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Changes in Relative Abundance and Size Composition of Sablefish in Coastal Waters of Washington and Oregon, 1979-83

By
Norman B. Parks

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U.S. DEPARTMENT OF COMMERCE
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CHANGES IN RELATIVE ABUNDANCE AND SIZE COMPOSITION OF SABLEFISH IN COASTAL WATERS OF WASHINGTON AND OREGON, 1979-83

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Norman B. Parks

Northwest and Alaska Fisheries Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
2725 Montlake Boulevard East
Seattle, Washington 98112

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KEYWORDS: *Marine fishes, *Coasts, *North Pacific Ocean, *Anoplopoma fimbria.

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ABSTRACT

Sablefish (Anoplopoma fimbria) abundance in index survey areas off Oregon and Washing&n, which had been decreasing between 1979 and 1981, appears to have rebounded sharply between 1981 and 1983. Highest catch rates in 1983 occurred at the Willapa Bay, Washington and Cape Lookout, Oregon sites, and the 300 fathom depth interval produced the highest catches for all sites combined.

The 1983 catches, although nearly equal in numbers to baseline year 1979 levels, were composed of a much higher percentage of submarketable-sized sablefish and a lower percentage of medium and large sablefish than in any of the previous surveys.!. Apparently fishing and natural mortality have reduced the numbers of larger sablefish off Oregon and Washington since 1979 while recruitment into the fishery, primarily from a strong 1980 year class, has greatly increased the proportion of smaller sized sablefish.

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INTRODUCTION

The sablefish (Anoplopoma fimbria) has, in recent years, become one of the most valuable species in the Pacific west coast groundfish fishery. Catches have increased sporadically since 1977 with highest catches occurring in 1979 and 1982 (Table 1). Sharply reduced sablefish prices, beginning in mid-1979, led to a substantial reduction in domestic effort and catch in 1980 and 1981, but in 1982 a strong market and attractive price for small sablefish resulted in increased trawl landings coastwide. Intensive fishing continued until late October 1982, when the optimum yield figure of 17,420 t was met and the Pacific Fishery Management Council set a sablefish trip limit of 3,000 lb for the remainder of 1982. The market demand and price, particularly for small *size* sablefish (<4 lb), declined substantially in mid-1983, resulting in reduced landings in 1983, especially in California (Table 1).

The economic importance of the sablefish fishery and the need for information to complement status of stock analyses based on fishery statistics were responsible for the initiation of a program at the Northwest and Alaska Fisheries Center (NWAFC) to monitor annual changes in distribution, relative abundance, size composition, biological characteristics, and migratory movements of sablefish in the northeastern Pacific Ocean. Sablefish abundance index surveys to periodically measure relative change in sablefish abundance at specific sites (called index sites) began in southeastern Alaska waters in 1978, and were expanded to include Oregon and Washington waters in 1979 and waters off California in 1980. These surveys have been conducted in accordance with guidelines established in a coastwide research plan developed in consultation with state fishery management agencies (Hughes 1980). The results of sablefish surveys during 1979-82 in the Washington-California region have been reported by Parks and Hughes (1981), Parks (1982), and Parks and Shaw (1983,).

Table 1 .--Domestic landings of sablefish by state and gear type, 1976-83.

State and gear	Sablefish landings, round weight (t)							
	1976	1977	1978	1979	1980	1981	1982	1983
Washington								
Trawl	314	480	676	669	441	571	1,774	1,377
Trap	121	359	491	435	387	1,305	1,621	1,470
Longline	204	299	666	1,564	577	676	677	495
Troll	1	2	-	-	1	1	2	3
Shrimp trawl	1	6	-	-	7	11	27	41
Set net	-	-	-	-	45	29	141	185
Handline	-	-	-	-	4	4	1	-
Total	641	1,146	1,833	2,668	1,462	2,597	4,243	3,571
Oregon								
Trawl	443	326	958	1,494	1,024	1,318	2,961	2,782
Trap	44	40	290	4,351	1,241	303[a]	1,457	1,309
Longline	0	6	268	1,819	379	682	641	543
Troll	-	-	28	-	-	1	1	-
Shrimp trawl	20	13	70	77	63	36	40	22
Total	507	385	1,614	7,741	2,707	2,340	5,100	4,656
California								
Trawl	1,854	2,474	2,345	2,272	2,902	3,572	5,432	3,100
Trap and Longline[b]	4,206	3,579	4,827	4,772	2,431	3,097	4,065	3,409
Total	6,060	6,053	7,172	7,044	5,333	6,669	9,497	6,509
Grand Total	7,208	7,584	10,619	17,453	9,502	11,606	18,840	14,736

[a] Includes 26 t taken by set net.
[b] Longline catch in California was a very small percentage of combined trap and longline catch until 1980 when longline catch rose to 28%.

This report updates the results given by these authors by including the 1983 survey off Washington and Oregon. The 1983 survey was conducted in October and November from the NOAA research vessel John N. Cobb.

SURVEY METHODS AND GEAR

The survey approach employed in this study and the trap gear used through 1982 are described in detail by Parks and Hughes (1981). Information on changes in relative abundance from year to year was determined from the catch per unit of effort (CPUE) obtained from trap catches at index sites off Washington and Oregon during August-September.

In 1983, the experimental design was modified in an effort to improve operational efficiency and the precision of abundance estimates. Analysis of past Washington-Oregon indexing data indicated that the survey would be able to detect substantially smaller annual changes in abundance if the number of index sites were increased in each area where monitoring of population trends is desired (Kimura and Balsiger 1983). The analysis also indicated that little loss of precision occurs when the number of sets at each depth location within a site is reduced from five to two. By reducing the number of sets, time for sampling at additional sites is allowed. The number of sampling sites designated off Washington and Oregon for the 1983 survey was therefore increased from four to eight with the new sites approximately equidistance from the original sites (Fig.1).

In addition to these sampling modifications, population changes would not be tracked by individual site or by sites grouped by state but data from all sites would be combined to identify population changes for the whole area off Washington and Oregon. Results from individual sites can still be examined, however, by those interested in local CPUE and size data.

