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Northwest Atlantic



Fisheries Organization

Serial No. N348

NAFO SCR Doc. 81/VI/64

SCIENTIFIC COUNCIL MEETING - JUNE 1981

Stock assessment of Greenland halibut in NAFO Subarea 2 and Divisions 3KL with projected catches for 1982

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LANDINGS AND EFFORT

Landings have been reasonably stable over the past 10 years at an average of 30,000-35,000 metric tons (Table 1). Historically, the fishery was prosecuted mostly by the offshore foreign fleet mainly the USSR and Poland with a smaller component of Canadian (Newfoundland) inshore gillnet fishermen. In recent years there has been a complete shift in fishing effort from offshore otter trawling to inshore gillnet fishing with the inshore gillnet fishery now comprising 80-90% of the total landings. Landings in 1980 were slightly lower than in 1979 however this was mainly a result of the exclusion of foreign effort from the fishery in 1980. Despite a general strike in the inshore fishing industry of Newfoundland for approximately 6-8 weeks in July-August 1980 (the peak fishing period) the gillnet landings were the highest ever recorded. Had fishing continued during this period, landings would undoubtedly have been much higher.

Adequate catch and effot data are not available from this Greenland halibut fishery however main species catch/effort from the Canaidan TC 5 vessels fishing in Funk Island Bank area (3K) have been available since 1976. The CPUE has increased from 0.187 t/hr in 1976 to 0.780 t/hr in 1979 and decreased to 0.531 t/hr in 1980. These figures must be treated with scepticism however since this effort is not particularly "directed" effort and represents less than 10% of the total landings. The 1980 CPUE was computed using only 4% of the total 1980 landings.

Research Vessel Surveys

Since 1977, stratified-random groundfish biomass surveys have been conducted by the Canadian research vessel GADUS ATLANTICA in Div. 2J and in Div. 3KL since 1978. Unfortunately the whole stratified area has never been completely covered by any of the surveys. This would tend to underestimate stock abundance probably to a fairly large degree since the deepest areas where the largest fish are located are rarely surveyed. The results of these surveys are presented in Tables 2, 3 and 4 for Div. 2J, 3K and 3L respectively. Blanks in the tables indicate strata that weren't surveyed and the numbers in brackets represent the numbers of sets in each particular stratum.

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Division 2J

The most complete coverage was GADUS 3, November 1977 (Table 2). The biomass estimate was about 107,000 t even though some strata were missed. The August-September cruise (GADUS 12) in 1978 estimated biomass at about 77,000 t however some critical strata were missed and if completed may have been more in line with the 1977 estimate. The 1979 and 1980 surveys are very incomplete however for common strata the estimates may not be too different. A visual comparison of GADUS 3 (1977) and GADUS 42 (1980) would suggest that had some of the more critical strata been covered in 1980 the estimates from GADUS 42 may have been somewhat higher.

Division 3K

The only complete survey in this division was GADUS 12, 1978 which yielded a biomass estimate of about 105,000 t. Since that time, the surveys have been incomplete. The most complete since that time would have been GADUS 42 in September 1980. If the surveys had been complete the biomass estimate would probably have been in the area of 70,000-80,000 t. A comparison of GADUS 27 (1979) with GADUS 42 (1980) and GADUS 29 (1979) with GADUS 44 (1980) suggest from both that biomass has been relatively stable from 1979 to 1980 probably at levels in excess of 80,000 t.

Division 3L

This division represents the southern limits of this stock and the distribution is essentially confined to the deeper water on the northern slopes of the Grand Bank. Although not completely covered, the main areas of importance were surveyed in GADUS 12, 1978 and GADUS 25, 1979 and to a lesser extent GADUS 36, 1980. Estimates of biomass from this area suggest a level of about 12,000-14,000 t.

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Minimum trawlable biomass estimates from Div. 2J3KL seem to be in the order of about 200,000 t. It should be noted that this does not include a significant portion of the unfished stock area i.e.: Div. 2GH where the most recent estimates of biomass from GDR in 1979 were in excess of 100,000 t. If estimates of trawl catchability of less than 20% for this species is anywhere near correct (Chumakov et al., 1979) then the abundance of Greenland halibut in this area may be substantially higher than shown here.

Virtual Population Analysis

Calculation of numbers at age - From 1975 to 1979 the numbers at age were the same as those calculated and presented in the previous assessment of this stock in NAFO SCR Doc. 80/VI/96. For 1980, samples were available for all segments of the inshore gillnet fishery which comprised most of the landings in 1980. The catches were consequently broken down by the usual procedure. Since the fishery in 1980 was exclusively Canadian, all offshore catches were broken down by the available Canada (N) samples collected. The 1980 breakdown is therefore considered to be a more than adequate representation of the 1980 fishery. The catch matrix used in the analysis is shown in Table 5.

