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Trawl Survey Results on Greenland Halibut Stock Evaluation in NAFO Divs. 0B and 2GH in October/December 1991

by

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INTRODUCTION

North of 47°30' N, one whole Greenland halibut stock dwells (Ernst, 1989). 0B and 2GH Divisions belong to the northern part of its area. Only some countries have conducted the directed Greenland halibut fishery, however, the total catch in 0+1 and 2+3KL subareas has always been less than TAC and the stock was under-exploited.

VPA calculation of both abundance and biomass can be successful only in the case of data on catch per unit effort being presented and based on the fishery information reflecting the dynamics of the fishery stock adequately. Accounting the peculiarities of Greenland halibut fishery, it is difficult to obtain a reliable timely information for the stock calculation by this method. To our mind, Greenland halibut stock estimations, obtained by results of research bottom surveys being conducted by Russia annually since 1980, are more correct. These surveys' results allow to evaluate TAC and fishery influence on the stock status including the possible effect of various fishery gear more accurately.

MATERIAL AND METHODS

Greenland halibut stocks in 0B and 2GH Divisions have being surveyed by random stratified scheme since 1983. Similar vessels with approximately equal power of the main engines are used for surveys. The gear used are research bottom trawls. Methods of works are standard, hence the survey results are comparable by the whole time series of observations. They were completely described in previous papers (Konstantinov, 1981; Bulatova, Chumakov, 1986). Trawl stations position was chosen occasionally taking the NAFO division stratification into account. Not less than 3 research trawlings were conducted in each stratum, and a trawl catchability factor was 1. Trawl stations location is presented in Figs. 1-3.

In 1991, RV "Kapitan Shaitanov" has conducted surveys on November 3-17 (0B), October 26-31 and November 17-21 (2G) and November 21-December 04 (2H). In 0B Div., 59 research trawlings were carried out within the range of 200-1500 m on the square of 36.6 sq.miles. In 2G Div., 138 trawlings were carried out in the range of 200-1500 m on the square of 16.8 thou. sq. miles. In 2H Div., 51 research trawlings were done within the range of 300 - 1500 m on the square of 3.1 thou. sq. miles.

RESULTS

Distribution of catches and stock estimation

Greenland halibut have occurred in catches within the whole area of observations excluding stratum No. 8 (0B). During the survey, the schools were scarce and concentrations appropriate for the effective trawl fishery were not noted. Maximum yield in 0B Div. was in the stratum No. 5 at the depth of 830 m and was equal to 175 kg per 1 trawling hour. In 2G Div., the maximum yield constituted 300 kg in the stratum No. 919 at the depth of 1090 m; and that of the 2H Div. was 370 kg in the stratum No. 939 at the depth of 1050 m.

At the small depths (down to 400 m), Greenland halibut were noted in the catches by the piece. The largest number of fish was at the depth of 900-1250 m.

According to the results of the survey in 0B Div., the total abundance of Greenland halibut constituted 50.8 mln. spec. and the biomass was 43.2 thou. t (Table 1). In 2GH Div., the abundance constituted 23.1 mln. spec. and biomass was 15.5 thou. t (Tables 2 and 3).

Length and age composition

Males of 12-70 cm long at age of 2-12 were noted in 0B Div. (Figs. 4 and 5). The mean length constituted 43.99 cm. 1984 year class at age of 7 was the basic one in the catches. The correlation of 6- and 8-year-old males was approximately equal (20% of every age group). The older age groups (9-12 year old) were small in number.

Females in 0B Div. were represented by species of 12-93 cm long at age of 2-14. The mean length constituted 44.2 cm and mode - 48-49 cm. Females at age of 7 constituted about 30 % of the number of the investigated fish and sufficiently dominated among other age classes. Besides 7-year-olds, fish at age of 3-9, the portion of which varied from 9 to 14 %, had a great importance.

The linear sizes of Greenland halibut were increasing with the increase of the depth. The mean length of males at the depth of

301-400 m constituted 31.3 cm and females - 29.9 cm, whereas at the depth of 1251-1500 m it was 49.4 cm and 53.6 cm, correspondingly. Three juveniles 8 cm long were caught in OB Div. for the whole period of the survey.

According to the 1991 observations, the mean age of males constituted 6.3 years and females - 6.4 years in OB Div.

Male lengths in 2GH Divs. varied from 12 to 67 and age - from 2 to 11 year old. To compare with OB Div., smaller specimens with average size of 40.8 cm and mode group of 44-45 cm have occurred on Labrador. 4-7-year-olds were the basis of the catches, in which specimens at age of 5 (1986 year class) dominated, and males at age of 6 and 7 (in equal correlation) were of the secondary importance.

Females were represented by the specimens of 12-99 cm long at age of 2-17. At that, the mean length constituted 41.7 cm and the mode - 42-45 cm. Abundance of year classes has been increasing with age from 2 to 6 year old and decreasing impetuously from 7 year old.

Linear sizes of Greenland halibut increased with the increasing of the depth the same way as in OB Div. The mean size of males constituted 23.3 cm at the depth of 500 m whereas the female mean size was 26.8 cm. Those at the depth of 501-750 m were 38.9 cm and 40.4 cm; and the depth of 1251-1500 m - 49.8 cm and 55.9 cm, correspondingly. 7 juveniles 8-11 cm long were caught.

The average age of males in Divs. 2GH constituted 5.6 year old and females - 5.8 year old.

Sex composition and maturity

In all investigated areas, males predominated quantitatively over females. In OB Div., males constituted 63.1 % of catches. The relative number of males increased from 54.6 % at the depth of 301-400 m to 70.4 % at the depth of 1001-1250 m and decreased slightly to 64.4 % in the depth range of 1251-1500 m.

