Northwest Atlantic Fisheries Organization

Serial No. N5674 NAFO SCR Doc. 09/38

SCIENTIFIC COUNCIL MEETING – JUNE 2009

The Canadian fishery for Greenland halibut in SA 2 + Div. 3KLMNO, with emphasis on 2008.

by

W. B. Brodie, D. Power, and B.P.Healey
Science Branch, Department of Fisheries and Oceans
P. O. Box 5667, St. John's, Newfoundland, Canada AlC 5Xl

Abstract

The Canadian catch of Greenland halibut in 2008 in NAFO Subarea 2 and Divisions 3KLMNO was reported to be 4862 tons, about 480 t lower than in 2007. The largest decrease was in the deepwater gillnet fleet, while otter trawl catches increased. Catches in 2008 were again highest in Div 2J, similar to 2007 levels, where almost all of the otter trawl catch was taken, similar in Div 3K, and declined in Div. 3L. About 31% of the catch was taken in June, although almost 80% of the otter trawl catch was taken in January to March. Overall, the catch at age in 2008 was dominated by the 2000 and 2001 year classes, which accounted for 81% of the catch numbers and 76% 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 2008 were similar to previous years. CPUE analysed from logbooks of Canadian trawlers increased by about 40% in 2008, following large increases in 2006 and 2007.

Review of the Canadian fishery

As reported in several previous documents (e.g. Brodie et.al. 2008), the Canadian fishery for Greenland halibut 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 tons in 1980 then declined steadily to between 2900 and 6300 tons in each year from 1993-99 (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 tons, more than two and a half times the catches in 1998 and 1999. However, catches have declined since then, to a level between 4,800 and 7,000 since 2002. Reasons for fluctuations in catch and effort include a switch of some effort by fishers in Divs. 3KL between snow crab and G.halibut due to changes in quotas and product prices, combined with variable catch rates for Greenland halibut 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 an average mesh size of about 150 mm. However, Canadian gillnet catches taken during recent years 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 fishery, gillnet mesh size for Greenland halibut in the Canadian zone in depths > 731 m (400 fm) was regulated to be no less than 191 mm, with the exception of Div. 2J. Other restrictions on numbers of nets also exist, as indicated in the tables below, which show the 2007 and 2008 conservation harvesting plans (CHP) regulations in

the Canadian gillnet fishery for Greenland halibut. In 2005-2008, 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 G. halibut 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.

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
3L	293 - 549	125	152 mm
2GH + 3KL	549 - 732	200	152
2GH+3K	> 732	250	191
2J	> 732	250	152
3LNO	> 732	500	191

Gillnet catches during the 1990's ranged from 2400 to 6700 tons, averaging about 4200 tons. Catches in 2000 from this sector then increased to 9300 tons, similar to the levels seen in the late 1980's, but since then have declined to between 2400 and 3900 tons. 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 avartaged about 550 tons from 2002-04, but have generally been < 200 t/year, and often less than 50 t/year.

Canadian otter trawl (OT) catches peaked at about 8,000 tons in 1982, but from 1993 to 1999, catches by this fleet were less than 1050 tons annually. OT catches increased sharply from less than 90 tons in 1998 and 1999, to around 1800 tons in 2001-02 and 2004, but were double this level at just over 3700 tons in 2003 (Table 1). Annual OT catch since then has been in the range of 1800 to 2400 tons. 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 from Subarea 2 were very low prior to the mid 1970's, then increased to a peak around 9000 tons in 1982 (Table 2). From 1991 to 2001, catches from Subarea 2 were in the range of 1000 to 2500 tons per year. The catch in SA 2 increased to almost 3000 tons 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, 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, as vessels transit to or from Subarea 0. In most years, Div. 3K has produced the largest Canadian catches, peaking around 18,000 tons in 1979-80. Catches in recent years from Div. 3K have fluctuated between 750 tons (1995) and 5800 tons (2000), with the 2007-08 values being around 1500 tons. Peak catches of around 13,000 tons in Div 3L occurred in 1966-67 and 1980, and averaged about 1300 tons in 2005 to 2007. Catches in Div. 3M , 3N, and 3O combined have generally been in the range of 100 tons or less in recent years, mainly from Div. 3O (Table 2).

The Canadian fishery in 2008

There were some differences in the spatial and temporal patterns in the Canadian fishery for G.halibut in 2008 compared to those observed in 2007 and other recent years. The total reported catch was just under 4900 tons, a decline of about 10% from 2007, and similar to the 2004 catch. Catches in the both gillnet fleets were lower in 2008, but catches in the otter trawl fleet increased. 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 ability of some fleets 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 except 2008 and 2003, when otter trawls dominated the catches, gillnet was the dominant gear. In 2004 to 2007 the gillnet catches in the shallow zone (<400 fm) 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. These gillnet catches are referred to in Tables 3 and 4 as GN<400 and GN>400. GN <400 catches have been stable around 1800 tons in 2006-08. Longline catches declined to less than 25 tons in 2007-08. The main change in the spatial pattern of the fishery in recent years has been the decline in catch in Div 3KL, from over 5300 tons in 2006, to about 2100 tons in 2008. Otter trawl catches occurred primarily in 2J in 2007 and 2008, although there was little consistency in the distribution of OT catches by division in 2004 to 2007. In 2006-08, there was negligible (actually zero in 2008) Canadian catch of G.halibut by otter trawl in Div. 3L, compared to about 1000 tons per year in this area in 2002-03.

Most of the total Canadian catch in 2008 occurred in summer, with just under 1500 tons taken in June, almost all by gillnet. Similar to 2007, a large percentage of otter trawl catches in 2008 occurred before April, although catches were earlier in 2008 than in 2007. The temporal pattern of catch in 2008 was unusual compared to 2005 and 2007, with only a small amount of catch occurring in July (similar to 2006). In 2008, almost all GN catch in Div. 2J and 3K took place in June, compared to July-August in Div. 2GH and 3L. In total, only 4.5 % of the 2008 catch occurred later than August, similar to the 5-6% in 2006-07.

