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An Assessment of the Greenland Halibut Stock Component in NAFO Subareas 0+1

by

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1. Description of the fishery and nominal catches.

In the period 1980-1989 catches of Greenland halibut in Subarea 0+1 have been rather stable with an annual average of 9,000 tons (Table 1-2). The bulk of the catches were taken by Greenland in the fjords of Division 1A. Traditionally, the Greenland fishery was a small-scale longline fishery carried out either by boats below 20 GRT or by means of dog sledges, typically in the inner parts of the fjords at depths of 500-800 meters. Most catches derives from the summer fishery. Since the middle of the 80'ies gillnets were used more commonly in the inshore Greenlandic fishery and since 1986 gillnets and longlines accounted equally for the catches in Div. 1A. Catches by Faroes in Subarea 0 mainly by longliners averages 450 tons in the period with an increasing trend in 1988 and 1989. Since 1987 trawl catches by Japan in the offshore part of Div. 1CD amounted to about 1300 tons annually.

Catches in Subarea 0B increased from 727 tons in 1989 to about 11000 tons in 1990, due to a new trawl fishery by Canada (Newfoundland) and a trawl- and longline fishery by Faroes and USSR (mainly trawl catches) in Division 0B. The fisheries took place during September-December in 1990. In Subarea 1 catches reached 8927 tons in 1990, which is about the same level as in 1989. Of the total catch Japanese offshore trawl catches comprised about 1000 tons (taken in Div.1CD in June-August), which is a minor decrease compared to 1989 (1300 tons). The remainder of the catches in Subarea 1 was taken by Greenland (7933 tons), mainly in Div. 1A in the areas Ilulissat, Uummannaq and Upernavik (Fig.1), of which Ilulissat makes up nearly 40%. Catches taken by longlines comprised about 75% of the catches in the inshore part of Subarea 1, which is an increase compared to previous years. The inshore fishery in Subarea 1 peaks in March and again in July/August/September.

2. Input data

2.1 Biological information

A pilot study of larval and 0-group fish off West Greenland carried out by Germany in summer and autumn 1989 and 1990 gave new information about horizontal and vertical distributions of Greenland halibut larvae in relation to temperature conditions. The larvae were caught exclusively in the upper 50 m at temperatures above 2 °C (Wieland, 1991).

A stomach sampling program of Greenland halibut was initiated in Subarea 1 in 1990. The sampling took place in July and September on the shrimp fishing grounds on the continental shelf down to about 550 m depths (Riget and Pedersen, 1991). 665 stomachs from Greenland halibut in the length range 5 - 54 cm were examined. Fish dominates the diet accounting for between 33% and 86% of the total prey weight, of which Sebastes sp. constitutes the majority. Among crustaceans, which accounted for between 14% and 59% of the total prey weight, the northern shrimp, Pandalus borealis was by far the most dominating prey item. Based on abundance estimates of Greenland halibut from shrimp surveys (Kanneworff and Pedersen, 1991), annual consumption by Greenland halibut in the West Greenland area is estimated to 670 tons of shrimp and 751 tons of redfish, corresponding to 0.5% and 7.5%, respectively of the estimated biomass of shrimp and redfish.

During a bottom trawl survey in Div. 1BCD in October-November 1990 by USSR/E-DEU stomachs of Greenland halibut were examined. Mean stomach fullness were between 0.00-1.33, 75% of the stomachs examined were empty. Most preferred prey for Greenland halibut were squids, shrimps, and fishes (redfish) (Borokov et al., 1991).

2.2 Research trawl surveys

Bottom-trawl surveys have been conducted jointly by Japan and Greenland in Subarea 1 since 1987. In 1990 two surveys were carried out in Subarea 1, in May-June and in August-September, respectively (Jørgensen and Akimoto, 1991). Both surveys covered the depth range 400 - 1500 m. The biomass in Div. 1ABCD was estimated to 61,500 t during the first survey and in Div. 1BCD to 51,300 t during second survey. Although the survey differed from year to year in areas and depths surveyed, the estimated survey biomass seems consistent in the period 1987-90 (Table 3). Within the period the surveys have showed difference in distribution of the biomass, which may be due to within-year migrations, as the surveys were carried out at different times of the year.