Partial Recruitment - An attempt was made to compare the 1980 research data with the 1980 commercial data in order to get a real time empirical estimate of partial recruitment. However, the comparison indicated almost zero recruitment in most age groups which did not appear reasonable or realistic. Partial recruitment was therefore derived based on average fishing mortalities at age for 1976-78 where the pattern appeared to be relatively stable from year to year. The partial recruitment curve and associated values are shown in Fig. 1. The curve is clearly dome-shaped which is not too surprising considering the selective fishing pattern and the emigration factor associated with this particular fishery.

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Terminal F - Since commercial CPUE data were inadequate the only alternative was to attempt to derive a recent mortality estimate from the research vessel data. It was considered that since the research vessel surveys in November, 1979 (GADUS 29) and November, 1980 (GADUS 44) in Div. 2J+3K were so near the end of each year, an estimate of mortality between the two for age groups fully recruited to the gear may provide a reasonable estimate of mortality during the 1980 fishing season. A weighted F calculated on the 6+ age groups was found to be F = 0.04 (Table 6). A fully recruited F was computed by iterating arbitrary levels of fully recruited F until average F weighted by population abundance at age was equal to 0.04. Fully recruited F was subsequently determined to be F = 0.20. Considering the drawbacks in the data this was felt to be the best estimate we could provide for Terminal F.

Catch curves were calculated for ages 7+ and 8+ from the combined research vessel data for 1978-80 to give some idea of average fishing mortality over the past 10-12 years. This level was about F = 0.36 to 0.40 for an average of 30,000-35,000 t. This value was felt to be extremely overestimated for two main reasons:

- The abnormally large year classes represented in the peak of the catch curve would force the slope of the curve much higher than average conditions.
- ii) Because of emigration of old fish and inadequate representation of old fish in the abundance index, due to lack of deeper water surveying, the extreme end of the curve would be forced much higher if older fish were more represented, consequently lowering the slope.

Average Weights

Average weights at age were derived for 1975-79 by applying a new length-weight relationship derived from 1980 research data against average length at age used in the previous assessment (Table 7). Weighted mean lengths at age were calculated for the 1980 samples and mean weights at age subsequently computed using the same length weight relationship. These mean weights were used to compute biomass estimates in the virtual population analysis as well as the catch projections for 1981-83.

Yield Per Recruit

A Thompson-Bell yield per recruit analysis was run using the average weights at age from 1975-79 and the average partial recruitment vector described in Fig. 1. The calculated $F_{0.1}$ value was 0.343. The computations are shown in Table 8.

VPA

A series of VPA runs were performed using Terminal F's from 0.10 to 0.50 at increments of 0.05. However, since the best estimate of $F_T = 0.20$, only the results of this run are presented in the document. The population numbers and mean population biomass are shown in Table 9 whereas a matrix of the fishing mortalities are presented in Table 10.

Catch Projections

Since no quantifiable data on recruitment levels were available, the geometric mean at age 5 from 1975-79 in the VPA runs were used in the catch projections as estimates of recruitment. Projections were run for $F_T = 0.10$ to 0.40 at increments of $F_T = 0.05$. The catch projections for 1982 were computed at a level of fully recruited F equal to $F_{0\cdot 1}$ assuming the TAC of 55,000 t will be taken in 1981. The projected catches for 1982 under these assumptions are presented in Table 11 for varying degrees of terminal F.

Since F = 0.20 was considered to be the best estimate of terminal F the projected population numbers and biomass to 1983 are shown in Table 12 for this one. The catch numbers and catch biomass for $F_T = 0.20$ to 1983 are shown in Table 13. If this level of fully recruited F for 1980 is correct then the recommended TAC for 1982 at $F_{0.1} = 0.343$ should be about 71,000 t.

