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The Canadian fishery for Greenland halibut in SA 2 + Div. 3KLMNO, with emphasis on 2010.

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Abstract

The Canadian catch of Greenland halibut in 2010 in NAFO Subarea 2 and Divisions 3KLMNO was reported to be 6525 t, about 800 t higher than in 2009. This increase was in the otter trawl fleet, while gillnet catches remained constant. Partly as a result of regulatory amendments, about 55% of gillnet catches in 2010 came from depths greater than 731 m, compared to only 24% of gillnet catches in this depth in 2009. Catches in 2010 were highest in Div 2J, unlike 2009 but similar to 2007 and 2008. About 22% of the catch was taken in each of July and August, mostly by gillnet, although most of the otter trawl catch occurred in April to June, and December. Overall, the catch at age in 2010 was dominated by the 2002 and 2003 year classes, which accounted for approximately 71% of the catch numbers and 64% 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 2010 were very similar to 2009, and to recent years. CPUE as analysed from logbooks of Canadian trawlers decreased by almost 50% in 2010, to a level around the long term mean, following a decline in 2009 and large increases in 2006 to 2008.

Canadian fishery for GHL in previous years and comparisons with 2010

As reported in several previous documents (e.g. Brodie et.al. 2010), 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 of this stock increased sharply 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, with the average from 2000 to 2010 being 6600 tons. 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, regulations, 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), 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 (MMS) of about 152 mm. However, Canadian gillnet catches taken since the mid to late 1980s also include 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, MMS 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, 2010), including 2010, which have increasingly permitted the used of smaller mesh in more areas. In 2010, the only remaining areas requiring 191 mm MMS was Div. 3NO deeper than 732 m, and Div. 3L deeper than 914 m (increased from 732 m in 2009). Also in 2010, 178 mm was introduced as the MMS in depths > 914 m in Div. 3K, compared to 152 mm MMS for all depths > 549 m in 2009.

Other restrictions on numbers of nets now exist, as indicated in the tables below, which show the 2007-2010 regulations in the conservation harvesting plans (CHP) in the Canadian gillnet fishery for GHL. 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.

2007

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

2009

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

2010

Area	Depth (m)	# of Nets	MMS (mm)
2GH + 3L	293-549	125	152
2GH	>549	200	152
2J	>732	300	152
3K + 3L	549-914	200	152
3K	>914	400	178
3L	> 914	400	191
3NO	> 732	400	191

Gillnet catches during the 1990's ranged from 2400 to 6700 t, averaging about 4200 t. Catches since 2000 from this sector ranged between 2400 and 9300 t, averaging about 4100 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 after 2006 (Table 1).

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. Otter trawl was the predominant gear in the Canadian fishery in 2003, 2008, and 2010. 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, 2008, and 2010. Most of the catch from Subarea 2 has come from Div. 2J (eg. 2007-10), although catches in 1993-96, 2003-04, and 2006 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 the Greenland halibut fishery in 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 2009 and 2010 values being 3000 and 2300 t. Peak catches of around 13,000 t in Div 3L occurred in 1966-67 and 1980, and catches averaged about 1000 t from 2007 to 2010. Catches in Div. 3M, 3N, and 3O combined have been less than 100 t per year since 2005 (less than 5 t in 2009-10) and occur mainly in Div. 3O (Table 2).

Additional details on the Canadian fishery for GHL in 2010

There were some differences in the spatial and temporal patterns in the Canadian fishery for GHL in 2010 compared to those observed in 2009 and other recent years. The total reported catch was just over 6500 t, an increase of almost 800 t from 2009, but similar to the 2005-06 catches. Catches in the otter trawl fleet were higher in 2010, but were basically unchanged in the gillnet sector, with the 1000 t reduction in shallow water gillnet catches being offset by an increase of the same magnitude in the deepwater gillnet catches. 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, in some years, 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, 2008, and 2010, when otter trawls took most of the catch. In 2004 to 2006, as well as 2010, the gillnet catches in the shallow zone (<400 fm, or 732 m) were lower than in the deep zone. 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, increased to approximately 2500 t in 2009, before declining to just under 1500 t in 2010. Longline catches declined to less than 10 t in 2008-10. 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 over 3500 tons in 2009 and 2010. Otter trawl catches were almost equally split between 2J and 3K in 2009, but occurred primarily in 2J in 2007, 2008, and 2010. There was little consistency in the distribution of OT catches by division from 2004 to 2010. In 2005-10, there was less than 200 t per year (zero in 2008) of Canadian catch of GHL by otter trawl in Div. 3L, compared to about 1000 t per year in this area in 2002-03. In 2010, approximately 21% (675 t) of the otter trawl catch was reported as coming from twin trawls, compared to 6% in 2009.

The catch in 2010 was distributed over a longer period than in some of the recent years, e.g. about 71 % of the 2010 catch occurred in May to August, compared to almost 95% in these months in 2009. There has been substantial variation in the temporal pattern of catch in recent years. Unlike in 2007 and 2008, when a large percentage of otter trawl catches were taken before April, OT catches in 2009 occurred mainly during May to July, and in 2010 were mainly in April to June, and December. In general, most of the otter trawl catches are taken by large vessels which are able to fish in seasons when the smaller gillnet vessels cannot.

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, Jul 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. In 2010, the test fishery was opened on Aug. 2, and only 21 t, or 2% of the available quota was taken; as this fishery was closed due to high by-catches of cod, as well as grenadier in some trips/areas (pers. comm. L. Knight, DFO St.John's). By-catches of snow crab in 2009 and 2010 were relatively low.

Catch at age

Details on the Canadian catch at age for previous years can be found in Bowering and Brodie (2000), Brodie and Power (2006), and Brodie et al. (2010), as well as in numerous other 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. It should be noted that the catch at age calculated does not include any discards (e.g. from the shrimp fishery).

Sampling data collected in 2010 by observers at sea and by port samplers, were available from Divs. 2J 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 2008-09.

2008	2J		3K		3LO	
Gill net < 400			2633		3247	
Gill net > 400	967	*144*	1398	*316*	451[1]	*325*
Otter trawl (incl twin)	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 (incl twin)	4066	*262*	2717	*151*		
Totals	8618	*755*	5961	*569*	6406	*131*

2010	2J		3K		3L	
Gill net < 400			1556		1836	
Gill net > 400	409	*47*	1332	*471*	1483	*453*
Otter trawl (incl twin)	7666	*279*	4098	*417*	1319	*108*
Totals	8075	*326*	6986	*888*	4638	*561*

[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 fisheries. The higher number of measurements from the otter trawl catch is due to the requirement for these vessels to have a higher percentage of observer coverage than the gillnet fleets. The total number of length measurements in 2010 was 19,699, a decrease of 6% compared to 2009 (2009 was up 51% from 2008, 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 to be adequately sampled for lengths in 2010. The number of otoliths collected in 2010 (1775) was 22% higher than in 2009, and 40% higher than in 2008, following a period of decline in the otolith sampling rate. As has been done in most years age-length keys were combined across some gears, Divisions, and seasons to calculate catch at age.