A bottom-trawl survey was conducted by USSR in cooperation with E-DEU in Div. 0B and 1BCD in October-November 1990, covering the depth range 200-1500 m (Borovkov et al., 1991). In Div. 0B Greenland halibut occurred in hauls over the whole surveyed area. Catches obtained on the shelf at depths of 200-500 m indicate that Greenland halibut gradually move into greater depths of the slope. The abundance of Greenland halibut in the trawl survey area in Div. 0B had remained at about the same level in the three preceding years: 83.8 x 10^6 fish in 1988, 91.8 x 10^6 in 1989, and 88.5 x 10^6 in 1990 with biomasses of 64,200 t, 83,700 t, and 78,900 t, respectively (Table 3). A higher abundance and biomass in 1989 relative to 1988 and 1990 seems to be associated with the strong 1984-1985 year-class reported from a Canadian shrimp surveys in Div. 2J+3KL (Borokov et al., 1991). Most of the Greenland halibut surveyed in Div. 0B in 1990 were distributed at depths of 1100 to 1500 m. The trawl survey in Div. 1BCD had the largest catches (peaked at 243.6 kg) at depths between 1001-1500 m. The length of Greenland halibut were between 18-109 cm, with a modal group of 50-51 cm for both sexes. Total abundance of Greenland halibut, as estimated in the 1990 fall survey off West Greenland, amounted to 73.0 x 10^6 fish with a biomass of 83,000 t. Investigations of the towing speed during the USSR/E-DEU trawl survey in 1990 in Div. 1BCD indicate that the calculated abundances and biomasses are underestimates since the actual towing speed generally seems to be lower than the towing speed used in the abundance and biomass calculations. Re-calculations with corrected towing speeds gave a biomass estimate of 95,600 t (Ernst et al., 1991).

In Div. 1BCD in 1990 the biomass of Greenland halibut has been estimated to be 59,400 t, 51,300 t and 83,000 t (with corrected towing speed: 95,600 t) from two Japan/Greenland surveys in May-June and August-September and a USSR/E-DEU survey in October-November. The differences in these estimates are probably due to the differences between the three surveys in time, area and depth coverage.

Catches of Greenland halibut during shrimp surveys off West Greenland in Div. 1ABCD from the 3-mile limit to the 600 m depth contour line in July-August 1988-1990 indicate a decrease in the catch rate from north to south, from deep to shallow water and from 1988 to 1990 (Kanneworff and Pedersen, 1991). The total biomass and abundance estimates decreased from about 12,000 t and 141 mill. in 1988 to about 4,600 t and 36 mill. in 1990, respectively. The largest reduction is seen in the areas north of Store Hellefiske Banke at depths of 300 - 600 m. However, from the lengths distributions given in percentage in (Kanneworff and Pedersen, 1991), it is hard to judge whether the decrease in abundance indices can be caused by weak recruitment of one or more year-classes. The observed decrease in biomass and abundance might be due to a deeper distribution of Greenland halibut during the survey in 1990. The catches during the shrimp survey confirm that major nursery grounds for Greenland halibut coincide with the distribution area for shrimp. Lengths ranges from 7 cm to 55 cm, with modes at 12, 18 and 25 cm being most pronounced in the northern areas, supposedly representing the age-groups 1, 2 and 3.

2.3 Other research results

Selectivity. By comparing catches in Div. 0B from bottom trawl and

long-line fishery, USSR estimated relative efficiency of long-line in comparison with bottom trawl to chance from 0.02 for small Greenland halibut (36-41 cm) to 13.01 for large ones (90-95 cm) (Chumakov and Soshin, 1991). The estimated long-line efficiency are important in order to be able to compare catch rates and abundances in areas not covered by bottom trawl surveys. The investigations of long-line efficiency compared to bottom trawl fishery should therefore be continued in the forthcoming years.

