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The Canadian Fishery for Greenland Halibut in Subarea 2 + Divisions 3KLMNO, with Emphasis on 2005

by

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Abstract

The Canadian catch of Greenland halibut in 2005 in NAFO Subarea 2 and Divisions 3KLMNO was reported to be about 6 600 tons, an increase of 1 800 tons from 2004. There was a small increase in otter trawl catches, primarily in Div. 3K. Catches in the gillnet sector were higher in 2005, in both the shallow-water and deep-water components. As in previous years, much (45%) of the catch in 2005 came from Div. 3K, and about 70% of the catch was taken in June to August. The catch at age in 2005 was dominated by the 1997-98 year-classes, which accounted for 70% of the catch numbers and 58% of the catch weight in the Canadian fishery. Catches in the deepwater gillnet sector have trended toward younger fish since 2001, particularly with the permitted use of smaller mesh in recent years. Mean weights at age in 2005 were similar to previous years. After a gradual increase from 1992 to 2001, CPUE from Canadian otter trawlers declined in 2002 and has been relatively stable at this low level since then.

Review of the Canadian Fishery Prior to 2005

As reported in previous documents, 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 2 900 and 6 300 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 Div. 3KLMNO increased to about 10 600 tons, more than two and a half times the catches in 1998 and 1999. However, catches declined by more than 2 000 tons from 2000 to 2001, then declined by a similar amount to about 6 300 tons in 2002. Catches in 2003 were just under 7 000 tons, but declined in 2004 to about 4 900 tons. Reasons for fluctuations in catch and effort include a switch of some effort by fishers in Div. 3KL from snow crab to G. halibut due to declining quotas for crab in certain areas, combined with variable catch rates for Greenland halibut in some of the traditional fishing areas (Brodie and Power, 2000).

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 table below, which show the 2005 regulations in the Canadian gillnet fishery for Greenland halibut (J. Perry, DFO - pers. comm.). Also in 2005, but not reflected in the table, was a provision whereby fishers could request special experimental permits for Div. 3K where they could use 152 mm mesh in waters deeper than 731 m. This resulted in some catch in the deeper water in 3K with the smaller mesh gear.

Area	Depth	Number of Nets	Min. Mesh Size
2GH + 3KL	293 - 549 meters	125	152 mm
2GH + 3KL	549 - 732 meters	200	152 mm
2GH + 3KL	> 732 meters	500	191 mm
2J	> 732 meters	500	152 mm
3NO	> 732 meters	500	191 mm

Gillnet catches during the 1990s ranged from 2 400 to 6 700 tons, averaging about 4 200 tons. Catches in 2000 from this sector then increased to 9 300 tons, similar to the levels seen in the late 1980s, but since then have declined to 6 400 tons in 2001, 3 900 tons in 2002, and to 2 700 tons in 2003, which is the lowest level since 1994. Catches in 2004 were near the long-term average. 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 has also been closed to fishing for some years. Both these areas have undergone modifications over time.

Canadian otter trawl catches peaked at about 8 000 tons in 1982, but from 1993 to 1999, catches by this fleet were less than 1 050 tons annually. Otter trawl catches increased sharply from less than 100 tons in 1998 and 1999, to around 1 800 tons in 2001-2002 and 2004, but were double this level at just over 3 700 tons in 2003, which is the highest level since 1985 (Table 1). Much of the otter trawl catch in the recent period occurred in the slope area around the boundary between Div. 3K and 3L, although the increase in 2003 was due to an increase in effort in Div. 2H (Brodie and Power, 2004). The 2004 OT catch was split between 2H and 3KL (Table 3c). 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.

Catches from Subarea 2 were very low prior to the mid-1970s, then increased to a peak around 9 000 tons in 1982 (Table 2). From 1991 to 2001, catches from Subarea 2 have been in the range of 1 000 to 2 500 tons per year, and were stable around 1 300 tons during 1999-2001. The catch in SA 2 increased to almost 3 000 tons in 2003, due to higher catches in Div. 2GH. Most of the catch from Subarea 2 has come from Div. 2J, although catches in 1993-96 and 2003-2004 were higher in Div. 2GH combined compared to Div. 2J. The catch in Div. 2GH declined from values around 1 400 tons in 1994-95 to less than 325 tons per year from 1999 to 2001, before increasing to a level near 2 200 tons in 2003, which is the highest catch from 2GH since 1983. Catches have since declined. In most years, Div. 3K has produced the largest Canadian catches, peaking around 18 000 tons in 1979-80. Peak catches of around 13 000 tons in Div. 3L occurred in 1966-67 and 1980. Catches in Div. 3M and 3N have been negligible, and catches in Div. 3O increased from similar low levels to a few hundred tons per year from 1993-2001, peaking at 567 tons in 2000.

The Canadian Fishery in 2005

There were some differences in the spatial and temporal patterns in the Canadian fishery for G. halibut in 2005 compared to those observed in 2002-2004. The total reported catch was just over 6 600 tons, an increase of about 1 800 tons from 2004, and a similar level as in 2002 and 2003 (Table 3). Most of this increase occurred in the gillnet sectors, mainly in Div. 2J and 3K. Catches by gillnet in 2005 were the highest since 2001, with increases occurring in both the shallow and deep water fleets (Tables 3d and 4).

Breakdowns of the catch by gear, Division, depth range and month are shown in Tables 3 and 4. As in most years gillnet was the dominant gear in 2005. In 2004 and 2005 the gillnet catches in the shallow zone were lower

than in the deep zone, contrasting to 2002 and 2003. These gillnet catches are referred to in Tables 3 and 4 as GN<400 and GN>400. Longline catches, which had not exceeded 130 tons per year since the early 1970s, increased to 650 tons in 2002, mostly in Div. 2GH, but dropped to just over 400 tons in 2004 and further to about 100 tons in 2005. Catches in Div. 3K increased to 3 000 tons in 2005, about 1 100 tons more than in 2004, and similar to 2002-2003. Catches in Div. 3L in 2005 were similar to the 2002 level, above that of 2003-2004.