Approximately 5.4 million GHL were caught in the 2010 Canadian fishery, a slight increase over 2009 levels. Age compositions are presented for both gillnet components (GN<400 and GN>400) as well as for otter trawl and twin trawl (Table 5). The predominant age in the otter/twin trawl catch was 7 (2003 year class), while age 8 (2002 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 2010 was dominated by the 2002 and 2003 year classes, which together accounted for 71% of the catch numbers and 64% of the catch weight. These are 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 2000-2010, age 8 contributed the second highest portion to the annual catch numbers after age 7, with the exception of 2009 when 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 increasingly permitted in deeper areas. For example, 3-15% of the catch in numbers by this fleet in 2006-10 (11% in 2010) was estimated to be age 10 or older, compared to 72-80% in 2001 and 2002. In 2009 and 2010 only 3.9% and 6.0% of the total Canadian catch numbers were from ages 10 and older.

Mean weights at age for all areas in 2010 were calculated from the mean lengths at age using the same length-weight relationship used for GHL catch at age in 1998-2009, i.e. log weight = 3.158 log length - 5.3431 (Gundersen and Brodie 1999). Weights at ages 6-7 and 10-11 in 2010 differed by less than 1% from those of 2009, and by less than 7% at ages 8, 9, and 12. At ages 5 or less and ages 12+ there are few fish in the catch, and weights at these ages are often variable between years, likely due to sampling. The sum of products (weights X numbers at each age) was 2.6% lower than the catch weight in 2010, compared to 1% in 2009.

Standardized Otter Trawl 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 and combined with data from 2003-2010 from Canada (N) logbook data. 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 2000-2010, and averaged 92% since 1995. In recent 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 in most years, with the exceptions of 2005 when they took 32%, and 2010 when they caught 21%.

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 summer and higher in Div. 2H. The divisional coefficients also suggest that CPUE 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. 1) 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 yearly increases during this period. The 1992 value was near the lowest in the catch rate series and except for some brief periods of increase, remained stable to 2005. Over the next three years, catch rates increased rapidly, by over 240%, and peaked at the highest rate in the series in 2008. The catch rate declined rapidly in 2009 and again in 2010 (down 47%), to near the mean value of the series. Some of the

estimates over the past 5 years are associated with particularly large variability. Scientific Council has, on a number of occasions, recommended against the use of this and other CPUE series as indices of abundance for this stock.

Fishery Distribution

Figs. 2-4 show the location of most of the Canadian catch of GHL in 2005-10. These data were aggregated by 10-minute squares from logbook records. In all six years, the plotted data account for 94% on average of the total Canadian catch. The spatial distributions of the catches in these 6 years were broadly similar, particularly so in 2009 and 2010. One notable difference is the reduction and eventual prohibition of gillnet catch in the north-central part of Div. 3L due to issues with cod by-catch (Brodie et al. 2010). Perhaps in connection with this is also the expansion of activity further south along the shelf break area in the Div. 3L in 2010.

Fig. 5 shows the location of the 2010 catch by the 4 major gear types (2 gillnet categories based on depth, otter trawl, and longline, with the latter being negligible again in 2010). Most of the otter trawl catch in 2010 was harvested in two main areas, in Div. 2J (64%) and Div 3K (30%) along the slope edge (Figs 5, 6). The proportion of the otter trawl catch has changed over the past several years with Div. 2H predominant in 2003-4 (50% of the catch), Div. 3K predominant in 2005 (>90% of the catch) and Div. 2J predominant in 2007-2008 (>90% of the catch). About 62% of the otter trawl catch in 2010 was taken in April and December, a different pattern than in 2009 when almost all OT catch was taken in May to August.

Most of the gillnet catch is taken in the summer by small vessels (<65' LOA). Canadian fisheries management regulations include a split season for GHL fixed gear quotas. In addition, as noted earlier, the number and mesh size of gillnets had been regulated based on depth zone (GN<=400 fathoms: minimum 6" (152 mm) mesh; GN>400 fathoms: minimum 7.5" (191 mm) mesh) but variations on mesh sizes and numbers of nets have been allowed. As a consequence, there have been changes in fishing patterns over the past 10 years within the gillnet fleets. In terms of a CPUE series, mesh size has been recorded on logbook data sheets in the past but it may be inconsistent. Nevertheless, only the past 2 years has the information been entered into a database for the purposes of developing establishing a standardized CPUE series. In 2010, about 55% of the GN<400 was caught in August and along the Div. 3KL boundary area (Fig. 5, 7). The spatial distribution of the deepwater gillnet (GN>400) fishery in 2010 (Fig. 5, 8) was similar to recent years, i.e. widely distributed along the slope edge from northern 3L to Div. 2J, with slightly more catch taken along the Div. 3KL boundary.

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Table 1. Canadian catch of G.halibut, by gear type, from 1960-2010.

	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
2010	3247	2			3276	6525

Table 2. Canadian catch of G.halibut, by Division, from 1960-2010.

	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
2010	31	30	2893	*2954*	2268	1301			2	6525

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 3i. Summary of Canadian catches of G.halibut in 2010 by area and gear.

	GN <400	GN >400	Longline	Otter trawl	Total Can
2G	10	21			31
2H	16	9		5	30
2J	55	741		2097	2893
3K	758	532		978	2268
3L	620	485		196	1301
3N					
3O			2		2
Total	1459	1788	2	3276	**6525**

Table 4. Breakdown of Canadian catches of G.halibut in SA 2 + Div 3KLMNO in 2010 by area, gear, and month.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2GH	GN<400 fm							2	24					26
	GN>400 fm							11	19					30
	Otter trawl								5					5
	Sub-Total							*13*	*48*					*61*
2J	GN<400 fm						3	31	19		2			55
	GN>400 fm						196	243	221	22	39	20		741
	Otter Trawl				569	159	188	16	62	45	38	105	470	1652
	Twin trawl				53		175		11				206	445
	Sub-Total				*622*	*159*	*562*	*290*	*313*	*67*	*79*	*125*	*676*	*2893*
3K	GN<400 fm						118	245	362	33				758
	GN>400 fm						181	247	101	3				532
	Otter Trawl			161	94	356	37	77		1	9		13	748
	Twin trawl						105	125						230
	Sub-Total			*161*	*94*	*356*	*441*	*694*	*463*	*37*	*9*		*13*	*2268*
3L	GN<400 fm						6	214	400					620
	GN>400 fm						91	210	184					485
	Otter Trawl			7		128	32	10			5		14	196
	Sub-Total			*7*		*128*	*129*	*434*	*584*	*0*	*5*		*14*	*1301*
3NO	Gillnet													
	Longline	1							1					2
	Sub-Total	*1*							*1*					*2*
	TOTAL	**1**		**168**	**716**	**643**	**1132**	**1431**	**1409**	**104**	**93**	**125**	**703**	**6525**

