and 1986 to 50.8 and 51.7 cm in 1988 and 1991, respectively. The proportion of small and undersized sablefish (<1.93 kg) was 75% of the catch in 1986, 90% in 1988, and 83% in 1991, whereas the proportions of medium (1.93 to 3.18 kg) and large (>3.18 kg) sablefish in 1991 were up slightly from 1988 to 14% and 3%, respectively (Table 3, Fig. 6). These proportions are still well below those seen in 1984 and 1986.

The sex-specific size composition for sablefish taken at the standard depths during the 1991 survey is shown in 'Figure 7. The mean sizes of males and females were 50.8 and 56.0 cm, respectively. Based upon calculations of length at 50% maturity from 1986 survey data (51.9 cm for males and 57.9 cm for females,

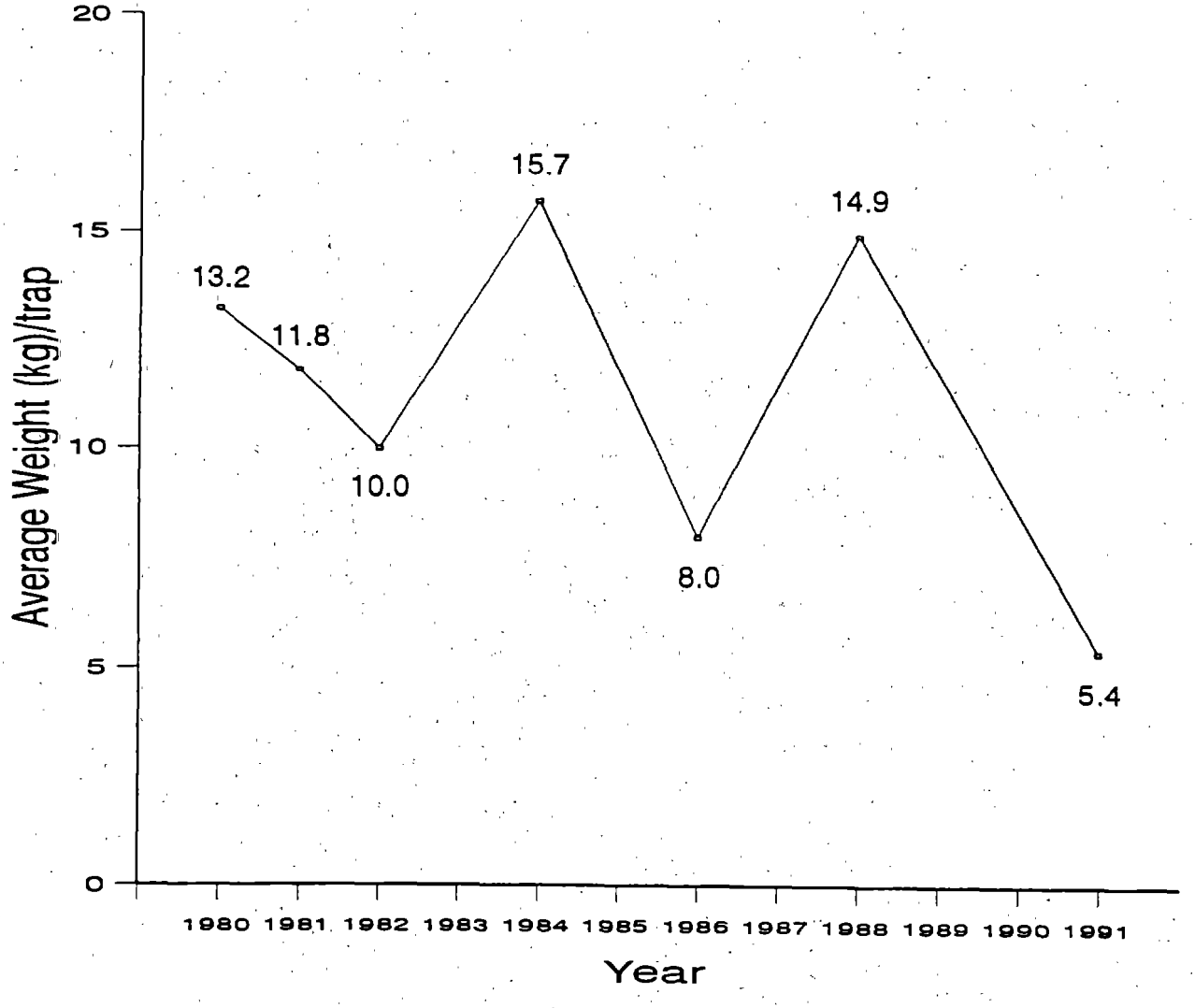

Figure. 5.--Mean catch rates of sablefish (kg/trap) at standard depths (225-525 fathoms) at the two original index sites off California 1980-82, arid at nine sites off the coasts of California and southernmost Oregon in later years..

Table 3.--The numbers of sablefish, average numbers and weight by trap, and percentage of sablefish by size[a] captured at-southernmost Oregon and California by depth in 1984 , 1986, 1988, and 1991.

DEPTH (FM)	YEAR	TOTAL NO. SABLEFISH	AVG. NO. SABLEFISH PER TRAP	AVG. WT. (KG) PER TRAP	% LARGE SABLEFISH	% MEDIUM SABLEFISH	% SMALL SABLEFISH	% UNDERSIZED SABLEFISH
150[d]	1984	420	5.2	7.3	1	11	26	62
	1986	286[c]	2.4	3.1	3	9	21	67
	1988	1,104[c]	6.3	7.7	<1	5	17	77
	1991	435	2.4	2.9	2	9	14	75
225	1984	2,736	15.2	23.1	2	16	32	50
	1986	1,262[c]	7.0	10.6	2	18	25	55
	1988	4,136[c]	23.0	28.5	<1	5	16	79
	1991	1,338	7.4	9.2	<1	7	13	79
300	1984	2,571	14.3	22.2	2	14	32	52
	1986	1,105[c]	6.1	10.5	4	20	31	45
	1988	2,382[c]	13.2	17.8	<1	7	18	74
	1991	913	5.1	7.8	1	15	22	62
375	1984	1,499	8.3	12.9	3	16	36	45
	1986	689	3.8	7.4	7	20	37	36
	1988	1,053[c]	5.8	8.4	<1	9	24	66
	1991	492[c]	2.7	4.6	4	19	27	50
450	1984	1,263[c]	7.0	11.6	2	17	41	40
	1986	595[c]	3.3	5.9	3	19	38	40
	1988	932[c]	5.2	8.2	2	14	29	55
	1991	236[c]	1.3	2.4	7	22	32	39
525	1984	757	4.2	8.5	5	34	44	17
	1986	479	2.7	5.4	4	33	45	18
	1988	1,075[c]	6.0	11.5	2	28	42	27
	1991	223[c]	1.2	2.7	10	41	37	12
> 600[e]	1986	189	2.4	8.4	47	49	4	0
	1988	502[c]	3.1	9.8	33	54	11	2
	1991	214[c]	1.5	5.7	48	48	4	0
All depths combined	1984	9,246[c]	9.4	15.0	2	17	35	46
	1986	4,605[c]	4.2	7.5	6	21	31	42
	1988	11,094[c]	9.1	13.3	2	10	21	67
	1991	3,851[c]	3.2	5.0	5	16	19	60
Standard depths combined	1984	8,826[c]	9.8[f]	15.7	2	17	35	46
	1986	4,130[c]	4.6[f]	8.0	4	21	33	42
	1988	9,579[c]	10.6[f]	14.9	<1	9	22	68
	1991	3,202[c]	3.6	5.4	3	14	21	62

[a]Large q over 3.18 kg round weight (rd. ut.); medium = 1.93-3.18 kg rd. wt.; small = 1.36-1.93 kg rd. ut.; and undersized = less than 1.36 kg rd. wt.

