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Comparison of Results for Greenland Halibut from Canadian and Japanese Research Vessel Surveys in Divisions 2GH in 1996.

by

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INTRODUCTION

During 1996, trawl surveys of NAFO Div. 2GH were conducted independently by Japan and Canada. The survey by Japan was their first in this area, while Canada has conducted several surveys in Div. 2GH since 1977, the most recent before 1996 being in 1991. This paper examines the results of these surveys as they pertain to Greenland halibut.

METHODS

The Japanese survey was conducted onboard the *RV Shinkai Maru* during August, and the Canadian survey was done with the *RV Teleost* from mid-September to mid-October. Both surveys used the stratification scheme outlined in Bowering (1987), and shown in Figs. 1 & 2. Details of the Japanese survey are given in Yokawa and Satani (1997). The fishing gear used in the Canadian survey was the Campelen 1800 shrimp trawl, outfitted with rock-hopper footgear and a 12.7 mm liner in the codend (see McCallum and Walsh (1996) for details on this trawl). SCANMAR equipment was used to monitor trawl performance at each fishing set, during which the trawl was towed along the bottom for 15 minutes at a speed of 3 knots. Catches were sorted by species, weighed and counted, and measurements and otoliths collected from several species, including Greenland halibut. Canadian age readers determined the ages of otoliths collected on both surveys. For both surveys, estimates of trawlable abundance and biomass were calculated, accounting for swept area in the usual manner, using STRAP software (Smith and Somerton 1981). Strata with only one haul were excluded from both analyses. Plots of Greenland halibut distribution, from both surveys, were done with ACON software (Black 1993), and were standardized to Campelen trawl units (0.75 n.mi distance, 16.84 metre wing spread) for ease of comparison.

RESULTS and DISCUSSION

A total of 134 sets was analysed from the Japanese survey, compared to 117 in the Canadian survey. Comparing Divs. 2G and 2H, Japanese coverage was better in Div. 2G, while Canadian coverage was better in Div. 2H (Tables 1 - 4). In the Canadian survey, only two strata deeper than 400 m were surveyed in Div. 2G, while only 3 strata in all of Div. 2H were not fished (Tables 5 & 6). The biomass estimates of G. halibut from Divs. 2GH combined, were both about 50,000 t (Tables 2 & 4), with differences in the Divisional estimates reflecting the differences in survey coverage noted above. Total abundance was substantially higher from the Canadian survey at 315 million fish, compared to 128 million fish from the Japanese survey (Tables 1 & 3). This is due to the higher catchability of young G.halibut in the Campelen trawl. The higher overall mean catch per tow in the Japanese survey is due to the larger wing spread (40.2 m) of the Japanese trawl, and the 30-minute tow duration (vs. 15-minute in the Canadian tows).

The distribution of G.halibut was similar in both surveys (Fig. 3), and was consistent with the patterns found in previous Canadian surveys in this area (Bowering and Power 1995). Relatively large catches were observed in the northern tip of Div. 2G, and in the southern half of Div. 2H. The largest catches in the Canadian survey in Div. 2G occurred in the northern strata 927-929 (Fig 1, Tables 3 & 4). These also produced large catches in the Japanese survey (Tables 1 & 2), although stratum 918 (1251 - 1500 m in northeast 2G), which was not covered by Canada, had the highest biomass. In Div. 2H, the largest biomass in both surveys was found in stratum 946 (depth 501 - 750 m in southwest 2H). For Divs. 2GH combined, there was a significant linear relationship between biomass estimates from the 32 strata sampled during both surveys (Fig. 4).

Modes in the length frequencies of G.halibut occurred around 14 and 22 cm in both surveys (Figs 5 & 6). In the Canadian survey, the largest mode was at the lower length, while in the Japanese survey the largest mode was at the bigger size. The age composition of the Canadian survey was dominated by fish of these sizes, corresponding to ages 1 and 2. However, the age composition of the Japanese survey contains almost equal numbers of fish at each age from 1 to 5 (Table 7, Fig. 7). The Canadian survey caught few fish older than age 5 (Table 8, Fig. 8), and none older than age 12. The Japanese survey caught more fish at ages 6+, up to a maximum age of 17, although few older than 9 were observed. The higher proportion of older fish in the Japanese survey is likely explained by the additional deepwater coverage in Div. 2G, where larger fish predominate, although there may also be differences in catchability of larger G.halibut between the two survey trawls.

Estimates of abundance and biomass from earlier Canadian surveys (Tables 5 & 6) are not directly comparable with the 1996 Campelen trawl results because of major differences in the trawl gears used in previous surveys and in 1996 (2 different versions of the Engels 145 trawl used historically, see McCallum and Walsh (1996)) . Comparison of catches from strata fished in the surveys of 1978-81 with the same data for 1987-91 indicates a decline in G.halibut abundance and biomass over this period. These data also show that Divs. 2GH have not been surveyed regularly in the past, and that coverage in some of the surveys has been incomplete, particularly in Div. 2G. As well, there were few sets done in depths greater than 750 m in most of the previous surveys. In addition to the Canadian surveys, some USSR/Russian surveys were conducted between 1978 and 1992, and showed sharp declines in the biomass of G.halibut from 1982 to 1985, followed by stability at a relatively low level (Gorchinsky 1993). Even though the catchability of the trawls used in 1996 is not known relative to all the trawls used in these previous survey series, it appears that the biomass of Greenland halibut in Divs. 2GH is at a lower level that that observed in the late 1970's and early 1980's

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REFERENCES

Black, G.A. 1993. ACON data visualization software : user manual - version 7.14. Unpublished manuscript. 179 p. (G. Black, Dept. of Fisheries and Oceans, P.O.Box 550, Halifax, N.S., Canada B3J 2S7).

Bowering, W.R. 1987. A newly developed stratification scheme for NAFO Divisions 2G and 2H. NAFO SCR Doc. 87/23, Ser. No. N1306.

Bowering, W.R. and D. Power. 1995. Spatial distribution of Greenland halibut in the Labrador - Eastern Newfoundland area of the Canadian Northwest Atlantic. NAFO Sci. Coun. Studies: No. 22, p. 51-61.

Gorchinsky, K.V. 1993. Results from Greenland halibut assessment in Divisions 0B, 2GH by the data from the 1992 trawl survey. NAFO SCR Doc. 93/15, Ser. No. N2192.

McCallum, B.R. and S.J. Walsh. 1996. Groundfish survey trawls used at the Northwest Atlantic Fisheries Centre, 1971 to present. NAFO SCR Doc. 96/50, Ser. No. N2726.

Smith, S.J. and G.A. Somerton. 1981. STRAP : A user oriented computer analysis system for groundfish research trawl survey data. Can. Tech. Rep. Fish. Aquat. Sci. 1030: iv + 66 p.

Yokawa, K. and M. Satani. 1997. Results of a stratified random bottom trawl survey in NAFO Divisions 2GH in 1996. NAFO SCR Doc. 97/23, Ser. No. N2853.

Table 1. Greenland halibut abundance estimates from a Japanese survey in Div. 2GH during August 1996.
Upper and lower in the summary tables refer to approximate 95% confidence intervals.

