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

by

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Abstract

In 1991-92, juvenile redfish (Sebastes spp., <=15 cm) dominated both aggregate redfish abundance (97%) and biomass (37-52%). Golden redfish (*Sebastes marinus*, >15 cm) formed an important part of aggregate biomass (47%) but was insignificant in abundance (2%). Abundance and biomass of beaked redfish (*Sebastes mentella*, >15cm) were negligible.

The presently poor status of stocks of golden and beaked redfish is evident. During 1991-92, abundance estimates decreased by -41%, -94% and -36% for golden, beaked and juvenile redfish, respectively. Biomass estimates decreased simultaneously by -47%, -95% and -24%. Beaked redfish almost disappeared from the area.

Spatial distribution was characterized by larger concentrations in southern and deep areas for golden and beaked redfish. Junvenile redfish were most abundant in shallow and northern strata distinguishing these areas as nursery grounds. Length distributions revealed that at present very small individuals domintate redfish stocks off West Greenland.

Introduction

Annual groundfish surveys covering the shelf areas and continental slope off West Greenland were established in 1982 in order to assess stock abundance and structure of cod in NAFO Divisions 1B-1F. Analysis of the fish community off West Greenland (Rätz, 1991 a) revealed the important rank of both golden (*Sebastes marinus*) and beaked redfish (*S. mentella*) in the ecosystem.

Former assessments (Messtorff and Cornus, 1989; Rätz, 1991 b; Cornus , 1992) of redfish resource off West Greenland based on these survey have been made separately for golden and beaked redfish disregarding or incorporating 0-group and juveniles (<=15 cm). When small redfish were determined to species level, they were usually identified 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 weights of juveniles. Small redfish, however, occurred occasionally in very high numbers resulting in important changes of abundance estimates. This paper represents reassessed stock abundance, biomass and length structure and geographic distribution for golden redfish (>15 cm), beaked redfish (>15cm) and juvenile redfish (Sebastes spp., <=15cm) in 1991-92.

Materials and Methods

Stratified-random surveys covered the shelf area and continental slope off West Greenland (NAFO Subdiv. 1B-1F) 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 geographical strata were subdivided into 2 depth strata covering the 0-200m and 201-400m depth zones. Thus, this stratification scheme produces 8 strata. Table 1 specifies strata boundaries, depth zones and stratum areas.

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. Detailed information about geometry of the trawl is given by Rätz (1990). Standard towing required 30 minutes, and 4.5 knots were aimed as towing speed. In case of net damage or hangup before 15 minutes towing time, the haul was rejected from evaluation.

Surveys were primarily designed for assessment of cod (*Gadus morhua*). Strategy was to allocate sampling effort proportionally to cod abundance and to area of the strata. Hauls were randomly distributed within strata. During 1991-92, 97 and 47 successful sets were carried out, respectively. Numbers of valid hauls per stratum are listed in Table 2. Main feature of effort distribution is the high number of tows allocated in shallow strata 1.1, 2.1, 3.1 and 4.1 (0-200m) in 1991. Strata 1.2, 2.2, 3.2 and 4.2 (201-400m) are distinguished by significantly lower numbers of hauls, especially southern strata, 3.2 and 4.2 which are characterized by extremely rough trawling grounds. Very deep strata (401-600m) are covered inadequately with hauls during prevoius surveys (1982-90). Therefore, sampling within very deep strata was stopped, and effort was shifted to shallow strata in 1991. Only 47 hauls were carried out in December 1992 due to technical reasons.

Redfish >15 cm were identified to species (golden redfish *Sebastes marinus*, beaked redfish *S. mentella*) and catch number and weight was recorded. Same procedure was applied to redfish <=15 cm, which were classified as Sebastes spp. Length measurements were made on 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 indices of abundance and biomass (relative abundance and biomass). Trawl parameters are listed in Table 3. Respective confidence intervals are given at the 95% level of significance in per cent of the stratified mean. Before summing up, length distributions were standardized, pooled by stratum and weighted by stratum abundance.

