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Survey Biomass and Abundance of Greenland Halibut (*Reinhardtius hippoglossoides*)
and Redfish (*Sebastes* spp.) in Greenland Trawl Survey 1992 (NAFO Subarea 1)

by

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1. INTRODUCTION.

A stratified-random survey was performed with a shrimp trawl off West Greenland during July to September 1992. In August 1992 an inshore area, Disko Bay, was also surveyed. This paper presents estimates of biomass, abundance indices and length frequency distributions of Greenland Halibut and Redfish based on data collected during the survey.

2. MATERIALS AND METHODS.

The survey was carried out in the Davis Strait offshore from West Greenland between 59°00' N to 72°30' N, and from the 3-mile limit to the 600 meter depth contour line. Further the inshore area of Disko Bay was covered by the survey (Fig. 1).

The survey was conducted with the commercial stern trawler M/tr PAAMIUT (722 GRT). The trawl used was Skjervoy 3000/20 with bobbin gear and a double-bag with 44 mm mesh size in the codend. The trawl doors used were of the type 'Perfect'. The wingspread was estimated by the use of SCANMAR equipment to an average of 23.1 m.

The standard trawling haul was about 60 minutes (30 minutes in Disko Bay) at a mean towing speed of 2.4 knots. Trawl operations were only performed during daytime.

The survey area was divided into subareas which were further divided into three depth strata (0-200, 201-400 and 401-600 m) on the basis of depth contours. The size of strata (km²) by subarea and depth are given in Table I and the subareas are shown in Fig.1.

North and south boundaries of the subareas corresponds to NAFO Divisions except for the boundary between subarea 1BN and 1BS, which was set at 67°00'N to compare with the stratification in the German trawl surveys conducted off West Greenland (Rätz 1993).

In subarea 1AN (North-West Greenland [NWGRL]) and the inshore area of Disko Bay (DISKO) it was not possible to make a depth stratification due to lack of information on the bottom topography. These subareas were hence treated as single strata.

Hauls were allocated to the strata proportionally to their size however a minimum of two hauls per stratum was always scheduled. Within the strata the trawling sites were chosen at random (Doubleday, 1981).

The catch from each haul was sorted by species, weighed and counted. Biomass and abundance indices with standard deviations were calculated by means of the swept area method and as described by Cochran (1977), assuming a catchability factor of

1.0. The catches of Greenland Halibut and Redfish were length measured to the nearest centimetre below to get the length frequency distributions.

Hauls taken outside Greenland areas were not included in these calculations.

3. RESULTS.

The number of hauls per stratum are shown in Table I. A total of 162 valid hauls were taken in the West Greenland offshore waters, with a single haul thus representing 930 km² of survey area as an overall mean. In the inshore area a total of 44 hauls were considered valid, with one haul representing 213 km².

3.1 GREENLAND HALIBUT. (*Reinhardtius hippoglossoides*).

Abundance estimates by subarea and depth strata are given in Table II. The total abundance was estimated to 290 mill. in the West Greenland offshore waters, with 86 and 11% located in subareas 1BN and 1AN respectively. Highest abundance was located in depthstratum 201-400 m of subarea 1BN (180 mill.). The mean densities and mean abundances are given in Table VI.

The total biomass off West Greenland was estimated to 8846 tons (Table VI), with 56 and 34% located in subareas 1BN and 1AN respectively. The largest biomass was found in the same division and stratum as the highest abundance (Table III).

In the Disko Bay area the total abundance was estimated to 69 mill. (Tables II + VI) and the biomass to 3958 tons (Tables III + VI).

The size compositions of Greenland halibut are shown in Fig. 2 for the total West Greenland area and Disko Bay. A marked peak is seen at 11-12 cm and at 17-18 cm supposedly representing yearclasses 1 and 2 (Smidt, 1969). In Fig. 3 the length frequencies are shown for northern and southern areas. From this it can be seen that the peak at 11-12 cm belongs to the areas north of 1BS. The Greenland Halibut in divisions 1BS to 1F had a totally different size composition with peaks at 15 cm, 18 cm and 25 cm. The length frequency distribution of Disko Bay was analogous to the one of areas 1BN to 1AN (Fig. 2 + 3).

