Northwest Atlantic Fisheries Organization

Serial No. N2362 NAFO SCR Doc. 94/6

SCIENTIFIC COUNCIL MEETING - JUNE 1994

Redfish Subarea 1 (0-400 m): Stock Abundance Indices, Species and Length Composition, 1982-93

by

Hans-Joachim Rätz

institute for Sea Fisheries, Hamburg Branch Office Bremerhaven
Fischkai 35, FRG 27572 Bremerhaven

Abstract

Survey indices indicate that exploitable stocks of golden (*Sebastes marinus*,>=16cm) and beaked redfish (*Sebastes mentella*,>=16cm) decreased dramatically during the period 1982-93, and are practically no longer existent. Juveniles (<16cm) assessed separately from recruits and adults (>=16 cm) were very abundant and dominated aggregate redfish abundance since 1986 (88%). Although juveniles were very abundant, recruitment of the redfish stocks failed recently.

Length distributions indicate significant year and species effects. Golden redfish were generally bigger as compared to beaked redfish and recent length structure is formed by relatively small specimens. In 1993, mean length amounted to 28cm and 27cm, respectively. No clear growth indications of strong recruiting cohorts were found in length frequencies of golden and beaked redfish between successive years. Contrarily, distinct peaks in length distributions of juvenile redfish around 6cm, 10cm and 15cm might correspond to age groups 0, 1 and 2 years.

Introduction

Since 1982, the demersal fish assemblage off West Greenland has been monitored annually by German groundfish surveys. Former assessments of the redfish resource off West Greenland based on results of these surveys (Messtorff and Cornus, 1989; Rätz, 1991; Cornus , 1992) have been carried out separately for golden and beaked redfish disregarding or incorporating the O-group and juveniles (<16cm). When small redfish were identified to species level, they were usually classified according to the predominant adult species of the catch due to time-consuming and difficult methods (Magnusson, 1981; Barsukov et al., 1992). Biomass estimates are insignificantly affected by inclusion or exclusion of juvenile specimens due to very low individual weights. Small redfish, however, occurred occasionally in very high numbers resulting in important changes of abundance estimates. Survey data have been corrected retrospectively and this paper presents reassessed abundance and biomass indices, length

structure and geographic distribution patterns for golden redfish (*Sebastes marinus* ,>=16cm), beaked redfish (*Sebastes mentella*, >=16cm) and juvenile redfish (*Sebastes spp.*, <16cm), 1982-93.

Materials and Methods

Analyses are based on data derived from annual groundfish surveys established in 1982. The stratified-random surveys covered the shelf area and continental slope off West Greenland (NAFO Div. 1B-1F, south of 67°N) outside the 3-mile limit to the 400m isobath. Because of favourable weather and ice conditions and to avoid spawning concentrations, the autumn season was chosen for the survey.

Figure 1 shows the area of investigation and the geographic stratification. 4 geographic strata were subdivided into 2 depth strata covering the 0-200m and 201-400m zones, respectively. Thus, this stratification scheme produces 8 strata. Table 1 specifies names of strata, boundaries, depth zones and stratum areas.

The standard gear used was the 140-feet bottom trawl rigged with a heavy ground gear and equipped with a small mesh liner inside the cod end. Standard towing required 30 minutes and 4.5 knots were aimed as the towing speed. In case of net damage or hangup before 15 minutes towing time, the haul was rejected from evaluation. In 1987 and 1988, some hauls were not excluded although their towing time was intentionally reduced to 10 minutes due to large catches being expected from traces of the echo sounder.

The surveys were primarily designed for the assessment of cod (*Gadus morhua*). The applied strategy was to allocate sampling effort proportionally to cod abundance and to area of the strata. Hauls were randomly distributed within trawlable areas of the strata. During 1982-93, 1,190 successful sets were carried out. Numbers of valid hauls per stratum are listed in Table 2. The main feature of effort distribution shown in Table 2 is the high number of tows allocated in shallow strata 1.1, 2.1, 3.1 and 4.1 (0-200m). The strata 1.2, 2.2, 3.2 and 4.2 (201-400m) are distinguished by lower numbers of hauls, especially the southern strata 3.2 and 4.2 which are characterized by extremely rough trawling grounds. Since 1992, the effort has been reduced significantly (50%) due to technical reasons and a combination of West and East Greenland surveys.

Fishes were identified to species or lowest taxonomic level and catch number and weight was recorded. Redfish >=16 cm were separated to golden (*Sebastes marinus*) or beaked redfish (*Sebastes mentella*), whereas redfish <16 cm were classified as *Sebastes spp*. Total length measurements were determined to the centimeter below.

Stratified abundance and biomass estimates were calculated using the "swept area" method (Cochran, 1953; Saville, 1977). Coefficient of catchability was set arbitrarily to 1.0 for all species. Consequently, estimates can be considered only as trawlable abundance and biomass defined as indices of total stock abundance and biomass (relative). Trawl parameters are listed in Table 3. Confidence intervals are given at the 95% level of significance in per cent of the stratified mean. Strata including less than 5 hauls were excluded from calculation of stratified mean abundance and biomass. The variation in survey area arising therefrom is negligible as the haul distribution was fairly consistent over the total time series. Before summing up, length distributions were standardized, pooled by stratum and weighted by stratum abundance.

Length distributions of golden and beaked redfish (>=16cm) were analysed for

year and species effects between mean length by means of ANOVA (CSS Statistical Software, Inc.).

Results

Figure 2 and 3 show the aggregate redfish abundance and biomass indices for golden, beaked and juvenile redfish (<16cm), 1982-93. Since 1986, unspecified juvenile redfish dominated the total redfish abundance (88%). There are two pronounced peaks in 1986 and 1991. Due to small individual size, biomass estimates of juvenile redfish <16cm are low. During 1982-93, golden redfish dominated aggregate biomass estimates by 81%. Beaked redfish contributed minor parts to the aggregate redfish abundance and biomass, 4% and 8% respectively.

Table 4 lists abundance and biomass indices for golden redfish by stratum and total, 1982-93. In 1982, only one big catch taken in stratum 2.1 causes the outstanding maximum abundance and biomass of 132 million inidividuals and 56,000t and the corresponding high confidence intervals. During 1983-88, both indices varied among 13 million and 45 million and 6,000t and 20,000t, respectively. The following period is characterized by continuous losses to record lows in 1993 amounting to 1 million individuals and 383t. No distinct geographic distribution pattern seems evident. Golden redfish disappeared from all strata. Figures 4, 5 and 6 illustrate the length distributions for golden redfish, 1982-93. Table 7 lists the corresponding mean lengths and standard deviations. Until 1991, length frequencies are approximately normal distributed and show pronounced peaks at 30-33cm. Variations in mean length are mainly caused by recruiting year classes. The peaks below 20cm formed by strong cohorts can be hardly identified over successive years. Length groups around 20cm show relatively low frequencies during this time series. Contrarily, distributions in 1992 and 1993 are scattered due to the low numbers of specimens caught and mean length is reduced to 29cm and 28cm, respectively. ANOVA results are listed in Table 8 and reveal significant year and species effects as compared with the generally smaller-sized beaked redfish.

Survey abundance and biomass indices for beaked redfish by stratum and year are listed in Table 5. Total estimates vary among 157,000 and 15 million individuals and 4,000t and 29t and are accompanied with high confidence intervals exceeding 100%. There is no clear trend but the estimates of recent years (1992, 1993) are the lowest on record. In contrast to the golden redfish, beaked redfish has a distinct distribution pattern, i. e. to be mainly distributed in deeper strata. Figures 7, 8 and 9 illustrate the length frequencies of beaked redfish, 1982-93.

The range, shape and peaks of these frequencies change significantly between successive years and no clear indications of the growth of strong year classes are derivable. Corresponding mean lengths and standard deviations are listed in Table 7. Mean length of beaked redfish shows a high variation and decreased from 30cm in 1982-83 to 20cm in 1986-87 and increased again to 26cm in 1993. Length distributions in 1992-93 are scattered due to few specimens in the catch. ANOVA results indicate significant differences in mean lengths between years and as compared with golden redfish (Tab. 8).

Both survey abundance and biomass of juvenile and unspecified redfish <16cm varied enourmously within and between years (Tab. 6). They are mainly distributed in northern areas and tend to spread over the total survey area in recent years. During 1986-87 and 1991-92, juvenile redfish were extremely abundant. Length frequencies are illustrated in Figures 10, 11 and 12. Comparing the 1982-93 frequencies, distinct peaks around 6cm, 10cm and 15cm seem to appear regularly.