NAFO Div. 2G

Stratum	No. sets	Units ('000)	No. caught	Avg./set	Total No.	Variance
901	11	31277.7	2104	191.3	5982572	57156
902	2	3094.3	112	56.0	173278	578
903	2	2062.8	166	83.0	171215	50
904	2	3945.2	486	243.0	958676	162
905	2	4228.8	467	233.5	987427	72581
908	4	15084.5	594	148.5	2240043	13414
911	5	17843.5	658	131.6	2348205	5186
912	2	1882.3	74	37.0	69646	2
913	2	1598.7	349	174.5	278972	5305
914	2	2913.8	332	166.0	483683	1800
918	2	13279.5	1077	538.5	7151004	114721
919	2	8148.2	1156	578.0	4709654	228488
920	2	4435.1	1126	563.0	2496956	40328
921	2	3661.5	66	33.0	120830	1352
922	2	4796.1	159	79.5	381289	3445
923	2	4796.1	60	30.0	143883	50
924	5	19493.8	456	91.2	1777832	2962
926	3	11165.1	362	120.7	1347253	13225
927	6	21453.5	781	130.2	2792526	5357
928	6	20190.0	1546	257.7	5202284	26713
929	12	32515.4	2753	229.4	7459576	15142
Totals	*78*	*227865.7*	*14884*			

Summary

	No./Tow			*Abundance (millions)*		
Mean	Upper	Lower		Total	Upper	Lower
207.5	268.6	146.4		47.3	61.2	33.4

NAFO Div. 2H

Stratum	No. sets	Units ('000)	No. caught	Avg./set	Total No.	Variance
931	2	7116.8	416	208.0	1480289	162
932	2	1418.2	1586	793.0	1124631	999698
933	2	1289.3	226	113.0	145688	800
934	2	2011.3	779	389.5	783387	24421
935	2	2475.4	3448	1724.0	4267589	66248
936	2	2011.3	1532	766.0	1540627	195938
937	2	2423.8	550	275.0	666553	25538
940	2	2501.2	1258	629.0	1573245	21218
942	2	1418.2	65	32.5	46091	265
943	2	9128.0	248	124.0	1131876	7938
944	5	22175.5	1790	358.0	7938812	32072
945	2	11887.1	2266	1133.0	13468056	318402
946	5	18591.3	5468	1093.6	20331426	42950
948	2	6343.2	1192	596.0	3780554	164738
951	2	6033.8	1545	772.5	4661100	353641
952	2	4564.0	2376	1188.0	5422053	233928
953	2	7503.6	1068	534.0	4006898	383688
955	2	10030.5	169	84.5	847579	685
958	2	7580.9	184	92.0	697444	392
959	2	4589.8	190	95.0	436031	2888
960	2	2759.0	250	125.0	344880	5832
961	2	5440.7	687	343.5	1868888	78013
962	2	6240.1	333	166.5	1038972	841
963	2	6833.1	468	234.0	1598953	6272
964	2	8818.6	342	171.0	1507982	7442
Totals	*56*	*161184.6*	*28436*			

Summary

	No./Tow			*Abundance (millions)*		
Mean	Upper	Lower		Total	Upper	Lower
500.7	629.0	372.5		80.7	101.4	60.0

Table 2. Greenland halibut biomass estimates from a Japanese survey in Div. 2GH during August 1996.
Upper and lower in the summary tables refer to approximate 95% confidence intervals.

NAFO Div. 2G

Stratum	No. sets	Units ('000)	Kg. caught	Avg./set	Total Kg.	Variance
901	11	31277.7	299.6	27.2	851891	1151
902	2	3094.3	13.8	6.9	21350	2
903	2	2062.8	46.0	23.0	47445	34
904	2	3945.2	217.6	108.8	429234	22
905	2	4228.8	159.0	79.5	336190	9522
908	4	15084.5	26.9	6.7	101443	11
911	5	17843.5	23.6	4.7	84221	8
912	2	1882.3	20.3	10.2	19106	24
913	2	1598.7	122.4	61.2	97840	1040
914	2	2913.8	126.2	63.1	183858	54
918	2	13279.5	1277.6	638.8	8482936	194813
919	2	8148.2	1010.5	505.3	4116873	98435
920	2	4435.1	664.4	332.2	1473337	21136
921	2	3661.5	33.3	16.7	60964	356
922	2	4796.1	71.5	35.8	171460	955
923	2	4796.1	12.8	6.4	30695	3
924	5	19493.8	74.3	14.9	289677	345
926	3	11165.1	194.4	64.8	723497	5055
927	6	21453.5	476.6	79.4	1704120	3014
928	6	20190.0	1043.0	173.8	3509691	342
929	12	32515.4	1821.1	151.8	4934483	5564
Totals	*78*	*227865.7*	*7734.9*			

Summary

Kg./Tow				*Biomass ('000 t)*		
Mean	Upper	Lower		Total	Upper	Lower
121.4	382.0	-139.1		27.7	87.0	-31.7

NAFO Div. 2H

Stratum	No. sets	Units ('000)	Kg. caught	Avg./set	Total Kg.	Variance
931	2	7116.8	12.2	6.1	43412	6
932	2	1418.2	40.4	20.2	28648	131
933	2	1289.3	62.5	31.3	40290	94
934	2	2011.3	207.8	103.9	208970	1210
935	2	2475.4	1439.6	719.8	1781793	57190
936	2	2011.3	792.6	396.3	797063	27378
937	2	2423.8	779.8	389.9	945051	60274
940	2	2501.2	752.2	376.1	940696	450
942	2	1418.2	19.1	9.6	13544	45
943	2	9128.0	13.8	6.9	62983	52
944	5	22175.5	197.1	39.4	874156	1904
945	2	11887.1	466.2	233.1	2770877	1040
946	5	18591.3	1327.5	265.5	4935985	3557
948	2	6343.2	213.0	106.5	675552	986
951	2	6033.8	508.4	254.2	1533788	32462
952	2	4564.0	378.6	189.3	863969	2394
953	2	7503.6	197.0	98.5	739100	12577
955	2	10030.5	17.9	9.0	89773	31
958	2	7580.9	11.3	5.7	42832	5
959	2	4589.8	26.3	13.2	60356	120
960	2	2759.0	67.7	33.9	93393	325
961	2	5440.7	368.8	184.4	1003269	30209
962	2	6240.1	197.4	98.7	615895	41
963	2	6833.1	443.5	221.8	1515247	3453
964	2	8818.6	460.9	230.5	2032249	8103
Totals	*56*	*161184.6*	*9001.6*			

Summary

Kg./Tow				*Biomass ('000 t)*		
Mean	Upper	Lower		Total	Upper	Lower
140.9	164.6	117.1		22.7	26.5	18.9

Table 3. G. halibut abundance from a Canadian survey in Div. 2GH during fall 1996.
Upper and lower in the summary tables refer to approximate 95% confidence intervals.

NAFO Div. 2G

Stratum	No. sets	Units ('000)	No. caught	Avg./set	Total No.	Variance
901	4	166861.6	340	84.9	14164696	4788
902	2	16507.3	282	141.2	2330285	3843
908	2	80473.2	224	112.0	9013002	242
909	8	381456.9	134	16.7	6378807	547
910	6	321755.4	15	2.5	804388	12
911	3	95192.3	150	50.0	4759614	1924
923	2	25586.4	68	34.0	869936	338
924	2	103996.2	83	41.5	4312375	2611
925	4	248160.2	6	1.4	358454	4
926	2	59564.0	47	23.3	1386516	275
927	2	114450.8	265	132.6	15176179	606
928	3	107710.3	411	137.0	14756315	18928
929	3	173464.5	404	134.8	23379164	12589
Totals	*43*	*1895179.1*	*2428*			

Summary

	No./Tow				*Abundance (millions)*	
Mean	Upper	Lower		Total	Upper	Lower
51.5	72.7	30.4		97.7	137.8	57.6