Results

Golden redfish contributed 2%, beaked redfish 1% and unidentified juveniles 97% of aggregate redfish abundance (Tab. 4, Fig. 2 and 3). Aggregate biomass distribution is dominated by golden redfish (47%) and juveniles (37-52%) while beaked redfish constituted only 2-16% (Tab 5). From 1991-92, abundance estimates decreased by -41%, -94% and -36% for golden, beaked and juvenile redfish, respectively. Biomass estimates decreased simultaneously by -47%, -95% and -24%. Confidence intervals exceeding 100% indicate low precision of these estimates.

3 components of redfish resource showed important effects in abundance regarding geographic, depth and length distribution. Golden redfish was found to be most abundant in the southern stratum 4.2 where 38-45% of the individuals and 47-57% of biomass was concentrated (Tab. 4 and 5). Deeper strata (201-400m) were occupied more frequently (73-84% of abundance, 83-89% of biomass). Decrease in abundance was reflected in total length distribution ranging from few individuals of 12.5 cm to 48.5 cm (Fig. 2 and 3). In 1991 and 1992, smaller individuals were distributed mainly in shallow and northern strata (0-200m) whereas the biggest golden redfish occurred in southern and deep strata 3.2 and 4.2 (201-400m, Fig. 4 and 5). Numerous peaks of the length distribution are due to low number of golden redfish caught.

Beaked redfish were distributed mainly in the south in deep strata (201-400m). 68-100% of total abundance and 87-100% of total biomass was observed in strata 3.2 and 4.2 (Tab. 4 and 5). Decrease of beaked redfish in numbers is impressively illustrated in Figures 2, 3, 6 and 7. Length distribution varied between 19.5 cm and 39.5 cm with only one pronouced peak at 24.5-25.5 cm. In 1992, few small individuals (19.5-23.5 cm) were caugth in northern areas (Fig. 6) whereas bigger individuals (24.5-30.5 cm) were concentrated in southern strata (Fig. 7).

While distributions of golden and beaked redfish were found to be similar, juveniles showed more complex patterns. Abundance and biomass was distributed mainly in northern strata (Tab. 4 and 5). Shallow strata (0-200m) hold the majority of abundance (54%). Contrarily, biomass was concentrated at deeper strata (201-400) by 74-78%. This indicates that bigger individuals are more abundant in deeper strata as shown in Figures 8 and 9. Length distributions both in 1991 and 1992 showed pronounced peakes at 6.5-7.5 cm and 9.5-13,5 cm.

Discussion

Presented stock abundance indices, species distribution and length composition of redfish off West Greenland are mainly affected by incomplete coverage of the distribution area. This applies to geographic and depth stratification of groundfish surveys (south of 67°N, 0-400m) as well as pelagic and inshore occurrence of redfish. Atkinson (1987) reported on concentrations of redfish in depth zones >400m. However, the larger part of golden redfish and of beaked redfish was observed in his study in areas covered by our surveys. Redfish distribution north of 67°N is considered as poor (Pedersen and Nygård, 1992). Biological relationships (larval drift and migration) of the West Greenland and Irminger Sea redfish stocks off East Greenland were discussed by joint NAFO/ICES Study Groups (Anon. 1983 and 1984).

Different procedures for species identification of juveniles redfish imply limited comparability with survey results before 1991 as given by Rätz (1993). However, juvenile redfish (<=15cm) treated separately from recruits and adults (>15 cm) dominated both aggregate redfish abundance (97%) and biomass (37-52%). Golden redfish formed an important part of aggregate biomass (47%) but was insignificant in abundance (2%). Contributions of beaked redfish were negligible (Fig. 2 and 3).

Recent decline in abundance and biomass and presently poor status of stocks of golden and beaked redfish is confirmed by groundfish surveys for Greenland halibut covering deeper areas (Jorgensen and Akimoto, 1990 and 1991; Yano and Jorgensen, 1992), by-catches during shrimp surveys (Pedersen and Kanneworff, 1991 and 1992) and decreasing annual landings (Cornus, 1992). However, statistics for

landings are incomplete due to unknown catches taken by shrimp fishery. Beaked redfish noted highest loss and disappeared almost.

