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Results from Bottom Trawl Survey on Flemish Cap of June-July 2007

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Abstract

A stratified random bottom trawl survey on Flemish Cap was carried out on June - July 2007, covering the bank up to 1460 m depth (800 fathoms). The survey was carried out on board *R/V Vizconde de Eza*, using a Lofoten bottom trawl gear, and 174 haul were done, 117 of them in the region with less than 730 m depth. Survey results are presented and compared with results of previous surveys in the series since 1988. Biomass and abundance indices are provided for main commercial species, as well as age composition for cod, American plaice, and Greenland halibut.

KEYWORDS: Survey, Flemish Cap, Cod, American plaice, Redfish, Greenland halibut.

Introduction

The survey on Flemish Cap was carried out on board *R/V Vizconde de Eza* in 2007. A total of 174 valid bottom trawls were made up to a depth of 1400 m (800 fathoms) (Figure 1). The survey covered all strata of the bank adequately with the exception of the strata corresponding with the Beothuk knoll (35-39 strata) in the southwest of the bank. A synoptic sheet of the survey with vessel and gear characteristics is shown in Table 1. This was the 20th survey of the series initiated by the EU in 1988. All surveys had a stratified random design following NAFO specifications (Doubleday, 1981). Dates of the previous surveys were:

Year	Vessel	Valid tows	Dates	Year	Vessel	Valid tows	Dates
1988	Cornide de Saavedra	115	8/7 – 22/7	1998	Cornide de Saavedra	119	17/7 – 2/8
1989	Cryos	116	12/7 – 1/8	1999	Cornide de Saavedra	117	2/7 – 20/7
1990	Ignat Pavlyuchenkov	113	18/7 – 6/8	2000	Cornide de Saavedra	120	10/7 – 28/7
1991	Cornide de Saavedra	117	24/6 – 11/7	2001	Cornide de Saavedra	120	3/7 – 20/7
1992	Cornide de Saavedra	117	29/6 – 18/7	2002	Cornide de Saavedra	120	30/6 – 17/7
1993	Cornide de Saavedra	101	23/6 – 8/7	2003	Vizconde de Eza	114	2/6 – 27/7
1994	Cornide de Saavedra	116	6/7 – 23/7	2004	Vizconde de Eza	124-177 ¹	25/6 – 2/8
1995	Cornide de Saavedra	121	2/7 – 19/7	2005	Vizconde de Eza	117-176	2/7 – 21/8
1996	Cornide de Saavedra	117	28/6 – 14/7	2006	Vizconde de Eza	115-179	1/7 – 26/7
1997	Cornide de Saavedra	117	16/7 – 1/8	2007	Vizconde de Eza	117-174	23/6 – 19/7

¹ Up to 730 m deep (400 f) – up to 1460 m deep (800 f)

Previous survey report was presented by Casas and González Troncoso (2007).

Results

Biomass estimated by swept area method (tons) of main species in past surveys are:

	year	cod	American plaice	redfish	Greenland halibut	roughhead grenadier	shrimp
120-730 m	1988	40839	16046	188331	6926	2009	5745
	1989	114050	14047	162535	4472	871	2298
	1990	59362	11983	126757	5799	852	3489
	1991	40248	10087	76955	8169	1335	11657
	1992	26719	8656	130209	8728	1577	25155
	1993	60963	7861	72608	6529	3021	12090
	1994	26463	8227	162525	8037	1975	3980
	1995	9695	6785	87644	10875	1558	7504
	1996	9013	4098	119662	11594	1362	10902
	1997	9966	3026	165816	16098	1197	7701
	1998	4986	3437	70832	24229	1691	41970
	1999	2854	2585	98651	21207	1250	25737
	2000	3062	1606	177990	16959	1047	19719
	2001	2695	2404	77345	13872	2079	28317
	2002	2496	2049	121312	12100	1211	40176
	2003	1593	2286	93816	6214	2348	21515
	2004	4071	3525	250605	12292	3597	20127
	2005	5242	2760	453040	11698	2387	30675
	2006	12505	1691	766709	11706	3933	15044
2007	23886	1053	464618	13040	1367	12863	
120-1460 m	2004	4071	3525	250638	28343	17184	20195
	2005	5242	2760	453086	21515	14253	31186
	2006	12505	1691	766738	24358	12109	15250
	2007	23886	1053	464660	31723	7807	17120

Values for surveys before 2003, when RV Cornide de Saavedra was used, are transformed to their equivalences for RV Vizconde de Eza following the accepted calibration among the two vessels (González Troncoso and Casas 2005). From 2004 onwards, abundances are calculated for 19 shallowest strata covering the bank up to 730 m deep, as it was done in previous years, and for 34 strata up to 1460 m deep.

