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Biomass Estimates of Greenland Halibut in NAFO Div. 2GH from Post-stratified and Stratified Canadian Groundfish Surveys

by

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Introduction

In 1978, 1979, and 1981, the Canadian research vessel "GADUS ATLANTICA" conducted groundfish surveys in NAFO Div. 2G and 2H. These surveys were conducted by means of line transects across 100-meter depth ranges up to 500 meters and ranges of 501-750, 750-1000, and > 1000 for depths beyond 500 meters. The major difficulty in conducting these surveys was the particularly inadequate charting of these areas. Nevertheless, in order to obtain some estimates of biomass from these surveys, stratification charts were constructed based upon the available charts for the area and the sets post-stratified. The results of this exercise are presented in Bowering (1982). With the advent of state of the art chartwork by the Canadian Hydrographic Service, these stratification charts were re-designed as shown in Figs. 1 and 2 and Tables 1 and 2 for Div. 2G and 2H respectively as published in Bowering (1987).

Materials and Methods

Using the new stratification schemes, the 1978, 1979, and 1981 groundfish surveys were again post-stratified and estimates of Greenland halibut biomass recalculated. In addition, the results of a stratified-random survey in 1987 are presented. In 1986, a similar survey was begun in Div. 2H; however, due to mechanical difficulties with the vessel, the survey was discontinued. The results of the few strata completed are also presented. The biomass and abundance estimates from all surveys are shown in Tables 3 and 4 for Div. 2G and Tables 5 and 6 for Div. 2H respectively. With the exception of the 1986 survey, the age compositions are presented in Table 7 and Fig. 3 for Div. 2G and Table 8 and Fig. 4 for Div. 2H.

Results and Discussion

For the strata fished in Div. 2G, the biomass estimates for 1978 to 1981 were similar between 35,000 and 38,000 tons (Table 3) although coverage was generally poor in the deeper water. In 1987, the estimate of 16,000 tons is less than half these previous year's estimates despite the better survey coverage in 1987 in deeper water. In nearly all strata common to all years, a declining trend can be observed. Similar observations can be made with respect to the abundance indices in Table 4. These estimates are considerably lower than those presented in Bowering (1982); however, the earlier calculations included several strata with only 1 set which in some cases inflated the estimates significantly. Nonetheless, the declining trend existed also in the earlier exercise.

For the strata fished in Div. 2H, the trends in estimated biomass and abundance (Tables 5 and 6) were similar to those shown for Div. 2G. The estimated biomass for this division in 1987 where survey coverage was essentially complete up to a depth of 1250 meters was 23,000 tons. The total biomass in 1987 for the two divisions combined would be about 40,000 t. It should be noted that in Div. 2G, depths $\leq$ 200 meters were not surveyed although it is considered that biomass of Greenland halibut at these depths would not contribute greatly to the overall estimate.

The age compositions are presented for Div. 2G and 2H in Figs. 3 and 4 respectively. In Div. 2G, fish were caught up to an age of 20 years; however, few fish were caught beyond 11 years old. Fish aged 7-9 generally dominated the catch with recruitment in the earlier

years apparently considerably better than recently. In Div. 2H, fish were caught up to an age of 16 years old with fish less than 6 years old generally dominating the catch, particularly in the earlier years. The 1987 survey indicates what may be a good 1985 year-class in both divisions while the 1982-84 year-classes appear relatively weak.

At present, the TAC for the Greenland halibut resource in Subarea 2 and Div. 3KL is 100,000 tons (of which 35,000 t has been allocated to be removed from Div. 2GH). This figure was largely based on earlier estimates of about 150,000-200,000 t of biomass in these divisions (Bowering 1982). Given the revised as well as new estimates presented here, it may be wise to reconsider this level of TAC.

References

Bowering, W. R. 1982. Minimum Trawlable Biomass Estimates of Greenland halibut in NAFO Div. 2G and 2H from Post-stratified Groundfish Surveys. NAFO SCR Doc. 82/IX/100, Serial No. N609.

Bowering, W. R. 1987. A Newly Developed Stratification Scheme for NAFO Div. 2G and 2H. NAFO SCR Doc. 87/23, Serial No. N1306.

Table 1. List of strata, depth zones and stratum areas for NAFO Division 2G.

