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The Greenland Halibut Fishery in NAFO Subarea 2 and  
Divisions 3KL

by

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The Fishery

Nominal catches ranged from 25,000-30,000 t during 1971-76, increased to 38,000 t in 1978 and subsequently declined to a level of 28,000 t in 1981 (Table 1). Despite the decline in overall catch since 1978 catches in the Canada (Nfld.) inshore gillnet fishery, particularly in Division 3KL, increased steadily from 7,000 t in 1976 to 27,000 t in 1980. The gillnet catch subsequently decreased to 18,000 t in 1981, however, this decrease was attributed mainly to socio-economic problems connected with local fishing industry in 1981. During 1981, one third of the landings were taken by otter trawlers. This increase was mainly due to Greenland halibut allocations to Poland and the Soviet Union as well as a diversion of Canadian offshore fishing effort towards Greenland halibut from the Div. 2J3KL cod fishery which closed in February. The Canadian otter trawlers accounted for over 5,000 t of the 1981 catch by the end of May, however, preliminary landing statistics for 1982 indicate that this portion of the effort has only taken 1,000 t over the same time frame.

Biomass Surveys

Stratified random biomass surveys were continued in 1981 in Div. 2J, 3K, and 3L similar to those discussed in NAFO SCR Doc. 81/VI/64. For the area surveyed in Div. 2J the minimum biomass estimated was about 77,000 t (Table 2). For similar strata, this shows a 28% decrease from the estimated biomass in the 1977 survey where coverage was complete.

In Div. 3K the estimated minimum biomass was about 78,000 t compared to 65,000 t for similar coverage in 1980. It also indicates a decrease of 26% in biomass from the 1978 (*Gadus* 12) survey where coverage was complete.

For surveys in Div. 3L (Table 4) the coverage was incomplete particularly in deeper strata where Greenland halibut are likely to be more abundant. For the area covered in two 1981 surveys the biomass was estimated between 7000 t and 13,000 t. However, fluctuations are likely to occur since the estimates are very dependent on few strata.

The most recent estimate of minimum biomass for the area covered in Div. 2J3KL is therefore about 167,000 t.

For surveys in Div. 2J+3K since 1978, the numbers-at-age per set are presented in Table 5. These numbers are weighted according to stratum area.

Commercial Data

Numbers at age - The numbers caught at age for 1975-80 were taken directly from NAFO SCR Doc. 81/VI/64. The 1981 numbers-at-age were calculated in the usual way from the samples collected by the Canadian Commercial Groundfish Sampling Section at the Northwest Atlantic Fisheries Center (Table 5). The fishery is very dependent on 4 age groups where 93% of the total landings (by number) are taken from ages 6-9. More than 65% of the landings have been taken from the 1973 and 1974 year-classes both of which have made significant contributions to the fishery since entry at age 5.

### Partial Recruitment

Partial recruitment was calculated by comparing the age composition from the 1980 survey (when commercial fishing was essentially complete) adjusted ahead by 1 age group to the 1981 commercial age composition (Fig. 1). The curve is clearly dome shaped with fish beyond 10 years old unavailable to the fishery. This is not unexpected since the fishery is mainly by nearshore gillnets and by trawlers fishing on the shelf with little fishing carried out on the continental slope where the larger fish are found.

### Fishing Mortality

With the lack of effort data and with such a short time series of research vessel data it was not possible to calculate a reliable estimate of fishing mortality in 1981. The only independent estimate of fishing mortality available however, was calculated from estimates of survival at age between the 1980 and 1981 fall surveys (Table 7). The F for the two fully-recruited age groups (Fig. 1) was calculated at  $F=0.26$ . The total F over the 7+ age groups was  $F=0.39$  with F for ages 7-10 equal to  $F=0.26$ .

It was concluded by the Committee in 1981 that estimates of terminal F used in VPA calculated in this manner were not reliable due to high variances in abundance indices. However, using the estimates in Table 7 as reference points VPA runs were produced for fully-recruited values of F from 0.20 to 0.40 at increments of  $F=0.05$ . The results of the respective runs are shown in Tables 9-13. The average weights at age used in the biomass calculations are shown in Table 8.

Using the partial recruitment pattern in Fig. 1. and the 1981 average weights in 1981 the calculated value of  $F_{0.1}=0.58$ . However, under average exploitation patterns the  $F_{0.1}=0.34$  (see NAFO SCR Doc. 81/VI/64).