These numbers are also presented in Table 2, and even they belong to different species and pelagic vs. demersal character and the transformation to the new scale was only applied to main species, a global index is presented for each year, which minimum occurred in 2001. Until 2003 redfish showed the highest annual variability probably due to its pelagic habitat, making accessibility to bottom gears more changeable than in the case of demersal or benthic species. However since 2004 the presence of some strong year classes mainly of *S. fasciatus* caused the increase of redfish and total biomass, reaching consecutive historic maximums in the last four years. The relative high values estimated in 2004 for American plaice did not keep in 2005 and 2006 and they were probably due to an occasional increases of catchability in 2004. Greenland halibut biomass maintained a continuous biomass increase to reach a maximum in 1998, since then the biomass decreased but maintained to a roughly same level, excluding the out of range 2003 value. In 2005, shrimp biomass was among the highest of the historical series. Such high level was not maintained in 2006 and 2007, but decreased to around 50%.

Excluding redfish, the whole period could be divided in two in regards to species composition: Cod, American plaice and skates dominating the first half, prior to 1995, Greenland halibut and shrimp the second half. For cod, 1995 was the spawning year for the first extremely weak recruitment; it had been 1991 for American plaice. The high cod indexes at age 1 in 2005 and 2006 could indicate the presence of two relative strong year classes in 2004 and 2005.

Cod

Mean catch per standard tow by strata and its standard error are presented in Table 3. Survey biomass, as calculated by the swept area method, is compared with results of previous years by stratum in Table 5. Survey biomass is compared with Russian survey results:

Year	EU (1)	Russia: (2)	(3)	Year	EU (1)	Russia: (2)	(3)
1983		23,070		1996	9,013	730	-
1984		31,210		1997	9,966	-	-
1985		28,070		1998	4,986	-	-
1986		26,060		1999	2,854	-	-
1987		10,150	21,600	2000	3,062		-
1988	40,839	7,720	34,200	2001	2,695	784	-
1989	114,050	36,520	78,300	2002	2,496	694	-
1990	59,362	3,920	15,200	2003	1,593		-
1991	40,248	6,740	8,200	2004	4,071		
1992	26,719	2,490	2,400	2005	5,242		
1993	60,963	8,990	9,700	2006	12,505		
1994	26,463	-	-	2007	23,886		tons
1995	9,695	8,260	-				

1) Biomass estimated from bottom trawl survey.

2) Biomass estimated from bottom trawl survey (Kiseleva and Vaskov 1994; Kiseleva 1996, 1997; Vaskov and Igashov, 2003).

3) Biomass estimated of bottom trawlable plus pelagic biomass (Borovkov *et al.* 1993; Kiseleva and Vaskov 1994).

The abundance at age is shown in the table below.

age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	4868	19604	2303	129032	71533	4075	3017	1425	36	37	23	5	178	473	0	684	13	8066	19711	3912
2	79905	10800	12348	26220	41923	138357	4130	11901	3121	150	83	84	16	1990	1330	54	3380	16	3876	11625
3	49496	91303	5121	16903	5578	31096	27756	1338	6659	3478	95	116	327	13	641	628	25	1118	56	5021
4	13448	54613	16952	2125	2385	1099	5097	3892	892	4803	1256	117	198	122	29	134	602	80	1472	21
5	1457	20424	15834	6757	385	1317	130	928	2407	391	1572	717	96	79	70	22	168	708	88	1138
6	211	1336	4492	1731	1398	173	67	33	192	952	78	444	446	15	33	42	19	137	587	58
7	225	143	340	299	244	489	7	23	8	21	146	19	172	142	26	7	5	0	121	425
8	72	126	146	68	14	87	111	0	5	0	0	5	11	99	96	8	10	16	8	74
9		6	77	32	0		0	21		0	6		17	6	30	39	3	8	0	13
10		7	25	4	0		5	5		0			0	6	0	24	5	8	8	20
11				10	8					0			0	6	5		16		8	
12										4			5						0	
13													0						8	
14													5							
total	149683	198363	57637	183181	123468	176693	40319	19567	13320	9837	3259	1507	1470	2951	2261	1642	4229	10157	25959	22307

Abundance in thousands

The 1990 year-class was the most abundant observed at age 1, but its level was not maintained in the following years, after recruitment. This may indicate that its abundance was overestimated in the 1991 survey. The abundance of the 1991 year-class, although recording a maximum at age 2, decreased quickly as a consequence of the intense fishery on ages 2 and 3 during 1993 and 1994. The 1992 to 1994 year-classes were weak, and those from 1992 to 2003 failed almost completely. The abundance of 2004 and 2005 year-classes are higher than in previous 12 years. The abundance of the 2006 year-class seems to be intermediate based on results at age 1 in 2007.