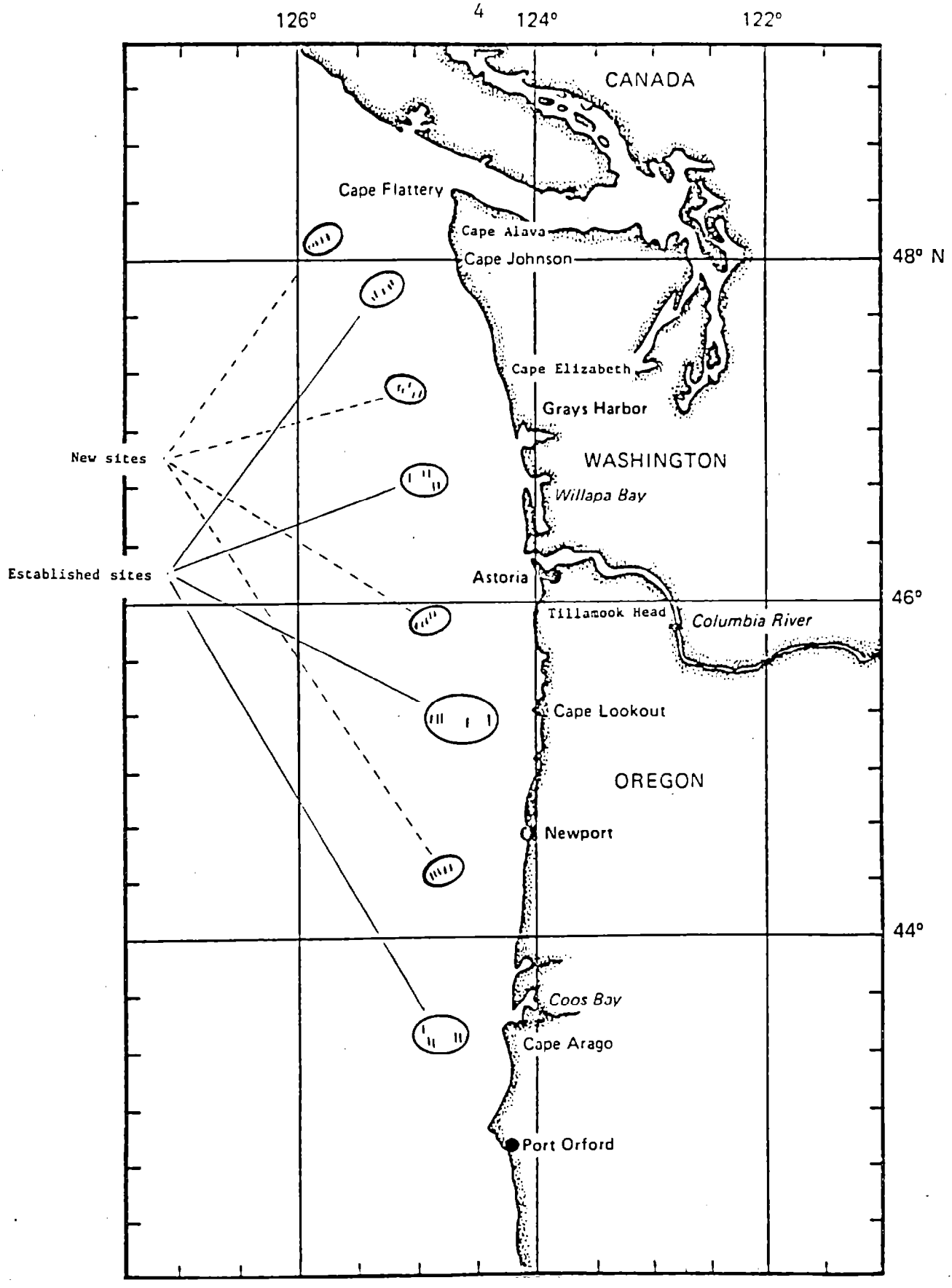

Figure 1 .--Abundance index sites established off Washington and Oregon.

In an effort to find more efficient and less labor intensive sampling gear, conical (Korean) style traps were employed during the 1983 Washington-Oregon survey. These traps had compared well in catching efficiency with the standard rectangular traps at sampling sites off southeastern Alaska (J. Fujioka, Auke Ray Laboratory, Auke Bay, NMFS Northwest and Alaska Fisheries Center, Auke Bay, AK 99821. Pers. commun.). We planned to make further comparisons to establish the feasibility of converting to the conical trap as the standard sampling unit. So, in the 1983 survey, 25 rectangular and 25 conical traps were used. The two trap types were alternated on each string (five rectangular and five conical per string).

Rectangular traps were the same traps used during previous surveys, with dimensions of 34 in x 34 in x 8 ft, and a single tunnel located on one end. The conical traps have a bottom ring 54 in outside diameter, a top ring 33.5 in outside diameter, a height of 28 in, and the tunnel entrance on the side. Groundlines were 550 fathoms in length and of 5/8 in line. Trap gangions were spaced at intervals of 50 fathoms. Trap bridles were attached to the gangions by brummel hooks or "C" hooks.

A string of 10 traps was fished twice at each of five depths (150, 225, 300, 375, and 450 fathoms) within a site. Soaking time for an individual set of one string was 24 hours. Loran C and depth sounders were used to position all replicate sets near depths and locations fished on previous cruises.

Data collected during the surveys included:

1. Number and weight of sablefish and all other species captured in each trap;
2. Fork lengths of all sablefish; and
3. Biological data to support life history studies which included age structures (otoliths), sex ratios, and sexual maturity.

Only the number of sablefish and their lengths have been included in this report. other data will be reported on at a later date.

RESULTS

Sampling at the four previously surveyed sites was completed successfully during Leg I of the cruise in October. Persistent adverse weather during November prevented any sampling at the four new sites.

Possible Differences in Catch between Conical and Rectangular Traps

Statistical analyses were applied to survey results to determine the statistical significance of differences in conical and rectangular trap catches. Frequency table analysis (Dixon 1983) was used to test the null hypothesis that there is no difference in the probabilities of one trap catching more than the other. under the assumption that sablefish counts in different sets were statistically independent, the data were analyzed by set units rather than by individual trap units. The G^2 (likelihood-ratio chi-square) value for the main effect due to trap type was not significant at the 95% level (P = 0.148). The depth-trap type interaction, however, was significant and was probably due mostly to larger catches by the rectangular traps at the 450 fathom depth in 7 of 8 sets. A disconcerting observation is that the catch rates of the conical traps improved as the survey progressed. These were newly constructed traps and although they had been immersed in salt water for a week prior to the survey, traps are known to be less effective when new than they are after a period of use. One test of trend (Jonckheere's test) did suggest an increasing trend in catches (P = .052) of conical traps relative to rectangular traps as the survey moved from north to south. Another test (Chacko's test), which may

be preferable to Jonckheere's test if the improvement was decreasing with time, produced results which were significant at the 88% level.

These test results relative to the comparative fishing efficiencies of the two trap types were inconclusive and it becomes clear that additional trap comparisons are required. We had two options for treating the 1983 data so they might be compared with survey results from previous years. In the first case, the 1983 sablefish catches are derived from doubling the catch from the five rectangular traps fished on each string and omitting the catch from the five conical traps. In the second case, there was assumed to be no difference in the fishing power of the two trap types and the total number of sablefish captured was used in the derivation of standard CPUE. Both /methods usually yield similar percentage changes in abundance values (Table 2). Due to the uncertainty about the relative performance of the two trap types and in the interest of providing the best continuity with previous surveys, only the catch figures obtained from doubling the rectangular trap catches are used for the 1983 survey for calculating sablefish abundance changes. Because only two sets were made at each site in 1983, comparisons were made using catches taken in only the first two sets made in 1979 and 1981. These data are provided in parentheses in Table 2.