NAFO Div. 2H

Stratum	No. sets	Units ('000)	No. caught	Avg./set	Total No.	Variance
930	4	141412.8	152	38.0	5373686	805
931	2	37966.9	334	167.0	6340466	54450
932	2	7565.9	654	327.0	2474036	1250
933	2	6878.1	261	130.5	897586	12961
934	2	10729.8	146	73.0	783273	1568
938	2	26274.2	20	10.0	262742	8
939	2	17882.9	83	41.5	742142	61
940	2	13343.4	64	32.0	426990	72
941	2	12242.9	44	22.0	269345	128
942	2	7565.9	66	33.0	249673	2
943	2	48696.6	215	107.5	5234887	9661
944	3	118302.5	169	56.3	6655613	3777
945	2	63415.7	317	158.5	10051382	10225
946	3	99181.5	926	308.7	30614036	44786
947	2	31226.4	672	336.0	10492059	968
948	2	33840.0	1526	763.2	25825581	88340
949	2	28337.6	2079	1039.5	29456918	41761
950	2	35903.4	116	58.0	2082400	722
951	2	32189.3	690	345.0	11105306	79202
952	2	24348.3	494	247.0	6014033	94178
953	2	40030.3	65	32.5	1300984	613
954	4	133571.8	59	14.9	1985026	496
955	2	53511.3	1867	933.4	49949791	26655
956	3	144576.7	15	5.0	722884	7
957	5	188596.3	15	3.0	565789	7
958	2	40443.0	99	49.5	2001926	841
959	2	24485.9	94	46.8	1145939	233
960	2	14719.0	28	14.0	206067	162
961	2	29025.4	45	22.5	653071	181
962	2	33289.8	93	46.5	1547975	421
963	2	36453.7	64	32.0	1166518	128
964	2	47045.9	18	9.1	428118	74
Totals	*74*	*1583053.0*	*11490*			

Summary

	No./Tow				*Abundance (millions)*	
Mean	Upper	Lower		Total	Upper	Lower
137.1	166.9	107.3		217.0	264.3	169.8

Table 4. G. halibut biomass from a Canadian survey in Div. 2GH during fall 1996.
Upper and lower in the summary tables refer to approximate 95% confidence intervals.

NAFO Div. 2G

Stratum	No. sets	Units ('000)	Kg. caught	Avg./set	Total Kg.	Variance
901	4	166861.6	12.8	3.1	516529.3	5.3
902	2	16507.3	37.8	18.9	312263.7	0.8
908	2	80473.2	15.1	7.5	605561.1	3.0
909	8	381456.9	3.0	0.4	141827.8	0.3
910	6	321755.4	0.4	0.1	23059.1	0.0
911	3	95192.3	7.6	2.5	240624.9	10.8
923	2	25586.4	15.6	7.8	199573.6	41.4
924	2	103996.2	4.3	2.2	225094.0	5.6
925	4	248160.2	0.2	0.1	15372.2	0.0
926	2	59564.0	14.3	7.2	426047.7	20.4
927	2	114450.8	117.6	58.8	6729136.2	2016.8
928	3	107710.3	193.6	64.5	6949111.5	2849.6
929	3	173464.5	101.9	34.0	5891048.2	196.4
Totals	*43*	*1895179.1*	*524.2*			

Summary

	Kg./Tow				*Biomass ('000t)*	
Mean	Upper	Lower		Total	Upper	Lower
11.8	23.4	0.1		22.3	44.4	0.2

NAFO Div. 2H

Stratum	No. sets	Units ('000)	Kg. caught	Avg./set	Total Kg.	Variance
930	4	141412.8	4.3	1.1	152019	1
931	2	37966.9	9.5	4.7	179773	43
932	2	7565.9	34.6	17.3	130700	15
933	2	6878.1	30.5	15.2	104718	92
934	2	10729.8	56.5	28.3	303116	392
938	2	26274.2	34.0	17.0	446661	83
939	2	17882.9	93.0	46.5	831557	78
940	2	13343.4	40.1	20.1	267536	30
941	2	12242.9	13.2	6.6	80497	10
942	2	7565.9	16.1	8.0	60716	1
943	2	4896.6	13.9	7.0	338442	1
944	3	118302.5	12.7	4.2	499500	3
945	2	63415.7	41.1	20.5	1301606	116
946	3	99181.5	141.6	47.2	4679716	613
947	2	31226.4	128.2	64.1	2001610	6
948	2	33840.0	191.1	95.6	3233603	325
949	2	28337.6	281.3	140.6	3985398	10
950	2	35903.4	15.8	7.9	282740	5
951	2	32189.3	101.2	50.6	1628778	509
952	2	24348.3	27.7	13.8	336615	185
953	2	40030.3	9.0	4.5	179135	18
954	4	133571.8	2.7	0.7	90866	1
955	2	53511.3	55.1	27.6	1475187	20
956	3	144576.7	0.3	0.1	12048	0
957	5	188596.3	0.4	0.1	14711	0
958	2	40443.0	8.8	4.4	177949	0
959	2	24485.9	12.4	6.2	151323	15
960	2	14719.0	13.2	6.6	97146	70
961	2	29025.4	19.7	9.8	285174	45
962	2	33289.8	53.1	26.6	883844	123
963	2	36453.7	56.2	28.1	1023437	6
964	2	47045.9	35.1	17.6	826361	189
Totals	*74*	*1539253.0*	*1551.8*			

Summary

	Kg./Tow				*Biomass ('000t)*	
Mean	Upper	Lower		Total	Upper	Lower
16.5	19.6	13.3		26.1	31.1	21.1

Table 5. Mean weight (kg) per tow, of G.halibut from Canadian surveys in Div 2G from 1978-96.
Values in parentheses are the numbers of sets.
G.A. is RV Gadus Atlantica, A.N is RV Alfred Needler, and Tel is RV Teleost

DEPTH RANGE (m)	STRATUM	G.A. 13 1978	G.A. 24 1979	G.A. 57 1981	G.A. 143 1987	G.A. 156 1988	A.N. 161 1991	TEL. 37 1996
<200	909	23.1 (13)	3.9 (12)	5.9 (8)	-	-	0.1 (10)	0.4(8)
	910	52.7 (8)	6.5 (8)	8.1 (8)	-	-	0.0 (2)	0.1(6)
	925	66.7 (5)	15.7 (4)	13.8 (3)	-	-	-	0.1(4)
201-300	901	48.3 (9)	52.9 (7)	15.6 (6)	10.5 (4)	18.0 (5)	3.0 (7)	3.1(4)
	911	7.3 (4)	10.9 (4)	6.7 (3)	2.8 (3)	0.2 (2)	1.5 (2)	2.5(3)
	924	8.2 (2)	12.0 (3)	19.5 (2)	4.5 (2)	1.5 (5)	-	2.2(2)
	926	-	-	-	-	10.9 (3)	-	7.2((2)
	908	7.7 (2)	20.3 (3)	6.4 (3)	2.34 (5)	3.8 (3)	0.9 (3)	7.5(2)
301-400	902	-	-	-	23.1 (3)	2.4 (2)	-	18.9(2)
	912	-	-	-	11.5 (2)	0.1 (2)	-	-
	923	306.2 (2)	-	77.5 (2)	3.8 (2)	12.0 (2)	-	7.8(2)
	927	-	-	-	29.9 (5)	6.3 (4)	-	58.8(2)
401-500	903	-	93.3 (2)	73.3 (2)	18.8 (2)	12.4 (2)	2.3 (2)	-
	913	-	-	-	27.0 (2)	21.8 (2)	-	-
	922	303.0 (2)	-	84.5 (2)	-	-	-	-
	928	-	-	-	48.2 (3)	11.5 (3)	-	64.5(3)
501-750	904	-	265.4 (3)	114.0 (4)	47.3 (3)	25.2 (3)	-	-
	914	-	-	-	33.9 (2)	75.0 (2)	-	-
	921	-	660.1(2)	-	12.8 (2)	17.5 (2)	-	-
	929	-	146.0 (4)	240.7 (3)	52.6 (5)	35.5 (4)	-	34.0(3)
751-1000	905	-	-	-	-	179.5 (2)	-	-
	915	-	-	-	-	193.5 (2)	-	-
	920	-	-	-	261.2 (4)	187.8 (2)	-	-
1001-1250	906	-	-	-	2.4 (2)	25.5 (2)	-	-
	916	-	-	-	-	10.2 (2)	-	-
	919	-	-	-	-	24.2 (2)	-	-
1251-1500	907	-	-	-	-	-	-	-
	917	-	-	-	-	-	-	-
	918	-	-	-	-	-	-	-
BIOMASS (t)		37187	35484	37746	16076	15307	420	22275