Figs. 1-2 show the location of most of the Canadian catch of Greenland halibut in 2005-08. These data were aggregated by 10-minute squares from logbook records. In all four years, the plotted data account for over 90% of the total Canadian catch. The spatial distributions of the catches in these 4 years were broadly similar (Figs 1-2). One difference between recent years and those prior to 2005 is the recent presence of the gillnet catches in the north-central part of Div. 3L, although less so in 2008, when the fishery was closed early due to cod by-catch (Brodie et al. 2008). 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 2008 catch by the 4 major gear types (2 gillnet categories, otter trawl, and longline, which were negligible in 2008). Most of the otter trawl fishery in 2008 (Figs 3, 6) was located in one main area, around the slope edge between 53 and 55 degrees N latitude in Div. 2J. In many years, this fishery operated at from the border between Divs. 3K and 3L north to about 51 N. The spatial distribution of the deepwater gillnet fishery in 2008 was similar to recent years, ie. widely distributed along the slope edge, with relatively more effort in Div. 3K, although catches in the fleet sector were much lower in 2008 than in recent 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 2002-08 compared to 2001 and earlier (eg. Brodie and Power 2006, and earlier documents). In 2008, much of the shallow water GN catches came from Div 3K, 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 2007, gillnet catches were about the same in each of June, July, and August, generally occurring in the early summer in 2J and 3K, and later in Div. 3L (Figs. 4 and 5). This contrasts with 2008, when very little catch was taken in July, and 58% of all GN catches were taken in June, primarily in Div. 3K. 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 G. halibut). Almost all of the otter trawl catch was taken in January to April in 2008, similar to the patterns in 2006-07, but earlier than in most years (e.g. May to July for the bulk of this fishery in 2005). As in 2006-07, the reasons for this in 2008 were favorable ice conditions, high CPUE, and generally low by-catch of species under moratorium in the winter months (Brodie et al 2008).

Catch at age

Details on the Canadian catch at age for previous years can be found in Bowering and Brodie (2000), and Brodie et al (2007, 2008) and Brodie and Power (2006; and earlier documents by 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 smaller fish, as smaller mesh is permitted in deeper areas.

Sampling data collected in 2007 by observers at sea and by port samplers, were available from Divs. 2J, 3KLO. The following table shows the number of length measurements by Division and gear, and the number of otoliths (in italics).

2007	**2J**		**3K**		**3LO**	
Gill net < 400	528		1197		7330	
Gill net > 400	2200	*201*	1758	*273*	1250	*490*
Otter trawl	8889	*226*	501		381	*43*
Totals	11617	*427*	3456	*273*	8861	*533*

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*

[1] Linetrawl, Div 3L

The otolith samples from the fixed gear sectors have been combined, as there is a mixture of mesh sizes in the deepwater 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 2008 was 13,943, a decrease of 42% from 2007 levels, following decreases of 33% and 50% in the previous 2 years. The number of length measurements collected in 2008, from a catch of about 4900 tons, was therefore only 21% of the 2005 total (from a catch of 6637 t). However, with the reduced quotas in 2007-08, and concentration of effort in relatively few gear/month cells (Table 4), most fleet sectors appeared to be adequately sampled for lengths in 2008. The number of otoliths (1262) was 2% higher than in 2007. As usual, it was necessary to combine age-lengths keys across some gear types, Divisions, and seasons to calculate catch at age, as there were not sufficient numbers of otoliths in all individual categories.

Age compositions for the 2008 fishery 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 (2001 year class), while age 8 (2000 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 2008 was dominated by the 2000 and 2001 year classes, which accounted for 81% of the catch numbers and 76% of the catch weight. The comparable figures for 2007 for ages 7 and 8 combined were 80 and 72%. In recent years, the catch at age has become more dominated more by these 2 ages (7+8). As was the case in 2000 - 2007, age 8 was second highest in the 2008 catch numbers, while ages 6 and 9 contributed similar numbers. The catch in the GN>400 fleet has been tending towards smaller fish in recent years, as smaller mesh is permitted in deeper areas. For example, only 6-15% of the catch in numbers by this fleet in 2006-08 was estimated to be age 10 or older, compared to 72-80% in 2001 and 2002. In total, only about 1% of the 2008 catch numbers were from fish older than 10 years. A longline sample from Div. 3O in March of 2008 contained much larger fish than length frequencies collected from other fleet sectors, which is not unusual for longline catches. Fish from that sample had an average weight of 3.1 kg, compared to 1.1 kg from the otter trawl fishery in Div. 2J. However, there was negligible impact on the overall catch at age, as longline catches totaled only 24 tons in 2008.

Mean weights at age for all areas were calculated using the same length-weight relationship used for Greenland halibut catch at age in 1998-2007, which was the Divisions-combined, year = 1997 (from Gundersen and Brodie 1999). Weights at ages 5 to 7 in 2008 were slightly higher than in 2005 and 2006, with those at ages 8-10 being very similar to the previous 2 years (Brodie and Power 2007). Beyond age 10 there are few fish in the catch, and weights at these ages are often variable between years. The sum of products was about 8% lower than the catch weight, which is a larger difference than usual. This may be related to the larger proportion of fish caught in the first quarter of the year.

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 2003-2008 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 2000-2008, 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 with the exception of 2005 when they took 32%, however, twin trawls were not used since 2006.

Residual plots (not shown) did not indicate model misspecification. The model resulted in a significant regression ($P < 0.05$) explaining 66% 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 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 a 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, remained stable to 2005 which was only slightly higher than the lowest catch rate estimated over the 32 year series. Over the next three years to 2008, the index increased rapidly, by over 240%, and is currently the highest in the series. These most recent increases are associated with large variability within each year.

Additional analysis was conducted on CPUE series in 2009, as reported in the Greenland halibut WG which met June 1-3. This analysis 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 stock.

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.

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 1960-2008.