Table 5. Catch at age for the Canadian catch of G.halibut in SA 2 + Div. 3KLMNO in 2010.
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 2 t of longline catch, not shown by gear-type in the table

								Mean		
Age	OT trawl	Twin trawl	GN<400	GN>400	Total	Pct	Len (cm)	Wgt (kg)	S.O.P(t)
3									
4	1				**1.5**	**0.03**	33.6	0.303	0.5
5	29	*	*		**30**	**0.55**	36.0	0.373	11.2
6	364	167	18	7	**556**	**10.28**	42.2	0.621	345.3
7	1208	407	304	275	**2195**	**40.58**	47.5	0.902	1979.9
8	552	99	465	531	**1648**	**30.47**	52.9	1.268	2089.7
9	183	31	209	233	**656**	**12.13**	57.9	1.681	1102.7
10	48	3	65	70	**186**	**3.44**	62.6	2.152	400.3
11	22	2	16	46	**86**	**1.59**	67.0	2.671	229.7
12	13	1	2	14	**31**	**0.57**	72.3	3.375	104.6
13	4	*	*	6	**10**	**0.18**	77.2	4.168	41.7
14	1	*	*	3	**4**	**0.07**	83.7	5.406	21.6
15	*	2	*	2	**5**	**0.09**	84.8	5.635	28.2
16				1	**0.6**	**0.01**	86.0	5.848	3.5
17									
18				*	**0.2**	**0.004**	88.5	6.388	1.3
19									
	2425	712	1079	1188	**5409**	**100.00%**			**6360**

2010 Catch: 6525

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 (2010 based on preliminary data).

REGRESSION OF MULTIPLICATIVE MODEL
MULTIPLE R..... 0.821
MULTIPLE R SQUARED..... 0.674

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARE	F-VALUE
INTERCEPT	1	2.35E2	2.35E2	
REGRESSION	54	1.14E2	2.12E0	12.148
Cntry|Gear|TC	6	1.39E1	2.31E0	13.255
Month	11	3.03E0	2.75E-1	1.578
Division	3	4.18E0	1.39E0	7.979
Year	34	4.28E1	1.26E0	7.218
RESIDUALS	317	5.53E1	1.75E-1	

REGRESSION COEFFICIENTS

CATEGORY	CODE	VAR #	REG. COEF	STD. ERR	NO. OBS
Cntry|Gear|TC(1)	125	INT	-1.185	0.311	372
Month(2)	9				
Division(3)	22				
Year(4)	76				
(1)	3123	1	-0.413	0.126	16
	3124	2	-0.126	0.202	5
	3126	3	0.138	0.125	16
	3127	4	0.661	0.111	54
	3857	5	0.747	0.140	16
	27125	6	0.133	0.101	25
(2)	1	7	-0.023	0.144	13
	2	8	0.085	0.148	13
	3	9	-0.138	0.124	23
	4	10	-0.016	0.112	33
	5	11	0.128	0.115	28
	6	12	0.152	0.101	43
	7	13	0.021	0.091	59
	8	14	0.083	0.088	53
	10	15	-0.179	0.117	22
	11	16	-0.197	0.132	16
	12	17	-0.018	0.116	24
(3)	23	18	-0.146	0.086	113
	31	19	-0.373	0.090	149
	32	20	-0.382	0.100	65
(4)	77	21	0.269	0.353	5
	78	22	0.821	0.339	8
	79	23	0.827	0.388	3
	80	24	1.001	0.325	13
	81	25	0.843	0.327	14
	82	26	0.931	0.332	10
	83	27	0.915	0.319	18
	84	28	1.062	0.325	12
	85	29	0.607	0.324	13
	86	30	0.367	0.340	8
	87	31	0.844	0.355	5
	88	32	0.061	0.369	4
	89	33	0.528	0.346	6
	90	34	0.467	0.325	12
	91	35	0.132	0.320	16
	92	36	0.028	0.318	20
	93	37	0.071	0.329	15
	94	38	0.238	0.369	4
	95	39	0.410	0.423	2
	96	40	0.266	0.336	8
	97	41	0.584	0.341	7
	98	42	0.343	0.424	2
	99	43	0.244	0.428	2
	100	44	0.449	0.334	9
	101	45	0.638	0.322	17
	102	46	0.222	0.329	11
	103	47	0.153	0.313	28
	104	48	0.171	0.317	20
	105	49	0.212	0.320	23
	106	50	0.769	0.341	10
	107	51	1.139	0.350	8
	108	52	1.469	0.360	6
	109	53	1.221	0.337	11
	110	54	0.573	0.326	20

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 (2010 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	-1.1853	0.0969	0.318	0.097	767	2414	9.5
1977	-0.9168	0.0459	0.426	0.090	2866	6721	20.9
1978	-0.3642	0.0340	0.745	0.136	3951	5300	30.0
1979	-0.3582	0.0723	0.736	0.195	5183	7045	35.4
1980	-0.1845	0.0259	0.896	0.144	3946	4405	42.9
1981	-0.3419	0.0246	0.766	0.120	6155	8036	59.2
1982	-0.2547	0.0235	0.836	0.128	8143	9739	73.4
1983	-0.2704	0.0179	0.825	0.110	7085	8583	87.4
1984	-0.1229	0.0202	0.955	0.135	6070	6353	90.4
1985	-0.5785	0.0204	0.606	0.086	4847	8001	91.2
1986	-0.8181	0.0301	0.474	0.082	1896	3997	74.6
1987	-0.3411	0.0440	0.759	0.158	2465	3247	85.6
1988	-1.1247	0.0558	0.345	0.080	629	1825	38.8
1989	-0.6577	0.0390	0.554	0.109	988	1782	21.2
1990	-0.7180	0.0234	0.526	0.080	2402	4565	75.9
1991	-1.0533	0.0226	0.376	0.056	3254	8645	70.0
1992	-1.1568	0.0195	0.340	0.047	2502	7361	50.2
1993	-1.1139	0.0280	0.353	0.059	1034	2927	87.7
1994	-0.9469	0.0552	0.412	0.096	575	1396	96.5
1995	-0.7752	0.0972	0.479	0.146	632	1320	56.2
1996	-0.9198	0.0320	0.428	0.076	1043	2436	81.0
1997	-0.6014	0.0358	0.588	0.110	1017	1731	94.7
1998	-0.8419	0.0992	0.447	0.138	46	103	63.0
1999	-0.9410	0.1018	0.405	0.126	81	200	81.5
2000	-0.7364	0.0309	0.515	0.090	1285	2497	99.3
2001	-0.5474	0.0228	0.624	0.094	1833	2937	99.2
2002	-0.9637	0.0272	0.411	0.067	1784	4343	98.7
2003	-1.0319	0.0137	0.386	0.045	3710	9605	89.9
2004	-1.0143	0.0171	0.392	0.051	1832	4668	98.5
2005	-0.9736	0.0246	0.407	0.064	2218	5447	98.1
2006	-0.4167	0.0366	0.706	0.134	2356	3335	94.8
2007	-0.0465	0.0456	1.018	0.215	1866	1832	99.7
2008	0.2836	0.0527	1.411	0.320	2430	1722	93.0
2009	0.0357	0.0359	1.111	0.209	2456	2211	98.9
2010	-0.6124	0.0302	0.583	0.101	3276	5622	98.4