The major number of fish were immature at the depth down to 750 m. Maximum of mature males (47.3 %) was noted in the depth range of 1001-1250 m and females (10.7 %) - from 1251 to 1500 m.

In total, males (56.2 %) predominated in Divs. 2GH, however, sex correlation at the 500 m depth was approximately equal.

About 95 % of the analyzed specimens were immature. Maturing fish occurred in catches only at the depth more than 1000 m.

Their number in various strata varied from 22.6 to 34.4 % in males and from 23.1 to 49.9 % in females. Pre-spawning and spawning fish at 4th and 5th gonads mature stages were not noted in any area.

DISCUSSION

Analysing dynamics of the length and age composition of Greenland halibut in Divs. 0B and 2GH, it should be noted that there was a decrease in mean length from 51.8 cm in males and 51.6 cm in females in 0B Div. in 1985 to 43.9 and 44.2 cm, correspondingly, in 1991 (Fig. 6). Mean length in 2GH has decreased in those years from 46.12 cm to 40.83 cm in males and from 48.0 to 41.7 cm in females (Fig. 7). Age composition has sufficiently changed in the same period as well. In spite of the fact that the basis of catches was 7-year-olds in 0B Div., according to our data, and in spite of the differences in abundance of various year classes, the mean age of males decreased in recent years from 7.1 to 6.3 and females - from 7.2 to 6.4 (Fig. 8). At this, the number of elder females has decreased. If the maximum fish age in trawl catches in 0B Div. in previous years constituted 20 years, then in 1991 14-year-olds were the oldest ones. The similar changes of age composition took place in 2GH as well (Fig. 9). Greenland halibut males begin to mature at the length of 46-47 cm and at age of 5-6, whereas females - 52-53 cm and 6-7 year old. In 0B Div., a half of males mature at age of 7 and females - at age of 11. In Divs. 2GH the mass maturation takes place in older specimens and constitutes 9 and 13 year old for males and females, correspondingly (Serebryakov et al., 1989). According to trawl surveys of 1985-1991, the number of fish, which overcame 50% - level of maturity, has decreased in 0B from 70.7 to 54.0% in males and from 7.4 to 3.0% in females (Table 4). The analogous process took place in 2GH (Table 5).

Concerning the period of 1980-1991, the largest abundance and biomass of Greenland halibut in 0B and 2GH were registered, due to our data, in 1982-1983 (Fig. 10). In subsequent years, stocks have decreased gradually in 0B. Some stabilization was noted in 1984-1986 and, at lower level, in 1987-1991.

In Divs. 2GH the decrease of stocks was more expressed beginning from 1984. According to the survey results and in comparison with 1982, Greenland halibut abundance has at present decreased approximately 6 times and biomass - 14 times.

At the same time, the total catch of Greenland halibut, the value of which varied in various years, has never exeeded TAC. The latter can be considered to be correct since it was calculated on the basis of the international scientific research in this area (Table 6). Therefore, the fishery itself could not, to our opinion, influence the stock status of this species.

One of the reason of the abundance and biomass decrease revealed during the surveys can be a gradual replacement of Greenland halibut down to great depths (Boje, 1991). In this case, it is necessary to enlarge the investigated area during the future surveys down to the depth of 2000 m.

To our view, the other reason of the commercial stock decrease and mainly its spawning part in recent years can be the intensive development of long-lining at great depths in off-shore subareas 0 and 2.

At present, several countries use long-line during the Greenland halibut fishery in the NAFO zone. However, Greenland conducts long-lining on coastal fish concentrations in fjords, whereas the Faroe Isla and Norway catch halibut off shore nearby the land slope. In 1990, the Faroe Isls has caught nearly a half of 2995 t of halibut from the 0B and 2GH Divisions with the use of long-line (Reinert, 1991).

The NAFO Scientific Council underlined that in the case of concentration of forces in the local areas with a small number of age groups, the sufficient component of the stock can occur under the harmful influence (Bowering, Brodie, 1990).

Unfortunately, we had very limited information on the size composition of halibut from long-lining catches. In 1990, females 58-87 cm long were the basis of the RV "Konakovo" catches in 0B Div. and 54-90 cm long - in 2H Div. (Fig. 11). Females were 5 times more than males in 0B Div. and 13 times more in 2H Div.

In the trawl catches, the Greenland halibut size curve is usually one-mode with maximum at 44-52 cm. At this, males predominate in number.

The peculiarity of the bathimetrical distribution of Greenland halibut is their size increase in the dependence of the depth. Results of tagging conducted by Canadian specialists allow to conclude on the presence of expressed halibut migrations in the shelf - slope direction (Bowering, 1984). In connection with the absence of the representative data, we can not discuss with Ernst (1989) the scheme of the long-term spawning migration of the Labrador - Newfoundland halibut into the area of the Davis Strait. We notify only that the spawning specimens with running gonads were observed earlier for several times in cruises of research and fishery vessels on the land slope along the whole peninsula of Labrador. The spawning area probably extends to the south towards the eastern slope of the Grand Bank including the Flemish Pass. Besides, the Greenland halibut reproduction takes place in the Gulf of St. Lawrence (Bowering, 1980).

Summerizing the given proves, it is possible to suppose that large halibut able to spawn in this area make concentrations along the land slope of Labrador at the depth of more than 1000 m in autumn.