			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

Table 2. Canadian catch of G.halibut, by Division, from 1960-2008.

					DIVISION						Canada
YEAR	2G	2H	2J	*SA2*	3K	3L	3M	3N	3O	Unk	**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				*0*	7140	4413		1	2		11556
1970				*0*	5937	4769		5			10711
1971				*0*	4160	5248		2			9410
1972				*0*	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	*2070*	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

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 4. Breakdown of Canadian catches of G.halibut in SA 2 + Div 3KLMNO in 2008 by area, gear, and month.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	GN<400 fm								122					122
	GN>400 fm								36					36
2GH	Otter trawl							10						10
	Longline													
	Total							10	158					168
	GN<400 fm								27					27
2J	GN>400 fm						202		8					210
	Otter Trawl	770	646	436		281	80						141	2354
	Longline													
	Total	770	646	436		281	282		35				141	2591
	GN<400 fm						908	7	138	1				1054
3K	GN>400 fm						264	14	38					316
	Otter Trawl		5	52		8								65
	Longline													
	Total		5	52		8	1172	21	176	1				1435
	GN<400 fm						12	261	261	55	21			610
	GN>400 fm							34						34
3L	Otter Trawl													
	Longline					1								1
	Total					1	12	295	261	55	21			645
	Gillnet													
3NO	Longline	7	2	8	5				1					23
	Total	7	2	8	5				1					23
	TOTAL	777	653	496	5	290	1466	326	631	56	21		141	**4862**

Table 5. Catch at age for the Canadian catch of G.halibut in SA 2 + Div. 3KLMNO in 2008.
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 24 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	1			**0.7**	**0.02%**	32.5	0.270	0.2
5	15	1	*	**15**	**0.36%**	37.2	0.424	6.4
6	275	32	3	**311**	**7.50%**	43.0	0.660	205.3
7	1291	666	87	**2044**	**49.27%**	47.7	0.916	1872.3
8	482	729	99	**1310**	**31.57%**	51.8	1.186	1553.7
9	128	148	52	**329**	**7.93%**	56.6	1.566	515.2
10	43	19	33	**97**	**2.34%**	61.1	2.006	194.6
11	16	1	5	**23**	**0.55%**	67.6	2.749	63.2
12	6	*	3	**10**	**0.24%**	71.3	3.255	32.6
13	4		1	**7**	**0.17%**	77.3	4.203	29.4
14	1		*	**2**	**0.05%**	76.7	4.089	8.2
15			*	**0.2**	**0.005%**	86.0	5.831	1.2
16								
17								
18								
19								
	2262	1596	283	4149	**100.00%**			**4482**
							Catch	4862

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 (2008 based on preliminary data).

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.811

MULTIPLE R SQUARED..... 0.658

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARE	F-VALUE
INTERCEPT	1	2.50E2	2.50E2	
REGRESSION	52	9.22E1	1.77E0	10.643
Cntry|Gear|TC	6	1.01E1	1.68E0	10.104
Month	11	2.68E0	2.44E-1	1.462
Division	3	3.05E0	1.02E0	6.091
Year	32	3.60E1	1.13E0	6.752
RESIDUALS	288	4.80E1	1.67E-1	
TOTAL	341	3.90E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VAR #	REG. COEF	STD. ERR	NO. OBS
Cntry|Gear|TC	3125	INT	-1.208	0.305	341
Month	9				
Division	22				
Year	76				
(1)	3123	1	-0.277	0.136	12
	3124	2	-0.148	0.198	5
	3126	3	0.017	0.130	14
	3127	4	0.768	0.124	35
	3857	5	0.778	0.157	11
	27125	6	0.138	0.099	25
(2)	1	7	-0.057	0.142	13
	2	8	0.056	0.146	13
	3	9	-0.178	0.123	23
	4	10	-0.092	0.114	31
	5	11	0.077	0.113	28
	6	12	0.060	0.104	37
	7	13	-0.023	0.092	51
	8	14	0.119	0.088	48
	10	15	-0.191	0.117	21
	11	16	-0.200	0.138	14
	12	17	-0.020	0.124	18
(3)	23	18	-0.136	0.085	95
	31	19	-0.336	0.089	140
	32	20	-0.349	0.100	61
(4)	77	21	0.281	0.346	5
	78	22	0.853	0.333	8
	79	23	0.865	0.379	3
	80	24	1.025	0.319	13
	81	25	0.902	0.320	14
	82	26	0.944	0.326	10
	83	27	0.939	0.313	18
	84	28	1.082	0.319	12
	85	29	0.613	0.318	13
	86	30	0.390	0.334	8
	87	31	0.833	0.347	5
	88	32	0.059	0.362	4
	89	33	0.538	0.340	6
	90	34	0.486	0.319	12
	91	35	0.149	0.314	16
	92	36	0.032	0.312	20
	93	37	0.130	0.323	15
	94	38	0.226	0.361	4
	95	39	0.377	0.414	2
	96	40	0.239	0.330	8
	97	41	0.603	0.335	7
	98	42	0.410	0.416	2
	99	43	0.335	0.420	2
	100	44	0.499	0.328	9
	101	45	0.681	0.316	17
	102	46	0.267	0.323	11
	103	47	0.174	0.307	28
	104	48	0.201	0.310	20
	105	49	0.201	0.316	23
	106	50	0.694	0.337	10
	107	51	1.061	0.346	8
	108	52	1.450	0.356	6

