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Greenland Halibut in NAFO Subarea 2 and Divisions 3KLM:
A Rapidly Declining Resource with a Rapidly Increasing Fishery

by

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Catch History and TACs

A directed fishery for Greenland halibut began in the early-1960s with the introduction of synthetic gillnets in the deepwater bays of eastern Newfoundland. Catches increased from fairly low levels in the early-1960s to over 36,000 tons by 1969 and ranged from 24,000 tons to 39,000 tons over the next 15 years (Fig. 1). From 1986 to 1989, catches exceeded 20,000 tons only in 1987 (Table 1; Fig. 1). In 1990, an extensive fishery for Greenland halibut developed in the deepwater area of the NAFO Regulatory area near the boundary of Div. 3L and Div. 3M in areas known as the Sackville Spur and the Flemish Pass. The development of this fishery quickly resulted in increased catches to about 47,000 tons in 1990. It was estimated that the catch in 1991 was at least as high as 55,000 tons (Table 1; Fig. 1 and 2) although some estimates put the catch at nearer 75,000 tons. Catches during 1992 and 1993 remained high and were estimated to be about 63,000 and 62,000 tons, respectively. The major participants in this fishery have been EU/Spain and EU/Portugal, as well as a variety of non NAFO-member countries such as Panama. Catches listed as "Subarea 3 Outside" in Table 1 include all non-Canadian catches during recent years and are illustrated in Fig. 2 for comparison with traditional fishing areas of Subarea 2 and 3 inside the Canadian zone.

Up until 1990, Canada, USSR, GDR, and Poland were usually the main participants in the fishery, although Portugal and Japan have become increasingly involved in the fishery since 1984.

Canadian catches have been taken mainly by gillnet and have been around 7,000-10,000 tons in recent years, down from a peak of about 28,000 tons in 1980. The 1993 gillnet catch of 3,200 tons was the lowest in the time series. The traditional gillnet fishery has been conducted by relatively small vessels (<35 m) fishing in the deepwater channels near the Newfoundland and Labrador coast as well as the Newfoundland east coast deepwater bays. However, this component of the fishery has declined rapidly in recent years and has now virtually collapsed. The Canadian gillnet catches that have been taken recently represent mainly those of a newly developed fishery along the deep edge of the continental slope especially in Div. 3KL during 1991 and 1992 but extended further north to Subarea 2 (Table 2) and also to Div. 0B to a much lesser extent.

Canadian otter trawl catches peaked at about 8,000 tons in 1982, declined to less than 1,000 tons in 1988, then increased to about 7,400 tons in 1991 which is the highest level since 1982. In 1992, otter trawl catches were less than half that of 1991 due to low catch rates. The catch in 1993 was just over 1,512 tons.

The TAC for this resource increased from 35,000 tons in 1980 to 55,000 tons in 1981-84, 75,000 tons in 1985, and 100,000 tons in 1986-89 (Fig. 1). These increases in TACs were the result of research vessel survey estimates of stock biomass which indicated both high levels of fishable biomass as well as prospects of several better than average recruiting year-classes. After observing a major reduction in stock biomass from the late-1970s to

the late-1980s in Subarea 2 and Div. 3KL of about 50% from similar
surveys the TAC was reduced to 50,000 tons in 1990 and this level
has been maintained since that time despite the substantive
declines in stock size throughout the normal range of observed
historical stock distribution. Although the Scientific Council, in
its deliberations during June 1993, could not advise an appropriate
catch level for 1994 a TAC of 25,000 tons was set by Canada in
Subarea 2 and Divisions 3KL. This level was based on advice of the
Fisheries Resource Conservation Council, an advisory body set up by
the Canadian Department of Fisheries and Oceans in 1993. It was
intended that this catch should include all catches in the area of
Subarea 2 and 3 for conservation purposes.

Commercial Catch and Effort

Catch and effort data from the directed fishery for the period
1975 to 1990 were obtained from ICNAF/NAFO Statistical Bulletins
and were combined with provisional 1991-1992 NAFO data and
preliminary Canadian data for 1992-1993.

The catch/effort data were analyzed with a multiplicative
model in order to derive a standardized catch rate series for hours
fished. Effects included in the model were a combination country-
gear-tonnage class category type (CGT), month, NAFO division and
year. Except for the year category type, individual observations of
catch or effort data less than 10 units were eliminated prior to
analysis as were categories where there were less than five samples
in the database. In the current analysis considerable data were
added to the database based upon information the Spanish fishery in
1992 which occurred in the NAFO Regulatory Area.

The regression was significant (p <.05), explaining 60% of the
variation in catch rates (Table 3). The standardized catch rate
series (Table 3, Fig. 3) shows high within year variability,
especially in the late-1970s to mid-1980s. There was an increasing
trend from the mid-1970s to about 1982 then declined to the lowest
level previously observed by 1986. The standardized catch rate
showed stability for the next several years but declined
significantly between 1990 and 1991. It has remained at about that
level to 1993. According to the diagnostics presented in the
updated analysis here (Table 3) there appears to be some indication
of seasonal variation with higher catch rates apparently occurring
during the winter months. In addition, the current analysis also
indicates that catch rates were somewhat higher in Subarea 2
relative to Subarea 3. The overall trends by year, nevertheless,
has not changed from the previous analysis.

Catch-at-age and mean weights-at age

Length sampling data from the catches of Canada, Portugal, and
Spain were available at this meeting, however, only Canadian aging
data were provided. Table 4 contains a summary of the sampling data
available from the Canadian catch in 1993 (Table 2); the calculated
catch numbers-at-age, mean weights (kg)-at-age and associated
statistics for the Canadian fisheries in 1993 are presented in
Table 5. For many of the previous years' assessments, Canadian age
sampling data often have been used to calculate estimates of total
removals-at-age for catches where sampling data were not available.
Catch at age data from these calculations for 1975-88 are presented
in Table 6 with the associated weights at age shown in Table 7.

Due to the serious uncertainties connected with catch
information in new fast developing fisheries this is no longer
considered acceptable. Consequently, catch-at-age for Canadian
sampling and Canadian catch only were re-calculated for 1988-93.
Catch numbers-at-age and catch weights -at-age (kg) for these data
are presented in Tables 8 and 9. Ages 6-8 dominated the catch in
most years up to 1991 (Table 8), which is typical of the Canadian
catch. Although the Canadian catch was much lower in 1992 and 1993
than in previous years, there were increases in the proportions of
ages 9-13 (Table 8). This is due to an increase in the exploitation
of Greenland halibut in the deepwater along the continental slope
by gillnetters using 8" mesh in depths to 1000 m and deeper. The
mean weights (kg)-at-age in did not indicate any significant
variation among years (Table 9).

Research vessel surveys

1)   Stratified-random groundfish surveys

Biomass estimates from Canadian stratified-random groundfish surveys in autumn in Div. 2J for 1977-92 are presented in Table 10. Due to a revision of the stratification scheme in 1993(see Bishop, this meeting) strata are not directly comparable, therefore, the results for Div. 2J in 1993 are presented separately in Table 11. Similarly, the biomass estimates for Div. 3K during 1978-1992 and 1993 are shown in Tables 12 and 13, respectively. No similar changes were made for Div. 3L, thus the biomass estimates for the entire time series available from 1981-93 are detailed in Table 14. In all cases the total annual biomass estimates are accompanied by 95% confidence limits.   Annual biomass estimates are also illustrated by division separately in Fig. 4 and cumulatively for Div. 2J, 3K and 3L in Fig. 5.

It should be noted that in Div. 2J and 3K, the strata from 1001-1500 m were rarely surveyed and thus were not included in the indices.   In Div. 3L, the deepest strata are only 732 m, and these areas were not surveyed in all years.   No Canadian survey data are available in Div. 2GH since those presented in Brodie and Baird (1992).

Cumulative abundance indices at age from Div. 2J, 3K and 3L are provided in Table 15 and illustrated by year in Fig. 6. A summary of annual abundance by various age groups i.e. Ages 1+; Ages 3-5; Ages 6-9; Ages 10+ are shown in Fig. 7. In order to better examine strengths of recruiting year-classes and trends in the abundance indices for individual ages 2-7, inclusive are presented in Fig. 8 with ages 2-4 and 95% confidence limits shown in Fig. 9.   Although there were no surveys in the fall of 1978-80 in Div. 3L estimates of abundance were obtained for these years by averaging estimates from spring surveys of adjacent years.

Biomass indices of Greenland halibut have been declining in Div. 2J since 1982 from a level of over 100,000 tons to less than 9,000 tons by 1992 (Table 10; Fig. 4 and 5). There was a slight increase in 1993 to near that of 1991 (Table 11) but still at a very low level.   The biomass index in Div. 3K peaked at 112,000 tons in 1984 but by 1987 biomass in this division also began a steep systematic decline similar to Div. 2J and reached a low of just over 20,000 tons in 1992 (Table 12; Fig.4 and 5). In 1993, there was a similar proportional increase in biomass as in Div. 2J to a level slighter higher than that of 1991.   Estimates for Div. 3L to a depth of 366 meters were relatively stable from 1981 to 1990 at about 15,000 tons (Table 14; Fig. 4 and 5).   Between 1990 and 1991, the biomass index fell from nearly 17,000 tons to 7,300 tons and further to 6,700 tons in 1992 despite the fact that survey coverage in 1991-92 was complete to depths of more than 720 meters.   Unlike the divisions to the north the biomass estimate in Div. 3L in 1993 declined from that of 1992 to a level near half the 1991 and 1992 estimates.   The cumulative biomass index for all three divisions (Fig. 5) has steadily declined from a high of over 200,000 tons to 37,000 tons in 1992 by far the lowest in the time series.   The increase in 1993 amounted to a total of about 49,000 tons.

Longer term declines in abundance are less apparent than indicated by the biomass indices due to the fact that the declines are not consistent across all age classes (Table 15; Fig. 7). An examination of the age structure in shows that the ages 6+ abundance has been declining since the mid 1980's and by 1993 the age 6+ abundance is far below anything ever observed at a level of about one third of that estimated in 1992.   Age 10+ has been declining since the early 1980's and by 1993 did not even appear incidently in the survey catches.   On the other hand, ages 3-5 were slowly increasing from the early 1980's to about 1989.   From 1989 to 1992, however, these age groups also declined very sharply to a level less than half the 1988 estimate.

The sudden increase in 1993 in both the age 1+ and ages 3-5 (Fig. 7)is attributed to a significant increase in the estimated abundance of ages 2 and 3 in the 1993 survey (Fig. 8 and 9). Although the increases in both ages are statistically significant (Fig. 9) caution must be exercised in interpreting the data based on a single estimate.   For example, even though the age 3 in 1993 is significantly higher than any other year-class in the time

series its representation at age 2 in the 1992 survey was much less impressive. Given the results of the 1994 Zandvoort survey in the winter of 1994 (see Morgan et al. (this meeting)) which also showed good signs of recruitment there is, however, some room for cautious optimism for future recruitment. The commercial age classes, on the other hand, have virtually disappeared compared to their historic numbers not so long ago. Unless serious consideration is given to controlling unregulated catches and fishing effort especially in the Regulatory Area, this stock will surely decline further and likely seriously compromise the growth potential of incoming year-classes if, in fact, they prove to be anywhere near as good as first observed.

