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The Canadian fishery for Greenland halibut in SA 2 + Div. 3KLMNO, with emphasis on 2009.

by

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Abstract

The Canadian catch of Greenland halibut in 2009 in NAFO Subarea 2 and Divisions 3KLMNO was reported to be 5739 t, about 870 t higher than in 2008. Most of this increase was in the shallow-water gillnet fleet, while otter trawl catches remained constant. Catches in 2009 were highest in Div 3K, unlike 2007 and 2008, but similar to many previous years. About 42% of the catch was taken in July, and 95% of the catch was taken in May to August. Overall, the catch at age in 2009 was dominated by the 2001 and 2002 year classes, which accounted for 78% of the catch numbers and 72% of the catch weight. Catches in the deepwater gillnet sector have trended toward younger fish since 2001, coincident with the permitted use of smaller mesh in deeper zones in recent years. Mean weights at age in 2009 were similar to previous years. CPUE analysed from logbooks of Canadian trawlers decreased by about 20% in 2009, but remains high, following large increases in 2006 to 2008.

Review of the Canadian fishery

As reported in several previous documents (e.g. Brodie et.al. 2009), the Canadian fishery for Greenland halibut (GHL) in Subareas 2 and 3 began in the early 1960s, using gillnets in the deepwater bays of eastern Newfoundland, particularly Trinity Bay. As catches declined here, the effort moved progressively northward in the other bays along the east and northeast coast of Newfoundland. In later years, vessels moved further offshore to the deep channels, such as the area in the central part of Div. 3K known as Funk Island Deep, and eventually to the continental slope. Canadian catches increased from fairly low levels in the early 1960s to almost 32,000 t in 1980 then declined steadily to less than 10,000 t/year (average 5500 t) during the 1990s (Table 1). This declining trend was mainly a result of low catch rates and reduced effort, as fishers pursued other species such as snow crab which were more profitable. In 2000, the Canadian catch in NAFO Subarea 2 and Divisions 3KLMNO increased to about 10,600 t, more than two and a half times the catches in 1998 and 1999. However, catches have again declined since then, to between 4,800 and 7,000 t since 2002. Reasons for fluctuations in catch and effort include a switch of some effort by fishers in Divs. 3KL between snow crab and GHL due to changes in quotas and product prices, combined with variable catch rates for GHL in some of the traditional fishing areas (Brodie et al. 2007).

Canadian catches have been taken mainly by gillnet (Table 1), and most of these gillnet catches are from Div. 3K. This fishery has been conducted mainly by small vessels (<20 m) fishing in the deepwater channels near the Newfoundland and Labrador coast as well as in the deepwater bays, using a minimum mesh size of about 152 mm. However, Canadian gillnet catches taken since the mid to late 1980s also include those from a substantial fishery along the deep edge of the continental slope. In an attempt to reduce the catch of young Greenland halibut in this deepwater gillnet fishery, minimum mesh size for GHL in the Canadian zone in depths > 732 m (400 fm) was regulated to be 191 mm, with the exception of Div. 2J in some years. However, there have been a number of changes in these regulations in the past several years (Brodie et al. 2009), including 2009, where the only area requiring 191 mm mesh size was Div. 3LNO deeper than 732m. Other restrictions on numbers of nets now exist, as indicated in the tables below, which show the 2007- 2009 conservation harvesting plans (CHP) regulations in the

Canadian gillnet fishery for Greenland halibut. In recent years, fishers in Div. 3K were permitted to use some 152 mm mesh gillnets in waters deeper than 732 m, but these fishers were then not permitted to fish for GHL in depths less than 732 m. The number of nets allowed in depths > 732 m in Div. 2GHJ + 3K was reduced from 500 to 400 in 2007, and further to 250 in 2008, but increased to 300 in 2009.

2007

Area	Depth (m)	# of Nets	Min. Mesh
2GH	293 – 549	125	152 mm
2GH + 3KL	549 – 732	200	152
2GH + 3K	> 732	400	191
2J	> 732	400	152
3LMNO	> 732	500	191

2008

Area	Depth (m)	# of Nets	Min. Mesh
2GH + 3KL	549 - 732	200	152 mm
2GH+3K	> 732	250	191
2J	> 732	250	152
3L	293 - 549	125	152
3LNO	> 732	500	191

2009

Area	Depth (m)	# of Nets	Min. Mesh
2GH + 3L	293 - 549	125	152 mm
2GH+3K	>549	300	152
2J	> 732	300	152
3L	>549	200	152
3LNO	> 732	400	191

Gillnet catches during the 1990's ranged from 2400 to 6700 t, averaging about 4200 t. Catches in 2000 from this sector then increased to 9300 t, similar to the levels seen in the late 1980's, but since then have declined to between 2400 and 3900 t. Since early-2002, an area in the Funk Island Deep region of Div. 3K (see Fig. 1) was closed to gillnetting in order to reduce by-catch of snow crab, and was partly responsible for the decline in gillnet catch. An area of Hawke Channel in Division 2J has also been closed to fishing for some years, due to crab – shrimp fishing interactions. The extent of these areas has undergone modifications over time. Longline catches averaged about 550 t from 2002-04, but have generally been < 200 t/year, and were less than 25 t/year in the most recent years.

Canadian otter trawl (OT) catches peaked at about 8,000 t in 1982, but from 1993 to 1999, catches by this fleet did not exceed 1050 t annually. OT catches increased sharply from less than 90 t in 1998 and 1999, to around 3700 t in 2003 (Table 1), but annual OT catch since then has been in the range of 1800 to 2500 t. Much of the otter trawl catch after 2002 was in the slope area around the boundary between Divs. 3K and 3L, although almost all otter trawl catch in 2007-08 occurred in Div. 2J. This fishery is conducted mainly by large vessels (>30 m in length), and minimum codend mesh size has been regulated to be 145 mm for several years, in all areas.

Catches of GHL from Subarea 2 were very low prior to the mid 1970's, then increased to a peak around 9000 t in 1982 (Table 2). From 1991 to 2001, catches from Subarea 2 were in the range of 1000 to 2500 t per year. The catch in SA 2 increased to almost 3000 t in 2003, due to higher catches in Div. 2GH, and was around this value in 2007-08. Most of the catch from Subarea 2 has come from Div. 2J (eg. 2007-09), although catches in 1993-96 and 2003-04 were higher in Div. 2GH combined compared to Div. 2J. In some cases, fishing in Subarea 2 has been opportunistic, by vessels transiting to or from Subarea 0. In most years, Div. 3K has produced the largest Canadian catches, peaking around 18,000 t in 1979-80. Catches in recent years from Div. 3K have fluctuated between 750 t (1995) and 5800 t (2000), with the 2007-08 values being around 1500 t. Peak catches of around 13,000 t in Div 3L occurred in 1966-67 and 1980, and

averaged about 1000 t from 2006 to 2008. Catches in Div. 3M, 3N, and 3O combined have been less than 100 t in recent years, and occur mainly in Div. 3O (Table 2).

The Canadian fishery in 2009

There were some differences in the spatial and temporal patterns in the Canadian fishery for GHL in 2009 compared to those observed in 2008 and other recent years. The total reported catch was just over 5700 t, an increase of almost 900 t from 2008, but similar to the 2007 catch. Catches in both gillnet fleet sectors were higher in 2009, but were basically unchanged in the otter trawl fleet. Some quotas within the Canadian zone are managed using different seasons, and this has had impacts on the temporal and spatial distribution of catches in recent years, as well as on the ability of some gear sectors to catch all their quota in a given season or area.

Breakdowns of the catch by gear, Division, depth range and month are shown in Tables 3 and 4. In all years gillnet was the dominant gear, except 2003 and 2008, when otter trawls took most of the catch. In 2004 to 2006 the gillnet catches in the shallow zone (<400 fm, or 732 m) were lower than in the deep zone, although the differences were small in 2006 and 2007. However, catches in the deep water gillnet fleet were much reduced in 2008 (596 t) and 2009 (786 t), comprising only a quarter of the total GN catch. These gillnet catches are referred to in Tables 3 and 4 as GN<400 and GN>400. GN <400 catches were stable around 1800 t in 2006-08, but increased to approximately 2500 t in 2009. Longline catches declined to less than 25 t in 2007-09. The main change in the spatial pattern of the fishery in recent years has been the change in catch levels in Div 3KL, from over 5300 t in 2006, to about 2100 t in 2008, and back to 4000 tons in 2009. Otter trawl catches were almost equally split between 2J and 3K in 2009, but occurred primarily in 2J in 2007 and 2008. There was little consistency in the distribution of OT catches by division from 2004 to 2009. In 2006-09, there was negligible (actually zero in 2008) Canadian catch of GHL by otter trawl in Div. 3L, compared to about 1000 t per year in this area in 2002-03. In 2009, approximately 6% of the otter trawl catch was reported as coming from twin trawls.