[b]The,1984 numbers are the result of upward adjustment on rectangular trap catches by 1.265 (a scaling factor to compensate for the lesser fishing efficiency of the rectangular traps) plus conical trap catches.

[c]Adjusted upward for missing string(s) of gear, second repetitions not made, or lost traps, based on the average decline of catch from the first set to the second set or the average catch in remaining traps.

[d]150 fathom depth fished at the four southern sites only in 1984, at the three northern and three southern sites only in 1986; and at eight sites in 1988.

[e]>600 fathom depth not fished in 1984, fished at the four northern sites only in 1986, and fished at the eight southern sites in 1988, and Cape Sebastian and Pt. Arena sites not fished in 1991.

[f]Standard error = 0.750 for 1984, 0.345 for 1986, and 1.16 for 1988.

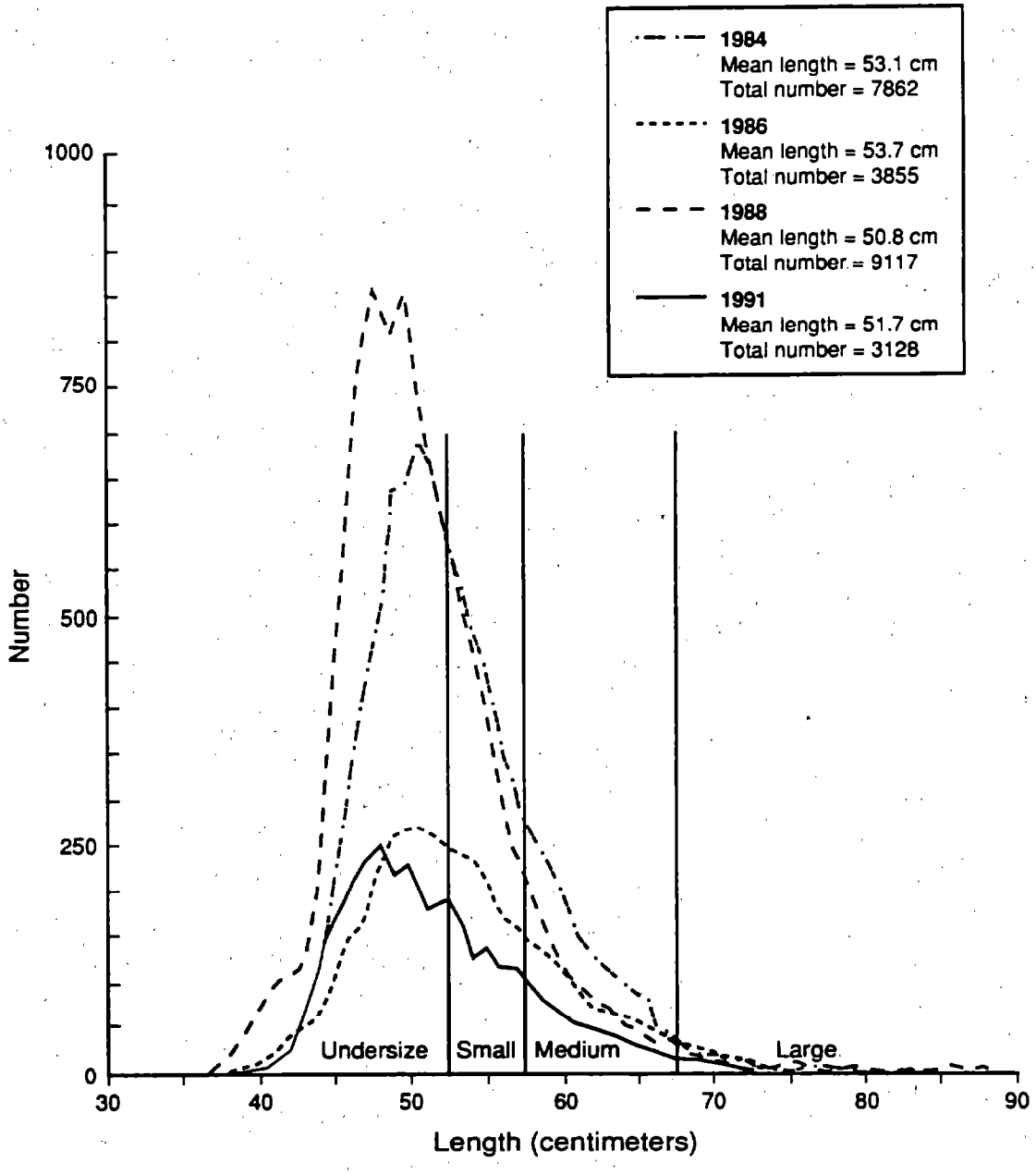

Figure 6. --Sablefish length compositions for all southern Oregon and California index sites combined at standard depths (225-525 fathoms) for 1984, 1986, 1988, and 1991.

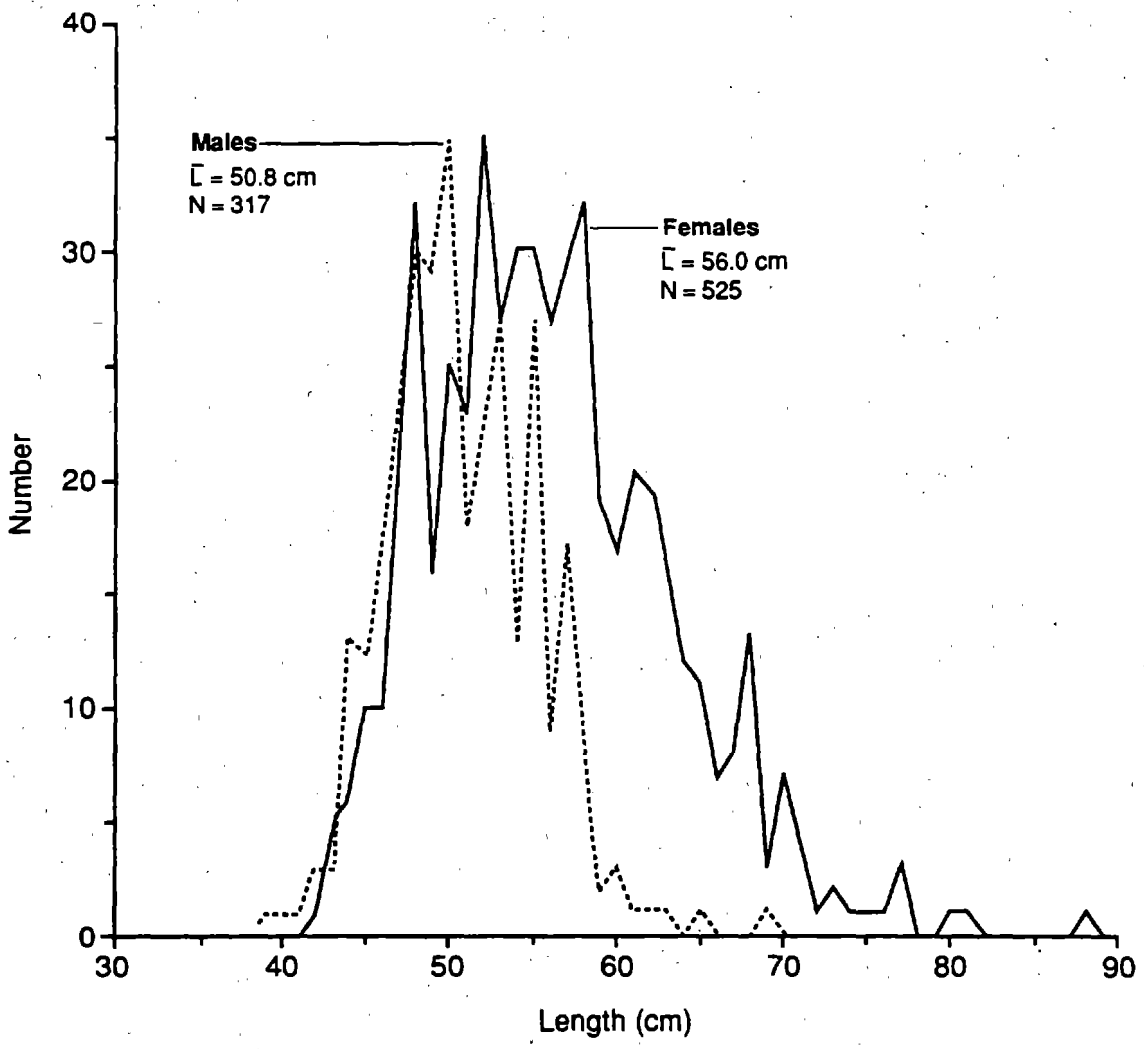

Figure 7.--Sablefish length compositions by sex of random samples taken from standard depths (225-525 fathoms) during the 1991 abundance index survey.