Table 6. Mean weight (kg) per tow, of G.halibut from Canadian surveys in Div 2H from 1978-96.
Values in parentheses are the numbers of sets.
G.A. is RV Gadus Atlantica, A.N is RV Alfred Needler, and Tel is RV Teleost

DEPTH RANGE (m)	STRATUM	G.A. 13 1978	G.A. 24 1979	G.A.57 1981	G.A. 143 1987	G.A. 156 1988	A.N. 161 1991	TEL.36&37 1996
<200	930	1.1 (4)	1.8 (6)	5.0 (8)	0.1 (9)	0.3 (10)	1.9 (3)	1.1(4)
	954	3.1 (5)	4.0 (5)	1.9 (6)	0.2 (11)	0.2 (10)	0.0 (3)	0.7(4)
	956	4.8 (3)	1.0 (6)	3.6 (4)	0.4 (10)	1.7 (10)	0.2 (5)	0.1(3)
	957	16.1 (5)	2.1 (6)	7.3 (6)	1.3 (11)	1.4 (14)	0.2 (6)	0.1(5)
201-300	931	15.4 (3)	1.2 (3)	35.8 (3)	1.3 (4)	0.8 (3)	4.8 (2)	4.7(2)
	943	19.3 (2)	0.2 (2)	28.8 (2)	1.9 (4)	8.3(4)	0.2 (2)	7.0(2)
	950	-	-	-	-	-	-	7.9(2)
	953	267.3 (2)	22.1 (3)	72.4 (4)	10.5(3)	5.0 (3)	28.8(2)	4.5(2)
	955	11.4 (2)	11.2 (3)	7.8 (3)	1.9 (4)	4.5 (4)	0.5 (2)	27.6(2)
	958	-	10.2 (2)	4.3 (2)	0.1 (3)	2.3 (3)	1.9 (2)	4.4(2)
301-400	932	-	-	-	3.6 (2)	3.8 (2)	3.9 (2)	17.3(2)
	944	46.0 (6)	45.8 (9)	102.1 (9)	4.6 (10)	5.9 (8)	1.9 (2)	4.2(3)
	949	-	-	-	-	-	-	140.6(2)
	952	-	197.8 (2)	92.5 (2)	34.3 (3)	65.0 (3)	5.8 (2)	13.8(2)
	959	-	87.3(3)	54.3 (3)	13.2 (3)	36.5 (2)	2.8 (2)	6.2(2)
401-500	933	-	-	-	-	3.7 (2)	2.3 (2)	15.2(2)
	942	-	270.8 (2)	148.5 (2)	8.7 (3)	6.4 (2)	4.8 (2)	8.0(2)
	945	-	259.1 (3)	134.9 (6)	37.0 (5)	63.3 (5)	17.1 (2)	20.5(2)
	948	-	-	-	-	-	-	95.6(2)
	951	77.4 (2)	316.7 (2)	102.3 (3)	78.8 (2)	57.5 (2)	25.0 (2)	50.6(2)
	960	-	436.3 (2)	48.0 (2)	44.2 (3)	8.2 (3)	1.3 (2)	6.6(2)
501-750	934	-	636.3 (2)	-	58.5 (2)	10.0 (3)	-	28.6(2)
	941	-	-	-	38.0 (2)	75.3 (2)	-	6.6(2)
	946	460.5 (4)	721.4 (5)	187.7 (7)	193.1 (8)	110.3 (6)	-	47.2(3)
	947	-	660.8 (2)	109.3 (4)	255.2 (3)	223.3 (2)	-	64.1(2)
	961	-	285.3 (3)	63.5 (3)	27.5 (2)	36.0 (3)	-	9.8(2)
751-1000	935	-	-	-	46.9 (2)	42.0 (2)	-	-
	940	-	-	-	40.1 (2)	30.0 (2)	-	20.1(2)
	962	-	-	-	49.9 (3)	72.5 (2)	-	26.6(2)
1001-1250	936	-	-	-	10.2 (2)	237.8 (2)	-	-
	939	-	-	-	21.8 (2)	42.5 (2)	-	46.5(2)
	963	-	-	-	57.8 (2)	78.8 (2)	-	28.1(2)
1251-1500	937	-	-	-	-	-	-	-
	938	-	-	-	-	-	-	17.0(2)
	964	-	-	-	-	-	-	17.6(2)
BIOMASS (t)		38605	86231	34005	23330	22008	2293	26062

Table 7. Stratified estimates of abundance at age for Greenland halibut from the Japanese survey in Div. 2GH during August 1996. Upper and lower limits are approx. 95% confidence intervals.

	Abundance			No/Tow		
Age (yrs)	Total Numbers	Upper Limit	Lower Limit	Mean	Upper Limit	Lower Limit
			negative in ( )			
0	0	0	0	0	0	0
1	18,408,812	24,273,232	12,544,395	23.485	30.970	16.01
2	18,738,444	55,569,696	(18,092,804)	23.905	70.895	(23.09)
3	17,407,778	26,384,250	8,431,307	22.210	33.660	10.76
4	19,464,202	24,310,172	14,618,233	24.830	31.015	18.65
5	16,987,336	20,432,360	13,542,310	21.670	26.070	17.28
6	14,985,187	18,969,978	11,000,397	19.120	24.200	14.04
7	12,578,226	19,836,050	5,320,402	16.045	25.305	6.79
8	4,020,311	11,588,176	(3,547,555)	5.130	14.785	(4.53)
9	3,056,634	11,694,576	(5,581,309)	3.900	14.920	(7.12)
10	591,028	2,042,674	(860,620)	0.755	2.605	(1.10)
11	378,480	1,406,694	(649,735)	0.485	1.795	(0.83)
12	303,752	586,815	20,689	0.390	0.750	0.03
13	167,831	327,560	8,102	0.215	0.420	0.01
14	69,512	110,091	28,934	0.090	0.140	0.04
15	20,609	46,359	(5,142)	0.025	0.060	(0.01)
16	602			0.001		
17	1,670	5,962	(2,622)	0.003	0.010	(0.01)
UNK.	13,717	148,913	(121,481)	0.015	0.19	(0.16)
TOTAL	**127,194,120**	**148,261,392**	**106,126,848**	**162.275**	**189.15**	**135.395**

Table 8. Stratified estimates of abundance at age for Greenland halibut from the Canadian survey in Div. 2GH during August 1996. Upper and lower limits are approx. 95% confidence intervals.