Strata	Depth range (m)	Area sq. mi.	
901	201-300	1213	
902	301-400	120	
903	401-500	80	
904	501-750	153	
905	751-1000	164	
906	1001-1250	229	
907	1251-1500	360	
908	201-300	585	
909	≤200	2773	
910	≤200	2339	
911	201-300	692	
912	301-400	73	
913	401-500	62	
914	501-750	113	
915	751-1000	96	
916	1001-1250	146	
917	1251-1500	165	
918	1251-1500	515	
919	1001-1250	316	
920	751-1000	172	
921	501-750	142	
922	401-500	186	
923	301-400	186	
924	201-300	756	
925	≤200	1804	
926	201-300	433	
927	301-400	832	
928	401-500	783	Total = 16790.
929	501-750	1261	

Table 2. List of strata, depth zones, and stratum areas for NAFO Division 2H.

Strata	Depth range (m)	Area sq. mi.	
930	≤200	1028	
931	201-300	276	
932	301-400	55	
933	401-500	50	
934	501-750	78	
935	751-1000	96	
936	1001-1250	78	
937	1251-1500	94	
938	1251-1500	191	
939	1001-1250	130	
940	751-1000	97	
941	501-750	89	
942	401-500	55	
943	201-300	354	
944	301-400	860	
945	401-500	461	
946	501-750	721	
947	501-750	227	
948	401-500	246	Some of this stratum not fishable
949	301-400	206	" " " " " "
950	201-300	261	" " " " " "
951	401-500	234	
952	301-400	177	
953	201-300	291	
954	≤200	971	117≤100 m included in total
955	201-300	389	
956	≤200	1051	
957	≤200	1371	
958	201-300	294	
959	301-400	178	
960	401-500	107	
961	501-750	211	
962	751-1000	242	
963	1001-1250	265	
964	1251-1500	342	
	Total	11776	

Table 3. Stratified mean weight(kg) per set of Greenland halibut in NAFO Division 2G. (Nos. in parentheses are nos. of successful sets.)

Depth Range	Stratum	Gadus 13 1978	Gadus 24 1979	Gadus 57 1981	Gadus 143 1987
≤ 200	909	23.12(13)	3.87(12)	5.94(8)	-
	910	52.69(8)	6.54(8)	8.06(8)	-
	925	66.74(5)	15.66(4)	13.83(3)	-
201-300	901	48.33(9)	52.86(7)	51.58(6)	10.50(4)
	911	7.25(4)	10.89(4)	6.67(3)	2.81(3)
	924	8.17(2)	11.96(3)	19.50(2)	4.50(2)
	926	-	-	-	-
	908	7.72(2)	20.28(3)	6.38(3)	2.34(5)
301-400	902	-	-	-	23.10(3)
	912	-	-	-	11.50(2)
	923	306.18(2)	-	77.50(2)	3.75(2)
	927	-	-	-	29.86(5)
401-500	903	-	93.29(2)	73.25(2)	18.79(2)
	913	-	-	-	27.00(2)
	922	303.04(2)	-	84.50(2)	-
	928	-	-	-	48.17(3)
501-750	904	-	265.44(3)	114.00(4)	47.25(3)
	914	-	-	-	33.88(2)
	921	-	660.11(2)	-	12.75(2)
	929	-	145.96(4)	240.67(3)	52.60(5)
751-1000	905	-	-	-	-
	915	-	-	-	-
	920	-	-	-	261.17(4)
1001-1250	906	-	-	-	2.42(2)
	916	-	-	-	-
	919	-	-	-	-
1251-1500	907	-	-	-	-
	917	-	-	-	-
	918	-	-	-	-
Biomass		37187	35484	37746	16076

Table 4. Stratified mean number per set of Greenland halibut in NAFO Division 2G (nos. in parentheses are nos. of successful sets).