Tables 6, 7, and 4 show length distribution, the age-length key and abundance at age by stratum respectively. Distribution of survey catches is presented in Figure 2.

Confidence limits for abundance at age results were calculated by bootstrap. In doing it, the random selection process was applied to catches on each stratum, length distribution of each selected haul and otolith age frequency of

each length class, following Vázquez and Cerviño (1998). It is observed that, while abundance of most ages have a like normal distribution, abundance at age 2 shows a multi-modal distribution (Figure 3). That is a consequence of catches of age 2 cod being concentrated in a single haul (number 50) on stratum 3.

American plaice

Mean catch per standard tow by strata is presented in Table 8. Survey biomass, as calculated by the swept area method, is compared with results of previous surveys in Table 10. This biomass is compared with Russian survey results in the following table:

Year	EU	Russia (1)	Year	EU	Russia (1)
1983		8,900	1996	4,098	
1984		7,500	1997	3,026	
1985		7,800	1998	3,437	
1986		20,200	1999	2,585	
1987		9,300	2000	1,606	
1988	16,046	6,500	2001	2,404	
1989	14,047	5,000	2002	2,049	548
1990	11,983	1,200	2003	2,286	1,398
1991	10,087	14,400	2004	3,525	
1992	8,656	1,200	2005	2,760	
1993	7,861	2,700	2006	1,691	
1994	8,227		2007	1,053	tons
1995	6,785				

1) Rikhter *et al.* 1991; Borovkov *et al.* 1992, 1993, 1994; Vaskov and Igashov, 2003.

The abundance at age is presented in the following table. The 1986 and 1990 year-classes, ages >15 in 2007, were between the most abundant cohorts in the period, but no good recruitment was observed since then. Fish aged 6 or more roughly correspond with fishable biomass. The abundance of this group (a 6+) decreased along the period except in 1992, when an increase was recorded as the consequence of the income of the abundant 1986 year-class, and in the 2001-204 period, even it can not be attributed to any abundant year-class.

age	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	0	40	8	40	0	0	0	0	8	8	0	8	16	0	0	8	0	0	8	207
2	402	563	426	354	852	8	40	32	32	16	24	0	24	40	0	8	113	32	24	7
3	1882	8364	917	1206	796	1544	48	113	121	113	32	24	8	48	32	32	281	113	40	13
4	1311	1874	8372	2171	1070	1086	2131	740	257	24	48	64	80	56	64	97	72	290	105	35
5	4230	4367	1126	5348	1938	780	1037	2131	587	121	72	80	105	105	16	80	80	105	137	106
6	6385	4359	3370	2445	4769	418	877	1367	1665	418	265	80	153	56	88	56	105	105	137	119
7	5010	4142	2340	2686	1279	4134	973	1375	893	1206	619	241	121	113	64	48	105	129	72	49
8	5460	2429	2228	2067	1504	450	3426	909	547	273	901	474	153	265	129	137	129	105	56	49
9	1753	804	1351	852	828	780	322	1536	402	410	523	507	394	434	161	290	249	225	121	35
10	458	346	627	298	378	370	651	161	627	290	354	257	426	579	193	233	314	201	161	47
11	97	40	113	8	177	257	225	177	145	491	298	338	225	483	298	426	281	225	201	76
12	161	16	16	56	97	306	225	145	80	129	290	209	185	418	225	483	595	249	193	122
13	129	0	32	0	16	362	249	145	80	24	88	121	72	193	249	281	426	354	193	143
14	48	0	16	0	0	1070	523	290	105	97	113	121	56	161	145	265	402	394	209	82
15	56	0	0	0	0	32	491	217	72	48	56	56	48	113	129	145	330	257	201	75
16+	40	0	0	0	0	40	8	32	24	113	105	97	56	97	185	161	523	547	322	236
Total	27415	27351	20949	17523	13711	11637	11226	9377	5645	3772	3804	2670	2131	3169	1970	2766	4013	3329	2187	1401
a 6+	19598	12135	10093	8412	9047	8219	7970	6353	4640	3498	3611	2501	1890	2911	1866	2525	3458	2791	1681	1033