Almost all (95%) of the total Canadian catch in 2009 occurred from May to August, with just over 2400 t taken in July, mostly by gillnet. This temporal pattern of catch in 2009 differed from that of recent years, although there has been substantial variation. Unlike in 2007 and 2008, when a large percentage of otter trawl catches occurred before April, OT catches in 2009 occurred mainly during May to July. In 2005, 2007 and 2009, a higher percentage of catch occurred in July, compared with 2006 and 2008. One similarity is that less than 6% of the total annual catch in 2006 to 2009 occurred later than August.

Beginning in 2004, a small "test" fishery for GHL using gillnets has been allowed in Div. 3L, mainly in depths between 293 and 549 m. This fishery was established to determine if it was possible to fish for GHL in these depths while minimizing the by-catch of snow crab. In 2009, 274 t of GHL were allocated to this fishery, and it was conducted in 2 phases, July 17-31 and Aug 26 – Sep 22. Total catches amounted to about 70 t of GHL, and quotas were not reached in many cases due to high by-catch of cod. By-catches of snow crab in 2009 were negligible.

Figs. 1-2 show the location of most of the Canadian catch of GHL in 2006-09. These data were aggregated by 10-minute squares from logbook records. In all four years, the plotted data account for over 94% of the total Canadian catch. The spatial distributions of the catches in these 4 years were broadly similar, particularly so in 2008 and 2009. One difference between recent years and those prior to 2005 is the recent presence of gillnet catches in the north-central part of Div. 3L, although less so in 2008-9, when the fishery was closed early due to cod by-catch (Brodie et al. 2009). This also corresponds with the reduction in catch from the central 3K (Funk Island Deep) area, due to the area closed to gillnetting (Brodie and Power, 2002). This was noted in previous sections, and is shown in Fig. 1, as well as in Power and Brodie (2006), where the closed area, which was not in the regulations in 2001, was overlaid on the 2001 catch.

Fig. 3 shows the location of the 2009 catch by the 4 major gear types (2 gillnet categories, otter trawl, and longline, the latter being negligible again in 2009). Most of the otter trawl fishery in 2009 (Figs 3, 6) was located in two main areas, in Div. 2J and Div 3K along the slope edge. In many years, this fishery operated around the border between Divs. 3K and 3L north to about 51 N. The spatial distribution of the deepwater gillnet (GN>400) fishery in 2009 (Fig. 5) was similar to recent years, i.e. widely distributed along the slope edge from northern 3L to Div. 2J, with slightly more effort in Div. 2J, although catches in this fleet sector were much lower in 2008 and 2009 than in the previous few years. With the closure of the Funk Island Deep area, the shallow water gillnet catches were more concentrated towards the slope area in 3K in 2002-09 compared to 2001 and earlier (eg. Brodie and Power 2006, and earlier documents by these

authors). In 2008 and 2009, much of the shallow water GN catches came from Div 3K (Fig. 4), compared to north-central 3L in 2007. As noted above, some smaller mesh gillnets have been allowed in Div. 2J and 3K in recent years. In 2009, 57% of GN<400 catches were taken in July. This contrasts with 2008, when very little catch was taken in July, and 58% of all GN catches were taken in June. The main reason for these variations is a split season used in managing the fixed gear quotas, and how these quotas affect effort in other fisheries (directed at species other than GHL). Almost all of the otter trawl catch in 2009 was from May to August contrasting with 2008 when most of the OT catch was taken in January to April.

Catch at age

Details on the Canadian catch at age for previous years can be found in Bowering and Brodie (2000), Brodie et al. (2009) and Brodie and Power (2006), as well as in earlier documents by these same authors. Ages 6-8 dominated the Canadian catch in most years, both in the otter trawl and shallow water gillnet fisheries. The catch in the GN>400 fleet has been tending towards younger GHL in the past decade, as use of smaller mesh is increasingly permitted in deeper areas.

Sampling data collected in 2009 by observers at sea and by port samplers, were available from Divs. 2HJ and 3KL. The following table shows the number of length measurements by Division and gear, and the number of otoliths (in italics), with a comparison to 2008.

2008	**2J**		**3K**		**3LO**	
Gill net < 400			2633		3247	
Gill net > 400	967	*144*	1398	*316*	451[1]	*325*
Otter trawl	4899	*440*	255	*37*	93	
Totals	5866	*584*	4286	*353*	3791	*325*

2009	**2HJ**		**3K**		**3L**	
Gill net < 400	2595		2985		5926	
Gill net > 400	1957	*493*	259	*418*	480	*131*
Otter trawl	4066	*262*	2717	*151*		
Totals	8618	*755*	5961	*569*	6406	*131*

[1] Linetrawl, Div 3L

The otolith samples from the fixed gear (GN) sectors have been combined, as there is a mixture of gillnet mesh sizes in the deepwater 985, an increase of 51% from 2008 levels, following decreases of 33% and 50% in the previous 2 years. With the reduced quotas (after 2006), and concentration of effort in relatively few gear/month cells (Table 4), most fleet sectors appeared fisheries. The large number of measurements from the otter trawl catch is due to the requirement for these large vessels to have a high percentage of observer coverage. The total number of length measurements in 2009 was 20, to be adequately sampled for lengths in 2009. The number of otoliths collected (1455) was 15% higher than in 2008. As has been done in most years age-lengths keys were combined across some gear types, Divisions, and seasons to calculate catch at age.

Approximately 5 million GHL were caught in the 2009 Canadian fishery. Age compositions are presented for both gillnet components (GN<400 and GN>400) as well as for otter trawl (Table 5). The predominant age in the otter trawl catch was 7 (2002 year class), while age 8 (2001 year class) was most abundant in the catches of both gillnet fleets. Ages 7 and 8 were also dominant in these fisheries in all recent years. Overall, the catch at age in 2009 was dominated by the 2001 and 2002 year classes, which together accounted for 78% of the catch numbers and 72% of the catch weight. These are very similar to the percentages for these ages in recent years, as the catch at age has become more dominated more by these 2 ages (7 and 8). During 2000 - 2008, age 8 contributed the second highest portion to the catch numbers, after age 7. However in 2009, the proportion of age 8 was slightly higher than that of age 7. The catch in the GN>400 fleet has been tending towards smaller fish in recent years, as the use smaller mesh is permitted in deeper areas. For example, 3-15% of the catch in numbers by this fleet in 2006-09 (13% in 2009)

was estimated to be age 10 or older, compared to 72-80% in 2001 and 2002. In 2009, only 3.9% of the total catch numbers were from ages 10 and older.

Mean weights at age for all areas in 2009 were calculated from the mean lengths at age using the same length-weight relationship used for GHL catch at age in 1998-2008 i.e. log weight = 3.158 log length - 5.3431, from Gundersen and Brodie (1999). Weights at ages 6 and 7 in 2009 were slightly higher than in 2008, with those at ages 8-10 being slightly lower. At ages 5 or less and ages 10+ there are few fish in the catch, and weights at these ages are often variable between years due to sampling. The sum of products was only 1% lower than the catch weight in 2009, compared to 8% in 2008, although that was a larger difference than usual.

CPUE

Catch and effort data from the Canadian otter trawl fishery directed for Greenland halibut during the period 1975 to 2002 were obtained from the NAFO STATLANT 21B database were combined with data from 2003-2009 from Canada (N) logbook (ZIFF) records. The catch/effort data were analysed with a multiplicative model (Gavaris, 1980) to derive a standardized catch rate index based on an hours-fished measure of effort. Ln (CPUE) was the dependent variable in the model. Independent variables (category types) were: (1) a combination country-gear-tonnage-class category type (CGT), (2) month, (3) NAFO Division and (4) Year. Consistent with previous catch rate standardizations (e.g. Power, 2004), individual observations with catch less than 10 tons or effort less than 10 hours were eliminated prior to analysis. Subsequently, within each dependent variable, categories with arbitrarily less than five observations were also eliminated, with the exception of the variable "year", which is the purpose of the standardization. The advantage of running the Gavaris model is the derived standardized index is retransformed into the original units of fishing effort and can be computed for any chosen combination of the main factors.