Figures 1-3 show the location of most of the Canadian catch of Greenland halibut in 2001, 2003, and 2005. These data were aggregated by 10-minute squares from logbook records. In 2003, the plotted data account for 95% of the total Canadian catch, however in 2005, only about 70% of the catch data had positional information associated with it at this time. Assuming the plotted data are representative, the spatial distributions of the 2003 and 2005 fisheries were similar (Fig. 2 and 3), with the major difference being the gillnet catches on the 3KL boundary, around 52 degrees W longitude, in 2005. This area was not fished in 2003. A major difference from 2002 onward was the reduction in catch from the central 3K (Funk Island Deep) area, due to the area closed to gillnetting. This was noted in previous sections, and is shown in Fig. 1, where the box, which was not in the regulations in 2001, is overlaid on the 2001 catch. Figure 4 also shows the location of the 2005 catch by the 4 major gear types (2 gillnet categories, otter trawl, and longline). Most of the otter trawl fishery in 2005 was located in 2 areas: one around the slope edge at the border between Div. 3K and 3L, similar to the fishery in recent years, and the second on the slope edge in the central part of Div. 2J, south of the area fished in 2003 and 2004. The spatial distribution of the deepwater gillnet fishery in 2005 was similar to recent years, i.e. widely distributed along the slope edge. With the closure of the Funk Island Deep area, the shallow water gillnet catches were more concentrated towards the slope area in 3K in 2002-05 compared to 2001 and earlier (Brodie and Power, 2002, 2003, 2004, 2005). As noted above, some smaller mesh gillnets have been allowed in Div. 2J and 3K in recent years. In 2005, about 70% of the catch occurred in the summer, June to August, similar to recent years. Temporal patterns for the gillnet and otter trawl fisheries in 2005 (Fig. 5-7) were similar to those seen in 2002 to 2004. The major fishing areas did not change by season in 2005, although the shallow water gillnet catches along the central part of the 3KL boundary did not occur until later in the year.

As in previous years, by-catches in the gillnet fishery include cod and snow crab, particularly in the GN<400 sector, while American plaice and witch flounder were taken as by-catch in the otter trawl fishery. By-catches of Greenland halibut in the Canadian shrimp fishery have been described in separate papers (e.g. Orr e*t al.*, 2002).

Catch at age

Details on the Canadian catch at age for previous years can be found in Bowering and Brodie (2000), and Brodie and Power (2001, 2002, 2003, 2004, 2005). Ages 6-8 dominated the Canadian catch in most years, both in the otter trawl and shallow water gillnet fisheries. The deep water gillnet fishery was comprised mainly of larger, older individuals.

Sampling data collected in 2005 by observers at sea and by port samplers, were available from Div. 2HJ, 3KLO. The following table shows the number of length measurements by Division and gear type, and the number of otoliths (in italics).

	2HJ		**3K**		**3L**		**3O**	
Gill net < 400	271	*207*	117	*561*	10968	*541*	-	-
Gill net > 400	3789		3809		3818		2191	
Longline	-		-		-		96	
Otter trawl	27982	*840*	9315	*316*	5039	*263*	-	
Totals	32042	*1047*	13241	*877*	19825	*804*	2287	-

The otolith samples from the fixed gear sectors have been combined, as there is a mixture of mesh sizes in the deepwater fisheries in 2J and 3K. The high 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. Gillnet<400 in 3L was also well-sampled in 2005. Under-sampled catches in 2005 include GN<400 in 3K. As in past years, the exact catch location

of some port samples from the fishery operating right on the boundary of Div. 3K and 3L was not known, and these samples have been assigned as Div. 3K. In general, sampling of catches for length frequencies was improved in 2005 over 2003 and 2004. The total number of length measurements in 2005 increased over 2004 proportional to the increased catch, about 40%. However, the number of otoliths was 13% lower in 2005.

Age compositions are presented for both gillnet components (GN<400 and GN>400) as well as for otter trawl (Table 5). As in previous years, any unsampled longline catches were assigned the same age composition as the deepwater gillnet gear catch at age. The predominant age in the otter trawl in all areas, and GN <400 sectors was 7 (1998 year-class), while age 8 (1997 year-class) was most abundant in the catches of deepwater gillnets. Ages 7 and 8 were also dominant in these fisheries in recent years. Overall, the catch at age in 2005 was dominated by the 1997 and 1998 year-classes, which accounted for 70% of the catch numbers and 58% of the catch weight. In 2004, the same ages (7+8) accounted for 61% of the catch in numbers and 47% of the catch in weight. As was the case in 2000-2004, age 8 was second highest in the catch numbers, followed by age 6. Almost equal numbers of ages 6 and 8 were caught by otter trawlers in 2005, and there was no major differences in the age compositions of this gear in all areas (Table 5), although catches in Div. 2JH tended toward larger fish. The catch in the GN>400 fleet has been tending towards smaller fish, as smaller mesh is permitted in deeper areas. For example, only 21% of the catch in numbers by this fleet in 2005 was estimated to be age 10 or older, compared to 80% in 2001 and 72% in 2002. Mean weights at age for all areas were calculated using the same length-weight relationship used for Greenland halibut catch at age in 1998-2003, which was the Divisions-combined, year = 1997 (from Gundersen and Brodie, 1999). Weights at age in 2005 were very similar to those from 2004 (Brodie and Power, 2005), and the sum of products was about 3.4% lower than the catch weight.

CPUE

Catch and effort data from the Canadian otter trawl fishery directed for Greenland halibut during the period 1975 to 1999 were obtained from ICNAF/NAFO Statistical Bulletins. These data were combined with provisional 2000-2002 NAFO STATLANT 21B data and 2003-2005 data from 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. 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. The percentage of otter trawl catch with reported hours fished effort utilized in the analysis, after the selection criteria were applied, ranged from 10% in 1976 to 99% in 2000-2002, and averaged 82% since 1995. The advantage of running the Gavaris model is that the derived index is retransformed into the original units of fishing effort and can be computed for any chosen combination of the main factors.

Residual plots did not indicate model misspecification. The model resulted in a significant regression (P <0.05) explaining 57% 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 twin trawlers is also much higher. The standardized catch rate index (Table 7, Fig. 8) shows much between-year variability. Initial CPUE increased rapidly, probably as a result of captains learning a relatively new fishery. Catch rates then showed period of stability from 1978 to 1984, during which time 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 the lowest in the series (excluding the first point in 1976). Between 1992 and 2001 catch rates increased gradually, doubling over this period. Catch rate declined sharply in 2002 and has remained stable to 2005 which is marginally higher than the lowest catch rates observed over the 30 year series.

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Table 1. Canadian catch of G.halibut, by gear type, from 1960-2005.

	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

Table 2. Canadian catch of G.halibut, by Division, from 1960-2005.

	DIVISION								Canada
YEAR	2G	2H	2J	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	2892	13705		1	3	16608
1968			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	3602	3233		1	7	6848
1974			19	2817	2909		9	3	5757
1975			22	3245	4540		7		7814
1976	62	168	153	4779	4144	1	7		9314
1977		72	419	10751	6725	1	2	3	17973
1978		14	1255	15875	7548	1	5	4	24702
1979		34	3163	18165	8578	2	17	6	29965
1980		217	1157	17658	12742	14	43	3	31834
1981	10	41	862	14379	8833		49	6	24180
1982	15	5155	3942	6031	4105		55	6	19309
1983		2578	2238	7679	4618		12	2	17127
1984		1913	2796	7496	5078		12	2	17297
1985		1758	3101	4395	3023		35	1	12313
1986		82	2476	2886	2769		2	1	8216
1987		6	4143	4740	4561		1		13451
1988	45	27	1867	4591	1921	2	12	2	8467
1989		190	2635	6342	2809	6	10	3	11995
1990	57	171	2798	4075	2020	38	4	4	9167
1991		50	3008	2215	1291	157	11	7	6739
1992	428	230	476	3882	1951	4	10	22	7003
1993	557	403	214	2398	880		19	435	4906
1994	1045	210	203	1032	258		1	204	2953
1995	1006	453	709	754	197			116	3235
1996	688	639	1058	2567	888			339	6179
1997	370	619	1513	2659	935			184	6280
1998	358	418	1234	1374	633		1	103	4121
1999	65	103	1094	1940	683			131	4016
2000	45	81	1152	5845	2901	1	1	567	10593
2001	63	251	1030	3999	2666		9	347	8365
2002	374	360	1030	2933	1466	15		112	6290
2003	258	1897	730	2873	964			252	6974
2004	147	1050	891	1844	794		1	142	4869
2005	39	378	1717	3006	1379		3	115	6637