Biological Studies

1) Maturity at Length

Samples were collected from the commercial deepwater gillnet fishery in Div. 0B, 2GHJ, and 3KL. Samples were taken from June to October 1993. A total of 7368 fish were sampled for length and maturity stage. 464 fish were sampled in Div. 3L 2529 in Div. 3K, 193 in Div. 2J, 1552 in Div. 2H, 1830 in Div. 2G and 800 in 0B. 93.5 % of the fish sampled were females so analyses will be restricted to that sex in this paper. There were sufficient samples in only Div. 0B, 2G, 2H, and 3K.

The length distribution of the sampled fish is given in Fig. 11 for each division. A large portion of the sampled distributions were composed of immature fish. There was also considerable overlap in the lengths of mature and immature fish, particularly in Div. 3K.

Maturity ogives were constructed for the females in each Div. (Fig. 12). The ogives were calculated using probit analyses assuming a normal distribution. The length at 50% maturity generally declined from south to north. The L_{50} in Div. 3K was 85.7 cm, in Div. 2H 77.2 cm, in 2G 75.2 cm, and in Div. 0B 69.4 cm. Much of the commercial catch is composed of fish below this size.

Table 1 . Catches of Greenland halibut in the Northwest Atlantic by division and selected areas from 1977-93.

Year	Div. 2G	Div. 2H	Div. 2J	Div. 3K	Div. 3L Inside	Total Inside	Subarea 3 Outside	Overall Total
1977	1778	1524	8237	13446	6956	31941	-	31941
1978	1899	1207	3723	24107	7596	38532	-	38532
1979	577	1623	3415	19843	8610	34068	-	34068
1980	36	444	1466	17923	12773	32642	-	32642
1981	1799	2141	1358	16472	8912	30682	-	30682
1982	369	8985	5931	6794	4135	26214	-	26214
1983	111	5671	6028	11374	4655	27839	-	27839
1984	214	4663	6368	8432	5120	24797	1900	26697
1985	193	2358	6724	5775	3061	18111	2200	20311
1986	455	1564	6823	4237	2794	15873	2100	17973
1987	2700	2631	12464	6860	4786	29441	3000	32441
1988	2068	2463	1971	6389	2019	14910	3500	18410
1989	837	1821	2952	7840	2860	16310	2600	18910
1990	905	1158	2911	4952	2020	11946	35500	47446
1991	1556	2591	3034	2019	1590	10790	54200	64990
1992	1264	107	382	3489	1694	6936	56225	63161
1993	961	426	159	2186	952	4684	57550	62234

Note: Catches in Subarea 2, 3K and 3L inside for 1992-93 are Canadian only.
Catches in Subarea 3 outside include estimates of non-reported catches.

Table 2. Canadian catch of Greenland halibut in Sa2 and 3 in 1993 by Division, month and gear.

Month	Gillnet						Otter Trawl							Other Gear
	Div. 2G	Div. 2H	Div. 2J	Div. 3K	Div. 3L	Total	Div. 2G	Div. 2H	Div. 2J	Div. 3K	Div. 3L	Div. 3N	Total	
Jan.										25	9			2
Feb.										350	70			
Mar.										54	104			
Apr.										3	7			
May.				4		4								4
Jun.				41	40	81								
Jul.				390	101	491								
Aug.	41	173	68	742	215	1239			6			11		
Sep.	299	171	52	200	218	940			11	260		5		
Oct.	164	56	22	36	131	409	48	24		39	33			
Nov.					14	14	409	2		42				
Dec.					1	1								
Total	504	400	142	1413	720	3179	457	26	17	773	223	16	1512	6

Table 3. ANOVA results and regression coefficients from a multiplicative model utilized to derive a standardized catch rate series for Greenland Halibut in SA2 + Div. 3LM (1991-1993 based on preliminary data).

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R............ 0.775
MULTIPLE R SQUARED..... 0.601

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	2.310E2	2.310E2	
REGRESSION	48	1.053E2	2.195E0	10.992
Country;Gear;TC (1)	14	1.976E1	1.412E0	7.070
Month (2)	11	8.156E0	7.415E⁻1	3.714
Division (3)	5	5.620E0	1.124E0	5.629
Year (4)	18	2.563E1	1.424E0	7.132
RESIDUALS	350	6.988E1	1.997E⁻1	
TOTAL	399	4.062E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
Country;Gear;TC	3125	INTERCEPT	⁻0.773	0.227	399
Month	9				
Division	22				
Year	75				
(1)	3126	1	0.559	0.188	8
	3127	2	0.150	0.207	6
	10127	3	1.005	0.197	8
	11125	4	0.088	0.146	16
	11126	5	⁻0.240	0.216	6
	11127	6	0.273	0.135	17
	14124	7	0.364	0.154	12
	14126	8	0.689	0.131	21
	14127	9	0.449	0.181	9
	16127	10	0.216	0.097	51
	19124	11	⁻0.124	0.166	23
	19126	12	0.308	0.164	23
	20127	13	⁻0.171	0.119	29
	27125	14	0.165	0.111	24
(2)	1	15	0.282	0.146	14
	2	16	0.219	0.148	14
	3	17	⁻0.027	0.137	18
	4	18	⁻0.013	0.126	24
	5	19	0.256	0.129	22
	6	20	0.311	0.120	23
	7	21	0.060	0.097	43
	8	22	0.111	0.089	51
	10	23	⁻0.291	0.100	43
	11	24	0.010	0.095	49
	12	25	0.193	0.103	42
(3)	21	26	0.104	0.099	37
	23	27	⁻0.010	0.072	95
	31	28	⁻0.388	0.094	83
	32	29	⁻0.232	0.124	51
	33	30	⁻0.464	0.168	25
(4)	76	31	⁻0.089	0.235	11
	77	32	0.133	0.227	19

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
(4)	78	33	0.365	0.245	18
	79	34	0.173	0.241	10
	80	35	0.376	0.250	12
	81	36	0.183	0.236	15
	82	37	0.423	0.229	19
	83	38	0.373	0.223	24
	84	39	0.307	0.225	23
	85	40	0.123	0.226	21
	86	41	⁻0.166	0.226	24
	87	42	0.080	0.218	30
	88	43	⁻0.251	0.226	22
	89	44	⁻0.055	0.232	22
	90	45	⁻0.033	0.231	26
	91	46	⁻0.611	0.240	15
	92	47	⁻0.542	0.235	70
	93	48	⁻0.703	0.257	12

PREDICTED CATCH RATE

YEAR	LN TRANSFORM		RETRANSFORMED		CATCH	EFFORT
	MEAN	S.E.	MEAN	S.E.		
1975	⁻0.7727	0.0516	0.497	0.112	28681	57666
1976	⁻0.8615	0.0280	0.461	0.077	24598	53415
1977	⁻0.6393	0.0235	0.576	0.088	31941	55412
1978	⁻0.4081	0.0262	0.725	0.117	38532	53124
1979	⁻0.5994	0.0349	0.596	0.111	34068	57118
1980	⁻0.3972	0.0273	0.733	0.121	32642	44539
1981	⁻0.5900	0.0241	0.605	0.093	30682	50686
1982	⁻0.3500	0.0177	0.772	0.102	26214	33956
1983	⁻0.3999	0.0163	0.735	0.094	27839	37881
1984	⁻0.4659	0.0150	0.688	0.084	26697	38778
1985	⁻0.6496	0.0176	0.572	0.076	20311	35498
1986	⁻0.9387	0.0173	0.429	0.056	17973	41934
1987	⁻0.6931	0.0172	0.548	0.072	32441	59204
1988	⁻1.0235	0.0185	0.394	0.053	18410	46785
1989	⁻0.8272	0.0179	0.479	0.064	18910	39479
1990	⁻0.8055	0.0159	0.490	0.062	47446	96826
1991	⁻1.3841	0.0239	0.274	0.042	64990	237516
1992	⁻1.3145	0.0186	0.294	0.040	63161	214737
1993	⁻1.4762	0.0277	0.249	0.041	62234	249844

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.149

LEGEND FOR ANOVA RESULTS:

CGT CODES:	3125 = Can(NFLD)	TC 5	14124 = Japan	TC 4
	3126 = "	TC 6	14126 = "	TC 6
	3127 = "	TC 7	14127 = "	TC 7
	10127 = Former FRG	TC 7	16127 = Poland	TC 7
	11125 = Former DDR	TC 5	19124 = Spain	TC 4
	11126 = "	TC 6	19126 = "	TC 6
	11127 = "	TC 7	20127 = Former USSR	TC 7
			27125 = Can(M)	TC 5

All of the above CGT are Stern Trawlers

DIVISION CODES: 21 = 2G, 22 = 2H, 23 = 2J, 31 = 3K, 32 = 3L, 33 = 3M

Table 4. Greenland halibut sampling data for 1993 in SA2 and Div. 3KL.
Canadian data only.

Age-Length Key	Length Frequency	Catch (tons)
Offshore Q3 3K (336)	GN June 3K (373)	85
Offshore Q3 3L (66)	GN July 3K (845)	390
	GN July 3L (271)	101
	GN Aug. 3K (1276)	957
Offshore Q4 2G (312)	GN Sept. 2G (163)	340
Offshore Q4 2H (595)	GN Sept. 2G (1540)	
	GN Sept. 2H (964)	344
	GN Sept. 2H (1721)	
	GN Oct. 2G (645)	164
	Gn Oct. 2H (459)	56
	Gn Oct. 2H (942)	
Offshore Q4 2G (312)	GN Sept. 2J (193)	120
Offshore Q4 2H (595)	GN Sept. 3K (239)	200
Offshore Q4 2J (33)	GN Sept. 3L (197)	218
Offshore Q4 3K (69)	GN Oct. 3K (131)	58
Offshore Q4 3L (59)	GN Oct. 3L (276)	146
Offshore Q1 3K (620)	OT Jan. 3K (637)	34
Offshore Q1 3L (101)	OT Feb. 3K (3349)	413
	OT Feb. 3L (571)	70
	OT Mar.. 3L (312)	111
Offshore Q3 2H (11)	OT Sept. 3K (5153)	260
Offshore Q3 2J (120)	OT Sept. 2J (407)	17
Offshore Q3 3K (467)		
Offshore Q3 2G (362)		
Offshore Q3 2H (75)		
Offshore Q4 2H (11)	OT Oct. 3K (81)	39
Offshore Q4 3K (55)	OT Nov. 3L (573)	49
Offshore Q4 2H (106)	OT Nov. 3K (328)	42
Offshore Q4 3L (63)		
	OT Oct. 2G (721)	48
	OT Oct. 2H (1778)	24
	OT Nov. 2G (1593)	411
Total		4697

Table 5. Catch at age and associated statistics of Greenland halibut from the Canadian fishery in SA2+3KL during 1993.