A study on gear selection was carried out for longlines and gillnets in the West Greenland area (Boje, 1991). Estimating the long-term yield for an exploitation exclusively by one of the gears, show that gillnets might provide greater catches of larger Greenland halibut compared to longlines.

2.4 Commercial fishery data.

In relation to information presented at STACFIS in June 1990 (Boje and Jørgensen, 1990), Greenland halibut in the inshore areas of Subarea 1 seem to be very stationary and each fjord component should therefore be assessed separately. As an attempt to obtain data for an analytical assessment for the main fjord areas in Subarea 1, catch at age data were estimated. In Subarea 1 91% of the Greenland catches derives from Div. 1A, and mainly from the fjord areas of Ilulissat, Uummannaq and Upernavik (see Fig. 1), where catches in 1990 were 3036 tons, 2453 tons and 1337 tons, respectively. Catches for the years 1988-90 by season and gear in Divisions 1A are shown in Table 4. Sampling has been carried out in all areas since 1988.

However, some areas are sparse covered concerning season and gear. In Ilulissat samplings are missing from the gillnet fishery in winter for the years 1988-89, and in the catch-at-age calculations it is assumed that the winter gillnet catch distribution are equal to that of gillnets in the summer. In Uummannaq samples are missing from the summer fishery in 1989 (longlines as well as gillnets), and in the catch-at-age estimates catch distributions from 1990 are used. For the Upernavik area samples are missing from the winter fishery in 1988, and in catch-at-age estimates the catch distribution from 1989 is used.

In Figure 2 is shown the age distributions of the catches for the three areas in 1990, weighted on the basis of the catches given in Table 4 taking into account season and gear. In Ilulissat most of the 1990 catches derives from a longline fishery in the summer. The age distribution of the catches ranges between age 7 and age 18, having a unimodal peak at age 11. In Uummannaq the 1990 fishery is mainly carried out as a longline summer fishery, although gillnets represent more than 30% of the annual catches. Age distributions of catches are in the age range 7 - 18, showing an unimodal peak at age 12. In Upernavik 75% of the 1990 catches derives from a summer longline fishery. Age-groups represented in the catches ranges between age 7 and age 18, having a mode at age 11.

Catch-at-age for each of the areas, Ilulissat, Uummannaq and Upernavik was estimated for the years 1988-1990, using pooled mean weight-at-age data on the basis of samplings in the three areas since 1986 (Table 5). As seen for the Ilulissat area in Table 6.1, catch in numbers decreased from 1988 to 1989 and increased again from 1989 to 1990. The same tendency seem to be the case for the Uummannaq area in Table 6.2, although the 1990 catch in numbers figure is less than the 1988 figure. In Upernavik catch in numbers steadily decreased from 1988 to 1990, a decrease of about 25% (Table 6.3). However, fishery in a larger scale in this area began in 1986 and a slight decrease in catches are therefore to be expected due to a fishery on a virgin stock component assuming unchanged effort. No effort data is available for any of the fisheries in the three areas, but it seems likely that the variation in the total catch in numbers for Ilulissat and Uummannaq areas might be due to changes in effort, as the fishery is highly dependent on weather and ice conditions in the fjords.

Length frequencies from the Canadian otter trawl fishery for Greenland halibut in Subarea 0 in 1990, (Fig.3a) show that catches were in the length range 32 - 96 cm, with a mode at 52 cm having the average length 60 cm. Applying an age-length key based on samplings from a japanese trawl fishery in Divisions 1CD in 1988 to this length distribution, results in the age distribution given in Fig.3b. Similar is for Japanese trawl surveys in Subarea 1, given length- and age distributions in Fig.4, (Jørgensen and Akimoto, 1991). No data is

available from the Japanese commercial fishery, however previous catch distributions from the Japanese surveys and commercial trawl fishery in Subarea 1 were very alike apart from fish below about 30 cm, appearing in the surveys. The same age-length key as used for the Canadian trawl catches was applied to the length frequencies and the resulting age distribution is shown in Fig.4b. From Fig.3 and 4 it is obvious that catches in the Canadian fishery are composed of larger fish.