3.2 REDFISH SPP. (*Sebastes* spp.).

The total abundance off West Greenland was estimated to 1429 mill., and for the Disko Bay area the total abundance was estimated to 6.2 mill. (Tables IV + VII). Most Redfish was located in subarea 1BN (76%) with a maximum abundance (1081 mill.) in the 201-400 m depth stratum (Table IV). In Table VII the mean densities and abundances are given.

The total biomass was estimated to 21307 tons for the offshore area and 330 tons in the Disko Bay (Tables V + VII). The largest part (14532 tons) was located in subarea 1BN, also with a maximum in stratum 201-400 m (Table V).

The length frequency distribution of Redfish is shown in fig. 4 for the offshore area and Disko Bay. Offshore two marked peaks were found at 7 cm and 10 cm, while in the Disko Bay area peaks were present at 10 and 20 cm.

The small Redfish (7-8 cm) are mainly found in the areas south of 67°N while the 10 cm group is seen in the northern areas (Fig. 5).

4. DISCUSSION.

Since 1988 a yearly stratified-random shrimp trawl survey has been conducted in the main distribution area for shrimp (*Pandalus borealis*) off West Greenland north of 61°52'5N (Carlsson & Kanneworff, 1991). In 1992 attempts were made to use the

collected by-catch data from the shrimp surveys in 1988 to 1991 to estimate biomass and abundance of Greenland Halibut (Kannevorff & Pedersen, 1992) and Redfish (Pedersen & Kannevorff, 1992). As an extension to these surveys the inshore area Disko Bay was surveyed in 1991 and Pedersen & Nygård (1992) used the by-catch data to present estimates of abundance and biomass of the fishes caught. In 1992 the offshore part of the survey was extended southward to include areas outside the main distribution area of shrimps, hence covering all NAFO divisions 1A to 1F (Fig. 1).

In the 1992-survey the sampling methods were improved so that the by-catch of commercial interesting fishspecies were sampled, weighed, length measured and counted by every haul. This gives a more accurate estimate of the abundance indices because these indices are estimated from the actual numbers in the samples, whereas in the former years the abundance indices were calculated by the use of an estimated meanweight of the fishes caught (Pedersen & Kannevorff, 1992; and Kannevorff & Pedersen, 1992).

In the former surveys stratification was done into different subareas and depth strata, and hence the areas of the new depth strata have been recalculated. Only three depth strata are used, where in the former years the four depth strata from the shrimp surveys have been used (Pedersen & Kannevorff, 1992; Kannevorff & Pedersen, 1992; and Pedersen & Nygård, 1992).

Some informations might be lost by the use of this new stratification, but it was found convenient to use NAFO-divisions as subareas in the West Greenland waters, as an attempt to standardize the information from the data collected in these surveys. Still some calibration work have to be done in order to readily compare the biomass and abundance indices with former years.

However, compared to the estimates for Greenland Halibut from the earlier years (Kannevorff & Pedersen, 1992) the biomass has increased from 5000 tons in 1991 to 8800 tons in 1992, whereas abundance has increased from 70 mill. to 290 mill. The peak of the yearclass 1 is solely seen on the nursery grounds (Smidt, 1969; and Riget & Boje, 1988) north of 67°N (1AN-1BN in Fig. 3). Taking into account that the sampling methods have improved since 1991, there still is an indication of a new strong yearclass coming up in 1992. The extended survey area has no influence on this increment (Tables II and III).

In the Disko Bay area the biomass of Greenland Halibut has also increased since 1991 from 2100 tons to 3900 tons with an abundance of 69 mill. No abundance is given for 1991 (Pedersen & Nygård, 1992) but the peaks in the length frequency distribution are also recognized in 1992 (Fig.2).