### References

BOWERING, W. R., and W. B. BRODIE. 1981. Stock assessment of Greenland halibut in NAFO Subarea 2 and Divisions 3KL with projected catches for 1982. NAFO SCR Doc. 81/VI/64, Serial No. N348, 17 p.

Table 1. Greenland halibut landings (MT), by country, by year, 2+3KL.

Country	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
CAN (MQ)	2				25	221	229	1,182	1,863	294	
CAN (N)	9,406	8,952	6,840	5,745	7,782	9,085	17,738	23,205	28,077	30,545	23,516
CUBA											
DEN (F)	970	950	4				350	268			
DEN (G)		65		2							
DEN (M)											
FRA (M)			5								
FRA (St. P)			6	48	32						
FRG	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	2										
JAP							3				
NOR	1,389	501	117		6	15	3		8		
POL	5,234	6,986	9,060	7,105	8,447	5,942	5,998	5,215	1,813	203	1,788
POR		207		161	231	73	119		38		
ROM	7	120	80					3			
SPA		3			1						
USSR	9,094	10,183	8,662	9,650	9,439	6,799	4,308	5,613	1,961	238	2,886
UK		731	201	1,112	62	476	53				
Other	647								32		
Totals	24,392	29,822	28,954	27,123	28,681	24,598	31,941	38,203	33,930	31,539	28,190 <sup>a</sup>

<sup>a</sup>provisional

Table 2. *Gadus* 2J - *G. halibut* average weight per set.

Stratum	Gadus							
	3 1977	12 1978	15 1978	27 1979	29 1979	42 1980	44 1980	58 1981
201	7.26(2)		1.36(3)		0.45(2)		2.83(3)	2.70(5)
202	21.34(2)	7.59(2)	25.20(2)	36.51(2)	7.48(2)	7.00(2)	51.00(2)	34.50(2)
203	31.55(2)	40.82(2)		87.09(2)		16.50(2)	25.75(2)	52.00(2)
204	175.70(2)	484.68(2)		260.36(2)				170.50(2)
205	20.97(4)		6.58(4)		10.21(2)		3.75(4)	14.94(8)
206	20.80(11)		7.78(7)		8.11(8)		10.11(7)	37.18(11)
207	77.77(5)		25.54(4)		10.39(5)		6.90(5)	18.22(9)
208	186.14(4)	90.26(2)	183.12(3)	53.97(2)	127.46(2)	110.00(2)	189.25(2)	240.75(2)
209	65.25(7)	34.70(2)	15.66(4)	190.51(2)	47.61(5)	25.50(2)	144.37(4)	55.67(6)
210	19.41(6)	13.62(3)	5.20(4)	14.97(2)	4.09(2)	21.75(2)	3.50(3)	5.00(3)
211	34.96(2)	105.69(2)	64.92(2)	57.65(2)	36.28(2)	133.00(2)	32.70(3)	35.75(2)
212	189.61(4)	150.82(2)		232.24(2)		103.50(2)		147.75(2)
213	16.46(8)	7.26(3)	17.59(4)	10.59(3)	8.84(4)	41.67(3)	11.70(5)	29.33(6)
214	38.97(6)	22.07(3)	67.76(4)	40.18(2)	12.93(4)	21.50(2)	11.33(3)	60.10(5)
215	37.68(4)	1.86(3)	34.14(5)	5.34(2)	8.00(4)	14.00(2)	23.00(2)	12.30(5)
216	102.83(2)	170.78(2)		251.14(2)	111.58(2)	235.00(2)	137.50(2)	63.25(2)
217	141.95(3)	168.28(2)		87.15(2)		156.00(2)		41.00(2)
218	217.92(2)	238.14(2)				129.50(2)		156.50(2)
219								48.00(2)
220		56.92(2)						
221								
222	115.32(4)	98.20(2)	42.07(3)	144.98(2)	8.39(2)	164.50(2)	16.25(2)	55.75(2)
223	251.52(2)	84.82(2)		63.99(2)		36.00(2)		94.75(2)
224	173.65(2)	78.70(2)		122.47(2)		32.75(2)		115.00(2)
225	39.95(2)		3.18(2)					
226								
227	115.32(4)	86.86(2)		27.47(2)		73.75(2)		43.50(2)
228	6.53(8)	2.19(3)		15.43(2)	4.88(4)	39.50(2)	4.33(3)	8.00(6)
229	39.03(4)	9.28(2)	19.52(2)	19.29(2)	28.35(2)	46.00(2)	5.25(2)	30.50(2)
230	243.28(3)	80.74(2)				169.44(2)		60.25(2)
231	64.24(2)	138.57(2)				186.50(2)		
232	49.03(2)	27.21(2)						
233								
234	49.03(2)	151.96(3)	18.38(2)	29.04(2)	101.38(2)	56.50(2)	101.50(2)	52.00(2)
235	117.59(4)	107.05(2)		83.99(2)		128.00(2)		39.00(2)
236	98.06(2)							44.75(2)
Total Weight (tons)	106,834	77,127	32,064	80,140	28,319	69,623	45,119	76,661

Table 3. Gadus 3K - G. halibut average weight per set.