Parks and Shaw 1988a) we calculated that 65% of the males and 68% of the females 'within the standard depths (225-525 fm) were immature.

Mean Length by Depth and by Latitude

Sablefish length compositions were summarized by depth for the 1991 survey. (Fig. 8). Mean lengths typically increase with depth (Parks and Shaw 1989) and this was again-true in 1991. The largest increases occurred between 450 and 525 fm, where mean lengths increased by just over 3 cm, and between 525 and >600 fm, where mean lengths increased approximately 9 cm'. The mean lengths of sablefish captured at depths greater than 600 fm. averaged about 19 cm greater-than sablefish captured at 150 fm. In the 1984 and 1986 surveys, mean length, generally decreased from north to south (Parks and Shaw 1989). In the 1988 and 1991 surveys, mean length was generally higher at the four northern sites with the largest fish at the Pt. Arena site -and lower at the four southern sites (Fig. 9).

Percentage of Females by Depth .

The percentage of females of our random samples by depth in all four survey years showed that females were generally most abundant at the. shallowest and deepest depths and least abundant; at the intermediate depths (Fig. 10). These trends in the percentage of females were relatively consistent for most survey

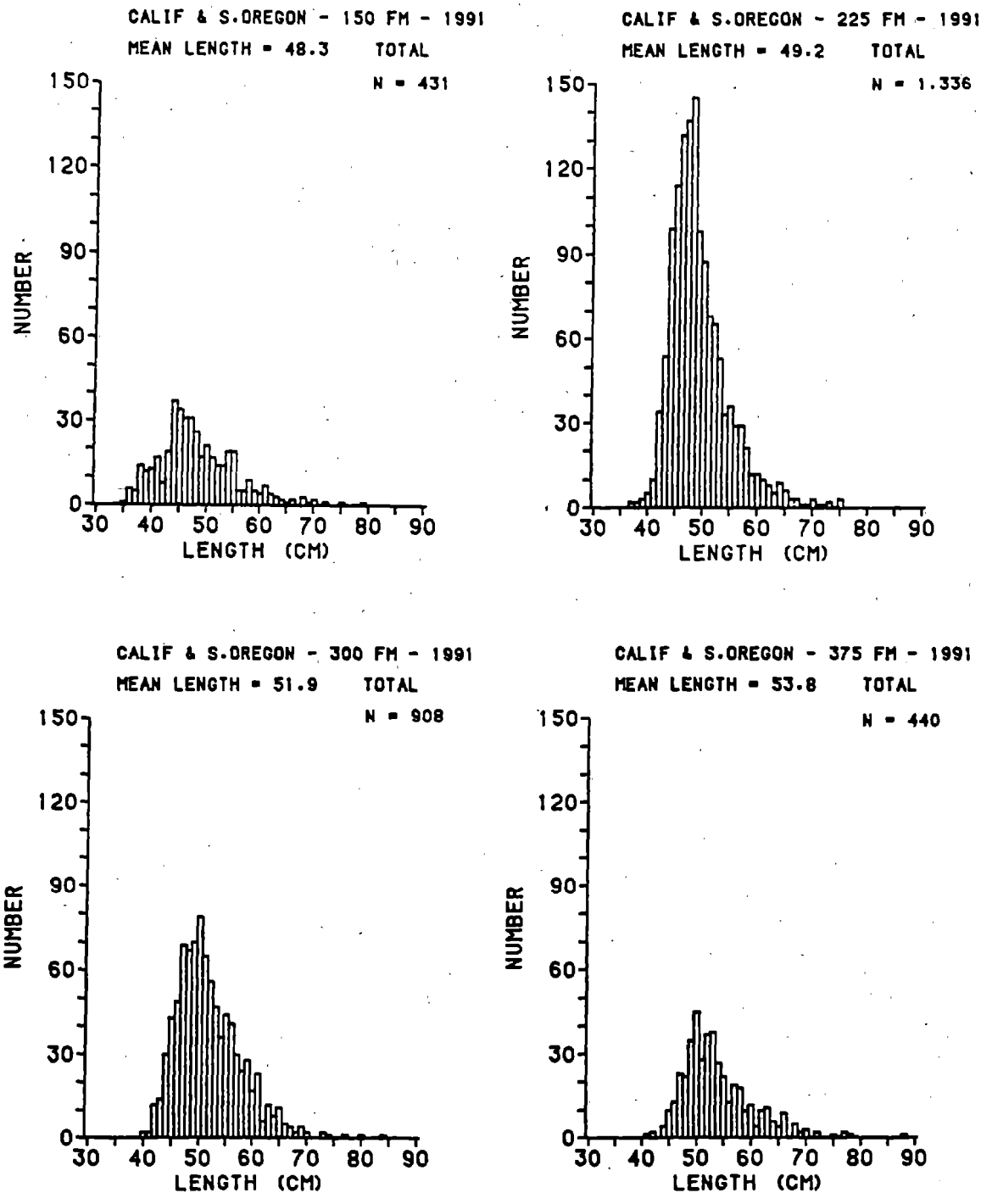

Figure 8.--Sablefish length compositions and mean lengths by depth for all sites combined during the 1991 abundance index survey (>600 fathoms fished at all sites except Cape Sebastian and Pt. Arena).