The influence of long-lining on Greenland halibut stock status within the long-term aspect needs the further studying. In connection with the fact that such fishery is based, as it was mentioned above, on the large mature females mainly, the further its development, to our mind, can lead to the weak reproductive capability of the local groups of Greenland halibut in the various parts of the area and to the reduction of the stock in the North-Western Atlantic.

Similar results were registered on Greenland halibut of the Norwegian and Barents Seas where the spawning part of the population was exhausted in the result of the intensive Norwegian fishery by long-line and gill nets in the spawning grounds that have caused the decrease of the population maturity and appearance of poor year-classes (Nizovtsev, 1989).

Removing of the largest specimens during the fishery can destruct the natural mechanism of reproduction and result in the population exhausting (Kovtsova, pers. com., 1992).

R E F E R E N C E S

BOJE, J.1991. An assessment of the Greenland halibut stock component in NAFO subareas 0+1. NAFO SCR Doc. 91/38, Ser.No.1918, 12 p.

BOWERING, W.R.1980. Fecundity of Greenland halibut, Reinhardtius hippoglossoides (Walbaum), from Southern Labrador and Southeastern Gulf of St.Lawrence. J.Northw.Atl.Fish.Sci., vol. 1, p. 39-43.

BOWERING, W.R.1984. Migrations of Greenland halibut, Reinhardtius hippoglossoides, in the Northwest Atlantic from tagging in the Labrador-Newfoundland region.J.Northw.Atl.Fish.Sci., vol. 5, p. 86-91.

BOWERING, W.R. and W.B.BRODIE.1990.An assessment of the Greenland halibut stock component in NAFO subarea 2 and divisions 3K and 3L. NAFO SCR Doc.90/51, Ser.No.1772, 21 p.

BULATOVA, A.Yu. and A.K.Chumakov.1986.USSR trawl surveys in NAFO subareas 0, 2, 3.NAFO SCR Doc.86/66, Ser.No.1183, 13 p.

ERNST, P.1989.On the distribution and stock delimination of Greenland halibut (Reinhardtius hippoglossoides WALB)in sea areas of East Canada and West Greenland.Fischerei-Forschung,27/4, p. 5-16.

KONSTANTINOV, K.G.1981.Methods and results of the total trawl survey of bottom fish in Subarea 3 in 1971-1980.NAFO SCR Doc.81/6, Ser.No.73.

REINERT, J.1991.Faroe Island research report for 1990.NAFO SCR Doc.91/11, Ser.No.1899, 6p.

SEREBRYAKOV, V.P., A.K.CHUMAKOV and I.I.TEVS.1989.Spawning stock, population fecundity and year class strength of Greenland halibut from the Northwest Atlantic in 1969-1988.NAFO SCR Doc.89/86, Ser.No.1670, 13 p.

NIZOVTSEV, G.P.1989.Recommendations on rational exploitation of Greenland halibut from the Norwegian-Barents Sea stock. Murmansk, PINRO, 93 p. (in Russian).

Table 1. Results of the trawl survey on Greenland halibut in OB Div. November, 1991.

Stratum No.	Depth, m	Trawlings quantity	Mean length cm	Mean mass g	Mean catch per 1 trawling spec.	Mean catch per 1 trawling kg	Abundance, thou.spec	Biomass, t
I	201-300	3	8,5	6	I,0	0,0I	87,3	0,5
8	-"-	3	-	-	-	-	-	-
22	-"-	3	32,5	32I	0,3	0,I	27,4	8,8
2	301-400	3	35,9	43I	8,0	3,4	546,4	235,3
9	-"-	3	35,4	443	4,3	I,9	644,8	286,0
23	-"-	3	28,4	206	27,3	5,6	946,5	I95,I
3	401-500	3	4I,6	726	23,3	I6,9	2260,7	I64I,I
I0	-"-	4	33,3	406	32,3	I3,I	I870,5	760,3
24	-"-	3	29,I	270	42,0	II,4	2254,0	609,5
4	501-750	4	45,6	925	64,8	59,9	II20I,8	I036I,I
II	-"-	4	40,6	690	56,5	39,0	4836,0	3336,8
25	-"-	4	32,9	388	4I,3	I6,0	3254,2	I262,7
5	751-1000	5	46,3	926	I03,4	95,8	7927,3	7343,8
I2	-"-	3	44,9	832	42,7	35,5	I490,2	I239,5
6	I001-I250	5	50,0	II62	II5,6	I34,3	8455,9	9825,7
I3	-"-	3	48,5	I038	93,3	96,8	II85,7	I230,3
7	I251-I500	3	50,9	I279	62,7	80,2	3808,8	487I,0
Total		59					50797,5	43207,5

Table 2. Results of Greenland halibut trawl survey in 2G Div. September-November, 1991.