Spatial distribution of abundance and biomass displayed bigger concentrations in southern and deep areas (201-400m) for golden and beaked redfish (Tab. 4 and 5). Junvenile redfish were most abundant in shallow and northern strata distinguishing these areas as nursery grounds (Fig. 4-9, Rätz, 1991 b). The pelagic distribution of 0-group redfish along several transects is described by Wieland (1992). Individual size seemed to increase generally with depth and decreasing latitude for the 3 components of redfish resource.

Length distributions revealed that at present very small individuals dominate redfish stocks (Fig. 2 and 3). Pronounced peaks of length distributions of juvenile redfish at 6.5-7.5 cm and 9.5-13.5 cm (Fig. 8 and 9) might correspond to age groups 0 and 1 year as smallest individuals were still silvery coloured.

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Table 1 Specification of the strata.

64°15'N - 67°00'N 50°00'W - 57°00'W
Stratum 1.1 depth 1-200m, area 6,805 nm^2
Stratum 1.2 depth 201-400m, area 1,881 nm^2

62°30'N - 64°15'N 50°00'W - 55°00'W
Stratum 2.1 depth 1-200m, area 2,350 nm^2
Stratum 2.2 depth 201-400m, area 1,018 nm^2

60°45'N - 62°30'N 48°00'W - 53°00'W
Stratum 3.1 depth 1-200m, area 1,938 nm^2
Stratum 3.2 depth 201-400m, area 742 nm^2

59°00'N - 60°45'N 44°00'W - 50°00'W
Stratum 4.1 depth 1-200m, area 2,568 nm^2
Stratum 4.2 depth 201-400m, area 971 nm^2

Table 2 Number of valid hauls per stratum, 1991-92

Stratum	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	total
Year									
1991	19	11	23	7	12	6	14	5	97
1992	6	6	6	5	6	6	7	5	47

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 Abundance indices (n*1,000) by species and stratum in 1991-92. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean.

Stratum	Sebastes marinus				Sebastes mentella				Sebastes spp.			
	1991	CI	1992	CI	1991	CI	1992	CI	1991	CI	1992	CI
1.1	227.8	95	127.3	115	0.0	0	0.0	0	51,939.1	74	25,714.9	202
1.2	255.9	87	105.6	106	0.0	0	35.2	115	59,845.2	55	19,083.6	122
2.1	95.6	89	73.3	167	0.0	0	0.0	0	34,871.1	68	12,690.3	163
2.2	691.0	76	190.4	77	0.0	0	15.2	279	22,667.6	200	17,276.5	198
3.1	235.7	90	193.4	184	0.0	0	0.0	0	13,692.0	140	17,462.5	191
3.2	527.5	107	476.6	163	652.4	200	106.4	171	2,507.8	125	13,973.2	105
4.1	20.6	156	192.2	177	0.0	0	0.0	0	892.2	172	41.2	170
4.2	1,671.1	183	835.6	96	1,772.9	189	0.0	0	1,540.4	246	13,717.9	248
total	3,725.2	61	2,194.4	43	2,425.3	107	156.8	95	187,955.4	35	119,960.1	55

Table 5 Biomass indices (t) by species and stratum in 1991-92. Confidence intervals (CI) are given at the 95% level of significance in per cent of the stratified mean.

Stratum	Sebastes marinus				Sebastes mentella				Sebastes spp.			
	1991	CI	1992	CI	1991	CI	1992	CI	1991	CI	1992	CI
1.1	43.5	106	18.2	122	0.0	0	0.0	0	198.1	55	151.5	175
1.2	83.1	102	34.8	150	0.0	0	2.8	124	796.7	66	384.7	162
2.1	24.0	86	20.5	178	0.0	0	0.0	0	73.3	68	48.8	186
2.2	225.6	132	60.9	86	0.0	0	1.5	282	242.2	191	111.1	113
3.1	119.7	109	53.2	171	0.0	0	0.0	0	28.9	147	73.8	224
3.2	272.6	136	241.2	156	152.9	192	28.0	157	23.9	129	220.1	99
4.1	3.3	150	70.4	175	0.0	0	0.0	0	2.2	136	0.7	190
4.2	1,006.7	177	447.0	102	445.0	183	0.0	0	14.7	247	64.5	133
total	1,778.5	75	946.2	49	597.9	104	32.3	107	1,380.0	44	1,055.2	56