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Table	

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
CAN (MQ)	1	2				25	221	229	1,182	1,863	294
CAN (N)	10,705	9,406	8,952	6,840	5,745	7,782	9,085	17,738	23,205	28,077	30,545
CUBA											
DEN (F)			026	950	4			350	268		
DEN (G)				65	2						
DEN (M)											
FRA (M)					5						
FRA (St. P)					9	48	32				
FRG	13		86	707	515	622	927	755	1,022		
GDR			402	1,681	2,701	2,025	1,512	1,953	1,636	178	227
ICE		8									
JAP									с С		
NOR			1,389	501	117		9	15	Э	8	
POL	8,266	5,234	6,986	9,060	7,105	8,447	5,942	5,998	5,215	1,813	203
POR				207	161	231	73	119		38	
ROM	225	7	120	80				· · ·	m		
SPA			'n				-				
USSR	7,384	9,094	10,183	8,662	9,650	9,439	6,799	4,308	5,613	1,961	238
UK			731	201	1,112	62		476	53		
Other		647			•						32
Totals	26,594	24,392	29,822	28,954	27,123	28,681	24,598	31,941	38,203	33,930	31,539

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Stratum	Gadus 3 1977	Gadus 12 1978	Gadus 15 1978	Gadus 27 1979	Gadus 29 1979	Gadus 42 1980	Gadus 44 1980
201 202 203	7.26(2) 21.34(2) 31.55(2)	7.59(2) 40.82(2) 484.68(2)	1.36(3) 25.20(2)	36.51(2) 87.09(2) 260 36(2)	0.45(2) 7.48(2)	7.00(2) 16.50(2)	2.83(3) 51.00(2) 25.75(2)
205 206 207 208 209	20.97(4) 20.80(11) 77.77(5) 186.14(4) 65.25(7)	90.26(2) 34.70(2)	6.58(4) 7.78(7) 25.54(4) 183.12(3) 15.66(4)	53.97(2) 190.51(2)	10.21(2) 8.11(8) 10.39(5) 127.46(2) 47.61(5)	110.00(2) 25.50(2)	3.75(4) 10.11(7) 6.90(5) 189.25(2) 144.37(4)
210 211 212 213 214	19.41(6) 34.96(2) 189.61(4) 16.46(8) 38.97(6)	13.62(3) 105.69(2) 150.82(2) 7.26(3) 22.07(3)	5.20(4) 64.92(2) 17.59(4) 67.76(4)	14.97(2) 57.65(2) 232.24(2) 10.59(3) 40.18(2)	4.09(2) 36.28(2) 8.84(4)	21.75(2) 133.00(2) 103.50(2) 41.67(3) 21.50(2)	3.50(3) 32.70(3) 11.70(5) 11.33(3)
214 215 216 217 218 219	37.68(4) 102.83(2) 141.95(3) 217.92(2)	1.86(3) 170.78(2) 168.28(2) 238.14(2)	34.14(5)	5.34(2) 251.14(2) 87.15(2)	8.00(4) 111.58(2)	14.00(2) 235.00(2) 156.00(2) 129.50(2)	23.00(2) 137.50(2)
219 220 221	/ - \	56.92(2)			/ - >		
222 223 224 225	115.32(4) 251.52(2) 173.65(2) 39.95(2)	98.20(2) 84.82(2) 78.70(2)	42.07(3)	144.98(2) 63.99(2) 122.47(2)	8.39(2)	164.50(2) 36.00(2) 32.75(2)	16.25(2)
226 227 228 229 230	115.32(4) 6.53(8) 39.03(4) 243.28(3)	3.18(2) 86.86(2) 2.19(3) 9.28(2) 80.74(2)	19.52(2)	27.47(2) 15.43(2) 19.29(2)	4.88(4) 28.35(2)	73.75(2) 39.50(2) 46.00(2) 169.44(2)	4.33(3) 5.25(2)
231 232 233 234 235	64.24(2) 49.03(2) 49.03(2)	138.57(2) 27.21(2) 151.96(3)	18.38(2)	29.04(2)	101.38(2)	186.50(2) 56.50(2)	101.50(2)
235 236 Total weight (tons)	98.06(2) 106,834	77,127	32,064	80,140	28,319	69,623	45,119
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Table **2**. Gadus 2J: G. halibut average weight per set