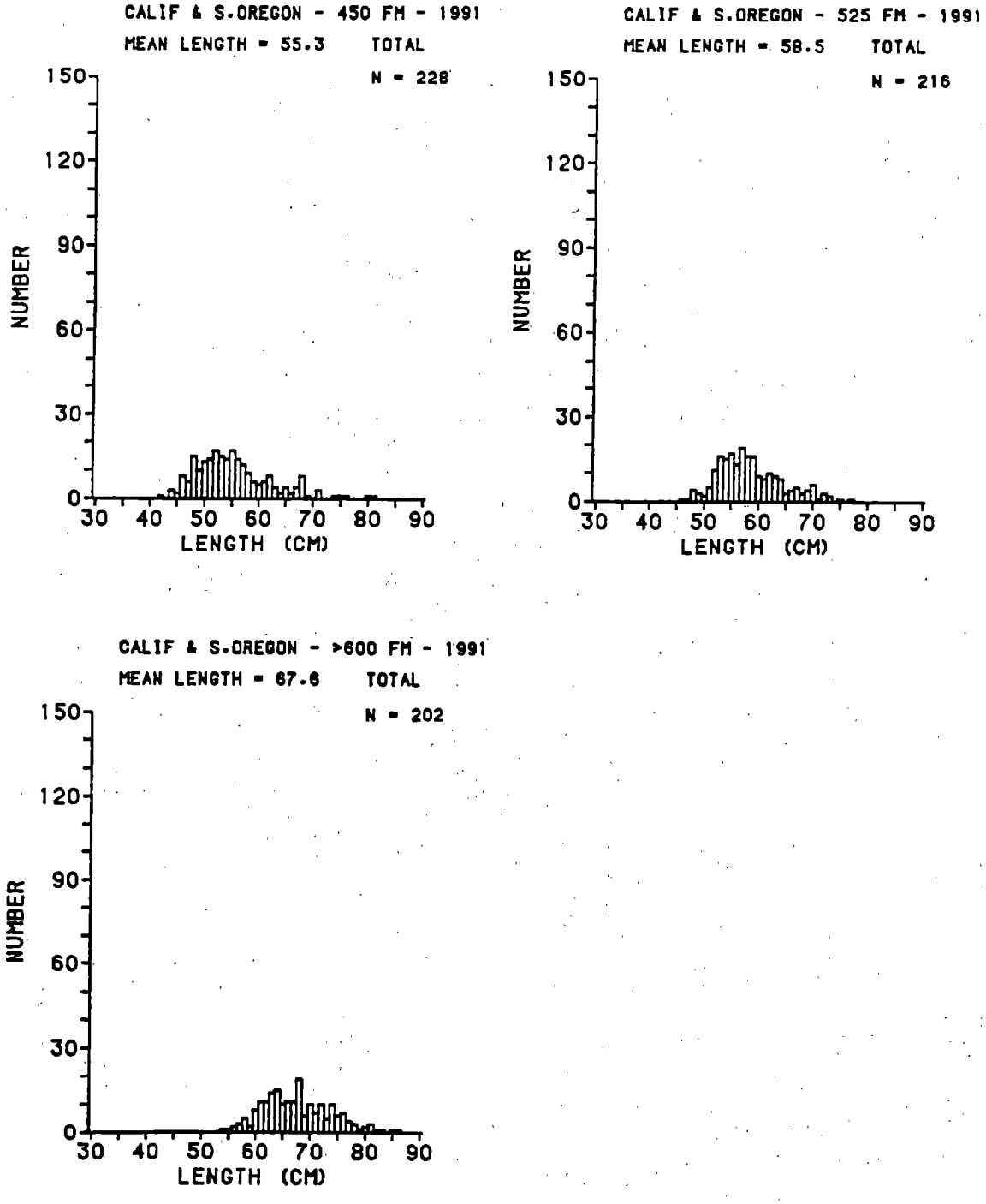

Figure 8. --(Continued).

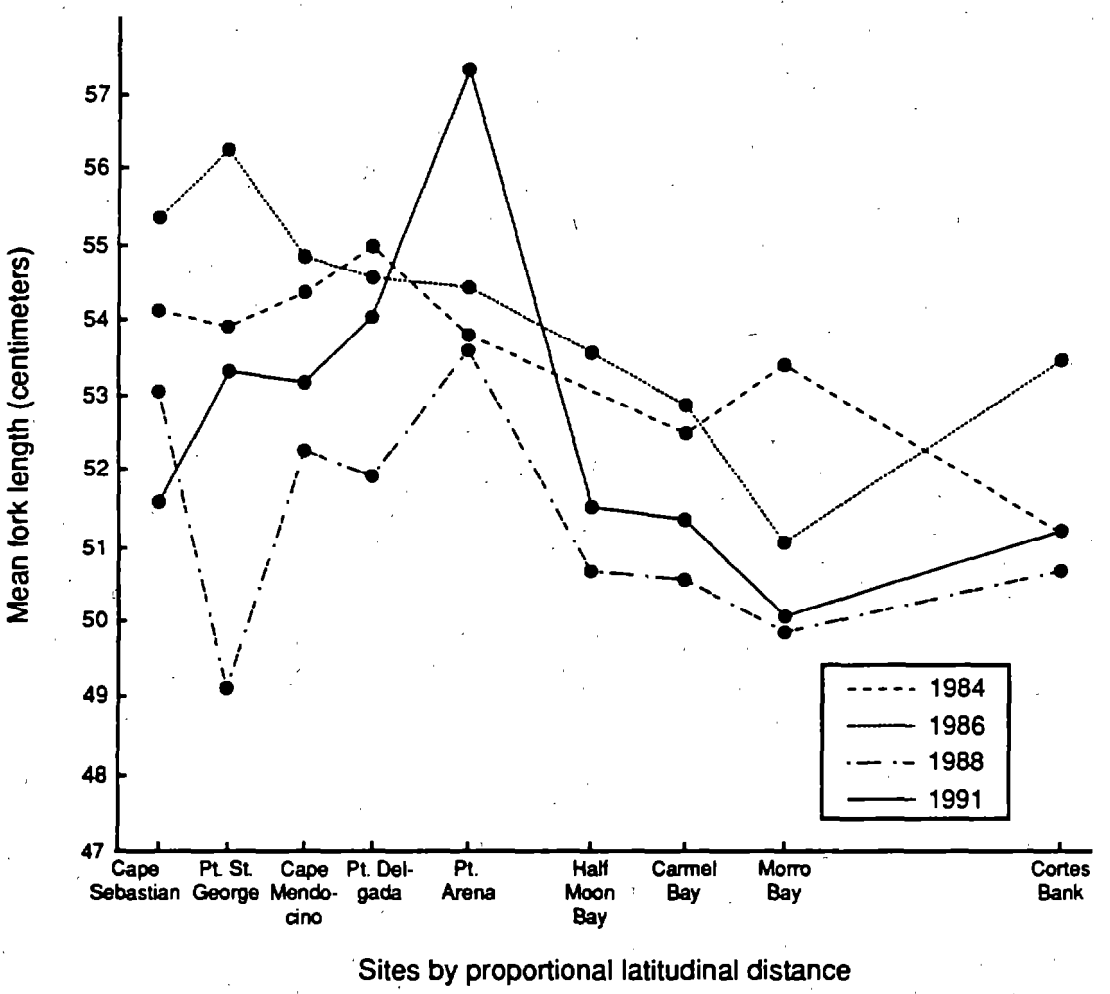

Figure 9.--Sablefish mean fork length by site from southern Oregon and California abundance index surveys in 1984, 1986, 1988, and 1991 (standard depths 225-525 fathoms).

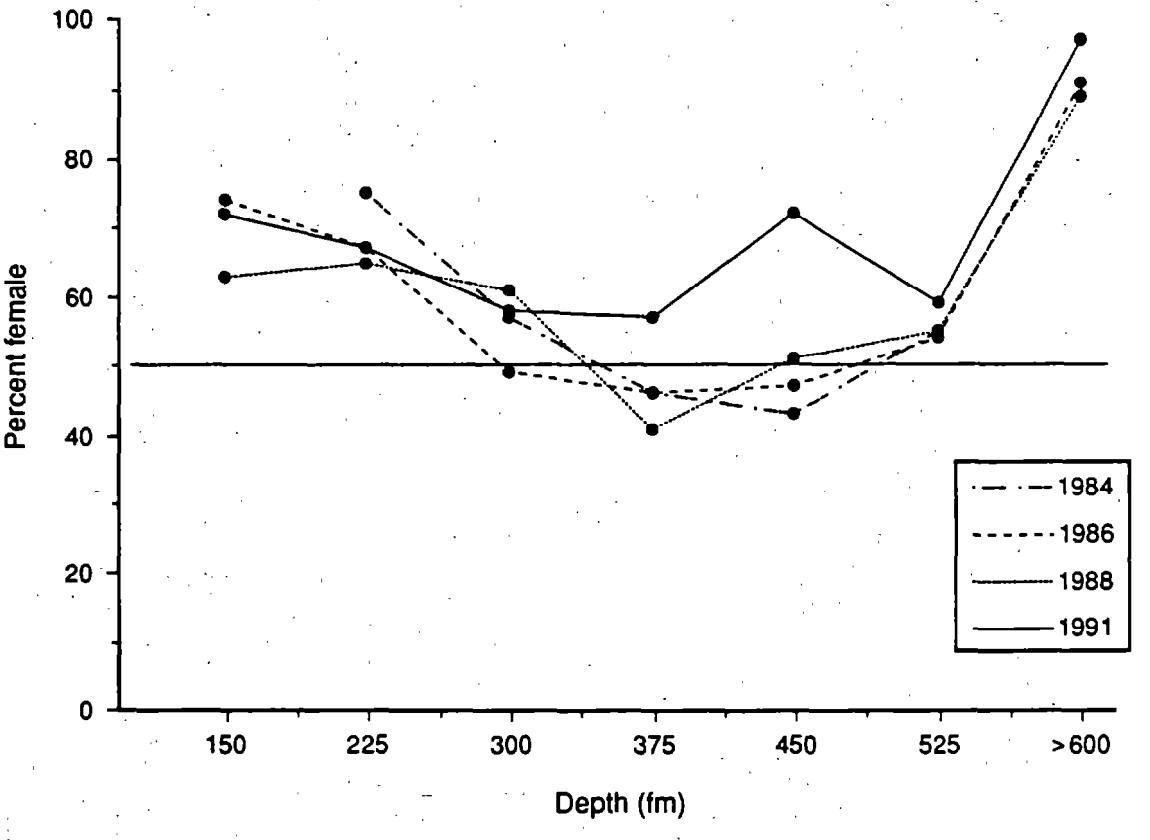

Figure 10.--Percent of females in random samples of sablefish from National Marine Fisheries Service abundance index surveys by depth and by survey year.