Stratum	Gadus						
	12 1978	15 1978	27 1979	29 1979	42 1980	44 1980	58&59 1981
620	126.38(5)	24.13(7)	10.89(3)	37.32(7)	38.83(3)	24.80(9)	25.72(10)
621	80.92(5)	159.03(7)	99.18(3)	120.09(8)	28.33(3)	54.42(10)	32.72(11)
622	143.11(2)		119.44(3)		43.75(2)		132.50(2)
623	164.96(3)	154.06(3)		36.55(3)	27.50(2)	111.00(4)	83.33(4)
624	5.45(4)	14.57(3)	9.87(2)	11.34(2)	9.00(2)	1.25(2)	3.75(2)
625	13.63(3)	21.49(3)	18.82(2)	11.19(3)	23.00(2)	10.25(4)	31.50(4)
626	72.58(3)	51.87(4)	52.85(2)	35.08(3)	82.00(2)	178.50(3)	58.20(5)
627	71.67(2)		41.73(3)		68.50(2)		189.75(6)
628	51.25(2)	39.95(5)	11.49(3)	72.13(2)	131.50(2)	36.56(4)	16.33(6)
629	32.51(3)	8.63(3)		13.38(2)	35.50(2)	19.83(3)	31.33(3)
630	27.23(2)		10.44(2)	11.11(2)	31.50(2)	11.25(2)	117.25(2)
631	45.42(2)		23.30(3)		34.50(3)		68.60(5)
632	2.50(4)	4.15(3)	3.63(2)	2.04(2)	19.50(2)	3.88(2)	6.25(2)
633	8.85(4)	7.49(5)	14.52(4)	5.41(6)	19.50(3)	14.64(7)	9.98(8)
634	7.04(4)	5.72(5)	9.98(2)	9.26(6)	4.00(2)	5.80(5)	5.41(7)
635	7.48(4)	6.06(5)	7.72(3)	5.17(5)	11.50(2)	23.13(4)	12.00(5)
636	8.28(4)	1.97(3)	5.33(2)	4.40(5)	6.25(2)	14.00(5)	12.75(6)
637	2.99(5)	5.11(4)	0.90(3)	6.58(4)	4.75(2)	6.63(4)	8.25(6)
638	22.53(3)	10.73(5)	17.71(2)	11.97(7)	8.33(3)	12.50(6)	21.31(8)
639	4.88(4)	5.33(5)	11.34(2)	4.31(2)	4.00(2)	7.88(4)	7.38(6)
640	32.91(2)				59.25(2)		36.00(2)
641	5.45(2)		26.77(2)		31.75(2)		21.80(2)
642	18.63(2)				33.25(2)		9.33(3)
643	7.49(2)		12.94(2)				
644	15.22(2)		4.99(2)				
645	18.61(2)				12.00(2)		21.75(2)
646	59.24(2)		88.96(2)		51.50(2)		63.25(2)
647	160.23(2)		48.13(2)		89.25(2)		82.50(2)
648	15.46(2)						
649	10.91(2)						
Total weight (tons)	105,020	65,695	57,262	52,641	65,325	52,819	77,966

Table 4. A.T. Cameron 3L - G. halibut average weight per set.