						حميقا والمتعاد والمتعاد والمتعاد والمتعاد
Stratum	Gadus 12 1978	Gadus 15 1978	Gadus 27 1979	Gadus 29 1979	Gadus 42 1980	Gadus 44 1980
620	126.38(5)	24.13(7)	10.89(3)	37.32(7)	38.83(3)	24.80(9)
621	80.92(5)	159.03(7)	99.18(3)	120.09(8)	28.33(3)	54.42(10)
622	143.11(2)		119.44(3)		43.75(2)	
623	164.96(3)	154.06(3)		36.55(3)	27.50(2)	111.00(4)
624	5.45(4)	14.57(3)	9.87(2)	11.34(2)	9.00(2)	1.25(2)
625	13.63(3)	21.49(3)	18.82(2)	11.19(3)	23.00(2)	10.25(4)
626	72.58(3)	51.87(4)	52.85(2)	35.08(3)	82.00(2)	178.50(3)
627	71.67(2)		41.73(3)		68.50(2)	
628	51.25(2)	39.95(5)	11.49(3)	72.13(2)	131.50(2)	36.56(4)
629	32.51(3)	8.63(3)		13.38(2)	35.50(2)	19.83(3)
630	27.23(2)		10.44(2)	11.11(2)	31.50(2)	11.25(2)
631	45.42(2)		23.30(3)		34.50(3)	· · · · · ·
632	2.50(4)	4.15(3)	3.63(2)	2.04(2)	19.50(2)	3.88(2)
633	8.85(4)	7.49(5)	14.52(4)	5.41(6)	19.50(3)	14.64(7)
634	7.04(4)	5.72(5)	9.98(2)	9.26(6)	4.00(2)	5.80(5)
635	7.48(4)	6.06(5)	7.72(3)	5.17(5)	11.50(2)	23.13(4)
636	8.28(4)	1.97(3)	5.33(2)	4.40(5)	6.25(2)	14.00(5)
637	2.99(5)	5.11(4)	0.90(3)	6.58(4)	4.75(2)	6.63(4)
638	22.53(3)	10.73(5)	17.71(2)	11.97(7)	8.33(3)	12.50(6)
639	4.88(4)	5.33(5)	11.34(2)	4.31(2)	4.00(2)	7.88(4)
640	32.91(2)				59.25(2)	
641	5.45(2)		26.77(2)		31.75(2)	
642	18.63(2)				33.25(2)	
643	7.49(2)		12.94(2)			
644	15.22(2)		4.99(2)		10.00(0)	
645	18.61(2)		00.00(0)		12.00(2)	
646	59.24(2)		88.96(2)		51.50(2)	
647	160.23(2)		48.13(2)		89.25(2)	
648	15.46(2)					
649	10.91(2)					
Total weight (tons)	105,020	65,695	57,262	52,641	65,325	52,819

Table $\mathbf{3}$. Gadus 3K: G. halibut average weight per set

			· · · · · · · · · · · · · · · · · · ·	·····
Stratum	Gadus 12 1978	Gadus 21 1979	Gadus 25 1979	Gadus 36 1980
328 341 342 343 344 345 346 347 348 349 350 363	36.04(3) 27.69(2) 25.43(2) 15.45(3)	0.36(5) 1.77(4) 3.06(4) 3.43(4) 10.21(4) 11.94(3) 12.25(4) 6.22(7) 8.81(5) 0.00(8) 0.00(7)	48.99(4) 17.92(4) 4.08(2)	10.70(5) 30.25(4) 6.75(2) 11.63(4)
364 365 366 368 369 370 371 372 384 385	4.88(3) 11.80(2) 0.76(3)	$\begin{array}{c} 0.51(10)\\ 2.10(4)\\ 2.27(4)\\ 17.12(4)\\ 4.99(4)\\ 1.33(4)\\ 0.00(4)\\ 0.00(9)\\ 0.00(4)\\ 1.98(7) \end{array}$	0.45(2) 8.47(3) 2.72(2)	4.00(6) 2.75(2) 4.00(4)
386 387 388 389 390 391	2.42(3) 6.35(2) 2.72(2) 1.51(3) 2.88(2)	6.69(4) 6.95(4) 9.70(4) 6.69(4) 0.41(5) 3.70(3)	4.09(2) 10.34(5) 20.26(3) 4.99(2)	2.75(4) 2.83(3) 0.25(2) 4.50(2) 0.50(2)
392 729 730 731 732 733 734 735 736	5.22(2) 7.94(2) 14.53(2) 23.83(2) 41.54(2) 43.15(2) 75.91(2)	23.49(4)	12.70(3) 22.39(3) 36.29(3) 42.04(3) 42.18(2) 27.06(3) 31.15(3) 52.01(3) 62.29(3)	5.67(3) 9.75(2) 0.00(2) 8.25(2) 3.00(3) 9.50(2) 2.25(2)
Total weight (tons)	13,856	9,493	12,083	7,817
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Table $oldsymbol{4}$. Gadus 3L. G. halibut average weight per set

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Age	1975	1976	1977	1978	1979	1980
5	322	19	464	3016	2182	204
6	2719	680	4351	8511	7980	2032
7	5547	3600	9374	9072	11726	8913
8	4781	6030	6377	7662	5611	9429
9	3821	4199	2546	2898	1069	5258
10	1628	2457	879	1454	440	3729
11	677	923	191	731	262	987
12	130	290	113	371	136	125
13	269	113	101	225	131	52
14	131	36	26	110	84	14
15	63	21	18	58	76	9
16	41	1	22	54	56	2

Table 5. Greenland halibut. Catch matrix ('000's) 2+3KL 1975-80.