Discussion

Redfish in Subarea 1 was an important resource. Maximum nominal catches amounted to 61,000t in 1962, decreasing to a low level of 3,000t in the early decade of the 70-ies. There are indications that the catch of 31,000t in 1977 was overestimated and until 1983, annual catches about 8,000t have been reported. Catches continued to decline to less than 500t in recent years. Reported catches are believed to be incomplete and to reflect inshore landings only and important by-catches taken by the shrimp fishery to be disregarded. However, the shrimp fishery expanded its geographic distribution to southern Divisions (Carlsson and Kanneworff, 1993) which might worsen the situation extremely.

During the period 1982-93, survey indices confirmed the depletion of this resource (Tab. 4, 5 and 6). Figure 2 and 3 indicate that exploitable stocks of golden (*Sebastes marinus*,>=16cm) and beaked redfish (*Sebastes mentella*,>=16cm) decreased dramatically and are practically no longer existent within the areas surveyed (south of 67°N, 0-400m). The recent decline and depleted status of stocks of golden and beaked redfish is also reflected by groundfish surveys for Greenland halibut covering deeper areas (Jorgensen and Akimoto, 1990 and 1991; Yano and Jorgensen, 1992; Satani et al., 1993) and by-catches during shrimp surveys (Pedersen and Kanneworff, 1991 and 1992; Bech, 1993).

Presented stock abundance indices, species distribution and length composition are affected by incomplete coverage of the distribution area. This applies to geographic and depth stratification of groundfish surveys as well as pelagic and inshore occurrence of redfish. Atkinson (1987) reported on concentrations of redfish in depth zones >400m. Abundance of commercial-sized redfish north of 67°N is considered as poor (Pedersen and Nygård, 1992). High confidence intervals (>100%) determined for unspecified juveniles (<16cm) and beaked redfish and completely different length structures between successive years for beaked redfish point to this problem. Different procedures for species identification of juvenile redfish and their consideration in abundance estimates imply limited comparability with survey results published earlier.

Juveniles (<16cm) assessed separately from recruits and adults (>=16 cm) were very abundant and dominated aggregate redfish abundance since 1986 (88%) as derived from the surveys. Golden redfish formed the most important part of aggregate biomass (81%) but contributions of beaked redfish were minor (4% abundance, 8% biomass, Fig. 2 and 3). Beaked redfish were most abundant in deeper strata and unspecified juveniles were mainly distributed in northern strata distinguishing these areas as nursery grounds (Rätz, 1991). The tendency to spread over the total survey area in recent years seems evident.

Length distributions indicate significant year and species effects. Golden redfish were generally bigger as compared to beaked redfish and recent length structure is formed by relatively small specimens. In 1993, mean lengths amounted to 28cm and 27cm, respectively. Clear growth indications of strong recruiting cohorts were hardly derivable from length frequencies of golden and beaked redfish between successive years. Contrarily, there are distinct peaks in length distributions for juvenile redfish around 6cm, 10cm and 15cm which might correspond to age groups 0, 1 and 2 years as smallest individuals were still silvery coloured. Similar peaks have been determined regularly by Greenland surveys.

Although juveniles were very abundant, recruitment of the redfish stocks failed recently. The origin of these juvenile redfish is probably located off East Greenland and Iceland and their future development is still unknown. The pelagic distribution of 0-group redfish along several transects is described by Wieland (1992). Biological relationships (larval drift and migration) between West

Greenland and Irminger Sea redfish stocks off East Greenland have been already discussed by joint NAFO/ICES Study Groups (Anon. 1983, 1984).

References

Anon. 1983. Report on the Joint NAFO/ICES Study Group on Biological Relationships of the West Greenland and Irminger Sea Redfish Stocks. ICES C. M., G:3:1-11

Anon. 1984. Report on the Joint NAFO/ICES Study Group on Biological Relationships of the West Greenland and Irminger Sea Redfish Stocks. ICES C. M., G:3:1-3

Atkinson, D. B. 1987. The Distribution and Abundance of Redfish (Sebastes marinus and S. mentella) in Davis Strait (Nafo Subarea 0+1). NAFO SCR Doc. 87/38, Ser. No. N1323:1-11

Barsukov, V. B., N.I. Litvinenko and V. P. Serebryakov 1992. Identification of Redfishes (Sebastes, Scorpaenidae) in the North Atlantic (Some Recommendations). NAFO SCR Doc. 92/42, Ser.No. N2093:1-17

Bech, G. 1993. Survey Biomass and Abundance of Greenland Halibut (Reinhardtius hippoglossoides) and Redfish (Sebastes spp.) in Greenland Trawl Survey 1992 (NAFO Subarea 1). NAFO SCR Doc. 93/52, SSer. No. N2235:1-8

Carlsson, D. M. and P. Kanneworff 1993. The Shrimp Fishery in NAFO Subarea 1 in 1992. NAFO SCR Doc. 93/64, Ser. No. N2248: 1-32

Cochran, W. G. 1953. Sampling techniques. John Wiley & Sons Inc., New York:1-330

Cornus, H.-P. 1992. 1991 Assessment of Redfishes (Sebastes marinus and Sebastes mentella) in NAFO Subarea 1. NAFO SCR Doc. 92/30, Ser. No. N2077:1-14

Jorgensen, O. and K. Akimoto 1990. Results of a Random Bottom Trawl Survey in NAFO Subarea 1 in 1989. NAFO SCR Doc. 90/39, Ser. No. N1756: 1-14

Jorgensen, O. and K. Akimoto 1991. Results of two Trawl Surveys in NAFO Subarea 1 in 1990. NAFO SCR Doc. 91/50, Ser. No. N1933: 1-14

Magnusson, J. V. 1981. Identification of Sebastes marinus, S. mentella and S. viviparus in O-group redfish. Rapp. P.-V. Reun. Cons. Int. Explor. Mer, 178:571-574

Messtorff, J. and H.-P. Cornus 1989. Survey Biomass and Abundance Estimates for Redfish (Sebastes marinus and S. mentella) off West Greenland (NAFO Subarea 1), 1982-88, and off East Greenland (ICES Div. XIVb), 1980-88. NAFO SCR Doc. 89/51, Ser. No. N1630: 1-12

Pedersen, S. A. and K. H. Nygård 1992. Survey Biomass of Fishes in the Disko Bay Area West Greenland-September 1991. NAFO SCR Doc. 92/43, Ser. No. N2094:1-9

Pedersen, S. A. and P. Kanneworff 1991. Survey Biomass of Redfish (Sebastes spp.) off West Greenland (NAFO Subareas 0+1), July-August 1988, 1989 and 1990. NAFO SCR Doc. 91/46, Ser. No. N1929:1-11

Pedersen, S. A. and P. Kanneworff 1992. Survey Biomass of Redfish (Sebastes spp.) off West Greenland (NAFO Subareas 0+1), July-August 1988-91. NAFO SCR Doc. 92/44, Ser. No. N2095:1-12

Rätz, H.-J. 1991. NAFO Subarea 1 Golden and Beaked Redfish: Spatial Distribution Pattern, Survey Abundance and Biomass Estimates in 1982-90 and Length Frequency in 1990. NAFO SCR Doc. 91/73, Ser. No. N1957:1-11

Rätz, H.-J. 1993. Redfish Subarea 1 (0-400m): Present Stock Abundance Indices, Species and Length Composition. NAFO SCR Doc. 93/89, Ser. No. N2275:1-10

Saville, A. 1977. Survey methods of apprising fishery resources. FAO Fish. Tech. Pap. 171: 1-76

Satani, M., S. Kawahara and O. Jorgensen 1993. Results of Two Stratified Random Trawl Surveys off West Greenland in 1992. NAFO SCR Doc., Ser. No. N2241:1-12

Wieland, K. 1992. Distribution of O-group Redfish (Sebastes spp.) off West Greenland in Autumn 1991. NAFO SCR Doc. 92/32, N2079:1-9

Yano, K. and O. Jorgensen 1992. Results of two Stratified Random Trawl Suveys at West Greenland in 1991. NAFO SCR Doc. 92/48, Ser. No. N2100:1-21

Table 1 Specification of Strata.

stratum	geographic boundaries				depth	area
	south	north	east	west	(m)	(nm^2)
1.1	64°15'N	67°00'N	50°00'W	57°00'W	1-200	6,805
1.2	64°15'N	67°00'N	50°00'W	57°00'W	201-400	1,881
2.1	62°30'N	64°15'N	50°00'W	55°00'W	1-200	2,350
2.2	62°30'N	64°15'N	50°00'W	55°00'W	201-400	1,018
3.1	60°45'N	62°30'N	48°00'W	53°00'W	1-200	1,938
3.2	60°45'N	62°30'N	48°00'W	53°00'W	201-400	742
4.1	59°00'N	60°45'N	44°00'W	50°00'W	1-200	2,568
4.2	59°00'N	60°45'N	44°00'W	50°00'W	201-400	971
sum						18,273

Table 2 Number of valid hauls by stratum, 1982-93.

stratum	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	sum
year									
1982	20	11	16	7	9	6	13	2	84
1983	26	11	25	11	17	5	18	4	117
1984	25	13	26	8	18	6	21	4	121
1985	10	8	26	10	17	5	21	4	101
1986	27	9	21	9	16	7	18	3	110
1987	25	11	21	4	18	3	21	3	106
1988	34	21	28	5	18	5	18	2	131
1989	26	14	30	9	8	3	25	3	118
1990	19	7	23	8	16	3	21	6	103
1991	19	11	23	7	12	6	14	5	97
1992	6	6	6	5	6	6	7	5	47
1993	9	6	9	6	10	8	7	0	55
sum	246	128	254	89	165	63	204	41	1,190

Table 3 Trawl parameters of the survey.