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 4. Breakdown of Canadian catches of G.halibut in SA 2 + Div 3KLMNO in 2005 by area, gear, and month.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	GN<400 fm							5	45					50
	GN>400 fm							31	119	55	36	40	5	286
2GH	Otter trawl					1								1
	Longline						6	10	33		31			80
	Total					1	6	46	197	55	67	40	5	417
	GN<400 fm									10				10
2J	GN>400 fm				13	73	242	247	126	18	48			767
	Otter Trawl	8		13	120	152	421	70	83			7	66	940
	Total	8		13	133	225	663	317	209	28	48	7	66	1717
	GN<400 fm						113	273	58	2				446
3K	GN>400 fm	1	7	4			572	614	242		1			1441
	Otter Trawl						61	376	19	13	455	34	161	1119
	Total	1	7	4			746	1263	319	15	456	34	161	3006
	GN<400 fm						2	30	432	507	25	6		1002
	GN>400 fm						18	79	89	32	2			220
3L	Otter Trawl						25	121		1		8		155
	Longline			2										2
	Total			2			45	230	521	540	27	14		1379
	Gillnet	15			36			5	11	29				96
3NO	Otter Trawl					1		1	1					3
	Longline			6	12							1		19
	Total	15		6	48	1		6	12	29		1		118
	TOTAL	24	7	25	181	227	1460	1862	1258	667	598	96	232	**6637**

Table 5. Catch at age for the Canadian catch of G.halibut in SA 2 + Div. 3KLMNO in 2005.
Catch at age in thousands of fish. See text for definition of GN gear types.

	Gear								Mean		
Age	OT 2HJ	OT 3K	OT 3L	**Total Ot trawl**	**GN<400**	**GN>400**	**Total**	**Pct**	**Len (cm)**	**Wgt (kg)**	**S.O.P(t)**
3	*	*		*			**0.3**	**0.01%**	31.1	0.242	0.1
4	2	7	1	10	*		**10**	**0.19%**	33.8	0.308	3.1
5	14	30	5	48	3	1	**52**	**0.99%**	37.1	0.412	21.4
6	128	207	25	359	53	28	**440**	**8.38%**	41.6	0.598	263.1
7	406	600	39	1045	775	492	**2312**	**44.04%**	47.1	0.883	2041.5
8	185	178	22	384	418	547	**1351**	**25.73%**	52.5	1.239	1673.9
9	76	82	22	180	109	286	**575**	**10.95%**	58.0	1.692	972.9
10	23	27	10	60	22	148	**230**	**4.38%**	62.7	2.161	497.0
11	12	10	5	27	2	110	**141**	**2.69%**	67.3	2.701	380.8
12	6	4	2	11	*	62	**74**	**1.41%**	72.7	3.443	254.8
13	5	2		7		30	**38**	**0.72%**	77.5	4.234	160.9
14	1	*	*	1		15	**17**	**0.32%**	80.0	4.684	79.6
15			*	*		4	**5**	**0.10%**	85.3	5.709	28.5
16			*	*		3	**3**	**0.06%**	89.3	6.597	19.8
17	*			*		1	**1**	**0.02%**	89.4	6.614	6.6
18							**0**	**0.00%**			
19	*			*		1	**1**	**0.02%**	95.6	8.328	8.3
							5250.3				
											6412

* indicates catch of less than 500 fish

catch= 6637

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 otter trawl fleet (2005 based on preliminary data).

REGRESSION OF MULTIPLICATIVE MODEL
MULTIPLE R..... 0.755
MULTIPLE R SQUARED..... 0.570

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARE	F-VALUE
INTERCEPT	1	2.77E2	2.77E2	
REGRESSION	49	5.84E1	1.19E0	6.947
Cntry|Gear|TC	6	6.03E0	1.00E0	5.857
Month	11	3.67E0	3.34E-1	1.946
Division	3	2.35E0	7.84E-1	4.568
Year	29	2.70E1	9.30E-1	5.418
RESIDUALS	257	4.41E1	1.72E-1	
TOTAL	307	3.80E2		

REGRESSION COEFFICIENTS

CATEGORY	CODE	VAR #	REG. COEF	STD. ERR	NO. OBS
Cntry|Gear|TC	3125	INT	-1.190	0.312	307
Month	9				
Division	22				
Year	76				
1	3123	1	-0.251	0.149	10
	3124	2	-0.185	0.202	5
	3126	3	-0.009	0.137	13
	3127	4	0.520	0.147	11
	3857	5	0.973	0.208	5
	27125	6	0.126	0.101	25
2	1	7	-0.141	0.154	11
	2	8	-0.077	0.155	12
	3	9	-0.372	0.136	18
	4	10	-0.239	0.121	28
	5	11	-0.040	0.119	27
	6	12	-0.031	0.109	34
	7	13	-0.082	0.097	43
	8	14	0.080	0.091	46
	10	15	-0.291	0.127	18
	11	16	-0.297	0.142	14
	12	17	-0.098	0.139	15
3	23	18	-0.113	0.090	77
	31	19	-0.316	0.094	127
	32	20	-0.287	0.105	59
4	77	21	0.338	0.352	5
	78	22	0.929	0.339	8
	79	23	0.937	0.385	3
	80	24	1.107	0.324	13
	81	25	0.988	0.327	14
	82	26	0.968	0.332	10
	83	27	0.965	0.319	18
	84	28	1.094	0.325	12
	85	29	0.615	0.324	13
	86	30	0.411	0.340	8
	87	31	0.826	0.354	5
	88	32	0.079	0.368	4
	89	33	0.551	0.346	6
	90	34	0.409	0.323	13
	91	35	0.204	0.319	16
	92	36	0.074	0.318	20
	93	37	0.209	0.329	15
	94	38	0.244	0.368	4
	95	39	0.359	0.422	2
	96	40	0.235	0.336	8
	97	41	0.633	0.341	7
	98	42	0.446	0.423	2
	99	43	0.387	0.428	2
	100	44	0.537	0.334	9
	101	45	0.753	0.322	17
	102	46	0.330	0.329	11
	103	47	0.221	0.313	28
	104	48	0.237	0.316	20
	105	49	0.303	0.328	12

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 (2005 based on preliminary data).