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Table 6. Average numbers caught per set for 2J+3K November surveys weighted by stratum area. Only common strata fished in each survey were used in the calculations.

Age Gadus 15 1978 Gadus 29 1979 Gadus 44 1980 Tota 1 0.63 0.55 0.22 1.44 2 3.57 3.60 0.75 7.93 3 7.23 5.23 1.79 14.22 4 8.98 5.61 3.59 18.16 5 12.80 10.58 8.63 32.07 6 10.57 9.07 15.19 34.83 7 6.80 3.31 8.05 18.10 8 1.83 0.79 1.78 4.44 9 0.59 0.29 0.43 1.31 10 0.36 0.35 0.27 0.99 11 0.45 0.13 0.34 0.9 12 0.28 0.12 0.20 0.66 13 0.13 0.12 0.08 0.33 14 0.07 0.03 0.07 0.11 15 0.02 0.01 0.01 0.02		
$\frac{1}{2} 0.63 \\ 2 3.57 \\ 3.60 \\ 0.75 \\ 7.93 \\ 4 8.98 \\ 5.61 \\ 3.59 \\ 12.80 \\ 6 10.57 \\ 9.07 \\ 15.19 \\ 34.83 \\ 0.79 \\ 1.78 \\ 4.44 \\ 9 \\ 0.59 \\ 0.29 \\ 0.43 \\ 10 \\ 0.36 \\ 0.35 \\ 0.27 \\ 0.90 \\ 11 \\ 0.45 \\ 0.13 \\ 0.13 \\ 0.13 \\ 0.12 \\ 0.28 \\ 0.12 \\ 0.20 \\ 0.01 \\ 0.$	Age Gadus 15 1978	Gadus 29 Gadus 44 Total 1979 1980
Catch curve <u>1978-80 (7+)</u> $r^{2} = 0.95$ Z = 0.60 F = 0.40 1978-80 (8+) $r^{2} = 0.95$ Z = 0.56 F = 0.36 $r^{2} = 0.36$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
$r^{2} = 0.95$ $Z = 0.56$ $F = 0.36$	Catch curve 1978-80 (7+) $r^2 = 0.95$ Z = 0.60 F = 0.40 1978-80 (8+)	$\frac{Z_{7+(1980)}}{6+(1979)} = 0.24$ F = 0.04 Fully recruited F = 0.20
	$r^2 = 0.95$ Z = 0.56 F = 0.36	

Age	Average length (cm)	Average weight (kg)	Average length (cm)	Average weight (kg)
	<u> 1975-79</u>	<u> 1975-79</u>	<u>1980</u>	1980
5	42.44	0.609	40.37	0.514
6	45.33	0.760	43.46	0.659
7	48.51	0.955	47.17	0.869
8	51.82	1.192	49.89	1.049
9	56.34	1.580	51.20	1.145
10	60.69	2.209	52.63	1.256
11	66.06	2.699	56.27	1.573
12	70.57	3.371	66.12	2.708
13	73.60	3.884	68.93	3.115
14	77.21	4.563	76.47	4.418
15	83.41	5.918	79.51	5.037
16	88.21	7.144	87.76	7.022
17	90.84	7.887	97.90	10.147

Table **7**. Greenland halibut, commercial 2+3KL, M+F, average weight at age 1975-79, 1980

F	Y/R (KG)	
0.001 0.050 0.100 0.200 0.250 0.300 0.350 0.400 0.450 0.500 0.550 0.600 0.750 0.800 0.750 0.800 0.900 0.950 1.000 1.050 1.100 1.150 1.200 1.250 1.300 1.350 1.400 1.550 1.500 1.550 1.600 1.650 1.700 1.750 1.800 1.950 2.000	0.0042 0.1814 0.3131 0.4084 0.4770 0.5260 0.5607 0.5850 0.6017 0.629 0.6245 0.6245 0.6268 0.6276 0.6268 0.6256 0.6241 0.6224 0.6224 0.6207 0.6189 0.6172 0.6189 0.6172 0.6183 0.6123 0.6188 0.6094 0.6094 0.6080 0.6088 0.6056 0.6045 0.6045 0.6045 0.6024 0.6024 0.6024 0.6024 0.6024 0.6024 0.6024 0.6024 0.6024 0.5998 0.5991 0.5964	

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Table 8. Summary of yield per recruit calculated from partial recruitment and average weight at age over ages 5 to 16.