Depth Range	Stratum	Gadus 13 1978	Gadus 24 1979	Gadus 57 1981	Gadus 143 1987
≤ 200	909	29.69(13)	7.92(12)	5.63(8)	-
	910	43.63(8)	9.38(8)	7.63(8)	-
	925	33.80(5)	15.75(4)	15.00(3)	-
201-300	901	78.78(9)	69.86(7)	67.00(6)	30.00(4)
	908	5.50(2)	35.00(3)	3.75(3)	13.20(5)
	911	4.50(4)	7.75(4)	5.00(3)	12.67(3)
	924	5.00(2)	8.67(3)	20.00(2)	10.00(2)
301-400	902	-	-	-	23.67(3)
	912	-	-	-	11.00(2)
	923	142.10(2)	-	43.00(2)	3.50(2)
	927	-	-	-	20.60(5)
401-500	903	-	86.00(2)	33.25(2)	14.93(2)
	913	-	-	-	29.50(2)
	922	116.50(2)	-	39.50(2)	-
	928	-	-	-	26.33(3)
501-750	904	-	154.00(3)	40.50(4)	39.33(3)
	914	-	-	-	27.00(2)
	921	-	393.50(2)	-	9.50(2)
	929	-	60.75(4)	86.67(3)	34.20(5)
751-1000	905	-	-	-	-
	915	-	-	-	-
	920	-	-	-	145.73(4)
1001-1250	906	-	-	-	2.28(2)
	916	-	-	-	-
	919	-	-	-	-
1251-1500	907	-	-	-	-
	917	-	-	-	-
	918	-	-	-	-
TOTAL (000's)		29960	26448	22221	13860

Table 5. Stratified mean weight(kg) per set of Greenland halibut in NAFO Division 2H (Nos. in parentheses are nos. of successful sets).

Depth Range (m)	Stratum	Gadus 13 1978	Gadus 24 1979	Gadus 57 1981	WT 52 1986	Gadus 143 1987
≤ 200	930	1.12(4)	1.75(6)	5.00 (8)	2.40(5)	0.06(9)
	954	3.13(5)	4.04(5)	1.92 (6)	-	0.21(11)
	956	4.84(3)	1.01(6)	3.63 (4)	-	0.38(10)
	957	16.07(5)	2.05(6)	7.25 (6)	-	1.25(11)
201-300	931	15.44(3)	1.18(3)	35.83 (3)	34.25(2)	1.33(4)
	943	19.29(2)	0.16(2)	28.75 (2)	0.63(2)	1.85(4)
	950	-	-	-	-	-
	953	267.33(2)	22.09(3)	72.38 (4)	-	10.53(3)
	955	11.35(2)	11.20(3)	7.83 (3)	-	1.92(4)
	958	-	10.21(2)	4.25 (2)	-	0.10(3)
301-400	932	-	-	-	-	3.60(2)
	944	46.00(6)	45.75(9)	102.11 (9)	3.89(2)	4.59(10)
	949	-	-	-	-	-
	952	-	197.76(2)	92.50 (2)	-	34.33(3)
	959	-	87.47(3)	54.33 (3)	-	13.17(3)
401-500	933	-	-	-	-	-
	942	-	270.81(2)	148.50 (2)	50.50(3)	8.67(3)
	945	-	259.08(3)	134.92 (6)	-	37.04(5)
	948	-	-	-	-	-
	951	77.41(2)	316.66(2)	102.27 (3)	-	78.75(2)
	960	-	436.29(2)	48.00 (2)	-	44.17(3)
501-750	934	-	636.31(2)	-	121.50(2)	58.50(2)
	941	-	-	-	12.25(2)	38.00(2)
	946	460.47(4)	721.41(5)	187.71 (7)	-	193.10(8)
	947	-	660.80(2)	109.25 (4)	-	255.17(3)
	961	-	285.26(3)	63.53 (3)	-	27.50(2)
751-1000	935	-	-	-	-	46.86(2)
	940	-	-	-	-	40.13(2)
	962	-	-	-	-	49.85(3)
1001-1250	936	-	-	-	-	10.18(2)
	939	-	-	-	-	21.81(2)
	963	-	-	-	-	57.81(2)
1251-1500	937	-	-	-	-	-
	938	-	-	-	-	-
	964	-	-	-	-	-
Biomass (t)		38605	86231	34005	2164	23330

Table 6. Stratified mean number per set of Greenland halibut in NAFO Division 2H (nos. in parentheses are nos. of successful sets).