The biomass estimates for *Sebastes* spp. shows a slightly decrease from 25000 tons in 1991 to 21000 tons in 1992. The abundance estimates decreased from 2100 mill. to 1400 mill in the same period. As for the Greenland Halibut the extended survey area has no influence on this decrement (Tables IV and V). The size composition with the two analogous peaks (Fig. 4) represents a supposedly new 1+ group at 7-8 cm and the remainings of the 1990 yearclass at 11 cm as described by Pedersen & Kannevorff, 1992.

Fig.5 confirms that the small redfish at 7-8 cm mainly are situated in the southern areas (1BS-1F), whereas the 11-12 cm group mainly are found in 1BN-1AN and in the Disko Bay area.

The Redfish biomass in Disko Bay was estimated to 215 tons in 1991 without abundance index. In 1992 the biomass has increased to 330 tons and the abundance was 6 mill.

The length frequencies from 1991 showed peaks at 7, 10, 13 and 19 cm in Disko Bay (Pedersen & Nygård, 1992). The 1992 data had no peak at 7 cm but instead at 10 cm, 12 cm, 17 cm and 20 cm which indicates very low abundance of the 1+ group in the Disko Bay area.

5. REFERENCES.

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AREA/AREAL	DEPTHSTR. km ²			TOTAL
	0-200 m	201-400 m	401-600 m	
1AN				41129
Nos. hauls	-	-	-	32
1AS	4280	7664	640	12584
Nos. hauls	4	10	2	16
1BN	15162	18242	4032	37436
Nos. hauls	11	24	6	41
1BS	6674	1600	1243	9517
Nos. hauls	3	4	1	8
1C	6254	5245	3349	14848
Nos. hauls	9	6	3	18
1D	8060	3492	888	12440
Nos. hauls	7	8	4	19
1E	6647	2545	196	9388
Nos. hauls	6	4	1	11
1F	8808	3330	1211	13349
Nos. hauls	10	7	0	17
TOTAL WEST				150691
Tot.hauls	50	63	17	162
DISKO				9364
Tot.hauls	-	-	-	44

Tabel I. Size of depthstratas and distribution of succeded hauls in Greenland trawlsurvey 1992.

AREA/DEPTH	0-200 m	201-400 m	401-600 m	TOTAL
1AN	-	-	-	31.92
1AS	0.18	3.54	0.45	4.17
1BN	0.13	181.90	67.76	249.79
1BS	0.11	0.50	0.94	1.55
1C	0.02	0.42	0.99	1.43
1D	0.03	0.64	0.04	0.71
1E	0	0.76	0	0.76
1F	0	0	0	0
TOTAL WEST				290.33
DISKO	-	-	-	68.69

Table II. Abundance of Greenland Halibut (mill.) distributed on subareas and depth strata in Greenland trawlsurvey 1992.

AREA/DEPTH	0-200 m	201-400 m	401-600 m	TOTAL
1AN	-	-	-	2980
1AS	13	76	73	162
1BN	3	3298	1639	4940
1BS	5	40	329	374
1C	18	33	197	248
1D	10	66	8	84
1E	0	58	0	58
1F	0	0	0	0
TOTAL WEST				8846
DISKO	-	-	-	3958

Table III. Biomass estimates (tons) of Greenland Halibut by depth and subarea in Greenland trawlsurvey 1992.

AREA/DEPTH	0-200 m	201-400 m	401-600 m	TOTAL
1AN	-	-	-	7.65
1AS	0.69	10.08	33.50	44.27
1BN	0.21	1032.00	48.66	1080.87
1BS	0.87	178.30	16.74	195.91
1C	0.54	50.18	3.79	54.51
1D	2.20	28.76	3.09	34.05
1E	1.12	5.16	0	6.28
1F	0.30	5.12	0	5.42
TOTAL WEST				1428.96
DISKO	-	-	-	6.24

Table IV. Abundance (mill.) of Redfish by subarea and depth in Greenland trawlsurvey 1992.