	Abundance			No/Tow		
Age (yrs)	Total Numbers	Upper Limit	Lower Limit	Mean	Upper Limit	Lower Limit
			negative in ( )			
0	1,999,322	3,560,672	437,972	0.57	1.02	0.13
1	126,818,304	155,457,872	98,178,728	36.46	44.69	28.23
2	87,425,568	116,463,384	58,387,748	25.14	33.48	16.79
3	40,385,828	50,846,856	29,924,798	11.61	14.62	8.60
4	26,480,672	32,865,666	20,095,678	7.61	9.45	5.78
5	16,635,228	50,277,760	(17,007,304)	4.78	14.45	-4.89
6	7,197,509	24,669,500	(10,274,481)	2.07	7.09	-2.95
7	2,889,926	4,844,133	935,719	0.83	1.39	0.27
8	2,680,841	4,070,270	1,291,412	0.77	1.17	0.37
9	880,590	1,469,902	291,278	0.25	0.42	0.08
10	492,006	1,036,003	(51,992)	0.14	0.30	-0.01
11	114,332	356,230	(127,567)	0.03	0.10	-0.04
12	117,408	449,620	(214,804)	0.03	0.13	-0.06
Unk.	599,757	1,330,382	(130,867)	0.17	0.38	-0.04
Total	**314,717,280**	**370,650,176**	**258,784,368**	**90.48**	**106.56**	**74.40**

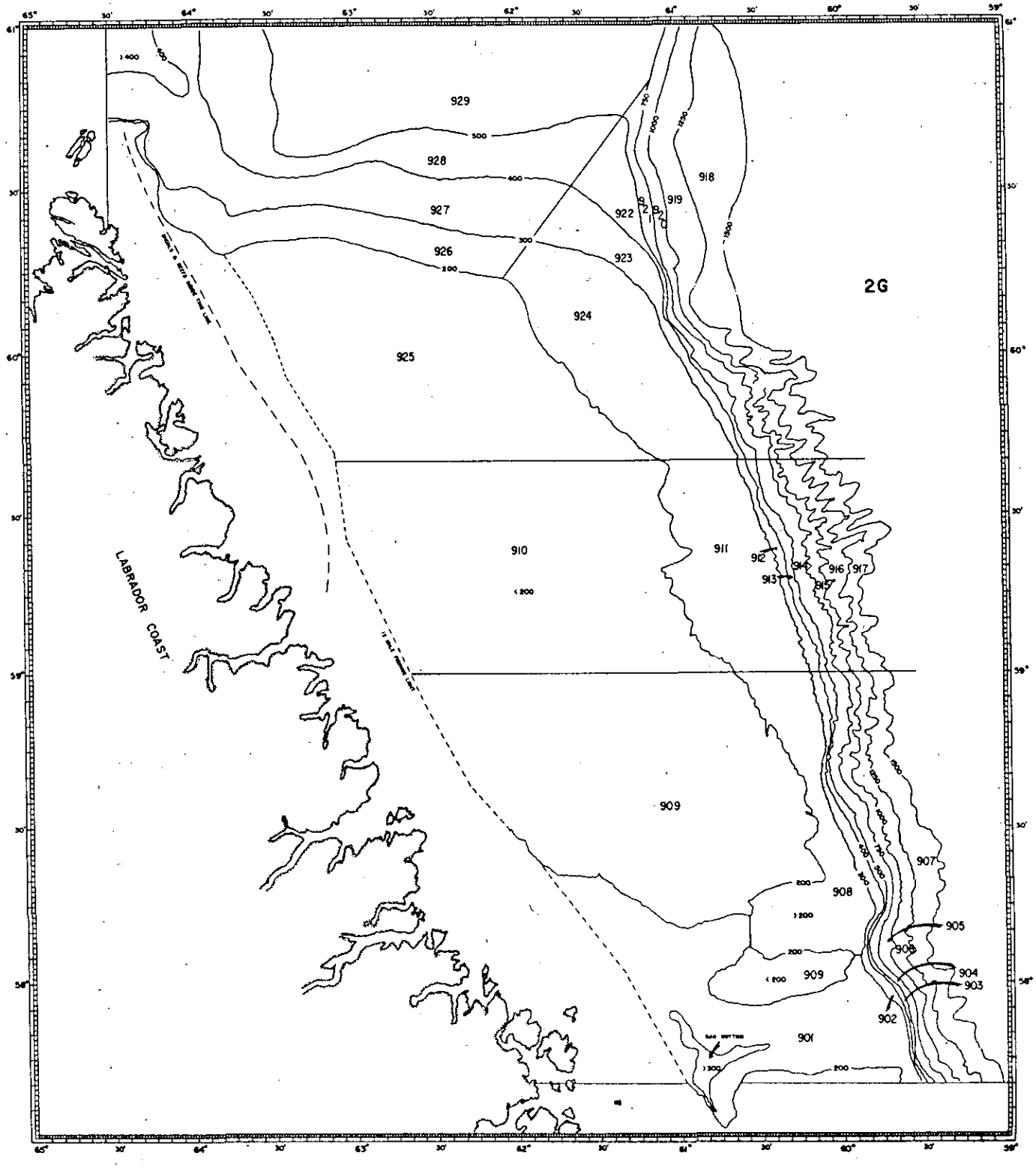

Fig. 1. Stratification scheme used in trawl surveys in Div. 2G (from Bowering 1987).

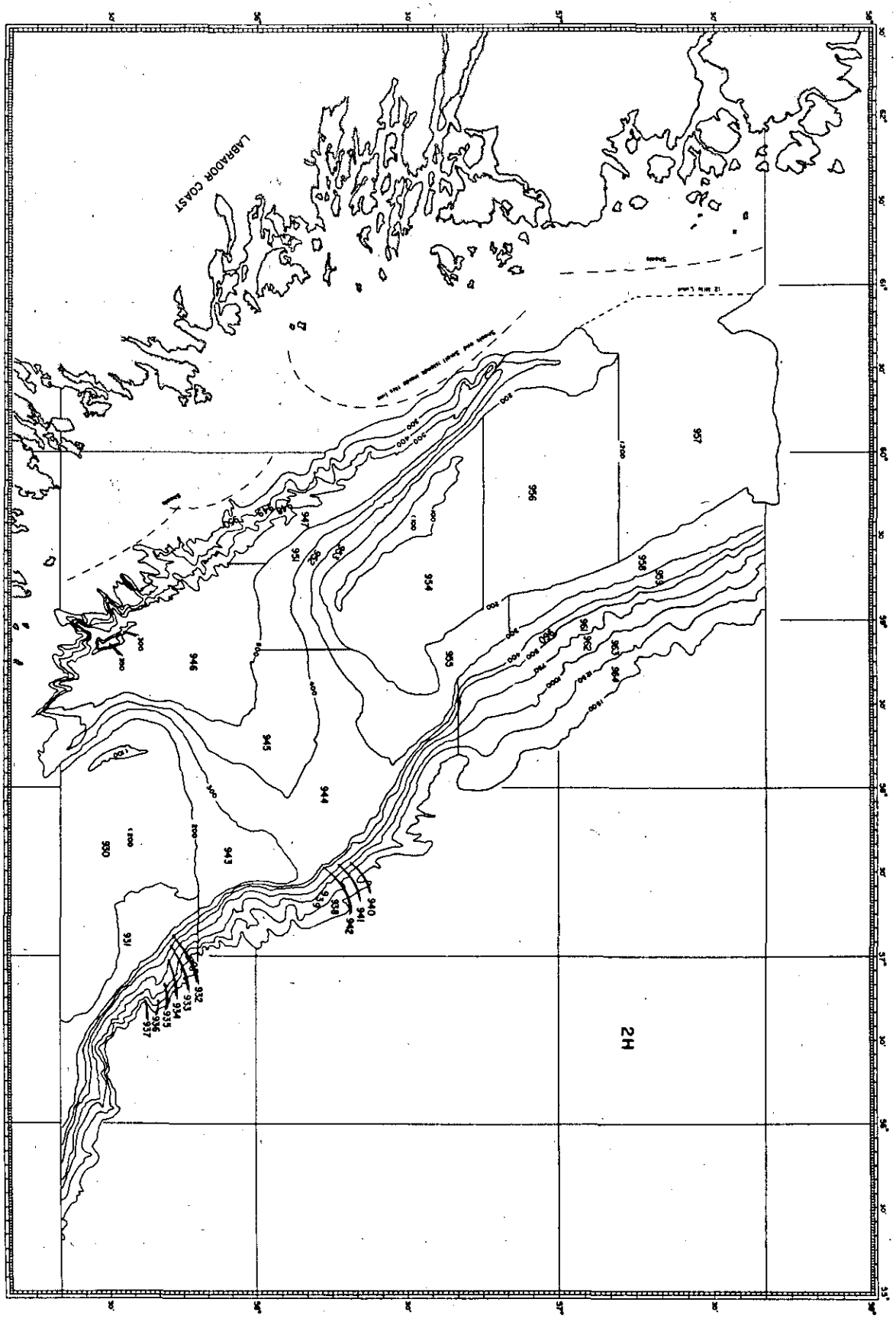

Fig. 2. Stratification scheme used in trawl surveys in Div. 2H (from Bowering 1987).