	PREDICTED CATCH RATE						
	LN TRANSFORM		RETRANSFORMED		FLEET		% OF CATCH IN
YEAR	MEAN	S.E.	MEAN	S.E.	CATCH	EFFORT	THIS ANALYSIS
1976	-1.1905	0.0973	0.316	0.096	767	2430	9.5
1977	-0.8520	0.0468	0.454	0.097	2866	6311	20.9
1978	-0.2612	0.0348	0.825	0.153	3951	4790	30.0
1979	-0.2531	0.0734	0.816	0.217	5183	6355	35.4
1980	-0.0834	0.0273	0.989	0.163	3946	3990	42.9
1981	-0.2022	0.0255	0.879	0.140	6155	7002	59.2
1982	-0.2222	0.0235	0.863	0.132	8143	9441	73.4
1983	-0.2255	0.0183	0.862	0.116	7085	8220	87.4
1984	-0.0962	0.0204	0.980	0.140	6070	6195	90.4
1985	-0.5757	0.0206	0.607	0.087	4847	7991	91.2
1986	-0.7792	0.0303	0.493	0.085	1896	3850	74.6
1987	-0.3642	0.0440	0.741	0.154	2465	3328	85.6
1988	-1.1110	0.0559	0.349	0.081	629	1803	38.8
1989	-0.6396	0.0393	0.564	0.111	988	1753	21.2
1990	-0.7811	0.0226	0.493	0.074	2402	4868	76.3
1991	-0.9869	0.0234	0.402	0.061	3254	8105	70.0
1992	-1.1168	0.0204	0.353	0.050	2502	7085	50.2
1993	-0.9817	0.0304	0.402	0.070	1034	2571	87.7
1994	-0.9467	0.0557	0.411	0.096	575	1398	96.5
1995	-0.8315	0.0968	0.452	0.138	632	1398	56.2
1996	-0.9558	0.0325	0.412	0.074	1043	2530	81.0
1997	-0.5579	0.0366	0.613	0.116	1017	1660	94.7
1998	-0.7443	0.0991	0.493	0.152	46	93	63.0
1999	-0.8032	0.1025	0.464	0.145	81	175	81.5
2000	-0.6532	0.0317	0.558	0.099	1285	2302	99.3
2001	-0.4373	0.0238	0.695	0.107	1833	2636	99.2
2002	-0.8610	0.0280	0.454	0.076	1784	3927	98.7
2003	-0.9698	0.0147	0.410	0.050	3710	9044	89.9
2004	-0.9537	0.0180	0.416	0.056	1832	4402	98.5
2005	-0.8878	0.0320	0.441	0.079	2216	5020	36.3

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.192

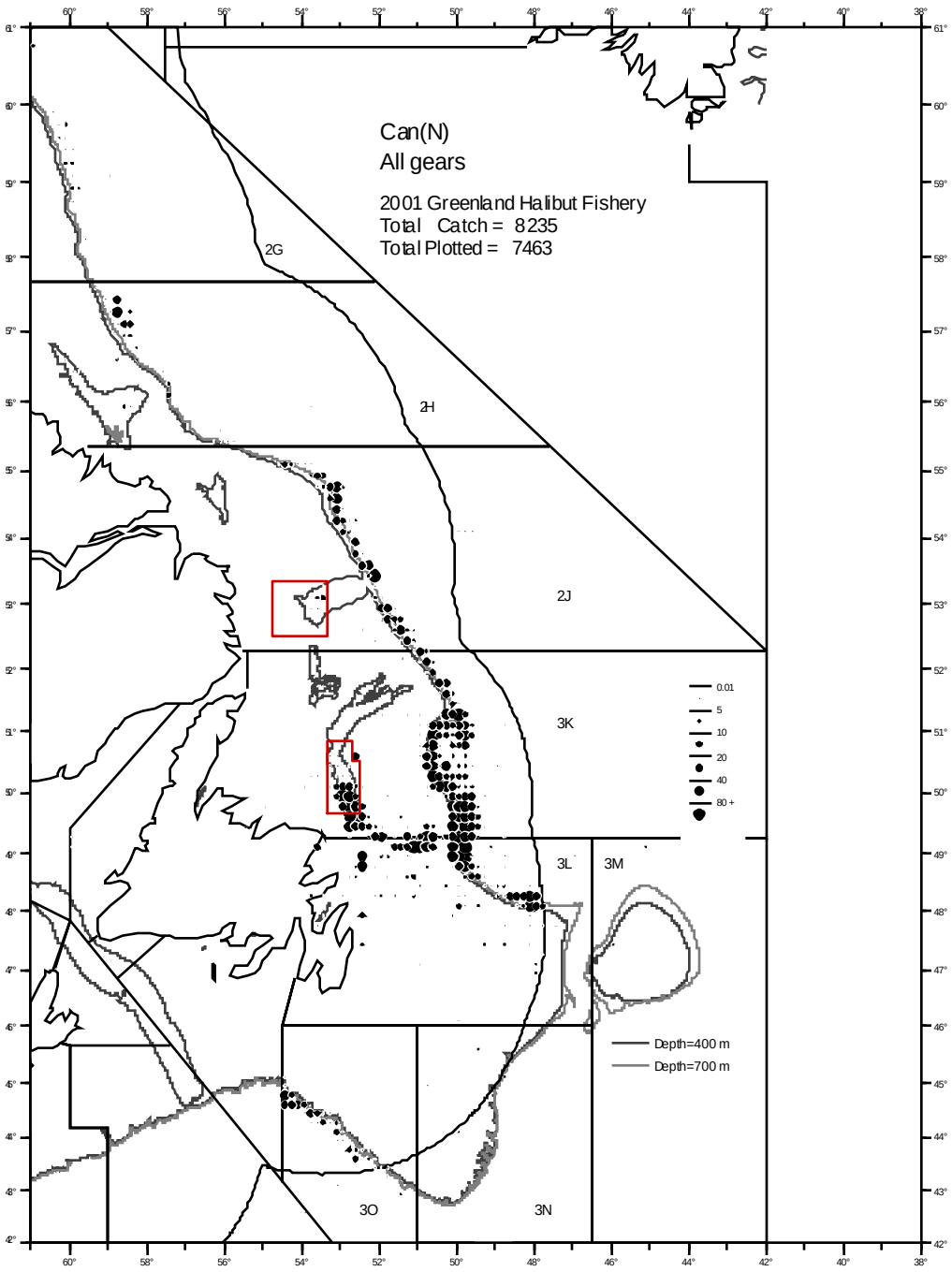

Fig. 1. Distribution of Can(N) Greenland halibut catch (tons) from the 2001 commercial fishery. Represented is catch from directed fisheries and by-catch from other fisheries aggregated by 10-minute square for all gears from Div. 2G to Div. 3O where position was recorded on the logbook. Also shown are area closures in effect in 2005 for various reasons in Div. 2J and Div. 3K.