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.191

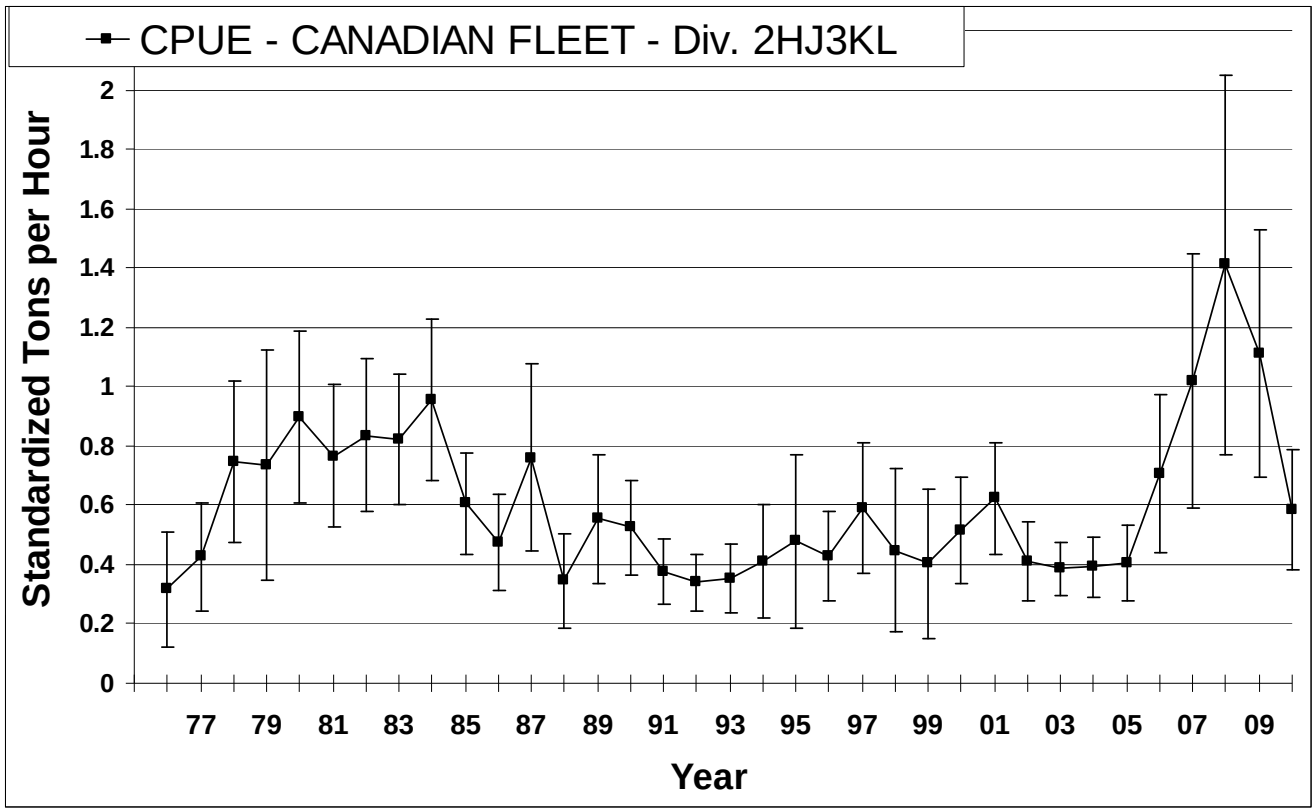

Fig. 1. Standardized Mean CPUE ± 2 s.e. for Greenland Halibut in Div. 2HJ3KL utilizing effort in HOURS fished from the CANADIAN OTTERTRAWL FLEET.

