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Data from the Offshore Canadian Commercial Fishery for Greenland Halibut in Subarea 0

by

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Abstract

This document updates information from the commercial fishery for Greenland halibut in Subarea 0, with a focus on the Canadian commercial fishery in 2000. Catch at age showed a slight shift to younger fish after 1993, with a peak at age 7 in each year since then. As in previous years, catch at age from 2000 indicates larger fish in the fixed gear catches compared to the mobile gears. There were no major trends in weight at age during the period 1990 to 2000. Due to the frequency of fleet changes in this fishery, and the lack of continuity among vessels within fleets, a standardized index of CPUE for Subarea 0 alone is not considered to be a reliable indicator of overall stock abundance. Unstandardized CPUE from the Canadian fishery showed a slight increase from 1998 to 1999, but has been relatively stable since 1996. CPUE data for 2000 are incomplete and indicate the presence of twin trawls in the Greenland halibut fishery, possibly for the first time.

Catch trends

Catches of Greenland halibut in Subarea 0 increased from less than 1000 tons annually in the late 1980's to an average of about 10,000 tons per year in 1990-92 (Jorgensen 2000). A new management unit was introduced in 1995, which excluded Division 1A in the inshore waters of Greenland from the TAC for Subareas 0+1. As a result, the TAC for Subarea 0+1 offshore was decreased from 25,000 tons to 11,000 tons, and catches in Subarea 0 were reduced to between 5,300 and 6,700 tons per year in 1995 to 1997. A further reduction to about 4400 tons occurred in 1998. In 1999 catches in Div 0B totalled about 4050 tons, with 517 tons being taken in Div. 0A, for a total of 4567 tons from Subarea 0. With the exception of a relatively small inshore fishery in Cumberland Sound, and some exploratory fishing in Subarea 0, virtually all the catch in Subarea 0 prior to 1999 occurred offshore in Division 0B. In 1999, there was no exploratory fishing in Div. 0A and catches in this Division were part of the regular commercial fishery. In 2000, Canadian catches in Subarea 0 totalled 5393 tons (Table 1). A complete breakdown by Division was not available, although at least 300 tons was reported from Div. 0A, 22 tons of which was caught under an experimental/exploratory license.

Catches have been taken mainly by otter trawl, although catches by gillnet are becoming more important (over 1900 tons in both 1999 and 2000). Relatively small amounts of longline catch also occur (399 tons in 1999, 521 tons in 2000). In 1997, about 70% of the catch of 5740 tons was taken by otter trawl, but this percentage was lower in 1998 and lower again in 1999 at about 40% (Brodie, 2000). In 2000, just over 50% of the catch came from otter trawls, about half of which was taken by twin trawls (based on observer data – see Table 1). Vessels from Canada, Japan, Faroes, Russia, and Norway have been the main participants in the fishery since the late 1980's, although there have been many changes to fleet compositions over time. During the 1990's, much of the Canadian quota in this fishery was caught under charter agreements with vessels from most of the nations listed above, although there were no such arrangements with non-Canadian vessels in 1999 and 2000.

Description of Data

Brodie (2000) presented catch at age and mean weight at age data from 1988-99, including data from previous documents by Atkinson et al. (1994), and Brodie and Bowering (1998). These data have been incorporated in the assessments of the G. halibut stock in Subareas 0+1 (e.g. Jorgensen, 2000). Most of the sampling data used in these analyses were collected at sea by observers, although some port sampling information was also included. From the fishery in 2000, samples were available from the otter trawl, gillnet, and longline catches, and were used to generate the catch at age and weights at age for 2000. Similar procedures were used as in previous years, although in the 1999 and 2000 data, some samples contained data in which the sex of each fish could not be recorded, because of processing at sea. In these cases, the sex was assigned as female, given the large percentage of females, which occurred in comparable sexed samples.