Gear	140-feet bottom trawl
Horizontal net opening	22 m
Standard trawling speed	4.5 kn
Towing time	30 minutes
Coefficient of catchability	1.0

Table 4 Survey abundance (* 1,000) and biomass (t) indices for golden redfish (*Sebastes marinus*, >=16 cm) by stratum and total, 1982-1993. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean.

ABUNDANCE

Stratum Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	Total	CI
1982	7,015	6,340	88,791	5,511	5,736	14,875	4,087	0	132,356	111.1
1983	4,024	3,185	3,355	6,523	4,043	5,885	1,697	0	28,714	35.0
1984	1,323	3,437	459	1,209	10,671	2,776	4,213	0	24,091	38.9
1985	4,658	10,450	6,157	1,569	3,220	14,441	4,973	0	45,470	44.5
1986	6,327	4,324	2,076	3,482	21,503	2,883	2,716	0	43,314	43.2
1987	906	652	1,327	0	9,611	0	658	0	13,156	57.1
1988	830	2,238	342	2,254	5,937	1,954	731	0	14,289	40.4
1989	421	422	776	689	6,489	0	360	0	9,160	61.9
1990	120	432	278	709	1,037	0	146	2,270	4,995	34.4
1991	227	255	95	691	235	527	20	1,671	3,724	61.0
1992	125	105	73	190	193	476	192	835	2,192	43.1
1993	169	481	58	266	79	131	0	0	1,187	53.1

Tab. 4 cont'd BIOMASS

Stratum Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	Total	CI
1982	1,797	1,353	34,440	2,557	3,205	9,794	2,532	0	55,681	100.2
1983	845	944	1,572	3,042	1,873	4,815	1,084	0	14,178	37.3
1984	308	893	196	518	4,934	2,284	2,088	0	11,225	46.9
1985	1,020	1,818	2,968	472	1,426	9,209	2,718	0	19,634	58.4
1986	1,282	1,215	751	1,229	10,122	1,704	1,762	0	18,068	46.4
1987	254	246	659	0	4,953	0	438	0	6,552	62.6
1988	145	403	118	942	2,570	1,341	382	0	5,902	41.1
1989	182	137	271	249	2,619	0	208	0	3,669	63.5
1990	38	149	74	274	478	0	78	1,342	2,437	46.2
1991	43	83	24	225	119	272	3	1,006	1,778	74.3
1992	18	34	20	60	53	241	70	447	946	48.9
1993	45	111	18	113	39	55	0	0	383	47.2

Table 5 Survey abundance (* 1,000) and biomass (t) indices for beaked redfish (*Sebastes mentella* ,>=16 cm) by stratum and total, 1982-1993. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean.

ABUNDANCE

Stratum Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	Total	CI
1982	0	390	16	348	0	2,359	0	0	3,115	105.1
1983	39	1,011	70	2,527	0	5,235	0	0	8,884	66.3
1984	40	2,966	6	1275	0	1,115	0	0	5,405	82.4
1985	0	369	30	26	55	327	0	0	809	115.3
1986	2,140	414	37	292	4	444	0	0	3,333	76.3
1987	987	13,678	41	0	56	0	0	0	14,764	78.9
1988	149	3,187	25	776	60	4,619	0	0	8,818	79.0
1989	0	186	8	101	0	0	7	0	303	59.1
1990	0	10	3	704	50	0	0	3,881	4,648	112.1
1991	0	0	0	0	0	652	0	1,772	2,424	106.4
1992	0	34	0	15	0	106	0	0	157	94.2
1993	0	23	0	158	7	0	0	0	190	159.6

Tab. 5 cont'd (BIOMASS)

Stratum Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	Total	CI
1982	0	95	6	114	0	892	0	0	1,109.2	116.4
1983	16	213	26	1,158	0	2,856	0	0	4,270.4	77.4
1984	6	798	4	490	0	472	0	0	1,770.7	88.7
1985	0	96	14	11	26	110	0	0	259.5	108.3
1986	223	38	20	110	3	179	0	0	573.8	64.6
1987	83	1,183	8	0	31	0	0	0	1,306.5	62.4
1988	20	425	21	159	44	1,877	0	0	2,549.1	92.4
1989	0	22	7	15	0	0	0	0	45.7	49.8
1990	0	5	1	86	7	0	0	541	643.2	109.4
1991	0	0	0	0	0	152	0	444	597.5	103.7
1992	0	2	0	1	0	28	0	0	32.9	105.4
1993	0	4	0	22	1	0	0	0	29.2	129.8

Table 6 Survey abundance (* 1,000) and biomass (t) indices for juvenile redfish (*Sebastes spp.*, <=15cm) by stratum and total, 1982-1993. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean.

ABUNDANCE

Stratum Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	Total	CI
1982	1,056	358	120	27	7	41	22	0	1,635	51.3
1983	3,955	505	14	138	8	16	21	0	4,659	74.3
1984	5,020	3,713	20	218	140	27	13	0	9,154	73.5
1985	4,888	9,614	54	2,711	46	66	54	0	17,437	76.6
1986	10,740	237,636	113	1,811	54	218	37	0	250,610	182.0
1987	12,455	113,989	4	0	20	0	18	0	126,487	120.3
1988	19,678	42,480	0	106	20	138	0	0	62,424	50.4
1989	7,716	13,160	3,071	5,370	18	0	69	0	29,406	44.5
1990	11,256	35,932	15,416	1,537	72	0	6,199	847	71,262	65.1
1991	51,938	59,845	34,870	22,667	13,692	2,507	892	1540	187,954	34.9
1992	25,714	19,083	12,690	17,276	17,462	13,973	41	13,717	119,960	54.2
1993	5,459	39,035	664	11,331	355	2,772	13	0	59,632	66.2

Tab. 6 cont'd (BIOMASS)

Stratum Year	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	Total	CI
1982	37	13	6	1	0	1	0	0	60	46.5
1983	103	20	0	6	0	0	0	0	133	66.7
1984	91	104	0	4	5	0	0	0	208	80.9
1985	82	367	1	57	2	2	1	0	515	102.7
1986	453	6,644	3	77	1	5	0	0	7,186	178.2
1987	264	5,021	0	0	0	0	0	0	5,286	128.8
1988	217	1,491	0	3	0	5	0	0	1,717	64.0
1989	110	270	22	48	0	0	0	0	453	39.9
1990	99	368	63	19	0	0	9	2	562	43.0
1991	198	796	73	242	28	23	2	14	1,379	44.0
1992	151	384	48	111	73	220	0	64	1,056	55.2
1993	71	512	17	264	5	76	1	0	950	75.0

Table 7 Mean length (ml) and standard deviations (sd) for golden redfish (*Sebastes marinus*) and beaked redfish (*Sebastes mentella*), 1982-93.

Year	golden redfish		beaked redfish	
	ml (cm)	sd (cm)	ml (cm)	sd (cm)
1982	31.59	5.08	30.64	3.94
1983	30.40	7.41	30.22	3.88
1984	30.88	6.65	28.72	5.13
1985	29.41	7.59	27.61	5.54
1986	28.84	6.31	21.89	6.71
1987	31.49	4.94	18.44	2.50
1988	29.68	6.78	26.51	6.26
1989	30.24	4.65	22.22	5.46
1990	30.81	6.72	22.02	1.62
1991	30.13	6.93	24.57	1.93
1992	29.04	6.01	24.16	5.18
1992	28.19	7.32	26.66	4.89

Table 8 Summary of statistical diagnostics for general ANOVA analysis for golden redfish (*Sebastes marinus*, >=16cm) and beaked redfish (*Sebastes mentella*, >=16cm) length distributions, 1982-93. Corresponding mean lengths and standard deviations are listed in Table 7.