years, especially at depths greater than 600 fm where the percent of females ranged from 89 to 97%. In the 1991 survey, the percentage of females at 375 and 450 fm was much higher than in the three- earlier survey years. In standard depths (225-525 fm),, females made up 52 to 62% of our random samples in all four survey years (Fig. 11). For all depths 'combined (150->600 fm), females made up 57 to 67% of our samples from the 1986, 1988, and 1991 surveys. This predominance of females, which also occurs in landings of the fixed-gear fishery, may be a result of the disproportional harvest of males by the trawl fishery. In trawl-caught samples of sablefish in the small size category (less than 58 centimeters fork length) from the Eureka and Monterey International North Pacific Fisheries Commission areas, a 5,000 fish sample (1,000 fish per year from 1986 through 1991) showed 56.4% to be males.

Length-Weight Relationship

The length-weight, relationship for male and female sablefish from the 1991 survey is shown in Figure 12. We found no significant difference in the average weight at length between males and females, as was the case for surveys conducted off Oregon and Washington (August and September 1987) and off southern Oregon and California (September to mid-November 1986) (Parks and Shaw 1988a, b). In the 1988 survey, the male and female length-weight relationships were significantly different

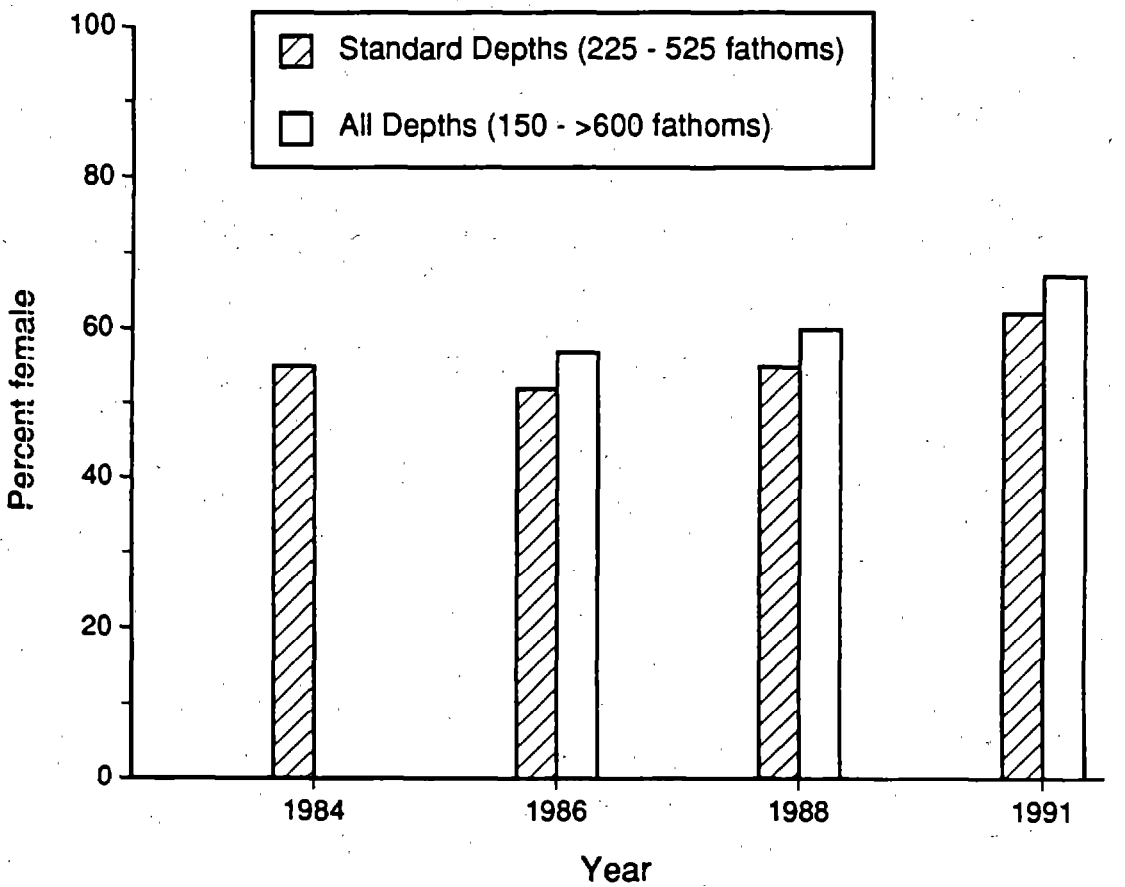

Figure 11.--Percentage of females in random samples of sablefish from the National Marine Fisheries Service abundance index surveys at -the standard depths. (225-525, fathoms) and at all depths sampled (150->600 fathoms) by survey year.. Only standard depths were sampled in 1984.