Age	Mean wt. (kg)	Mean len. (cm)	No. Fish (000s)	Std. Err.	C.V.
5	0.398	37.247	33	5.99	0.18
6	0.580	41.729	281	22.33	0.08
7	0.814	46.131	847	30.36	0.04
8	1.196	51.746	411	18.83	0.05
9	1.815	58.572	190	8.19	0.04
10	2.445	64.064	169	8.54	0.05
11	3.064	68.529	173	9.36	0.05
12	3.984	74.033	192	9.70	0.05
13	5.120	79.775	107	7.66	0.07
14	6.091	83.997	54	5.18	0.10
15	7.125	88.044	31	3.34	0.11
16	8.462	92.622	12	1.71	0.14
17	9.763	96.623	2	0.80	0.35
18	13.680	107.006	<1	0.00	0.00

Table 6. Greenland halibut catch at age matrix.

AGE	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
5	322	19	464	3016	2182	204	810	236	766	858	1662	245	128	269
6	2719	680	4351	8511	7980	2032	4242	2020	3889	2211	4449	1958	1779	2900
7	5547	3600	9374	9072	11726	8913	9209	5552	10714	5560	4955	5604	10293	7405
8	4781	6030	6377	7662	5611	9429	10753	5064	8215	7308	2933	4450	8358	3986
9	3821	4199	2546	2898	1069	5258	4045	3112	2509	3888	1156	1284	2652	1172
10	1628	2457	879	1454	440	3729	836	1480	756	1198	429	412	798	423
11	677	923	191	731	262	987	240	524	229	387	133	213	359	183
12	130	290	113	371	136	125	133	225	83	136	83	122	263	96
13	269	113	101	225	131	52	40	143	116	101	73	61	210	97
14	131	36	26	110	84	14	27	70	93	55	40	49	157	56
15	63	21	18	58	76	9	20	55	74	73	18	32	99	48
16	41	1	22	54	56	2	13	29	10	28	12	20	53	11
17	43	1	7	39	44	1	5	14	14	18	2	1	17	2
5+	20172	18370	24469	34201	29797	30755	30373	18524	27468	21821	15945	14451	25166	16648

Table 7. Greenland halibut mean weights at age (kg).

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
5	0.609	0.609	0.609	0.609	0.609	0.514	0.392	0.525	0.412	0.377	0.568	0.350	0.364	0.363
6	0.760	0.760	0.760	0.760	0.760	0.659	0.598	0.684	0.629	0.583	0.749	0.584	0.589	0.569
7	0.955	0.955	0.955	0.955	0.955	0.869	0.789	0.891	0.861	0.826	0.941	0.811	0.836	0.805
8	1.190	1.190	1.190	1.190	1.190	1.050	0.985	1.130	1.180	1.100	1.240	1.100	1.160	1.163
9	1.580	1.580	1.580	1.580	1.580	1.150	1.240	1.400	1.650	1.460	1.690	1.580	1.590	1.661
10	2.210	2.210	2.210	2.210	2.210	1.260	1.700	1.790	2.230	1.940	2.240	2.120	2.130	2.216
11	2.700	2.700	2.700	2.700	2.700	1.570	2.460	2.380	3.010	2.630	2.950	2.890	2.820	3.007
12	3.370	3.370	3.370	3.370	3.370	2.710	3.510	3.470	3.960	3.490	3.710	3.890	3.600	3.925
13	3.880	3.880	3.880	3.880	3.880	3.120	4.790	4.510	5.060	4.490	4.850	4.950	4.630	5.091
14	4.560	4.560	4.560	4.560	4.560	4.420	5.940	5.850	6.060	5.730	6.130	6.090	5.480	6.203
15	5.920	5.920	5.920	5.920	5.920	5.040	8.060	7.530	7.310	6.850	7.160	7.640	6.670	7.644
16	7.140	7.140	7.140	7.140	7.140	7.020	8.710	8.680	8.600	8.330	8.920	9.810	7.650	9.187
17	7.890	7.890	7.890	7.890	7.890	10.100	9.580	11.500	11.300	9.570	11.800	10.100	9.840	11.444

Table 8. Catch at age (000) of Greenland halibut from the Canadian fishery in SA 2+3 from 1988 - 1993.

Age	1988	1989	1990	1991	1992	1993
5	41	166	148	159	18	33
6	2124	1878	2979	1684	255	281
7	5429	7076	6706	4348	1319	847
8	1659	3568	1813	2121	840	411
9	404	597	300	900	359	190
10	130	90	78	295	316	169
11	25	19	34	89	268	173
12	10	4	21	80	234	192
13	2	2	11	21	119	107
14	2	1	13	21	70	54
15	1	1	9	4	36	31
16	1	1	2	1	8	12
17	0	1	1	1	4	2
5+	9828	13404	12115	9724	3846	2502

Table 9. Weight at age (kg) of Greenland halibut from the Canadian fishery in SA 2+3 from 1988 - 1993.

Age	1988	1989	1990	1991	1992	1993
5	0.397	0.403	0.416	0.410	0.386	0.398
6	0.583	0.561	0.587	0.596	0.560	0.580
7	0.801	0.765	0.754	0.808	0.797	0.814
8	1.157	1.065	1.052	1.179	1.252	1.196
9	1.640	1.619	1.542	1.736	1.937	1.815
10	2.240	2.201	2.116	2.404	2.544	2.445
11	2.837	2.980	2.850	3.078	3.169	3.064
12	3.593	3.981	3.632	3.821	3.942	3.984
13	4.456	4.455	4.524	5.294	5.111	5.120
14	5.512	5.623	5.567	5.940	6.220	6.091
15	6.821	6.962	6.906	6.674	7.194	7.125
16	7.782	7.547	8.546	9.001	8.290	8.462
17	0.000	9.659	9.601	9.659	10.623	9.763

Table 10. Biomass (tons) of Greenland halibut per stratum from fall surveys in Division 2J from 1977-92.

Stratum	Depth (m)	Area	Units	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
206	101-200	2582	194	4031	1508	1572	1959	7206	3628	1686	2105	861	781	79	345	126	182	23	37
207		2246	169	13112	4306	1752	1183	3072	1742	1290	1055	368	204	44	8	7	0	0	0
201		1427	107	778	146	48	303	289	1036	398	517	44	105	20	9	86	57	6	0
205		1823	137	2870	900	1397	513	2044	3297	1950	954	197	152	48	144	53	41	48	8
Total				20790	6860	4769	3939	12612	9702	5324	4631	1469	1242	192	506	272	280	78	45
215	201-300	1270	95	3592	2100	678	1764	1173	3649	1378	4004	1545	1415	1132	859	514	671	324	251
234		508	38	1870	3757	2487	3012	1983	3737	1781	3459	699	486	197	772	388	187	111	70
228		1428	107	700	235	899	1972	858	992	1107	1769	682	1116	566	279	565	914	228	159
214		1171	88	3425	4235	1935	1354	5283	7411	3923	5252	5874	779	1208	1941	525	447	68	105
202		440	33	705	541	727	958	886	1503	1016	3063	332	281	587		16	111	70	43
210		774	58	1128	512	554	627	290	1213	2411	1582	302	213	232	458	393	687	138	137
213		1725	129	2131	1704	1242	2970	3798	4427	3011	2854	4639	2546	1142	757	304	293	32	79
209		1608	121	7876	2657	10675	12644	6720	15648	6370	4517	4161	1650	1032	1354	1241	990	304	223
Total				21427	15741	19196	25302	21243	38580	20997	26280	18234	8485	6095	6420	3945	4301	1276	1087
208	301-400	448	34	6260	4909	3051	5032	8096	11725	3699	16686	13658	6377	3462	2825	6785	5749	1240	697
229		567	43	1661	613	1014	1091	1298	915	1553	468	553	624	252	137	131	96	301	389
203		480	36	1137	1444	2354	781	1874	2318	8173	6459	901	3889	1003	1225	3242	877	1109	201
222		441	33	3817	2136	2539	2992	1846	6223	4353	916	1126	74	1092	1374	265	471	32	71
211		330	25	866	2113	1164	1804	886	1381	3338	1381	4062	2550	1102	2019	578	3749	440	145
216		384	29	2964	4202	5228	5369	1823	6205	2959	4987	2356	998	1474	101	362	228	89	90
Total				16705	15417	15348	17048	15822	28767	24076	30896	22657	14514	8384	7681	11362	11169	3211	1593
227	401-500	686	51	5938	4473	1415	3798	2240	2827	1983	1888	1912	1064	1891	1648	2697	2103	858	1014
217		268	20	2856	3385	1753	3138	825	1172	1298		2917	2187	834	880	121	645	87	69
223		180	14	3398	1146	864	1838	1280	1189	834	1537	1084	1715	284	858	213	317	41	45
204		354	27	4669	12879	6918	4035	4531	7547	6665	6909	438	7104	3893	4411	15073	3326	1490	988
235		420	32	3707	3375	2648		1230	2827	7981	2585	2680	5762	3742	2215	4579	5862	404	285
Total				20568	25258	13599	12809	10105	15562	18740	12919	9032	17832	10644	10012	22683	12252	2881	2402
230	501-750	237	18	4328	1436		3014	1072	548	1654	382	467	1819	1209	787	770	827	551	1032
212		664	50	9451	7517	11575	5159	7364	7182	2230	3530	5470	19079	18665	3751	2131	3988	1062	1336
218		420	32	6870	7508		4083	4934	1261	1230		954	2592	1544	1844	567	1329	668	94
224		270	20	3519	1595	2482	664	2331	740	1024	760	567	4949	1286	1277	53	250	134	107
Total				24168	18057	14058	12920	15701	9731	6138	4673	7458	28439	22704	7659	3520	6394	2414	2569
236	751-1000	122	9	898				410	611	925	485	781	2050	860	119		1014	1014	360
231		182	14	878	1893		2548		1281	700	1349	1636	386	526	2329		1704	374	485
219		213	16					767		1647		1339	4574	1342	723	580	1502	200	130
Total				1776	1893	0	2548	1177	1892	3272	1834	3756	7011	2728	3172	580	4220	1588	954
-225	1001-1250	177	13	531	482														
-232		236	18	869	1384														
-220		324	24																
Total				1399	1866	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-233	1251-1500	180	14																
-221		268	20																
-226		180	14		43														
Total				0	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Biomass (t)				106834	85135	66969	74565	78660	104234	78547	81234	62605	77522	50747	35450	42342	38617	11248	8630
95% Lower				90708	62722	53867	54260	49579	82993	63918	55160	47364	47571	25957	26531	74245	29215	8574	5267
95% Upper				122960	107550	80071	94867	103742	125473	93175	107308	77842	107539	75588	44364	158923	48018	13925	11993

Table. 11. Estimated biomass (tons) per stratum of G. halibut from the autumn survey of the GADUS ATLANTICA in Div. 2J during 1993. Based on the new stratification system.