Natural mortality = 0.20

No. of ages = 12 First age = 5

Age	Avg. wt.	P. rec.
5	609	0 021
6	760	0.108
7	955	0.329
.8	1192	0.690
9	1580	0.876
10	2209	1.000
11	2699	0.912
12	33/1	0.699
13	3884	0.696
14	4003	0.389
16	7144	0.144

 $F_{0,1}$ is 0.343 and Y/R is 0.5821 F_{max} is 0.669 and Y/R is 0.6277

(* 1. 1893) 1995 - 1995 1997 - 1997

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		POPL	LATION	NUMBERS		
	1975	1976	1977	1978	1979	1980
5	96120	112133	177951	244193	130510	53699
6 1	42852	78406	91790	145275	197205	104882
7	24700	32631	63579	71224	111261	154255
8	15243	15236	23471	43611	50139	80522
9	9364	8191	7077	13490	28809	35993
10	4355	4249	2963	3514	8438	22,622
11	1 1910	2107	1295	1637	1576	6512
12	694	957	900	888	687	1055
13	4287	451	524	635	395	440
14	1 2969	3267	268	338	319	206
15	1 476	2313	2642	196	178	185
16	1 92	333	1875	2147	108	- 78
17	1 1670	39	272	1515	1709	39
5+	204734	260313	374608	528664	531336	460488
6+	108613	148180	196656	284,470	400826	406789
7+	65761	69774	104867	139195	203621	301907
9.	1 11041	37143	41288	67971	92359	147652
, oʻi	1 41001	071.40	-12.00	w////	/ 4	
	1 41001	MEAN POPU	JLATION	BIOMASS	(кб) 2	21/ 5/81
	1 1975	MEAN FOFT 1976	JLATION 1977	BIOMASS 1978	(кс) <u>2</u> 1979	21/ 5/81 1980
	1975 	MEAN FOFU 1976 61888	11200 JLATION 1977 	1978 133897	(KG) 2 1979 71393	21/ 5/81
	1975 	1976 61888 53758	JLATION 1977 98086 61615	1978 133897 96910	(KG) 2 1979 71393 132887	21/ 5/81 1980 24966 61995
	1975 	61888 53758 26549	98086 61615 50586	1978 1978 133897 96910 57363	(KG) 2 1979 71393 132887 90787	24966 61995 117711
5 6 7 8	1 1975 52960 28507 1 18707 1 13534	61888 53758 26549 12683	98086 61615 50586 21482	1978 1978 133897 96910 57363 42555	(KG) 2 1979 71393 132887 90787 50870	24966 61995 117711 71674
5 6 7 8 9	1975 52960 28507 18707 13534 10228	61888 53758 26549 12683 8124	JLATION 1977 98086 61615 50586 21482 8041	1978 133897 96910 57363 42555 17012	(KG) 1979 71393 132887 90787 50870 40434	21/ 5/81 1980 24966 61995 117711 71674 34363
5 6 7 8 9 10	1 1975 52960 28507 1 18707 1 13534 1 10228 1 6839	61888 53758 26549 12683 8124 5491	19200 1977 98086 61615 50586 20586 20586 20482 8041 4938	1978 133897 96910 57363 42555 17012 5339	(KG) 1979 71393 132887 90787 50870 40434 16420	24966 61995 117711 71674 34363 23418
5 6 7 8 9 10 11	1 1975 52960 28507 1 18707 1 13534 1 10228 1 6839 1 3723	41888 53758 26549 12683 8124 5491 3831	19200 1977 98086 61615 50586 21482 8041 4938 2911	1978 133897 96910 57363 42555 17012 5339 2954	(KG) 1979 71393 132887 90787 50870 40434 16420 3503	24966 61995 117711 71674 34363 23418 8512
5 6 7 8 9 10 11 12	1 1975 52960 28507 1 18707 1 13534 1 10228 1 6839 1 3723 1 1902	61888 53758 26549 12683 8124 5491 3831 2423	19200 1977 98086 61615 50586 21482 8041 4938 2911 2563	1978 133897 96910 57363 42555 17012 5339 2954 2052	(KG) 1979 71393 132887 90787 50870 40434 16420 3503 1870	24966 61995 117711 71674 34363 23418 8512 2421
5 6 7 8 9 10 11 12 13	1975 52960 28507 18707 13534 10228 6839 3723 1902 14581	61888 53758 26549 12683 8124 5491 3831 2423 1366	19200 1977 98086 61615 50586 21482 8041 4938 2911 2563 1646	1978 133897 96910 57363 42555 17012 5339 2954 2052 1782	(KG) 1979 71393 132887 90787 50870 40434 16420 3503 1870 1128	24966 61995 117711 71674 34363 23418 8512 2421 1164