2.5 Other information on the fisheries.

Information on a trial longline fishery for Greenland halibut in April 1990 in Qaanaaq most northerly in Div. 1A (77°30'N, see Fig.1), shows that Greenland halibut are in the length range 30-95 cm, with a marked mode at the length group 55-59 cm. Based of about 7000 hooks, mean catch of Greenland halibut was estimated to 78 gr per hook.

Prognoses.

A summarize of the biological information on the stocks of Greenland halibut in the NAFO convention area (Boje and Jørgensen, 1990), in relation to a recommendation by STACFIS "that consideration should be given to the biological and practical implications of combined stock assessment for Subarea 0, 1, 2 and Divs.3KL", concludes that Greenland halibut in the fjords in Subarea 1 seem to be very stationary and therefore these components should be assessed separately. Further, it is concluded that there is no reason to maintain two separate assessments for the remaining areas in Subareas 0, 1, 2, and 3KL. However, at present practical implications impede such a combined assessment, as the main part of the fishery takes place in areas not covered by the surveys.

For the offshore areas of Subarea 0+1, biomass estimates from the USSR/GDR and Japanese surveys seem consistent during the last 3 or 4 years. However, attention most be paid to the marked increase in catches in Subarea 0 from 1989 to 1990.

For the fjord areas in Subarea 1, catch at age seem consistent in the period 1988-90, although total catch showed some variation, probably due to changes in effort.

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Table 1. Greenland halibut landings (metric tons) by year and country for Subarea 0 from 1980 to 1989.

Country	YEAR 80	81	82	83	84	85	86	87	88	89	90[a]
Can-M	136	-	-	-	-	-	-	-	-	-	-
Can-N	-	-	-	-	-	-	-	-	2	-	6194
Can-Q	-	-	-	-	-	-	-	-	-	-	-
DDR	-	-	-	-	-	335	-	-	-	-	-
E/DEU	-	-	-	-	-	-	-	-	-	-	-
E/FRA-M	-	-	-	-	-	-	-	-	-	-	-
E/FRA-Sp	-	-	-	-	-	-	-	-	-	-	-
E/GBR	-	-	-	-	-	-	-	-	-	-	-
GRL	1	-	-	-	-	-	-	-	-	-	-
FRO	60	170	337	765	370	525	240	388	963	698	2540
JPN	-	-	-	-	-	-	-	-	-	-	-
NOR	-	-	-	-	-	-	-	-	-	-	-
POL	-	-	-	-	-	-	-	-	-	-	-
PRT	-	-	-	-	-	-	-	-	-	-	-
SUN	1546	3626	3468	3772	109	179	32	-	59	29	1528
USA	-	-	-	-	-	-	-	-	-	-	-
Total	1743	3796	3805	4537	479	1039	272	388	1024	727	10262

[a] Provisional data

Table 2. Greenland halibut landings (metric tons) by year and country for Subarea 1 from 1980 to 1989.

Country	YEAR 80	81	82	83	84	85	86	87	88	89	90[a]
Can-M	-	-	-	-	-	-	-	-	-	-	-
Can-N	-	-	-	-	-	-	-	-	-	-	-
Can-Q	-	-	-	-	-	-	-	-	-	-	-
DDR	-	-	-	-	-	-	-	-	-	-	-
E/DEU	1174	33	9	14	15	-	-	-	-	-	-
E/FRA-M	-	-	-	-	-	-	-	-	-	-	-
E/FRA-Sp	-	-	-	-	-	-	-	-	-	-	-
E/GBR	-	-	-	-	-	-	-	-	-	-	-
GRL	5355	5755	5397	4136	6509	9127	8705	8668	7003	7427	7933
FRO	-	-	-	-	-	-	-	-	-	-	131
JPN	-	-	-	-	26	5	-	906	1581	1300	861
NOR	-	-	-	-	2	-	-	-	-	-	-
POL	-	-	-	-	-	-	-	-	-	-	-
PRT	-	-	-	-	-	-	-	-	-	-	-
SUN	-	-	-	-	-	-	-	-	-	-	-
USA	-	-	-	-	-	-	-	-	-	-	-
Total	6529	5765	5406	4150	6552	9132	8705	9574	8584	8727	8927

[a] Provisional data

Table 3. Biomass estimates (000' tons) from Greenland/Japanese surveys and USSR/GDR surveys for the years 1987-1990 in areas of Subareas 0+1.