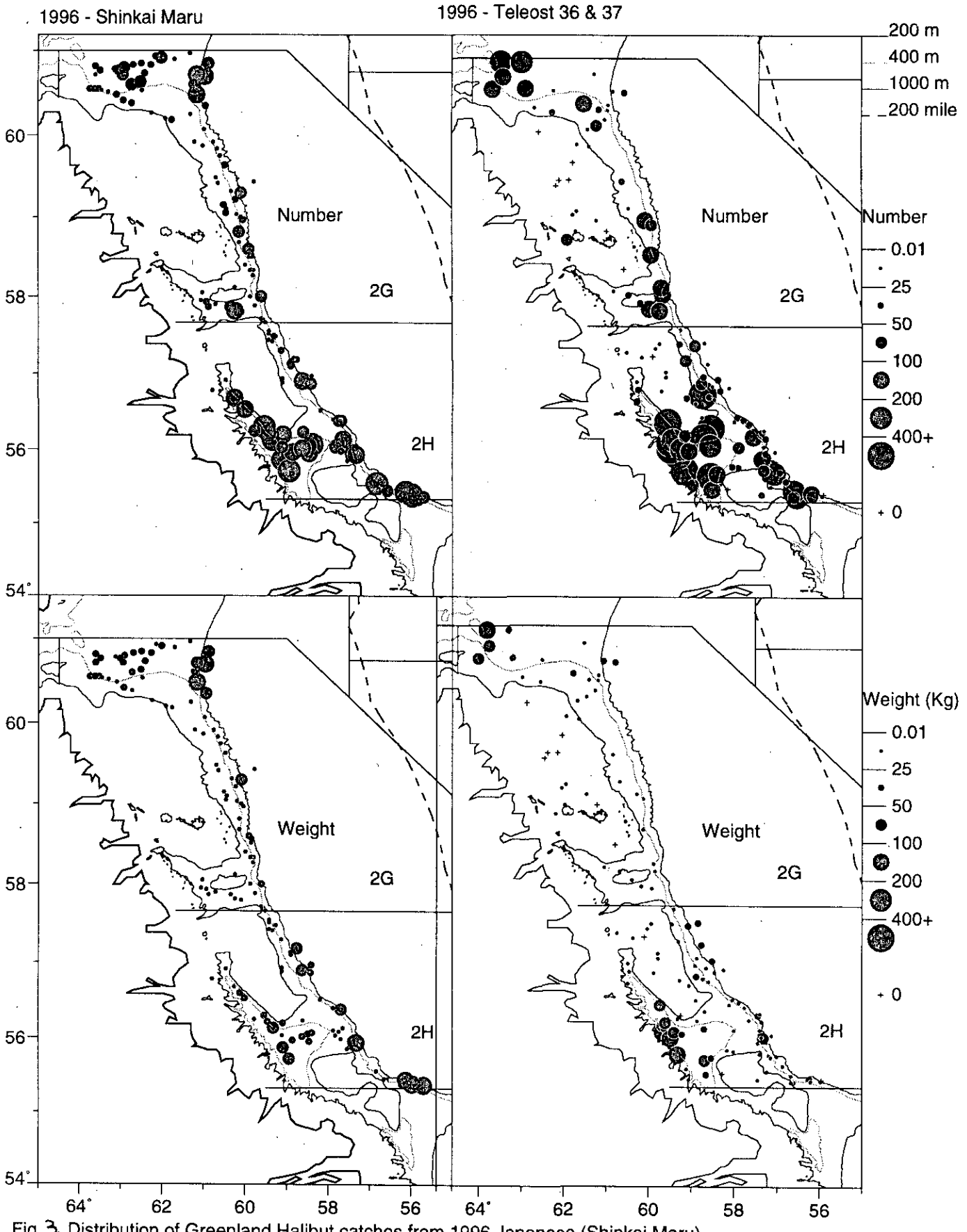

Fig. 3. Distribution of Greenland Halibut catches from 1996 Japanese (Shinkai Maru) and Canadian (Teleost 36 & 37) fall surveys to 2GH using survey trawl. (All sets standardized to 15 min. (dist. = .8 nm.; wing = 55.25 ft) tows).

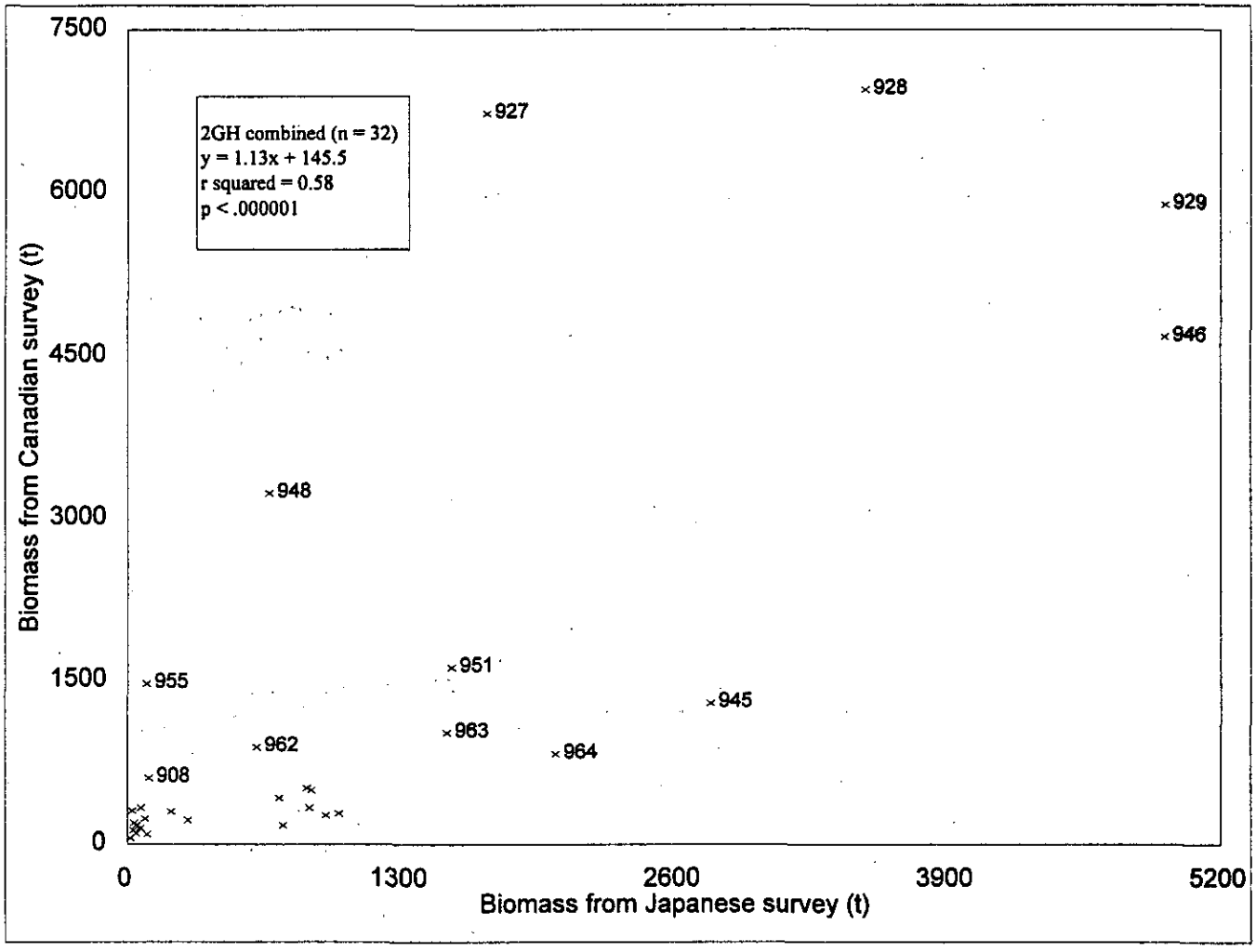

Fig. 4. Comparison of G. halibut biomass estimates from strata fished in both Canadian and Japanese surveys in 1996. Some points are identified with stratum number.