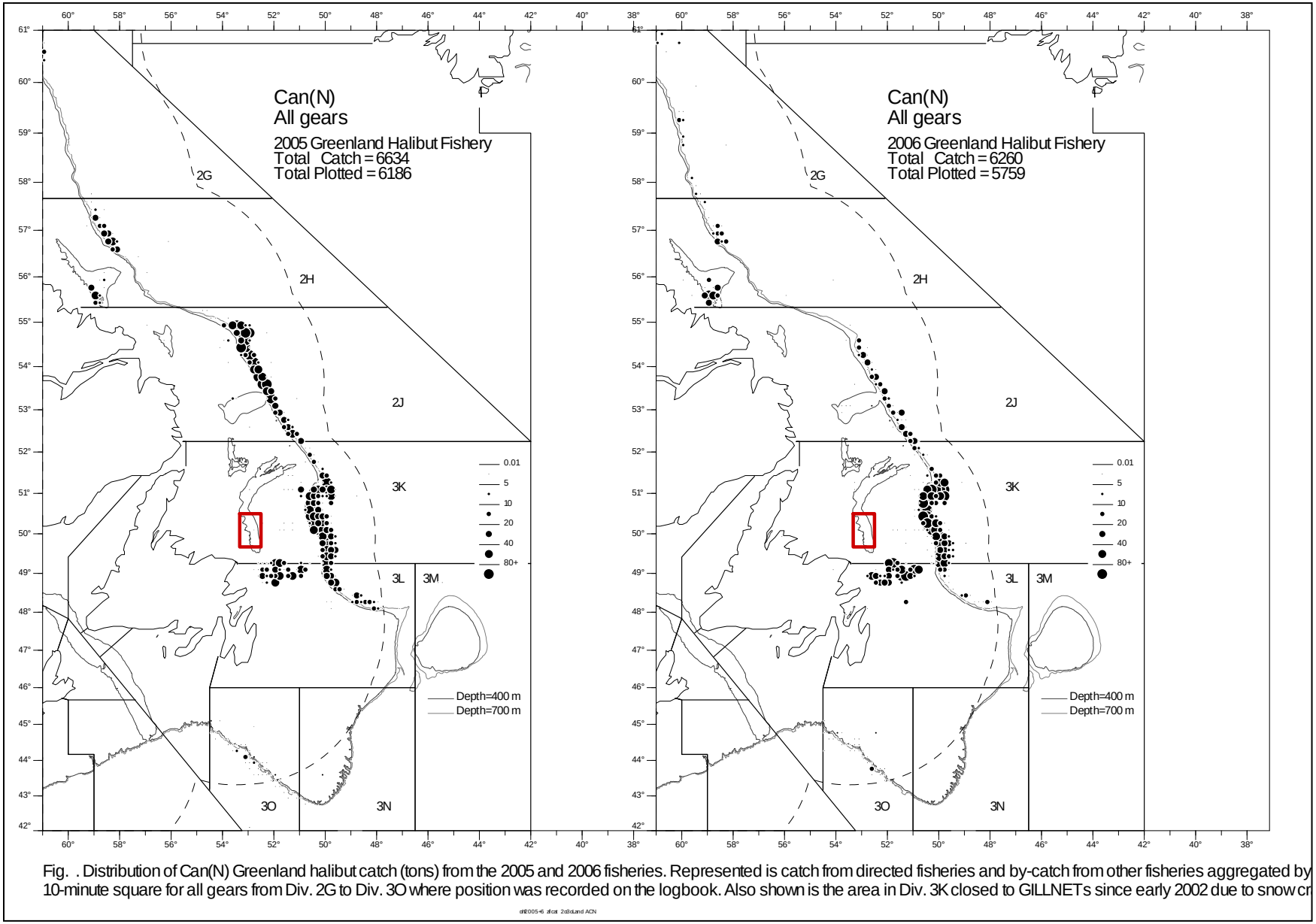

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2005 and 2006 fisheries. Represented is catch from directed fisheries and by-catch from other fisheries aggregated by 10-minute square for all gears from Div. 2G to Div. 3O where position was recorded on the logbook. Also shown is the area in Div. 3K closed to GILLNETs since early 2002 due to snow cr

Fig 2

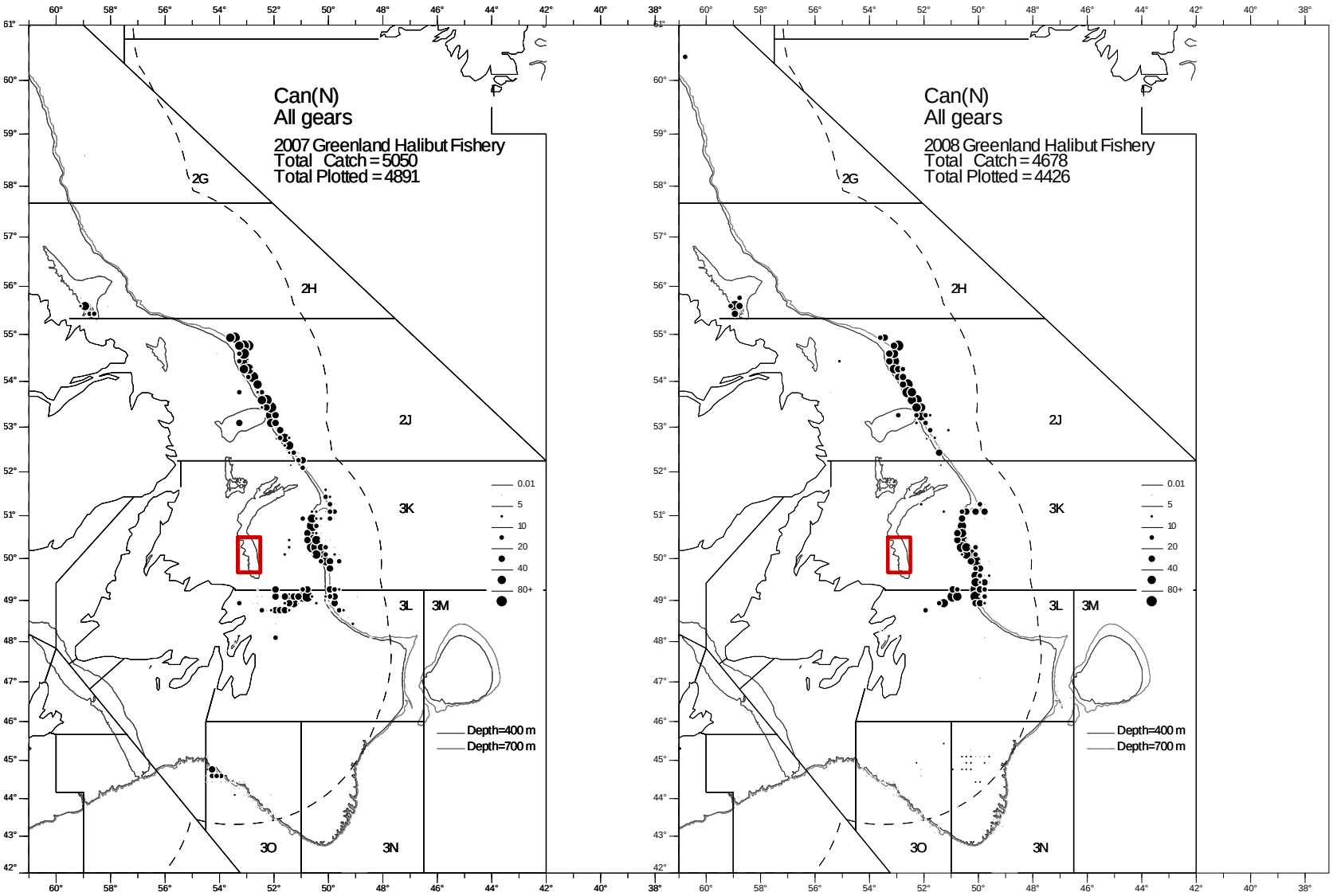

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2007 and 2008 fisheries. Represented is catch from directed fisheries and by-catch from other fisheries aggregated by 10-minute square for all gears from Div. 2G to Div. 3O where position was recorded on the logbook. Also shown is the area in Div. 3K closed to GILLNETs since early 2002 due to snow crab bycatch.