Depth Range (m)	Stratum	Area (sq. nm)	Trawlable Units (000)	1993
101-200	201	633	48	1
	205	1594	120	1
	206	1870	140	11
	207	2264	170	0
	237	733	55	0
	238	778	58	-
Total				14
201-300	202	621	47	1
	209	680	51	166
	210	1035	78	253
	213	1583	119	62
	214	1341	101	241
	215	1302	98	502
	228	2196	165	345
	234	530	40	407
Total				1977
301-400	203	487	37	863
	208	588	44	433
	211	251	19	573
	216	360	27	166
	222	450	34	78
	229	536	40	119
Total				2231
401-500	204	288	22	975
	217	241	18	143
	223	158	12	77
	227	598	45	843
	235	414	31	340
	240	133	10	43
Total				2421
501-750	212	557	42	2732
	218	362	27	137
	224	228	17	54
	230	185	14	79
	239	120	9	556
Total				3559
751-1000	219	283	21	429
	231	186	14	406
	236	193	14	558
Total				1394
1001-1250	220	303	23	-
	225	195	15	-
	232	228	17	-
Total				-
1251-1500	221	330	25	-
	226	201	15	-
	233	237	18	-
Total				-
Biomass (t)				11595
95% Lower				9598
95% Upper				13589

Table 12. Biomass (tons) per stratum of Greenland halibut from fall surveys in Division 3K from 1978-92.

Stratum	Depth (m)	Area	Units							Year								
				1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
618	101-200	1455	109	-	-	-	-	-	-	164	484	22	8	3	36	0	0	0
619		1588	119	-	-	-	-	-	-	226	68	26	7	1	32	0	0	0
Total				0	0	0	0	0	0	390	552	48	15	4	68	0	0	0
637	201-300	1132	85	334	353	510	701	825	1258	422	1147	930	772	336	286	461	169	86
632		447	34	107	95	392	210	252	115	0	288	75	67	27	53	242	55	104
635		1274	96	640	585	1841	1148	1635	749	974	403	1054	1060	434	668	164	25	44
636		1455	109	609	510	1288	1393	2386	442	808	474	371	186	434	384	222	135	100
621		2859	215	27144	24549	10387	7033	3150	6840	3932	6552	1075	1751	1453	1792	210	524	685
624		668	50	469	532	257	188	263	119	251	249	181	291	115	165	181	159	135
634		1618	121	766	1147	642	657	1711	802	720	568	452	1099	419	327	386	288	109
620		2709	203	13570	5976	5757	5230	4541	3914	2660	2985	2591	1212	1936	323	230	415	51
Total				43640	33747	21074	16559	14764	14239	9767	12666	6729	6437	5154	4000	2094	1770	1314
639	301-400	1463	110	563	860	723	810	2092	1286	265	515	805	395	355	303	502	460	517
638		2059	155	2342	2046	1717	3294	3151	2790	1940	5335	3933	2887	1700	1776	4261	1312	1266
625		850	64	1120	909	925	2010	558	4232	2740	3548	2488	3358	1951	449	2210	997	185
628		1085	81	3517	2912	5555	1330	1052	2939	2216	6675	4918	3458	3282	2435	1422	516	263
623		1027	77	12297	2585	6412	6424	11271	16742	20815	5204	13847	10546	10461	6326	2758	2433	844
626		919	69	4190	2910	9651	4015	8306	7019	15021	8602	10693	4574	6560	6824	1620	1749	1595
633		2179	164	1325	1480	2633	1632	1297	2025	1971	2365	3222	3208	2166	3654	1961	1966	1495
630		544	41	1112	440	873	4788	-	2767	316	1354	1256	2307	2300	1607	1145	1166	434
629		495	37	764	497	970	1164	2545	2440	1157	817	2006	2960	3734	2462	578	230	505
Total				27230	14639	29459	25467	30273	42239	46440	34415	43169	33693	32510	25837	16457	10829	7104
645	401-500	204	15	285	-	184	333	271	50	831	641	-	390	175	49	312	59	123
627		1194	90	6424	3740	6139	17007	11152	19792	26938	12580	23626	12265	13009	21830	10390	5664	1371
631		1202	90	4098	2102	3113	6190	3429	6018	9501	6394	6098	9812	6904	10089	3153	10139	1787
622		632	47	6789	5666	2076	6286	5732	10627	6820	2864	26745	9826	10500	7034	18287	2916	1397
640		198	15	489	-	881	535	320	-	204	275	152	301	93	134	245	178	74
Total				18085	11509	12392	30350	20903	36487	44294	22754	56621	32595	30681	39136	32387	18957	4751
646	501-750	333	25	1481	2224	1287	1581	387	2281	2512	1662	-	750	-	-	260	692	232
641		584	44	239	1174	1392	956	1074	2689	2740	995	-	1135	-	-	1750	364	286
Total				1720	3397	2679	2537	1461	4969	5252	2657	0	1885	0	0	2010	1056	518
642	751-1000	931	70	1302	1478	2324	652	2329	-	5685	2341	-	1936	-	-	3159	2659	6580
647		409	31	4919	-	2740	2533	1213	-	-	3522	-	-	-	-	2938	763	432
Total				6221	1478	5064	3185	3542	0	5685	5863	0	1936	0	0	6097	3422	7013
643	1001-1250	1266	95	712	1230	-	-	-	-	-	-	-	-	-	-	-	-	-
648		232	17	269	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total				981	1230	0	0	0	0	0	0	0	0	0	0	0	0	0
644	1251-1500	954	72	1090	357	-	-	-	-	-	-	-	-	-	-	-	-	-
649		263	20	215	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total				1305	357	0	0	0	0	0	0	0	0	0	0	0	0	0
Biomass (t)				99182	66356	70668	78098	70944	97934	111829	78907	106567	76561	68350	69041	59045	36034	20700
95% Lower				68648	49413	55888	64299	55559	76918	86170	63917	76206	57939	51398	53665	40175	28656	16511
95% Upper				129622	83247	85358	91633	86182	118664	137055	93691	136567	95025	85143	84090	80368	43318	24917

Table. 13. Biomass (tons) per stratum of G. halibut from the autumn survey of the
GADUS ATLANTICA in Div. 3K during 1993.
Based on the new stratification system.

Depth Range(m)	Stratum	Area (sq. nm.)	Trawl units ('000)	1993
101-200	618	1347	101	0
	619	1753	132	0
Total				0
201-300	620	2545	191	34
	621	2736	205	407
	624	1105	83	286
	634	1555	117	391
	635	1274	96	51
	636	1455	109	395
	637	1132	85	201
Total				1765
301-400	617	593	45	1957
	623	494	37	496
	625	888	67	1005
	626	1113	84	1178
	628	1085	81	544
	629	495	37	582
	630	332	25	430
	633	2067	155	1516
	638	2059	155	1253
	639	1463	110	700
Total				9660
401-500	622	691	52	2788
	627	1255	94	10455
	631	1321	99	3580
	640	69	5	40
	645	216	16	56
	650	134	10	95
Total				17014
501-750	641	230	17	228
	646	325	24	58
	651	359	27	387
Total				673
751-1000	642	418	31	1014
	647	360	27	1618
	652	516	39	1521
Total				4154
1001-1250	643	733	55	-
	648	228	17	-
	653	531	40	1180
Total				1180
1251-1500	644	474	36	-
	649	212	16	-
	654	479	36	-
Total				-
Biomass (t)				34445
95% Lower				29067
95% Upper				39821

Table 14. Biomass (tons) per stratum of Greenland halibut from fall surveys in Division 3L

Stratum	Depth (f)	Area	Units	1981	1982	1983	1984	1985	Year 1986	1987	1988	1989	1990	1991	1992	1993
371	31-50	1121	84	1	0	0	0	0	3	0	0	0	0	1	0	0
363		1780	134	0	0	0	0	0	0	0	0	0	0	0	0	0
372		2460	185	0	0	0	0	0	2	0	0	0	0	0	0	0
350		2071	155	0	0	0	0	0	0	0	0	0	0	0	0	0
384		1120	84	-	0	0	0	0	7	0	0	0	0	0	0	0
Total				1	0	0	0	0	12	0	0	0	0	1	0	0
348	51-100	2120	159	67	331	48	18	97	140	68	70	46	41	0	0	0
343		525	39	35	-	21	0	3	1	0	0	11	4	0	0	0
328		1519	114	-	-		23	10	59	29	7	11	1	0	0	0
341		1574	118	59	22	95	59	31	5	73	37	31	21	0	35	0
342		585	44	58	124	38	0	32	9	0	10	7	25	0	0	0
349		2114	159	14	5	68	16	11	14	38	0	6	10	0	0	0
370		1320	99	0	50	44	39	151	228	25	1	4	72	0	0	0
385		2356	177	46	387	566	88	219	826	432	0	30	127	0	108	0
390		1481	111	0	389	8	0	302	402	118	0	63	58	241	36	13
364		2817	211	104	53	184	0	11	30	112	57	74	44	2	6	0
365		1041	78	225	215	102	23	9	84	248	23	70	24	1	5	0
Total				608	1576	1172	266	877	1798	1143	205	354	428	245	191	13
391	101-150	282	21	0	58	455	397	630	175	87	51	275	128	365	87	163
344		1494	112	778	112	487	20	276	519	323	359	773	127	38	0	25
389		821	62	-	486	-	1186	1652	604	693	547	632	387	283	525	128
347		983	74	135	223	190	13	56	217	10	1498	1114	291	1	0	5
369		961	72	956	938	1010	374	962	459	667	263	294	894	343	83	10
386		983	74	2730	1605	-	936	2767	615	452	359	804	854	421	710	27
366		1394	105	523	1002	628	652	1893	1141	849	2160	1203	713	29	129	9
Total				5123	4424	2770	3579	8235	3730	3081	5236	5096	3393	1481	1533	368
368	151-200	334	25	539	721	-	445	727	167	226	545	683	4629	246	185	82
392		145	11	0	152	166	288	272	196	90	144	131	117	241	73	56
346		865	65	584	755	1136	1775	2325	1692	1461	1039	1672	2119	827	378	243
345		1432	107	2230	932	994	4257	3935	673	1935	2480	1336	2646	223	274	828
387		718	54	3638	2354	-	2641	2277	431	1419	687	826	647	1322	748	635
388		361	27	-	63	-	650	671	-	467	515	420	113	345	814	274
Total				6992	4977	2297	10056	10207	3159	5598	5410	5068	10271	3203	2471	2119
731	201-300	216	16	-	-	-	677	243	-	-	-	-	295	116	232	84
735		272	20	-	674	-	858	597	970	-	-	-	-	294	380	220
729		186	14	-	-	-	988	426	250	-	-	-	316	357	269	149
733		468	35	-	-	-	448	1259	-	-	-	-	503	928	969	416
Total				0	674	0	2970	2525	1220	0	0	0	1114	1695	1851	868
734	301-400	228	17	-	-	-	302	633	-	-	-	-	315	226	133	147
736		175	13	-	394	-	-	920	690	-	-	-	252	208	147	231
730		170	13	-	-	-	156	86	-	-	-	-	-	195	141	109
732		231	17	-	-	-	219	364	-	-	-	-	282	71	269	21
Total				0	394	0	678	2003	690	0	0	0	849	699	691	507
Biomass (tons)				12723	12045	6239	17548	23846	10609	9822	10851	10518	16054	7323	6737	3875
95% Lower				5692	9130	5010	12286	19726	6743	6996	8443	8133	-44558	4584	4875	3106
95% Upper				19752	14168	8258	22810	27970	14477	12646	13259	12903	76667	10067	8596	4646

Table 15. Abundance (000s) of Greenland halibut at age from Canadian research vessel surveys in Div. 2J3KL from 1978-93.