Stratum No.	Depth, m	Trawlings quantity	Mean length, cm	Mean mass, g	Mean catch per 1 trawl. spec.	Mean catch per 1 trawl. kg	Abundance, thou.spec	Biomass, t
909	200	6	30,5	401	3,2	1,3	325,3	130,5
910	-"-	4	12,5	13	1,0	0,01	86,6	1,1
925	-"-	4	15,9	36	1,8	0,1	116,9	4,2
901	201-300	3	30,4	315	43,3	13,7	1946,8	612,1
908	-"-	4	34,2	447	24,5	10,9	530,8	237,4
911	-"-	4	31,9	391	52,5	20,5	1345,6	525,8
924	-"-	4	34,5	413	12,0	5,0	336,0	138,8
926	-"-	3	29,5	292	10,7	3,1	171,1	49,9
902	301-400	5	31,5	363	60,4	21,9	268,4	97,5
912	-"-	5	36,2	518	26,4	13,7	71,4	36,9
923	-"-	5	42,3	751	52,8	39,7	363,7	273,2
927	-"-	3	36,0	457	10,0	4,6	308,1	140,9
903	401-500	5	36,9	520	104,2	54,2	308,7	160,6
913	-"-	5	39,3	593	47,6	28,2	109,3	64,8
922	-"-	5	43,5	815	38,8	31,6	267,3	217,9
928	-"-	3	39,3	602	104,3	62,9	3025,7	1824,0
904	501-750	5	36,5	474	92,4	43,8	523,6	248,5
914	-"-	5	39,3	626	43,8	27,4	183,3	114,8
921	-"-	7	43,6	803	39,6	31,8	208,1	167,1
929	-"-	3	41,7	708	65,3	46,2	3051,3	2159,7
905	751-1000	5	45,6	880	83,2	73,2	505,4	444,8
915	-"-	5	45,4	878	65,6	57,6	233,2	204,8
920	-"-	7	47,1	991	74,1	73,4	472,3	467,9
906	1001-1250	5	49,2	1110	66,6	73,9	564,9	627,2
916	-"-	5	49,7	1234	51,0	62,9	275,8	340,2
919	-"-	7	50,4	1228	70,7	86,9	827,6	1016,8
907	1251-1500	5	53,1	1524	49,0	74,7	653,3	995,9
917	-"-	5	55,1	1795	11,4	20,5	69,7	125,1
918	-"-	6	51,8	1340	42,0	56,3	801,1	1073,8
Total		138					17951,3	12502,2

Table 3. Results of Greenland halibut trawl survey in 2H Div. November-December, 1991.

Stratum No.	Depth, m	Trawlings quantity	Mean length, cm	Mean mass, g	Mean catch per 1 trawling spec.	Mean catch per 1 trawling kg	Abundance, thou. spec	Biomass, t
932	30I-400	3	33,9	372	25,0	9,3	50,9	I8,9
944	-"-	3	33,I	357	20,7	7,4	658,3	235,4
959	-"-	3	33,4	375	33,3	I2,5	2I9,8	85,5
933	40I-500	3	32,9	339	33,3	II,3	6I,7	20,9
942	-"-	3	3I,I	293	II5,3	33,8	234,9	68,9
960	-"-	3	33,7	406	72,0	29,3	285,3	II6,I
934	50I-750	3	34,0	362	I5,0	5,4	43,3	I5,7
94I	-"-	3	35,2	420	80,7	33,9	265,9	III,9
96I	-"-	3	37,5	5I4	48,0	24,7	375,I	I92,8
935	75I-I000	3	39,5	557	83,7	46,6	297,5	I65,7
940	-"-	3	40,8	6I8	66,3	4I,0	238,3	I47,4
962	-"-	3	4I,9	686	45,0	30,9	403,3	276,6
936	I00I- I250	3	40,7	607	99,0	60,I	286,0	I73,5
939	-"-	3	43,I	732	I65,0	I20,8	794,4	58I,7
963	-"-	3	44,5	838	43,3	36,3	425,3	356,3
938	I25I-I500	3	44,4	828	43,7	36,I	308,9	255,7
964	-"-	3	5I,4	I469	I2,0	I7,6	I52,0	223,3
Total		5I					5I00,9	3046,3

Table 4. Dynamics of Greenland halibut age composition in 0B Div. by data of research surveys in 1985-91.

Years	Age, years					
	males			females		
	I-6	6	number of spec.	I-I0	I0	number of spec.
I985	29,3	70,7	8502	92,6	7,4	495I
I986	32,3	67,7	9242	9I,8	8,2	408I
I987	36,0	64,0	3730	87,I	I2,9	1494
I988	35,I	64,9	4729	9I,5	8,5	2059
I989	5I,9	48,I	3I9I	90,0	I0,0	2078
I990	39,0	6I,0	27I2	94,0	6,0	I503
I99I	46,0	54,0	I749	97,0	3,0	I0I4

Table 5. Dynamics of Greenland halibut age composition in 2GH by data of research surveys in 1985-91.

Years	Age, years					
	males			females		
	I-8	8	number of spec.	I-I2	I2	number of spec.
I985	96,4	3,6	2074	98,4	I,6	2052
I986	78,3	2I,7	I720	8I,6	I8,4	I348
I987	88,8	II,2	3426	92,0	8,0	2683
I988	85,4	I4,6	278I	93,0	7,0	I870
I989	90,4	9,6	4404	90,9	9,I	3I0I
I990	95,8	4,2	I348	96,3	3,7	II72
I99I	98,7	I,3	5I92	99,0	I,0	4I76

Table 6. Total catch and TAC of Greenland halibut in NAFO subareas 0+1 and 2+3 in 1983-92 (thou. t)

Area	Factor	Year									
		I983	I984	I985	I986	I987	I988	I989	I990	I99I	I992
0+I	TAC	25	25	25	25	25	25	25	25	25	25
	Catch	9	7	I0	9	I0	I0	9*	I9*		
2+3	TAC	55	55	75	I00	I00	I00	I00	50	50	50
	Catch	28	25	I9	I6	3I	I9	I9*	47*		