Effect	df effect	MS effect	F	p-level
Species	1	162812.3	4667.272	0.00
Year	11	63143.5	1810.109	0.00
Both	11	70075.8	2008.835	0.00

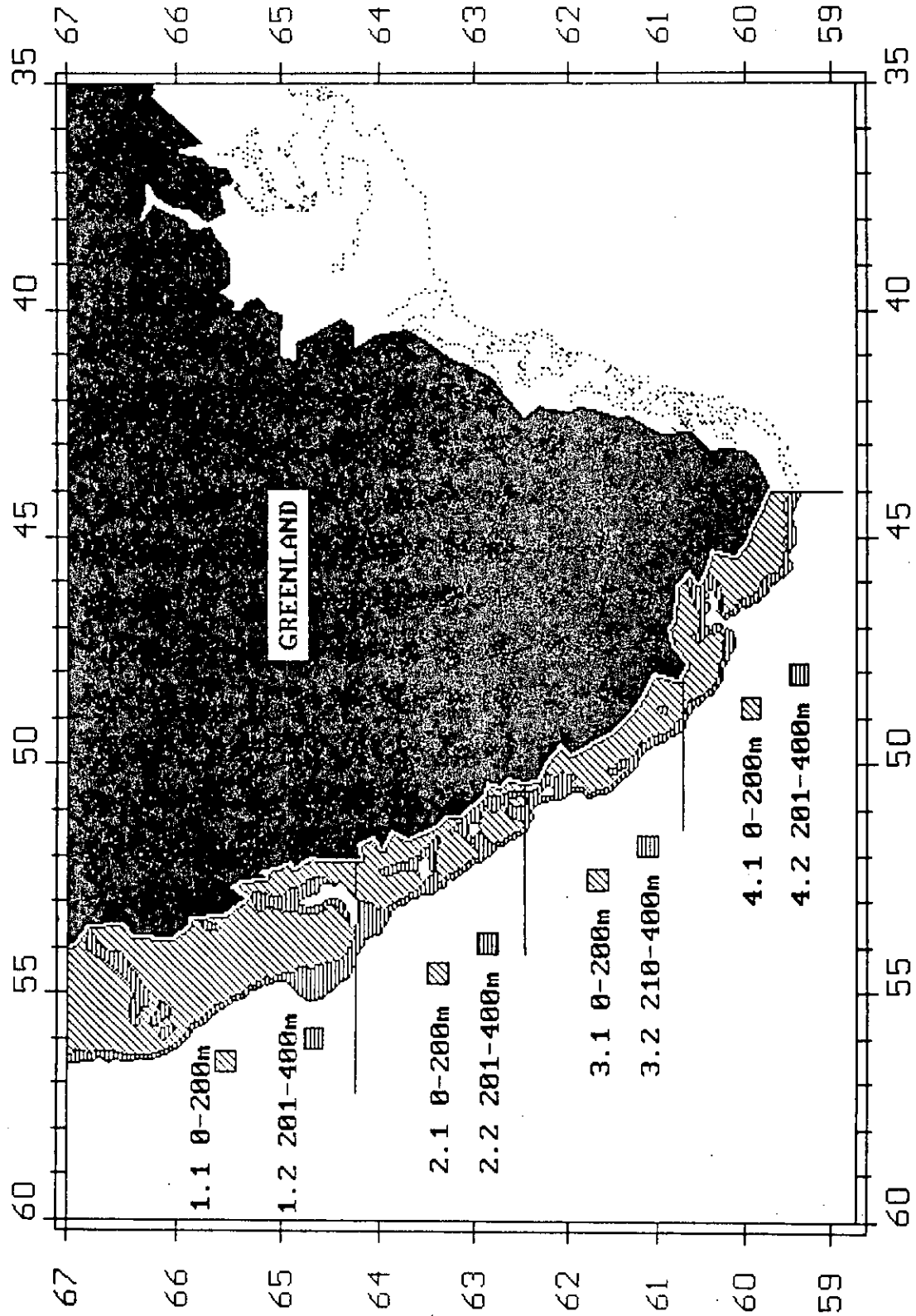

Fig. 1 Survey area and stratification scheme as specified in Table 1.