Age (yrs)	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	2538	2805	2994	7563	2137	1004	1452	7460	13005	1491	4025	3407	547	5814	1684	7690
2	25686	22523	8911	22486	5991	5905	7148	18147	22185	8685	12436	10414	5347	6726	14858	64350
3	54708	28846	15315	30875	23971	19036	21435	20024	32997	47694	28404	35816	14506	11369	26664	100945
4	55914	25799	22680	21226	31204	31465	36094	36224	55685	35752	50345	69334	68019	37832	34313	47991
5	57650	35886	35995	34277	31061	40182	72180	44886	45213	35854	58938	77935	65410	38273	23316	17606
6	45141	38805	42154	38654	29062	34742	38931	37715	57886	33486	39603	56524	48199	27416	17109	6261
7	28923	18843	27942	26647	32070	38908	30683	22359	45327	33956	29733	32108	28837	9020	8406	2394
8	13379	7378	9511	11458	32617	31538	21712	12761	12676	20722	9257	9627	6828	2155	962	731
9	6983	3316	4207	5281	13535	11559	10222	6293	3306	7621	2525	2884	1839	475	95	63
10	5112	3179	3229	2824	5375	3040	4132	3498	1430	2156	809	675	718	231	48	0
11	4237	2102	3601	2255	2801	2049	1869	1592	960	1065	542	558	488	104	13	0
12	2541	1843	2393	1030	1790	1497	1216	1218	961	642	309	161	267	61	0	0
13	1611	1520	1551	579	1276	1089	964	517	441	504	267	56	160	14	0	0
14	476	762	858	276	1306	713	804	636	411	200	210	73	115	5	0	0
15	335	493	326	155	835	306	427	330	213	151	151	77	49	0	0	0
16	243	426	182	19	325	81	294	210	62	100	81	23	27	2	0	0
17	130	153	53	0	51	0	140	161	0	10	38	0	0	0	0	0
Ages 1+	305607	194679	181902	205605	215407	223114	249703	214031	292758	230089	237673	299672	241356	139497	127468	248031
Ages 3-5	168272	90531	73990	86378	86236	90683	129709	101134	133895	119300	137887	183085	147935	87474	84293	166542
Ages 6-9	94426	68342	83814	82040	107284	116747	101548	79128	119195	95785	81118	101143	85703	39066	26572	9449
Ages 10+	14685	10478	12193	7138	13759	8775	9846	8162	4478	4828	2407	1623	1824	417	61	0
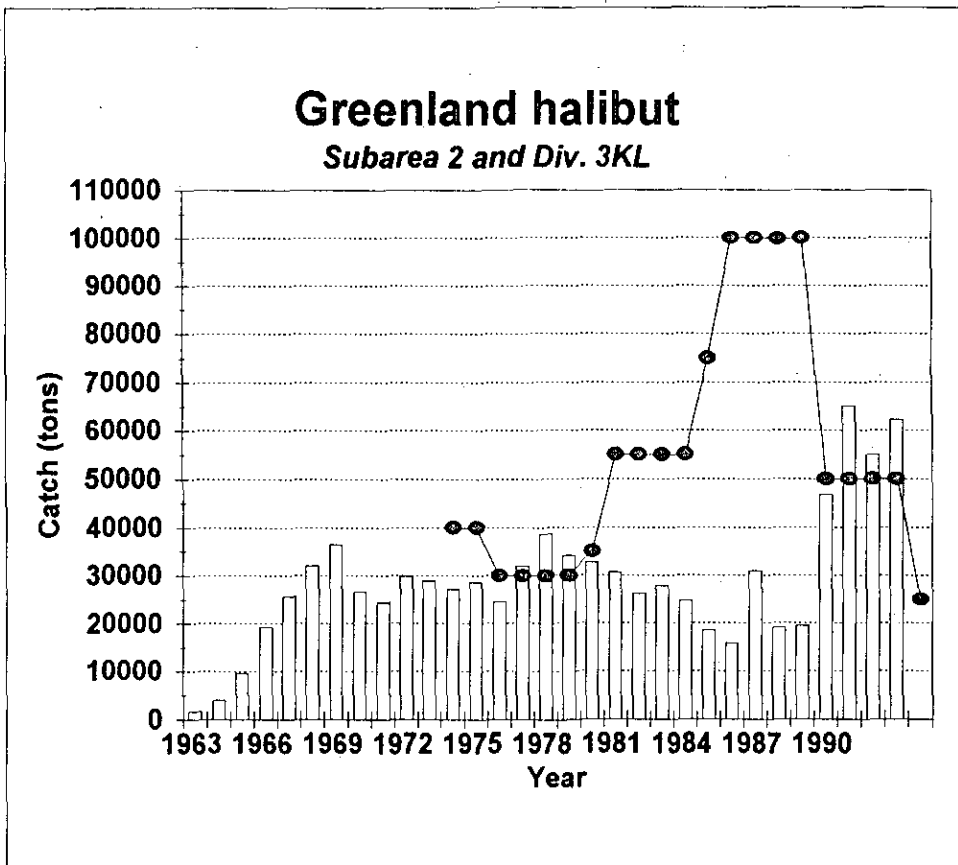
Fig. 1. Nominal catches of G. halibut in Subarea 2 and Div. 3KL.
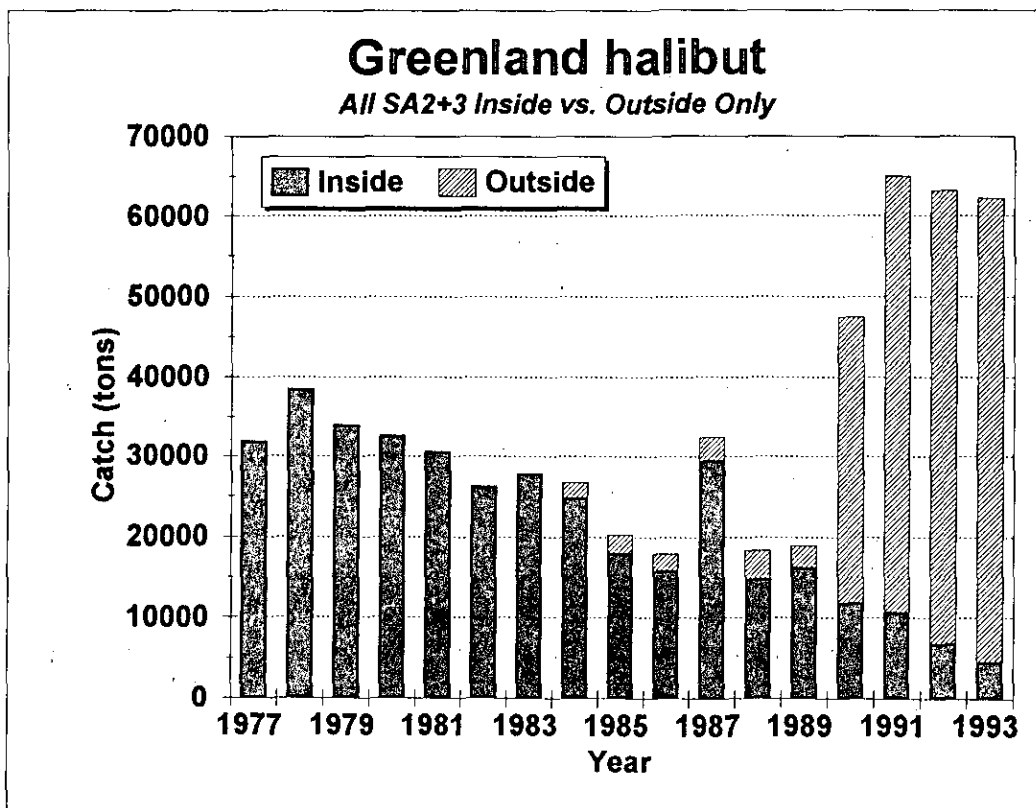Recent years include Div. 3MN.

Fig. 2. Total catch of G. halibut inside 200 miles (all areas) compared
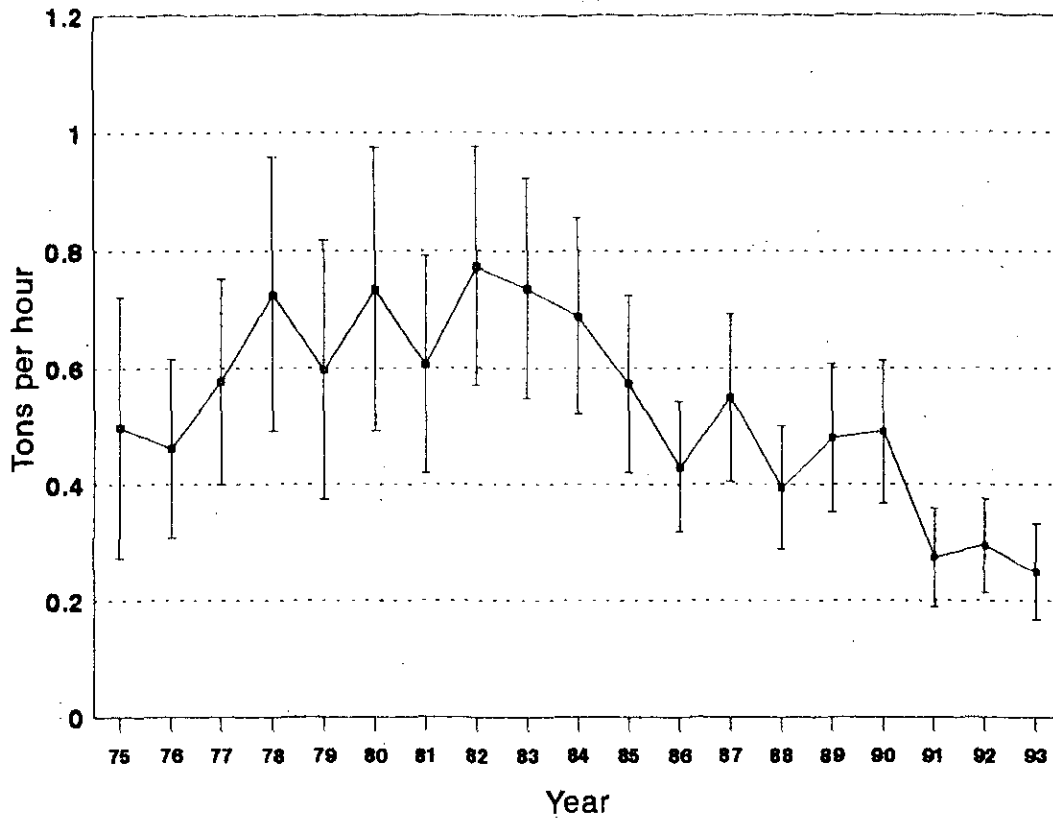to the catch outside 200 miles (Subarea 3) from 1977-93.