AREA/DEPTH	0-200 m	201-400 m	401-600 m	TOTAL
1AN	-	-	-	279
1AS	16	119	712	847
1BN	3	12715	1814	14532
1BS	114	1543	1175	2832
1C	5	1140	315	1460
1D	126	747	167	1040
1E	24	103	0	127
1F	12	178	0	190
TOTAL WEST				21307
DISKO	-	-	-	330

Table V. Biomass estimates (tons) of *Sebastes* spp. by depth and subarea in Greenland trawlsurvey 1992.

Mean density. (tons/km ²)	Mean abundance. (pr km ²)
0.0587 +- 2 x 0.0115 (W)	1926 +- 2 x 472 (W)
0.4227 +- 2 x 0.0694 (D)	7335 +- 2 x 1435 (D)
Total biomass. (tons)	Total abundance.
8846 +- 2 x 1733 (W)	290295076 +- 2 x 71170797 (W)
3958 +- 2 x 650 (D)	68685482 +- 2 x 13441151 (D)

Table VI. **Greenland Halibut**. Mean and total biomass and abundance with 95 % confidence limits for West Greenland waters (W) and Disko Bay (D) in Greenland trawlsurvey 1992.

Mean density. (tons/km ²)	Mean abundance. (pr km ²)
0.1414 +- 2 x 0.0532 (W)	9480 +- 2 x 3968 (W)
0.0352 +- 2 x 0.0068 (D)	666 +- 2 x 155 (D)
Total biomass. (tons)	Total abundance.
21307 +- 2 x 8011 (W)	1428586870 +- 2 x 597925402 (W)
330 +- 2 x 64 (D)	6236541 +- 2 x 1452488 (D)

Table VII. **Sebastes** spp.. Mean and total biomass and abundance with 95 % confidence limits for West Greenland waters (W) and Disko Bay (D) from Greenland trawlsurvey 1992.