Year/Divisions	USSR/GDR 0B	1BCD	Japan/Grl 1ABCD	1BCD
1987	37	56	54[a]	54[a]
1988	55	47	63	53
1989	84	no survey	63	63
1990	79	83	56[b]	53[b]

[a] In 1987 the survey did not cover the depth stratum 1000-1500 m.

[b] Average values of two surveys.

Table 4. Catches of Greenland halibut in Div.1A (tons) by area, gear and season in the period 1988-1990 used in the weighting of the catch-at-age estimations.

Season	Gear	Ilulissat	Uummannaq	Upernavik	Totals
			1988		
Winter	gillnets	393	501	0	894
	longlines	188	573	466	1226
	not known	566	282	0	848
Summer	gillnets	452	768	0	1220
	longlines	220	424	1274	1919
	not known	782	233	0	1016
Totals		2601	2784	1740	7122
			1989		
Winter	gillnets	382	599	0	981
	longlines	558	453	575	1585
	not known	243	58	0	302
Summer	gillnets	403	671	0	1075
	longlines	89	456	1184	1729
	not known	168	45	0	213
Totals		1843	2282	1759	5885
			1990		
Winter	gillnets	182	421	0	603
	longlines	944	528	137	1609
	not known	15	13	1	29
Summer	gillnets	523	380	0	903
	longlines	1335	1104	1199	3638
	not known	37	8	0	45
Totals		3036	2453	1337	6826

Table 5. Mean weight-at-age (kg) of Greenland halibut on the basis of samplings in Divisions 1ADF in 1986-88.

Age	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Mean wgt	0.409	0.512	0.865	1.180	1.674	2.183	3.024	3.657	4.498	5.668	6.658	7.802	8.632	9.429
No.sampl.	22	86	118	249	383	305	305	212	161	156	92	46	27	8

Table 6.1. Catch-at-age of Greenland halibut in 1988-1990 for the most important fjord areas in Subarea 1 (Div. 1A). Ilulissat.

	Catch in numbers (thou.).		
age	1988	1989	1990
5	0	0	0
6	1	0	0
7	9	0	1
8	59	14	24
9	182	106	141
10	173	121	185
11	132	94	188
12	73	49	126
13	63	33	80
14	65	39	59
15	38	31	42
16	18	19	23
17	11	14	15
18	4	8	6
Total	827	529	890

Table 6.2. Catch-at-age of Greenland halibut in the most important fjord areas in Subarea 1. Uummannaq (Div. 1A).

	Catch in numbers (thou.)		
age	1988	1989	1990
5	0	0	0
6	0	0	0
7	1	0	1
8	5	2	3
9	20	9	15
10	52	35	47
11	121	98	108
12	143	120	121
13	121	99	101
14	96	76	82
15	49	38	42
16	23	19	20
17	13	14	15
18	4	6	6
Total	648	516	563

Table 6.3. Catch-at-age of Greenland halibut in the most important fjord areas in Subarea 1. Upernavik (Div. 1A).