Fig. 3 Standardized CPUE with approximate 95% confidence
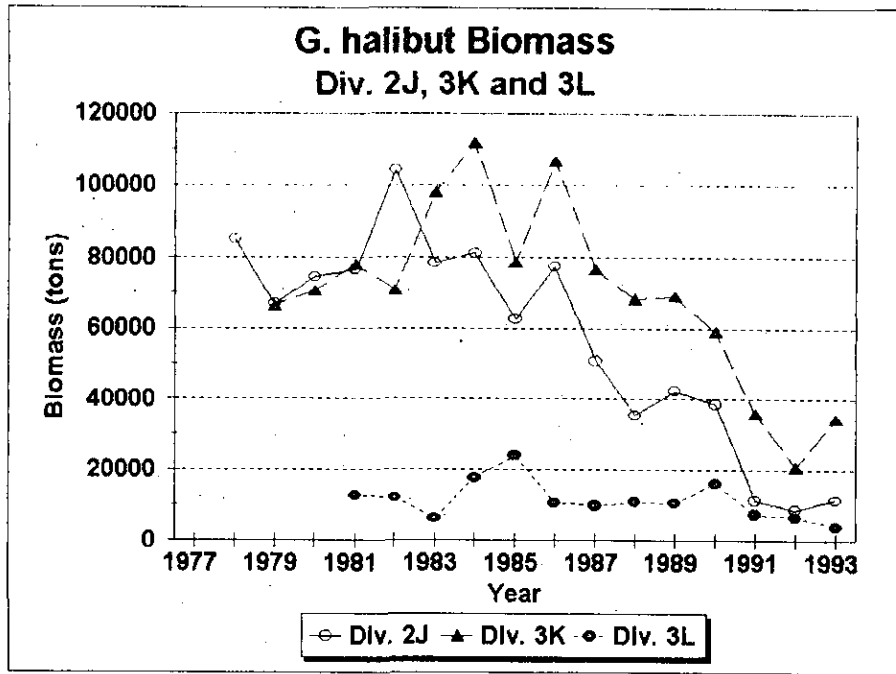intervals for Greenland Halibut in SA2 + Div. 3KLM from 1975-1993.

Fig. 4. G. halibut biomass estimates separately by division from research vessel surveys in Div. 2J, 3K and 3L during 1977-93.
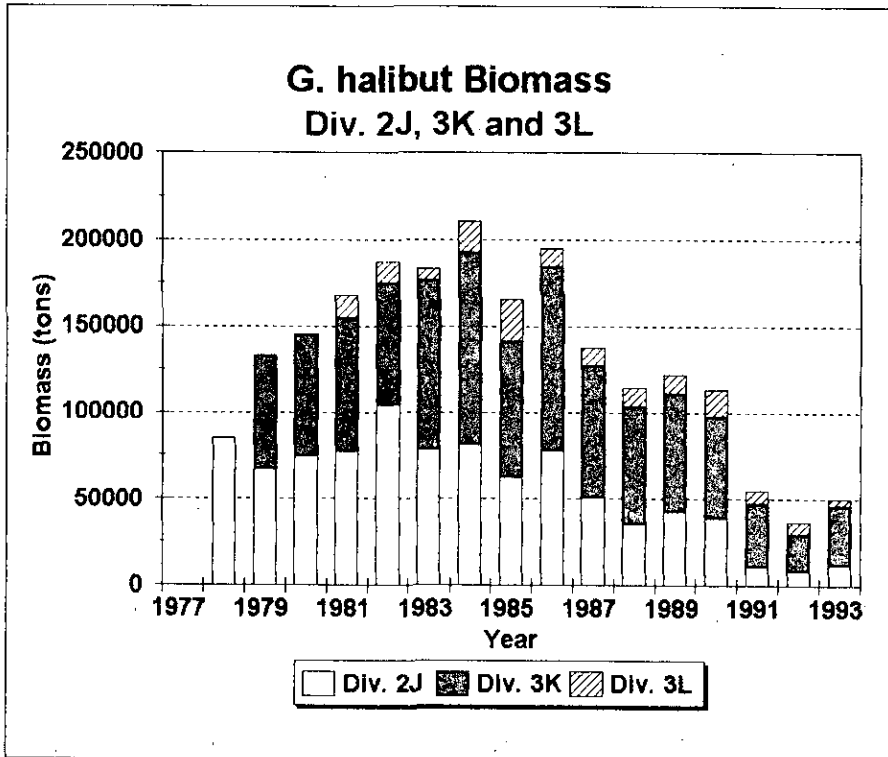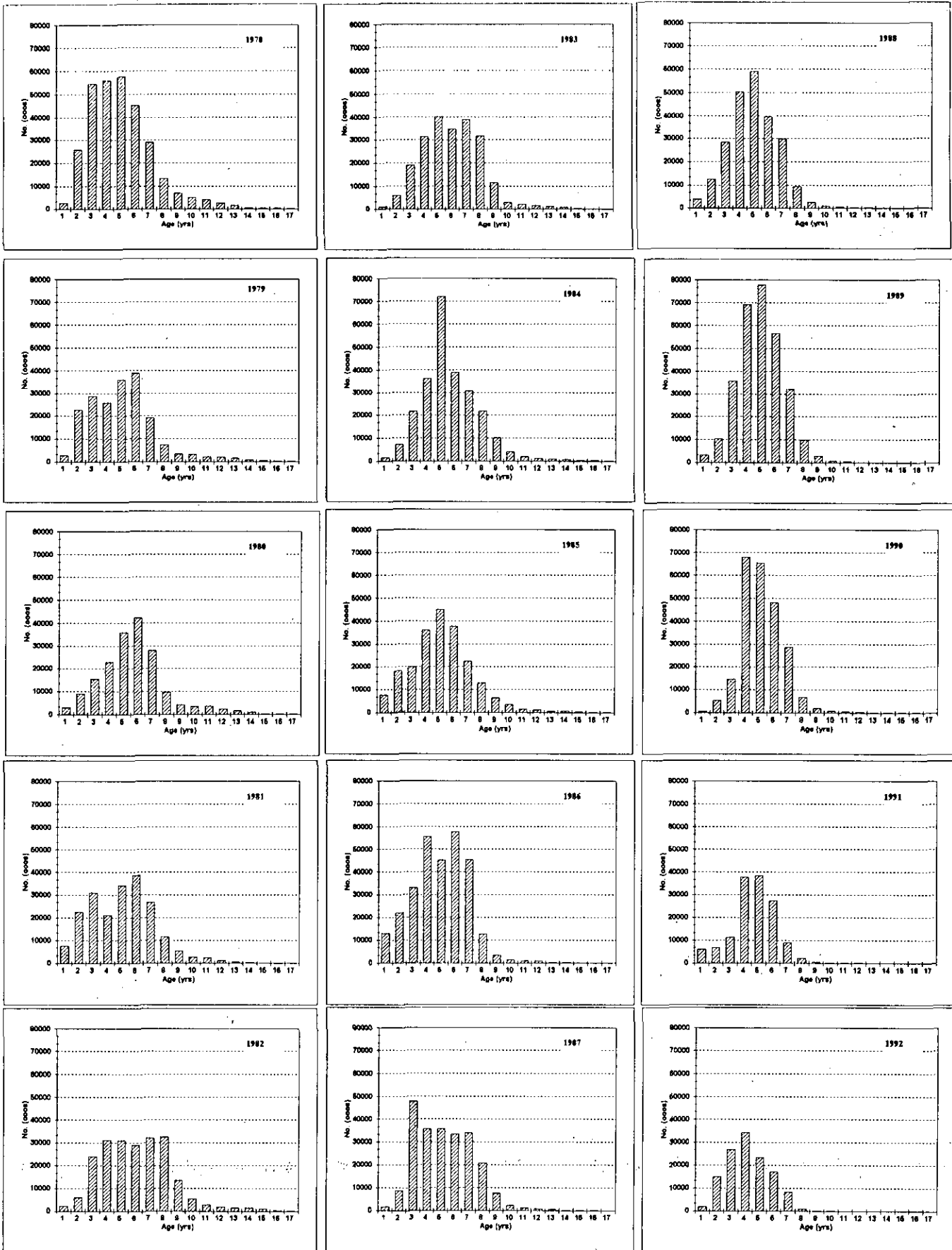

Fig. 5. G. halibut biomass estimates cumulatively by division from research vessel surveys in Div. 2J, 3K and 3L during 1977-93.