Fig 3

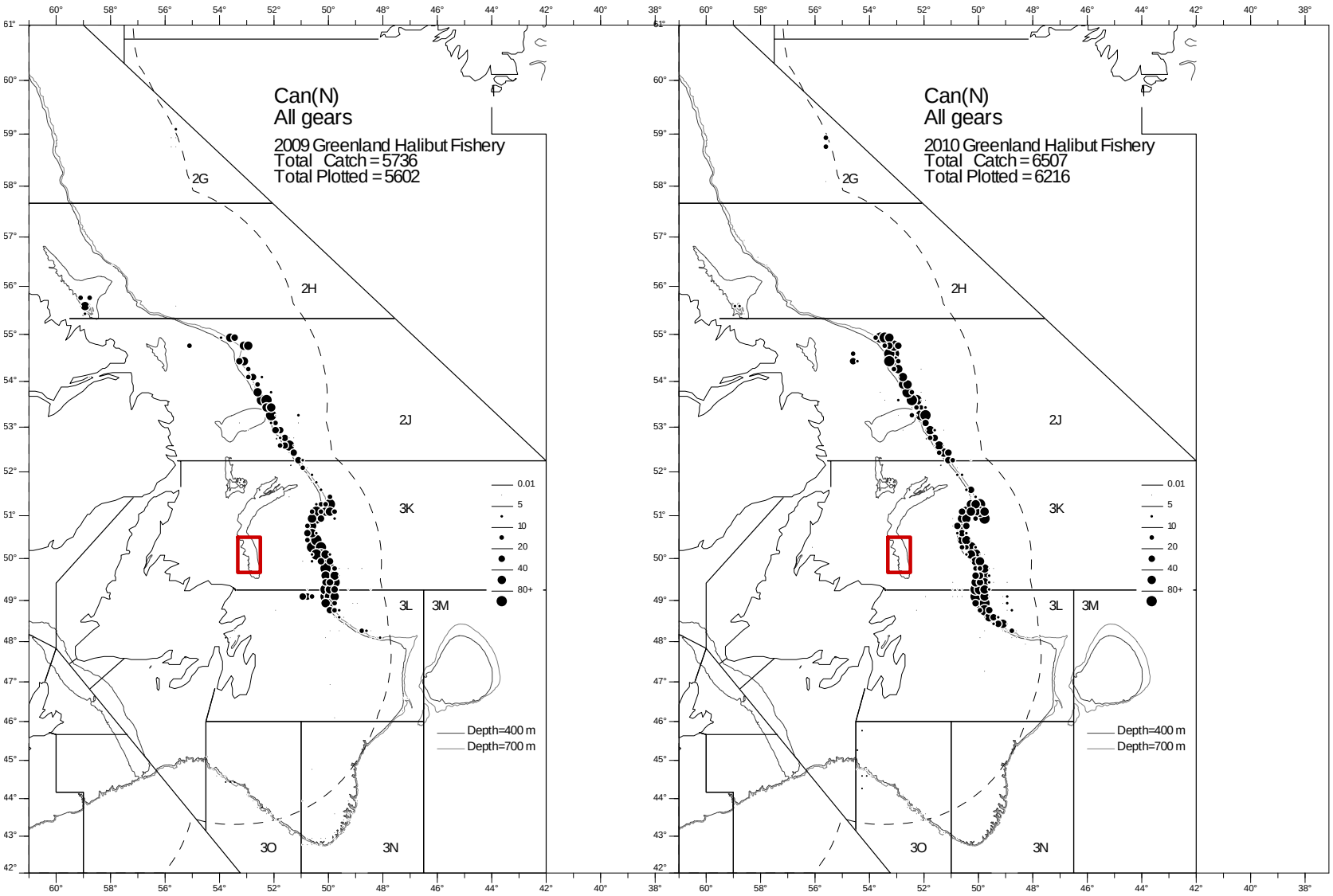

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2009 and 2010 fisheries. Represented is catch from directed fisheries and by-catch from other fisheries aggregated by 10-minute square for all gears from Div. 2G to Div. 3O where position was recorded on the logbook. Also shown is the area in Div. 3K closed to GILLNETs since early 2002 due to snow crab bycatch.