Differences in Catch by Fishing Depth

Sablefish catches, length compositions and mean length by depth for all sites in 1983 are combined and shown in Figure 2. Catches were greatest at 300 fathoms, followed by those at 225 fathoms, 375 fathoms, and 450 fathoms, and were lowest at 150 fathoms. Mean length was highest at 150 fathoms and 300 fathoms and was lowest at the two deepest depth intervals.

Table 2.- **Total numbers** of sablefish and **numbers** of marketable-size and suhnarketable-elre eablefish captured at megon and Washington abundance index site8 during the 1979-61 and 1983 surveye. Annual percentage change in numbers of sablefish and percentage change from the baseline year 1979 are indicated by site and size category.

	Total sablefish			Marketable-size[a]			Submarketable-size[b]		
Site/year	Number	Annual change (%)	Change from 1979 (%)	Number	Annual change (%)	Change from 1979 (%)	Number	Annual change (%)	Change from 1979 (%)
OREGON									
Cape Arago									
1979	1,222			929			293		
	(543)[d]	+43		(425)	+1		(118)	+179	
1980	1,753		+43	936[c]		+1	817[c]		+179
		-67			-67			-66	
1981	587		-52	313		-66	274		-6
	(174)[d]			(92)			(82)		
		+290			+320			+256	
1983[e]	678		+25	386		-9	292		+147
1983[f]	806	+363	+48	459	+399	+8	347	+323	+194
Cape Lookout									
1979	2,874			2,139			555		
	(1,546)	-61		(1,245)	-70		(301)	-23	
1980	1,125		-61	700		-70	425		-23
		-31			-21			-48	
1981	774		-73	551		-76	223		-60
	(315)			(241)			(74)		
		+142			+94			+297	
1983[e]	762		-51	468		-62	294		-2
1983[f]	855	+171	-45	525	+118	-58	330	+346	+10
WASHINGTON									
Willapa Bay									
1979	1,310			846			464		
	(746)	-26		(473)	-20		(273)	-36	
1980	974		-26	675		-20	299		-36
		+10			+6			+21	
1981	1,074		-18	713		-16	361		-22
	(398)			(269)			(129)		
		+139			+97			+226	
1983[e]	950		+27	529		+12	421		+54
1983[f]	1,017	+156	+36	566	+110	+20	451	+250	+65
Cape Johnson									
1979	952			760			192		
	(404)	+44		(315)	+24		(89)	+122	
1980	1,370		+44	944		+24	426		+122
		-31			-38			-14	
1981	950		0	584		-23	366		+91
	(491)			(291)			(200)		
		+29			+13			+52	
1983[e]	634		+57	330		+5	304		+242
1983[f]	598	+22	+48	311	+7	-1	287	+44	+222
Oregon and Washington sites combined									
1979	6,358			4,854			1,504		
	(3,240)	-18		(2,458)	-33		(782)	+31	
1980	5,222		-18	3,255		-33	1,967		+31
		-35			-34			-38	
1981	3,385		-47	2,161		-55	1,224		+19
	(1,378)			(893)			(485)		
		+119			+92			+170	
1983[e]	3,024		-7	1,713		-30	1,311		+68
1983[f]	3,276	+138	+1	1,861	+108	-24	1,415	+192	+81

[a] 52 cm or greater fork length.
[b] 51 cm or less fork length, which is below minimum marketable size in Washington and Oregon.
[c] A correction of the number presented in the report by Parks and Hughes (1981).
[d] All numbers in parentheses indicate the numbers of sablefish taken in only the first two sets in 1979 and 1981 for comparison with the two sets made in 1983.
[e] Doubling of the rectangular trap catches at each site. Conical trap catches are omitted.
[f] Total number of sablefish captured in both rectangular and conical trap types.