* Preliminary data

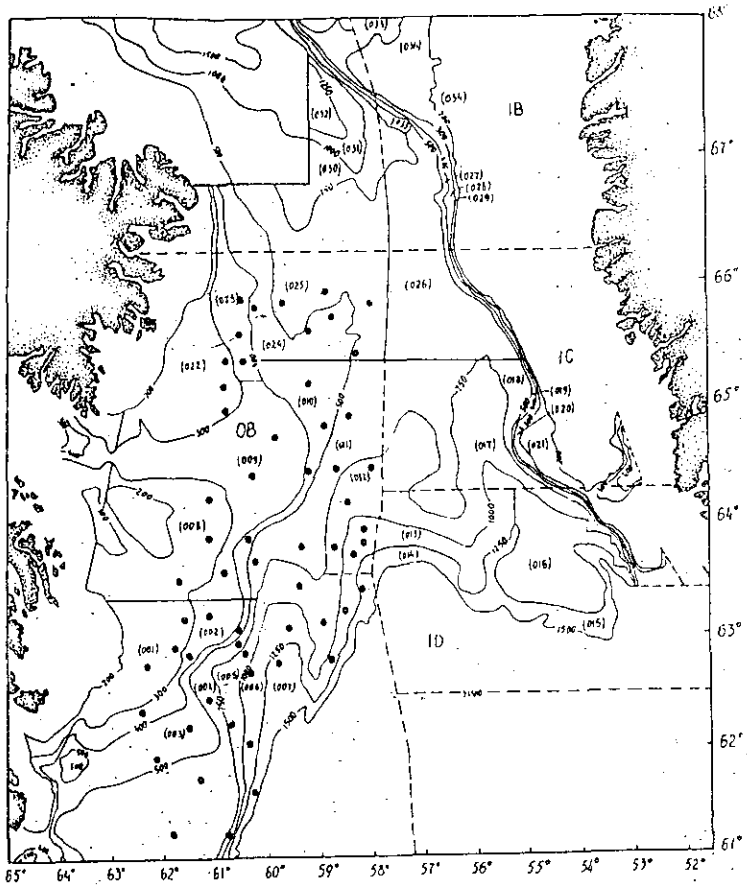

Fig.1. Stratification and trawling points in 0B Division. November, 1991.

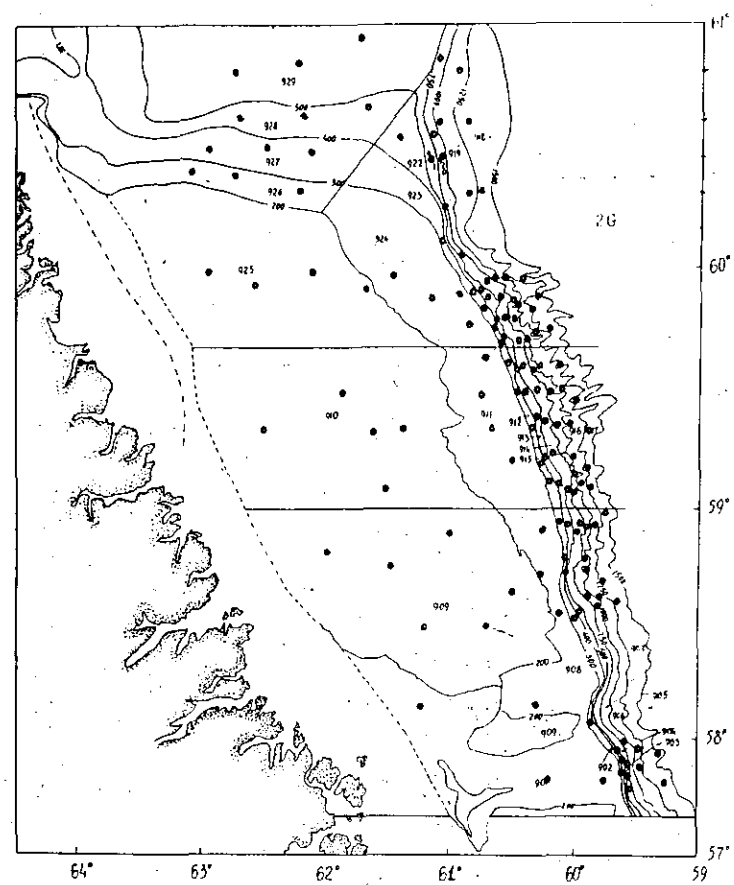

Fig.2. Stratification and trawling points in 2G Division. October-November, 1991.

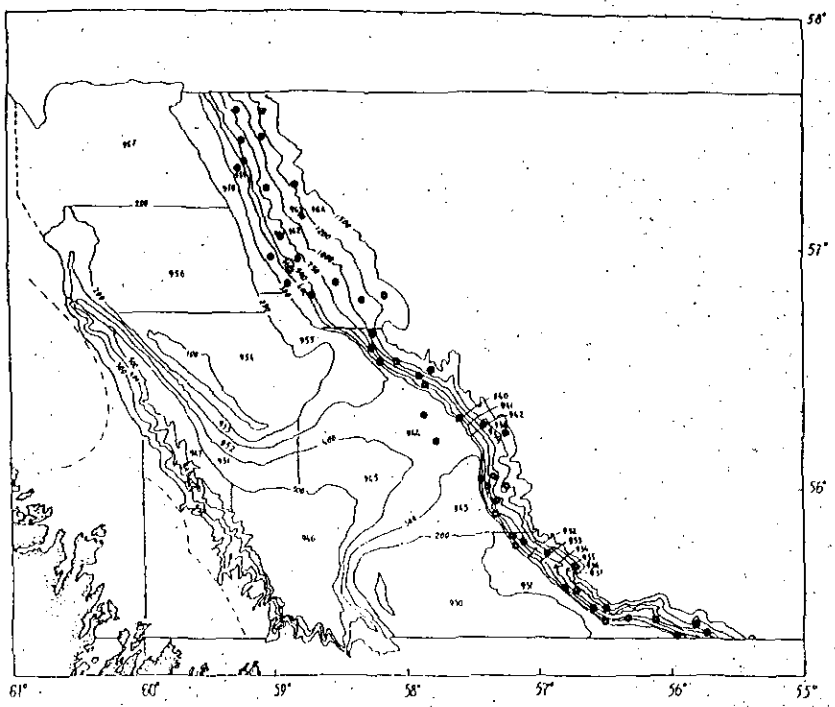

Fig.3. Stratification and trawling points in 2H Divivsion. November-December, 1991.