Fig 4

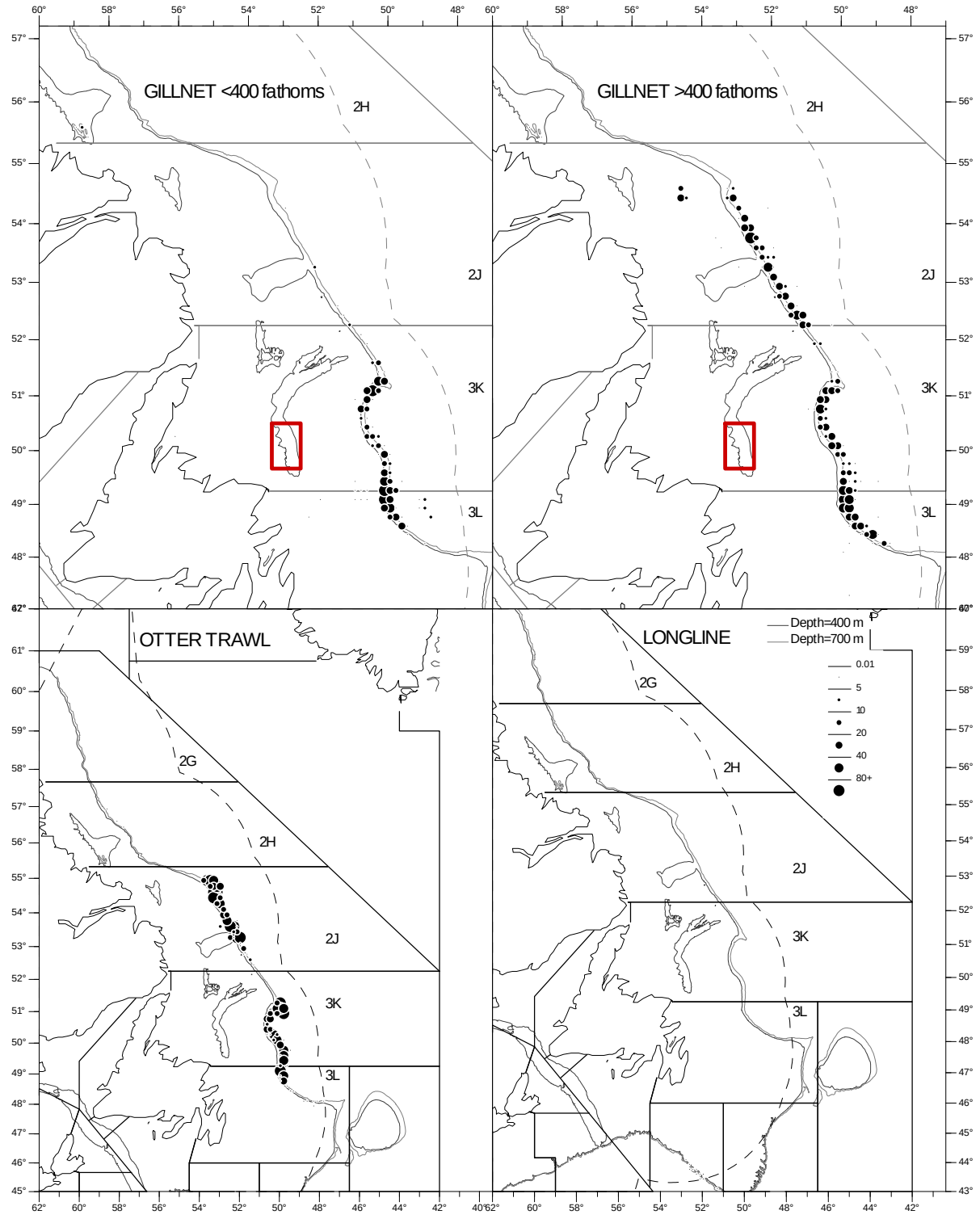

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2010 commercial fishery. Represented is LONGLINE, GILLNET (<400 fathoms and >400 fathoms) and OTTER TRAWL from both directed and by-catch fisheries. Data are aggregated by 10-minute square where position information exists. Note the closed area for GILLNETs in Div. 3K due to crab bycatch.

Fig. 5

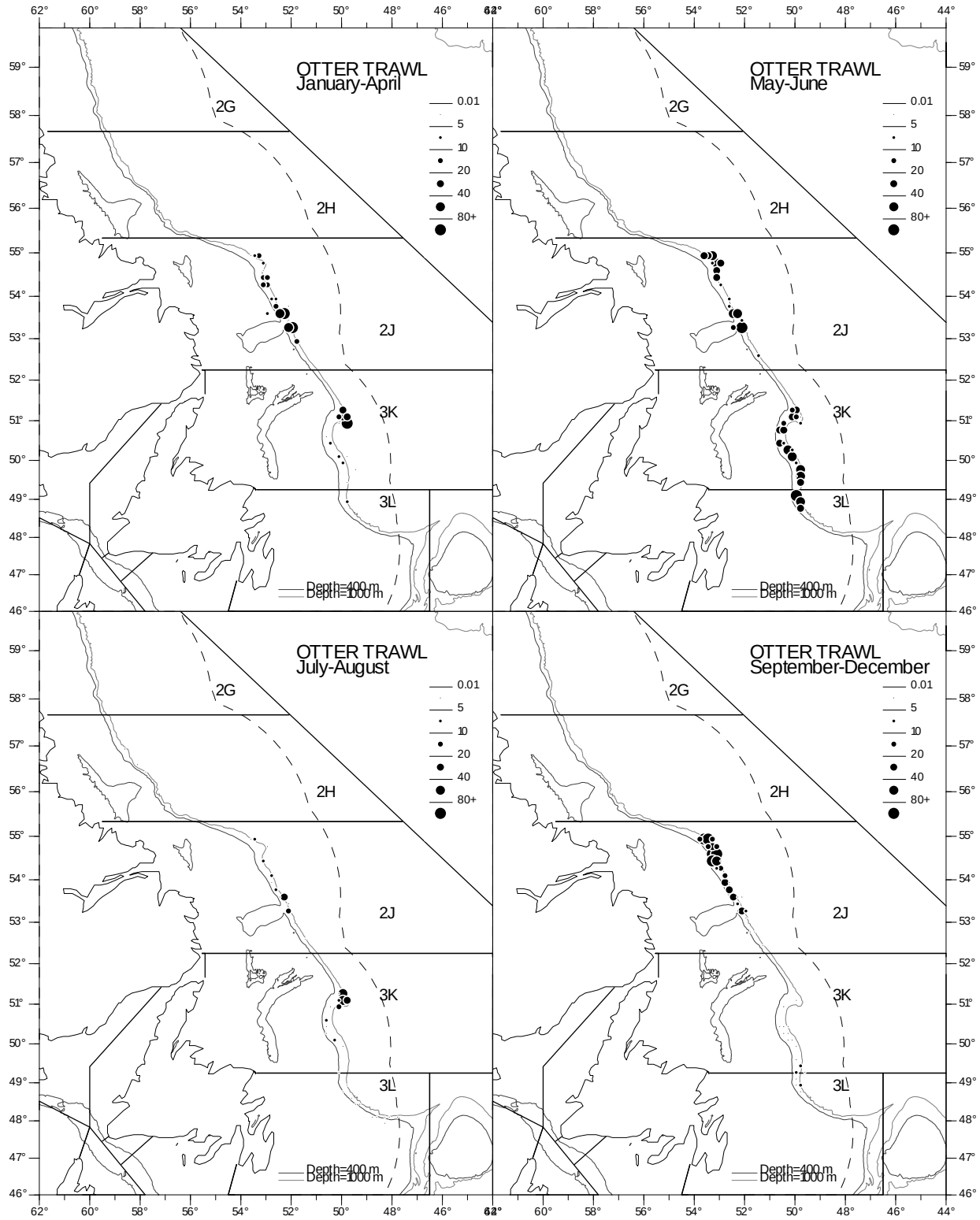

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2010 commercial fishery. Represented is OTTER TRAWL catch for various months from directed fisheries and by-catch from other fisheries. The data are aggregated by 10-minute square for Div. 2J3KL where position was recorded on the logbook.