Depth Range	Stratum	Gadus 13 1978	Gadus 24 1979	Gadus 57 1981	WT 52 1986	Gadus 143 1987
≤ 200	930	3.00(4)	5.17(6)	2.75(8)	3.60(5)	1.44(9)
	954	10.80(5)	9.40(5)	1.50(6)	-	2.64(11)
	956	22.33(3)	8.17(6)	10.50(4)	-	3.20(10)
	957	36.00(5)	11.50(6)	11.17(6)	-	6.73(11)
201-300	931	12.00(3)	3.67(3)	16.67(3)	32.50(2)	7.25(4)
	943	18.50(2)	1.50(2)	25.50(2)	2.50(2)	16.25(4)
	950	-	-	-	-	-
	953	986.50(2)	58.00(3)	158.50(4)	-	87.00(3)
	955	13.00(2)	40.33(3)	3.00(3)	-	14.50(4)
	958	-	21.00(2)	1.50(2)	-	6.00(3)
301-400	932	-	-	-	-	4.00(2)
	944	32.00(6)	72.67(9)	40.33(9)	4.07(2)	17.21(10)
	949	-	-	-	-	-
	952	-	332.00(2)	77.00(2)	-	79.67(3)
	959	-	76.33(3)	19.67(3)	-	20.00(3)
401-500	933	-	-	-	-	-
	942	-	137.00(2)	59.00(2)	57.67(3)	14.00(3)
	945	-	356.67(3)	96.50(6)	-	94.00(5)
	948	-	-	-	-	-
	951	87.50(2)	427.50(2)	49.00(3)	-	97.50(2)
	960	-	228.50(2)	15.50(2)	-	49.00(3)
501-750	934	-	184.92(2)	-	89.00(2)	68.00(2)
	941	-	-	-	13.00(2)	43.50(2)
	946	256.25(4)	686.20(5)	86.43(7)	-	392.88(8)
	947	-	747.50(2)	76.50(4)	-	304.67(3)
	961	-	141.00(3)	30.73(3)	-	27.00(2)
751-1000	935	-	-	-	-	38.73(2)
	940	-	-	-	-	39.15(2)
	962	-	-	-	-	36.00(3)
1001-1250	936	-	-	-	-	12.46(2)
	939	-	-	-	-	16.62(2)
	963	-	-	-	-	24.23(2)
1251-1500	937	-	-	-	-	-
	938	-	-	-	-	-
	964	-	-	-	-	-
TOTAL (000's)		46625	91501	21830	2126	41663

Table 7. Stratified mean number per set at age of Greenland halibut in NAFO Division 2G from post-stratified surveys in 1978, 1979, and 1981 and a stratified-random survey in 1987.

Age (Years)	Gadus 13 1978	Gadus 24 1979	Gadus 57 1981	Gadus 143 1987
1	0.0	1.19	0.45	2.03
2	3.76	1.14	1.17	2.20
3	2.64	2.40	1.52	1.10
4	3.28	3.35	2.30	0.90
5	4.24	3.89	3.12	0.85
6	4.53	3.36	3.82	1.82
7	5.05	3.62	4.74	4.14
8	4.92	4.38	2.89	5.28
9	4.07	3.20	1.93	3.13
10	2.35	1.36	1.02	2.03
11	1.22	0.53	0.55	0.91
12	0.41	0.32	0.20	0.30
13	0.22	0.11	0.03	0.35
14	0.09	0.12	0.02	0.10
15	0.05	0.09	0.00	0.09
16	0.04	0.06	0.00	0.01
17	0.00	0.00	0.00	0.00
18	0.00	0.01	0.00	0.00
19	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
Unknown	0.01	0.00	0.07	0.00
TOTAL	36.87	29.13	23.83	25.27

Table 8. Stratified mean number per set at age of Greenland halibut in NAFO Division 2H from post-stratified surveys in 1978, 1979, and 1981 and a stratified-random survey in 1987.

Age (Years)	Gadus 13 1978	Gadus 24 1979	Gadus 57 1981	Gadus 143 1987
1	0.0	2.40	0.76	2.36
2	5.33	14.72	3.99	12.63
3	9.52	23.90	3.92	5.89
4	15.64	25.46	2.52	2.07
5	12.94	18.35	3.44	3.98
6	8.97	10.64	3.78	11.77
7	6.09	8.88	4.55	8.49
8	4.50	8.75	3.50	2.42
9	4.42	7.46	2.28	1.01
10	3.12	3.99	1.21	0.30
11	2.22	2.20	0.72	0.16
12	1.09	1.39	0.29	0.08
13	0.69	0.63	0.09	0.06
14	0.36	0.63	0.05	0.06
15	0.24	0.28	0.01	0.02
16	0.09	0.15	0.00	0.01
17	0.02	0.03	0.00	0.01
18	0.00	0.02	0.00	0.00
19	0.00	0.02	0.00	0.00
20	0.00	0.00	0.00	0.00
Unknown	0.00	0.00	0.01	0.00
TOTAL	75.24	129.90	31.11	51.34