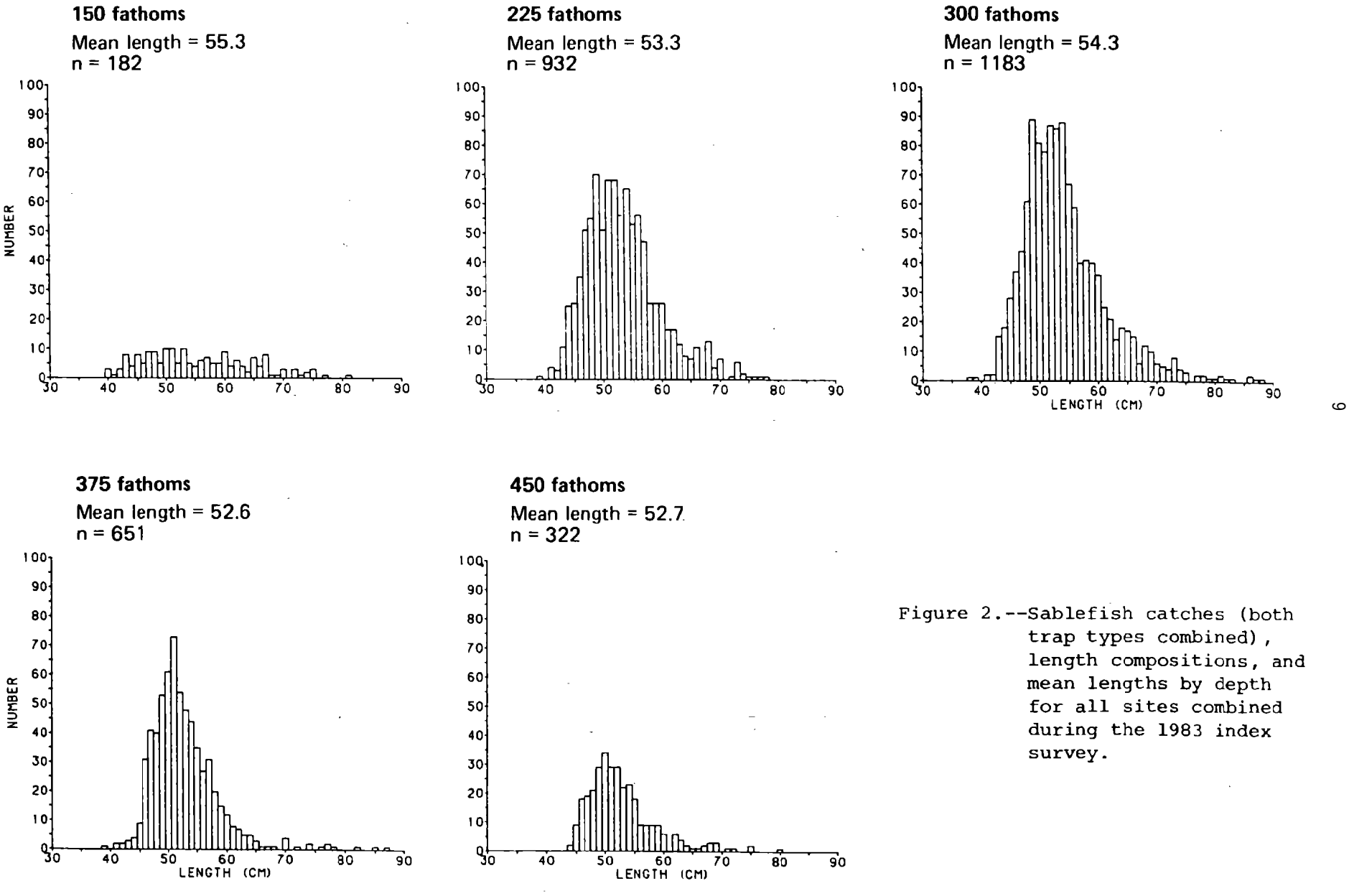

Figure 2.--Sablefish catches (both trap types combined), length compositions, and mean lengths by depth for all sites combined during the 1983 index survey.

Catch Rates and Size Composition by Index Site

Sablefish catches at the Cape Arago site increased very sharply between the 1981 and 1983 surveys after having decreased between 1980 and 1981 surveys (Table 2). Table 3 shows actual catches by depth and indicates catch rates were up at all depth intervals in 1983, especially at 225 fathoms where 46 sablefish were captured in the first two sets in 1981 and 392 in 1983. This large increase between 1981 and 1983 was evident in both marketable and submarketable size categories (Table 2). sablefish catches since baseline year 1979 were also up somewhat; however, all of the increase was in the submarketable size. The percentage abundance by size category for the Cape Arago catches is shown in Table 4. Cape Arago produced the highest percentage of small sablefish and the lowest percentage of medium and large sablefish of all sites in 1983. overall, the sharply increased abundance appeared to occur in all size categories, and mean length remained at 53 cm in 1983 as in 1981 (Fig. 3). This mean length is down from the 57 cm observed in 1979.

Sablefish catches at Cape Lookout, after having decreased since 1979, increased sharply in 1983 from 1981 levels (Table 2). Catches were still down, however, from baseline year 1979 levels. In 1983, catch rates were up sharply at 300 and 375 fathoms where the largest catches occurred (Table 5). The largest increases in 1983 were in the submarketable sizes. Even so, this site, as in 1981, had the lowest percentage of submarketables and the highest percentage of medium and large sablefish of any site (Table 4). Comparing the length composition (Fig. 31, numbers of fish measuring 55 cm and greater remained relatively constant between the 1981 and 1983 surveys, while the substantial increase in 1983 abundance occurred primarily among fish measuring 54 cm and less. As a result, mean length decreased from 57 cm in 1981 to 55 cm in 1983.

Table 3.--Total numbers of sablefish and marketable-size sablefish[a] (in parentheses) captured by depth and set at the Cape Arago, Oregon, site during the 1979-81 and 1983 abunddnce index surveys. Each catch was obtained from one string of 10 sablefish traps fished for 24 hours.

Area, year and set	Depth (fathom/meter) 150/275	225/412	300/550	375/686	450/824	Total catch
	Number of fish					
Cape Arago						
1979						
1	39 (36)	88 (70)	61 (50)	86 (63)	74 (58)	348 (277)
2	39 (19)	54 (42)	42 (35)	26 (21)	34 (31)	195 (148)
3	51 (27)	48 (41)	64 (46)	77 (60)	54 (41)	294 (215)
4	21 (17)	50 (46)	19 (12)	50 (35)	52 (30)	192 (140)
5	22 (11)	33 (30)	21 (11)	33 (30)	84 (67)	193 (149)
Total	172 (110)	273 (229)	207 (154)	272 (209)	298 (227)	1,222 (929)
Mean	34 (22)	55 (46)	41 (31)	54 (42)	60 (45)	244 (186)
1980						
1	171 (70)	54 (30)	40 (19)	36 (19)	20 (14)	321 (152)
2	166 (71)	80 (44)	61 (30)	17 (8)	10 (6)	334 (159)
3	303 (115)	48 (22)	44 (27)	19 (14)	6 (4)	420 (182)
4	150 (92)	86 (56)	51 (34)	15 (9)	9 (5)	311 (196)
5	238 (147)	83 (70)	12 (8)	23 (14)	11 (8)	367 (247)
Total	1,028 (495)	351 (222)	208 (118)	110 (64)	56 (37)	1,753 (936)
Mean	206 (106)	70 (50)	42 (25)	22 (13)	11 (7)	351 (187)
1981						
1	1 (1)	24 (16)	47 (12)	20 (13)	14 (10)	106 (52)
2	10 (6)	22 (15)	20 (10)	10 (6)	6 (3)	68 (40)
3	10 (3)	80 (45)	12 (8)	20 (10)	7 (5)	129 (71)
4	11 (6)	90 (51)	39 (26)	37 (12)	14 (9)	191 (104)
5	9 (3)	50 (25)	13 (6)	12 (6)	9 (6)	93 (46)
Total	41 (19)	266 (152)	131 (62)	99 (47)	50 (33)	587 (313)
Mean	8 (4)	53 (30)	26 (12)	20 (9)	10 (7)	117 (63)
1983[b]						
1	20 (8)	223 (147)	107 (56)	74 (33)	60 (30)	484 (274)
2	16 (5)	169 (115)	56 (31)	52 (24)	29 (10)	322 (185)
Total	36 (13)	392 (262)	163 (87)	126 (57)	89 (40)	806 (459)
Mean	18 (6)	196 (131)	82 (44)	63 (28)	44 (20)	403 (230)

[a] Sablefish measuring 52 cm or greater in fork length.
[b] Total number of sablefish captured in both trap types.

Table 4.--Percentage abundance of submarketable-size and marketable-size sablefish at the four Oregon and Washington abundance index sites during the 1979-81 and 1983 surveys.