After the selection criteria were applied, the percentage of otter trawl catch with hours fished effort utilized in the analysis ranged from 10% in 1976 to at least 90% from 2000-2009, and averaged 92% since 1995. In some years, there was sufficient data available from the tonnage class 4 trawlers, and, the tonnage class 7 trawlers utilizing twin trawls for inclusion in the standardization. The twin trawls were introduced in 2003 but have accounted for less than 11% of the otter trawl catch with the exception of 2005 when they took 32%, however, twin trawls were not used since 2006 by the Can (N) fleet.

Residual plots (not shown) did not indicate model misspecification. The model resulted in a significant regression ($P < 0.05$) explaining 68% of the variation in catch rates (Table 6). Based on the regression coefficients, over the entire time series, catch rates were better in late summer and higher in Div. 2H. The divisional coefficients also suggest catch rate decreases from north to south. The fishing power of the large trawlers (TC 7) is the highest with no difference between single and twin trawls.

The standardized catch rate series (Table 7, Fig. 7) shows much between-year variability. CPUE more than doubled from 1976 to 1978, probably as a result of captains learning a relatively new fishery, then showed period of stability to 1984, during which time some of the highest catch rates were realized. CPUE declined by about two-thirds from 1984 to 1992 although there were some sporadic increases over this period. The 1992 value was near the lowest in the series, but catch rates increased gradually to 2001, doubling over this period. Catch rate declined sharply in 2002, and remained stable to 2005, which was only slightly higher than the lowest catch rate estimated over the 33 year series. Over the next three years to 2008, the index increased rapidly, by almost 3.5 times, to the highest rate in the series. The catch rate declined by 20% in 2009 but remained the second highest in the series. These most recent increases are associated with large variability within each year. The large increase in recent years has also been present in the CPUE data for fleets fishing in the NAFO Regulatory Area.

Additional analysis conducted on the CPUE series in 2009 suggested that increased CPUE may be partly due to fleets moving to areas of higher fish densities. In any case, Scientific Council has not accepted any CPUE series as indices of abundance for this Greenland halibut stock, and has recommended that further analyses be conducted on available CPUE data from all fleets.

References

Bowering, W. R., and W. B. Brodie. 2000. Calculation of catch-at-age for commercially caught Greenland halibut in NAFO Subarea 2 and Divisions 3KLMNO during 1975-99 with particular emphasis on construction of the catch-at-age matrix since 1989. NAFO SCR Doc. 00/24.

Brodie, W. B. and D. Power. 2001. The Canadian fishery for Greenland halibut in SA2 + Div. 3KLMNO, with emphasis on 2000. NAFO SCR Doc. 01/65, Ser. No. N4443, 13 p.

Brodie, W. B. and D. Power. 2002. The Canadian fishery for Greenland halibut in SA2 + Div. 3KLMNO, with emphasis on 2001. NAFO SCR Doc. 02/39, Ser. No. N4650, 12 p.

Brodie, W. B. and D. Power. 2003. The Canadian fishery for Greenland halibut in SA2 + Div. 3KLMNO, with emphasis on 2002. NAFO SCR Doc. 03/36, Ser. No. N4854, 14 p.

Brodie, W. B. and D. Power. 2004. The Canadian fishery for Greenland halibut in SA2 + Div. 3KLMNO, with emphasis on 2003. NAFO SCR Doc. 04/33, Ser. No. N4983, 14p.

Brodie, W. B. and D. Power. 2005. The Canadian fishery for Greenland halibut in SA2 + Div. 3KLMNO, with emphasis on 2004. NAFO SCR Doc. 05/62, Ser. No. N5148, 16p.

Brodie, W. B. and D. Power. 2006. The Canadian fishery for Greenland halibut in SA2 + Div. 3KLMNO, with emphasis on 2005. NAFO SCR Doc. 06/47, Ser. No. N5273, 19p.

Brodie, W. B. , D. Power and B. P.Healey. 2007. The Canadian fishery for Greenland halibut in SA2 + Div. 3KLMNO, with emphasis on 2006. NAFO SCR Doc. 07/50, Ser. No. N5402, 20p.

Brodie, W. B. , D. Power and B. P.Healey. 2008. The Canadian fishery for Greenland halibut in SA2 + Div. 3KLMNO, with emphasis on 2007. NAFO SCR Doc. 08/47, Ser. No. N5549, 21p.

Brodie, W. B. , D. Power and B. P.Healey. 2009. The Canadian fishery for Greenland halibut in SA2 + Div. 3KLMNO, with emphasis on 2008. NAFO SCR Doc. 09/38, Ser. No. N5674, 20p.

Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci. 37:2272-2275.

Gundersen, A.C. and W.B.Brodie. 1999. Length-weight relationships of Greenland halibut in NAFO Divisions 2GHJ and 3KLMNO, 1990-97. NAFO SCR Doc. 99/31, Ser. No. N4087.

Orr, D.C., P. Veitch, and D. Sullivan. 2002. An update of information pertaining to northern shrimp (*Pandalus borealis* Kroyer) and groundfish in NAFO Divisions 3LNO. NAFO SCR Doc. 02/160, Ser. No. N4789, 55 p.

Table 1. Canadian catch of G.halibut, by gear type, from 1960-2009.

			GEAR			**Canada**
YEAR	GILLNET	LONGLINE	MISC	UNSP	OT TRAWL	**TOTAL**
1960				660		660
1961				741		741
1962				586		586
1963		5		771		776
1964				1757		1757
1965				8082		8082
1966	257	194	15	15640	120	16226
1967	93	144	95	15478	798	16608
1968		94		12766	493	13353
1969	9980	850	69	412	245	11556
1970	9818	371	119	318	85	10711
1971	8947	153	55	180	75	9410
1972	8775	34	22	50	71	8952
1973	6546	35	70	102	95	6848
1974	5500	49	16	8	184	5757
1975	7510	3	53	1	247	7814
1976	8500	6	41		767	9314
1977	15038	33	36		2866	17973
1978	20622	46	83		3951	24702
1979	24550	116	116		5183	29965
1980	27703	128	57		3946	31834
1981	17927	55	43		6155	24180
1982	11038	69	59		8143	19309
1983	9911	58	73		7085	17127
1984	11100	27	100		6070	17297
1985	7422	2	42		4847	12313
1986	6293	7	20		1896	8216
1987	10849	22	115		2465	13451
1988	7715	70	53		629	8467
1989	10956	16	35		988	11995
1990	6732	18	15		2402	9167
1991	3440	36	9		3254	6739
1992	4470	30	1		2502	7003
1993	3863	4	5		1034	4906
1994	2378				575	2953
1995	2602	1			632	3235
1996	5134	1		1	1043	6179
1997	5202	61			1017	6280
1998	3963	108	4		46	4121
1999	3870	65			81	4016
2000	9271	18	5	14	1285	10593
2001	6395	123	14		1833	8365
2002	3854	652			1784	6290
2003	2668	596			3710	6974
2004	2634	403			1832	4869
2005	4317	101	1		2218	6637
2006	3848	175			2356	6379
2007	3202	3		268	1866	5339
2008	2409	24			2429	4862
2009	3280	3			2456	5739

Table 2. Canadian catch of G.halibut, by Division, from 1960-2009.

						DIVISION				Canada
YEAR	2G	2H	2J	*SA 2*	3K	3L	3M	3N	3O	**TOTAL**
1960					610	50				660
1961					613	128				741
1962					479	107				586
1963					592	184				776
1964					870	887				1757
1965					2129	5953				8082
1966					3691	12518		17		16226
1967			7	*7*	2892	13705		1	3	16608
1968			53	*53*	3672	9597		31		13353
1969					7140	4413		1	2	11556
1970					5937	4769		5		10711
1971					4160	5248		2		9410
1972					4736	4216				8952
1973			5	*5*	3602	3233		1	7	6848
1974			19	*19*	2817	2909		9	3	5757
1975			22	*22*	3245	4540		7		7814
1976	62	168	153	*383*	4779	4144	1	7		9314
1977		72	419	*491*	10751	6725	1	2	3	17973
1978		14	1255	*1269*	15875	7548	1	5	4	24702
1979		34	3163	*3197*	18165	8578	2	17	6	29965
1980		217	1157	*1374*	17658	12742	14	43	3	31834
1981	10	41	862	*913*	14379	8833		49	6	24180
1982	15	5155	3942	*9112*	6031	4105		55	6	19309
1983		2578	2238	*4816*	7679	4618		12	2	17127
1984		1913	2796	*4709*	7496	5078		12	2	17297
1985		1758	3101	*4859*	4395	3023		35	1	12313
1986		82	2476	*2558*	2886	2769		2	1	8216
1987		6	4143	*4149*	4740	4561		1		13451
1988	45	27	1867	*1939*	4591	1921	2	12	2	8467
1989		190	2635	*2825*	6342	2809	6	10	3	11995
1990	57	171	2798	*3026*	4075	2020	38	4	4	9167
1991		50	3008	*3058*	2215	1291	157	11	7	6739
1992	428	230	476	*1134*	3882	1951	4	10	22	7003
1993	557	403	214	*1174*	2398	880		19	435	4906
1994	1045	210	203	*1458*	1032	258		1	204	2953
1995	1006	453	709	*2168*	754	197			116	3235
1996	688	639	1058	*2385*	2567	888			339	6179
1997	370	619	1513	*2502*	2659	935			184	6280
1998	358	418	1234	*2010*	1374	633		1	103	4121
1999	65	103	1094	*1262*	1940	683			131	4016
2000	45	81	1152	*1278*	5845	2901	1	1	567	10593
2001	63	251	1030	*1344*	3999	2666		9	347	8365
2002	374	360	1030	*1764*	2933	1466	15		112	6290
2003	258	1897	730	*2885*	2873	964			252	6974
2004	147	1050	891	*2088*	1844	794		1	142	4869
2005	39	378	1717	*2134*	3006	1379		3	115	6637
2006	102	402	499	*1003*	3904	1438			34	6379
2007	3	121	2648	*2772*	1456	1015		5	92	5340
2008	10	158	2591	*2759*	1435	645		4	19	4862
2009	54	102	1554	*1710*	3018	1008		2	1	5739