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 (2008 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	-1.2081	0.0933	0.310	0.093	767	2475	9.5
1977	-0.9274	0.0442	0.421	0.088	2866	6813	20.9
1978	-0.3547	0.0327	0.750	0.135	3951	5267	30.0
1979	-0.3430	0.0697	0.745	0.194	5183	6957	35.4
1980	-0.1831	0.0253	0.894	0.141	3946	4414	42.9
1981	-0.3057	0.0238	0.791	0.122	6155	7778	59.2
1982	-0.2641	0.0225	0.825	0.123	8143	9865	73.4
1983	-0.2691	0.0172	0.824	0.108	7085	8603	87.4
1984	-0.1256	0.0195	0.950	0.132	6070	6393	90.4
1985	-0.5955	0.0196	0.594	0.083	4847	8166	91.2
1986	-0.8184	0.0289	0.473	0.080	1896	4011	74.6
1987	-0.3754	0.0422	0.731	0.149	2465	3371	85.6
1988	-1.1496	0.0535	0.335	0.077	629	1876	38.8
1989	-0.6703	0.0375	0.546	0.105	988	1810	21.2
1990	-0.7217	0.0226	0.522	0.078	2402	4599	75.9
1991	-1.0587	0.0218	0.373	0.055	3254	8722	70.0
1992	-1.1765	0.0188	0.332	0.045	2502	7534	50.2
1993	-1.0780	0.0276	0.365	0.060	1034	2834	87.7
1994	-0.9822	0.0531	0.396	0.090	575	1450	96.5
1995	-0.8311	0.0933	0.452	0.135	632	1398	56.2
1996	-0.9686	0.0307	0.406	0.071	1043	2566	81.0
1997	-0.6055	0.0346	0.583	0.108	1017	1744	94.7
1998	-0.7977	0.0953	0.467	0.141	46	99	63.0
1999	-0.8731	0.0982	0.432	0.132	81	187	81.5
2000	-0.7096	0.0299	0.527	0.091	1285	2439	99.3
2001	-0.5274	0.0221	0.635	0.094	1833	2889	99.2
2002	-0.9409	0.0263	0.419	0.068	1784	4260	98.7
2003	-1.0339	0.0134	0.384	0.044	3710	9661	89.9
2004	-1.0067	0.0166	0.394	0.051	1832	4650	98.5
2005	-1.0073	0.0253	0.392	0.062	2225	5675	97.8
2006	-0.5138	0.0373	0.638	0.122	2282	3575	97.9
2007	-0.1470	0.0457	0.917	0.194	1866	2034	99.7
2008	0.2422	0.0528	1.349	0.306	2429	1801	93.0

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.188

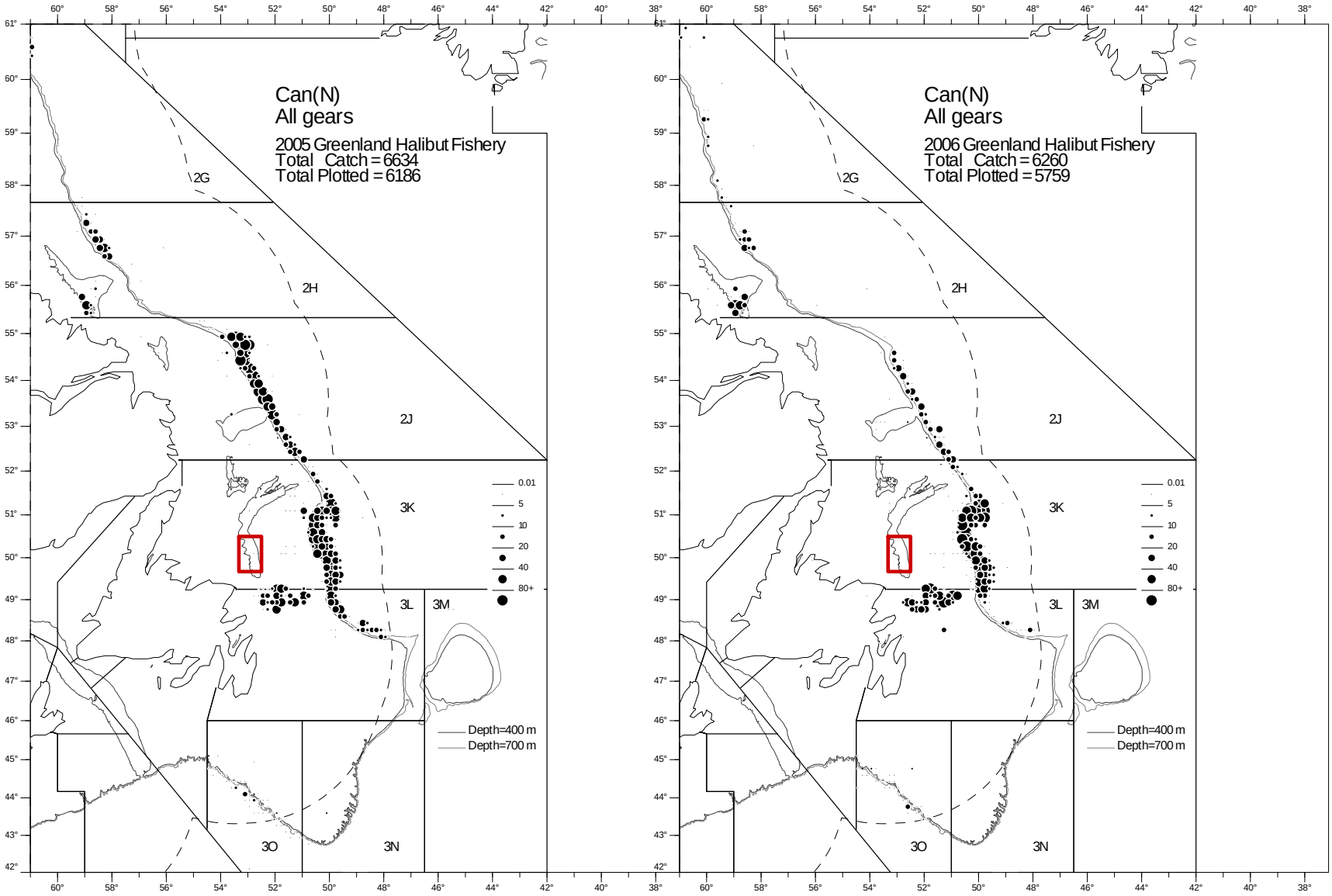

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2005 and 2006 fisheries. Represented is catch from directed fisheries and by-catch from other fisheries aggregated by 10-minute square for all gears from Div. 2G to Div. 3O where position was recorded on the logbook. Also shown is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