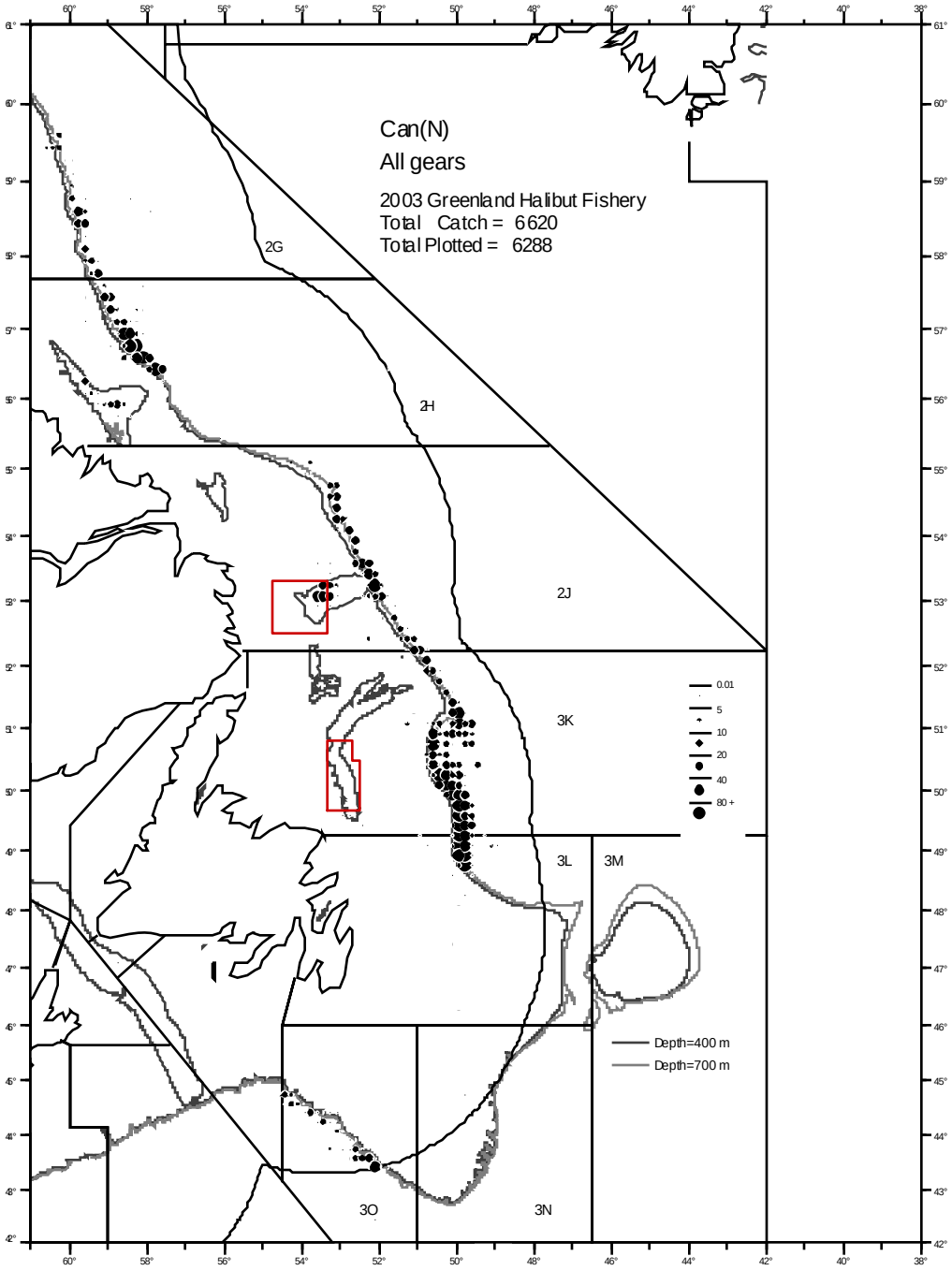

Fig. 2. Distribution of Can(N) Greenland halibut catch (tons) from the 2003 commercial fishery. Represented is catch from directed fisheries and by-catch from other fisheries aggregated by 10-minute square for all gears from Div. 2G to Div. 3O where position was recorded on the logbook. Also shown are area closures in effect in 2005 for various reasons in Div. 2J and Div. 3K.