Table 3a. Summary of Canadian catches of G.halibut in 2002 by area and gear.

	GN <400	GN >400	Longline	Otter trawl	Can (N)
2GH	154	7	573		734
2J	389	597	9	35	1030
3K	1304	830	28	771	2933
3L	56	424	8	978	1466
3MO	93		34		127
Total	1996	1858	652	1784	**6290**

Table 3b. Summary of Canadian catches of G.halibut in 2003 by area and gear.

	GN <400	GN >400	Longline	Otter trawl	Total Can
2G			253	5	258
2H		52	160	1685	1897
2J	263	271		196	730
3K	1462	539	2	870	2873
3L	5		5	954	964
3O		76	176		252
Total	1730	938	596	3710	**6974**

Table 3c. Summary of Canadian catches of G.halibut in 2004 by area and gear.

	GN <400	GN >400	Longline	Otter trawl	Total Can
2G			144	3	147
2H	52		131	867	1050
2J	262	533		96	891
3K	173	1231	38	402	1844
3L	208	116	6	464	794
3N			1		1
3O		59	83		142
Total	695	1939	403	1832	**4869**

Table 3d. Summary of Canadian catches of G.halibut in 2005 by area and gear.

	GN <400	GN >400	Longline	Otter trawl	Total Can
2G			39		39
2H	50	286	41	1	378
2J	10	767		940	1717
3K	446	1441		1119	3006
3L	1002	220	2	155	1379
3N		3			3
3O		93	19	3	115
Total	1508	2810	101	2218	**6637**

Table 3e. Summary of Canadian catches of G.halibut in 2006 by area and gear.

	GN <400	GN >400	Longline	Otter trawl	Total Can
2G			102		102
2H	200	134	51	17	402
2J	52	370	5	72	499
3K	292	1373	5	2234	3904
3L	1299	133	2	4	1438
3O		24	10		34
Total	1843	2034	175	2327	**6379**

Table 3f. Summary of Canadian catches of G.halibut in 2007 by area and gear.

	GN <400	GN >400	Longline	Otter trawl	Total Can
2G		3			3
2H	48	73			121
2J	331	577		1740	2648
3K	576	760		120	1456
3L	881	128		6	1015
3N			5		5
3O		88	4		92
Total	1836	1629	9	1866	**5340**
		Includes 269 t for Can (SF)			

Table 3g. Summary of Canadian catches of G.halibut in 2008 by area and gear.

	GN <400	GN >400	Longline	Otter trawl	Total Can
2G				10	10
2H	122	36			158
2J	27	210		2354	2591
3K	1054	316		65	1435
3L	610	34	1		645
3N			4		4
3O			19		19
Total	1813	596	24	2429	**4862**
	Includes 156 t for Can (SF)				

Table 3h. Summary of Canadian catches of G.halibut in 2009 by area and gear.

	GN <400	GN >400	Longline	Otter trawl	Total Can
2G	54				54
2H	66	34		2	102
2J	32	361		1161	1554
3K	1481	280		1257	3018
3L	861	111		36	1008
3N			2		2
3O			1		1
Total	2494	786	3	2456	**5739**

Table 4. Breakdown of Canadian catches of G.halibut in SA 2 + Div 3KLMNO in 2009 by area, gear, and month.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	GN<400 fm								118	2				120
	GN>400 fm								32	2				34
2GH	Otter trawl						2							2
	Total						*2*		*150*	*4*				*156*
	GN<400 fm						4		12	16				32
2J	GN>400 fm						182	179						361
	Otter Trawl					281	314	152	200			160	54	1161
	Total					*281*	*500*	*331*	*212*	*16*		*160*	*54*	*1554*
	GN<400 fm						649	824		8				1481
3K	GN>400 fm						161	119						280
	Otter Trawl					322	414	457	64					1257
	Total					*322*	*1224*	*1400*	*64*	*8*				*3018*
	GN<400 fm						51	604	180	26				861
	GN>400 fm						4	78	29					111
3L	Otter Trawl				4	11			21					36
	Total				*4*	*11*	*55*	*682*	*230*	*26*				*1008*
	Gillnet													
3NO	Longline	1	1	1										3
	Total	*1*	*1*	*1*										*3*
	TOTAL	**1**	**1**	**1**	**4**	**614**	**1781**	**2413**	**656**	**54**		**160**	**54**	**5739**

Table 5. Catch at age for the Canadian catch of G.halibut in SA 2 + Div. 3KLMNO in 2009.
Catch at age in thousands of fish. See text for definition of GN gear types.
Asterisk represents catch of less than 500 fish. SOP is catch number x mean wgt.
Total includes 3 t of longline catch, not shown by gear-type in the table

							Mean		
Age	OT trawl	GN<400	GN>400	Total	Pct	Len (cm)	Wgt (kg)	S.O.P(t)
3									
4	*			**0.5**	**0.01**	32.8	0.281	0.1
5	16			**16**	**0.32**	37.3	0.422	6.8
6	316	32	7	**355**	**7.13**	42.3	0.625	221.9
7	1221	489	119	**1831**	**36.76**	47.5	0.903	1653.4
8	682	1126	260	**2070**	**41.56**	51.9	1.190	2463.3
9	130	307	77	**514**	**10.32**	57.3	1.629	837.3
10	29	54	35	**118**	**2.37**	62.7	2.163	255.2
11	15	10	21	**46**	**0.92**	67.0	2.681	123.3
12	8	1	7	**16**	**0.32**	72.7	3.458	55.3
13	2	*	4	**6**	**0.12**	73.9	3.648	21.9
14	1	*	2	**3**	**0.06**	75.8	3.954	11.9
15	2	1	2	**5**	**0.10**	80.8	4.840	24.2
16			*	**0.5**	**0.01**	85.5	5.730	2.9
17			*	**0.2**	**0.004**	82.5	5.118	1.0
18								
19								
	2422	2020	534	4981	**100.00%**			**5678**
							Catch	5739

Table 6. ANOVA results and regression coefficients from a multiplicative model utilized to derive a standardized CPUE index for Greenland halibut in NAFO Div. 2HJ3KL. Analysis is based on HOURS FISHED from the Canadian ottertrawl fleet (2009 based on preliminary data)

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REGRESSION OF MULTIPLICATIVE MODEL
MULTIPLE R..... 0.823
MULTIPLE R SQUARED..... 0.678