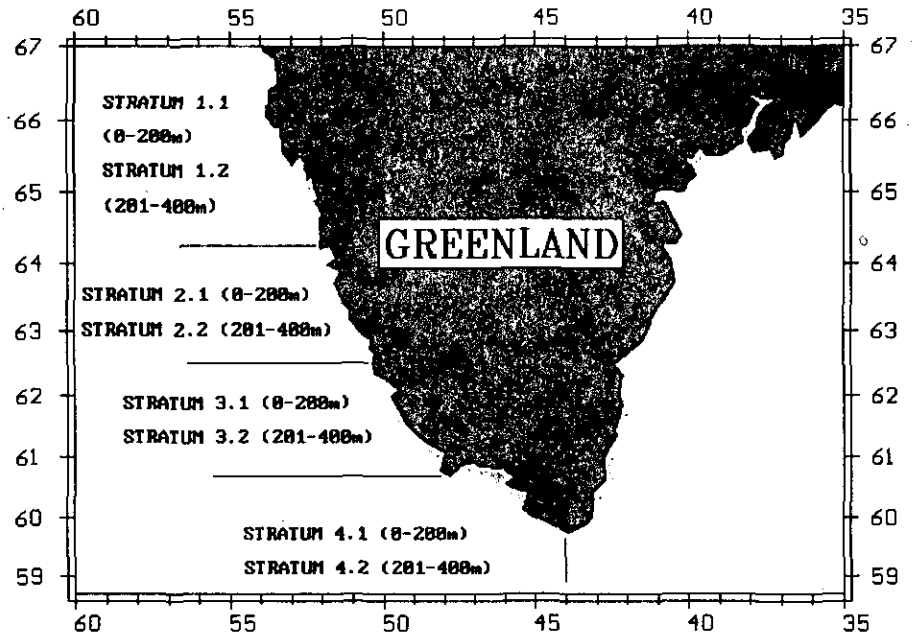


Fig. 1 Survey area and stratification scheme as specified in Table 1.

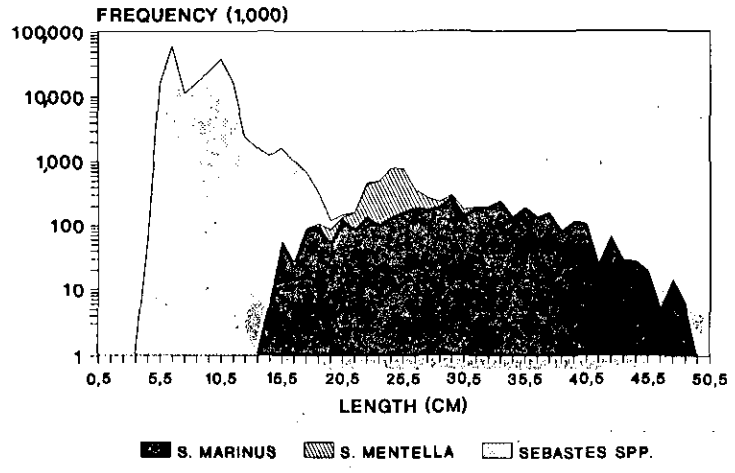


Fig. 2 Redfish Sub-area 1, species composition, stock abundance (Tab. 4) and length structure of the stocks in 1991.