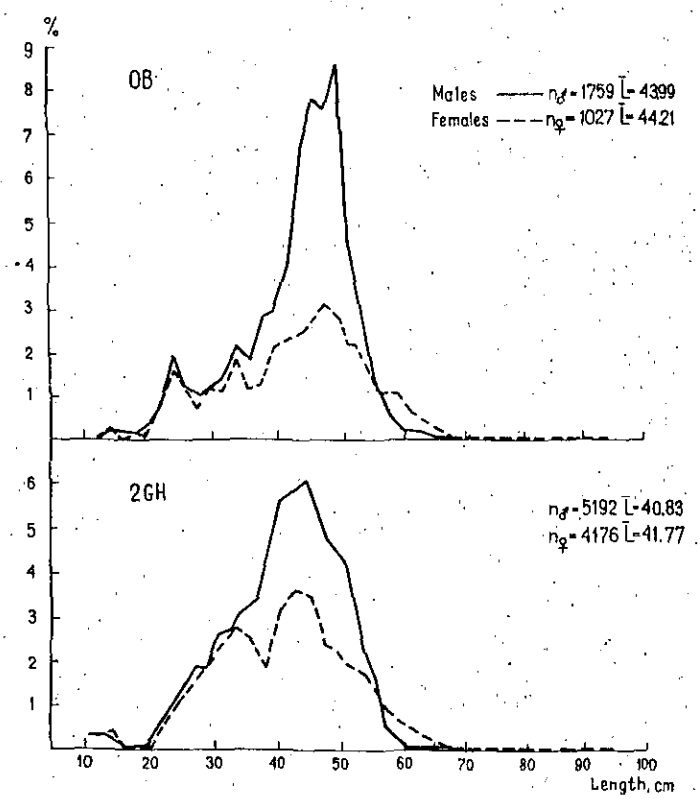

Fig.4. Greenland halibut length composition in Divs. 0B and 2GH. October-December, 1991.

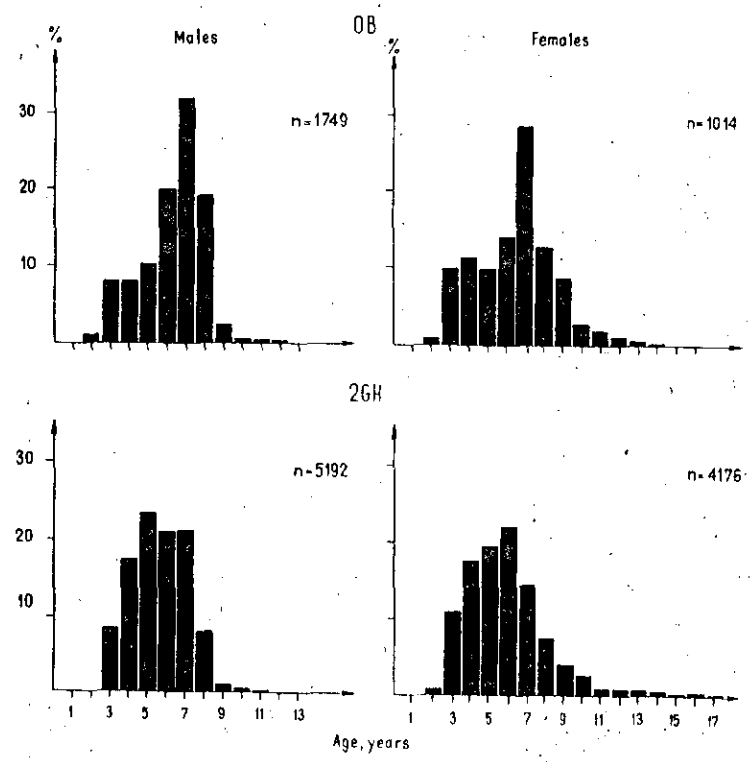

Fig.5. Greenland halibut age composition in Divs. 0B and 2GH. October-December, 1991.