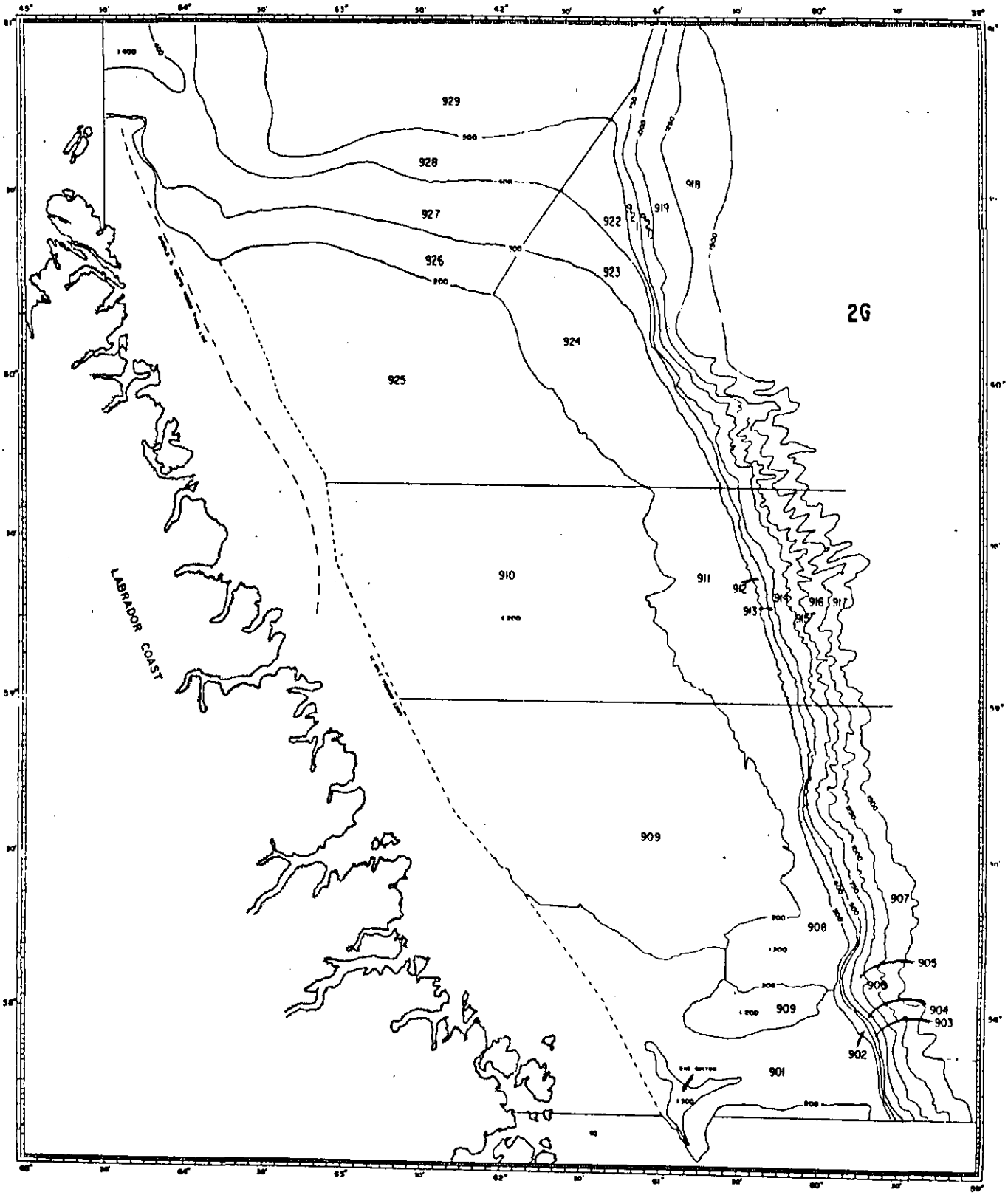


Fig. 1 Stratification scheme for NAFO Division 2G.