 5 6 7 8 9 10 11 12 13 14	1975 52960 28507 18707 13534 10228 6839 3723 1902 14581 11989	61888 53758 26549 12683 8124 5491 3831 2423 1366 13432	19200 1977 98086 61615 50586 21482 8041 4938 2911 2563 1646 1050	1978 133897 96910 57363 42555 17012 5339 2954 2052 1782 1138	(KG) 1979 71393 132887 90787 50870 40434 16420 3503 1870 1128 1123	24966 61995 117711 71674 34363 23418 8512 2421 1164 795
5 6 7 8 9 10 11 12 13 14 15	1975 52960 28507 13534 13534 10228 6839 3723 1902 14581 11989 2370	41888 53758 26549 12683 8124 5491 3831 2423 1366 13432 12346	19200 1977 98086 61615 50586 21482 8041 4938 2911 2563 1646 1050 14122	1978 133897 96910 57363 42555 17012 5339 2954 2052 1782 1138 875	(KG) 1979 71393 132887 90787 50870 40434 16420 3503 1870 1128 1123 716	24966 61995 117711 71674 34363 23418 8512 2421 1164 795 824
 5 6 7 8 9 10 11 12 13 14 15 16	1975 52960 28507 18707 13534 10228 6839 3723 1902 14581 11989 2370 441	MEAN FOFU 1976 61888 53758 26549 12683 8124 5491 3831 2423 1366 13432 12346 2154	19200 1977 98086 61615 50586 21482 8041 4938 2911 2563 1646 1050 14122 12062	1978 133897 96910 57363 42555 17012 5339 2954 2052 1782 1138 875 13716	(KG) 1979 71393 132887 90787 50870 40434 16420 3503 1870 1128 1128 1123 716 484	24966 61995 117711 71674 34363 23418 8512 2421 1164 795 824 488
5 6 7 8 9 10 11 12 13 14 15 16 17	1975 52960 28507 18707 13534 10228 6839 3723 1902 14581 1989 2370 441 11776	41888 53758 26549 12683 8124 5491 3831 2423 1366 13432 12346 2154 274	19200 1977 98086 61615 50586 21482 8041 4938 2911 2563 1646 1050 14122 12062 1917	1978 133897 96910 57363 42555 17012 5339 2954 2052 1782 1138 875 13716 10680	(KG) 1979 71393 132887 90787 50870 40434 16420 3503 1870 1128 1123 716 484 12050	24966 61995 117711 71674 34363 23418 8512 2421 1164 795 824 488 352
5 6 7 8 9 10 11 12 13 14 15 16 17 	1 1975 52960 28507 18707 13534 10228 6839 3723 1902 14581 1992 14581 11989 2370 441 11776 177556	1976 61888 53758 26549 12683 8124 5491 3831 2423 1366 13432 12346 2154 274 204319	19200 1977 98086 61615 50586 21482 8041 4938 2911 2563 1646 1050 14122 12062 1917 281019	1978 133897 96910 57363 4255 17012 5339 2954 2052 1782 1138 875 13716 10680 	(KG) 1979 71393 132887 90787 50870 40434 16420 3503 1870 1128 1123 716 484 12050 423665	24966 61995 117711 71674 34363 23418 8512 2421 1164 795 824 488 352 348683
5 6 7 8 9 10 11 12 13 14 15 16 17 5+ 6+	1 1975 1 52960 28507 18707 13534 10228 6839 3723 1 1581 1 14581 1 14581 1 1789 1 11776 1 177556 1 124596	41888 53758 26549 12683 8124 5491 3831 2423 1366 13432 12346 2154 274 204319 142431	19200 1977 98086 61615 50586 21482 8041 4938 2911 2563 1646 1050 14122 12062 1917 281019 182933	1978 133897 96910 57363 42555 17012 5339 2954 2052 1782 1138 875 13716 10680 386273 252376	(KG) 1979 71393 132887 90787 50870 40434 16420 3503 1870 1128 1123 716 484 12050 423665 352272	24966 61995 117711 71674 34363 23418 8512 2421 1164 795 824 488 352 348683 323717
5 6 7 8 9 10 11 12 13 14 15 16 17 5+ 6+ 7+	1975 52960 28507 18707 13534 10228 6839 3723 1902 14581 1989 2370 441 11776 127556 124596 96089	41976 61888 53758 26549 12683 8124 5491 3831 2423 1366 13432 12346 2154 274 204319 142431 88673	19200 1977 98086 61615 50586 21482 8041 4938 2911 2563 1646 1050 14122 12062 1917 281019 182933 121318	1978 1978 133897 96910 57363 42555 17012 5339 2954 2052 1782 1138 875 13716 10680 386273 252376 155466	(KG) 1979 71393 132887 90787 50870 40434 16420 3503 1870 1128 1123 716 484 12050 423665 352272 219385	24966 61995 117711 71674 34363 23418 8512 2421 1164 795 824 488 352 348683 323717 261722

TABLE 10.