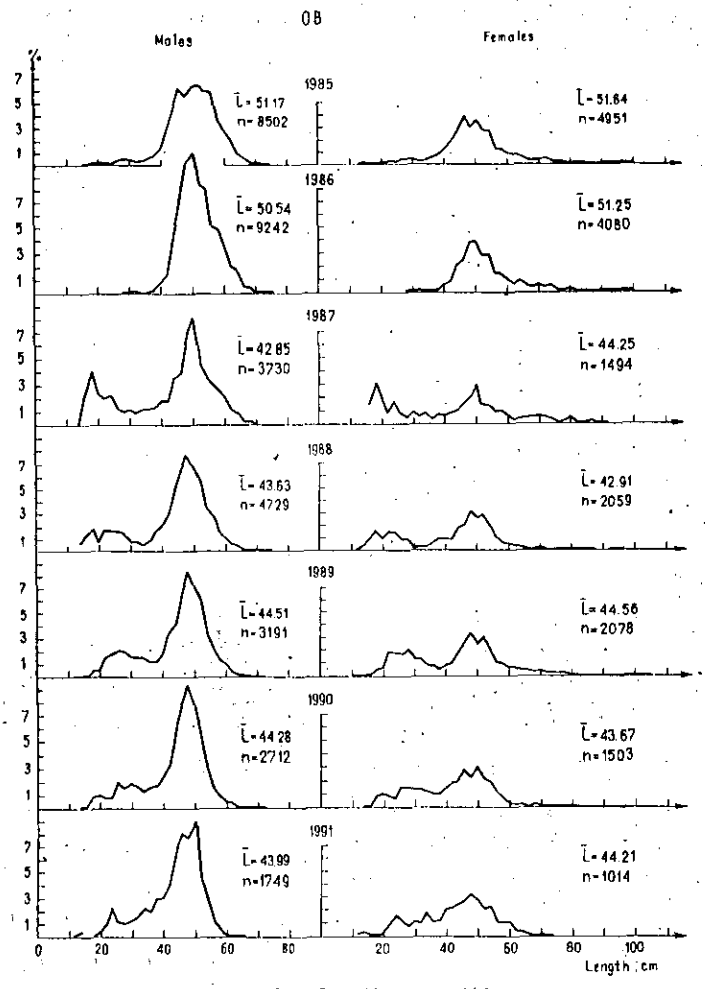

Fig.6. Greenland halibut length composition in 0B Div. in 1985-1991.

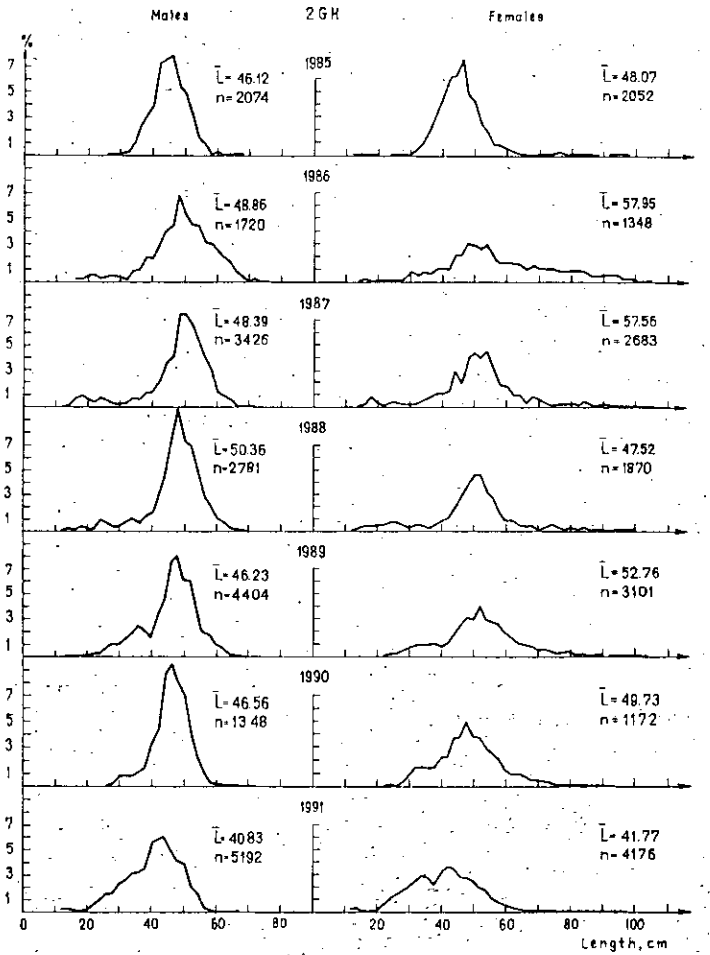

Fig.7. Greenland halibut length composition in 2GH Div. in 1985-1991.

