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An evaluation of the Greenland halibut (Reinhardtius hippoglossoides) stock complex in NAFO Subarea 2 and Divisions 3KL

by

W.R. Bowering and W.B. Brodie
Department of Fisheries and Oceans
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1

The Fishery

Nominal catches of Greenland halibut were relatively stable from 1971-76 at about 25,000-30,000 t (Fig. 1). Landings increased to 39,000 t in 1978 and have declined annually since that time to a level of 24,000 t in 1982. The decline in catches in recent years has not been attributed to declining abundance of Greenland halibut but rather a decline in directed effort as well as emigration of large year-classes of Greenland halibut from the main fishing areas. Historically, the fishery has been mainly prosecuted by otter trawlers particularly those of the USSR, Poland, and GDR with the main Canadian component of the fishery being midshore gillnets in the northeastern Newfoundland area. The gillnet component accounted for 54% of the total catch in 1978 and increased to 72% and 88% in 1979 and 1980 respectively and since that time declined to 53% in 1982. These large increases were a result of strong 1972, 73, and 74 year-classes which became abundant in the deepwater bays of eastern Newfoundland at younger ages. These have since emigrated to deeper waters of the continental slope to the more northerly areas as they approach maturity. In 1982, the Canadian otter trawlers accounted for about one-third of the total catch while fishing mainly in the Hopedale Channel area of NAFO Div. 2H, where Greenland halibut of these and older year-classes were commercially abundant.

Because of the nature of the fishery itself and the distribution and migratory patterns of Greenland halibut, it is difficult to obtain any degree of reliable catch and effort statistics as indicators of abundance except in relative terms. Newfoundland trawlers (TC5) did however direct some effort in Div. 3K during the spring of 1980, 1981, and to a lesser extent in 1982. In 1982 a more concentrated effort was placed to the north in Subarea 2, particularly NAFO Div. 2H. The details are as follows:

Year	NAFO Div.	Months	Mean CPUE(t/hr)	Directed catch(t)
1980	3K	Mar.-May	0.559	1148
1981	3K	Mar.-May	0.485	3118
1982	3K	May	0.416	304
	2J	Aug.-Sept.	0.610	1132
	2H	Aug.-Sept.	0.924	3406

The CPUE in Div. 3K declined only slightly from 1980-82 however 1982 data were based on only 304t. In Div. 2J there was a considerable increase in CPUE compared to Div. 3K. In Div. 2H the CPUE is about double any CPUE index from Div. 3K. The slight decline in catch rates in Div. 3K is probably an indicator of some emigration of the larger year-classes northward which might subsequently explain the substantial increase in catch rate to the north where exploitation has been practically negligible prior to 1982.

Estimates of Biomass from Surveys in Div. 2J3KL

Stratified random biomass surveys were continued in 1982 in Div. 2J,3K, and 3L similar to those reported in NAFO SCR Doc 82/VI/67. In Div. 2J for the area covered, the estimated minimum trawlable biomass was 104,000 t (Table 1) compared to about 76,000 t for similar survey coverage in 1981, an increase of about 28,000 t. It also approximates the level of biomass in 1977 which was the highest in the series where coverage was nearly complete. In Div. 3K, the estimated minimum trawlable biomass in 1982 was about 71,000 t compared to 77,000 t in 1981, a drop of about 6,000 t (Table 2).

For Div. 3L, both the spring surveys and the autumn surveys were fairly complete in 1982 (Table 3). These indicated estimates of biomass from about 4600 t in the spring to about 12,000 t in the autumn where the Greenland halibut appear to be more available in the area surveyed for both 1981 and 1982. The values for 1981 and 1982 autumn surveys were about the same.

The overall estimate of minimum trawlable biomass in Div. 2J3KL for 1982 was about 187,000 t compared to 167,000 t in 1981 from NAFO SCR Doc. 82/VI/67.

Catch at age from surveys

Numbers at age from the 1978-82 autumn surveys in Div. 2J+3K were derived from age length keys and adjusted to stratum area (Table 4). Only strata common to each survey were used in the calculations. The 1972, 1973, and 1974 year-classes at ages 8-10 were still more abundant than any other year-classes at the same ages in the time series. However, with the exception of possibly the 1974 year-class these strong year-classes now appear to have passed through the southern contingent of the stock (ie: Div. 2J and 3K). While they may not be as strong as the 1972-74 year-classes, the 1975-78 year-classes appear reasonably strong, at least in the 1982 surveys. The mean number per tow of these year-classes and 95% confidence limits at age 4 are shown in Fig. 2 for comparison with the 1974 year-class.

The mean number per tow at all ages in Table 4 are also shown in Fig. 3 with 95% confidence limits. Although the 1978 and 1982 indices of abundance appear to be up, the confidence limits would suggest relatively stable conditions throughout the survey area.

Commercial data

Numbers caught at age - The numbers caught at age (Table 5) for 1975-80 were extracted directly from NAFO SCR Doc. 82/VI/67. The 1981 numbers at age were adjusted upwards to proportionately reflect the final catch statistics for 1981 available since the previous assessment. The 1982 numbers-at-age were calculated in the usual way from samples collected by the Canadian Commercial Groundfish Sampling Section at the Northwest Atlantic Fisheries Center. The fishery in 1982 was mainly dependent on ages 6-10 (1972-76 year-classes) comprising 93% of the catch. The strong 1972-74 year-classes still accounted for half the 1982 catch with the 1975-76 year-classes accounting for 41%. The numbers of proportionately older fish in the 1982 catch is a reflection of the change in fishing pattern with substantial catches coming from the otter trawler fleet in Div. 2H.

Partial recruitment - Given the variations in yearly fishing patterns based on annual proportions taken by gillnets versus otter trawlers and areas fished, the partial recruitment pattern varies from year to year. For comparison, partial recruitment patterns were calculated from 1978-82 by comparing catch at age from the commercial data with that of the research vessel surveys in NAFO Div. 2J+3K. The results are presented in Table 6. The partial recruitment pattern in 1982 is also presented in Fig. 4. As usual for Greenland halibut, all patterns are dome shaped with the 1982 pattern showing a less dramatic decline in partial recruitment of the older ages. This again was expected with considerable trawler effort in northern deep waters where the larger fish occur.

Fishing mortality - Determining an accurate level of fishing mortality in 1982 was not possible due to the lack of adequate catch effort data and a short, incomplete time series of research data. However, in order to determine some estimate of average F over time, a catch curve was constructed (Fig. 5) from combining the catch at age in the survey data from 1978-82 (Table 4). The 5+ fishing mortality according to this method yielded an average F = 0.34 over approximately the last 12 years. It should be pointed out however that this value may be highly overestimated because of the influence of very strong recruitment in the earlier years as well as emigration in the older age groups. The catch curve in Fig. 5 would not entirely support high levels of emigration unless the emigration factor is about the same as the difference in average recruitment compared to the strong recruitment experienced in recent years.

Since the 1972-74 year-classes have been the main support of the fishery in recent years an attempt was made to obtain some level of F on these age groups over the last few years. A catch curve regression was therefore calculated using these same three cohorts from 1979-82 in the research data (Table 4). The F value derived from this regression yielded an F=0.11 which should approximate average F on these cohorts in the last 4-6 years.

Since it was not possible to pinpoint terminal F for VPA several runs are presented using fully recruited F's from 0.05 to 0.25 at increments of 0.05. Partial recruitment as shown in Table 6 and average weights shown in Table 7 were used for the calculations. The VPA results in ascending order are presented in Tables 8-12 respectively.