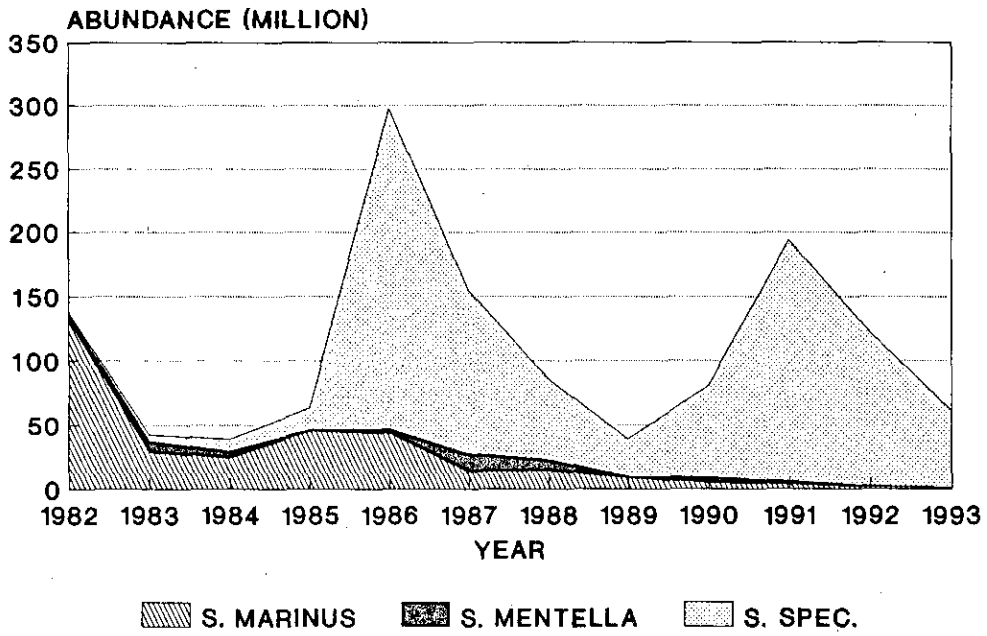

Fig. 2 Aggregate redfish abundance indices as listed in Tables 4, 1982-93.
5, 6,

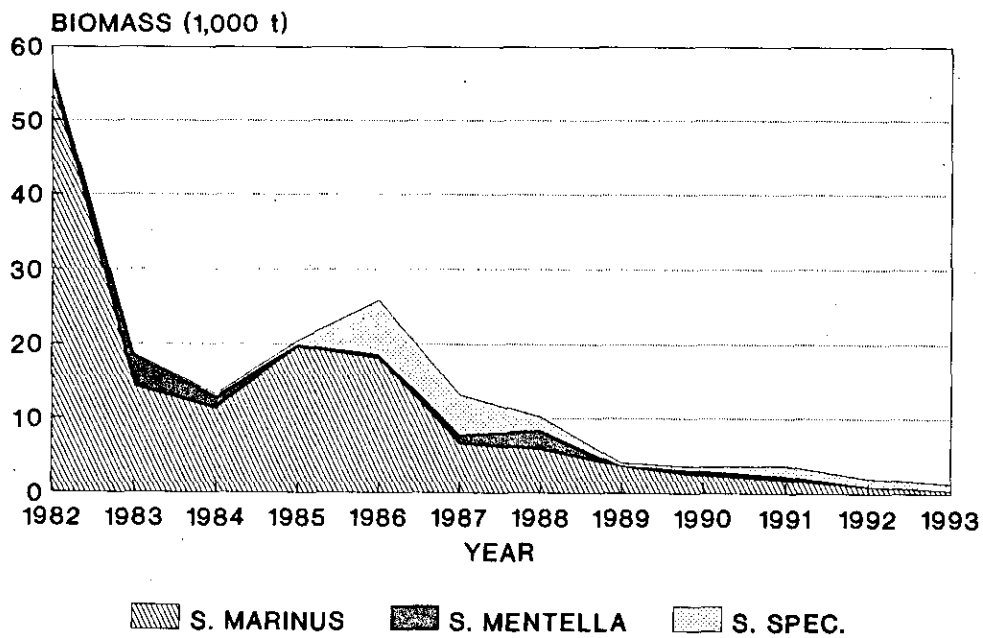

Fig. 3 Aggregate redfish biomass indices as listed in Tables 5, 1982-93
4 6

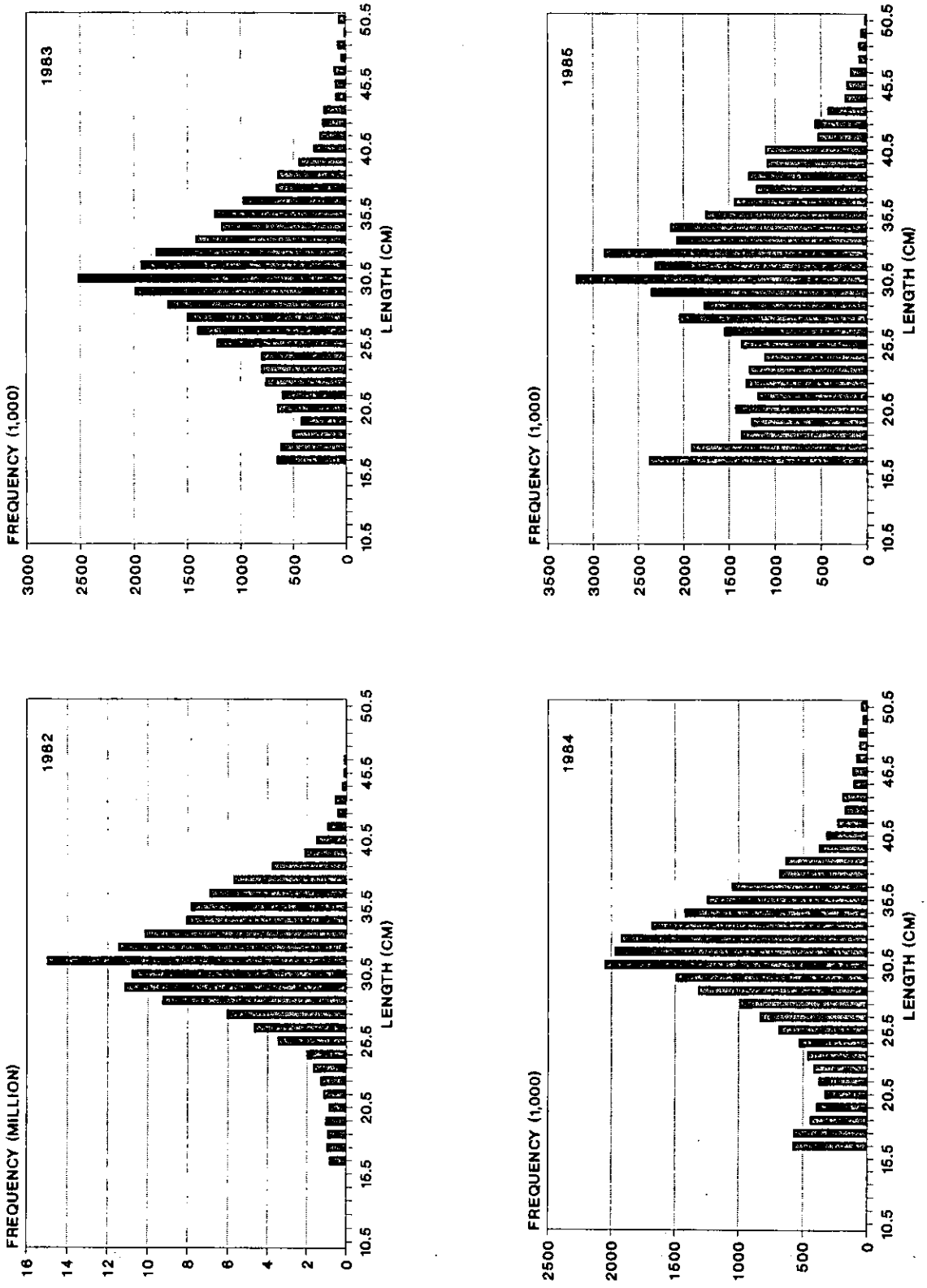

Fig. 4 Golden redfish (*Sebastes marinus*), length distributions 1982-85.

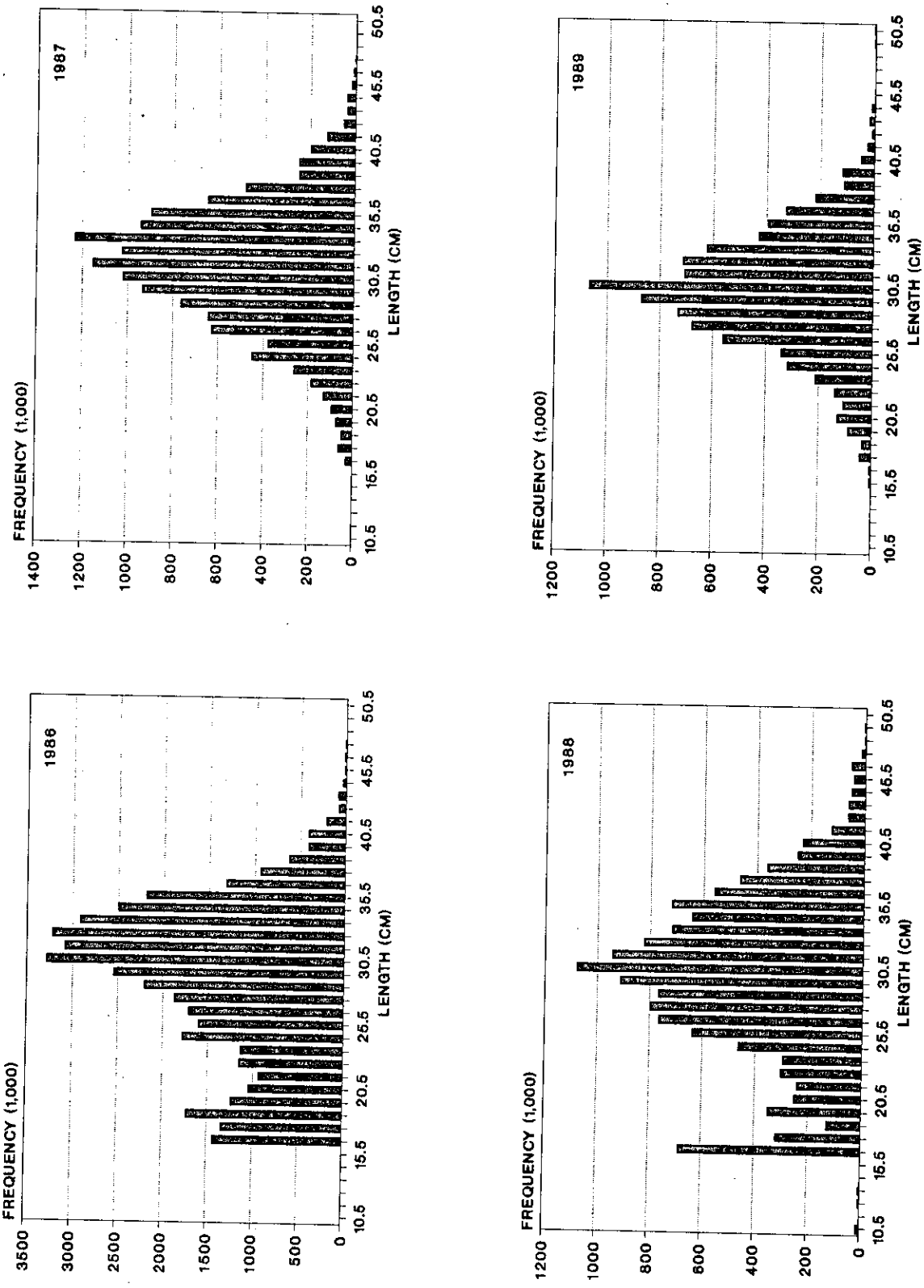

Fig. 5 Golden redfish (*Sebastes marinus*), length distributions 1986-89.