CPUE data were collected by observers on a set by set basis, and aggregated in this analysis by vessel and month. Some additional data from 1999, which were not available at the time of he 2000 analysis, were examined here. Data from the exploratory fishery in Div 0A in 1996-98 and 2000 were included in the catch rate analysis where available. As noted previously, there was no exploratory fishery in Div. 0A in 1999, but the commercial fishery did operate there in both 1999 and 2000. There are no data on by-catch from the shrimp fishery in Subarea 0 included in this paper, or from catches in the inshore fixed-gear fishery (primarily in Cumberland Sound). Catches from these fisheries are relatively small and have generally been dealt with elsewhere.

It should be noted that there are considerable uncertainties with the Canadian catch data for Greenland halibut in Subarea 0. In the data for the early 1990's, the use of charter vessels from non-Canadian countries to fish Canadian quotas resulted in some double-counting of catch data, although this problem has been resolved for some time. Logbook data for catches in 2000 by some Newfoundland-based vessels were not available for inclusion in this document and these catches were summarized from quota reports, resulting in incomplete data for month fished (Table 1). As well, it is likely that some data for vessels fishing with licenses issued for Nunavut-based companies may not have been tabulated for the years 1997-1999. The full extent of this is not known at present, although approximately 975 tons of catch for such vessels were tabulated for 2000 (M. Treble, DFO Winnipeg, pers. com.). This may explain some of the apparent shortfall of reported catches by Canada of about 1000 tons against the 5500 ton quotas in 1998 and 1999. Where possible, observer data have also been used to obtain estimates of catch in 2000.

Catch at age

Table 2 shows the catch at age calculations for the 2000 fishery. Sampling of the longline fishery consisted of length frequencies collected in the months of June, July, and October, totaling about 3010 measurements. Only 2 length frequencies were collected from the gillnet fishery, consisting of 639 unsexed measurements from catches in June. The otter trawl component contained many samples from May and from all months during August to December, consisting of over 24,000 measurements. Almost 8000 of these measurements were taken from the twin trawl fishery. As was the case with the sampling data from 1997-1999, the discrepancy in sampling intensity can be explained by the deployment of observers on most of the vessels fishing otter trawls in 2000. Sampling was improved in 2000 compared to 1999, although gillnet sampling was again inadequate, and highlights the difficulty in obtaining samples from some of the Canadian fixed gear fleets operating in Subarea 0.

Age length keys, consisting of 1115 otoliths taken in conjunction with various length frequency samples, were used to derive the age composition of Greenland halibut caught in 2000. Otolith sampling in 2000 was somewhat reduced compared to 1999 (when 1421 otoliths were collected), requiring age-length keys to be combined by gear type. Age composition in the otter trawl fishery in 2000 was very similar to previous years, with ages 7 and 8 dominating (Table 2). The twin trawl component peaked at age 7, and the single trawl component at age 8. Longline catches were dominated by ages 8 to 10, and the gillnet landings, which comprised a much larger component of the fixed gear catch in 2000, were comprised mainly of fish aged 10 to 12. Table 2 and Fig. 1 also show a comparison of the catch at age totals from fixed gear and mobile gear. For similar tonnages in 2000, the mobile gear fishery caught about two and a half times more G. halibut in numbers than the fixed gear fishery. Ages 7 and 8 were dominant in the combined catch at age, which is adjusted to reflect the catch of 5393 tons, including the 200 tons from unspecified gears.

Table 3 (a and b) shows the catch at age and mean weights at age for 1988-2000 along with a sum-of-products (S.O.P.) check (Table 3c). The nominal catches used to derive the total catch at age values for 1988-99 were taken from Jorgensen (2000). For 2000, as in 1998-99, mean weights at age were calculated from mean lengths at age using the length-weight relationship for NAFO Div. 2G, calculated from survey data obtained in 1997 (Gundersen and Brodie 1999). As noted by Atkinson et al. (1994), there was a shift in the catch at age to younger fish with the increased otter trawl fishery in 1990 onward. In 1988-89, catches were taken mainly by longlines in deep water, and contained proportionally more old fish. From 1990-93, age 8 was predominant in catches, but from 1994-2000, the modal age in each year was 7. This may be due in part to the fishery occurring slightly later in the year in the latter period. Few fish older than 13 years appeared in the catch at age after 1990, although a few individuals as old as 16 were taken in the fishery every year. Age 18 was the oldest age found in the catch in 2000. Mean weights at ages 7 to 13 showed little in the way of trends over time (Fig. 1). The S.O.P. check (Table 3c) indicated a slight bias toward underestimating the catch weight in most years, although the opposite was true in 2000.