Yield per recruit calculations are shown in Table 13 using the 1982 partial recruitment and the 1982 commercial weights at age. Fishing at $F_{0.1}$ would give an F of 0.35.

References

Robson, D.S. and D.G. Chapman. 1961. Catch curves and mortality rates. Trans. Am. Fish. Soc. 90: 181-189.

Table 1. Average weight (kg) of Greenland halibut caught per set from research vessel surveys by the GADUS ATLANTICA in Division 2J. Numbers in parenthesis indicate the number of sets per stratum.

Stratum	Gadus 3 1977	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58 1981	Gadus 71&72 1982
201	7.26(2)	1.36(3)	0.45(2)	2.83(3)	2.70(5)	9.67(6)
202	21.34(2)	25.20(2)	7.48(2)	51.00(2)	34.50(2)	45.50(2)
203	31.55(2)			25.75(2)	52.00(2)	64.33(3)
204	175.70(2)				170.50(2)	284.00(3)
205	20.97(4)	6.58(4)	10.21(2)	3.75(4)	14.94(8)	24.09(12)
206	20.80(11)	7.78(7)	8.11(8)	10.11(7)	37.18(11)	18.72(18)
207	77.77(5)	25.54(4)	10.39(5)	6.90(5)	18.22(9)	10.33(15)
208	186.14(4)	183.12(3)	127.46(2)	189.25(2)	240.75(2)	348.67(3)
209	65.25(7)	15.66(4)	47.61(5)	144.37(4)	55.67(6)	129.64(11)
210	19.41(6)	5.20(4)	4.09(2)	3.50(3)	5.00(3)	20.88(6)
211	34.96(2)	64.92(2)	36.28(2)	32.70(3)	35.75(2)	55.75(2)
212	189.61(4)				147.75(2)	144.10(5)
213	16.46(8)	17.59(4)	8.84(4)	11.70(5)	29.33(6)	34.19(10)
214	38.97(6)	67.76(4)	12.93(4)	11.33(3)	60.10(5)	84.31(8)
215	37.68(4)	34.14(5)	8.00(4)	23.00(2)	12.30(5)	38.28(9)
216	102.83(2)		111.58(2)	137.50(2)	63.25(2)	215.25(2)
217	141.95(3)				41.00(2)	58.25(2)
218	217.92(2)				156.50(2)	40.00(2)
219					48.00(2)	
220						
221						
222	115.32(4)	42.07(3)	8.39(2)	16.25(2)	55.75(2)	188.00(3)
223	251.52(2)				94.75(2)	88.00(2)
224	173.65(2)				115.00(2)	36.50(2)
225	39.95(2)					
226						
227	115.32(4)				43.50(2)	54.90(5)
228	6.53(8)		4.88(4)	4.33(3)	8.00(6)	9.25(10)
229	39.03(4)	19.52(2)	28.35(2)	5.25(2)	30.50(2)	21.50(4)
230	243.28(3)				60.25(2)	30.80(2)
231	64.24(2)					93.75(2)
232	49.03(2)					
233						
234	49.03(2)	18.38(2)	101.38(2)	101.50(2)	52.00(2)	98.00(3)
235	117.59(4)				39.00(2)	89.67(3)
236	98.06(2)				44.75(2)	66.75(2)
BIomass (tons)	106,834	32,064	28,319	45,119	76,661	104,233

Table 2. Average weight (kg) of Greenland halibut caught per set from research vessel surveys by the GADUS ATLANTICA in Division 3K. Numbers in parenthesis indicate the number of sets per stratum.

Stratum	Gadus 15 1978	Gadus 29 1979	Gadus 44 1980	Gadus 58&59 1981	Gadus 71&72 1982
620	24.13(7)	37.32(7)	24.80(9)	25.72(10)	22.33(9)
621	159.03(7)	120.09(8)	54.42(10)	32.77(11)	14.68(14)
622				132.50(2)	120.83(3)
623	154.06(3)	36.55(3)	111.00(4)	83.33(4)	146.20(5)
624	14.57(3)	11.34(2)	1.25(2)	3.75(2)	5.25(4)
625	21.49(3)	11.19(3)	10.25(4)	31.50(4)	8.75(2)
626	51.87(4)	35.08(3)	178.50(3)	58.20(5)	120.40(5)
627				189.75(6)	124.43(7)
628	39.95(5)	72.13(2)	36.56(4)	16.33(6)	12.92(6)
629	8.63(3)	13.38(2)	19.83(3)	31.33(3)	68.50(2)
630		11.11(2)	11.25(2)	117.25(2)	
631				68.60(5)	38.00(2)
632	4.15(3)	2.04(2)	3.88(2)	6.25(2)	7.50(3)
633	7.49(5)	5.41(6)	14.64(7)	9.98(8)	7.93(7)
634	5.72(5)	9.26(6)	5.80(5)	5.41(7)	14.09(11)
635	6.06(5)	5.17(5)	23.13(4)	12.00(5)	17.10(5)
636	1.97(3)	4.40(5)	14.00(5)	12.75(6)	21.85(10)
637	5.11(4)	6.58(4)	6.63(4)	8.25(6)	9.71(7)
638	10.73(5)	11.97(7)	12.50(6)	21.31(8)	20.39(15)
639	5.33(5)	4.31(2)	7.88(4)	7.38(6)	19.05(10)
640				36.00(2)	21.50(2)
641				21.80(2)	24.50(4)
642				9.33(3)	33.33(6)
643					
644					
645				21.75(2)	17.67(3)
646				63.25(2)	15.50(2)
647				82.50(2)	39.50(2)
648					
649					
Biomass (tons)	65,695	52,641	52,819	77,966	70,870

Table 3. Average weight (kg) of Greenland halibut caught per set from research vessel surveys by the A.T. CAMERON in Division 3L. Numbers in parenthesis indicate the number of sets per stratum.