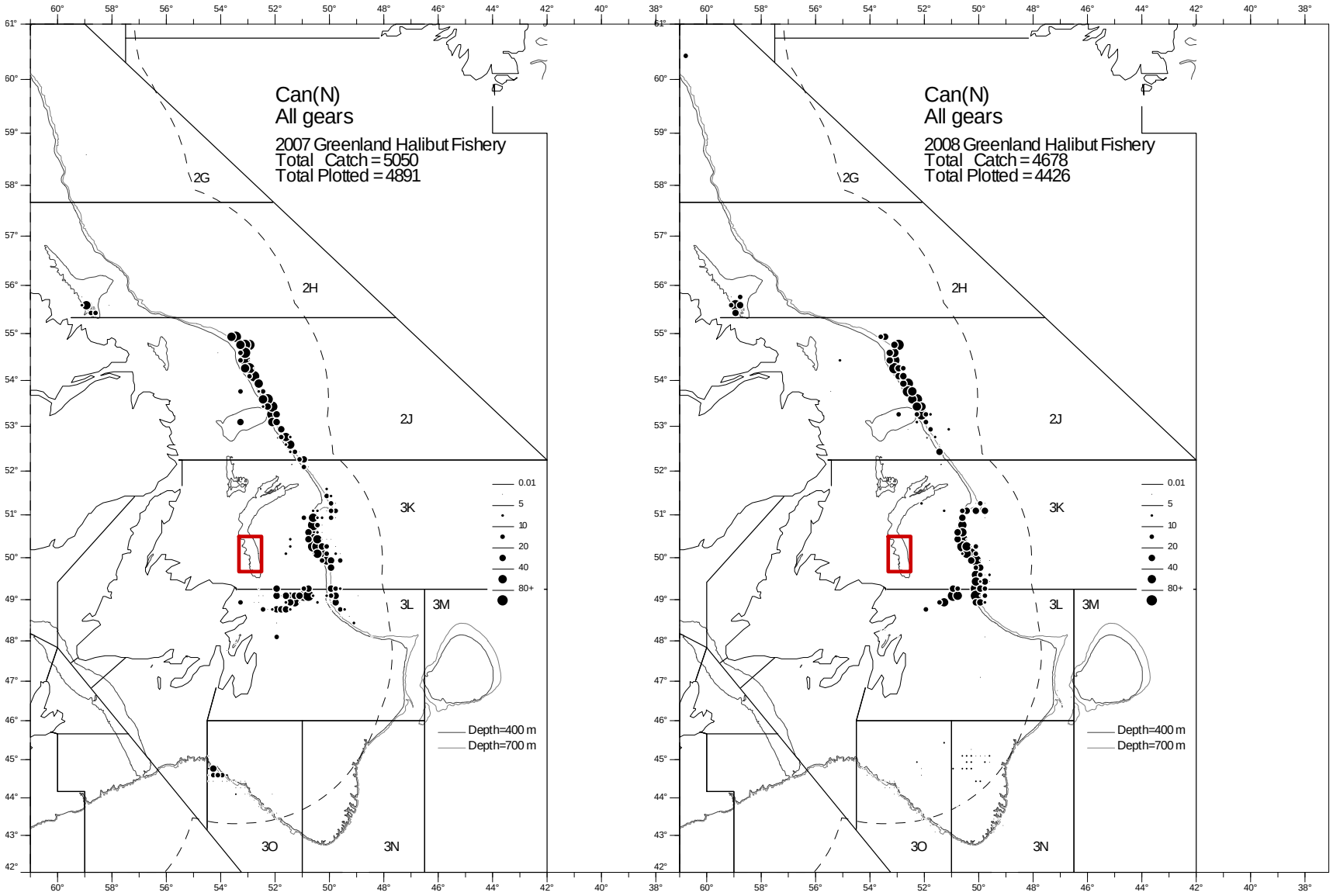

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2007 and 2008 fisheries. Represented is catch from directed fisheries and by-catch from other fisheries aggregated by 10-minute square for all gears from Div. 2G to Div. 3O where position was recorded on the logbook. Also shown is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