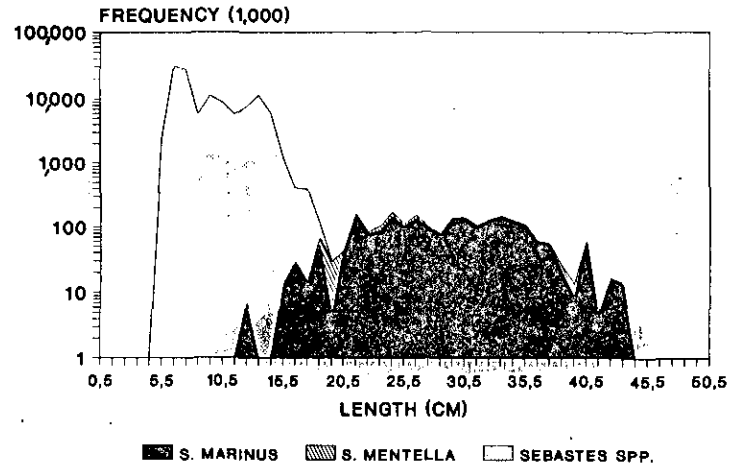


Fig. 3 Redfish Sub-area 1, species composition, stock abundance (Tab. 4) and length structure of the stocks in 1992.

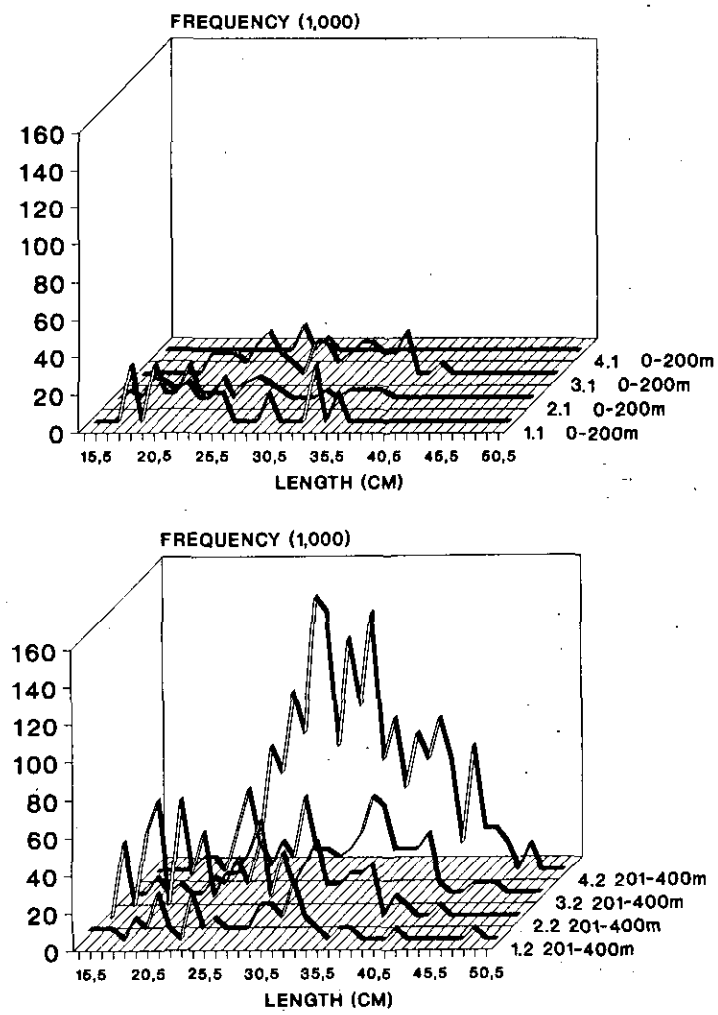
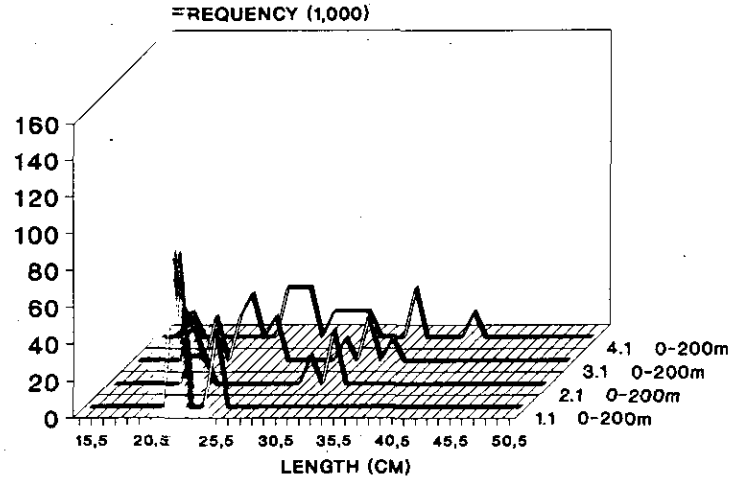


Fig. 4 Golden redfish (Sebastes marinus) Sub-area 1, stock abundance (Tab. 4) and length structure by stratum in 1991.