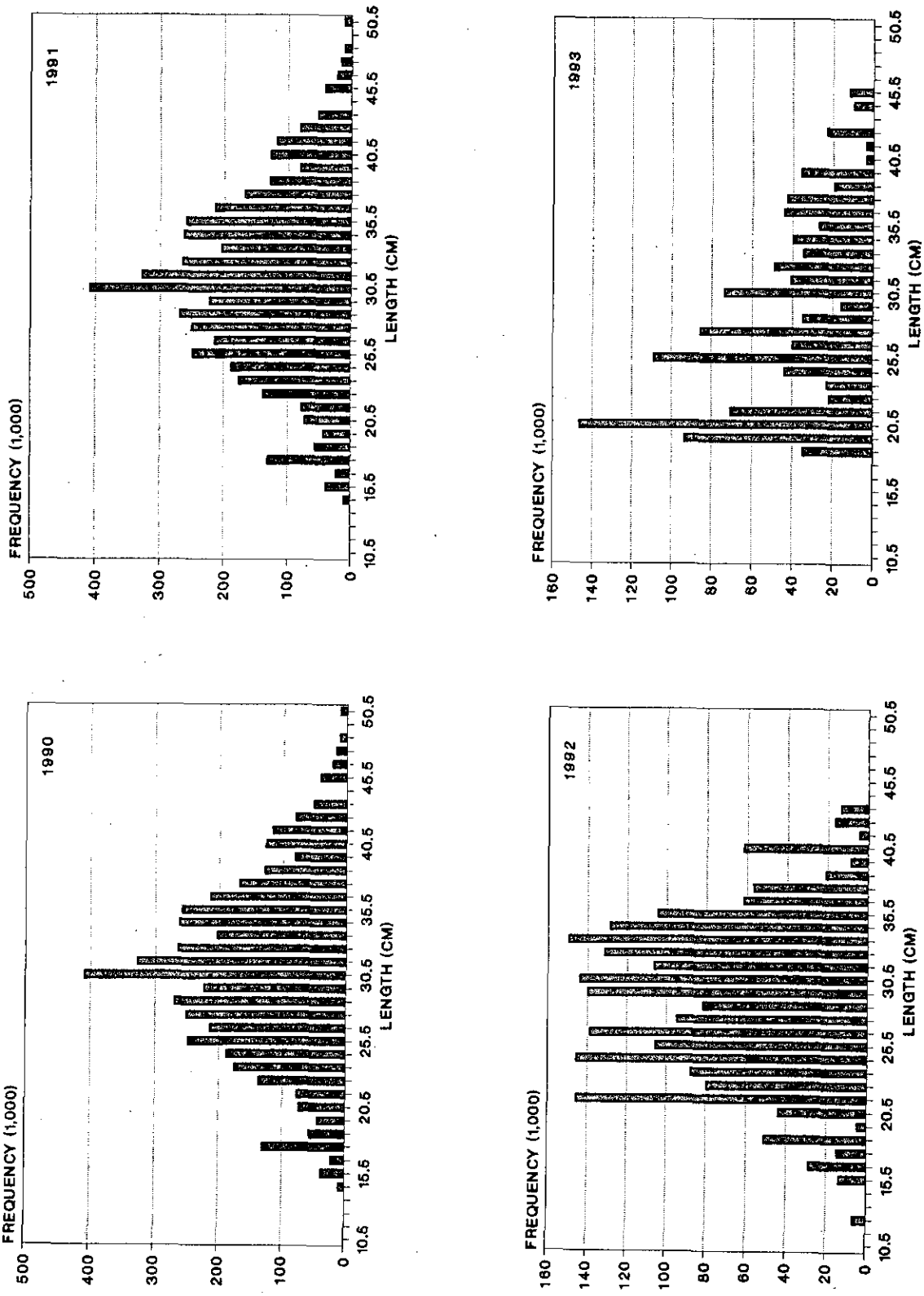

Fig. 6 Golden redfish (*Sebastes marinus*), length distributions 1990-93.

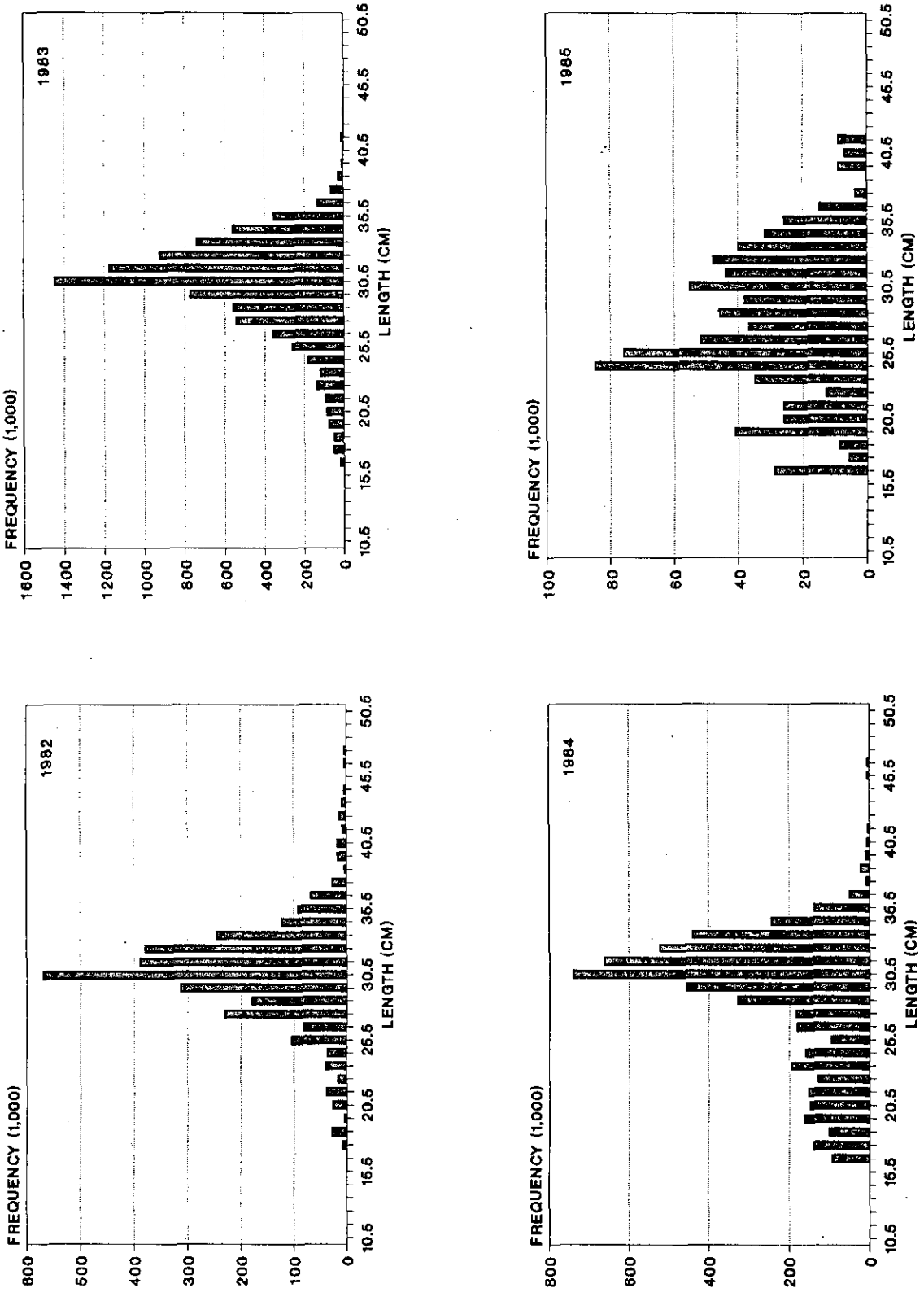

Fig. 7 Beaked redfish (*Sebastes mentella*), length distributions 1982-85.