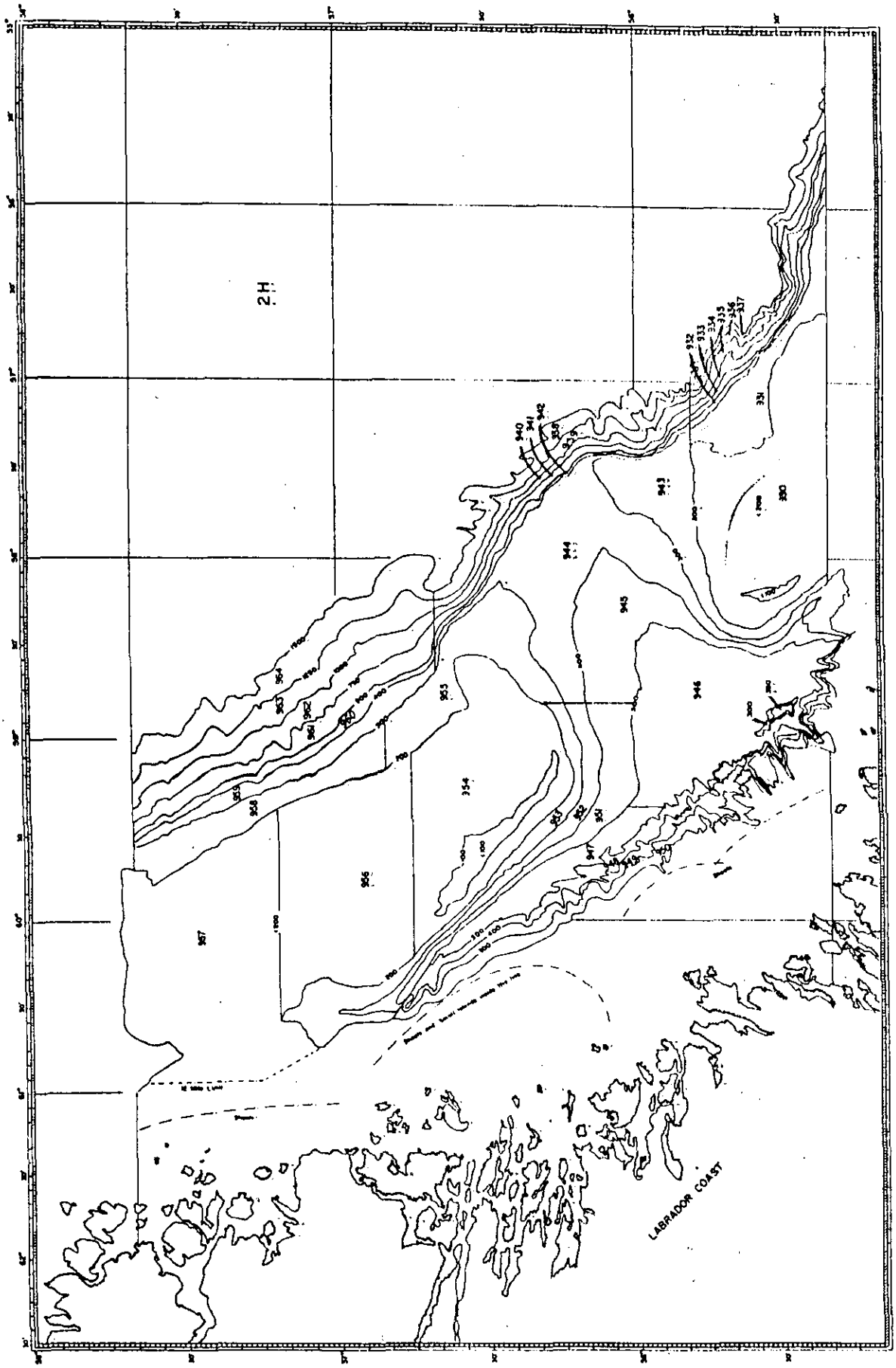


Fig. 2 Stratification scheme for NAFO Division 2H.