Stratum	ATC					
	262 1977	276 1978	290 1979	304-305 1980	317-318 1981	323-325 1981
328	0.05(3)		0.14(5)		1.30(2)	
341	0.51(4)	0.01(4)	1.26(6)	0.29(6)	0.00(2)	0.50(3)
342	0.00(2)	0.00(2)	1.19(4)	0.88(4)		1.33(3)
343	0.11(2)	0.00(3)	1.31(4)	0.50(4)	0.00(2)	0.88(4)
344	10.84(4)	14.30(4)	14.53(2)	2.68(3)	3.90(5)	6.94(4)
345	122.37(4)	59.47(2)	13.62(4)	12.10(5)	5.70(4)	20.75(4)
346	9.34(3)		6.30(4)	6.00(3)	6.83(3)	9.00(3)
347	3.40(3)	1.48(4)	4.43(4)	6.50(5)	0.24(4)	1.83(3)
348	0.92(6)	2.31(6)	3.14(6)	5.29(7)	1.31(7)	0.42(6)
349	0.26(6)	0.23(6)	1.95(7)	2.01(9)	0.22(4)	0.09(7)
350	0.00(4)	0.00(6)	0.00(9)	0.00(10)	0.00(3)	0.00(6)
363	0.00(5)	0.00(5)	0.00(8)	0.00(5)	0.00(3)	0.00(4)
364	0.02(7)	0.15(6)	0.48(8)	0.42(6)	0.25(2)	0.49(9)
365	0.53(3)	0.00(2)	2.39(4)	1.32(4)		2.88(4)
366	4.61(4)		1.36(4)	5.38(4)	0.00(3)	5.00(3)
368	15.28(3)		9.08(4)	12.00(2)	8.50(2)	21.50(2)
369	19.28(3)	3.40(2)	6.13(4)	2.83(3)	19.00(2)	13.25(2)
370	0.00(3)	0.58(3)	1.36(4)	2.17(3)	0.00(2)	0.00(4)
371	0.00(3)	0.00(3)	0.00(3)	0.00(3)	0.00(2)	0.01(4)
372	0.00(6)	0.00(7)	0.00(9)	0.00(6)	0.00(4)	0.00(5)
384	0.00(2)	0.00(3)	0.00(4)	0.00(2)	0.00(2)	
385	1.02(6)	0.00(6)	1.17(7)	2.25(4)	1.83(3)	0.26(8)
386	9.99(3)	1.74(3)	2.56(4)	4.83(3)	12.50(2)	37.00(3)
387	15.66(2)	3.78(3)	3.06(4)	1.63(2)	20.50(2)	67.50(2)
388	6.36(2)	2.50(2)	4.92(3)	5.25(2)	7.50(2)	
389	1.06(3)	1.59(3)	3.63(4)	4.83(3)	6.00(2)	
390	0.68(2)	0.00(4)	0.54(5)	0.00(3)	0.00(2)	0.00(3)
391	3.00(2)	1.02(2)	5.10(4)	9.75(2)	4.25(2)	
392	3.63(2)	2.04(3)	15.59(3)	9.50(2)	14.25(2)	
729						
730						
731						
732						
733						
734						
735					3.45(2)	
736						
Total weight (tons)	19,966	9,387	7,398	6,789	6,781	12,722

Table 5. Average numbers caught per set for 2J+3K November surveys weighted by stratum area. Only common strata fished in each survey were used in calculations.

Age	Gadus	Gadus	Gadus	Gadus
	15 1978	29 1979	44 1980	58-59 1981
1	0.63	0.55	0.22	1.60
2	3.57	3.60	0.75	3.15
3	7.23	5.23	1.79	5.49
4	8.98	5.61	3.59	4.88
5	12.80	10.58	8.63	7.00
6	10.57	9.07	15.19	7.48
7	6.80	3.31	8.05	5.02
8	1.83	0.79	1.78	2.17
9	0.59	0.29	0.43	0.84
10	0.36	0.35	0.27	0.37
11	0.45	0.13	0.34	0.26
12	0.28	0.12	0.20	0.09
13	0.13	0.12	0.08	0.05
14	0.07	0.03	0.07	0.02
15	0.02	0.01	0.01	0.01
16	0.04	0.01	0.01	0.01
17	0.02			

Table 6. Greenland halibut. Catch matrix ('000's) 2+3KL  
1975-81.

Age	1975	1976	1977	1978	1979	1980	1981
5	322	19	464	3016	2182	204	763
6	2719	680	4351	8511	7980	2032	3996
7	5547	3600	9374	9072	11726	8913	8675
8	4781	6030	6377	7662	5611	9429	10130
9	3821	4199	2546	2898	1069	5258	3811
10	1628	2457	879	1454	440	3729	788
11	677	923	191	731	262	987	226
12	130	290	113	371	136	125	125
13	269	113	101	225	131	52	38
14	131	36	26	110	84	14	25
15	63	21	18	58	76	9	19
16	41	1	22	54	56	2	12
17	43	1	7	39	44	1	5

Table 7. Population abundance ('000's) from common strata (2J+3K) in surveys during 1980-81.