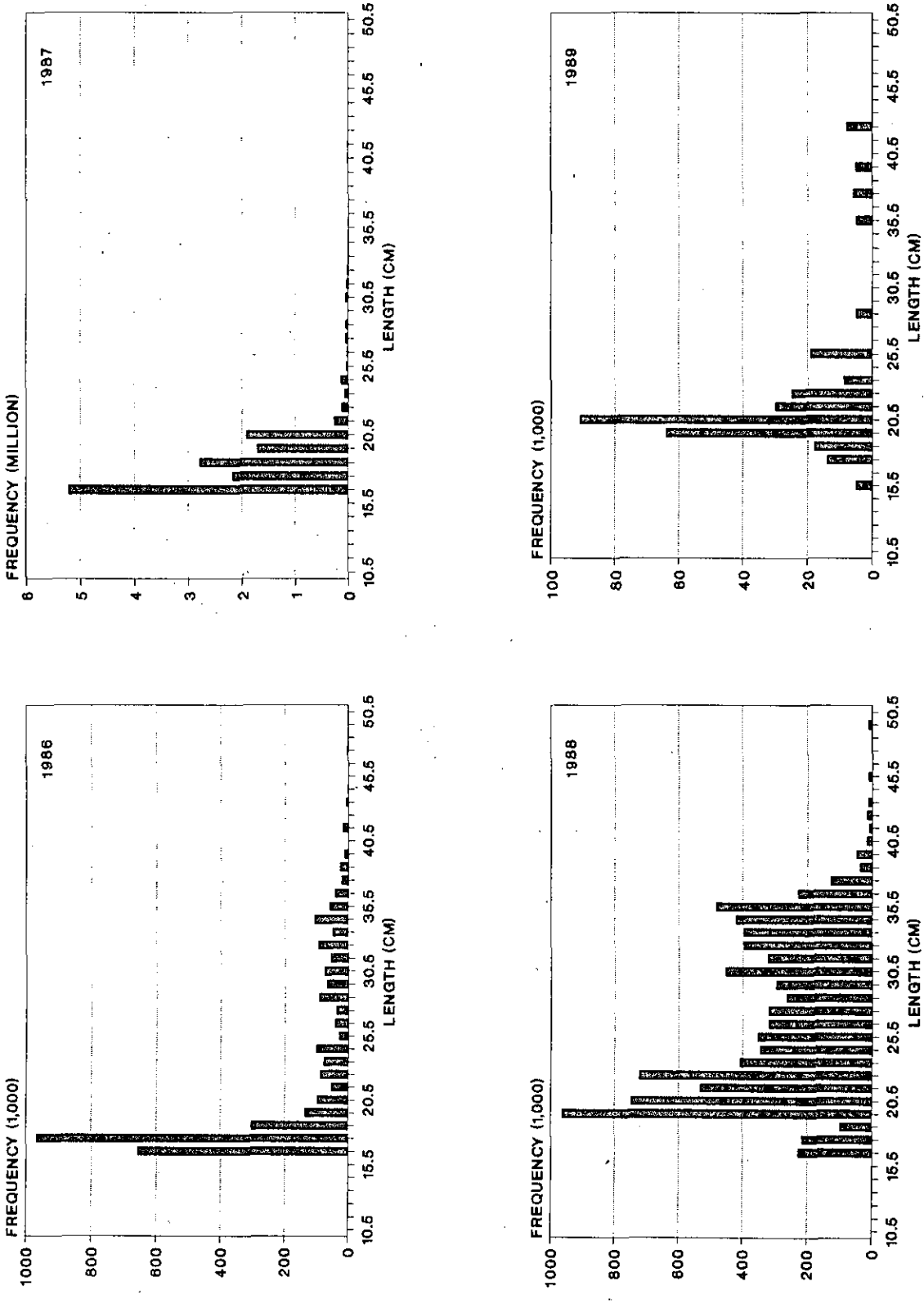

Fig. 8 Beaked redfish (*Sebastes mentella*), length distributions 1986-89.

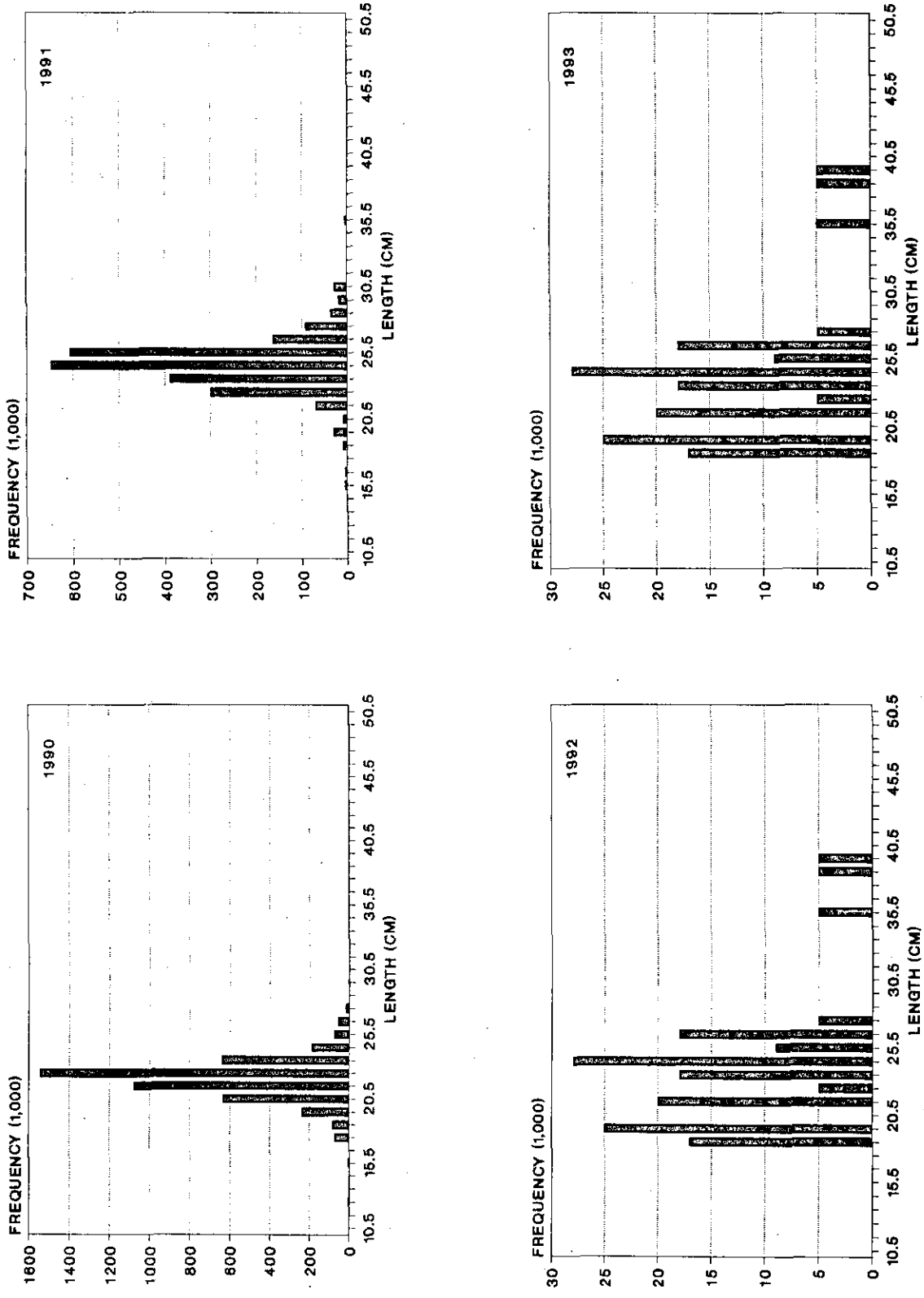

Fig. 9 Beaked redfish (*Sebastes mentella*), length distributions 1990-93.

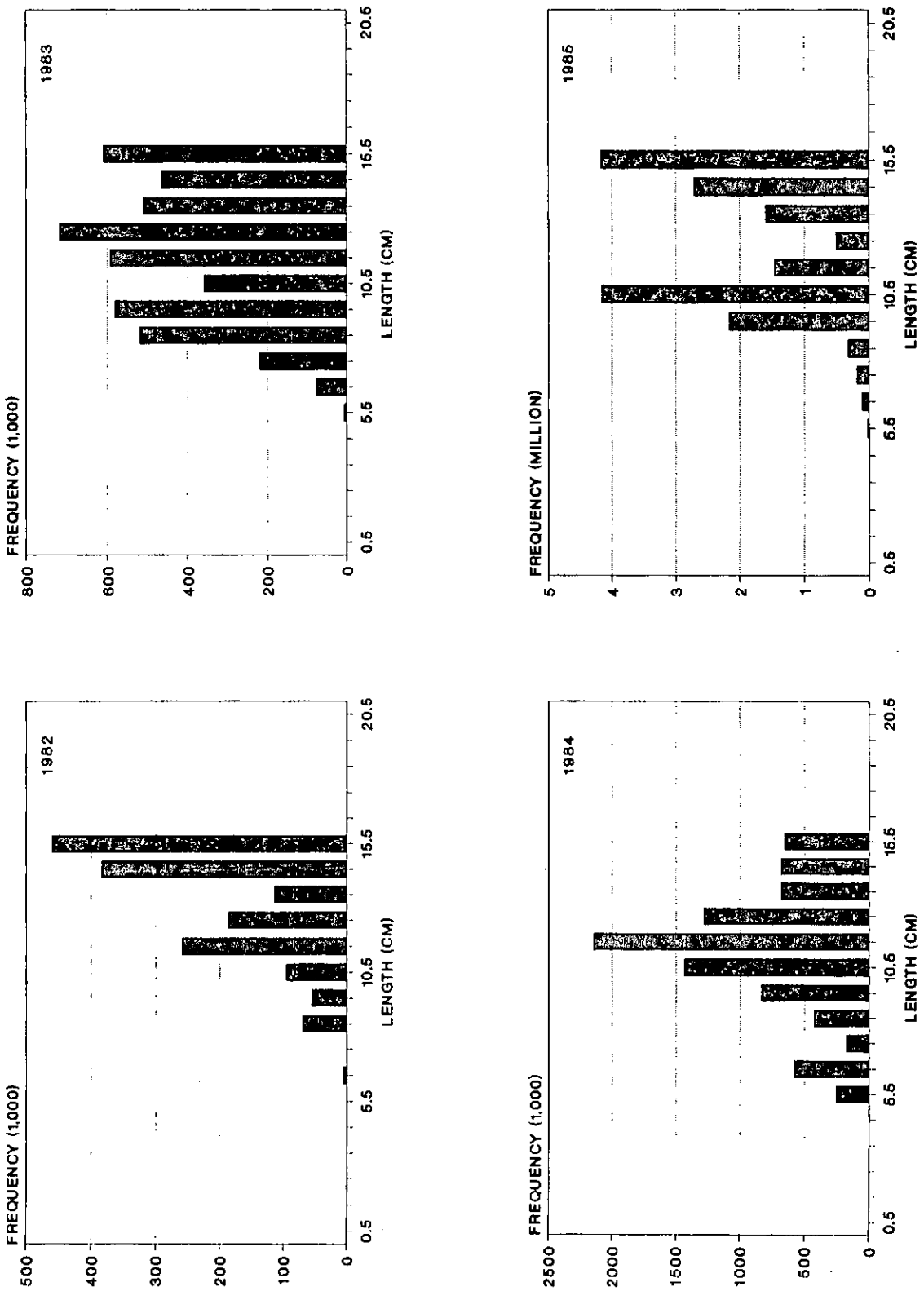

Fig. 10 Juvenile redfish (*Sebastes spp.*,<=15.5cm), length distributions 1982-85.