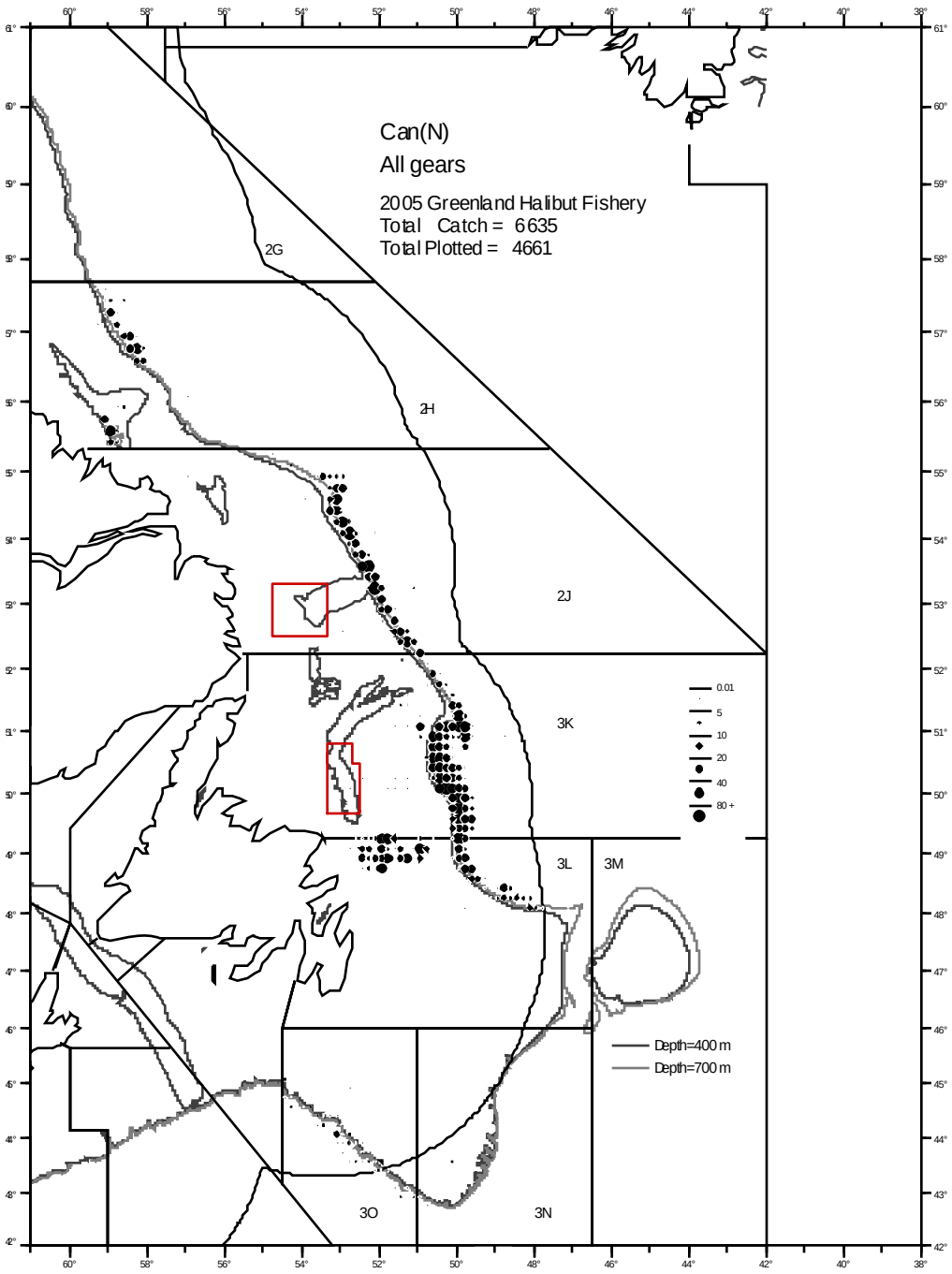

Fig. 3. Distribution of Can(N) Greenland halibut catch (tons) from the 2005 commercial fishery. Represented is catch from directed fisheries and by-catch from other fisheries aggregated by 10-minute square for all gears from Div. 2G to Div. 3O where position was recorded on the logbook. Also shown are area closures in effect in 2005 for various reasons in Div. 2J and Div. 3K.

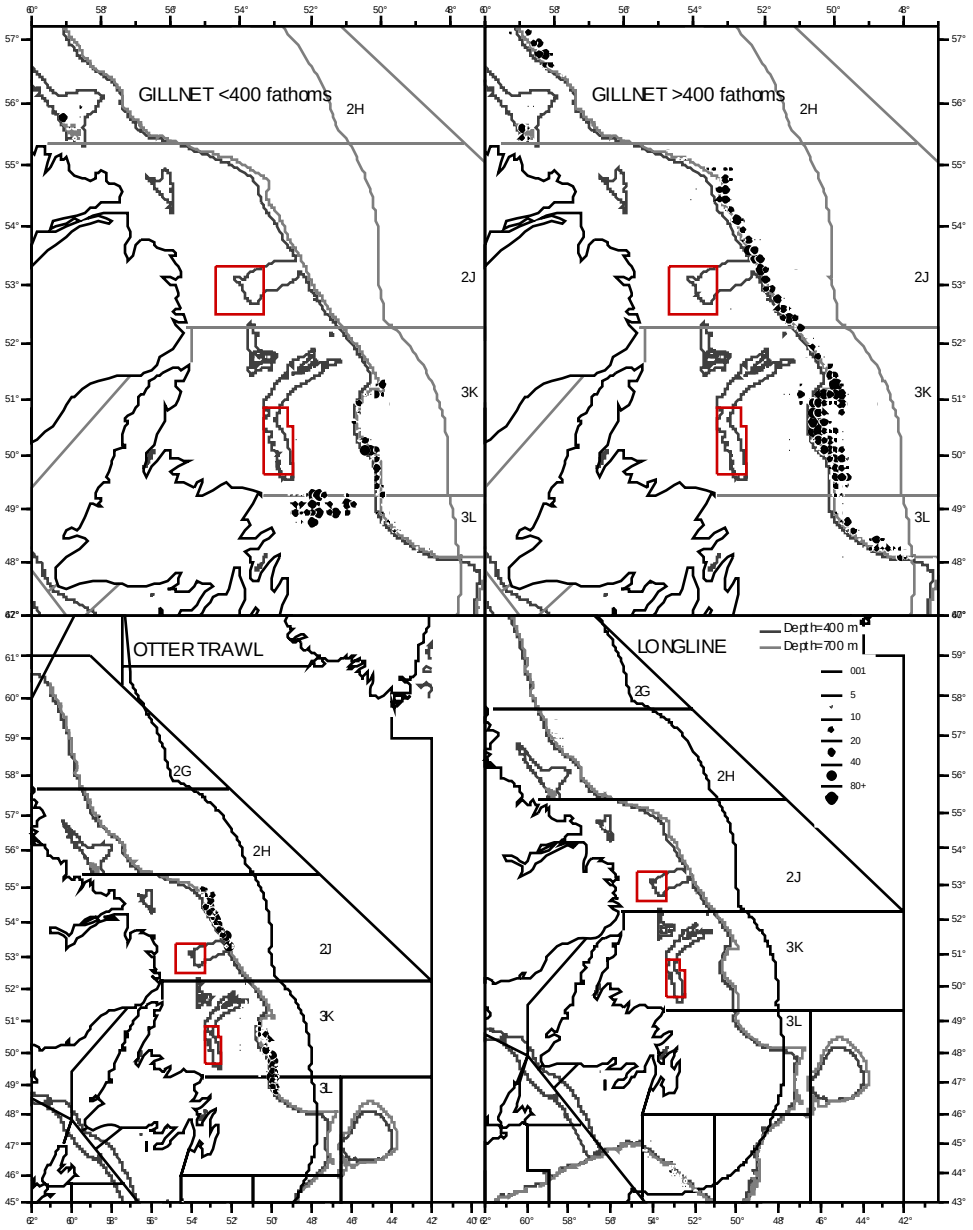

Fig. 4. Distribution of Can(N) Greenland halibut catch (tons) from the 2005 commercial fishery. Represented is LONGLINE, GILLNET (<400 fathoms and >400 fathoms) and OTTER TRAWL from both directed and by-catch fisheries. Data are aggregated by 10-minute square where position information exists. Note the area closures in effect in 2005 for various reasons in Div. 2J3K.