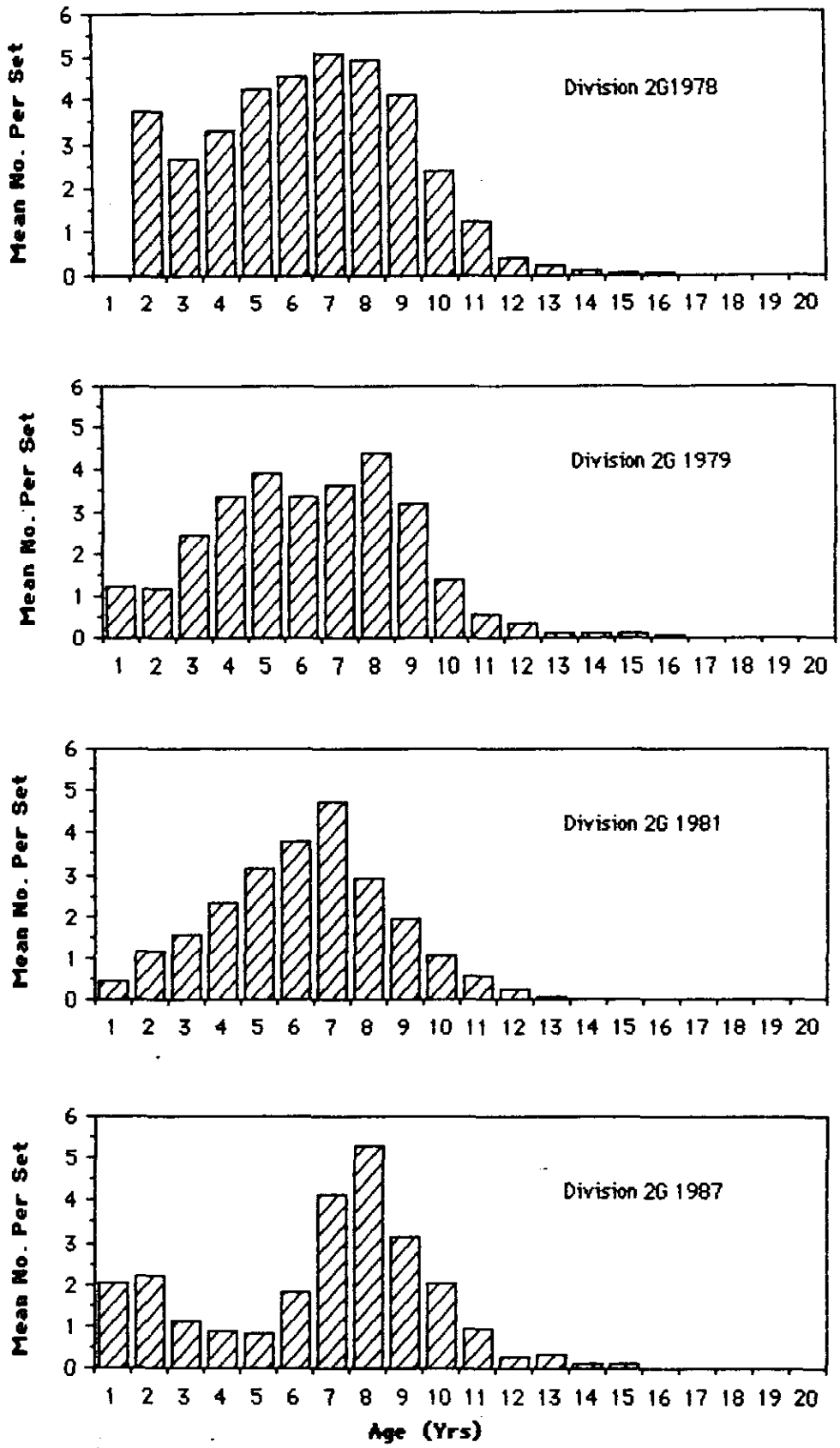
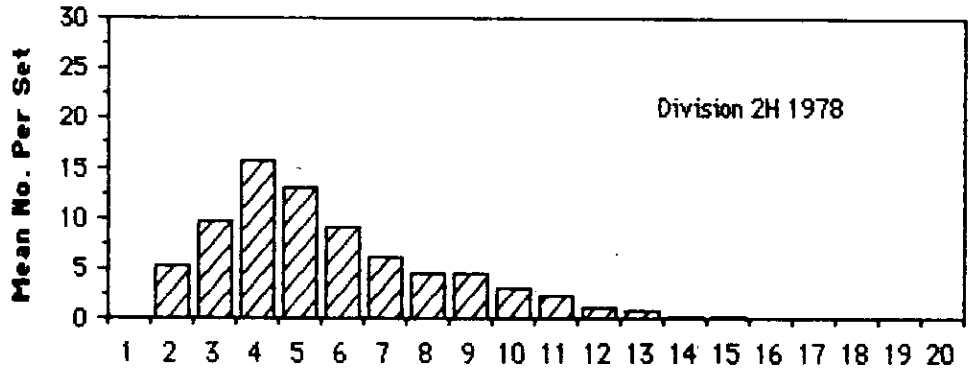