Age	GADUS 42 1980	GADUS 58-59 1981	
1	2,772	4,030	
2	9,134	13,795	
3	19,446	23,217	
4	20,477	16,114	
5	20,229	23,128	
6	20,634	30,880	$F_{8-9} = 0.26$
7	15,362	22,315	
8	6,791	9,653	
9	3,616	4,272	
10	2,989	2,363	
11	2,849	1,937	
12	2,102	918	$F_{7-10} = 0.26$
13	1,611	532	
14	671	250	
15	353	142	
16	187	19	
17	49		

Table 8. Greenland halibut, commercial 2+3KL, M+F, average weight at age 1975-79, 1980 and 1981.

Age	Average length (cm)	Average weight (kg)	Average length (cm)	Average weight (kg)	Average length (cm)	Average weight (kg)
	1975-79	1975-79	1980	1980	1981	1981
5	42.44	0.609	40.37	0.514	37.25	0.392
6	45.33	0.760	43.46	0.659	42.21	0.598
7	48.51	0.955	47.17	0.869	45.84	0.789
8	51.82	1.192	49.89	1.049	48.97	0.985
9	56.34	1.580	51.20	1.145	52.36	1.235
10	60.69	2.209	52.63	1.256	57.58	1.700
11	66.06	2.699	56.27	1.573	64.26	2.460
12	70.57	3.371	66.12	2.708	71.40	3.507
13	73.60	3.884	68.93	3.115	78.35	4.794
14	77.21	4.563	76.47	4.418	83.42	5.944
15	83.41	5.918	79.51	5.037	91.41	8.055
16	88.21	7.144	87.76	7.022	93.56	8.710
17	90.84	7.887	97.90	10.147	96.23	9.576

TABLE 9. VPA run - Full recruited.  $F = 0.25$ .

### POPULATION NUMBERS

AGE		1975	1976	1977	1978	1979	1980	1981
5	1	78657	78815	101493	140682	115663	86995	70561
6	1	97845	64108	64511	82677	112457	92727	71041
7	1	45256	77654	51873	48892	60017	84873	74083
8	1	31732	32053	60329	34033	31865	38588	61454
9	1	16259	21674	20817	43644	20975	21038	23119
10	1	6957	9877	13967	14749	33118	16208	12500
11	1	2075	4233	5879	10642	10765	26718	9918
12	1	892	1092	2636	4641	8054	8577	20984
13	1	11340	613	634	2056	3465	6471	6909
14	1	8088	9041	400	428	1480	2718	5251
15	1	1229	6503	7370	304	251	1136	2213
16	1	180	949	5305	6018	197	138	922
17	1	4767	111	776	4324	4878	111	111
5+	1	305276	306723	335989	393089	403186	386298	359067
6+	1	226619	227908	234496	252407	287523	299303	288506
7+	1	128774	163800	169985	169730	175065	206576	217464
8+	1	83518	86146	118112	120839	115048	121703	143381
9+	1	51787	54093	57783	86805	83183	83115	81927
10+	1	35528	32419	36966	43161	62208	62077	58808

**POPULATION BIOMASS (MID-YEAR)**

AGE		1975	1976	1977	1978	1979	1980	1981
5	+	43321	43497	55884	76760	63198	40477	24925
6	+	66394	43909	42819	53765	74495	54734	37338
7	+	36553	65539	40424	37983	46333	63032	49598
8	+	31450	31030	61432	32160	31085	31676	49890
9	+	20230	27712	27822	60260	29213	18779	23533
10	+	12111	17022	27015	27949	65836	16085	18606
11	+	4133	9099	14130	25068	25989	37336	21964
12	+	2507	2839	7867	13565	24384	20887	66633
13	+	39412	1938	2035	6806	11949	18191	29963
14	+	33157	37313	1597	1514	5935	10856	28234
15	+	6408	34821	39479	1459	1117	5165	16110
16	+	1020	6141	34276	38778	1070	869	7258
17	+	33914	789	5521	30759	34703	1015	959
5+	+	330611	321649	360301	406827	415308	319101	375011
6+	+	287291	278152	304417	330067	352110	278624	350086
7+	+	220896	234243	261598	276302	277615	223889	312749
8+	+	184343	168704	221174	238319	231282	160857	263150
9+	+	152893	137674	159742	206160	200197	129181	213260
10+	+	132663	109662	131919	145899	120984	110403	189727

#### FISHING MORTALITY

TABLE 10. VPA run - Fully recruited.  $F = 0.25$ .