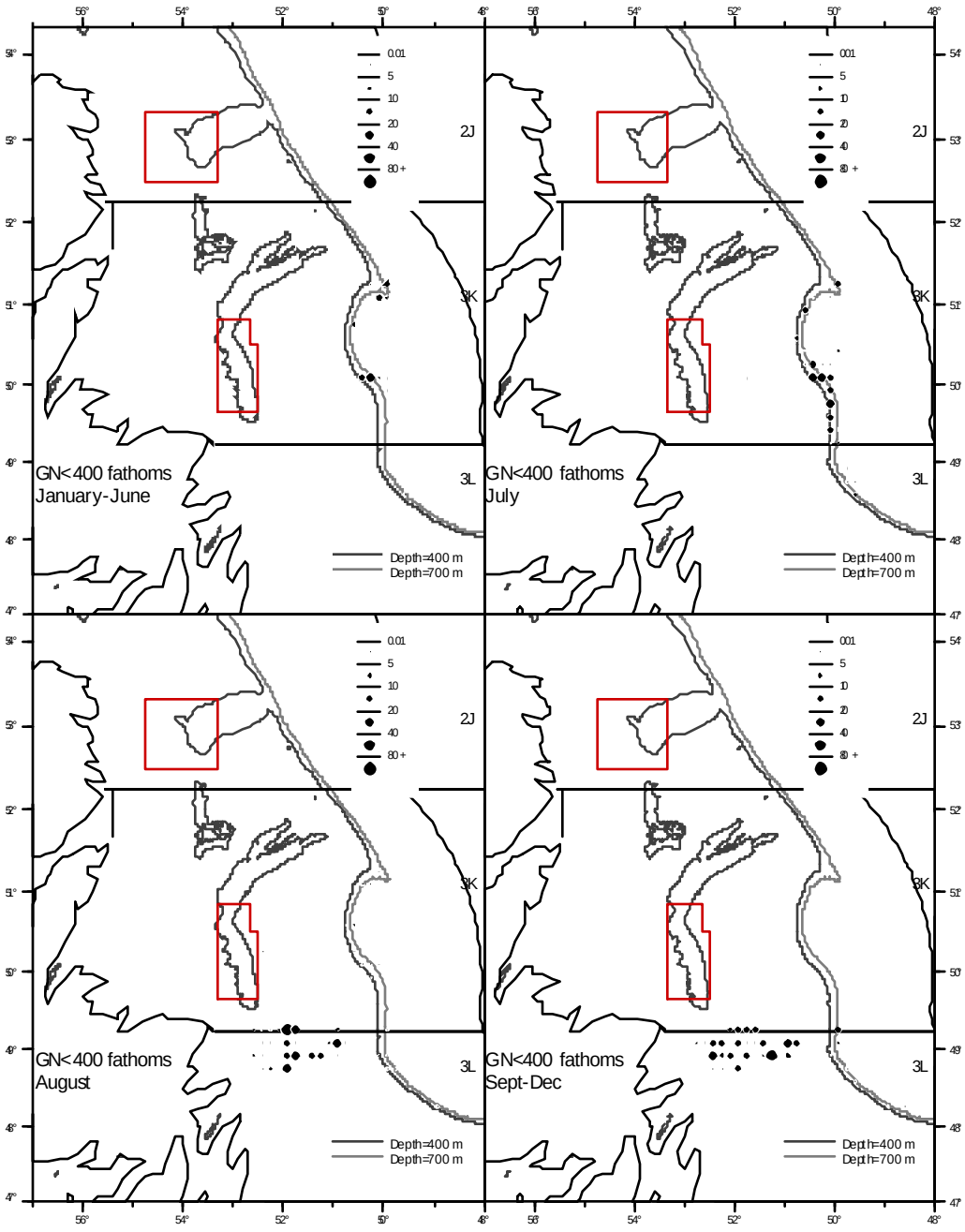

Fig. 5. Distribution of Can(N) Greenland halibut catch (tons) from the 2005 commercial fishery. Represented is GILLNET (<400 fathoms) for various months from both directed fisheries and by-catch fisheries. Data are aggregated by 10-minute square where position information exists. Note the area closures in effect in 2005 for various reasons in Div. 2J3K.

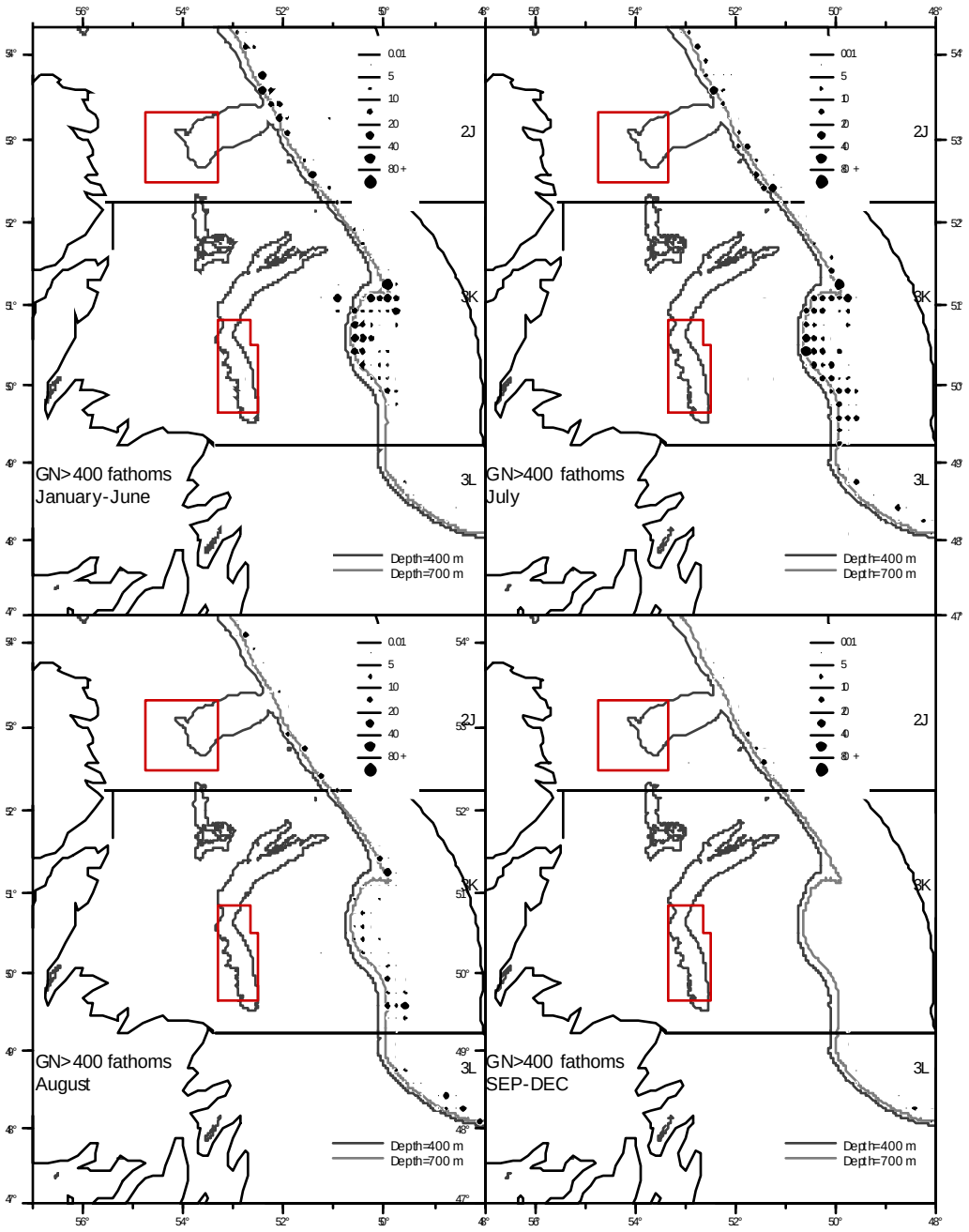

Fig. 6. Distribution of Can(N) Greenland halibut catch (tons) from the 2005 commercial fishery. Represented is GILLNET (>400 fathoms) for various months from both directed fisheries and by-catch fisheries. Data are aggregated by 10-minute square where position information exists. Note the area closures in effect in 2005 for various reasons in Div. 2J3K.