Stratum	ATC 262 1977	ATC 276 1978	ATC 290 1979	ATC 304-305 1980	ATC 317-318 1981	ATC 323-325 1981	ATC 327,28,29 1982	ATC 333,33 1982
328	0.05(3)		0.14(5)		1.30(2)		0.03(3)	
341	0.51(4)	0.01(4)	1.26(6)	0.29(6)	0.00(2)	0.50(3)	3.42(5)	0.19(4)
342	0.00(2)	0.00(2)	1.19(4)	0.88(4)		1.33(3)	0.27(3)	2.83(3)
343	0.11(2)	0.00(3)	1.31(4)	0.50(4)	0.00(2)	0.88(4)	0.00(4)	
344	10.84(4)	14.30(4)	14.53(2)	2.68(3)	3.90(5)	6.94(4)	5.63(4)	1.00(3)
345	22.37(4)	59.47(2)	13.62(4)	12.10(5)	5.70(4)	20.75(4)	10.13(4)	8.67(6)
346	9.34(3)		6.30(4)	6.00(3)	6.83(3)	9.00(3)	3.83(3)	11.63(4)
347	3.40(3)	1.48(4)	4.43(4)	6.50(5)	0.24(4)	1.83(3)	1.75(2)	3.02(4)
348	0.92(6)	2.31(6)	3.14(6)	5.29(7)	1.31(7)	0.42(6)	0.07(4)	2.08(5)
349	0.26(6)	0.23(6)	1.95(7)	2.01(9)	0.22(4)	0.09(7)	0.13(6)	0.03(5)
350	0.00(4)	0.00(6)	0.00(9)	0.00(10)	0.00(3)	0.00(6)	0.00(7)	0.00(2)
363	0.00(5)	0.00(5)	0.00(8)	0.00(5)	0.00(3)	0.00(4)	0.00(5)	0.00(3)
364	0.02(7)	0.15(6)	0.48(8)	0.42(6)	0.25(2)	0.49(9)	0.29(6)	0.25(11)
365	0.53(3)	0.00(2)	2.39(4)	1.32(4)		2.88(4)	0.01(3)	2.75(4)
366	4.61(4)		1.36(4)	5.38(4)	0.00(3)	5.00(3)	0.20(5)	9.58(6)
368	15.28(3)		9.08(4)	12.00(2)	8.50(2)	21.50(2)	2.51(2)	28.75(2)
369	19.28(3)	3.40(2)	6.13(4)	2.83(3)	19.00(2)	13.25(2)	3.00(2)	13.00(4)
370	0.00(3)	0.58(3)	1.36(4)	2.17(3)	0.00(2)	0.00(4)	0.00(2)	0.50(6)
371	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(2)	0.01(4)	0.00(4)	0.00(5)
372	0.00(6)	0.00(7)	0.00(9)	0.00(6)	0.00(4)	0.00(5)	0.00(6)	0.00(7)
384	0.00(2)	0.00(3)	0.00(4)	0.00(2)	0.00(2)		0.00(2)	0.00(4)
385	1.02(6)	0.00(6)	1.17(7)	2.25(4)	1.83(3)	0.26(8)	0.01(3)	2.19(8)
386	9.99(3)	1.74(3)	2.56(4)	4.83(3)	12.50(2)	37.00(3)	4.67(3)	21.75(4)
387	15.66(2)	3.78(3)	3.06(4)	1.63(2)	20.50(2)	67.50(2)	6.50(3)	43.67(3)
388	6.36(2)	2.50(2)	4.92(3)	5.25(2)	7.50(2)		10.50(2)	2.33(3)
389	1.06(3)	1.59(3)	3.63(4)	4.83(3)	6.00(2)		9.00(2)	7.88(4)
390	0.68(2)	0.00(4)	0.54(5)	0.00(3)	0.00(2)	0.00(3)	0.00(4)	3.50(4)
391	3.00(2)	1.02(2)	5.10(4)	9.75(2)	4.25(2)		3.75(2)	2.75(2)
392	3.63(2)	2.04(3)	15.59(3)	9.50(2)	14.25(2)		4.00(2)	14.00(2)
735					3.45(2)			33.00(2)
Biomass (tons)	19,966	9,387	7,398	6,789	6,781	12,722	4,572	11,649

Table 4. Average numbers caught per set for 2J+3K November surveys weighted by stratum area. Only common strata fished in each survey were used in calculation.

Age	GADUS 15 1978	GADUS 29 1979	GADUS 44 1980	GADUS 58&59 1981	GADUS 71&72 1982	Total 1978-82 5+
1	0.60	0.54	0.22	1.57	0.35	
2	3.61	3.58	0.79	3.14	0.90	
3	7.22	5.27	1.79	5.56	4.25	
4	9.04	5.59	3.60	4.90	6.54	
5	12.78	10.61	8.64	7.00	7.85	46.88
6	10.59	9.05	13.32	7.44	7.15	47.55
7	6.82	3.30	8.05	5.13	7.81	31.11
8	1.82	0.79	1.78	2.11	7.82	14.32
9	0.59	0.30	0.42	0.82	2.84	4.97
10	0.37	0.35	0.27	0.35	0.94	2.28
11	0.46	0.13	0.34	0.26	0.48	1.67
12	0.27	0.12	0.20	0.10	0.28	0.97
13	0.13	0.12	0.07	0.05	0.19	0.56
14	0.06	0.03	0.07	0.02	0.18	0.36
15	0.02	0.01	0.00	0.01	0.11	0.15
16	0.04	0.01	0.01	0.00	0.03	0.09
17	0.02	-	-	-	0.00	0.02
18	0.00	-	-	-	0.01	0.01
UK	0.03	0.00	0.01	0.14	0.01	
Total	54.48	39.79	39.60	38.60	47.75	$F_{5+} = 0.34$ (Robson & Chapman (1961) Method)

$F_{(1972-74\ yc)}$ from 1979-82 = 0.11
r = 0.77

Table 5. Greenland Halibut. Catch matrix (000's) 2+3KL 1975-82

Age	1975	1976	1977	1978	1979	1980	1981	1982
5	322	19	464	3016	2182	204	810	236
6	2719	680	4351	8511	7980	2032	4242	2020
7	5547	3600	9374	9072	11726	8913	9209	5552
8	4781	6030	6377	7662	5611	9429	10753	5064
9	3821	4199	2564	2898	1069	5258	4045	3112
10	1628	2457	879	1454	440	3729	836	1480
11	677	923	191	731	262	987	240	524
12	130	290	113	371	136	125	133	225
13	269	113	101	225	131	52	40	143
14	131	36	26	110	84	14	27	70
15	63	21	18	58	76	9	20	55
16	41	1	22	54	56	2	13	29
17	43	1	7	39	44	1	5	14

Table 6. Partial recruitment estimates, 1978-82, derived from commercial vs. research catch at age.

Age	1978	1979	1980	1981	1982
5	0.05	0.03	-	0.02	0.02
6	0.16	0.12	0.01	0.11	0.18
7	0.26	0.50	0.08	0.35	0.45
8	0.32	1.00	0.38	1.00	0.41
9	1.00	0.50	0.87	0.98	0.68
10	0.78	0.18	1.00	0.48	1.00
11	0.30	0.31	0.21	0.19	0.70
12	0.28	0.17	0.04	0.26	0.49
13	0.35	0.14	0.07	0.13	0.52
14	0.30	0.10		0.26	0.26
15	0.40				0.26
16	0.40				0.26
17	0.20				0.26
% T.C. Gillnets	54%	72%	88%	58%	53%

Table 7.

GREENLAND HALIBUT WEIGHT MATRIX 1975-1982 (KG)

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	0.609	0.609	0.609	0.609	0.609	0.514	0.392	0.547
6	0.760	0.760	0.760	0.760	0.760	0.659	0.598	0.711
7	0.955	0.955	0.955	0.955	0.955	0.869	0.789	0.923
8	1.192	1.192	1.192	1.192	1.192	1.049	0.985	1.168
9	1.580	1.580	1.580	1.580	1.580	1.145	1.235	1.444
10	2.209	2.209	2.209	2.209	2.209	1.256	1.700	1.839
11	2.699	2.699	2.699	2.699	2.699	1.573	2.460	2.445
12	3.371	3.371	3.371	3.371	3.371	2.708	3.507	3.554
13	3.884	3.884	3.884	3.884	3.884	3.115	4.794	4.605
14	4.563	4.563	4.563	4.563	4.563	4.418	5.944	5.966
15	5.918	5.918	5.918	5.918	5.918	5.037	8.055	7.669
16	7.144	7.144	7.144	7.144	7.144	7.022	8.710	8.841
17	7.887	7.887	7.887	7.887	7.887	10.147	9.576	11.719

Table 8.