CPUE

In previous papers (Brodie 1999, Brodie and Bowering 1998), a standardized CPUE was calculated from available data using a multiplicative model (Gavaris 1980). However, it was thought that the lack of overlap of fleets throughout the time series likely caused some problems in the CPUE standardization in Subarea 0. It was noted that there is not a single fleet which is present in all 11 years of the time series, and that there was only one fleet involved in the 1999 -2000 fisheries for which data were available. As well, the presence of twin trawls on at least one vessel in 2000 has added a new gear type and poses a question on how the effort data for such gears has been recorded.

In examining the unstandardized data up to 1999, Brodie (2000) noted that one of the longer series, Faroes TC 7, showed a relatively constant increase over time, although this fleet did not fish after 1997. The Canadian fleet had relatively stable CPUE during 1996-99, and was the only fleet involved in the fishery in each of these years. Missing data from some Canadian vessels, as well as the question with the twin trawl data, precludes the comparison of the Canadian CPUE data for 2000 with previous years. Given the wide confidence limits around the standardized CPUE estimates from the 1998 and 1999 analyses, and the lack of continuity in the fleet and gear composition, it is unlikely that the CPUE data available for Subarea 0 alone can be considered a reliable index of overall stock abundance. Further examination of the CPUE data is warranted before additional analyses are undertaken. This could include identification of individual vessels present in this fishery over a number of years, as well as closer examination of twin trawl data for 2000.

Other factors besides stock abundance which could affect CPUE include learning, since the otter trawl fishery was new in 1990 and many fleets joined the fishery for short periods in the 1990's, and migration of G. halibut in either direction between Subarea 0 and 1, given the geographic features of the depth contours in the area of the boundary. There is no recent time series of research vessel surveys of Div. 0B to verify trends in CPUE, although USSR/Russia conducted stratified random trawl surveys in this area from 1979-92 (Gorchinsky 1993). These data show a sharp drop in the biomass index from higher levels in 1979-86 to a much lower value in 1987. The index increased slightly up to 1990, then declined in 1992 to just above the 1987 value.

A research vessel survey of Division 0A was conducted in 1999 (Treble et al. 2000) and a survey of Division 0B was done in 2000 (Treble et al. 2001). For 2001, a survey of both Divisions is planned. The 1999 and 2000 surveys and the one planned for 2001 will be comparable with the surveys of Subarea 1 on the same vessel (*RV Paamiut*), and thus, if continued, the surveys could eventually provide a fishery independent index of abundance for the offshore stock of G. halibut in Subareas 0+1.

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Table 1. Canadian catch of G.halibut in Subarea 0 (offshore) in 2000.

	Can (N)					Can (M+Q)			Can(C&A)	
	Otter trawl	Gillnet	Longline	Unspecified	Sub-Total	OT	Unsp.	Sub-Total	OT	TOTAL
May		95			95	487		487		582
June		444	128		572					572
July		220	183		403					403
August		424	126		549				40	589
September		274			274				272	546
October		257	84		341				438	779
November		191			191				226	417
Unspecified1	904			114	1018		86	86	402 2	1506
Total	***904***	***1903***	***521***	***114***	***3442***	***487***	***86***	***86***	***1378*** 3	**5393**

Footnotes:

1) Based on quota reports

2) 402 t based on observer estimates.

3) 1339 t caught by twin trawl, from observer data

Gear Totals

OT	2769 3
GN	1903
LL	521
Unsp.	200
Total	5393

Table 2. Catch at age and mean lengths and weights at age, for G.halibut in the commercial fishery in Subarea 0 in 2000.