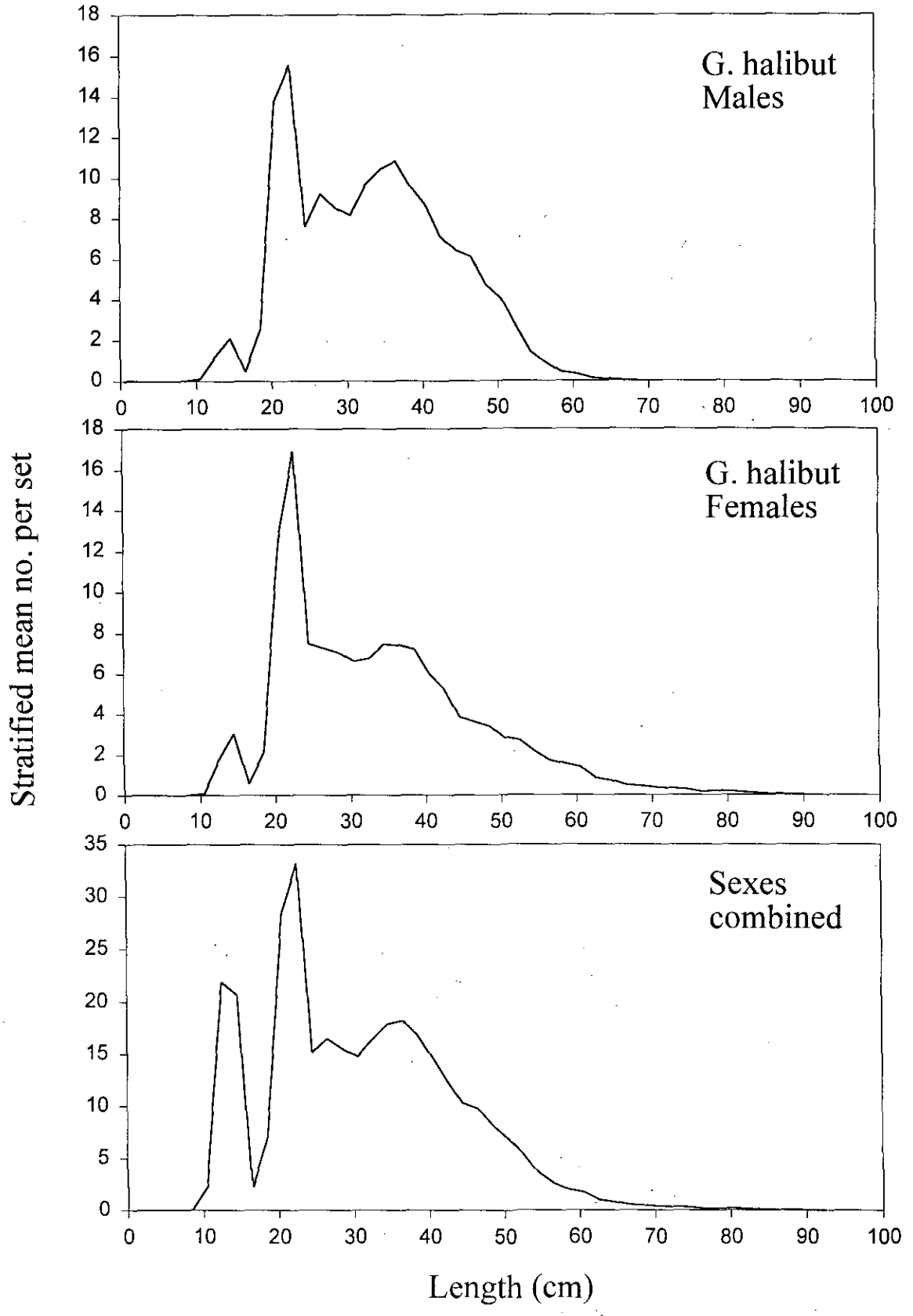

Fig. 5. Stratified mean no. per set at length for Greenland halibut in Div. 2GH combined from a Japanese stratified-random survey in August 1996.

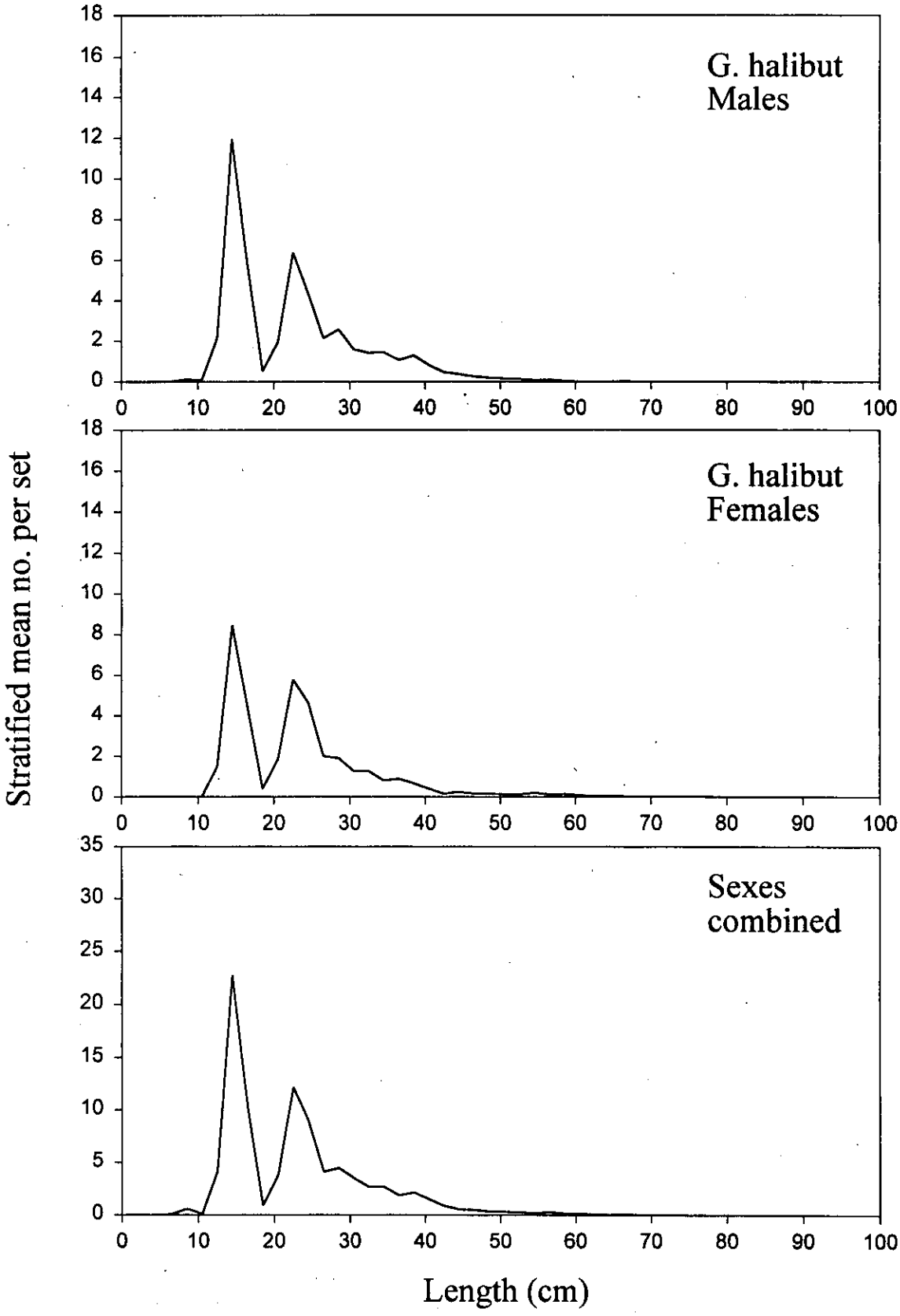

Fig. 6. Stratified mean no. per set at length for Greenland halibut in Div. 2GH combined from a Canadian stratified-random survey in the fall of 1996.