FISHING MORTALITY

1	1975	1976	1977	1978	1979	1980
5 1	0,004	0.000	0.003	0.014	0.019	0.004
6 1	0.072	0.010	0.054	0.067	0.046	0.022
· 7 I	0.283	0.129	0.177	0.151	0.123	0.066
8 1	0.421	0.567	0.354	0.215	0.131	0.138
91	0.590	0.817	0.500	0.269	0.042	0.175
10 1	0.526	0.988	0.393	0.602	0.059	0.200
11.1	0.491	0,650	0.177	0.668	0.202	0.182
12 1	0.230	0.404	0.149	0.610	0.245	0.140
13 1	0.072	0.321	0.238	0.490	0.451	0.139
14	0.050	0.012	0.113	0.441	0.341	0.078
15:1	0.157	0.010	0.008	0.392	0.628	0.055
16 1	0.664	0.003	0.013	0.028	0.826	0.029
17 1	0.029	0.029	0.029	0.029	0.029	0.029
·						
5+1	0.129	0.102	0.081	0.078	0.065	0.078

Terminal F	GM Age 5 1975-1979 ('000's)	*Catch at F _{0,1} = 0.343 1982 (MT)
0.10	254,601	155,716
0.15	180,769	98,973
0.20	143,630	70,629
0.25	121,200	53,648
0.30	106,142	42,353
0.35	95,310	34,309
0.40	87,129	28,300

Table 11. Greenland halibut catch projections 1982

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*Assuming the TAC of 55,000 MT is taken in 1981.

TABLE 12 FOPULI	ATION NUMBERS
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ľ	1980	1981	1982	1983	
5 1	143630	143630	143630	143630	• • •
6 1	104882	117410	116912	116750	
7 1	154255	84035	93292	92238	
8 1	80522	118251	62806	68231	
9 1	35993	57428	79963	40584	
10 1	22622	24733	36883	48478	
11	6512	15164	15348	21429	
12	1055	4443	9642	9190	
13 1	440	751	2997	6211	
14 1	206	313	507	1932	
15	185	156	230	363	
16 1	78	143	118	172	
17	39	62	113	92	
5+1	550419	566519	562441	549301	
6+1	406789	422889	418811	405671	
7+1	301907	305479	301900	288921	
8+1	147652	221444	208607	196683	
	FOP	ULATION	BIOMASS	(AVERAGE)	:

		PO	PULATI	101	BI	OMASS	(AV	ERAGE)	22/	5	/81
		1	980		1	981		1982		1	983
51	r	66861	• 06	66	723	•87	666	79.35	666	579	.35
7 1	1	17711	•54	63	355	• 49	696	14.87	686	328	• 32
9 1		/16/3 34363	•64 1 •27	102 53	657 127	•13 •51	533	82.63	579	773 560	• 27 • 40
10 11		23418 8512	•19 •39	24 19	703 183	•55 •51	357 188	45.56	469	83 870	.06 .58
12		2422	•21 •25	9	744 734	•84 •78	211 75	26.57	201 156	136 562	.37
14 15		794 822	• 62 • 47	1	191 686	•69 •71	19	05.02	72	260 185	.14
16 1		489	• 60 • 7 4	. (894 559	•91	7	35.65	10	066	.58
+	3	90579	.72 4	140	184	. 03	4182	80.13	4184	57	
6+1	3	23718	• 6 6 3	347	362	.15	3516	00.78	3517	74	.17
8+1	1	44012	• 7 3 2	2148	384	.47	2030	91.80	2832	4	+ 84 - 52

TABLE 13

CATCH NUMBERS ____ 6 1 7 1 8 1 9 1 10 1 11 | 12 1 13 1 1.20 14 1 15 | 16 I 17 | ---+ -- -- -- -- --- ---5+1 30755 49936 60831 57720 6+1 7+1 8+1 47001 43997 CATCH BIOMASS 22/ 5/81 6 1 7 T 8 1 9 | 10985 ... 10 1 11 1 12 1 13 | 14 I 15 | 16 1 17 | ---+ ------------5+1 6+1

7+1

8+1

22779 46766