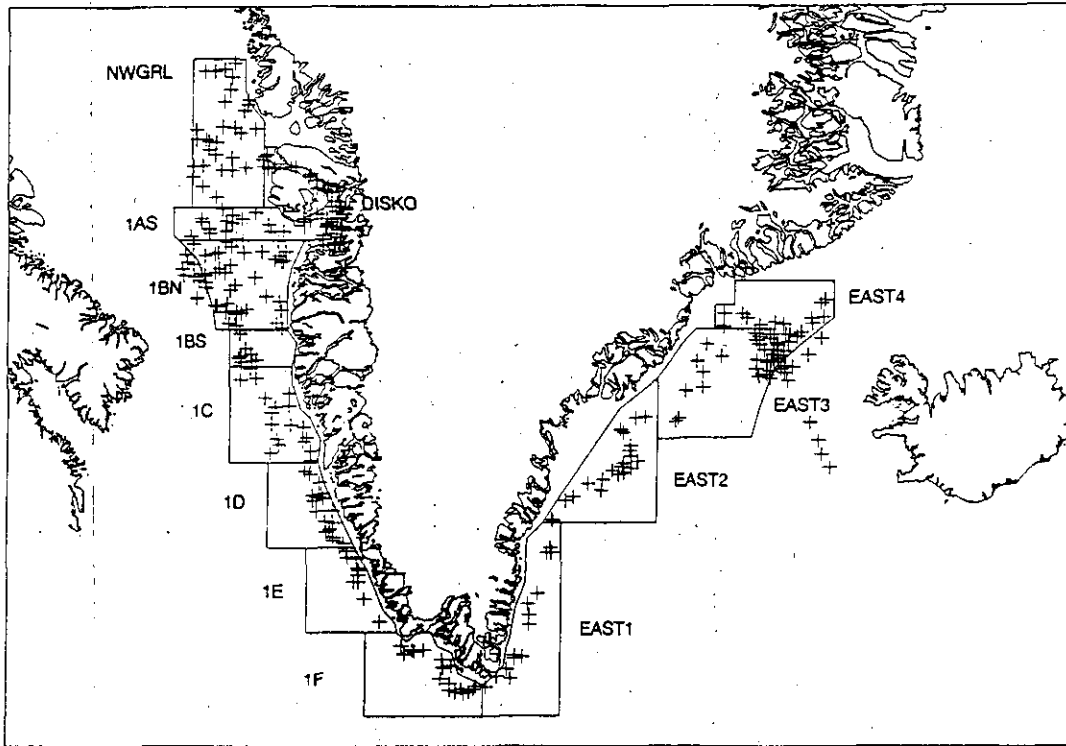


Fig. 1. Location of subareas and hauls in Greenland trawlsurvey 1992. NWGRL = 1AN.

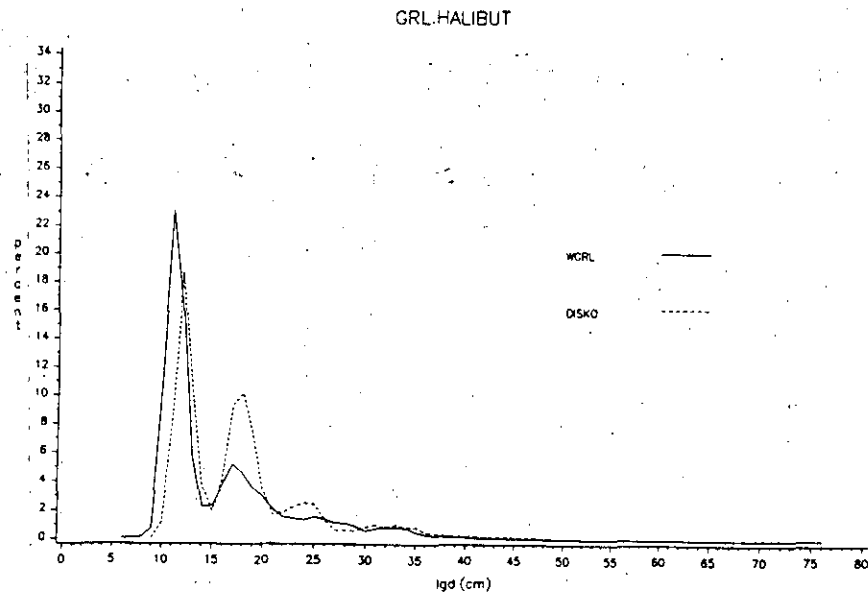


Fig. 2. Relative length frequency distribution of Greenland Halibut in West Greenland waters and Disko Bay in Greenland trawlsurvey 1992.

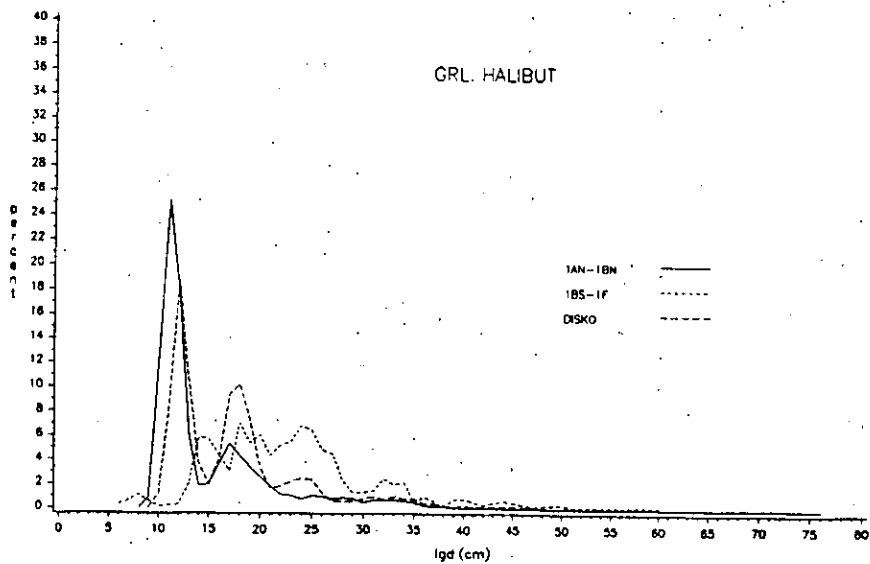


Fig. 3. Relative length frequency of Greenland Halibut by northern and southern subareas in Greenland trawlsurvey 1992.