#### POPULATION NUMBERS

AGE		1975	1976	1977	1978	1979	1980	1981
5	+	72088	72227	92140	120384	95006	70173	56531
6	+	83918	58730	59117	75018	95839	75814	57269
7	+	40667	66251	47470	44476	53749	71269	60237
8	+	28245	28298	50993	30431	28254	33461	50318
9	+	14788	18821	17745	36003	18031	18084	18930
10	+	6345	8675	11634	12235	26863	13798	10086
11	+	2075	3732	4896	8732	8707	21597	7948
12	+	892	1092	2226	3836	6490	6892	16791
13	+	11340	613	634	1721	2806	5191	5530
14	+	8088	9041	400	428	1206	2179	4203
15	+	1229	6503	7370	304	251	912	1772
16	+	180	949	5305	6018	197	138	738
17	+	4767	111	776	4324	4878	111	111
5+	+	274620	275043	300707	343911	342276	319619	290463
6+	+	202532	202816	208567	223528	247271	249445	233933
7+	+	118615	144086	149450	148509	151432	173631	176664
8+	+	77948	77835	101980	104033	97683	102362	116427
9+	+	49703	49537	50987	73601	69430	68901	66109
10+	+	34915	30716	33241	37598	51399	50817	47179

POPULATION BIOMASS (MID-YEAR)

AGE		1975	1976	1977	1978	1979	1980	1981
5	+	39695	39861	50721	65556	51795	32640	19940
6	+	56800	40204	39102	48483	63041	44632	29870
7	+	32575	55667	36597	34145	40880	52303	39679
8	+	27672	26954	51333	28242	27168	26760	39912
9	+	18108	23606	23416	49313	24996	15685	18826
10	+	10876	14593	22341	22910	53313	13320	14884
11	+	4133	7866	11726	20393	20956	30033	17571
12	+	2507	2839	6616	11106	19606	16752	53306
13	+	39412	1938	2035	5624	9631	14576	23970
14	+	33157	37313	1597	1514	4800	8697	22587
15	+	6408	34821	39479	1459	1117	4140	12888
16	+	1020	6141	34276	38778	1070	869	5807
17	+	33914	789	5521	30759	34703	1015	959
5+	+	306277	292593	324760	358282	353076	261422	300200
6+	+	266582	252731	274039	292726	301281	228781	280260
7+	+	209782	212527	234937	244243	238240	184149	250390
8+	+	177207	156860	198340	210098	197360	131847	210711
9+	+	149535	129906	147007	181857	170192	105087	170799
10+	+	131427	106300	123591	132544	145196	89402	151923

FISHING MORTALITY

TABLE 11. VPA run - Fully recruited.  $F = 0.30$ .

### POPULATION NUMBERS

AGE		1975	1976	1977	1978	1979	1980	1981
5	+	67704	67831	85909	106874	81246	58961	47177
6	+	74631	55140	55518	69918	84778	64549	48089
7	+	37606	58648	44531	41530	49574	62215	51013
8	+	25919	25793	44769	28028	25844	30048	42909
9	+	13806	16918	15697	30909	16067	16114	16143
10	+	5936	7872	10078	10559	22693	12190	8478
11	+	2075	3398	4241	7459	7335	18182	6634
12	+	892	1092	1953	3300	5447	5769	13996
13	+	11340	613	634	1497	2367	4337	4611
14	+	8088	9041	400	428	1023	1820	3504
15	+	1229	6503	7370	304	251	762	1478
16	+	180	949	5305	6018	197	138	616
17	+	4767	111	776	4324	4878	111	111
5+	+	254171	253910	277182	311147	301702	275195	244757
6+	+	186468	186079	191272	204273	220456	216234	197580
7+	+	111837	130939	135754	134355	135677	151685	149491
8+	+	74231	72291	91223	92826	86104	89470	98478
9+	+	48312	46498	46455	64798	60260	59423	55569
10+	+	34506	29580	30757	33888	44193	43309	39426

**POPULATION BIOMASS (MID-YEAR)**

AGE		1975	1976	1977	1978	1979	1980	1981
5	+	37275	37435	47282	58099	44200	27417	16616
6	+	50402	37731	36621	44965	55416	37903	24892
7	+	29919	49084	34041	31581	37245	45158	33066
8	+	25150	24232	44595	25623	24552	23477	33260
9	+	16689	20862	20475	42012	22182	13614	15689
10	+	10050	12969	19224	19549	44963	11470	12404
11	+	4133	7042	10124	17275	17600	25165	14643
12	+	2507	2839	5781	9466	16421	13996	44422
13	+	39412	1938	2035	4836	8086	12167	19975
14	+	33157	37313	1597	1514	4043	7258	18823
15	+	6408	34821	39479	1459	1117	3456	10740
16	+	1020	6141	34276	38778	1070	869	4839
17	+	33914	789	5521	30759	34703	1015	958
5+	+	290038	273196	301052	325915	311597	222963	250326
6+	+	252763	235761	253770	267816	267397	195546	233709
7+	+	202361	198030	217149	222852	211981	157643	208818
8+	*	172441	148946	183108	191271	174737	112485	175752
9+	+	147291	124714	138512	165648	150185	89009	142492
10+	+	130602	103852	118037	123636	128003	75395	126803

#### FISHING MORTALITY

TABLE 12. VPA run - Fully recruited. F = 0.35.