POPULATION NUMBERS

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	88449	103371	151209	278918	521892	416538	304677	260512
6	53668	72125	84616	123379	225630	423315	340848	248715
7	46806	41480	58435	65340	93313	177510	346379	275224
8	33512	33302	30703	39361	45288	65788	137268	275259
9	19083	23111	21810	19368	25293	32001	45331	102656
10	8815	12166	15122	15552	13235	19741	21443	33454
11	4214	5744	7738	11586	11418	10437	12788	16799
12	1128	2837	3867	6162	8824	9111	7652	10253
13	1356	806	2061	3064	4710	7102	7346	6145
14	1028	867	558	1596	2305	3737	5767	5978
15	356	723	677	433	1207	1811	3047	4697
16	84	235	573	538	302	919	1475	2477
17	267	31	191	449	392	197	751	1196
5+	258766	296798	377560	565747	953808	1170207	1234773	1243366
6+	170317	193428	226351	286829	431916	753669	930096	982854
7+	116649	121303	141736	163450	206286	328355	589248	734138
8+	69843	79823	83300	98109	112972	150845	242869	458914
9+	36331	46521	52597	58749	67685	85057	105601	183655
10+	17248	23410	30788	39381	42392	53055	60270	81000

POPULATION BIOMASS (MID-YEAR)

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	48726	57051	83325	153062	287422	193998	108094	129092
6	35958	49430	56668	81812	152463	253384	183507	159580
7	37887	34210	46099	52241	75207	136022	244163	227755
8	33364	32365	29325	37918	45607	57618	117338	288524
9	24278	29759	29238	25449	35396	30194	48279	132168
10	15838	21617	29326	29554	26024	20113	32345	54434
11	9393	12804	18678	27374	27586	14115	28226	36605
12	3230	8186	11631	18215	26738	22197	24097	32639
13	4247	2619	7062	10357	16331	19971	31827	25327
14	3956	3505	2249	6353	9346	14935	30992	32125
15	1724	3820	3581	2152	6253	8247	22169	32446
16	381	1517	3635	3294	1755	5844	11587	19722
17	1742	221	1341	3062	2629	1904	6494	12620
5+	220724	257103	322157	450843	712757	778443	889118	1183039
6+	171998	200052	238832	297781	425335	584445	781023	1053947
7+	136040	150621	182164	215969	272872	331061	597517	894367
8+	98154	116412	136064	163728	197665	195039	353354	666612
9+	64790	84047	106739	125810	152058	137421	236016	378087
10+	40511	54287	77501	100361	116662	107227	187737	245919

FISHING MORTALITY

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	0.004	0.000	0.003	0.012	0.005	0.001	0.003	0.001
6	0.058	0.010	0.059	0.079	0.040	0.005	0.014	0.009
7	0.140	0.101	0.195	0.167	0.150	0.057	0.030	0.022
8	0.172	0.223	0.261	0.242	0.147	0.172	0.091	0.021
9	0.250	0.224	0.138	0.181	0.048	0.200	0.104	0.034
10	0.228	0.253	0.066	0.109	0.037	0.234	0.044	0.050
11	0.195	0.196	0.028	0.072	0.026	0.110	0.021	0.035
12	0.136	0.120	0.033	0.069	0.017	0.015	0.019	0.025
13	0.247	0.168	0.056	0.085	0.031	0.008	0.006	0.026
14	0.152	0.047	0.053	0.079	0.041	0.004	0.005	0.013
15	0.217	0.033	0.030	0.160	0.072	0.006	0.007	0.013
16	0.780	0.005	0.043	0.118	0.229	0.002	0.010	0.013
17	0.195	0.036	0.041	0.100	0.132	0.006	0.007	0.013

WEIGHTED FISHING MORTALITIES AGES 5 TO 17

AGE	1975	1976	1977	1978	1979	1980	1981	1982
	0.094	0.075	0.078	0.072	0.036	0.031	0.028	0.017

Table 9.

POPULATION NUMBERS

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	67906	75954	106838	166562	273599	213476	153447	130319
6	41365	55305	62169	87051	133641	222029	174595	124899
7	34760	31407	44665	46963	63571	102195	179944	139108
8	24047	23440	22456	28087	30241	41437	75605	138993
9	14093	15362	13735	12616	16062	19682	25394	52171
10	6405	8081	8778	8942	7707	12184	11357	17131
11	3011	3771	4393	6391	6005	5911	6601	8542
12	881	1853	2253	3424	4571	4680	3947	5187
13	1061	604	1254	1742	2467	3620	3718	3111
14	722	626	392	936	1223	1902	2917	3008
15	267	473	480	297	667	925	1544	2363
16	72	161	368	376	191	477	749	1246
17	193	22	131	281	259	106	389	602
5+	194784	217058	267911	363668	540203	628623	640206	626679
6+	126878	141104	161074	197106	266604	415147	486759	496360
7+	85512	85799	98905	110054	132964	193118	312164	371461
8+	50752	54392	54240	63092	69393	90923	132221	232353
9+	26705	30952	31783	35005	39152	49486	56615	93361
10+	12612	15590	18048	22390	23090	29803	31221	41190

POPULATION BIOMASS (MID-YEAR)

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	37387	41918	58834	91044	150372	99400	54364	64546
6	27480	37845	41200	56770	89084	131965	93396	79790
7	27437	25481	34129	36281	49390	76675	125126	113878
8	23103	21644	20342	25649	29305	34369	62218	144262
9	17079	18588	17645	15737	22173	17335	25925	66084
10	10985	13366	16615	16294	14954	11441	16800	27217
11	6438	7954	10494	14657	14345	7650	14430	18303
12	2473	5172	6696	9841	13744	11321	12318	16319
13	3202	1904	4223	5698	8437	10141	16063	12664
14	2687	2506	1563	3621	4868	7584	15634	16062
15	1240	2475	2520	1422	3352	4201	11195	16223
16	299	1041	2307	2244	1030	3029	5859	9861
17	1208	151	910	1860	1680	967	3350	6310
5+	161015	180045	217478	281118	402734	416076	456678	591520
6+	123628	138126	158644	190074	252361	316677	402314	526974
7+	96148	100282	117444	133304	163277	184712	308918	447184
8+	68712	74800	83315	97024	113888	108037	183792	333306
9+	45609	53157	62973	71375	84583	73668	121574	189044
10+	28530	34569	45328	55638	62409	56333	95649	122959

FISHING MORTALITY

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	0.005	0.000	0.005	0.020	0.009	0.001	0.006	0.002
6	0.075	0.014	0.081	0.114	0.068	0.010	0.027	0.018
7	0.194	0.135	0.264	0.240	0.228	0.101	0.058	0.045
8	0.248	0.335	0.377	0.359	0.229	0.290	0.171	0.041
9	0.356	0.360	0.229	0.293	0.076	0.350	0.194	0.068
10	0.330	0.410	0.117	0.198	0.065	0.413	0.085	0.100
11	0.286	0.315	0.049	0.135	0.049	0.204	0.041	0.070
12	0.178	0.190	0.057	0.128	0.033	0.030	0.038	0.049
13	0.329	0.232	0.093	0.154	0.060	0.016	0.012	0.052
14	0.224	0.066	0.076	0.139	0.079	0.008	0.010	0.026
15	0.303	0.050	0.042	0.243	0.135	0.011	0.014	0.026
16	0.998	0.007	0.068	0.173	0.392	0.005	0.019	0.026
17	0.281	0.052	0.061	0.165	0.207	0.010	0.014	0.026

WEIGHTED FISHING MORTALITIES AGES 5 TO 17

AGE	1975	1976	1977	1978	1979	1980	1981	1982
	0.129	0.108	0.114	0.116	0.066	0.061	0.055	0.033

Table 10.