	Catch (000 of fish)							Mean		
Age	Gillnet	Longline	*FG total*	Twin trawl	Single trawl	*MG total*	**Total**	Len (cm)	Wgt (kg)	SOP (t)
4				1	*	*1*	**1**	36.5	0.387	0.4
5		*	*	33	26	*59*	**61**	39.5	0.504	30.7
6	1	*	*1*	166	214	*380*	**389**	42.4	0.634	246.6
7	12	10	*21*	489	226	*715*	**752**	47.2	0.905	680.6
8	34	38	*73*	285	298	*583*	**669**	52.4	1.268	848.3
9	73	46	*119*	129	147	*277*	**404**	58.7	1.828	738.5
10	132	37	*169*	44	77	*121*	**296**	63.9	2.399	710.1
11	161	30	*191*	27	40	*67*	**264**	68.7	3.046	804.1
12	126	24	*151*	13	17	*30*	**185**	73.7	3.829	708.4
13	68	14	*81*	2	5	*7*	**91**	78.9	4.768	433.9
14	29	9	*38*	1	2	*3*	**42**	82.8	5.596	235.0
15	23	7	*30*	*	1	*1*	**32**	86.2	6.369	203.8
16	4	1	*6*	*	*	*1*	**6**	92.3	7.926	47.6
17	*	*	*	*	*	*	**1**	95.8	8.964	9.0
18		*	*				**0.1**	99.5	10.138	1.0
			880			2245	3193			5698.0
										Catch=5393 t

* indicates less than 500 fish

Table 3. A) Catch-at-Age B) mean weight-at-age C) sum of products, for Greenland Halibut in Subarea O (mainly Div. OB).

A) Catch-at-Age (000's)													
Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	1	0	0
4	0	0	0	0	9	1	2	0	2	6	6	1	1
5	0	0	2	14	45	30	45	18	34	58	42	25	61
6	0	0	53	208	524	332	181	189	296	355	225	145	389
7	1	2	398	1191	2078	1668	1033	1254	1726	1273	579	610	752
8	5	9	1387	1888	2738	1933	735	641	1193	1050	416	523	669
9	9	11	1186	1059	1688	891	483	388	596	478	307	346	404
10	18	13	663	447	657	474	140	245	309	216	253	199	296
11	24	14	335	175	217	156	85	168	134	173	224	119	264
12	31	30	184	122	147	89	82	168	84	90	97	104	185
13	39	32	183	96	120	50	57	62	34	67	75	104	91
14	30	34	111	50	60	22	25	29	17	15	49	57	42
15	24	20	63	30	24	13	17	16	10	9	6	33	32
16	8	8	14	4	6	4	11	5	2	7	1	18	6
17	1	0	2	0	1	0	2	1	1	1	0	9	1
18	0	0	0	0	0	0	1	0	0	0	0	1	1
19	0	0	0	0	0	0	0	0	0	0	0	1	0
Total	190	173	4580	5285	8313	5663	2899	3184	4439	3798	2281	2295	3194
Catch(t)	1024	907	9498	8606	12358	7489	4274	5299	6721	5740	4370	4567	5393
B) Weight- at Age (kg)													
3											0.173		
4					0.196	0.175	0.228		0.269	0.241	0.337	0.367	0.387
5			0.376	0.356	0.333	0.302	0.406	0.358	0.351	0.359	0.450	0.466	0.504
6			0.562	0.554	0.572	0.526	0.559	0.568	0.537	0.547	0.630	0.599	0.634
7	0.818	0.785	0.813	0.820	0.829	0.810	0.857	0.897	0.896	0.862	0.909	0.866	0.905
8	1.200	1.076	1.098	1.143	1.162	1.170	1.210	1.302	1.321	1.276	1.280	1.270	1.268
9	1.781	1.585	1.533	1.632	1.692	1.716	1.690	1.810	1.814	1.838	1.845	1.780	1.828
10	2.446	2.149	2.122	2.333	2.420	2.357	2.235	2.523	2.397	2.378	2.490	2.372	2.399
11	3.244	2.878	2.961	3.390	3.390	3.264	2.767	3.152	3.141	3.005	3.185	3.024	3.046
12	4.169	3.822	3.916	4.364	4.309	4.266	3.426	3.927	3.979	3.831	3.903	3.761	3.829
13	5.136	4.929	4.986	5.610	5.555	5.519	4.608	5.007	5.132	4.932	4.819	4.765	4.768
14	6.317	6.265	6.275	7.022	7.176	6.803	6.038	5.893	5.943	5.713	6.025	5.463	5.596
15	7.736	7.825	8.049	8.669	8.786	7.976	6.534	6.849	6.568	6.783	6.858	6.835	6.369
16	9.511	9.883	10.354	10.849	10.269	9.786	6.106	8.654	8.168	8.002	7.977	8.068	7.926
17	10.772		12.804		11.951		10.006	9.937	8.694	8.641		9.104	8.964
18							6.655					10.611	10.138
19												11.736	