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARE	F-VALUE
INTERCEPT	1	2.38E2	2.38E2	
REGRESSION	53	1.06E2	2.00E0	11.843
Cntry|Gear|TC	6	1.13E1	1.88E0	11.094
Month	11	2.24E0	2.04E-1	1.205
Division	3	3.83E0	1.28E0	7.540
Year	33	4.16E1	1.26E0	7.458
RESIDUALS	298	5.04E1	1.69E-1	
TOTAL	352	3.95E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VAR #	REG. COEF	STD. ERR	NO. OBS
Cntry|Gear|TC	3125	INT	-1.236	0.308	352
Month	9				
Division	22				
Year	76				
1	3123	1	-0.341	0.130	14
	3124	2	-0.142	0.200	5
	3126	3	0.146	0.123	16
	3127	4	0.715	0.118	41
	3857	5	0.739	0.152	12
	27125	6	0.131	0.100	25
2	1	7	-0.034	0.142	13
	2	8	0.083	0.147	13
	3	9	-0.141	0.123	23
	4	10	-0.055	0.114	31
	5	11	0.114	0.114	28
	6	12	0.097	0.102	39
	7	13	-0.010	0.091	54
	8	14	0.082	0.088	52
	10	15	-0.166	0.118	21
	11	16	-0.137	0.134	15
	12	17	0.047	0.123	19
3	23	18	-0.124	0.085	101
	31	19	-0.358	0.089	144
	32	20	-0.370	0.100	62
4	77	21	0.298	0.348	5
	78	22	0.866	0.335	8
	79	23	0.868	0.382	3
	80	24	1.021	0.321	13
	81	25	0.912	0.323	14
	82	26	0.977	0.328	10
	83	27	0.970	0.315	18
	84	28	1.115	0.321	12
	85	29	0.655	0.320	13
	86	30	0.421	0.336	8
	87	31	0.880	0.350	5
	88	32	0.094	0.364	4
	89	33	0.573	0.342	6
	90	34	0.508	0.321	12
	91	35	0.154	0.316	16
	92	36	0.067	0.314	20
	93	37	0.096	0.325	15
	94	38	0.274	0.364	4
	95	39	0.446	0.417	2
	96	40	0.295	0.332	8
	97	41	0.629	0.337	7
	98	42	0.419	0.419	2
	99	43	0.332	0.423	2
	100	44	0.505	0.330	9
	101	45	0.689	0.318	17
	102	46	0.279	0.325	11
	103	47	0.195	0.309	28
	104	48	0.220	0.313	20
	105	49	0.240	0.317	23
	106	50	0.763	0.338	10
	107	51	1.116	0.347	8
	108	52	1.459	0.357	6
	109	53	1.211	0.333	11

LEGEND FOR ANOVA RESULTS:

CGT CODES: All are Stern Trawlers

3123 = Can(NFLD) Otter Trawl TC 3

3124 = " " TC 4

3125 = " " TC 5

3126 = " " TC 6

3127 = " " TC 7

3857 = " Twin Otter Trawl TC 7

27125 = Can(M) Otter Trawl TC 5

DIVISION CODES:

22 = 2H, 23 = 2J, 31 = 3K, 32 = 3L

Table 7. Standardized CPUE for Greenland halibut in NAFO 2HJ3KL based on a multiplicative model based utilizing HOURS FISHED as a measure of effort. Results are from the CANADIAN OTTERTRAWL fleet (2009 based on preliminary data).

PREDICTED CATCH RATE

	LN TRANSFORM		RETRANSFORMED				% OF CATCH IN
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT	THIS ANALYSIS
1976	-1.2364	0.0946	0.302	0.091	767	2544	9.5
1977	-0.9385	0.0448	0.416	0.087	2866	6882	20.9
1978	-0.3701	0.0332	0.739	0.134	3951	5343	30.0
1979	-0.3681	0.0707	0.727	0.190	5183	7128	35.4
1980	-0.2151	0.0255	0.867	0.138	3946	4553	42.9
1981	-0.3240	0.0241	0.778	0.120	6155	7913	59.2
1982	-0.2592	0.0228	0.831	0.125	8143	9805	73.4
1983	-0.2668	0.0175	0.826	0.109	7085	8573	87.4
1984	-0.1211	0.0197	0.955	0.134	6070	6357	90.4
1985	-0.5816	0.0199	0.603	0.085	4847	8045	91.2
1986	-0.8155	0.0293	0.475	0.081	1896	3995	74.6
1987	-0.3567	0.0428	0.746	0.153	2465	3305	85.6
1988	-1.1422	0.0543	0.338	0.078	629	1861	38.8
1989	-0.6633	0.0380	0.550	0.106	988	1796	21.2
1990	-0.7287	0.0229	0.519	0.078	2402	4626	75.9
1991	-1.0829	0.0220	0.365	0.054	3254	8926	70.0
1992	-1.1699	0.0190	0.335	0.046	2502	7475	50.2
1993	-1.1405	0.0274	0.343	0.057	1034	3013	87.7
1994	-0.9628	0.0538	0.405	0.093	575	1421	96.5
1995	-0.7903	0.0945	0.471	0.142	632	1342	56.2
1996	-0.9415	0.0311	0.418	0.073	1043	2495	81.0
1997	-0.6076	0.0350	0.583	0.108	1017	1746	94.7
1998	-0.8172	0.0966	0.458	0.139	46	100	63.0
1999	-0.9041	0.0994	0.419	0.129	81	193	81.5
2000	-0.7319	0.0302	0.516	0.089	1285	2492	99.3
2001	-0.5472	0.0223	0.623	0.093	1833	2943	99.2
2002	-0.9571	0.0266	0.412	0.067	1784	4325	98.7
2003	-1.0418	0.0136	0.381	0.044	3710	9726	89.9
2004	-1.0163	0.0169	0.391	0.051	1832	4689	98.5
2005	-0.9965	0.0250	0.397	0.062	2218	5589	98.1
2006	-0.4733	0.0369	0.666	0.127	2356	3539	94.8
2007	-0.1200	0.0456	0.944	0.200	1866	1977	99.7
2008	0.2230	0.0525	1.325	0.300	2430	1834	93.0
2009	-0.0254	0.0358	1.042	0.196	2456	2356	98.4

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.189

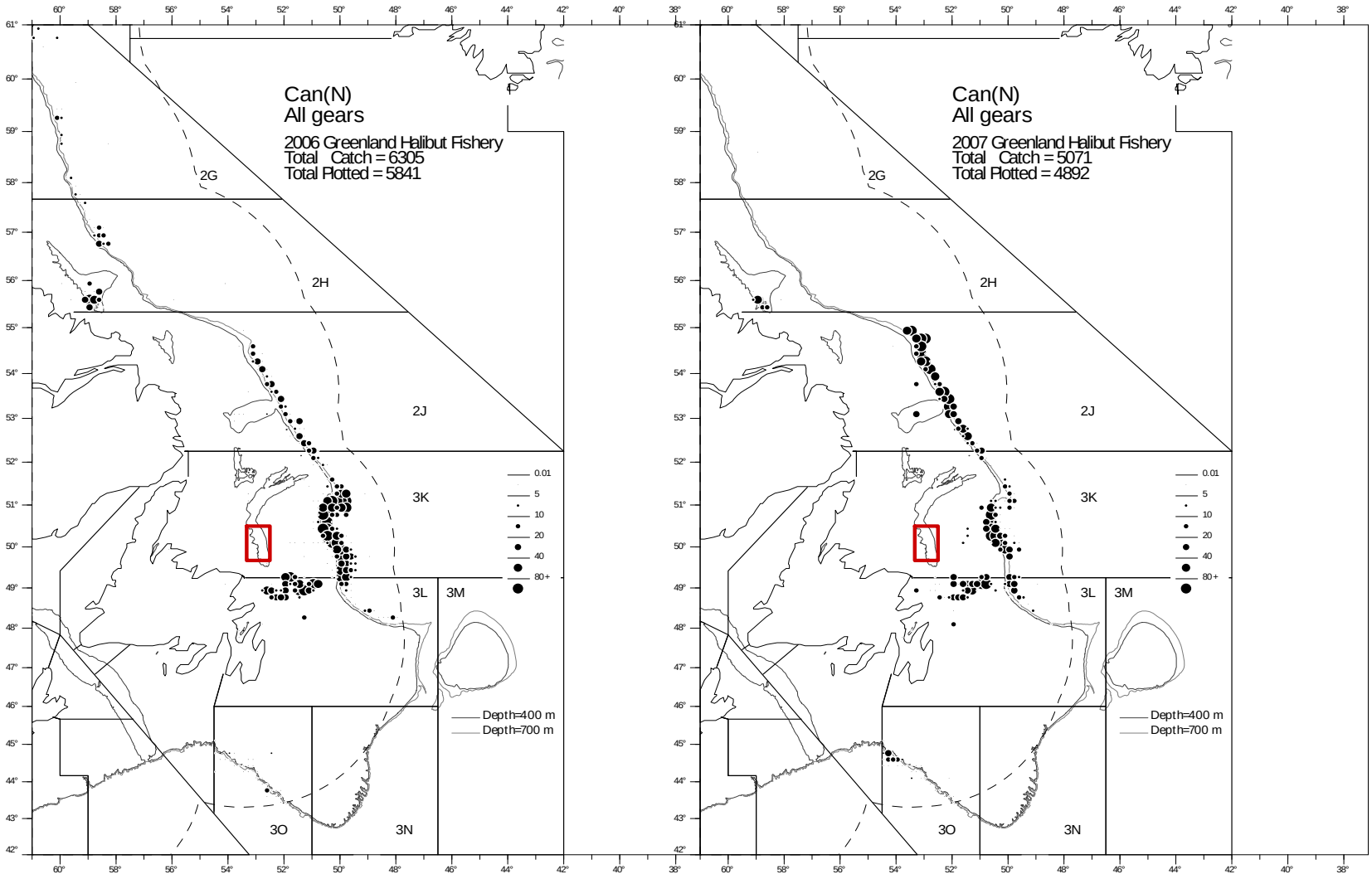

Fig.1. Distribution of Can(N) Greenland halibut catch (tons) from the 2006 and 2007 fisheries. Represented is catch from directed fisheries and by-catch from other fisheries aggregated by 10-minute square for all gears from Div. 2G to Div. 3O where position was recorded on the logbook. Also shown is the area in Div. 3K closed to GILLNETs since early 2002 due to snow crab bycatch.