	Catch in numbers (thou.)		
age	1988	1989	1990
5	0	0	0
6	0	0	0
7	0	0	0
8	6	2	2
9	33	16	17
10	55	34	41
11	80	59	62
12	74	66	57
13	68	69	52
14	62	73	48
15	31	40	25
16	13	18	11
17	7	10	5
18	2	3	1
Total	431	389	323

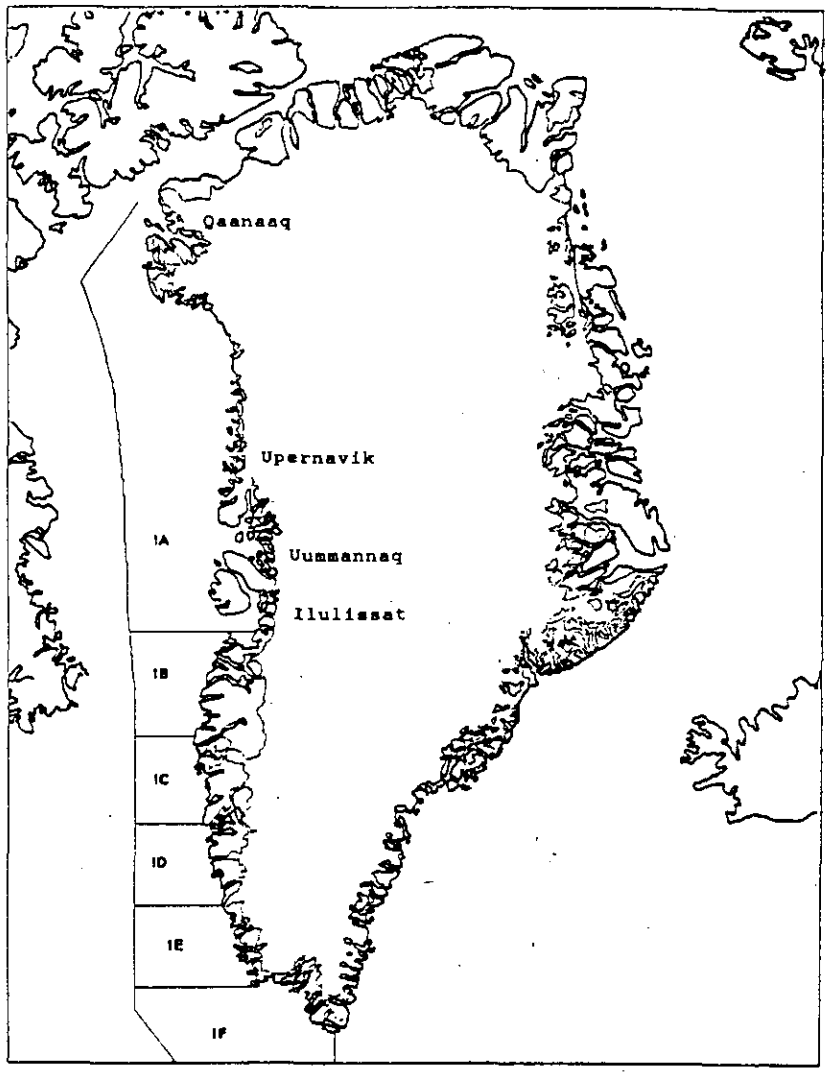


Fig. 1. Map of Subarea 1 showing localities mentioned in the text.