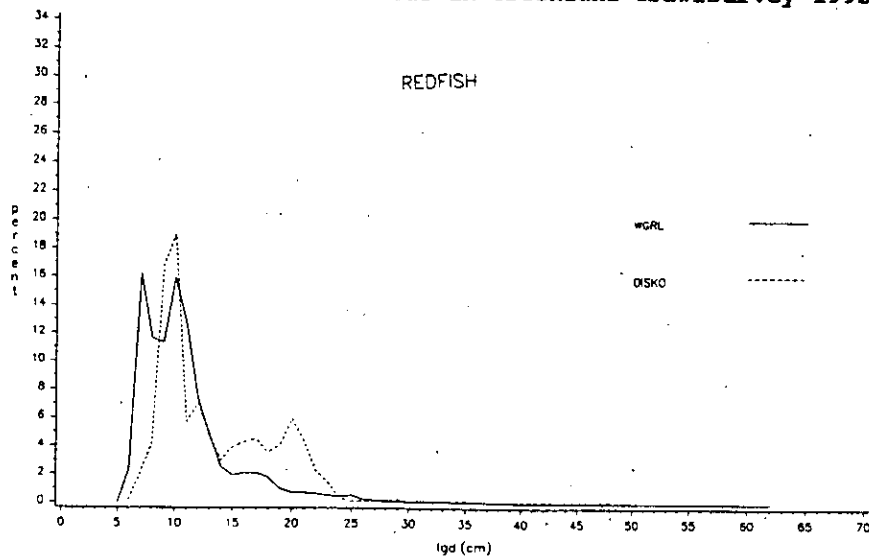


Fig. 4. Relative length frequency (1 cm) of Sebastes spp. in West Greenland waters and Disko Bay in Greenland trawlsurvey 1992.

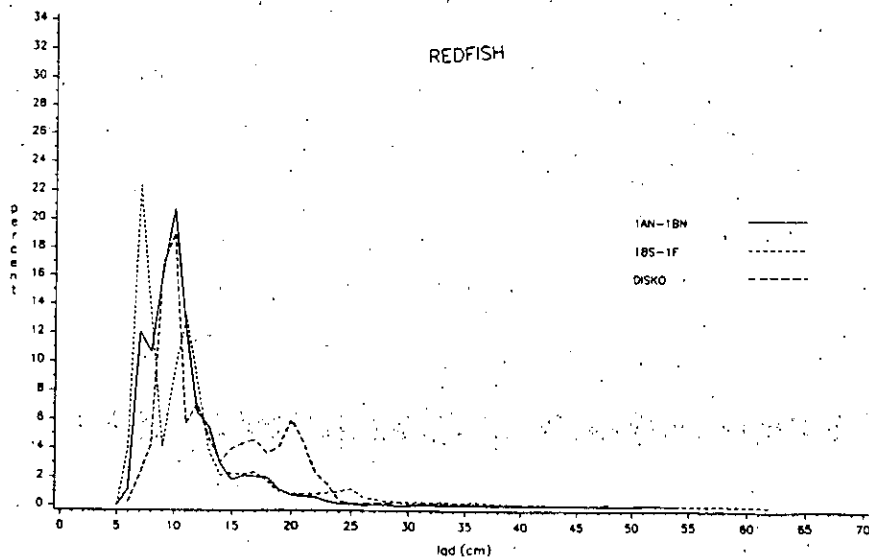


Fig. 5. Relative length frequency of Sebastes spp. by northern and southern subareas in Greenland trawlsurvey 1992.