ghl2006+7 xfcat 2g3oland.ACN

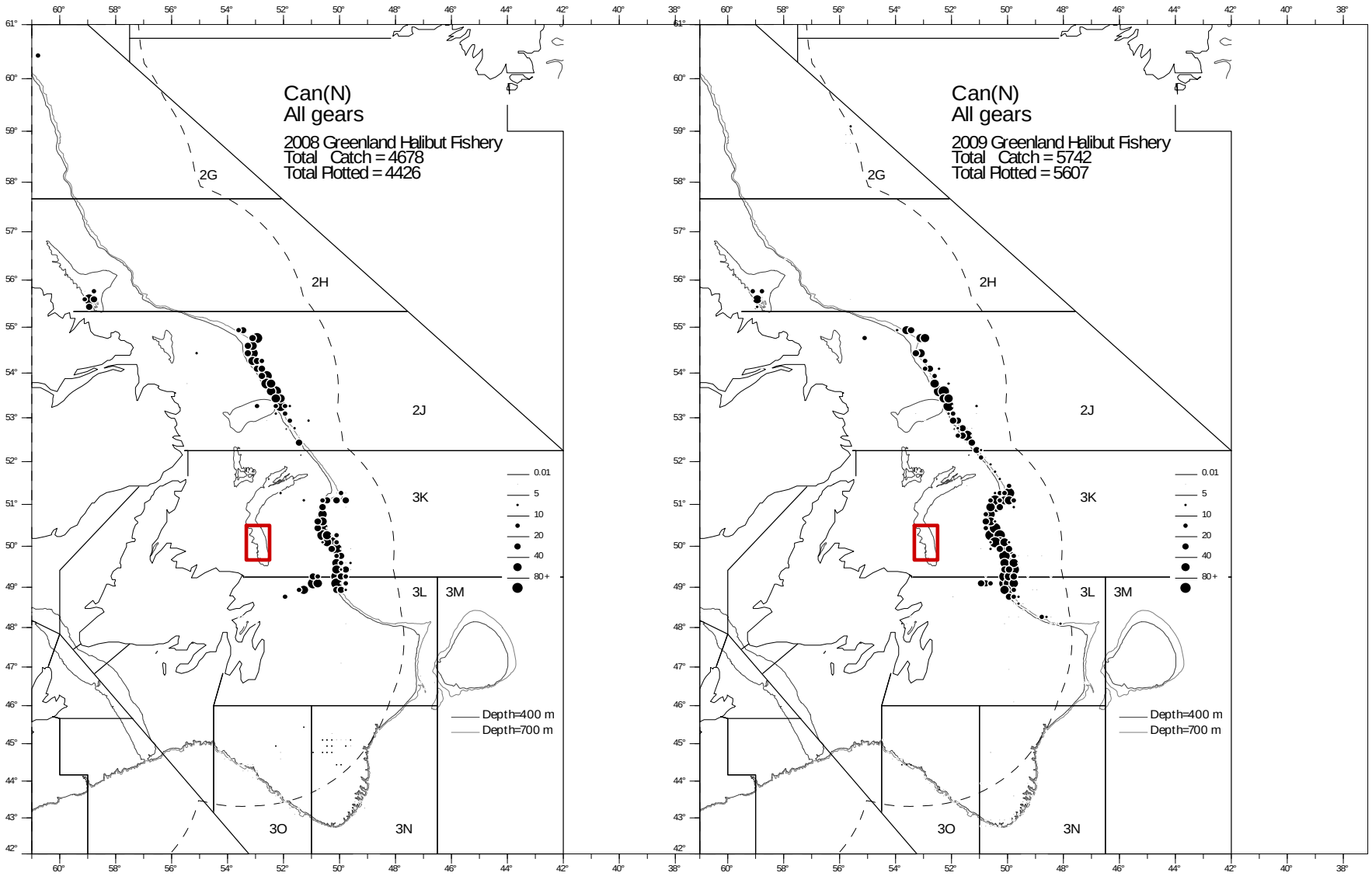

Fig.2. Distribution of Can(N) Greenland halibut catch (tons) from the 2008 and 2009 fisheries. Represented is catch from directed fisheries and by-catch from other fisheries aggregated by 10-minute square for all gears from Div. 2G to Div. 3O where position was recorded on the logbook. Also shown is the area in Div. 3K closed to GILLNETs since early 2002 due to snow crab bycatch.

gh2008+9 zfcat 2g3otland ACN

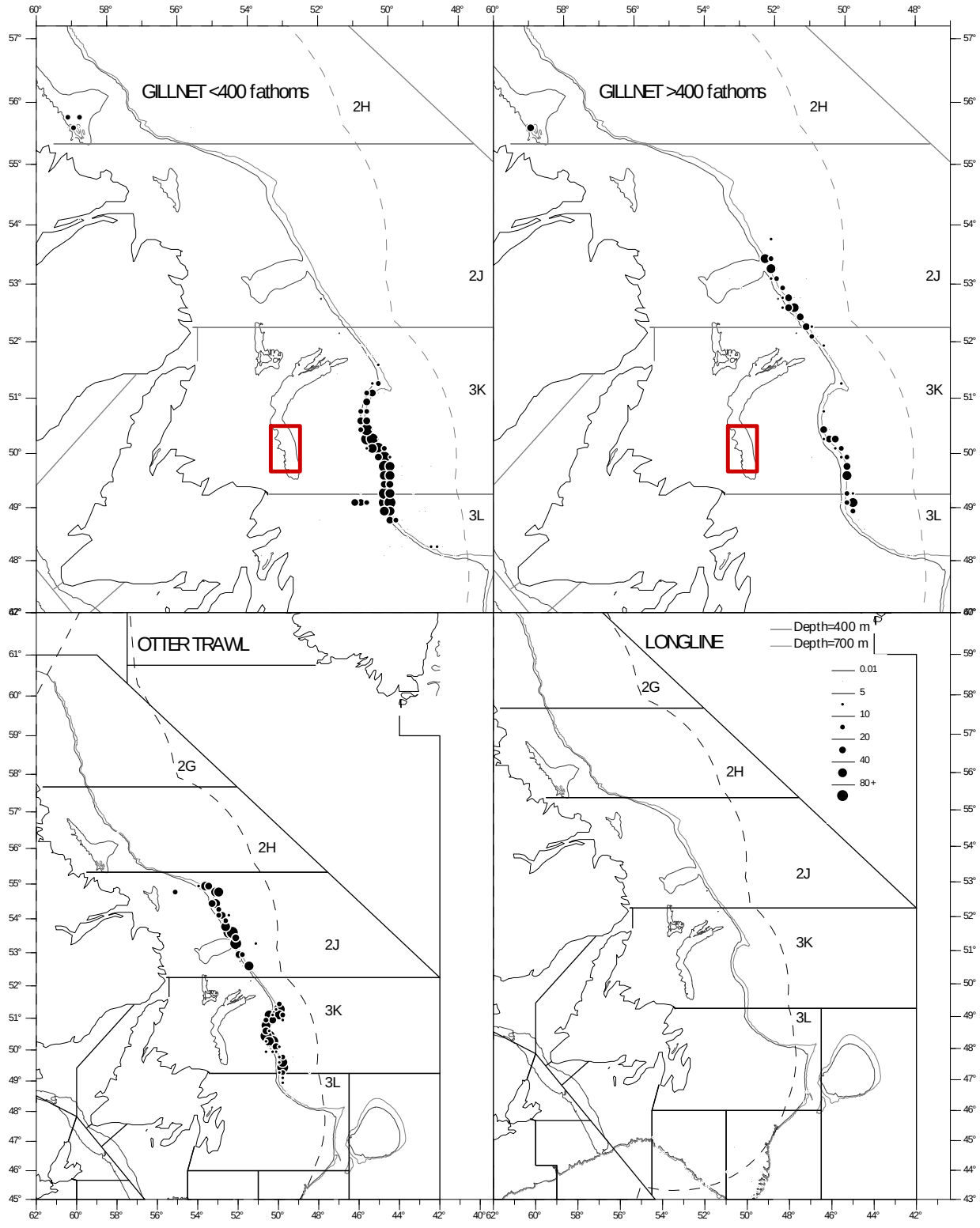

Fig.3 Distribution of Can(N) Greenland halibut catch (tons) from the 2009 commercial fishery. Represented is LONGLINE, GILLNET (<400 fathoms and >400 fathoms) and OTTER TRAWL from both directed and by-catch fisheries. Data are aggregated by 10-minute square where position information exists. Note the closed area for GILLNETs in Div. 3K due to crab bycatch.