POPULATION NUMBERS

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	61059	66819	92058	129123	190845	145800	103038	86921
6	37265	49700	54689	74951	102988	154276	119186	83627
7	30745	28050	40076	40839	53664	77099	124472	93743
8	20892	20153	19708	24329	25227	33326	55058	93576
9	12429	12779	11044	10365	12986	15577	18753	35348
10	5602	6719	6663	6738	5864	9665	7996	11694
11	2610	3114	3278	4660	4201	4403	4539	5790
12	799	1525	1714	2511	3154	3202	2712	3499
13	963	536	986	1301	1720	2459	2509	2100
14	620	545	337	716	862	1290	1966	2018
15	237	389	414	252	486	630	1043	1585
16	68	137	300	322	154	329	507	836
17	168	18	111	225	215	75	268	404
5+	173459	190484	231377	296334	402366	448132	442048	421142
6+	112399	123665	139319	167210	211522	302332	339010	334221
7+	75134	73965	84629	92259	108534	148056	219824	250593
8+	44389	45915	44554	51420	54870	70957	95352	156850
9+	23496	25762	24846	27091	29643	37631	40294	63274
10+	11067	12983	13802	16726	16656	22054	21540	27926

POPULATION BIOMASS (MID-YEAR)

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	33608	36876	50676	70378	104695	67872	36454	43031
6	24654	33984	36045	48424	67959	91496	63362	53193
7	23949	22571	30130	30950	40769	56886	85441	75918
8	19674	18052	17331	21537	23859	26587	43811	96175
9	14667	14839	13769	12486	17765	13017	18459	44056
10	9360	10590	12375	11863	11263	8518	11618	18145
11	5449	6329	7766	10413	9930	5489	9831	12202
12	2220	4165	5051	7047	9412	7695	8392	10880
13	2852	1665	3276	4142	5804	6864	10808	8442
14	2263	2173	1334	2709	3375	5134	10516	10708
15	1078	2027	2167	1178	2384	2852	7538	10815
16	271	882	1864	1894	786	2090	3950	6574
17	1029	128	767	1458	1363	688	2302	4207
5+	141073	154281	182550	224480	299366	295189	312480	394346
6+	107465	117405	131874	154101	194672	227317	276026	351316
7+	82811	83422	95830	105677	126713	135821	212665	298122
8+	58862	60851	65699	74727	85943	78935	127223	222204
9+	39188	42799	48368	53190	62084	52348	83413	126029
10+	24521	27960	34599	40704	44319	39331	64953	81973

FISHING MORTALITY

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	0.006	0.000	0.006	0.026	0.013	0.002	0.009	0.003
6	0.084	0.015	0.092	0.134	0.090	0.015	0.040	0.027
7	0.222	0.153	0.299	0.282	0.276	0.137	0.085	0.067
8	0.292	0.401	0.443	0.428	0.282	0.375	0.243	0.061
9	0.415	0.451	0.294	0.370	0.095	0.467	0.272	0.102
10	0.387	0.518	0.158	0.272	0.087	0.556	0.123	0.150
11	0.338	0.397	0.067	0.190	0.071	0.285	0.060	0.105
12	0.198	0.236	0.076	0.178	0.049	0.044	0.056	0.074
13	0.369	0.265	0.120	0.212	0.088	0.024	0.018	0.078
14	0.266	0.076	0.089	0.186	0.114	0.012	0.015	0.039
15	0.348	0.061	0.049	0.293	0.190	0.016	0.021	0.039
16	1.103	0.008	0.085	0.205	0.514	0.007	0.029	0.039
17	0.330	0.062	0.072	0.211	0.255	0.015	0.021	0.039

WEIGHTED FISHING MORTALITIES AGES 10 TO 17

AGE	1975	1976	1977	1978	1979	1980	1981	1982
	0.356	0.407	0.116	0.225	0.086	0.311	0.071	0.106

Table 11.

POPULATION NUMBERS

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	57637	62253	84677	110413	149475	111969	77834	65222
6	35216	46898	50952	68908	87670	120406	91488	62992
7	28738	26372	37782	37779	48716	64557	96741	71066
8	19315	18510	18334	22451	22722	29275	44790	70872
9	11598	11488	9698	9241	11448	13526	15437	26941
10	5201	6038	5606	5636	4943	8406	6317	8978
11	2410	2785	2720	3795	3299	3649	3508	4415
12	757	1360	1445	2054	2445	2464	2095	2655
13	914	502	851	1081	1346	1879	1904	1595
14	569	505	309	606	681	984	1491	1523
15	222	348	381	230	396	482	793	1197
16	66	124	266	295	135	256	386	631
17	156	17	101	197	193	60	208	305
5+	162798	177200	213122	262686	333472	357913	342992	318392
6+	105161	114947	128445	152272	183996	245944	265157	253170
7+	69945	68049	77493	83365	96326	125538	173670	190177
8+	41207	41677	39712	45586	47611	60981	76928	119112
9+	21892	23167	21377	23135	24889	31706	32138	48239
10+	10294	11679	11679	13894	13440	18180	16701	21298

POPULATION BIOMASS (MID-YEAR)

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	31719	34356	46602	60050	81860	52111	27500	32273
6	23242	32054	33468	44254	57399	71266	48347	39895
7	22204	21115	28129	28282	36456	46989	65595	56939
8	17956	16250	15820	19473	21132	22682	34586	72131
9	13458	12953	11826	10854	15561	10841	14718	33042
10	8545	9192	10253	9640	9418	7040	9026	13609
11	4954	5512	6401	8288	7723	4405	7532	9151
12	2094	3661	4228	5648	7247	5882	6429	8160
13	2677	1546	2803	3363	4488	5226	8161	6332
14	2050	2007	1220	2253	2628	3909	7956	8031
15	997	1803	1990	1056	1899	2178	5709	8111
16	256	803	1642	1719	663	1621	2995	4931
17	939	116	695	1257	1204	549	1778	3155
5+	131090	141368	165077	196137	247679	234699	240352	295760
6+	99371	107012	118475	136087	165819	182588	212852	263487
7+	76130	74958	85007	91832	108419	111322	164505	223592
8+	53926	53843	56878	63550	71963	64333	98910	166633
9+	35969	37593	41058	44076	50831	41650	64324	94522
10+	22512	24640	29232	33223	35270	30809	49606	61480

FISHING MORTALITY

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	0.006	0.000	0.006	0.031	0.016	0.002	0.012	0.004
6	0.089	0.016	0.099	0.147	0.106	0.019	0.053	0.036
7	0.240	0.164	0.320	0.308	0.309	0.166	0.111	0.090
8	0.320	0.446	0.485	0.473	0.319	0.440	0.308	0.082
9	0.453	0.517	0.343	0.426	0.109	0.561	0.342	0.136
10	0.425	0.597	0.190	0.336	0.104	0.674	0.158	0.200
11	0.372	0.456	0.081	0.239	0.092	0.355	0.079	0.140
12	0.210	0.269	0.090	0.223	0.063	0.058	0.073	0.098
13	0.394	0.286	0.141	0.261	0.114	0.031	0.023	0.104
14	0.293	0.082	0.098	0.224	0.146	0.016	0.020	0.052
15	0.377	0.069	0.054	0.327	0.238	0.021	0.028	0.052
16	1.166	0.009	0.096	0.226	0.610	0.009	0.038	0.052
17	0.361	0.068	0.079	0.245	0.288	0.018	0.027	0.052

WEIGHTED FISHING MORTALITIES AGES 5 TO 17

AGE	1975	1976	1977	1978	1979	1980	1981	1982
	0.159	0.140	0.148	0.166	0.110	0.114	0.108	0.067

Table 12.