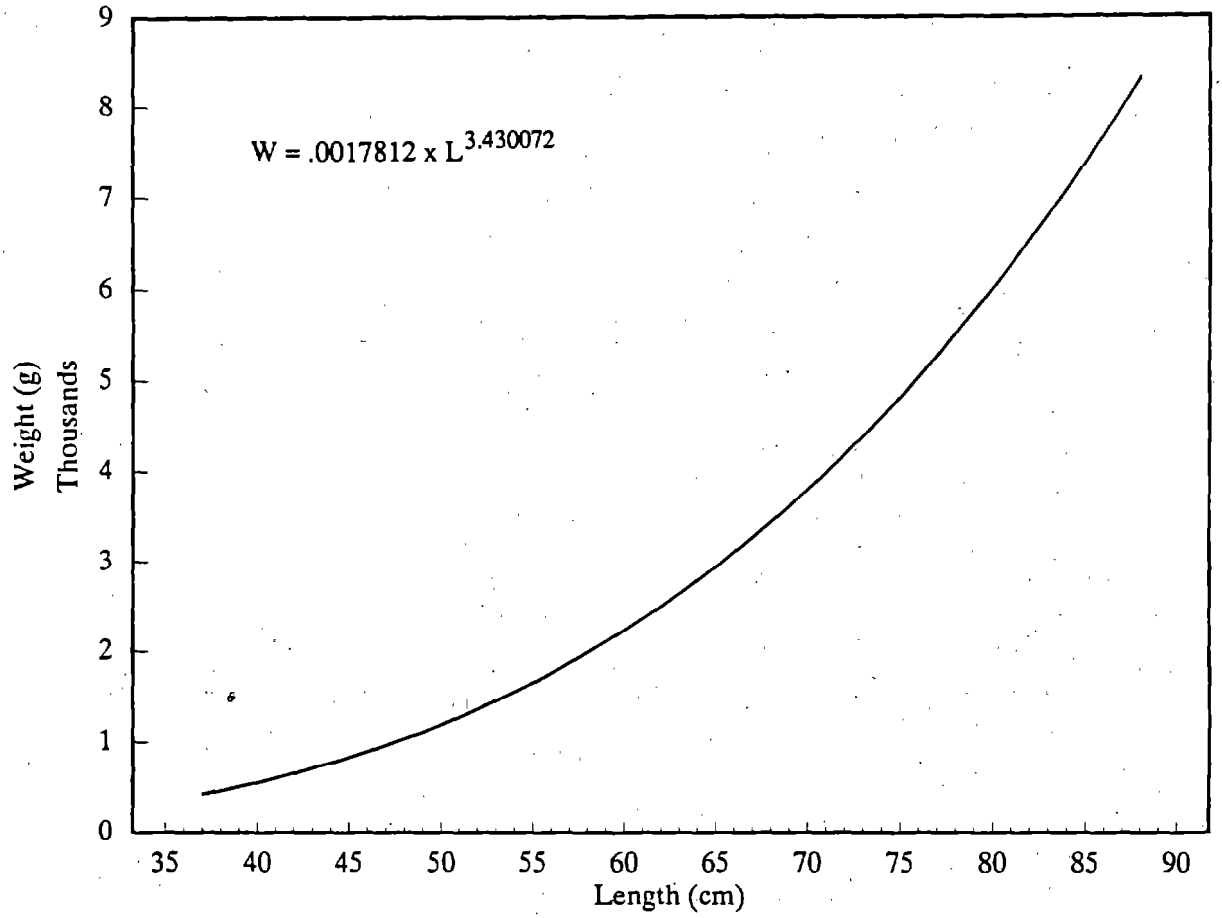

Figure 12. --Length-weight relationship derived for sablefish (sexes combined) collected off southern Oregon and California in September and October 1991.

at the 99.9% level (Parks and Shaw 1989). The 1991 length-weight relationship for sexes combined is $W = .0017812 \times L^{3.4300R}$, where w = weight, in grams and L = length in centimeters (Fig. 12).

SUMMARY AND CONCLUSIONS

Sablefish catch rates (mean number per trap) in surveys off California and southern Oregon decreased by 66% between 1988 and 199:L. Catch rates of small and undersized sablefish (<1.93 kg) declined 69%from 1988.to 1991,'whereas. catch rates of medium-size sablefish (1.93-3.18 kg) declined 48% and large-size sablefish (>3.18 kg) declined 3%. Catch rates decreased at all sites-in 1991, with the largest decreases generally occurring from Pt. Delgada southward to Morro Bay. The three southern sites had the highest catch rates. At the Cortes Banksite, where fishing pressure is probably the lowest, the catch rate was over twice as great as the rate at the nexthighest site, Carmel Bay (Appendix-Fig.1). The lowest catch rates were found at the four sites between Cape Mendocino and Half Moon Bay; Tagging studies indicate that approximately 29% of the sablefish tagged in the Conception INPFC area were recovered north 'of the Conception INPFC area where fishing effort is greater (Shaw 1984). Because fishing pressure is lower at the two southern sites, a higherpercentage of sablefish tagged in the Conception INPFC area was recovered outside that area than in other INPFC areas.

In 1991, over 62% of our catch consisted of undersized (<1.36 kg) sablefish, down from 68% in 1988. The proportion of small (1.36 to 1.93 kg) sablefish changed only slightly from 22% in 1988 to 21% in 1991, while the proportion of medium and large fish rose 9% to 14% and from 1% to 3%, respectively (Appendix Table 1). The mean length of males was 50.8 cm and the mean length of females was 56.0 cm (Fig. 7). Mean lengths increased with depth as, in previous surveys (Parks and Shaw 1989). Sablefish mean lengths were highest at the northern sites, peaked at the Pt. Arena site, and were lowest the four southern sites (Appendix Fig. 2).

While the 1988 survey indicated good recruitment of 2+ and 3+ year old (40-50 cm) sablefish, the low catches of small and medium fish in 1991 suggest that this substantial group of fish has apparently been removed from the population since the 1988 survey. As in the 1988 survey, the mean lengths for both sexes are shorter than our calculated lengths at 50% maturity (51.9 cm for males and 57.9 cm for. females) (Parks and Shaw 1988a). We estimate that only about one-third of the population surveyed in both 1988 and 1991 is sexually mature. The size composition of the commercial catches indicate that large numbers of sablefish are being harvested before they have an opportunity to spawn.

CITATIONS

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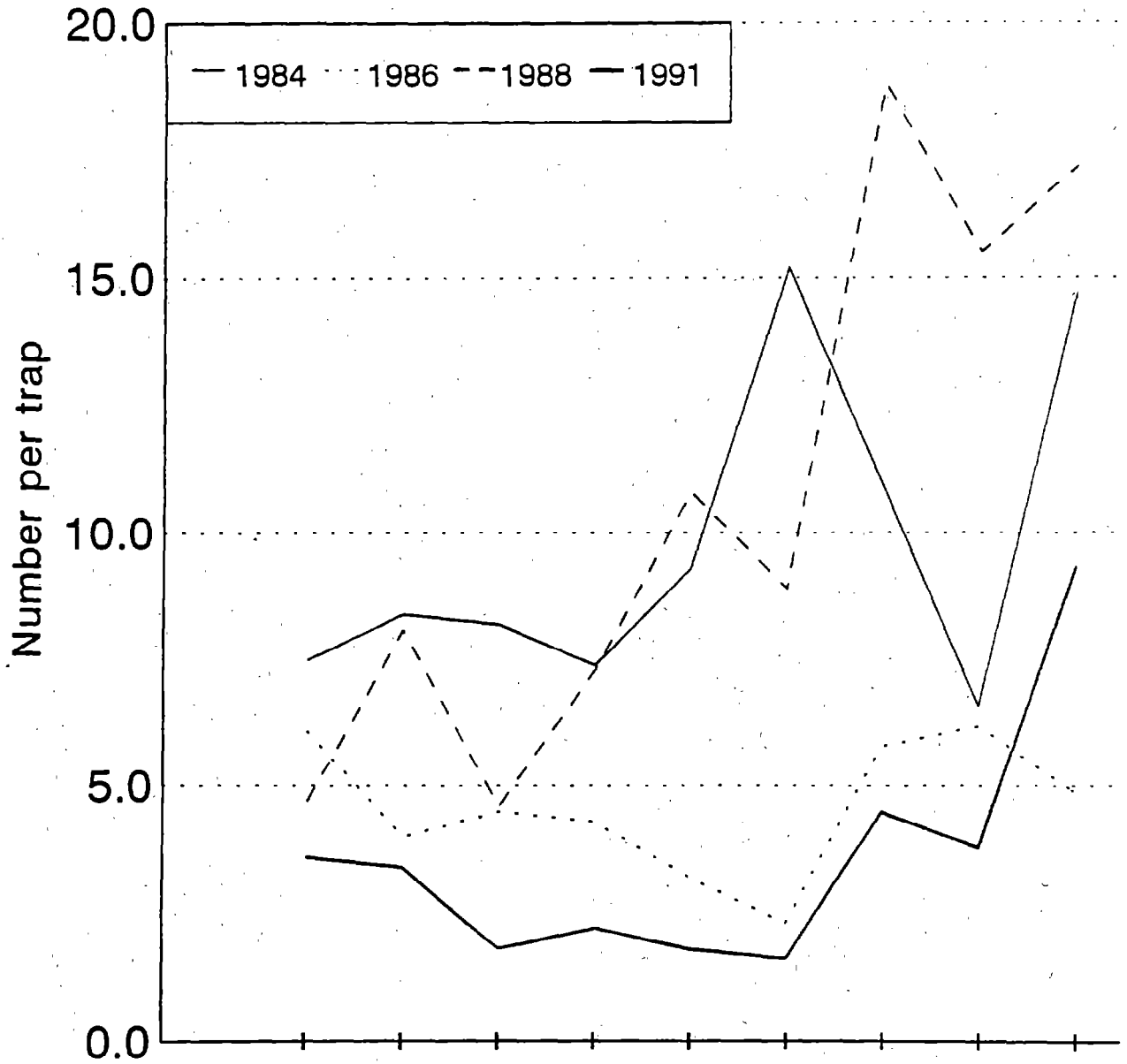
APPENDIX