Fig 6

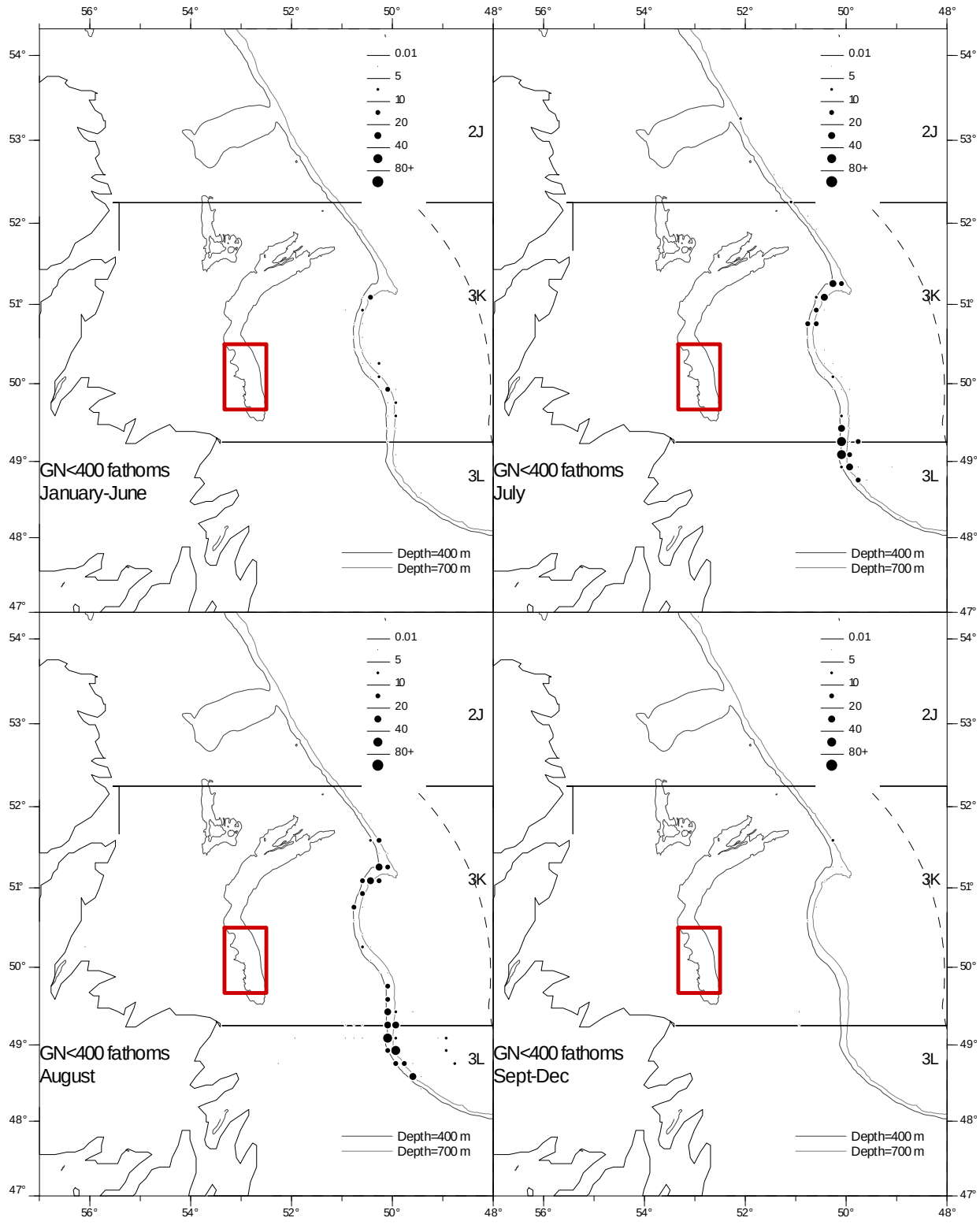

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2010 commercial fishery. Represented is GILLNET (<400 fathoms) for various months from both directed fisheries and by-catch fisheries. Data are aggregated by 10-minute square where position information exists. Note the closed area for GILLNETs in Div. 3K due to crab bycatch.

Fig 7

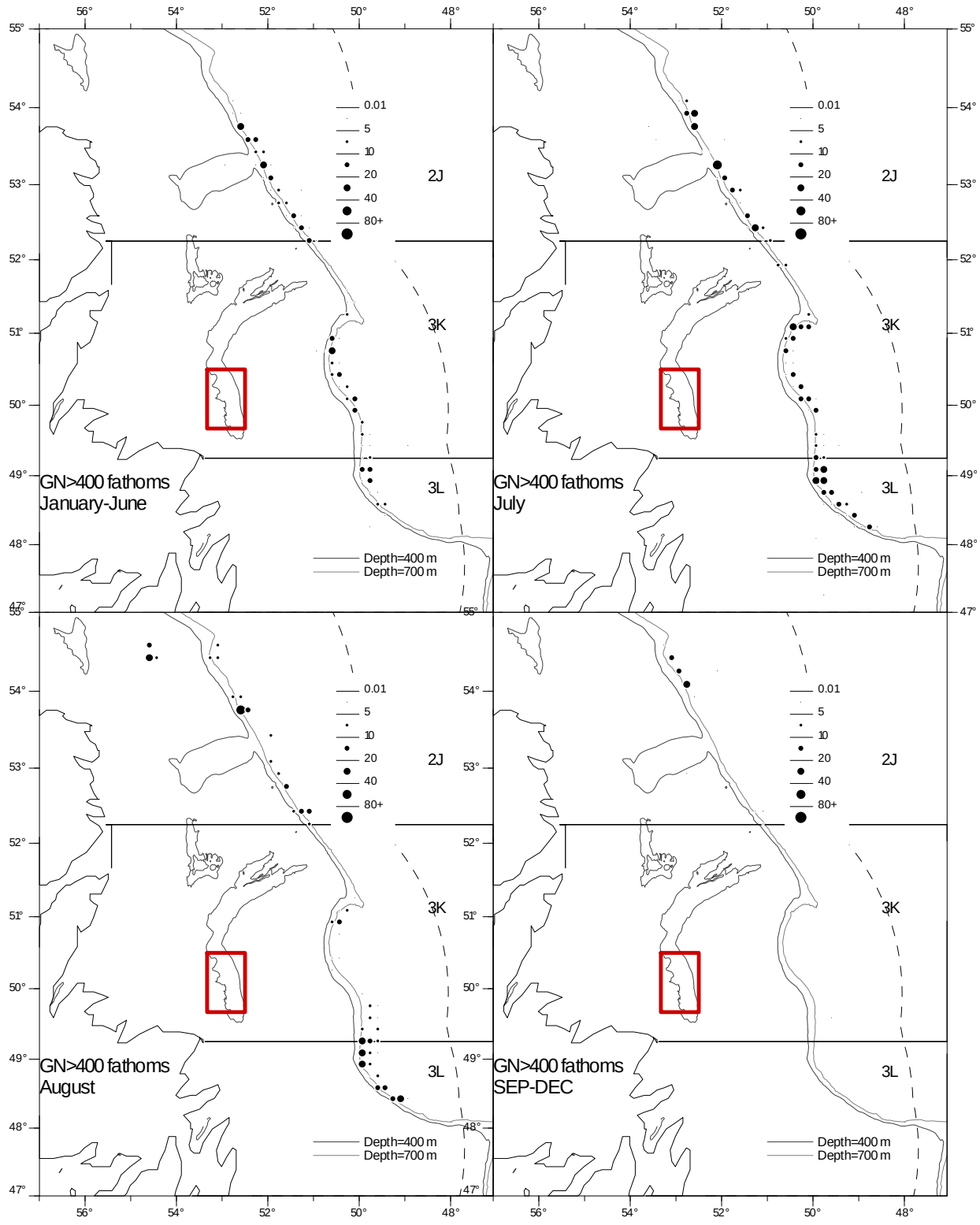

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2010 commercial fishery. Represented is GILLNET (>400 fathoms) for various months from both directed fisheries and by-catch fisheries. Data are aggregated by 10-minute square where position information exists. Note the closed area for GILLNETs in Div. 3K due to crab bycatch.

Fig 8