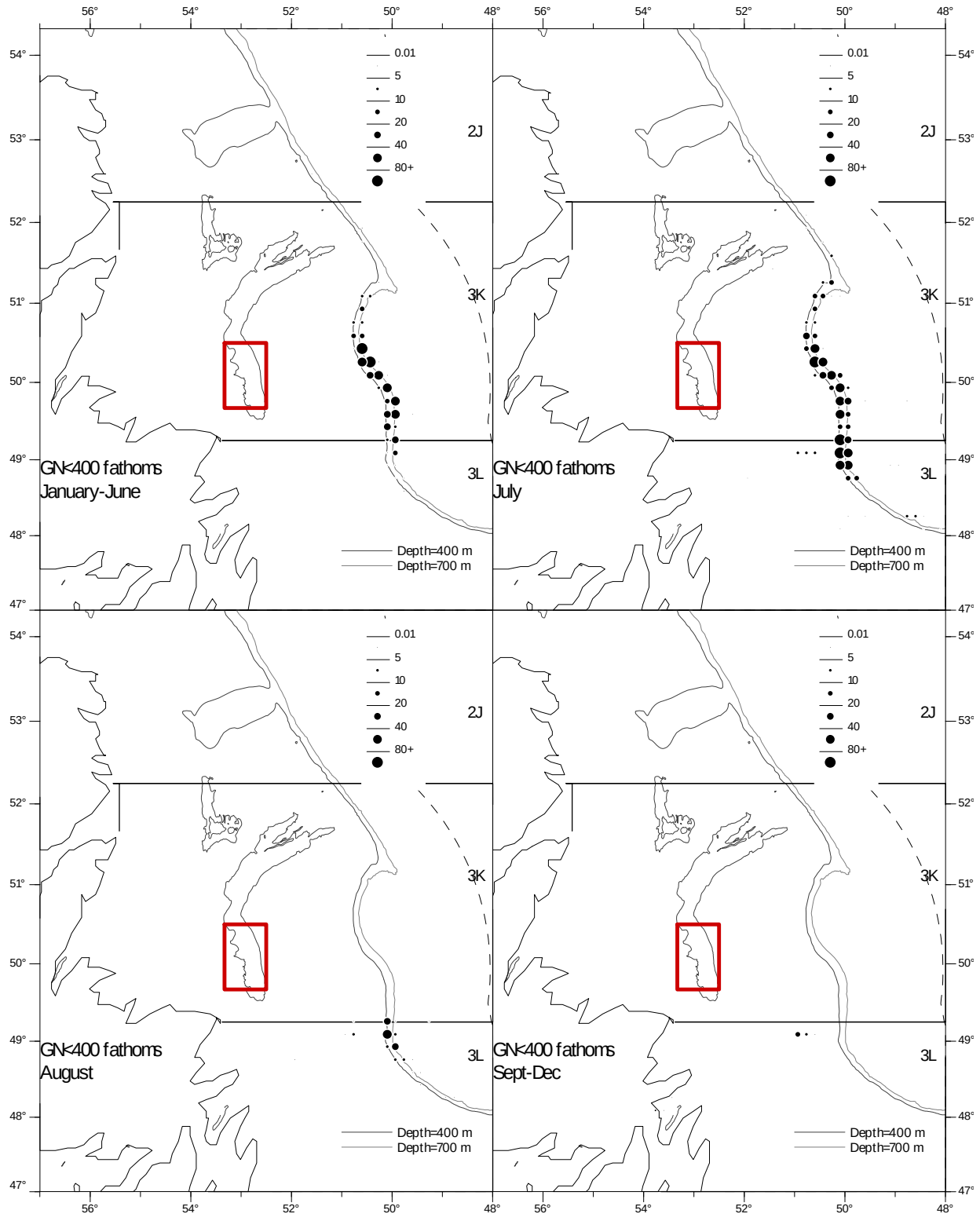

Fig.4. Distribution of Can(N) Greenland halibut catch (tons) from the 2009 commercial fishery. Represented is GILLNET (<400 fathoms) for various months from both directed fisheries and by-catch fisheries. Data are aggregated by 10-minute square where position information exists. Note the closed area for GILLNETs in Div. 3K due to crab bycatch.

gh2009 .zfcat GNLE400.ACN

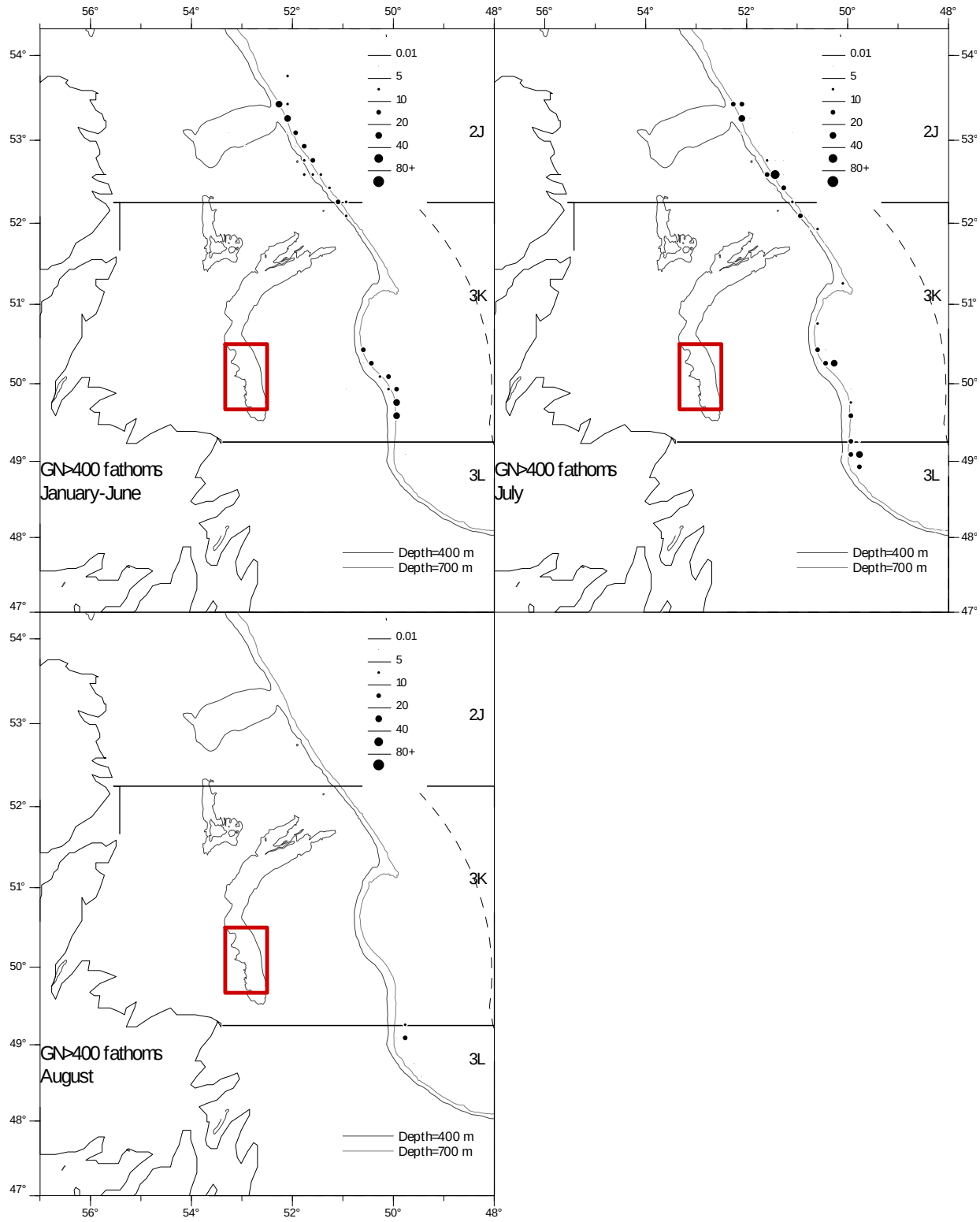

Fig.5. Distribution of Can(N) Greenland halibut catch (tons) from the 2009 commercial fishery. Represented is GILLNET (>400 fathoms) for various months from both directed fisheries and by-catch fisheries. Data are aggregated by 10-minute square where position information exists. Note the closed area for GILLNETs in Div. 3K due to crab bycatch.