Year and area	Sub-marketable[a] (%)	Marketable			
		Small[b] (%)	Medium[c] (%)	Large[d] (%)	Total (%)
1979					
Cape Arago	24	53	13	10	100
Cape Lookout	19	57	13	11	100
Willapa Bay	35	51	7	7	100
Cape Johnson	20	55	13	12	100
Average	24	54	12	10	100
1980					
Cape Arago	47	39	8	6	100
Cape Lookout	38	44	9	9	100
Willapa Bay	31	52	8	9	100
Cape Johnson	31	54	8	7	100
Average	37	47	8	8	100
1981					
Cape Arago	47	44	6	3	100
Cape Lookout	29	46	12	13	100
Willapa Bay	34	52	7	7	100
Cape Johnson	39	52	6	3	100
Average	37	49	8	6	100
1983					
Cape Arago	43	49	5	3	100
Cape Lookout	39	47	8	6	100
Willapa Bay	44	44	7	5	100
Cape Johnson	48	42	7	3	100
Average	44	45	7	4	100

[a] less than 52 cm fork length = less than 3.0 lb round weight.
[b] 52-61 cm fork length = 3.0-5.0 lb round weight.
[c] 62-67 cm fork length = 5.0-7.0 lb round weight.
[d] 68 cm or greater fork length = more than 7.0 lb round weight.

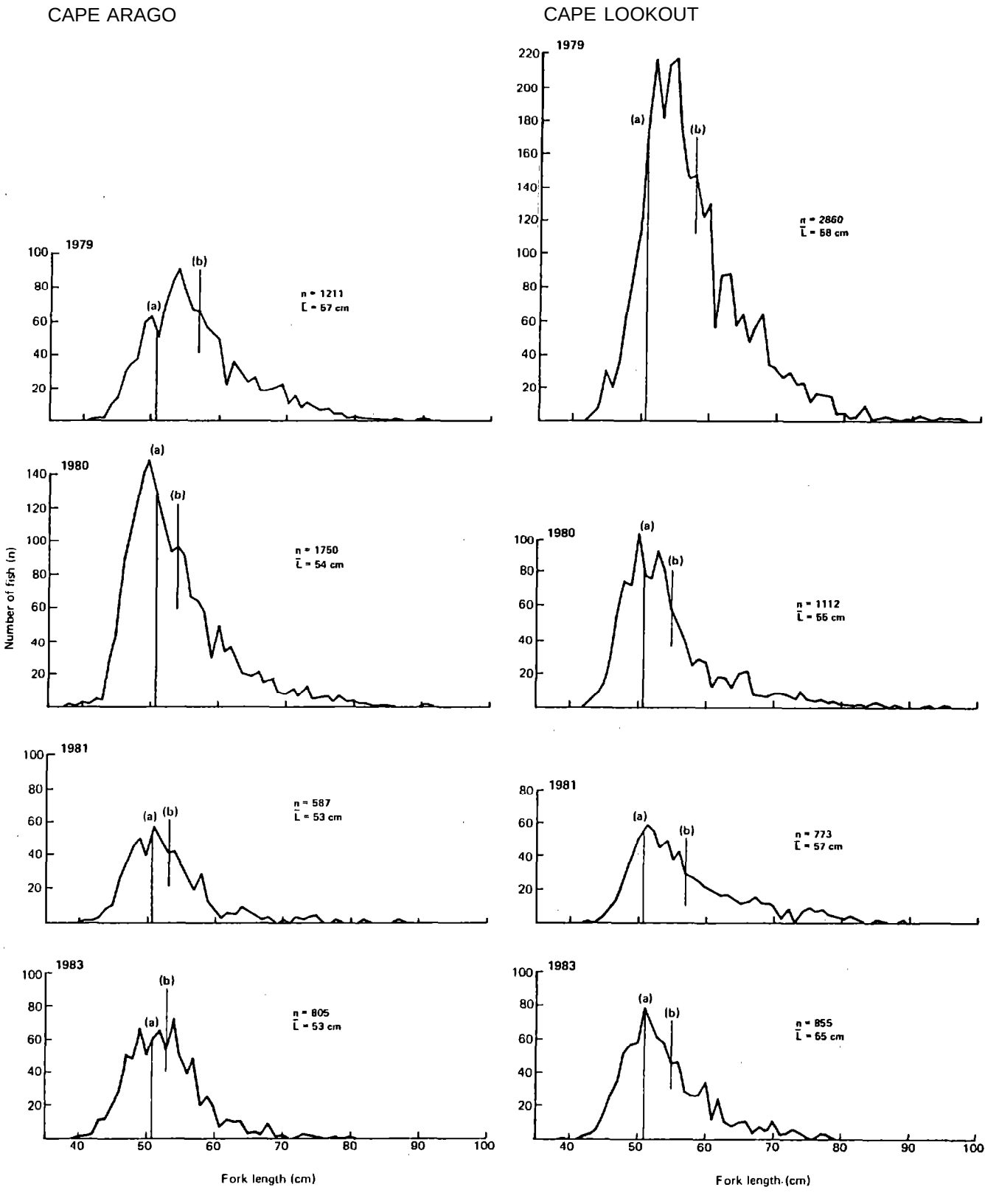

Figure 3.--Length composition of sablefish captured at the Cape Arago and Cape Lookout, Oregon, sites during the 1979-81 and 1983 index surveys. vertical line (a) is the division between submarketable-size and marketable-size sablefish, and vertical line (b) is the mean length.

Table 5.--Total numbers of sablefish and marketable-size sablefish[a] (in parentheses) captured by depth and set at the Cape Lookout, Oregon, site during the 1979-81 and 1983 abundance index surveys. Each catch was obtained from one string of 10 sablefish traps fished for 24 hours.

Area, year and set	Depth (fathom/meter) 150/275	225/412	300/550	375/686	450/824	Total catch
	Number of fish					
Cape Lookout						
1979						
1	158 (103)	138 (131)	360 (293)	222 (177)	213 (158)	1,091 (862)
2	30 (24)	72 (68)	134 (111)	87 (74)	132 (106)	455 (383)
3	25 (14)	97 (95)	146 (123)	114 (93)	99 (74)	481 (399)
4	57 (45)	92 (89)	98 (76)	116 (92)	116 (88)	479 (390)
5	23 (16)	85 (65)	66 (54)	83 (67)	111 (83)	368 (285)
Total	293 (202)	484 (448)	804 (657)	622 (503)	671 (509)	2,874 (2,319)
Mean	59 (40)	97 (90)	161 (131)	124 (101)	134 (102)	575 (464)
1980						
1	93 (54)	24 (18)	60 (41)	29 (18)	35 (22)	241 (153)
2	55 (35)	26 (20)	95 (59)	28 (15)	23 (16)	227 (145)
3	85 (50)	74 (45)	50 (28)	40 (23)	10 (7)	259 (153)
4	45 (25)	53 (36)	102 (54)	44 (33)	29 (12)	273 (160)
5	28 (18)	30 (28)	23 (14)	27 (20)	17 (9)	125 (89)
Total	306 (182)	207 (147)	330 (196)	168 (109)	114 (66)	1,125 (700)
Mean	61 (36)	41 (29)	66 (39)	34 (22)	23 (13)	225 (140)
1981						
1	22 (20)	25 (22)	31 (25)	35 (24)	14 (9)	127 (100)
2	35 (30)	73 (59)	27 (16)	30 (21)	23 (15)	188 (141)
3	40 (33)	48 (35)	30 (16)	22 (18)	39 (24)	179 (126)
4	40 (32)	36 (27)	27 (14)	16 (11)	8 (3)	127 (87)
5	31 (24)	49 (42)	30 (9)	22 (13)	21 (9)	153 (97)
Total	168 (139)	231 (185)	145 (80)	125 (87)	105 (60)	774 (551)
Mean	34 (28)	46 (37)	29 (16)	25 (17)	21 (12)	155 (110)
1983[b]						
1	2 (1)	31 (27)	164 (108)	123 (67)	39 (21)	359 (224)
2	15 (10)	42 (35)	246 (159)	157 (83)	36 (14)	496 (301)
Total	17 (11)	73 (62)	410 (267)	280 (150)	75 (35)	855 (525)
Mean	8 (6)	36 (31)	205 (134)	140 (75)	38 (18)	428 (262)