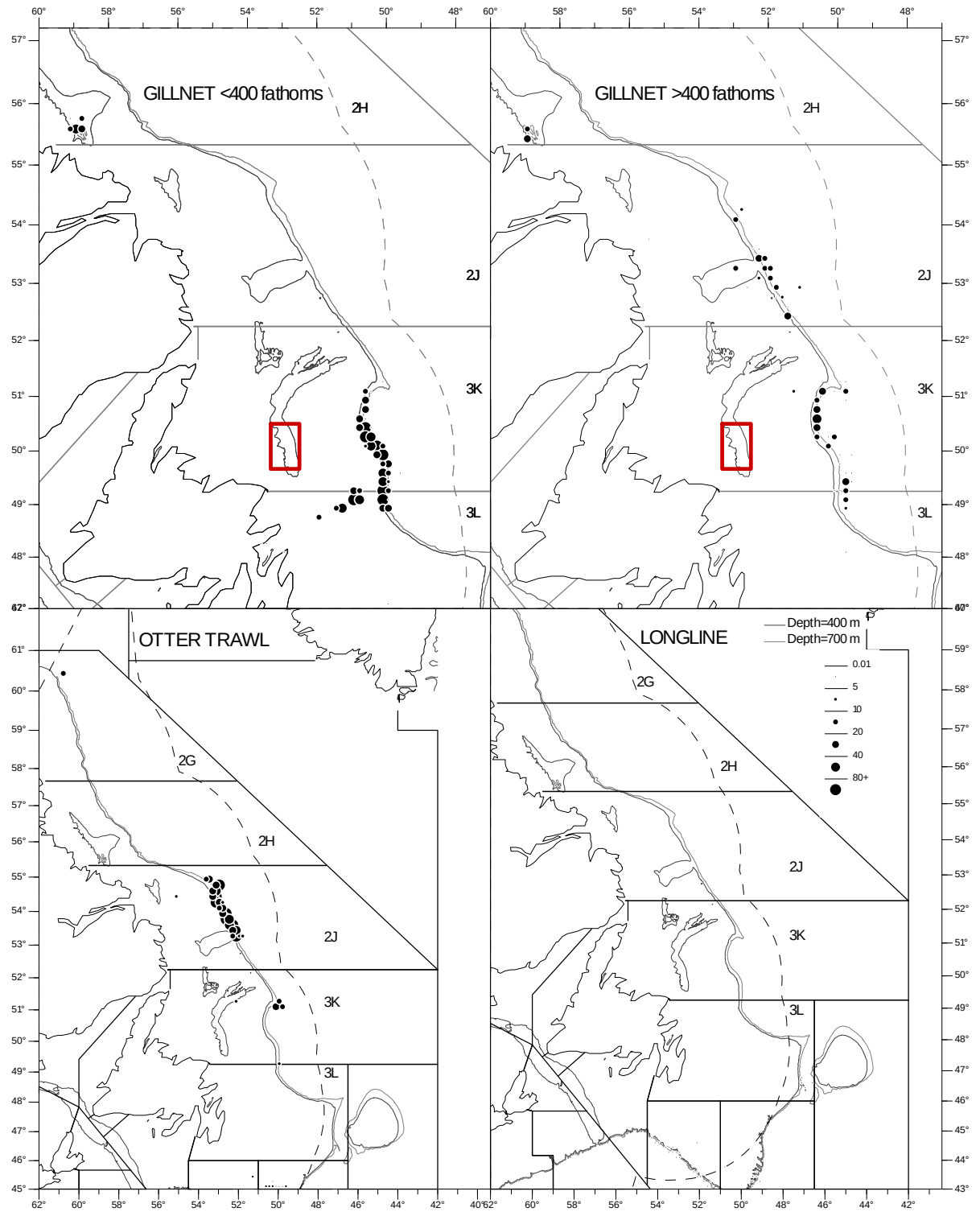

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2008 commercial fishery. Represented is LONGLINE, GILLNET (<400 fathoms and >400 fathoms) and OTTER TRAWL from both directed and by-catch fisheries. Data are aggregated by 10-minute square where position information exists. Note the closed area for GILLNETs in Div. 3K due to crab bycatch.

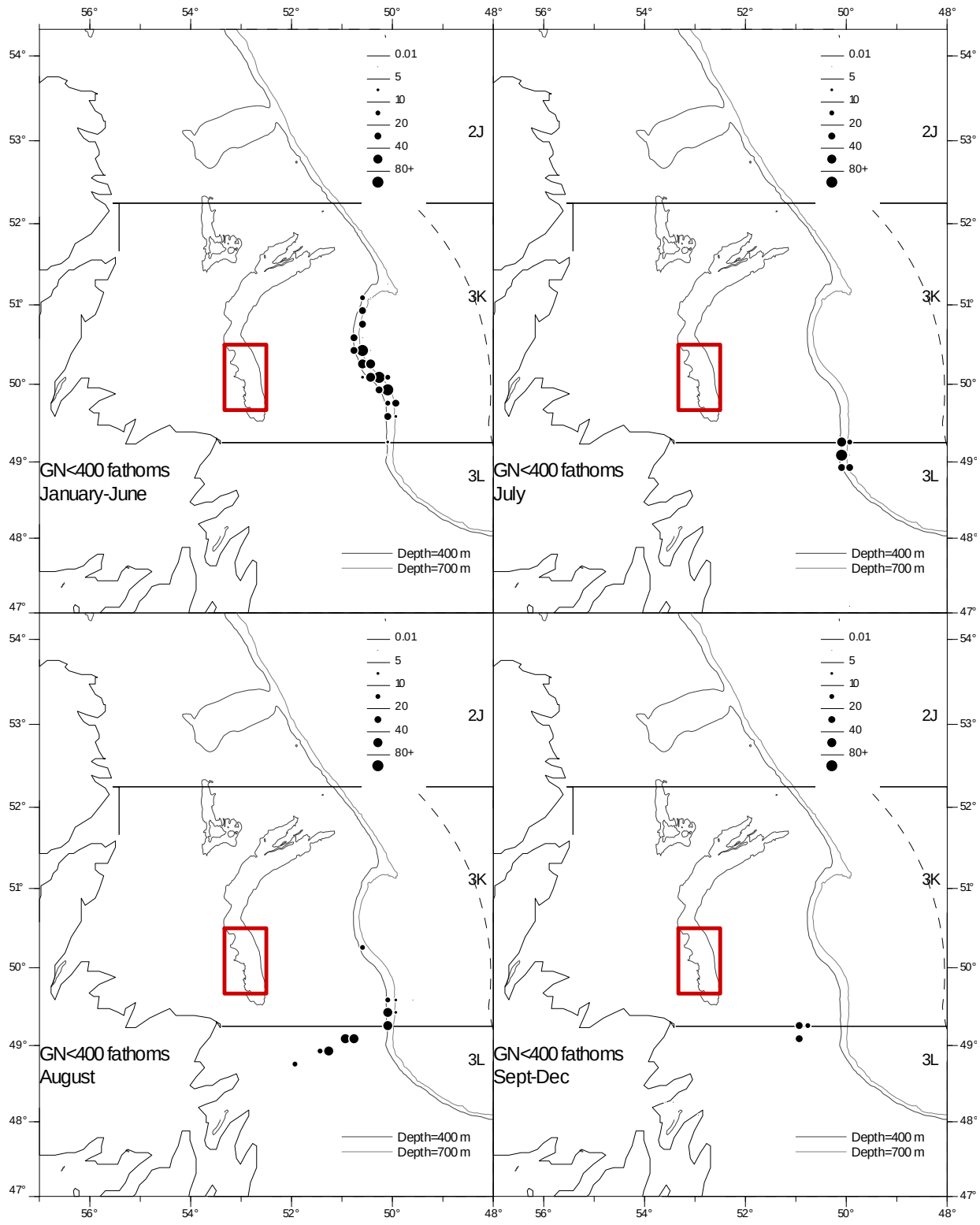

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2008 commercial fishery. Represented is GILLNET (<400 fathoms) for various months from both directed fisheries and by-catch fisheries. Data are aggregated by 10-minute square where position information exists. Note the closed area for GILLNETs in Div. 3K due to crab bycatch.