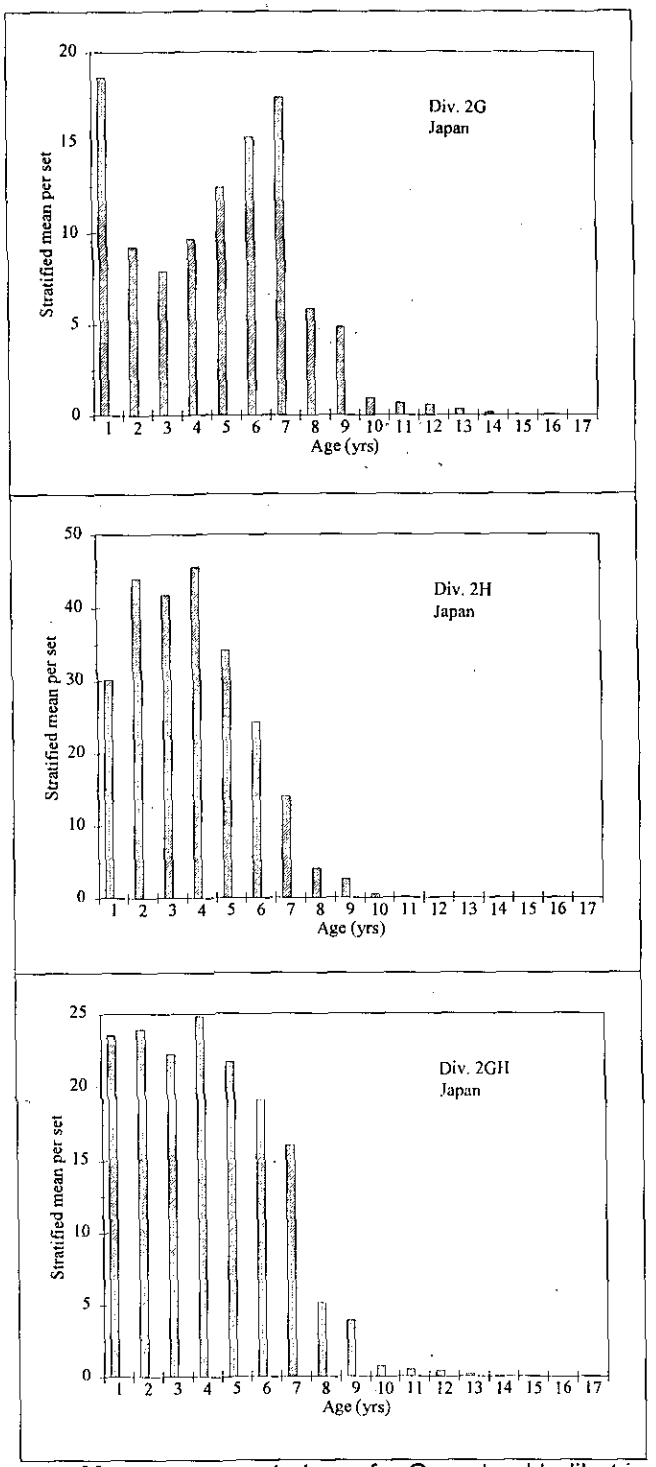

Fig. 7. Mean no. per set at age for Greenland halibut in Div. 2G and 2H from the Japanese survey conducted during August 1996.

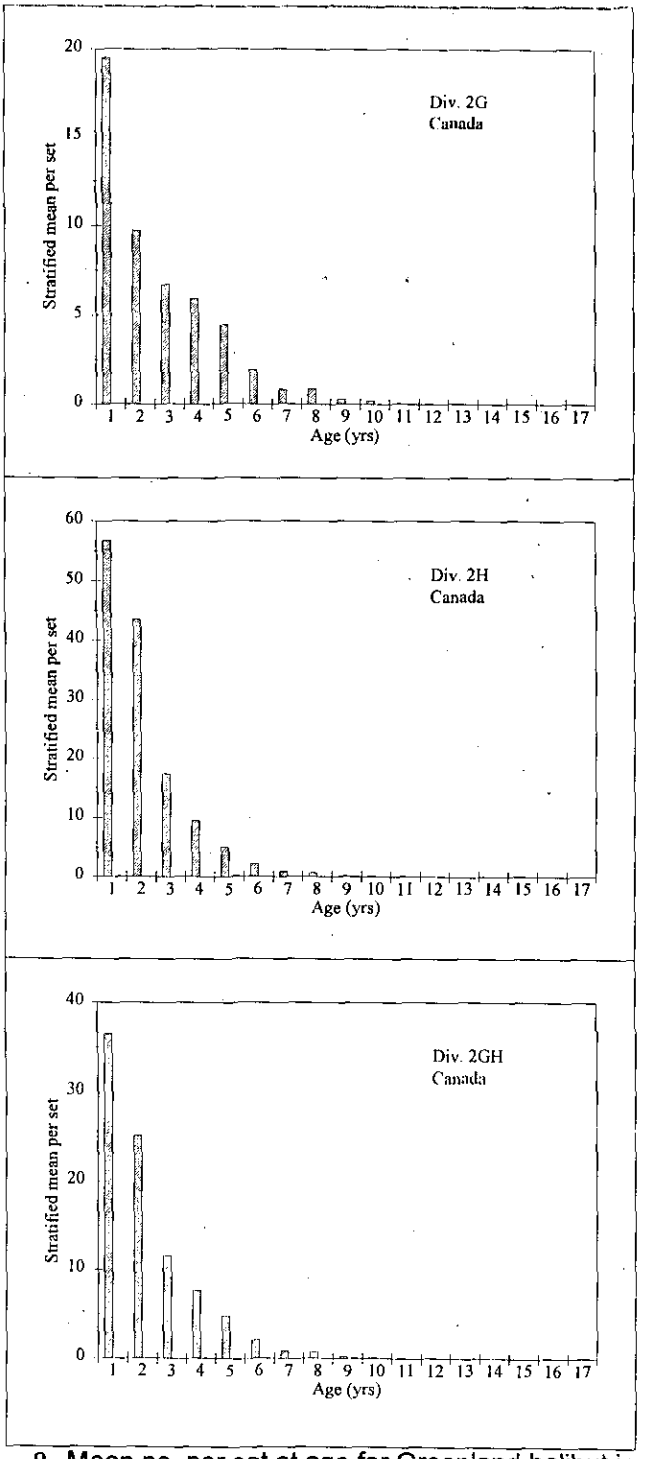

Fig. 8. Mean no. per set at age for Greenland halibut in Div. 2G and 2H from the Canadian survey conducted during fall 1996.