[a] Sablefish measuring 52 cm or greater in fork length.
b Total number of sablefish captured in both trap types.

Table 6.--Total numbers of sablefish and marketable-size sablefish[a] (in parentheses) captured by depth and set at the Willapa Bay, Washington, site during the 1979-81 and 1983 abundance index surveys. Each catch was obtained from one string of 10 sablefish traps fished for 24 hours.

Area, year and set	Depth (fathom/meter) 150/275	225/412	300/550	375/686	450/824	Total catch
	Number of fish					
Willapa Bay						
1979						
1	34 (18)	80 (24)	102 (81)	109 (81)	184 (106)	509 (310)
2	23 (13)	39 (15)	83 (62)	47 (40)	45 (33)	237 (163)
3	8 (6)	57 (23)	82 (71)	32 (23)	32 (22)	211 (145)
4	18 (12)	27 (8)	29 (18)	48 (35)	56 (42)	178 (115)
5	6 (5)	20 (7)	39 (26)	56 (40)	54 (35)	175 (113)
Total	89 (54)	223 (77)	335 (258)	292 (219)	371 (238)	1,310 (846)
Mean	18 (11)	45 (15)	67 (52)	58 (44)	74 (48)	262 (169)
1980						
1	57 (33)	42 (23)	72 (52)	31 (23)	42 (24)	244 (155)
2	21 (15)	35 (21)	27 (21)	28 (24)	53 (42)	164 (123)
3	59 (37)	54 (42)	42 (35)	32 (29)	56 (36)	243 (179)
4	32 (19)	32 (14)	44 (34)	25 (18)	27 (22)	160 (107)
5	29 (18)	38 (21)	49 (41)	23 (19)	24 (12)	163 (111)
Total	198 (122)	201 (121)	234 (183)	139 (113)	202 (136)	974 (675)
Mean	40 (24)	40 (24)	47 (37)	28 (23)	40 (27)	195 (135)
1981						
1	42 (31)	81 (49)	38 (27)	27 (11)	29 (19)	217 (137)
2	20 (20)	80 (50)	25 (20)	31 (24)	25 (18)	181 (132)
3	15 (11)	124 (72)	28 (18)	23 (12)	28 (22)	218 (135)
4	50 (36)	139 (93)	18 (14)	16 (12)	36 (26)	259 (181)
5	16 (11)	83 (45)	9 (6)	31 (19)	60 (47)	199 (128)
Total	143 (109)	507 (309)	118 (85)	128 (78)	178 (132)	1,074 (713)
Mean	29 (22)	101 (62)	24 (17)	26 (16)	36 (26)	215 (143)
1983[b]						
1	74 (48)	153 (62)	125 (83)	102 (52)	65 (30)	519 (275)
2	56 (38)	84 (40)	231 (142)	76 (38)	51 (33)	498 (291)
Total	130 (86)	237 (102)	356 (225)	178 (90)	116 (63)	1,017 (566)
Mean	65 (43)	18 (51)	178 (112)	89 (45)	58 (32)	508 (283)

[a] Sablefish measuring 52 cm or greater in fork length.
[b] Total number of sablefish captured in both trap types.