POPULATION NUMBERS

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	55585	59516	80255	99195	124660	91677	62713	52203
6	33987	45217	48711	65287	78485	100089	74874	50612
7	27534	25366	36406	35944	45752	57038	80107	57463
8	18369	17524	17510	21324	21220	26848	38634	57254
9	11099	10713	8891	8566	10526	12296	13450	21901
10	4960	5629	4972	4976	4391	7651	5310	7352
11	2290	2588	2386	3275	2758	3197	2890	3591
12	733	1262	1284	1781	2020	2021	1724	2149
13	884	482	771	949	1122	1531	1542	1291
14	539	481	293	540	573	800	1206	1226
15	213	322	361	216	342	393	642	963
16	65	117	245	279	124	212	314	508
17	148	16	95	181	180	51	171	245
5+	156403	169234	202178	242512	292154	303803	283576	256758
6+	100819	109717	121923	143317	167493	212126	220864	204554
7+	66832	64500	73212	78030	89008	112038	145990	153942
8+	39298	39134	36807	42086	43257	55000	65883	96479
9+	20929	21611	19296	20762	22037	28152	27249	39226
10+	9831	10898	10406	12196	11511	15856	13799	17325

POPULATION BIOMASS (MID-YEAR)

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	30586	32845	44161	53858	68163	42658	22127	25818
6	22394	30896	31923	41756	51066	59130	39339	31916
7	21156	20242	26927	26681	33868	41051	53685	45551
8	16925	15166	14912	18232	19494	20333	29038	57705
9	12730	11816	10657	9871	14239	9526	12468	26434
10	8055	8346	8979	8302	8311	6142	7470	10887
11	4656	5021	5583	7010	6398	3752	6153	7321
12	2018	3359	3734	4807	5947	4794	5252	6528
13	2571	1474	2518	2895	3698	4243	6605	5065
14	1923	1907	1151	1978	2179	3174	6421	6425
15	948	1669	1884	982	1608	1773	4612	6489
16	248	755	1509	1613	589	1339	2422	3944
17	885	109	652	1137	1109	465	1464	2524
5+	125095	133605	154590	179122	216669	198382	197055	236608
6+	94509	100759	110429	125265	148506	155724	174928	210789
7+	72115	69864	78506	83509	97440	96594	135589	178873
8+	50959	49621	51579	56828	63572	55542	81904	133322
9+	34034	34456	36667	38596	44078	35209	52866	75617
10+	21304	22639	26010	28725	29839	25683	40398	49184

FISHING MORTALITY

AGE	1975	1976	1977	1978	1979	1980	1981	1982
5	0.006	0.000	0.006	0.034	0.020	0.002	0.014	0.005
6	0.093	0.017	0.104	0.156	0.119	0.023	0.065	0.045
7	0.252	0.171	0.335	0.327	0.333	0.190	0.136	0.112
8	0.339	0.479	0.515	0.506	0.346	0.491	0.368	0.103
9	0.479	0.568	0.380	0.468	0.119	0.640	0.404	0.170
10	0.451	0.658	0.217	0.390	0.117	0.774	0.191	0.250
11	0.396	0.501	0.093	0.283	0.111	0.417	0.096	0.175
12	0.218	0.293	0.102	0.262	0.077	0.071	0.089	0.123
13	0.410	0.300	0.156	0.304	0.138	0.038	0.029	0.130
14	0.313	0.086	0.103	0.255	0.177	0.020	0.025	0.065
15	0.397	0.075	0.057	0.352	0.281	0.026	0.035	0.065
16	1.207	0.009	0.105	0.240	0.689	0.011	0.047	0.065
17	0.383	0.072	0.085	0.271	0.313	0.022	0.033	0.065

WEIGHTED FISHING MORTALITIES AGES 5 TO 17

AGE	1975	1976	1977	1978	1979	1980	1981	1982
	0.166	0.149	0.157	0.182	0.127	0.138	0.133	0.084

Table 13.

AGE	WEIGHT-AT-AGE	PARTIAL RECRUITMENT
5	0.547	0.020
6	0.711	0.180
7	0.923	0.450
8	1.168	0.410
9	1.444	0.680
10	1.839	1.000
11	2.445	0.700
12	3.554	0.490
13	4.605	0.520
14	5.966	0.260
15	7.669	0.260
16	8.841	0.260
17	11.719	0.260

NATURAL MORTALITY RATE : 0.2
F0.1 COMPUTED AS 0.3517 AT Y/R OF 0.5481
FMAX COMPUTED AS 0.6752 AT Y/R OF 0.5896

YIELD PER RECRUIT ANALYSIS

	FISHING MORTALITY	CATCH (NUMBER)	YIELD (KG)	AVG. WEIGHT (KG)	YIELD PER UNIT EFFORT
	0.1000	0.146	0.289	1.979	1.854
	0.2000	0.248	0.443	1.791	1.423
	0.3000	0.321	0.524	1.634	1.121
F0.1---	0.3517	0.350	0.548	1.564	1.000
	0.4000	0.375	0.564	1.505	0.904
	0.5000	0.416	0.582	1.400	0.747
	0.6000	0.448	0.589	1.314	0.629
FMAX---	0.6752	0.468	0.590	1.260	0.560
	0.7000	0.474	0.590	1.243	0.540
	0.8000	0.496	0.588	1.186	0.471
	0.9000	0.514	0.585	1.138	0.417
	1.0000	0.530	0.582	1.098	0.373
	1.1000	0.544	0.579	1.065	0.338
	1.2000	0.556	0.576	1.037	0.308
	1.3000	0.567	0.574	1.012	0.283
	1.4000	0.577	0.572	0.991	0.262
	1.5000	0.586	0.570	0.973	0.244