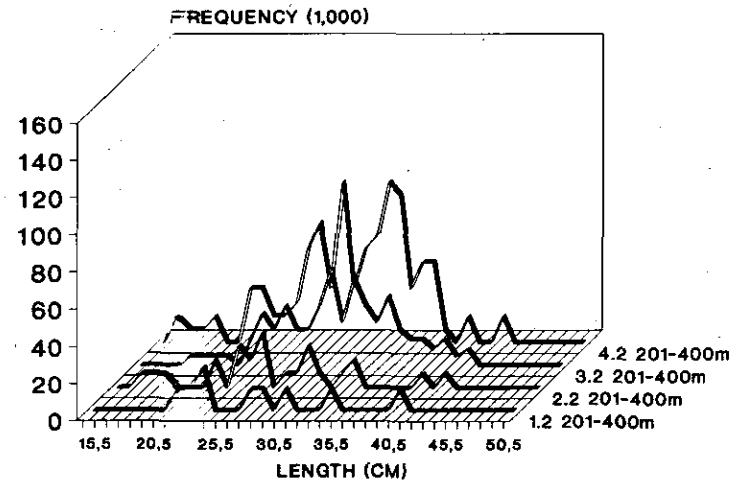
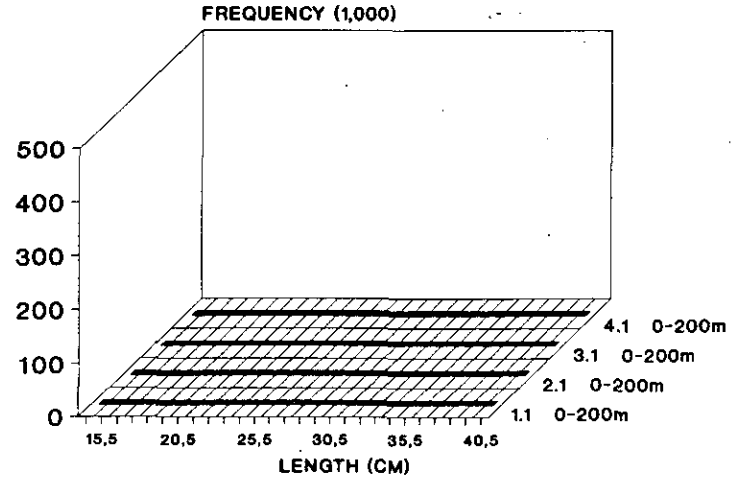


Fig. 5 Golden redfish (*Sebastes marinus*) Sub-area 1, stock abundance (Tab. 4) and length structure by stratum in 1992.