drf2008 zfcat GNLE400 ACN

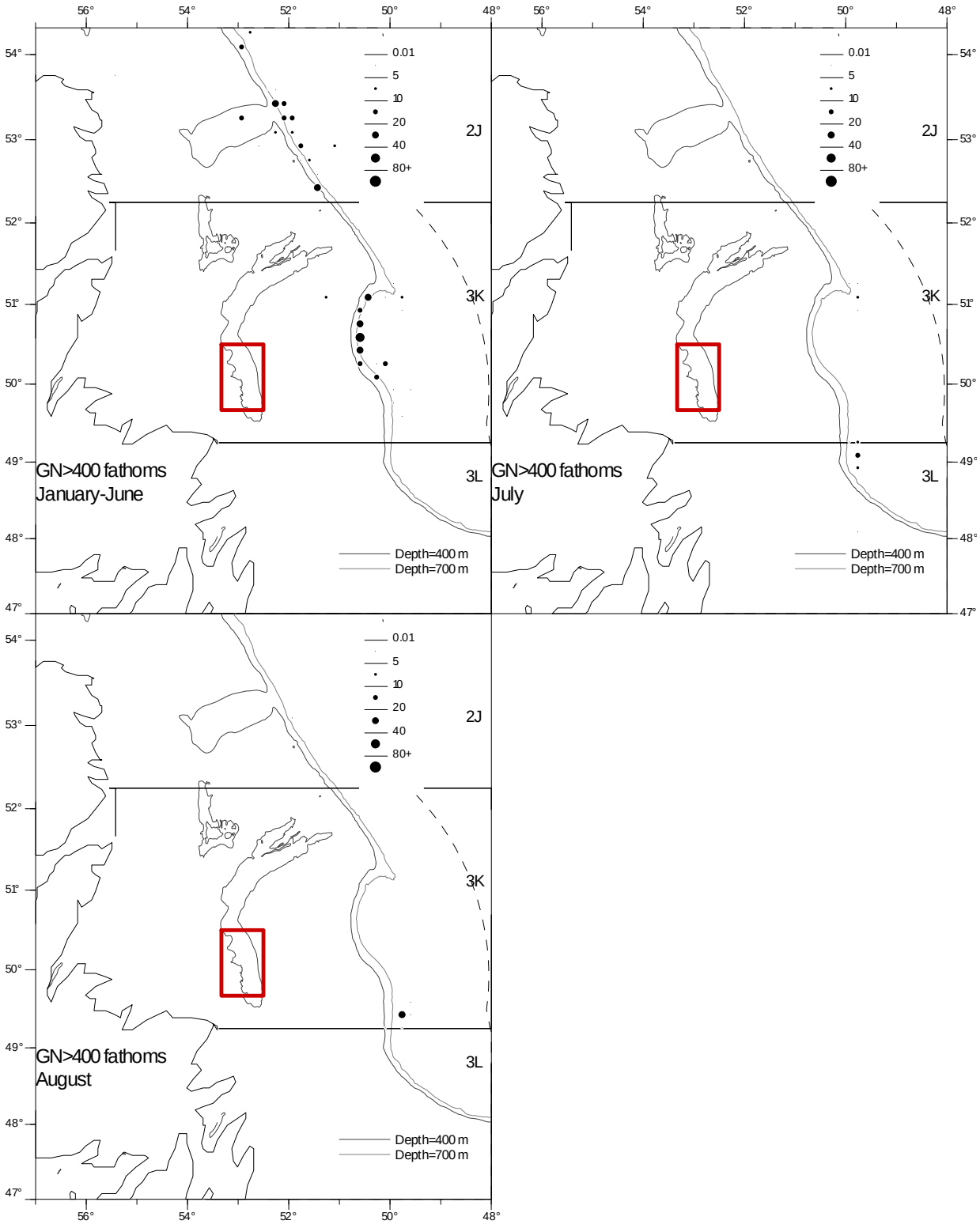

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2008 commercial fishery. Represented is GILLNET (>400 fathoms) for various months from both directed fisheries and by-catch fisheries. Data are aggregated by 10-minute square where position information exists. Note the closed area for GILLNETs in Div. 3K due to crab bycatch.