Mean No. Per Set
Division 2G1978
Division 2G 1979
Division 2G 1981
Division 2G 1987
0 1 2 3 4 5 6
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Age (Yrs)

Fig. 3


Mean No. Per Set
Division 2H 1978
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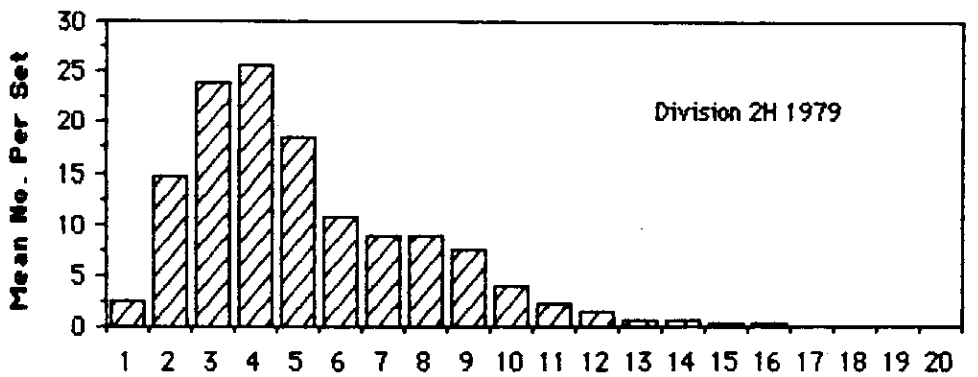
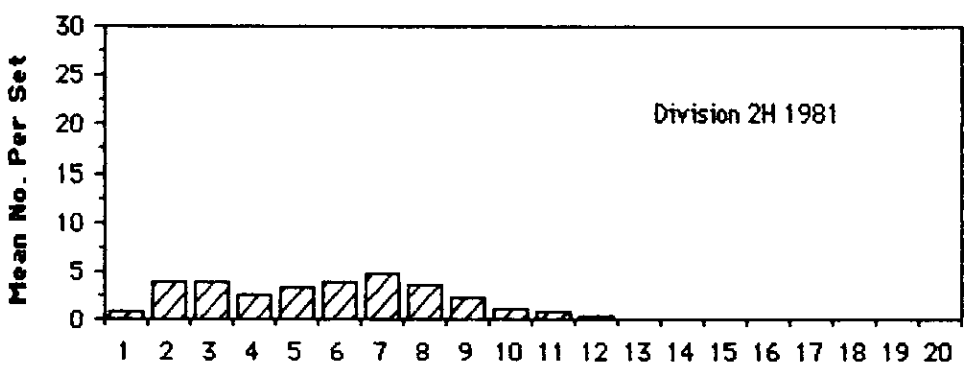
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20


Mean No. Per Set
Division 2H 1979
0 5 10 15 20 25 30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20


Mean No. Per Set
Division 2H 1981
0 5 10 15 20 25 30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

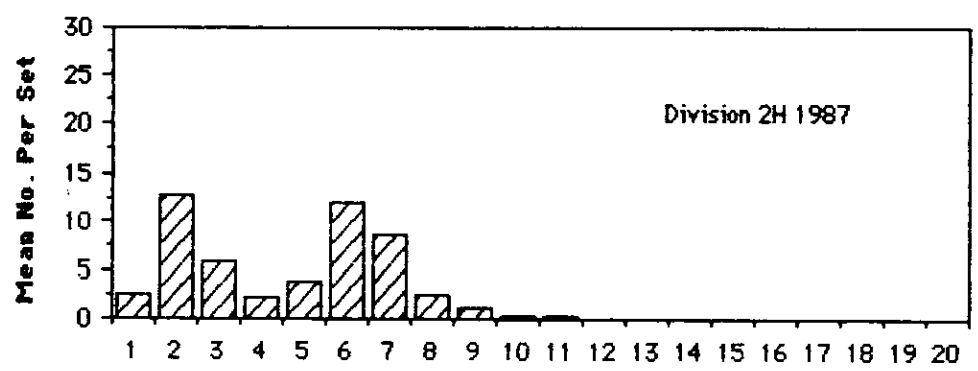

Mean No. Per Set
Division 2H 1987
0 5 10 15 20 25 30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Age (Yrs)

Fig. 4