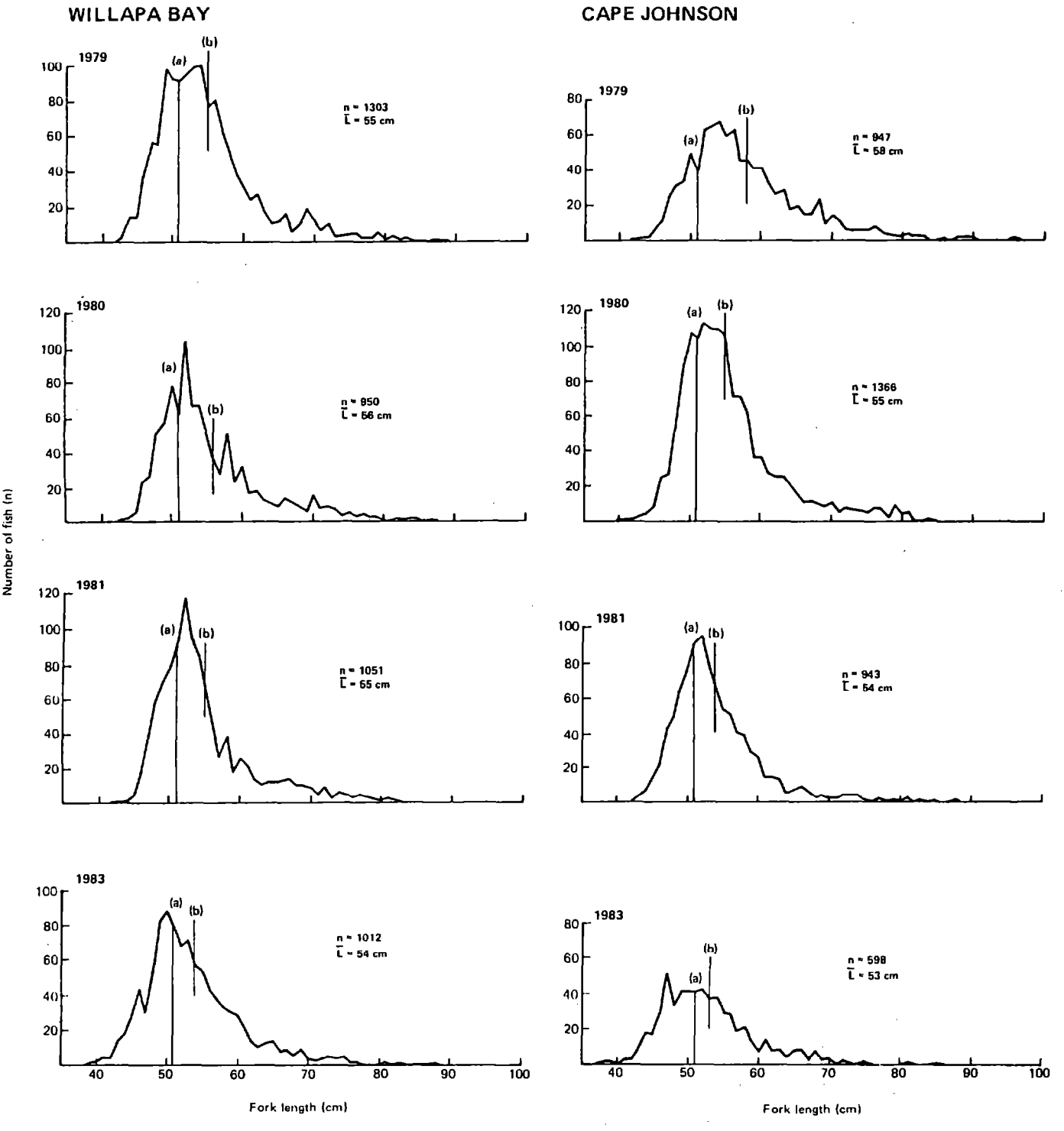

Figure 4.--Length composition of sablefish captured at the Willapa Bay and Cape Johnson,. Washington, sites during the 1979-81 and 1983 index surveys. Vertical line (a) is the division between submarketable-size and marketable-size sablefish, and vertical line (b) is the mean length.

The sablefish catch at the Willapa Bay site off the southern Washington coast increased sharply in 1983 from 1981 levels (Table 2). Catches were up at all depth intervals with the largest increase occurring at 300 fathoms (Table 6). The increase was highest for submarketable sizes. The percentage of submarketable size increased by 10% to 44% in 1983, whereas the percentage abundance of small and large sablefish decreased (Table 4). The length composition and mean length of sablefish captured at the Willapa Bay sites are shown in Figure 4.

Total sablefish catches at Cape Johnson in 1983 were up slightly from 1981 (Table 2). Catches increased at the 225 and 300 fathom depth intervals from 1981 levels; however, catches were lower at the remaining depth intervals (Table 7). The increases were primarily in the submarketable size sablefish (Table 2). The percentage abundance of submarketables was 48%, the highest of any sites, and up substantially from previous years (Table 4). The increase in submarketables also shows up in the length composition (Fig. 4) and the mean length has continued to decrease in each survey year from 58 cm in 1979 to only 53 cm in 1983.

The catch data for all Oregon and Washington sites combined indicate that sablefish abundance dropped nearly 50% between baseline year 1979 and 1981 surveys (Table 2). Catches increased greatly in 1983 from 1981 levels (up 119%) approaching the catches made in 1979. Using the figures for doubling the rectangular trap catches shows a 7% decline from 1979 levels. Catches of marketable-sized sablefish, after dropping 55% between 1979 and 1981, also increased substantially in 1983. They remained, however, at levels 30% below 1979 catches. Catches of submarketable-size sablefish showed a different pattern. Their abundance, according to survey catch rates, was up very sharply between 1981 and 1983 and also showed an increase of 68% in 1983 over 1979 levels.

Table 7.--Total numbers of sablefish and marketable-size sablefish[a] (in parentheses) captured by depth and set at the Cape Johnson, Washington, site during the 1979-81 and 1983 abundance index surveys. Each catch was obtained from one string of 10 sablefish traps fished for 24 hours.

Area, year and set	Depth (fathom/meter) 150/275	225/412	300/550	375/686	450/824	Total catch
	Number of fish					
Cape Johnson						
1979						
1	30 (22)	30 (23)	24 (21)	79 (51)	72 (59)	235 (176)
2	20 (14)	9 (6)	18 (17)	47 (38)	75 (64)	169 (139)
3	11 (10)	15 (12)	27 (22)	31 (23)	68 (63)	152 (130)
4	27 (22)	10 (7)	16 (14)	28 (20)	93 (76)	174 (139)
5	74 (54)	24 (24)	26 (22)	35 (26)	63 (50)	222 (176)
Total	162 (122)	88 (72)	111 (96)	220 (158)	371 (312)	952 (760)
Mean	32 (24)	18 (14)	22 (19)	44 (32)	74 (62)	190 (152)
1980						
1	7 (6)	69 (52)	54 (33)	45 (24)	58 (52)	233 (167)
2	6 (6)	47 (39)	46 (30)	20 (13)	46 (37)	165 (125)
3	22 (21)	72 (58)	67 (40)	65 (38)	81 (59)	307 (216)
4	15 (11)	99 (86)	52 (33)	34 (25)	77 (50)	277 (205)
5	23 (15)	71 (52)	119 (58)	80 (42)	95 (64)	388 (231)
Total	73 (59)	358 (287)	338 (194)	244 (142)	357 (262)	1,370 (944)
Mean	15 (12)	72 (57)	68 (39)	49 (28)	71 (52)	274 (189)
1981						
1	15 (13)	66 (46)	15 (7)	68 (32)	47 (33)	211 (131)
2	4 (3)	77 (50)	33 (20)	58 (26)	108 (61)	280 (160)
3	6 (6)	33 (18)	10 (5)	51 (29)	45 (35)	145 (93)
4	25 (22)	21 (15)	29 (23)	39 (14)	43 (24)	157 (98)
5	12 (9)	14 (8)	27 (23)	28 (16)	76 (46)	157 (102)
Total	62 (53)	211 (137)	114 (78)	244 (117)	319 (199)	950 (584)
Mean	12 (11)	42 (27)	23 (16)	49 (23)	64 (40)	190 (117)
1983[b]						
1	1 (1)	103 (43)	176 (102)	25 (11)	21 (11)	326 (168)
2	4 (1)	127 (64)	78 (45)	42 (20)	21 (13)	272 (143)
Total	5 (2)	230 (107)	254 (147)	67 (31)	42 (24)	598 (311)
Mean	2 (1)	115 (54)	127 (74)	34 (16)	21 (14)	299 (156)

[a] Sablefish measurig 52 cm or greater in fork length.
[b] Total number of sablefish captured in both trap types.