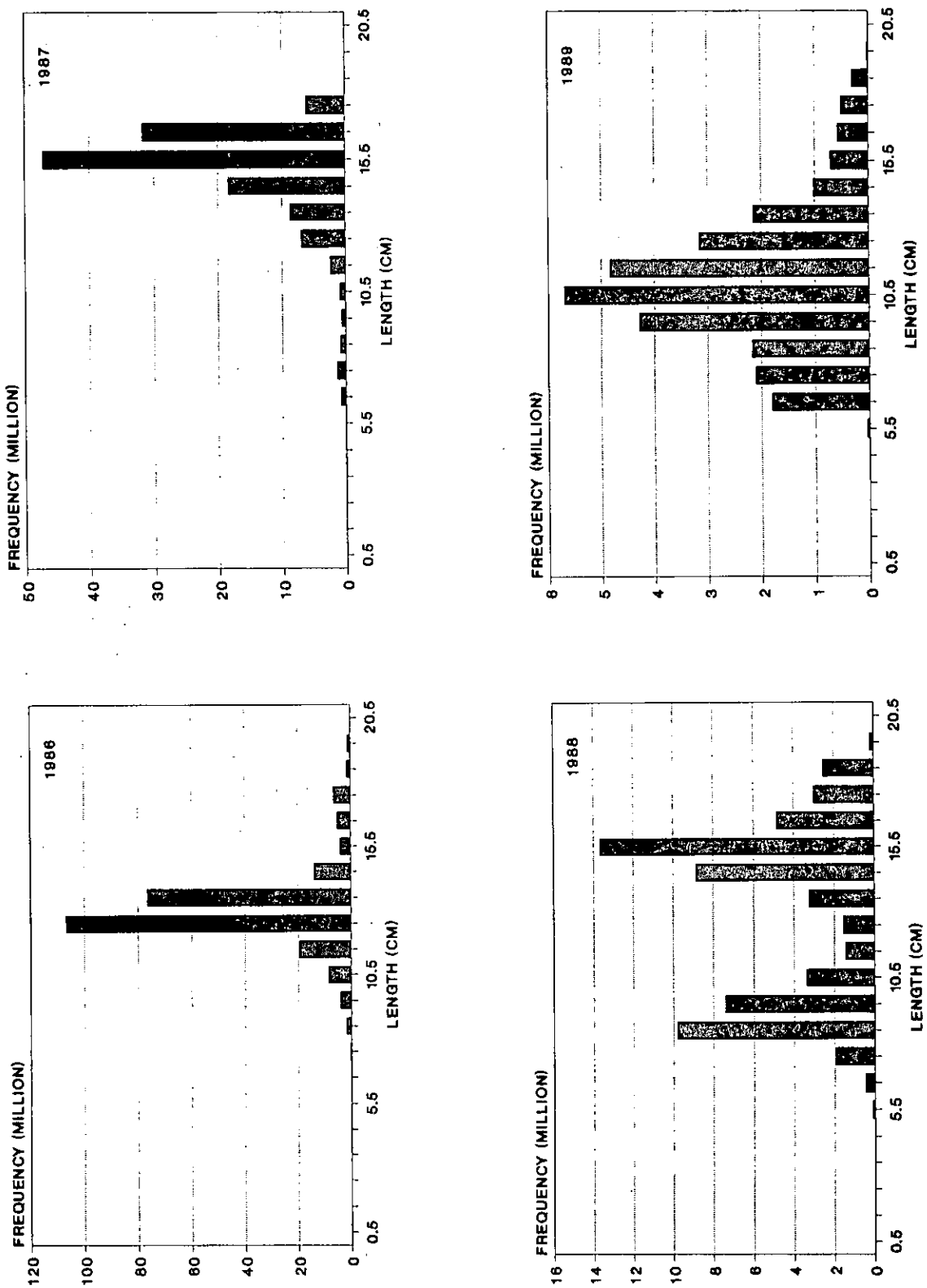

Fig. 11 Juvenile redfish (*Sebastes spp.*,<=15.5cm), length distributions 1986-89.

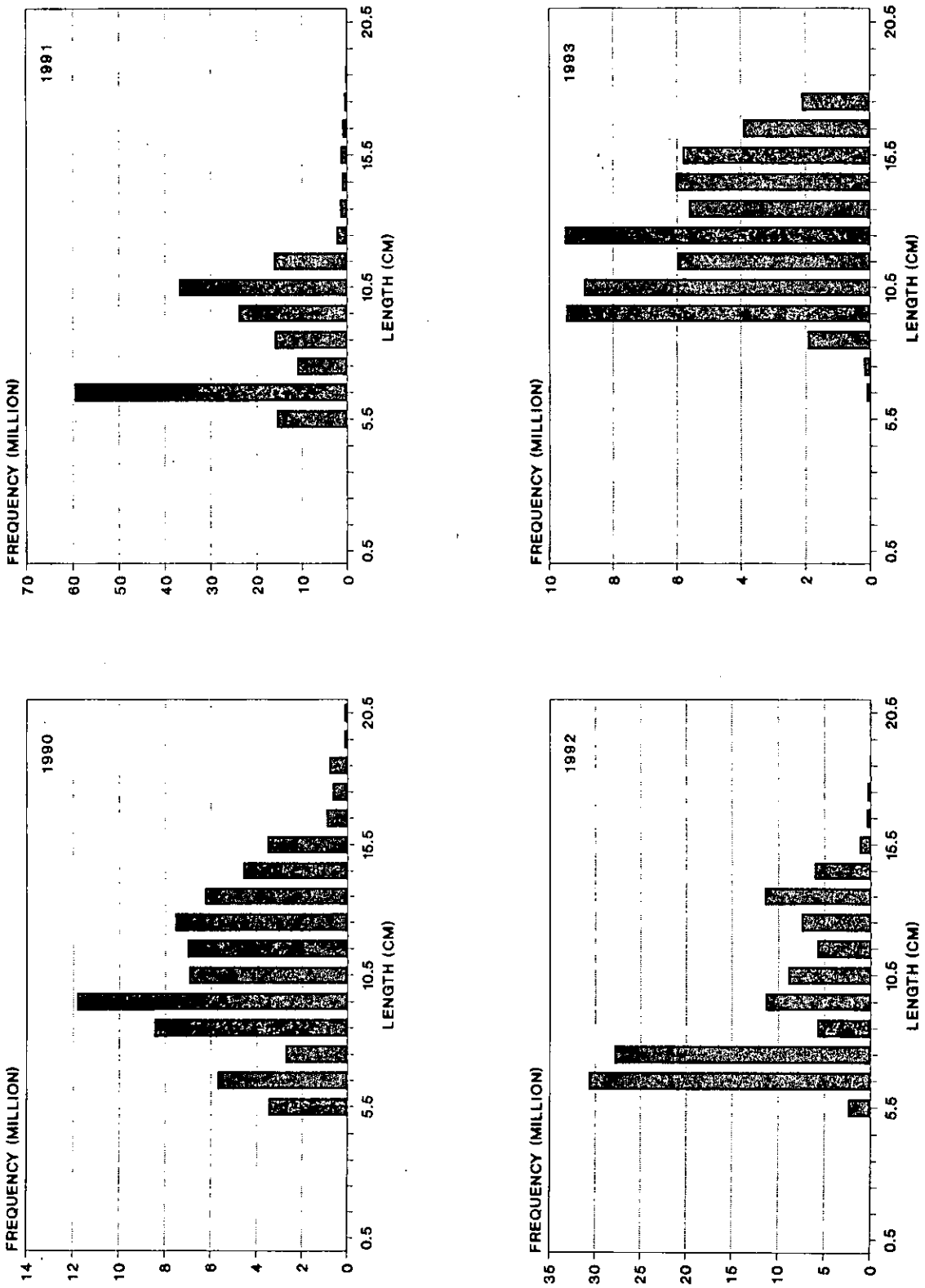

Fig. 12 Juvenile redfish (*Sebastes spp.*,<=15.5cm), length distributions 1990-93