Table 3. (continued).

C) Sum of products (t)													
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
4	0.0	0.0	0.0	0.0	1.8	0.2	0.5	0.0	0.7	1.4	2.0	0.4	0.4
5	0.0	0.0	0.7	5.0	14.9	8.9	18.5	6.4	12.0	20.8	18.9	11.5	30.7
6	0.0	0.0	29.9	115.2	299.7	174.9	101.2	107.4	158.9	194.2	141.8	86.7	246.6
7	0.8	1.6	324.0	976.8	1722.5	1351.4	885.0	1124.8	1546.1	1097.3	526.3	528.1	680.6
8	6.0	9.7	1522.9	2158.2	3181.9	2261.6	889.3	834.6	1576.5	1339.8	532.5	664.3	848.3
9	16.0	17.4	1817.8	1728.9	2856.4	1529.4	815.7	702.3	1080.2	878.6	566.4	616.2	738.5
10	44.0	27.9	1405.9	1043.2	1590.3	1117.6	313.9	618.1	741.4	513.6	630.0	472.9	710.1
11	77.9	40.3	990.9	592.1	736.2	510.5	235.4	529.5	420.8	519.9	713.4	359.8	804.1
12	129.2	114.7	719.6	533.6	631.9	377.7	281.3	659.7	334.3	344.8	378.6	391.0	708.4
13	200.3	157.7	911.5	538.9	665.4	276.9	264.4	310.4	175.0	330.4	361.4	495.4	433.9
14	189.5	213.0	698.0	349.6	433.8	147.2	149.3	170.9	101.3	85.7	295.2	310.3	235.0
15	185.7	156.5	506.0	257.4	206.6	102.0	109.9	109.6	64.0	61.0	41.1	227.1	203.8
16	76.1	79.1	140.2	47.4	57.5	38.5	66.4	43.3	19.9	56.0	8.0	147.0	47.6
17	10.8	0.0	24.8	0.0	13.4	0.0	19.8	9.9	10.6	8.6	0.0	78.1	9.0
18	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	11.4	1.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7	0.0
SOP	936.3	817.9	9092.2	8346.3	12412.1	7896.7	4157.0	5227.0	6241.8	5452.3	4215.8	4400.1	5698.0
SOP/catch	**0.91**	**0.90**	**0.96**	**0.97**	**1.00**	**1.05**	**0.97**	**0.99**	**0.93**	**0.95**	**0.96**	**0.96**	**1.06**