Fig. 6. Age distributions of G. halibut from surveys in Div. 2J and 3KL, 1978-92.
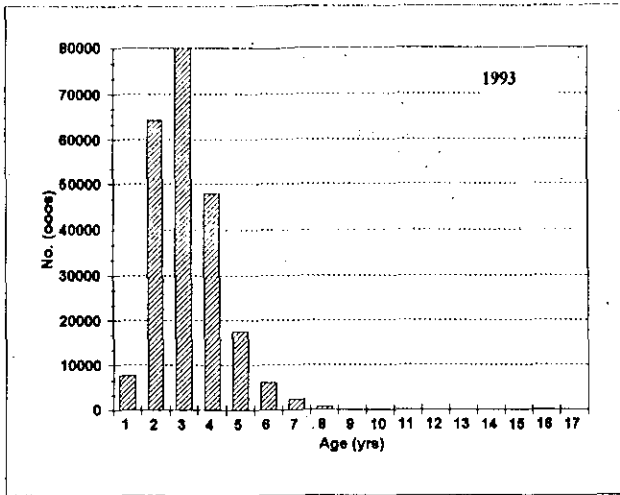
Fig. 6 con'd. Age distributions of G. halibut from
surveys in Div. 2J and 3KL, 1993.
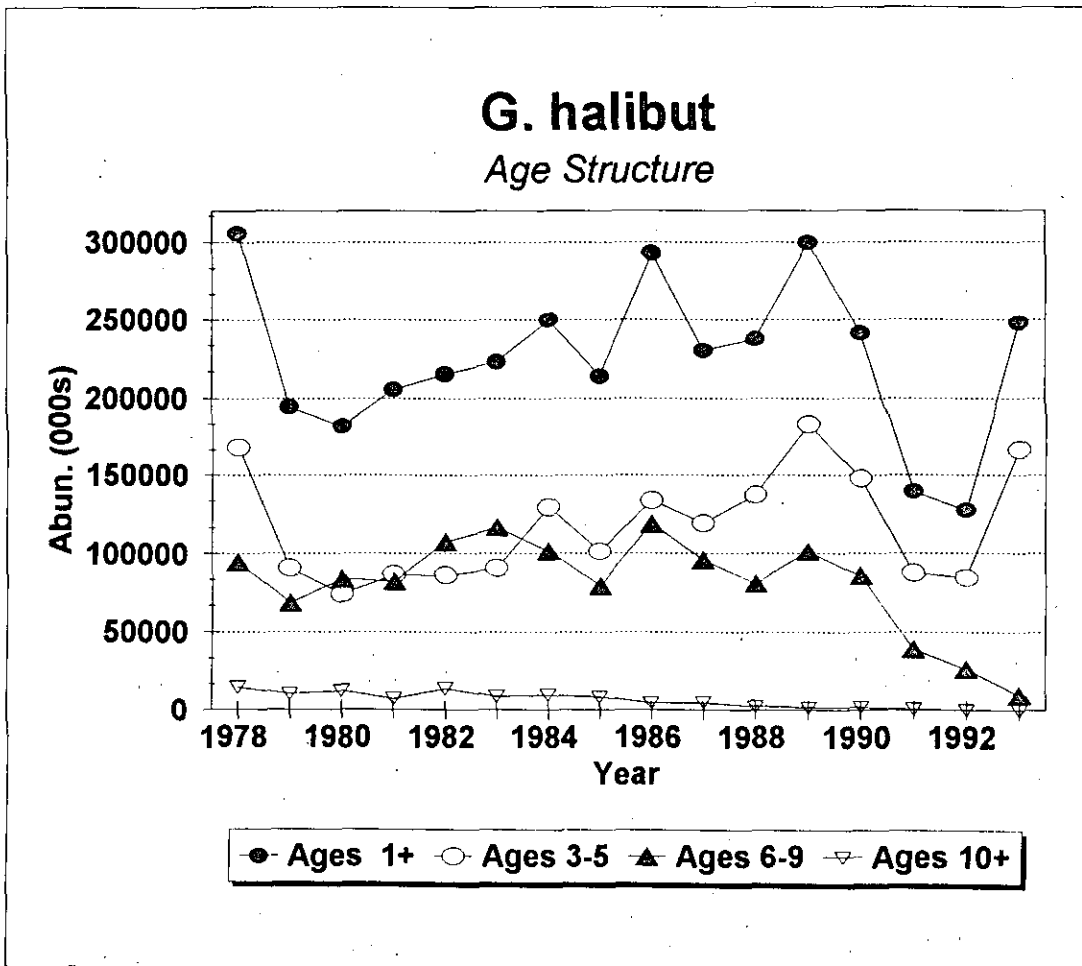
Fig.   7. Age composition of G. halibut by age range from research surveys in
Div. 2J,3KL during the fall of 1978-93.
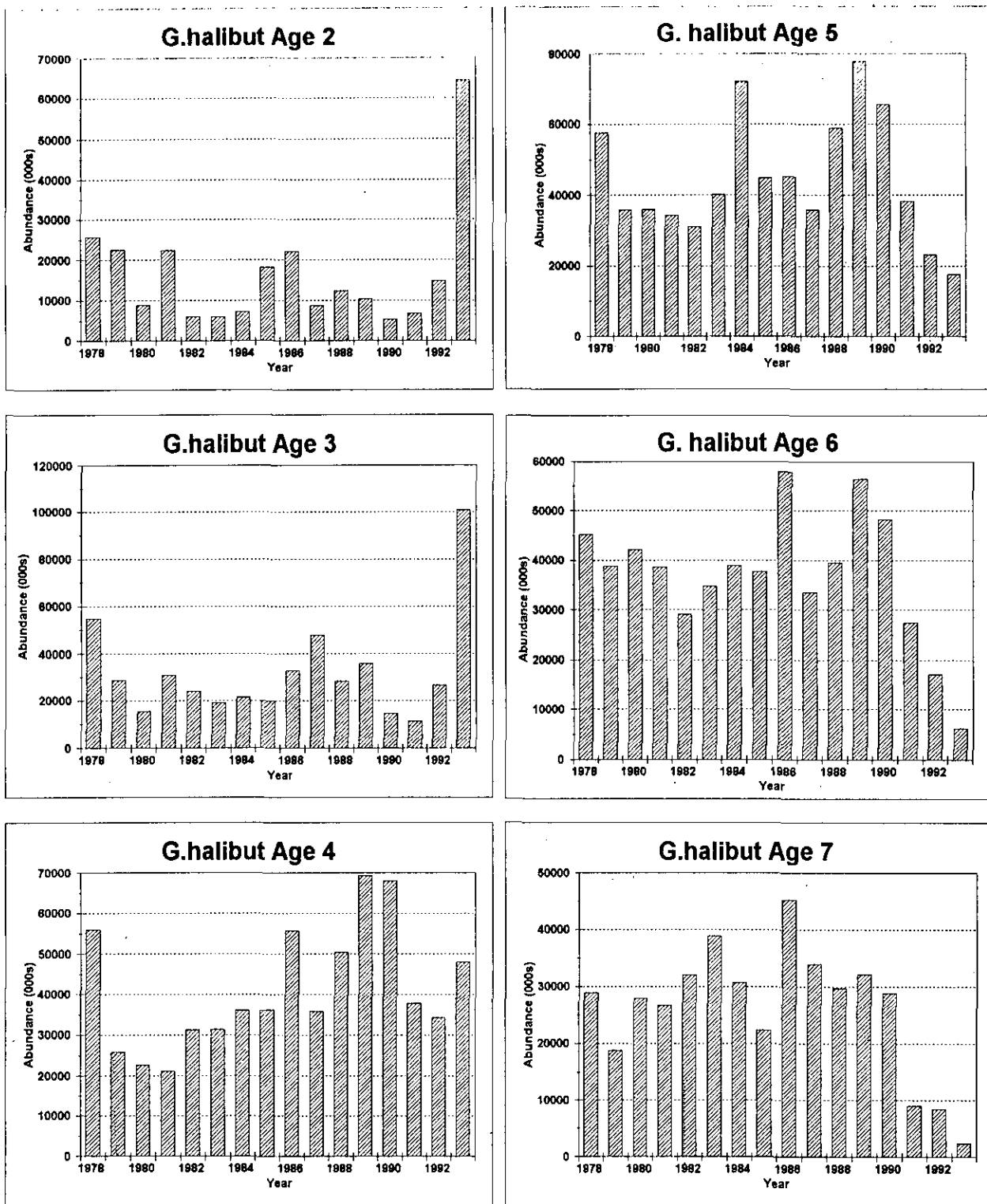
Fig. 8. Abundance of G. halibut from surveys in Div. 2J3KL at ages 2-7 separately from 1978-93.