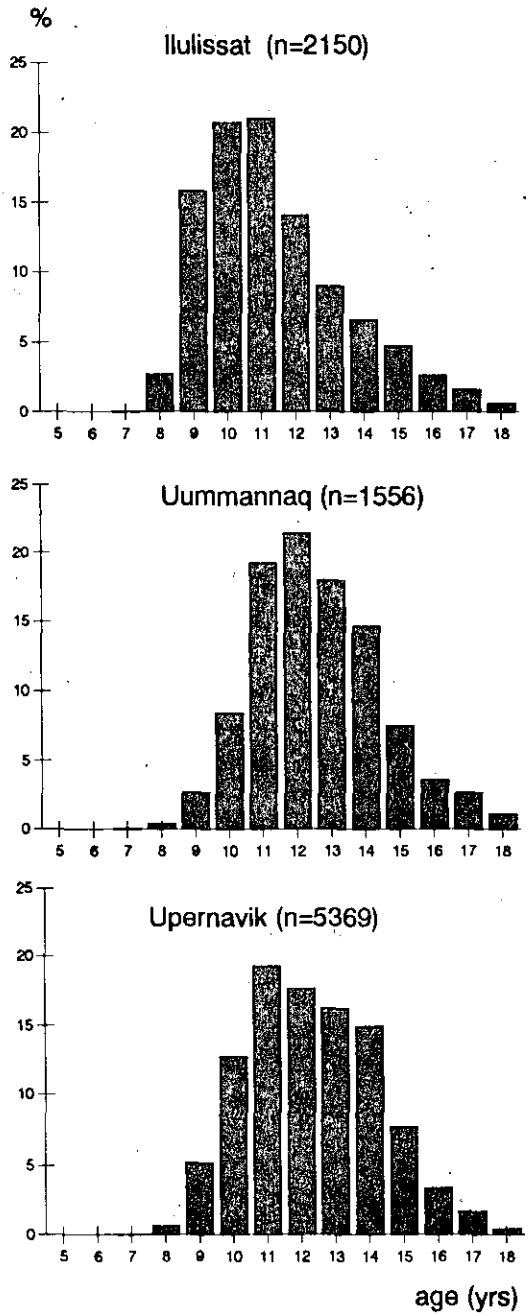
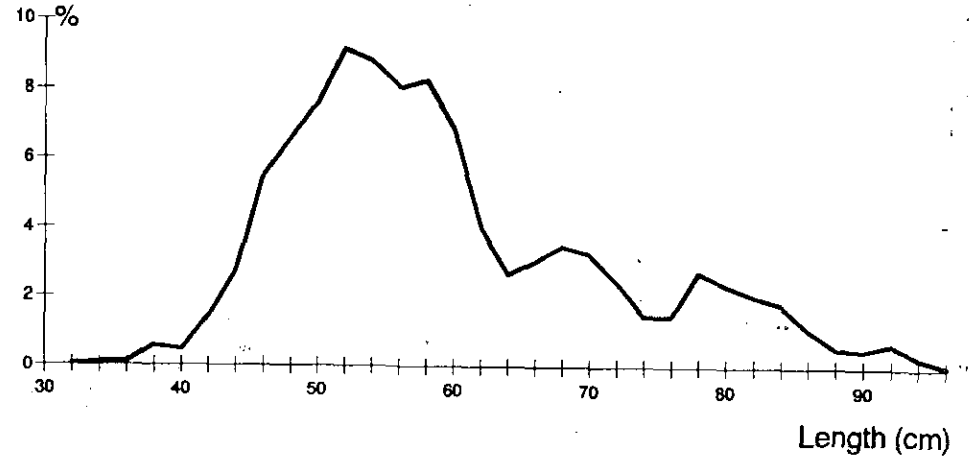


Fig. 2. Age distributions of catches of Greenland halibut in 1990 in Subarea 1 (Div.1A), for each of the important fjord areas.