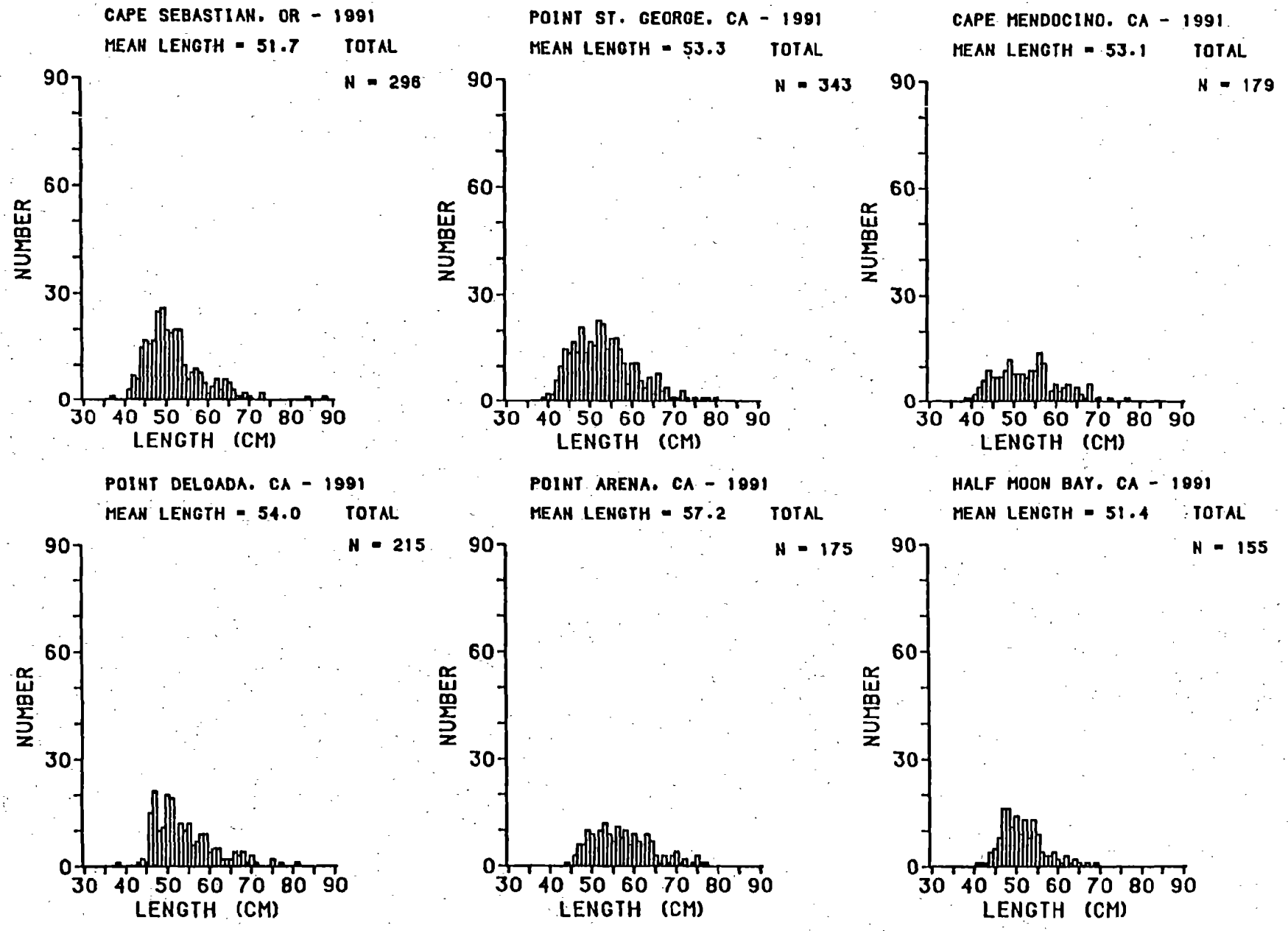
Individual Index Site Data



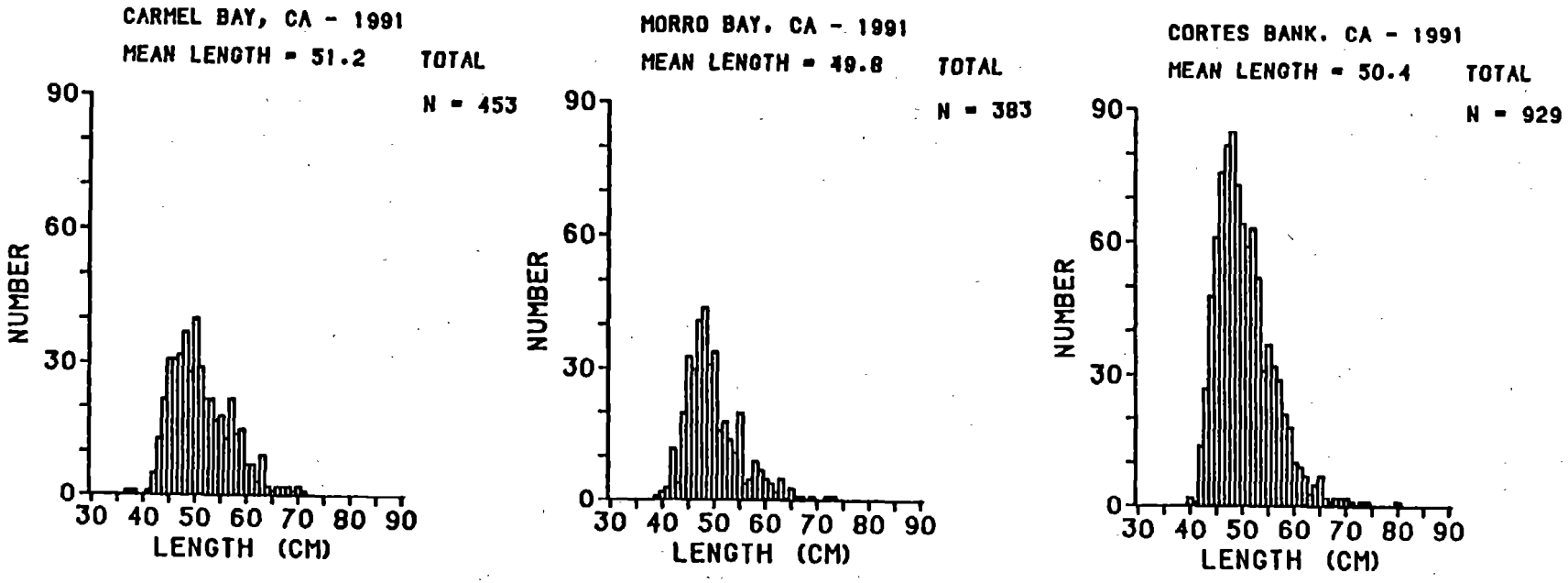
		Cape Sebastian	Pt. St. George	Cape Mendocino	Point Delgada	Point Arena	Half Moon Bay	Carmel Bay	Morro Bay	Cortes Bank
1984		7.5	8.4	8.2	7.4	9.3	15.2	10.9	6.6	14.7
1986		6.1	4.0	4.5	4.3	3.2	2.3	5.8	6.2	4.9
1988		4.7	8.1	4.6	7.3	10.8	8.9	18.8	15.5	17.2
1991		3.6	3.4	1.8	2.2	1.8	1.6	4.5	3.8	9.3

s i t e s

Appendix Figure 1 .-- Mean catch rates of sablefish at nine index sites fished off California and southern Oregon in 1984, 1986, 1968, and 1991 (225525 fathoms),



Appendix Figure 2.--Sablefish length compositions by abundance indexing site at the standard depths (225 - 525 fathoms) during the 1991 abundance indexing survey.



Appendix Figure 2.--(Continued).