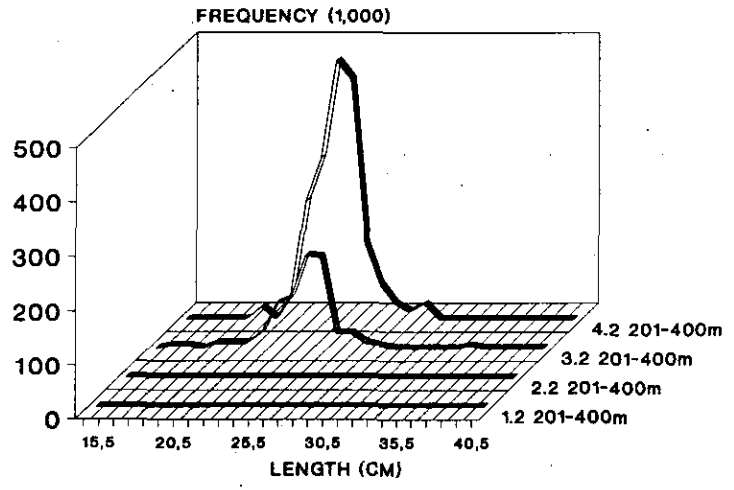
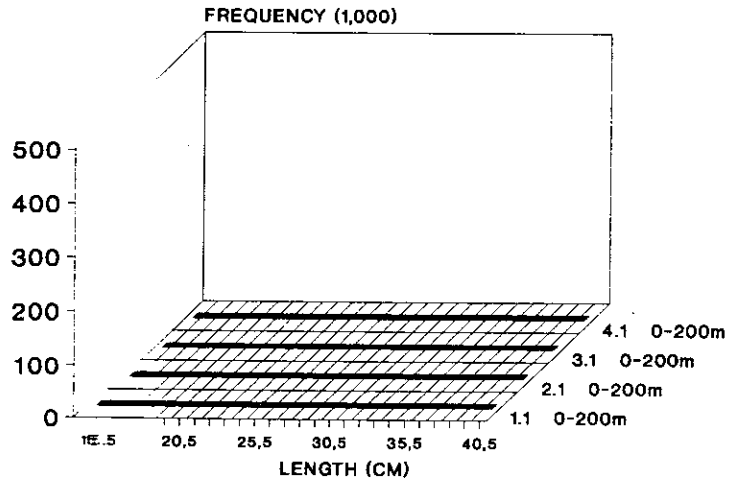
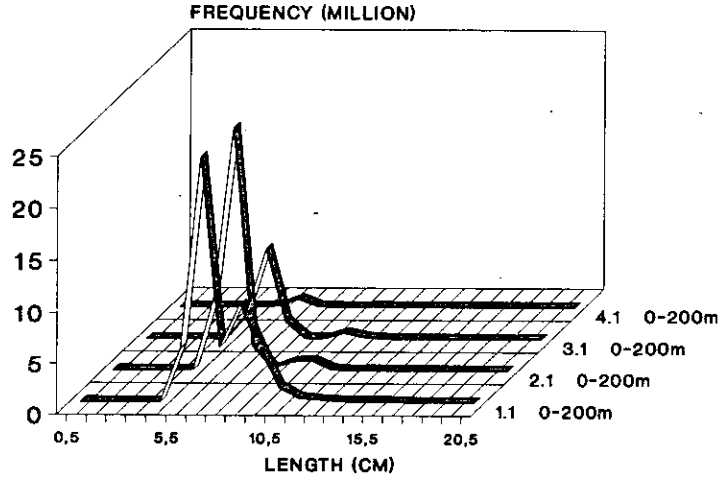
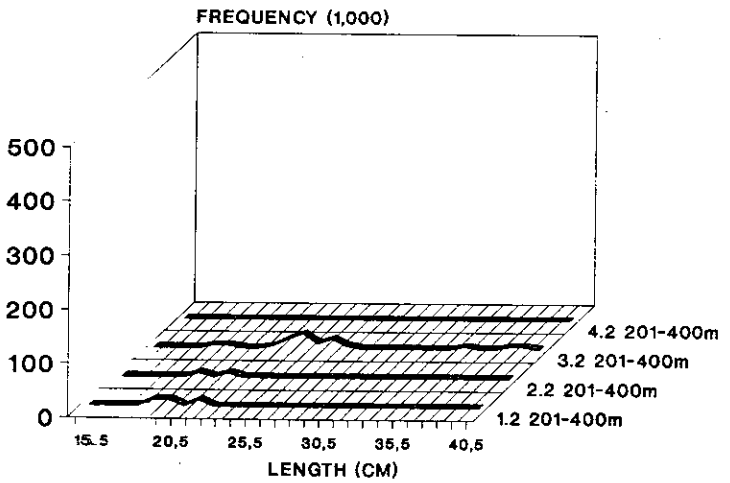


Fig. 6 Beaked redfish (*Sebastes mentella*) Sub-area 1, stock abundance (Tab. 4) and length structure by stratum in 1991.