dfl2008 zfcat GNGT400 ACN

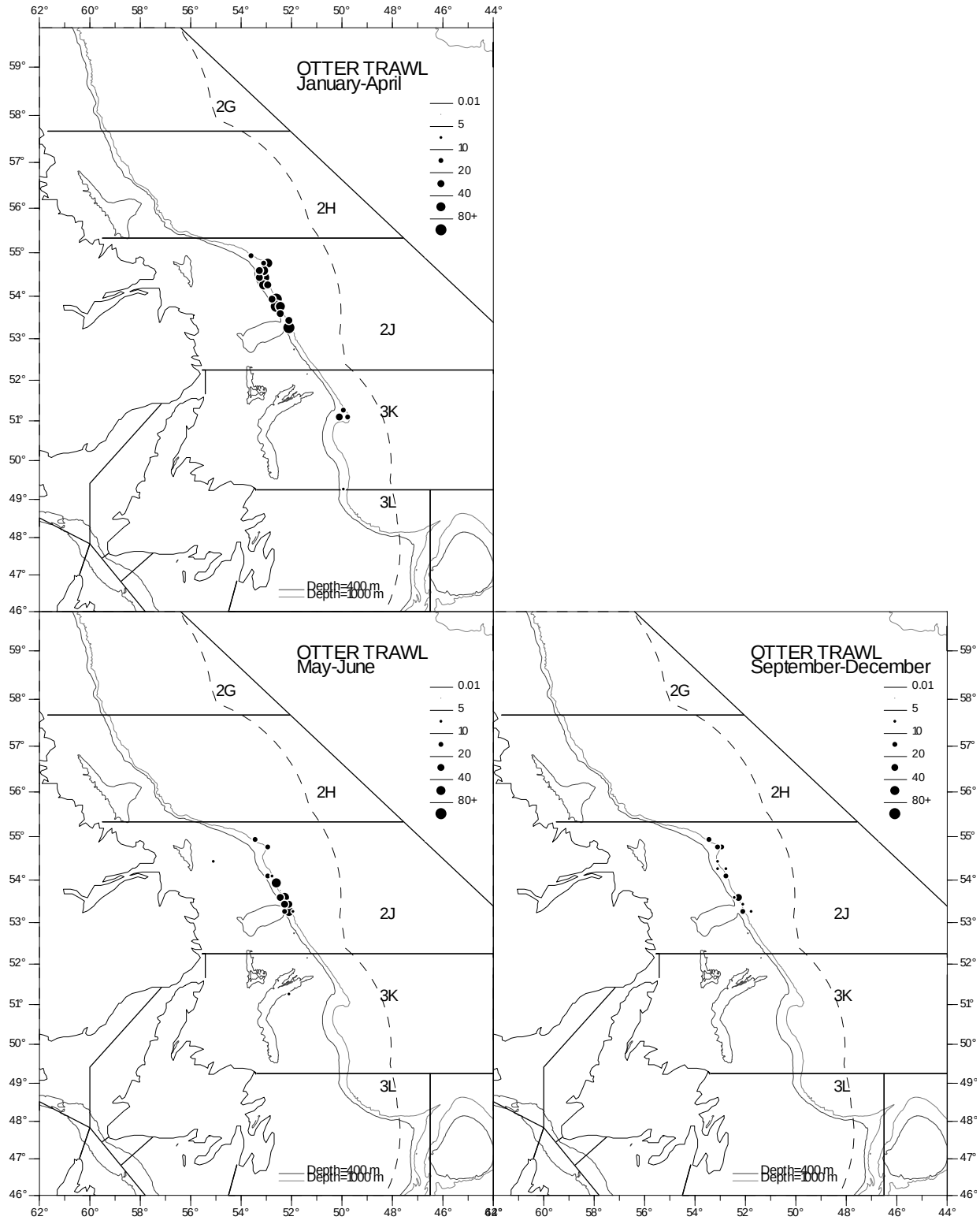

Fig. . Distribution of Can(N) Greenland halibut catch (tons) from the 2008 commercial fishery. Represented is OTTER TRAWL catch for various months from directed fisheries and by-catch from other fisheries. The data are aggregated by 10-minute square for Div. 2J3KL where position was recorded on the logbook.

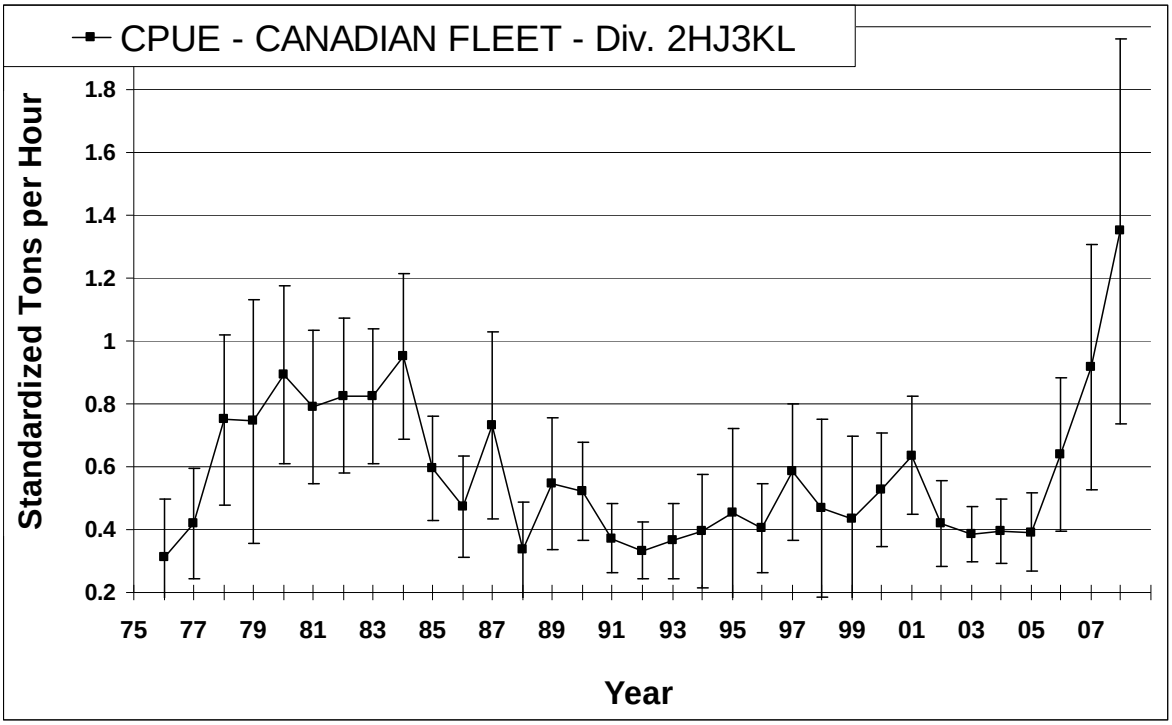

Fig. 7. Standardized Mean CPUE ± 2 standard errors for Greenland Halibut in Div. 2HJ3KL utilizing effort in HOURS fished from the CANADIAN OTTERTRAWL FLEET.