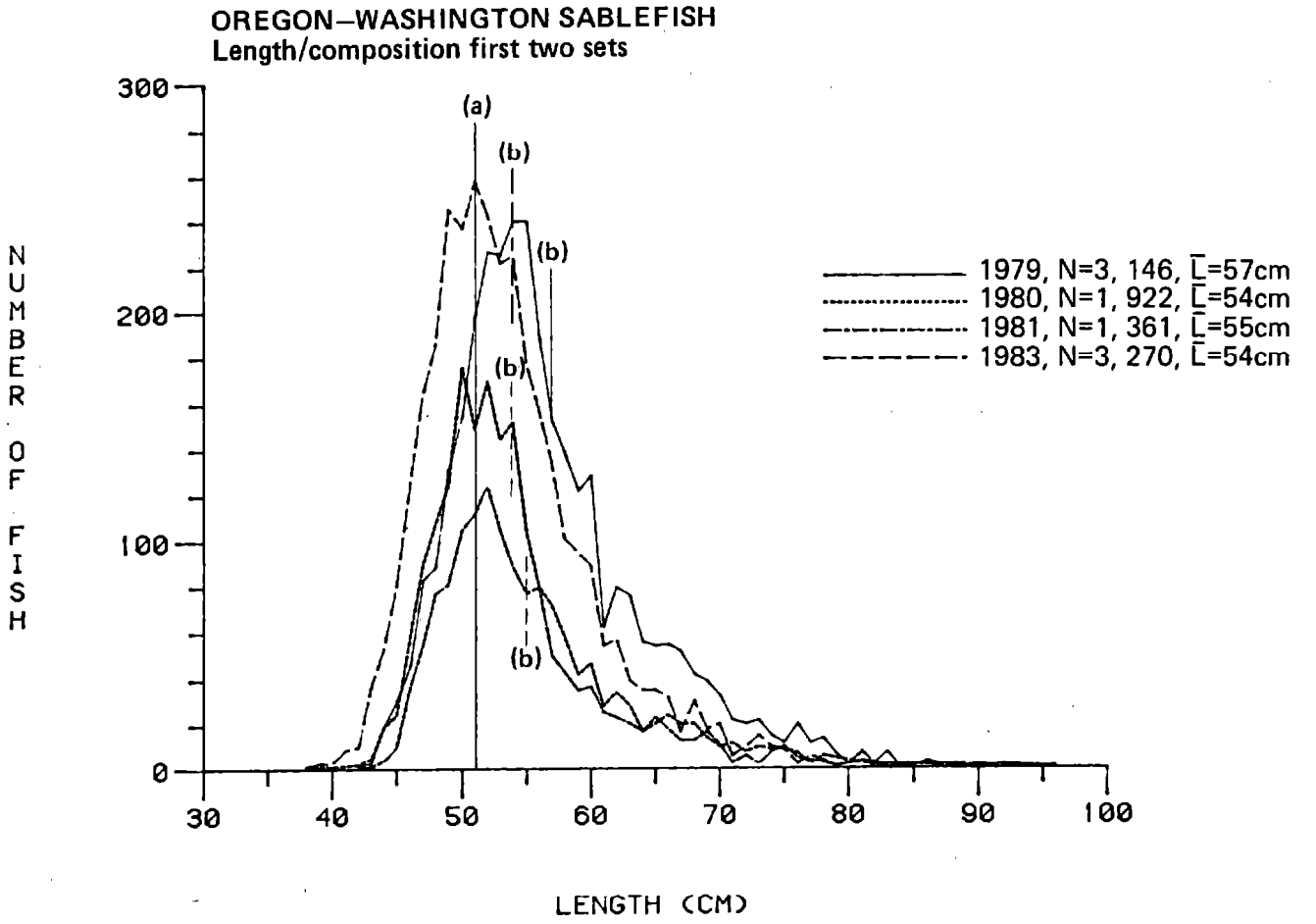

Figure 5.--Combined length composition of sablefish captured in the first two sets at all sites of Oregon and Washington during the 1979-81 and 1983 index surveys. vertical line (a) is the division between submarketable-size and marketable-size sablefish, and vertical lines (b) are the mean lengths.

In looking at the combined length composition of all sablefish captured in the first two sets of all sites off Oregon and Washington during the 1979-81 and 1983 index surveys (Fig. 5), several changes are apparent. There has been a definite reduction in the proportion of sablefish over 55 cm taken since the 1979 survey. At the same time, the proportion of submarketable-size sablefish (51 cm or less) captured in surveys since 1979 has increased, especially in the 1983 survey. The mean length of sablefish has dropped from 57 cm in 1979 to 54 cm in 1983. This size group of small sablefish (41-51 cm) evident in 1983 corresponds primarily with age 3 (Pruter 1954). A sharp increase in similar size sablefish was reported by Sasaki (1984) for the Chirikof, Kodiak, and Yakutat areas of the Gulf of Alaska in his 1983 Japan-U.S. joint longline survey by the Anyo Maru No. 21. NMFS Auke Bay Laboratory also reported an increase in the number of prerecruit sablefish (<57 cm in fork length) caught in each trap at three of four survey sites in 1983 off southeastern Alaska (Auke Bay Laboratory 1983). The abundance of these small sablefish indicates that the 1980 year class may be a strong year with a relatively high abundance along the coast of Oregon and Washington and throughout the Gulf of Alaska.

SUMMARY AND CONCLUSIONS

Survey catch rates suggest that sablefish abundance off Oregon and Washington, which had been decreasing between 1979 and 1981, rebounded sharply between the 1981 and 1983 surveys. The 1983 catches, although nearly equal in numbers to baseline year 1979 levels, were composed of a much higher percentage of submarketable-sized sablefish (44%) and a lower average percentage of medium and large sablefish (7 and 4%, respectively) than in any of the previous surveys (Table 4). Highest catch rates in 1983 occurred at the Willapa Bay

site, followed by Cape Lookout, Cape Arago, and Cape Johnson. The 300 fathom depth interval produced the highest catches for all sites combined, followed by the 225 and 375 fathom depth intervals.

Apparently fishing and natural mortality have reduced the numbers of larger sablefish off Oregon and Washington since 1979, while at the same time recruitment of primarily 3-year-old sablefish into the fishery, from a strong 1980 year class, has greatly increased the proportion of smaller size sablefish. Survey results tend to be consistent with observations by some fishermen who operated in the same area. Some longline fishermen reported that sablefish catches in the fall of 1983 off northern Washington were greatly improved over those in recent years. Trap fishermen from both Oregon and Washington have reported larger percentages of smaller size sablefish being taken in late 1983 and early 1984 than in the previous 2 years.

Future plans include surveying the expanded number of sablefish abundance indexing sites off Oregon and Washington (the Vancouver and Columbia statistical areas of the International North Pacific Fisheries Commission (INPFC)), and increasing the numbers of sites off California (the Eureka, Monterey, and Conception INPFC areas) from two to nine. Plans are for these areas to be surveyed during alternate years. Additional catch comparison studies between conical and rectangular trap types will be conducted during the next survey to determine whether catches are significantly different between the two trap types and to establish a conversion factor if they are. We will continue to make two sets at each abundance index site rather than five as before. Survey results will be compared with commercial CPUE data or other indices of abundance as these become available to assess the performance of the survey design.

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