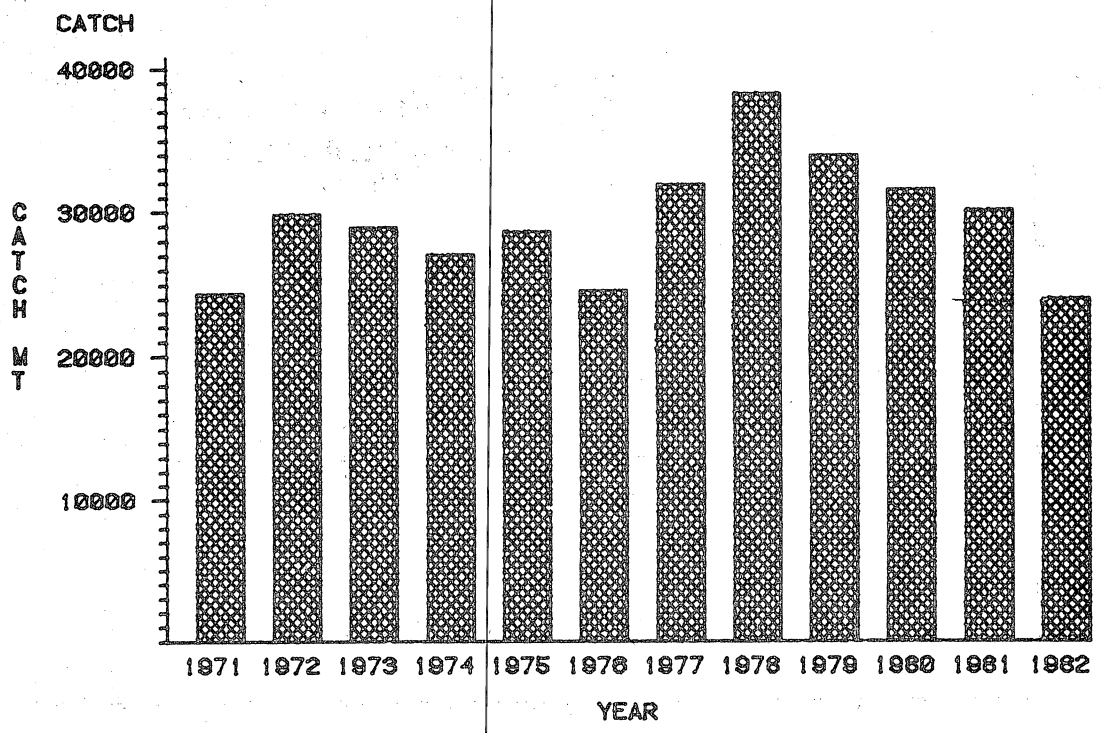

FIG.1: NOMINAL CATCHES OF GREENLAND HALIBUT IN NAFO DIV.2+3KL (1982 IS PROVISIONAL)

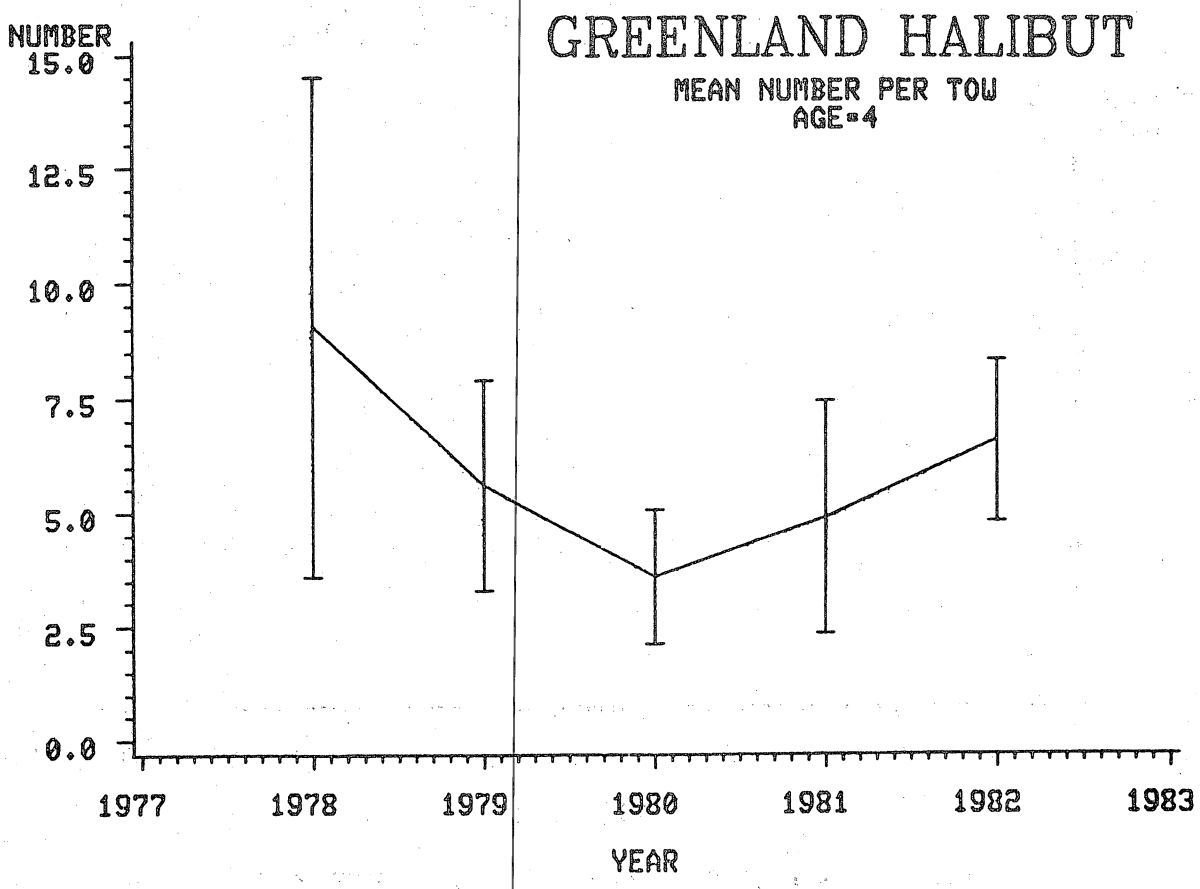

Fig. 2.

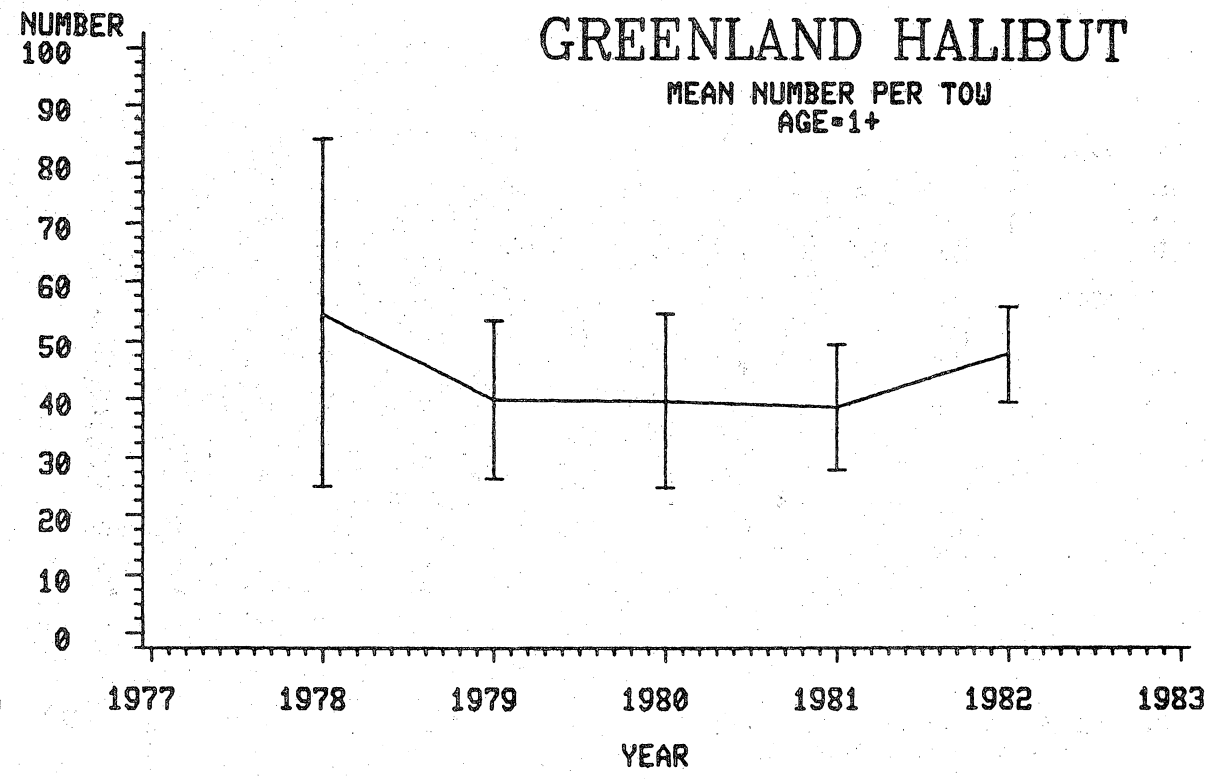

Fig. 3.