### **POPULATION NUMBERS**

AGE	1	1975	1976	1977	1978	1979	1980	1981
5	1	64568	64688	81465	97244	71428	50954	40496
6	1	67996	52573	52945	66278	76894	56511	41533
7	1	35418	53216	42429	39423	46595	55761	44433
8	1	24256	24003	40322	26309	24121	27613	37628
9	1	13104	15558	14234	27270	14662	14705	14156
10	1	5644	7299	8967	9362	19715	11040	7329
11	1	2075	3159	3773	6549	6356	15744	5696
12	1	892	1092	1758	2917	4703	4967	11999
13	1	11340	613	634	1337	2054	3728	3954
14	1	8088	9041	400	428	892	1563	3005
15	1	1229	6503	7370	304	251	655	1267
16	1	180	949	5305	6018	197	138	528
17	1	4767	111	776	4324	4878	111	111
5+	1	239556	238804	260376	287764	272747	243490	212135
6+	1	174988	174117	178912	190519	201319	192536	171639
7+	1	106992	121544	125967	124241	124425	136025	130106
8+	1	71574	68328	83539	84818	77830	80264	85673
9+	1	47318	44326	43217	58509	53708	52650	48045
10+	1	34214	28768	28983	31239	39046	37945	33889

POPULATION BIOMASS (MIP-YEAR)

AGE		1975	1976	1977	1978	1979	1980	1981
5	+	35544	35700	44829	52783	38780	23687	14243
6	+	45831	35963	34848	42454	49980	33101	21336
7	+	28021	44380	32211	29747	34648	40063	28342
8	+	23347	22284	39779	23746	22680	21128	28509
9	+	15674	18899	18373	36796	20170	12128	13447
10	+	9459	11804	14997	17146	38999	10143	10632
11	+	4133	6452	8979	15047	15203	21687	12551
12	+	2507	2839	5185	8294	14146	12027	38076
13	+	39412	1938	2035	4272	6982	10445	17121
14	+	33157	37313	1597	1514	3502	6230	16134
15	+	6408	34821	39479	1459	1117	2968	9206
16	+	1020	6141	34276	38778	1070	869	4148
17	+	33914	789	5521	30759	34703	1015	957
5+	+	278427	259322	284109	302795	281979	195490	214701
6+	+	242883	223623	239280	250012	243199	171804	200458
7+	+	197052	187660	204432	207558	193220	138702	179123
8+	+	169031	143280	172221	177812	158572	98640	150781
9+	+	145684	120996	132442	154065	135892	77512	122272
10+	+	130010	102097	114069	117269	115722	65384	108625

#### FISHING MORTALITY

TABLE 13. VPA run - Fully recruited.  $F = 0.40$ .

### **POPULATION NUMBERS**

AGE	+	1975	1976	1977	1978	1979	1980	1981
5	+	62213	62326	78136	90039	64074	44950	35485
6	+	63018	50645	51013	63554	70995	50489	36618
7	+	33776	49141	40850	37842	44365	50933	39503
8	+	23009	22659	36986	25018	22829	25791	33678
9	+	12577	14538	13136	24541	13609	13648	12670
10	+	5424	6869	8133	8464	17481	10178	6467
11	+	2075	2980	3422	5866	5621	13915	4993
12	+	892	1092	1612	2630	4144	4365	10502
13	+	11340	613	634	1218	1819	3270	3461
14	+	8088	9041	400	428	794	1371	2631
15	+	1229	6503	7370	304	251	575	1110
16	+	180	949	5305	6018	197	138	462
17	+	4767	111	776	4324	4878	111	111
5+	+	228587	227468	247773	270245	251057	219734	187690
6+	+	166375	165140	169637	180206	186983	174784	152205
7+	+	103356	114496	118624	116652	115988	124294	115587
8+	+	69580	65355	77774	78810	71622	73361	76084
9+	+	46572	42696	40788	53792	48794	47570	42406
10+	+	33995	28158	27652	29251	35185	33922	29737