Appendix Table 1.--Sablefish catch rates and percentage by size category from southern Oregon and California index sites by depth in 1984 , 1986, 1986, and 1991 (standard depths 225-525 fathoms).

	YEAR	TOTAL NO. SABLEFISH	AVG. NO. SABLEFISH PER TRAP	AVG. WT. (KG) PER TRAP	% LARGE[b] SABLEFISH	% MEDIUM[c] SABLEFISH	% SMALL[d] SABLEFISH	% UNDERSIZED[e] SABLEFISH
Cape Sebastian, OR	1984	748[f]	7.5	14.3	7	19	25	49
	1986	613[f]	6.1	11.7	9	21	32	38
	1988	472[f]	4.7	7.8	2	16	32	50
	1991	359[f]	3.6	5.7	3	14	18	65
Pt. St. George, CA	1984	843[f]	8.4	14.4	3	22	34	41
	1986	405[f]	4.0	7.6	7	28	35	30
	1988	807[f]	8.1	9.7	2	6	17	75
	1991	343	3.4	6.1	4	20	26	50
Cape Mendocino, CA	1984	819[f]	8.2	14.9	5	23	30	42
	1986	448[f]	4.5	8.2	5	29	31	35
	1988	458[f]	4.6	6.9	3	14	27	56
	1991	182[f]	1.8	3.0	4	18	28	50
Pt. Delgada, CA	1984	735[f]	7.4	13.2	4	23	39	34
	1986	427[f]	4.3	8.3	5	26	32	37
	1988	726[f]	7.3	10.5	2	11	25	62
	1991	220	2.2	3.7	6	21	22	51
Pt. Arena, CA	1984	928	9.3	15.4	1	20	41	38
	1986	325	3.2	6.0	4	25	33	39
	1988	1,079[f]	10.8	17.6	2	17	33	48
	1991	178[f]	1.8	3.5	10	35	27	28
Half Moon Bay, CA	1984	1,525	15.2	23.4	<1	15	40	44
	1986	226[f]	2.3	3.9	1	20	38	41
	1988	892[f]	8.9	12.0	<1	7	20	73
	1991	155	1.6	2.8	<1	11	24	64
Carmel Bay, CA	1984	1,094	10.9	16.6	<1	14	31	51
	1986	580	5.8	9.4	1	17	36	46
	1988	1,875	18.8	24.8	<1	7	18	75
	1991	453	4.5	6.4	1	14	20	65
Morro Bay, CA	1984	664	6.6	11.1	2	17	37	44
	1986	619[f]	6.2	9.1	<1	13	27	59
	1988	1,546[f]	15.5	21.0	<1	7	16	77
	1991	383	3.8	5.2	<1	9	14	76
Cortes Bank, CA	1984	1,470	14.7	20.0	<1	10	30	59
	1986	487[f]	4.9	7.7	1	19	36	44
	1988	1,724[f]	17.2	23.5	<1	9	22	69
	1991	929	9.3	12.2	1	9	20	70
All sites combined	1984	8,826[f]	9.8	15.9	2	17	35	46
	1986	4,130[f]	4.6	7.9	4	21	33	42
	1988	9,579[f]	10.6	14.9	<1	9	22	68
	1991	3,202[f]	3.6	5.3	3	14	21	62

[a] These numbers are the result of upward adjustment on rectangular trap catches by 1.265 plus conical trap catches.

[b] Over 3.18 kg round weight.

[c] 1.93-3.18 kg round weight.

[d] 1.36-1.93 kg round weight.

[e] Less than 1.36 kg round weight.

[f] Adjusted upward for missing string(s) of gear, second repetition which was not made, or individual traps which were lost, based on the average decline of catch from the first set to the second set.

Appendix Table 2.--Sablefish catch rates and percentage above the minimum size limit' by index site during the 1991 abundance index survey.

DEPTH (FM)	NO. OF FISH	NO. PER TRAP	WT. PER TRAP (KG)	% ABOVE SIZE LIMIT	NO. OF FISH	NO. PER TRAP	WT. PER TRAP (KG)	% ABOVE SIZE LIMIT	NO. OF FISH	NO. PER TRAP	WT. PER TRAP (KG)	% ABOVE SIZE LIMIT
	Cape Sebastian, OR				Pt. St. George, CA				Cape Mendocino, CA			
150	3	0.2	0.1	50	80	4.0	6.2	42	108	5.4	6.9	32
225	105	5.2	7.6	30	131	6.6	9.9	37	87	4.4	6.1	31
300	100	5.0	7.7	29	123	6.2	10.2	44	28	1.4	1.8	32
375	124[b]	6.2	10.4	44	53	2.6	6.0	70	27	1.4	2.9	70
450	20[b]	1.0	1.6	50	23	1.2	2.9	87	17	0.8	1.7	88
525	10[b]	0.5	1.4	83	13	0.6	1.4	85	23[b]	1.2	2.7	100
650-850	--	--	--	--	20	1.0	3.4	100	20[b]	1.0	4.8	100
All Depths	362	3.0	4.8	35	443	3.2	5.7	51	310	2.2	3.8	47
	Pt. Delgada, CA				Pt. Arena, CA				Half Moon Bay, CA			
150	14	0.7	1.1	57	19	0.9	1.2	32	42	2.1	2.4	31
225	103	5.2	7.9	37	42[b]	2.1	3.2	28	33	1.6	1.9	15
300	51[b]	2.6	4.0	44	38	1.9	3.8	76	33	1.6	1.9	21
375	32	1.6	2.5	50	36[b]	1.8	3.8	71	49	2.4	3.2	29
450	21	1.0	2.5	90	17	0.8	1.9	82	8	0.4	0.6	38
525	13	0.6	1.5	92	45	2.2	4.9	93	32	1.6	3.4	84
650-850	36	1.8	6.3	100	--	--	--	--	58[b]	2.9	11.9	100
All Depths	270	1.9	3.7	56	197	1.6	3.1	68	255	1.8	3.6	49

Appendix Table 2.--(Continued).

DEPTH (FM)	NO. OF FISH	NO. PER TRAP	WT. PER TRAP (KG)	% ABOVE SIZE LIMIT	NO. OF FISH	NO. PER TRAP	WT. PER TRAP (KG)	% ABOVE SIZE LIMIT	NO. OF FISH	NO. PER TRAP	WT. PER TRAP (KG)	% ABOVE SIZE LIMIT
	Carmel Bay, CA				Morro Bay, CA				Cortes Bank, CA			
150	50[b]	2.5	2.1	6	30	1.5	1.5	3	89	4.4	4.4	8
225	201	10.0	12.1	20	150	7.5	7.7	5	486	24.3	25.9	14
300	139	7.0	10.2	34	133	6.6	9.1	22	268	13.4	21.6	47
375	49	2.4	3.5	43	30	1.5	2.5	43	92	4.6	7.0	47
450	23	1.2	2.1	65	41	2.0	3.5	54	66	3.3	5.0	38
525	41	2.0	4.4	85	29	1.4	2.9	76	17	0.8	1.6	88
630-850	23	1.2	4.2	100	46	2.3	7.7	100	11	0.6	1.5	100
All Depths	526	3.8	5.5	36	459	3.3	5.0	31	1,029	7.4	9.6	28
	All sites combined											
150	435[b]	2.4	2.9	25								
225	1,338[b]	7.4	9.2	21								
300	913[b]	5.1	7.8	39								
375	492[b]	2.7	4.6	50								
450	236[b]	1.3	2.4	61								
525	223[b]	1.2	2.7	88								
630-850[c]	214	1.5	5.6	100								
All Depths	3,851	3.2	5.0	40								

[a] Regulation set by the Pacific Fishery Management Council and includes sablefish smaller than 22 inches total length (52.4 cm fork length) or 15.5 inches dorsal length (origin of dorsal fin to the tip of the tail if beheaded).

[b] Adjusted upward for second set not made or for lost traps.

[c] 630-850 fathom depth fished at seven sites.

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