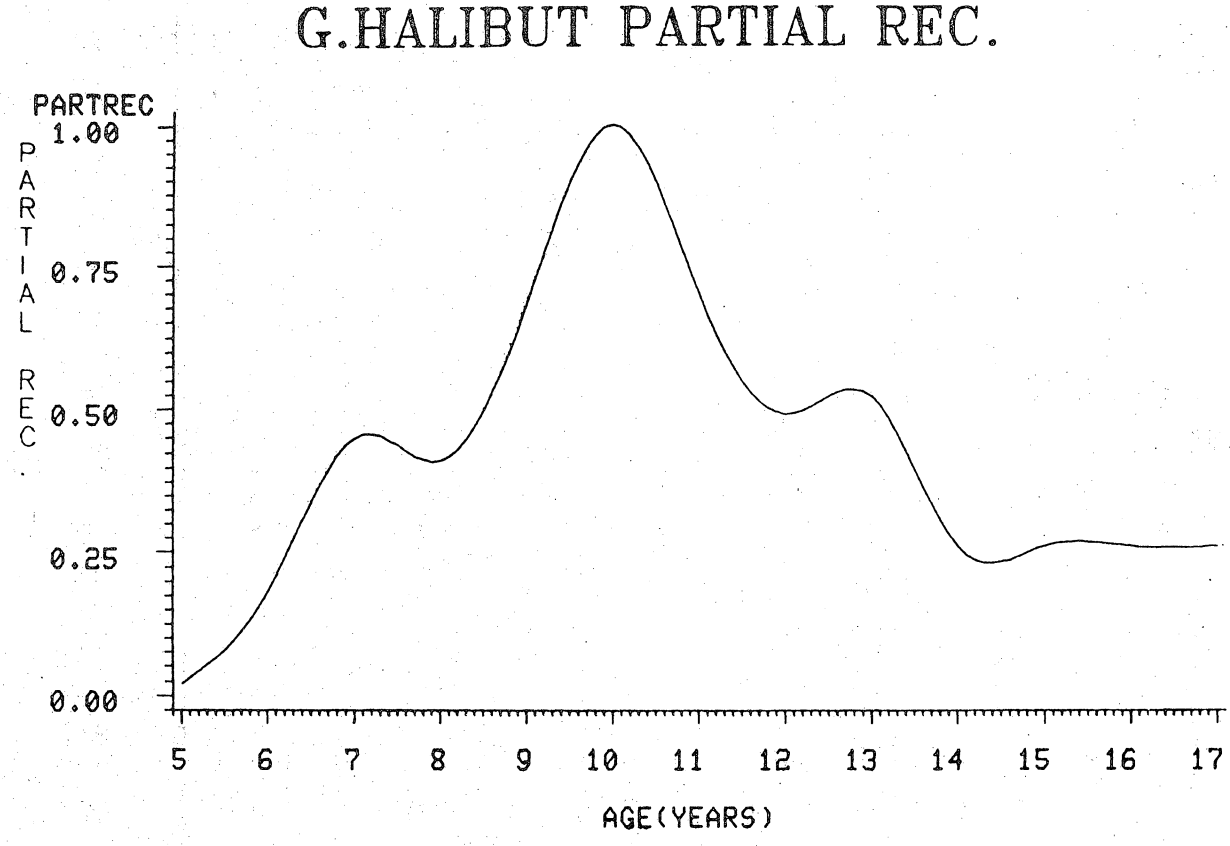

Fig. 4.

RESEARCH VS COMMERCIAL

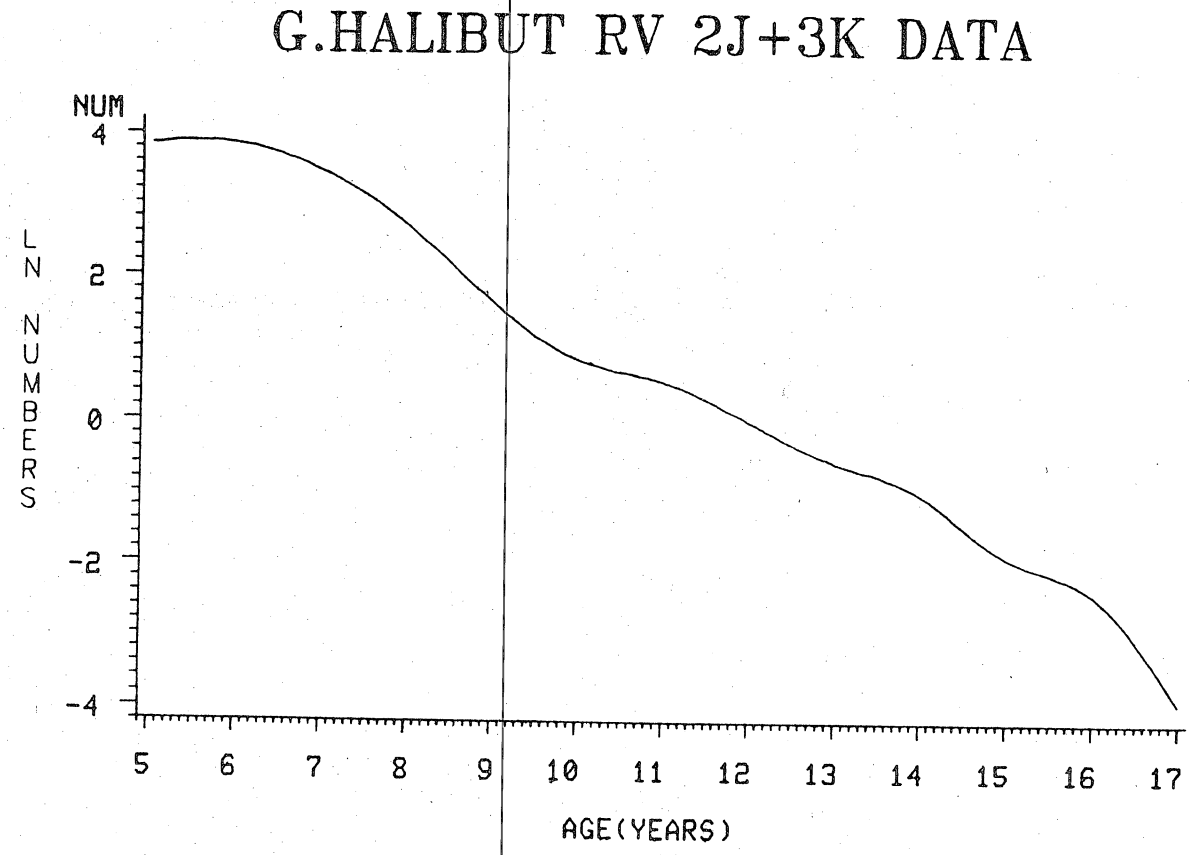

Fig. 5. CATCH CURVE 1978-82