AGE 2

AGE 3

AGE 4
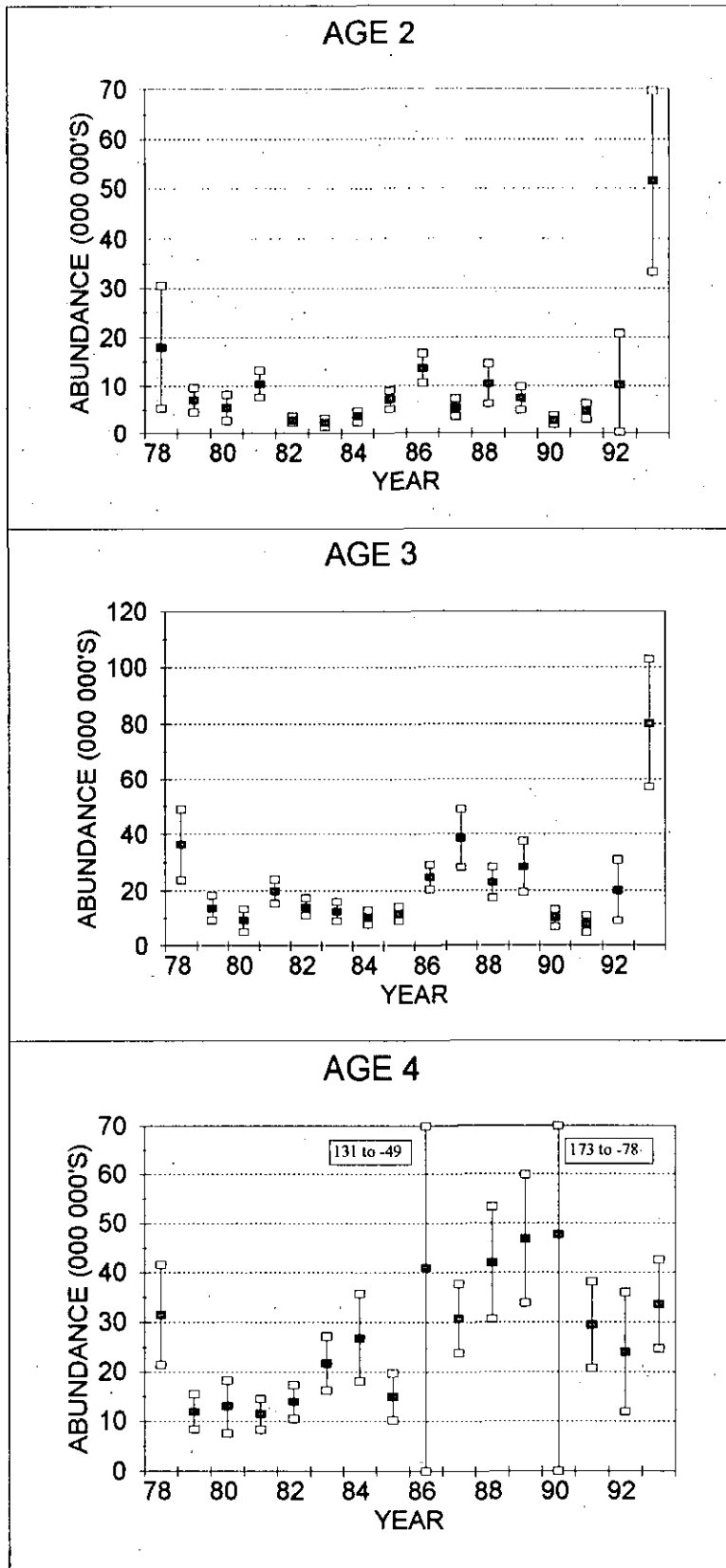
Fig.9 G. Halibut abundance (millions) at ages 2 to 4 in 3K from RV surveys
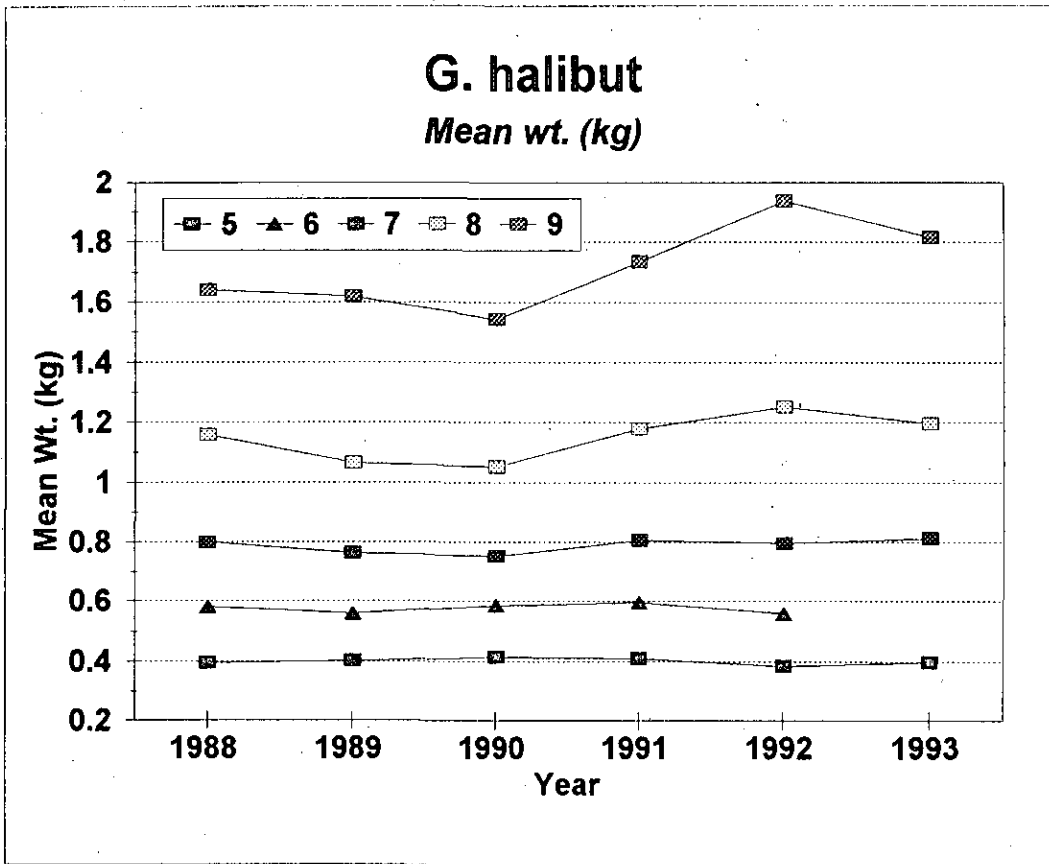
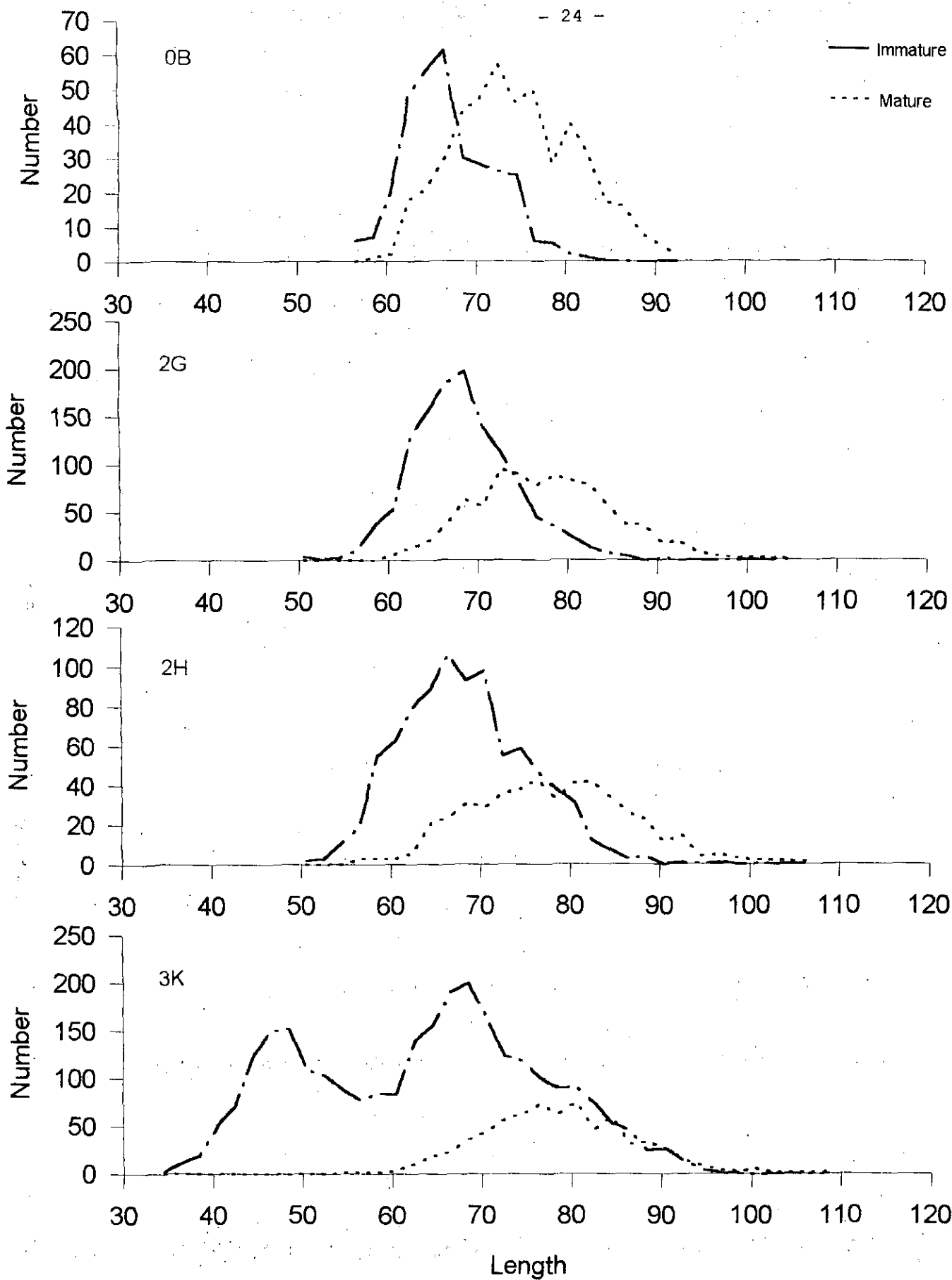Fig. 10. Mean weight (kg) at age of Greenland halibut from the Canadian fishery in SA2+3KL, 1988-93.

Fig. 11.   Frequency at length of immature and mature Greenland halibut from the commercial fishery in Divisions 0B, 2G, 2H and 3K.
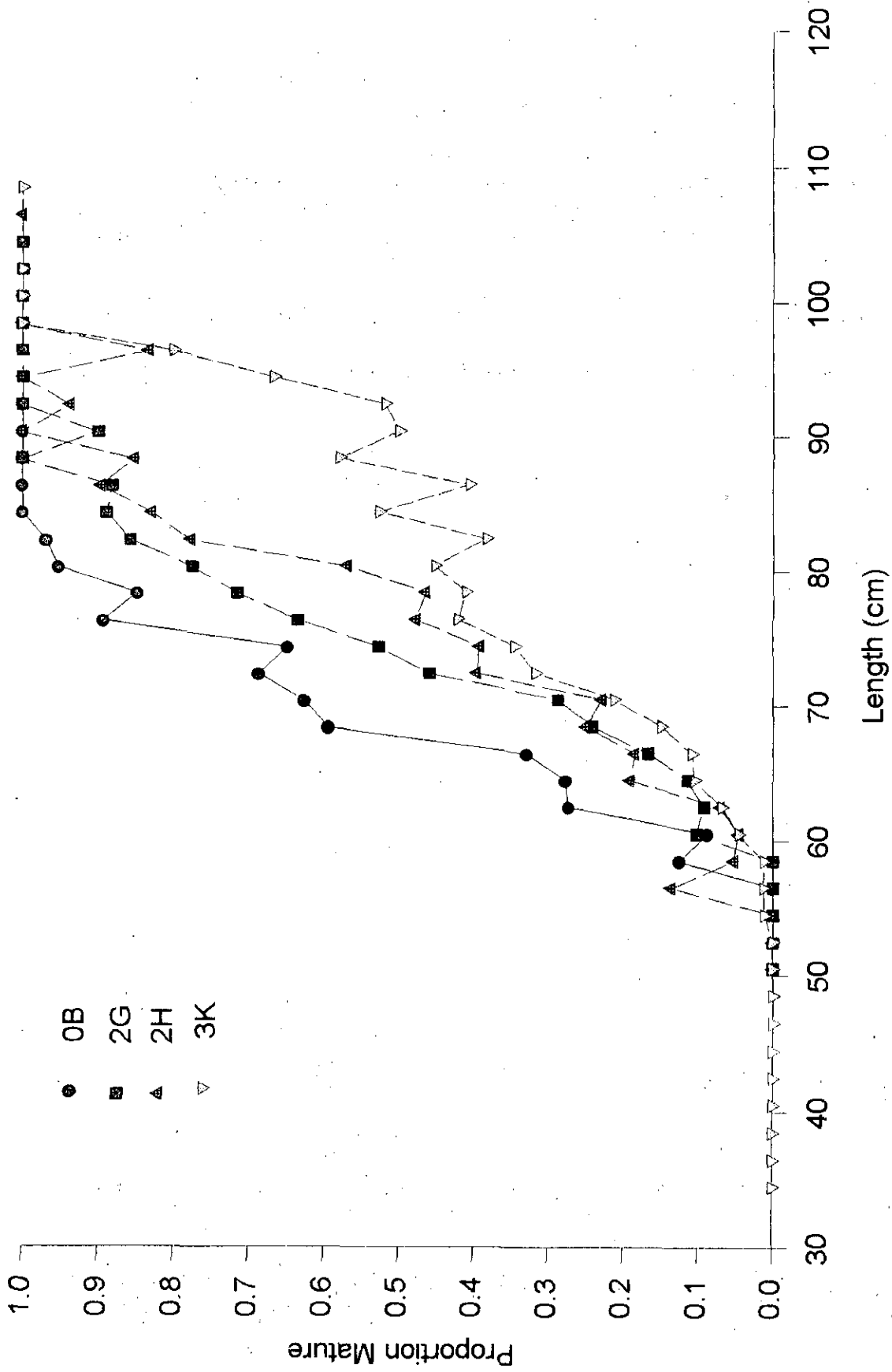
Fig. 12. Proportion mature at length of female Greenland halibut sampled from the commercial fishery in Div. 0B, 2G, 2H and 3K.