gh2009 .zfcat GNGT400.ACN

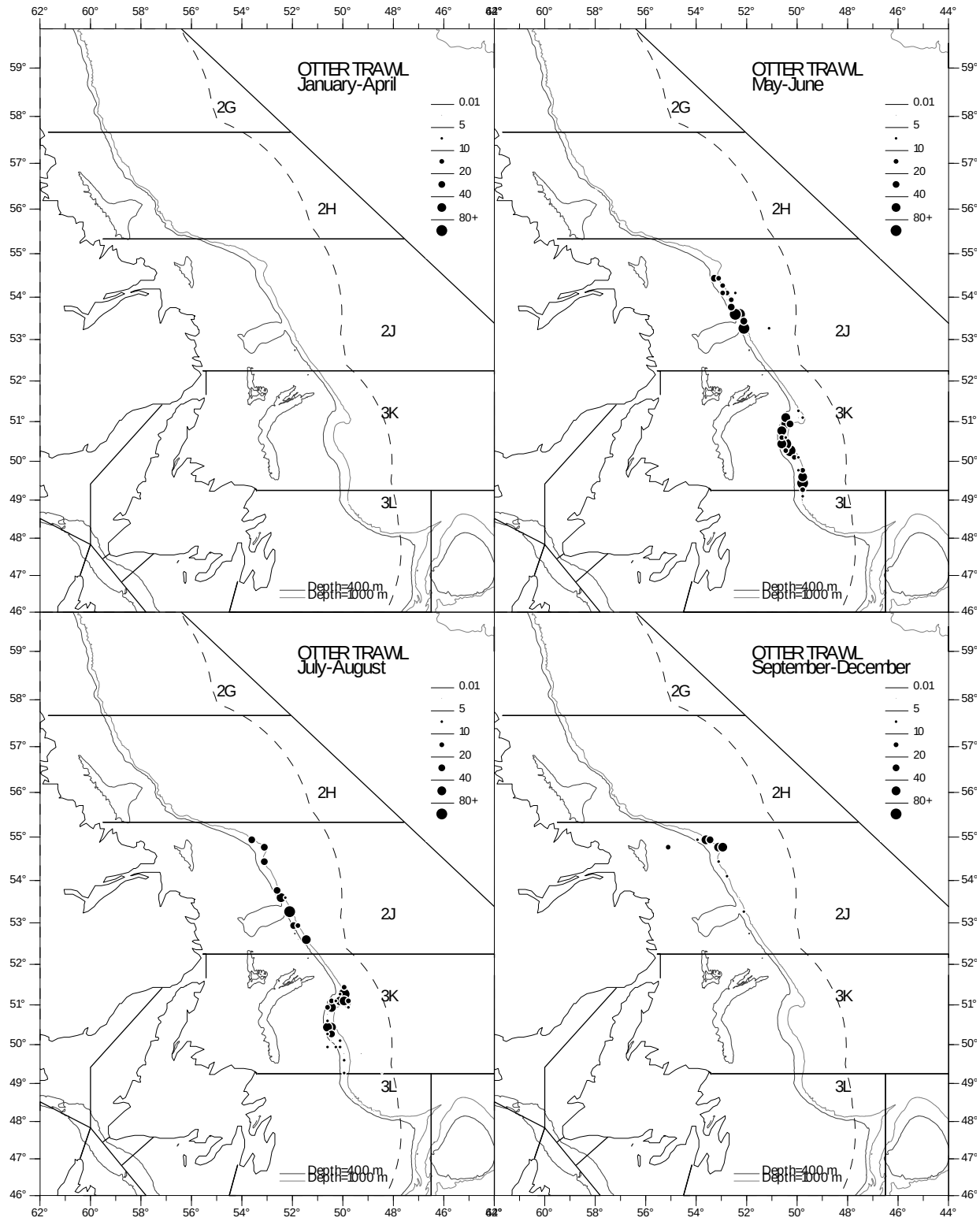

Fig6. Distribution of Can(N) Greenland halibut catch (tons) from the 2009 commercial fishery. Represented is OTTER TRAWL catch for various months from directed fisheries and by-catch from other fisheries. The data are aggregated by 10-minute square for Div. 2J3KL where position was recorded on the logbook.

gh2009 .sfcat OT.ACN

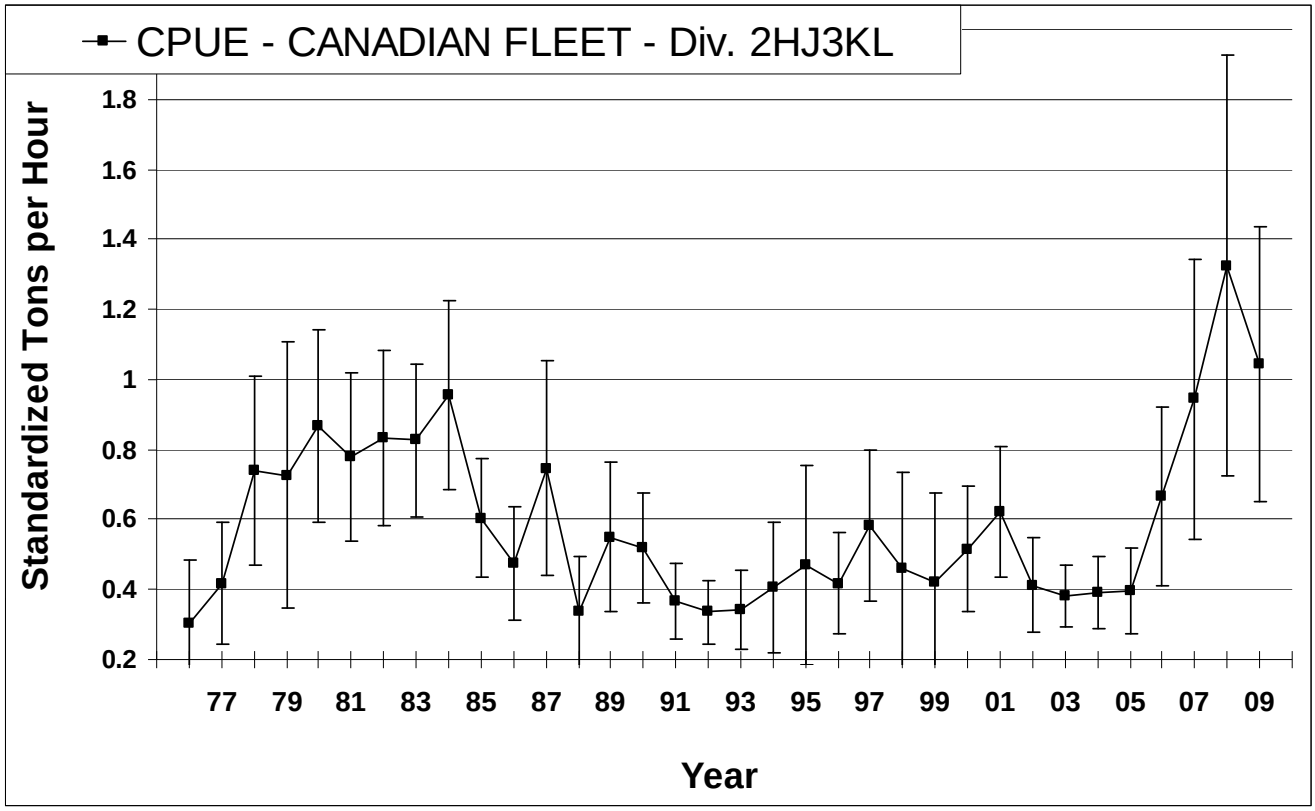

Fig. 7. Standardized Mean CPUE ± 2 standard errors for Greenland Halibut in Div. 2HJ3KL utilizing effort in HOURS fished from the CANADIAN OTTERTRAWL FLEET.