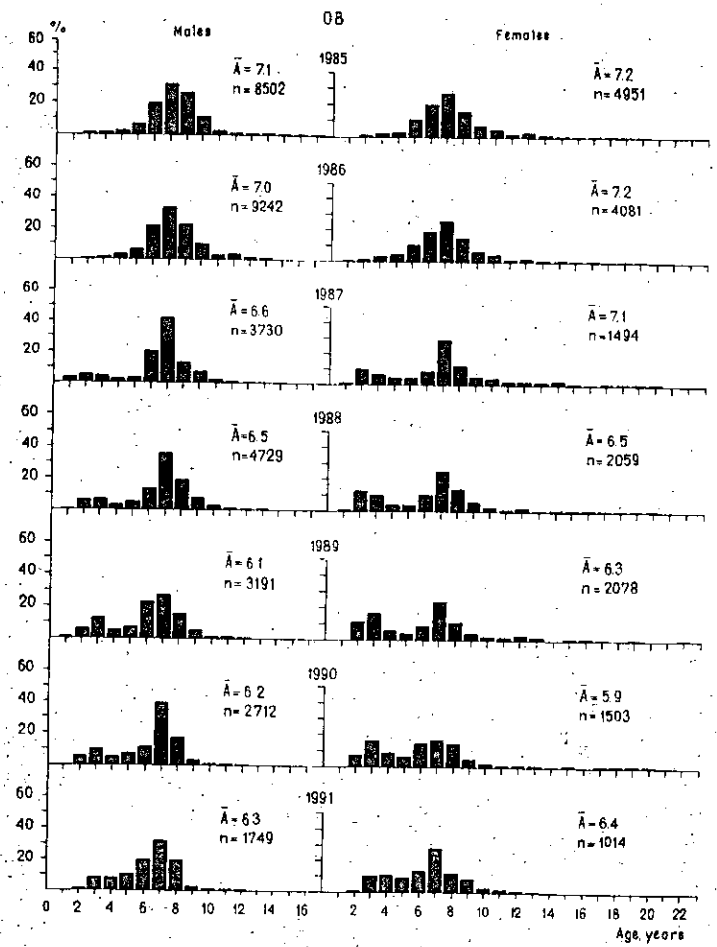

Fig.8. Greenland halibut age composition in 0B Div. in 1985-91

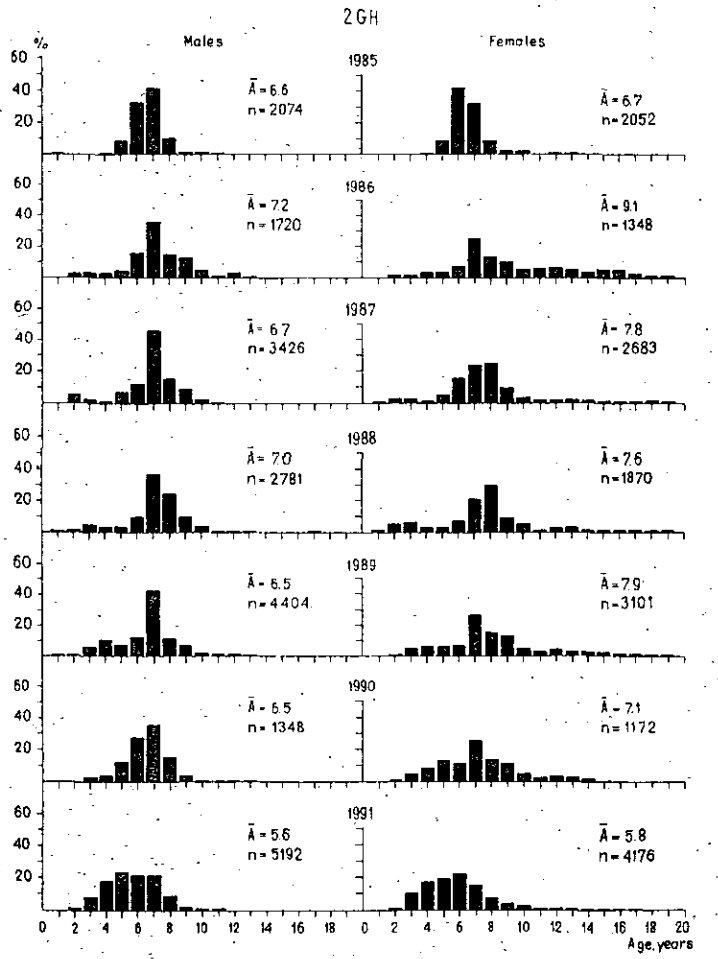

Fig.9. Greenland halibut age composition in 2GH Div. in 1985-91

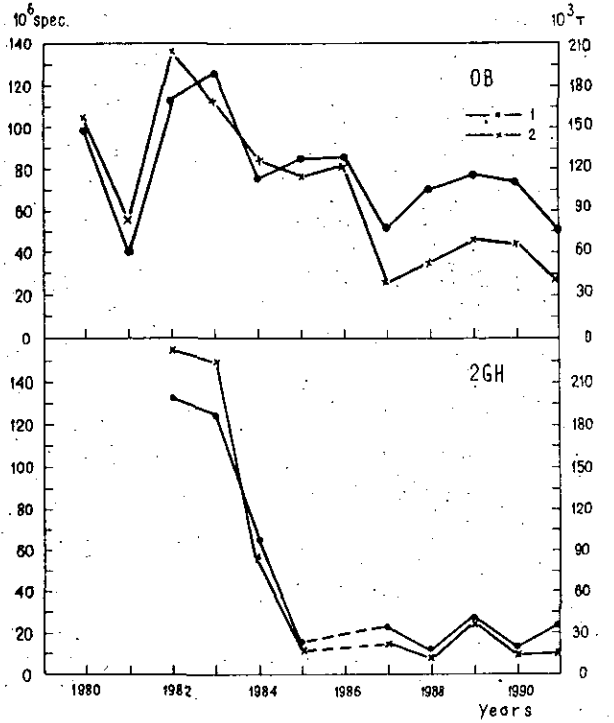

Fig.10. Abundance (1) and biomass (2) of Greenland halibut in Divs. OB and 2GH by data of trawl surveys in 1980-1991

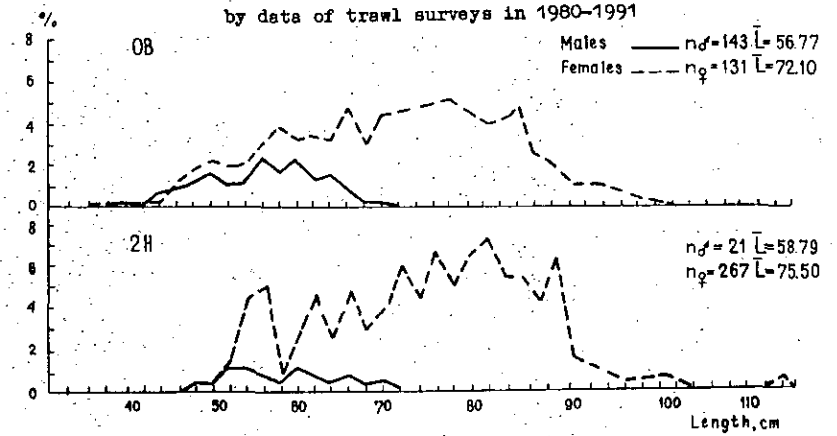

Fig.11. Greenland halibut length composition in Divs. OB and 2H from long-lining catches. August-December, 1990.