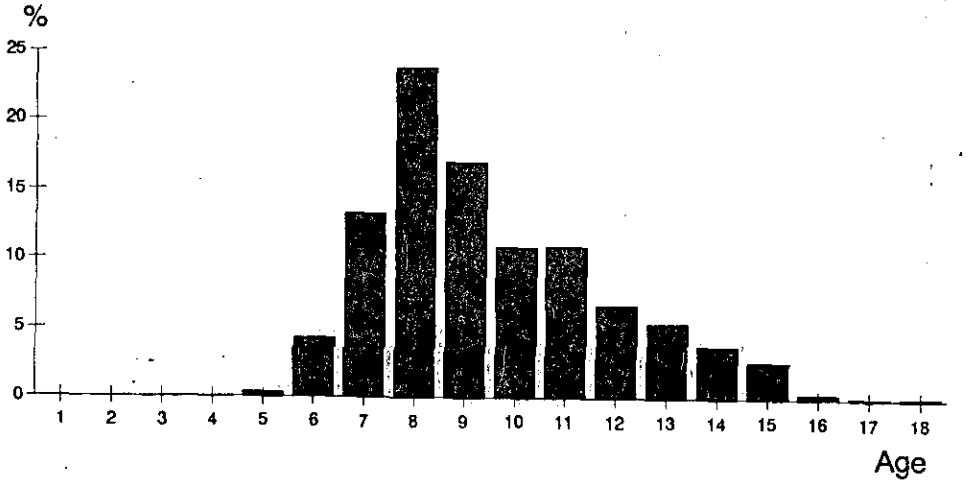
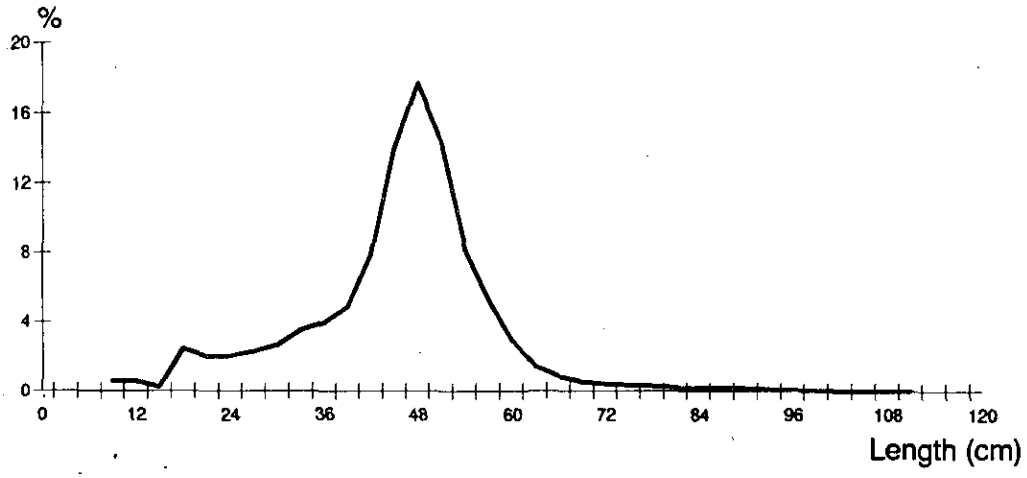


Fig. 3. Length- and age distributions of catches of Greenland halibut by Canadian Otter trawlers in Subarea 0 in October/November 1990.



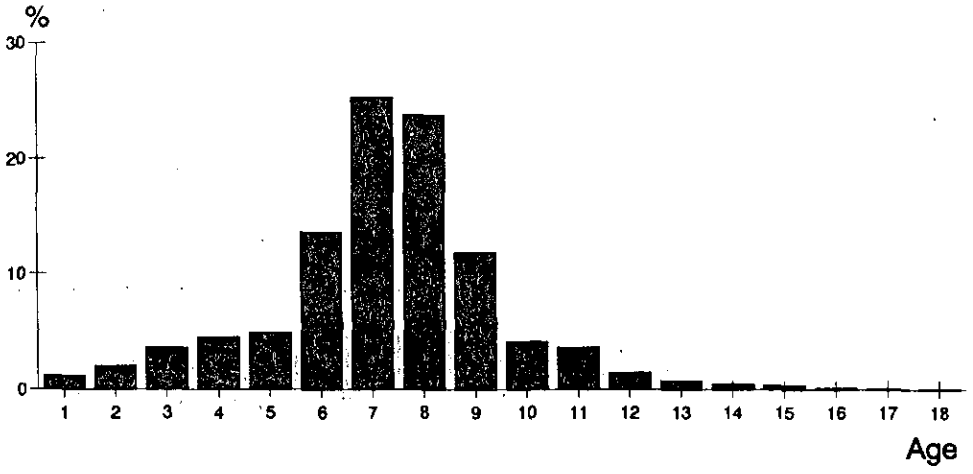


Fig. 4. Length- and age distributions of catches of Greenland halibut from the Japanese/Greenland trawl survey in Div. 1ABCD in 1990.