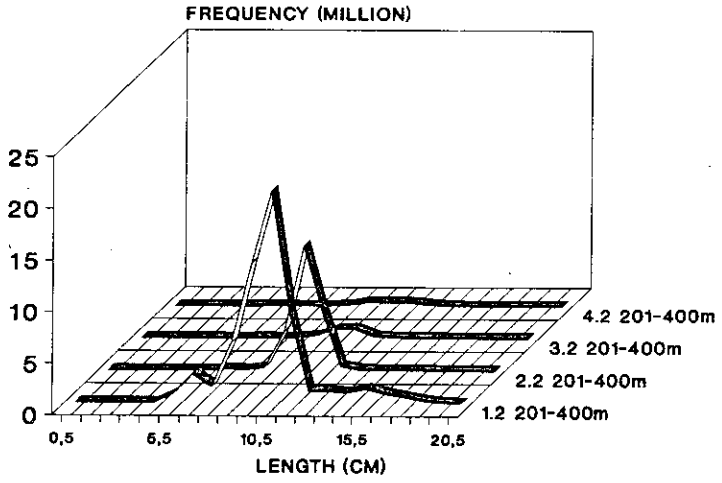


Fig. 7 Beaked redfish (*Sebastes mentella*) Sub-area 1, stock abundance (Tab. 4) and length structure by stratum in 1992.

Fig. 8 Juvenile redfish (Sebastes spec.) Sub-area 1, stock abundance (Tab. 4) and length structure by stratum in 1991.

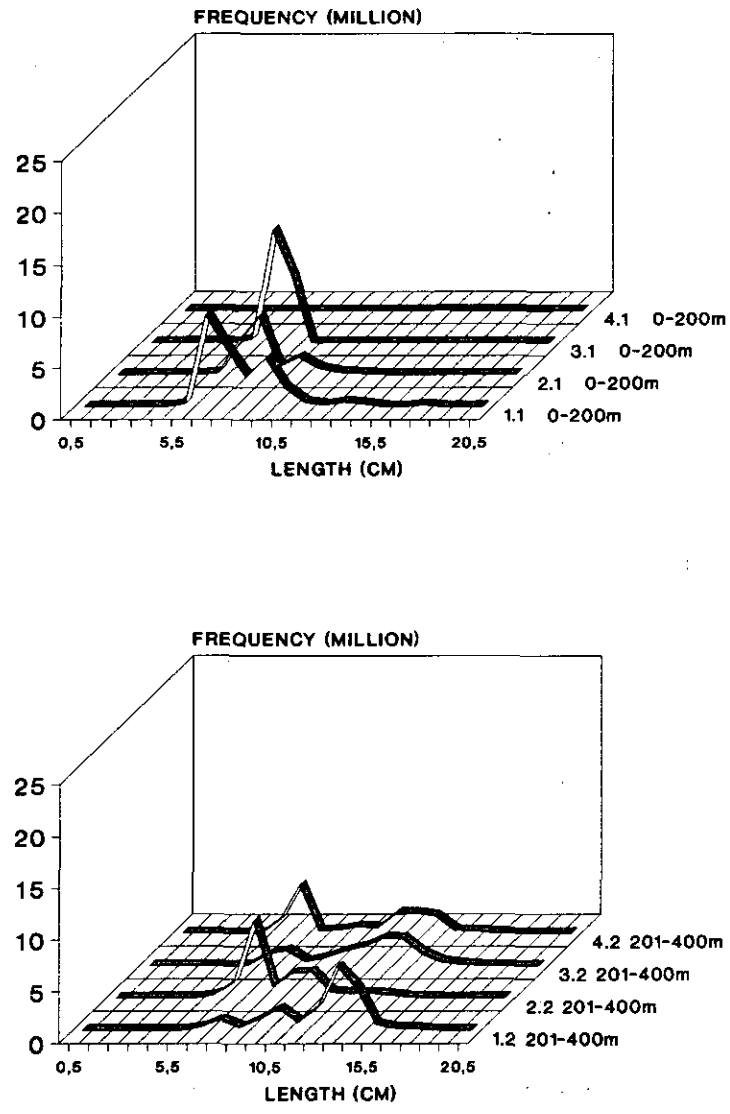


Fig. 9 Juvenile redfish (Sebastes spec.) Sub-area 1, stock abundance (Tab. 4) and length structure by stratum in 1992.