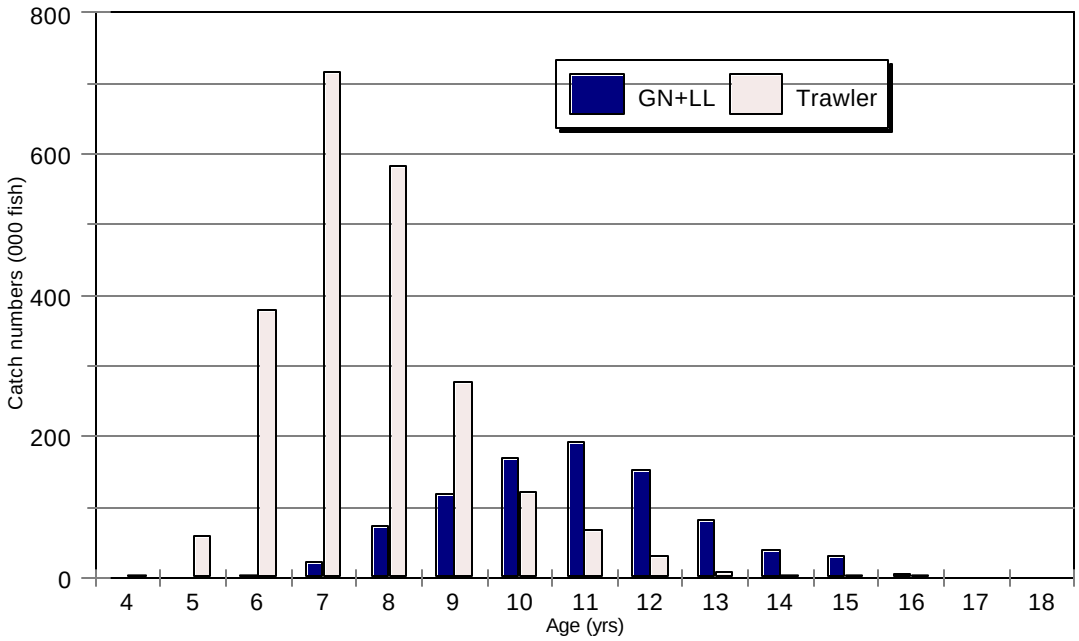

Fig. 1. Comparison of Greenland halibut catch numbers at age for fixed and mobile gears in SA 0 in 2000.

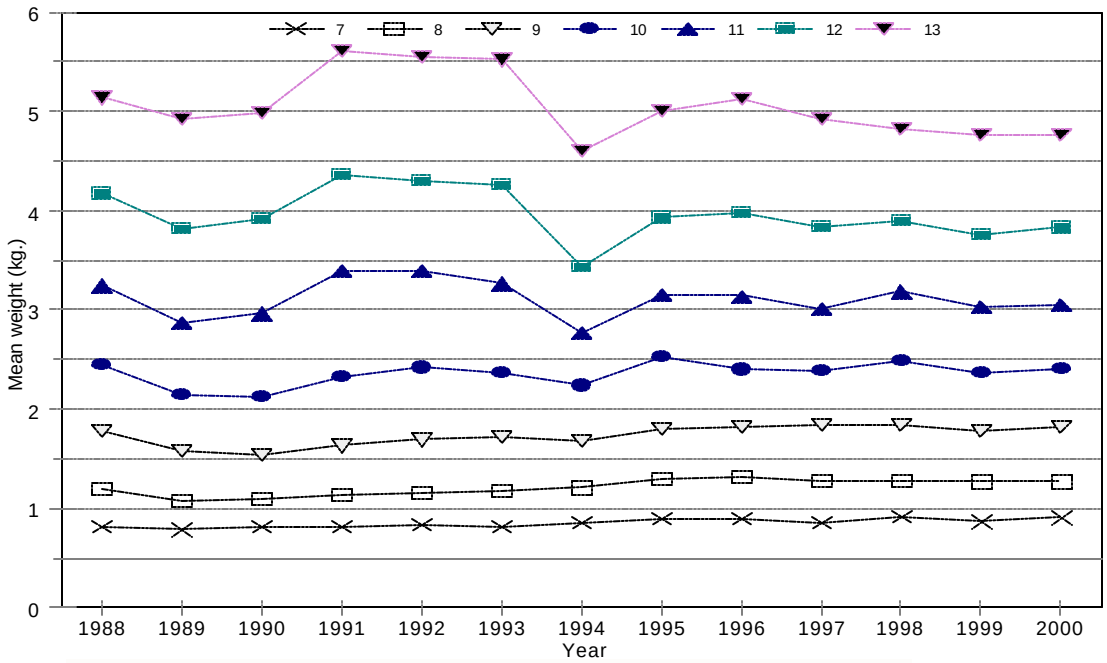

Fig. 2. Mean weights at age of G.halibut caught in the commercial fishery in Subarea 0