**POPULATION BIOMASS (MID-YEAR)**

AGE		1975	1976	1977	1978	1979	1980	1981
5	+	34244	34397	42992	48806	34720	20890	12462
6	+	42402	34635	33516	40573	45912	29505	18669
7	+	26595	40851	30837	28369	32702	36248	24799
8	+	21992	20821	36164	22336	21273	19364	24945
9	+	14910	17423	16794	32882	18660	11009	11766
10	+	9014	10928	15326	15343	34526	9143	9303
11	+	4133	6009	8120	13375	13405	19078	10982
12	+	2507	2839	4738	7414	12439	10550	33317
13	+	39412	1938	2035	3849	6153	9154	14981
14	+	33157	37313	1597	1514	3097	5459	14117
15	+	6408	34821	39479	1459	1117	2602	8055
16	+	1020	6141	34276	38778	1070	869	3629
17	+	33914	789	5521	30759	34703	1015	957
5+	+	269711	248904	271396	285457	259778	174887	187982
6+	+	235467	214506	228404	236652	225057	153997	175520
7+	+	193064	179872	194888	196078	179146	124492	156851
8+	+	166469	139021	164051	167709	146444	88244	132052
9+	+	144476	118200	127887	145374	125171	68880	107107
10+	+	129566	100777	111092	112492	106511	57871	95341

## ESTIMATING MORTALITY

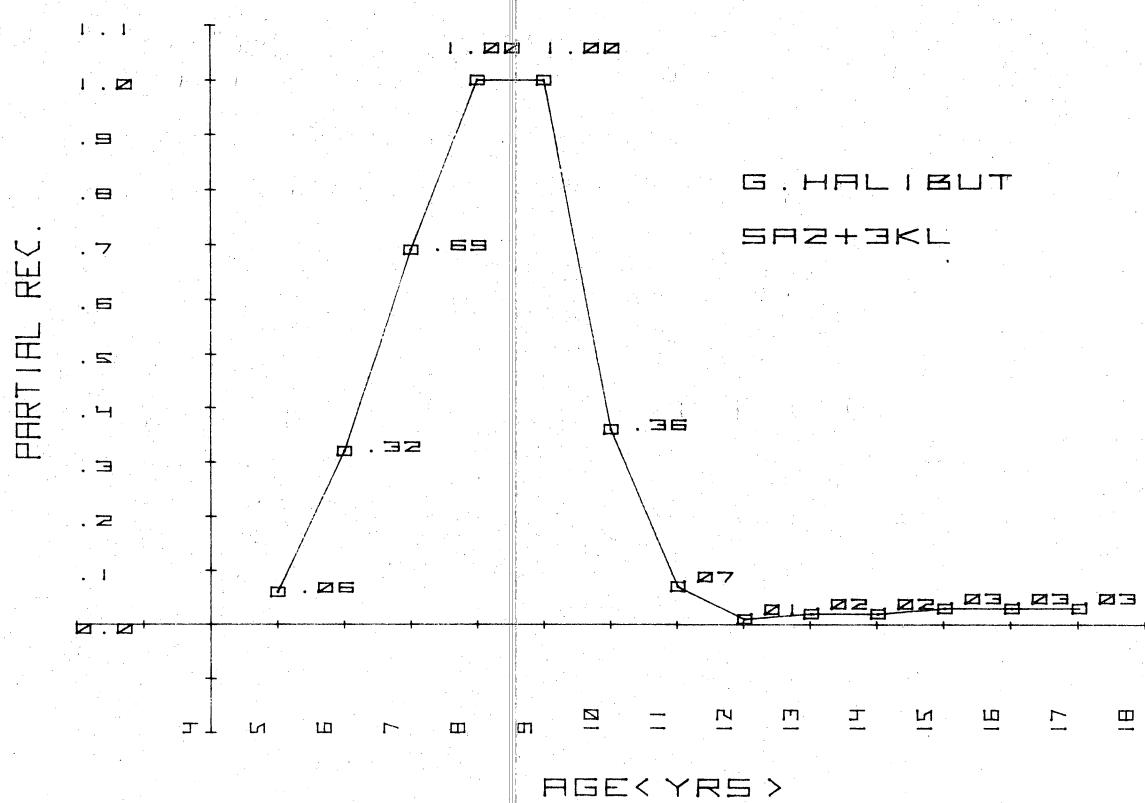


Fig. 1.