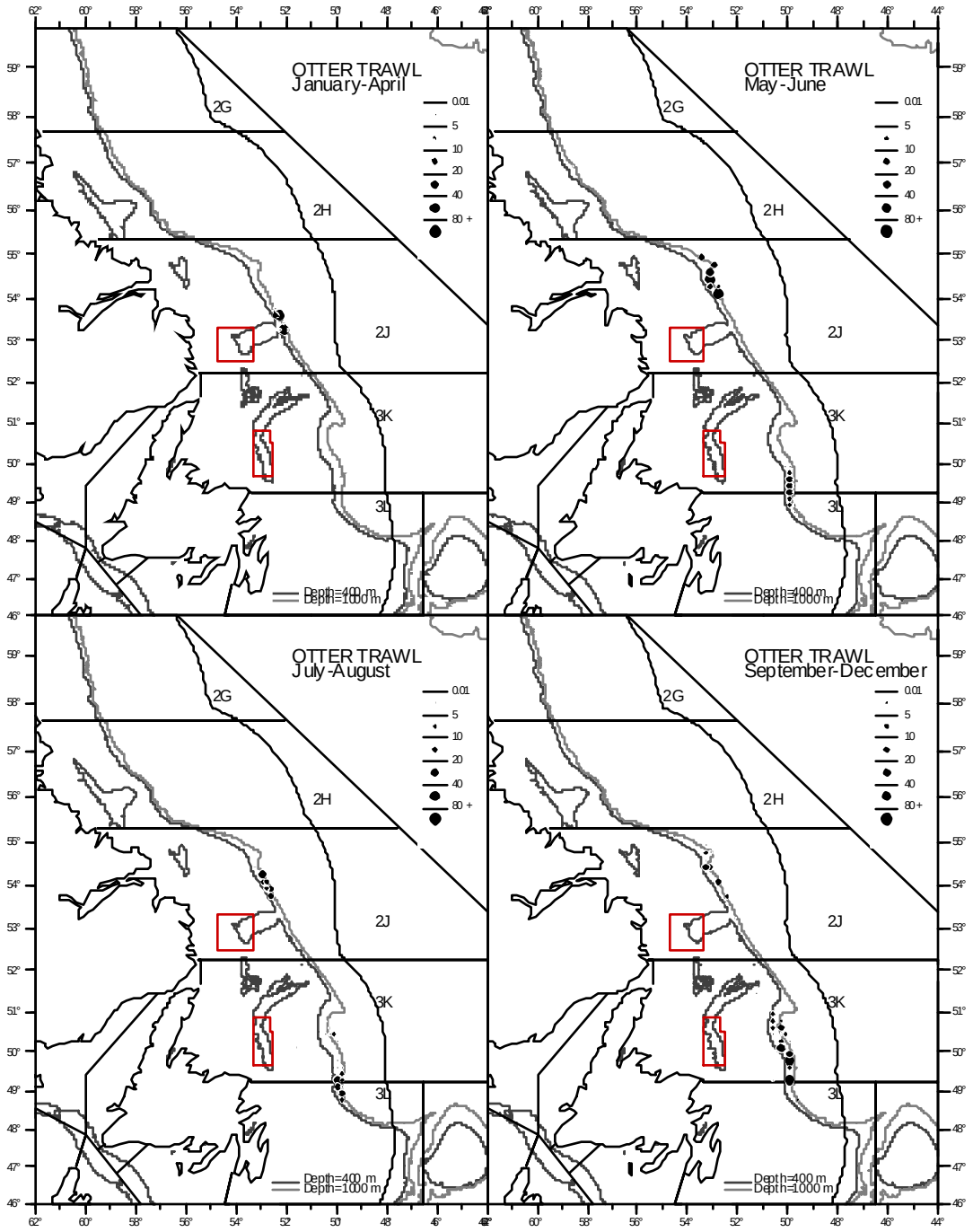

Fig. 7. Distribution of Can(N) Greenland halibut catch (tons) from the 2005 commercial fishery. Represented is OTTER TRAWL catch for various months from directed fisheries and by-catch from other fisheries. The data are aggregated by 10-minute square for Div. 2J3KL where position was recorded on the logbook. Note the area closures in effect in 2005 for various reasons in Div. 2J3K.

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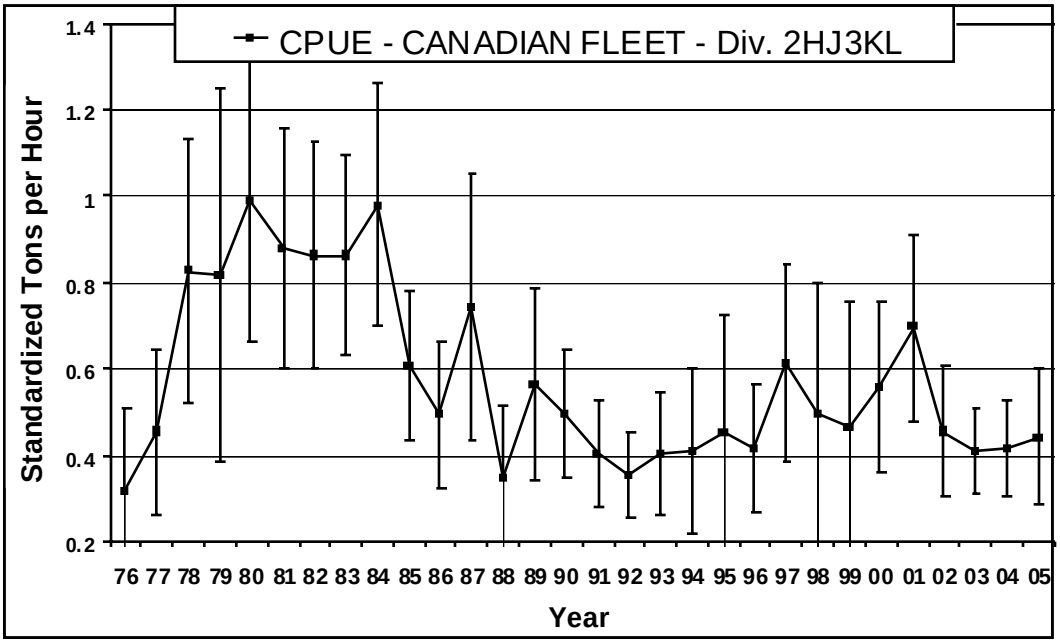

Fig. 8. Standardized Mean CPUE ± 2 standard errors for Greenland Halibut in Div. 2HJ3KL utilizing effort in HOURS fished from the CANADIAN OTTERTRAWL FLEET.