Abundance in thousands

Total abundance and abundance 6+ have declined over the whole period, reaching their lowest level in 2007: more than 10 times lower than in the 1988-1990 period. Data in the table above indicates two periods for recruitment, and a change from an upper abundance level to a lower one. The 1991 year-class was the first weak

cohort. The relative high values founded in 2004 and 2005 for American plaice, mainly in the ages older than 13 years old, are probably due to the relative strong year classes previous to 1991.

Tables 11, 12, and 9 show length distribution, the age-length key and abundances at age by stratum respectively. Distribution of survey catches is presented in Figure 4.

Redfish

All redfish catches were classified by species. The group named *juvenile* contains those individuals of small size for which routine classification was not possible. The 15 cm maximum length is a good reference for this group, but it was never used as a criterion. The skill required to identify the species increased over time, so the group *juvenile* is not an uniform defined group, but it is maintained for practical reasons.

Mean catch per standard tow by strata for *Sebastes marinus*, *S. mentella*, *S. fasciatus* and the *juvenile* group are presented in Table 13. The following table shows the total survey biomass (tons) by year in the strata up to 730 m deep (400 fathoms)

Year	<i>Sebastes</i>	<i>Sebastes spp.</i>			total
	<i>marinus</i>	<i>mentella</i>	<i>fasciatus</i>	juvenile	
1988	18,229	170,102			188,331
1989	27,312	135,223			162,535
1990	16,751	86,695		23,311	126,757
1991	4,864	59,552	6,755	5,784	76,955
1992	4,909	85,408	6,314	33,578	130,209
1993	4,789	21,235	5,175	41,409	72,608
1994	39,516	42,495	9,303	71,211	162,525
1995	10,754	70,567	5,986	337	87,644
1996	13,431	92,647	13,112	472	119,662
1997	77,125	66,710	20,780	1,201	165,816
1998	7,640	53,946	7,656	1,590	70,832
1999	11,215	77,610	9,460	366	98,651
2000	53,388	106,283	15,364	2,955	177,990
2001	10,244	45,931	13,715	7,455	77,345
2002	11,651	48,760	27,556	33,345	121,312
2003	40,110	28,785	15,031	9,890	93,816
2004	85,383	45,999	76,164	43,059	250,605
2005	147,688	105,110	123,326	75,762	451,215
2006	298,290	105,849	319,387	43,396	766,922
2007	88,071	51,183	261,788	63,576	464,618

Tables 14, 15, 16 and 17 show length distribution for the four groups. Catches per haul distribution for the three species and juveniles are presented in Figures 5, 6, 7 and 8.

Greenland halibut

Mean catch per standard tow by strata and its standard error are presented in Table 18. Survey biomass are compared with results of previous surveys in Table 20. The following table summarises the total biomass by year:

Year	EU	Year	EU
1988	6,926	1998	24,229
1989	4,472	1999	21,207
1990	5,799	2000	16,959
1991	8,169	2001	13,872
1992	8,728	2002	12,100
1993	6,529	2003	6,214
1994	8,037	2004	12,292
1995	10,875	2005	11,698
1996	11,594	2006	11,706
1997	16,098	2007	13,040 tons

Length distribution, age-length keys and abundance at age are presented in Tables 19, 22 and 21, respectively. Catch per haul distribution is presented in Figure 9. Abundance at age in the 19 strata less than 730 m depth calculated as follows:

age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	1302	1677	1423	1429	9978	4699	2674	2200	852	3014	6459	3282	1768	1762	437	548	336
2	207	1260	1245	996	2045	6408	3036	1716	563	235	1153	2364	804	2644	652	322	74
3	348	447	777	1365	1793	1942	4822	6180	2419	479	1456	2248	489	3517	2554	525	456
4	1054	1023	692	1435	1535	2442	5225	8843	8419	1741	799	1342	1217	1585	2007	943	275
5	2307	1852	1021	1545	2136	3380	5714	9919	10787	5703	2242	3045	1991	5601	5537	4807	2765
6	1291	2249	1545	2385	4099	4680	6800	9085	10119	11336	6262	4498	2362	6271	6105	6002	5928
7	2212	1947	1627	2139	3029	2001	4014	6304	4467	4346	5328	4610	1552	2040	2345	2665	4632
8	534	1054	1266	1180	1706	1299	1731	2108	1466	1865	2584	1025	375	518	491	623	1217
9	462	468	776	631	1052	341	528	600	280	361	147	104	105	233	89	180	247
10	352	273	213	219	209	70	177	157	82	92	36	48	79	107	97	143	165
11	141	138	104	90	53	21	23	27	6	44	5	16	15	63	44	103	62
12	12	67	38	47	18	31	17	6	3	0	0	6	4	38	15	45	38
13	0	25	21	18	0	0	17	16	3	0	0	0	0	5	3	10	5
14	0	12	9	0	5	4	0	0	5	0	0	0	0	3	3	0	2
15	15	0	0	0	0	5	6	0	0	0	0	0	0	3	3	0	
16+	8	0	0	0	0	0	9	0	0	0	0	0	0	3	3	0	
total	10245	12490	10757	13479	27659	27323	34792	47160	39470	29216	26471	22587	10762	24390	20374	16918	16204
n 10+	7334	8084	6620	8254	12307	11832	19035	28221	27217	23747	16605	13352	6483	14884	14734	14578	272

Abundance in thousands

Shrimp

Casas (2007) presented detailed results.

Roughhead grenadier (*Macrourus berglax*)

Survey biomass and mean catch per standard tow along this survey series on 19 shallowest strata were:

year	biomass	catch/tow	year	biomass	catch/tow
1988	2,009	2.50	1998	1,691	2.10
1989	871	1.08	1999	1,250	1.55
1990	852	1.06	2000	1,047	1.30
1991	1,335	1.66	2001	2,079	2.59
1992	1,577	1.96	2002	1,211	1.51
1993	3,021	3.76	2003	2,348	2.92
1994	1,975	2.46	2004	3,597	4.47
1995	1,558	1.94	2005	2,387	2.97
1996	1,362	1.69	2006	3,933	4.89
1997	1,197	1.49	2007	1,367	2.97

tons Kg

Detailed results are presented by González and Murua (2008).

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Table 1 – Technical data of the 2007 survey.

Procedure	Specification
Vessel	R/V Vizconde de Eza
GT	1 400 t
Power	1 800 HP
Mean trawling speed	3.5 knots
Trawling time	30 minutes effective time
Fishing gear	type Lofoten
footrope / handrope	31.20 / 17.70 m
footgear	27 steel bobbins of 35 cm
vertical opening	3.0 m (SCANMAR)
warps	100 meters, 45 mm, 200 Kg/100m
trawl doors	polyvalent, 850 Kg
wire length	$26.712 \times \text{depth echo sounder (m.)}^{0.6268}$
mesh size in cod-end	35 mm
Type of survey	Stratified sampling
Station selection procedure	Random
Criterion to change position of a selected tow	- Unsuitable bottom for trawling according to ecosounder register. - Information on gear damage from previous surveys.
Criterion to reject data from tow	- tears in cod-end - severe tears in the gear - less than 20 minutes tow - bad behaviour of the gear
Daily period for fishing	6.00 to 22.00 hours
Species for sampling	All fish, squid, shrimp, and other invertebrates
Species for age determination	Cod, American plaice, redfish (<i>Sebastes mentella</i>), Greenland halibut and Roughhead grenadier (<i>Macrourus berglax</i>).

Table 2 – Biomass (t) for several species or groups of species in 1988-2007 surveys in depths lesser than 400 fathoms.

Species	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Rajidae	4495	1938	2823	4061	3780	6241	3506	2268	2051	1842	1978	1608	1150	2236	1544	4608	6241	4238	3506	2181
<i>Synaphobranchus sp.</i>	217	88	40	80	72	105	8	16	0	8	40	0	0	24	8	24	88	72	32	66
<i>Urophycis sp.</i>	643	169	169	257	72	169	217	80	80	32	225	249	169	394	129	547	667	740	611	251
<i>Antimora sp.</i>	394	306	281	563	724	820	796	193	185	233	491	290	265	667	346	306	1158	1110	474	585
Macrouridae	3088	1456	1222	2252	2589	6498	3233	2606	2340	2292	2831	2332	1809	3080	2043	3691	4914	3353	5026	2362
<i>Notacanthus sp.</i>	499	410	64	474	450	740	458	346	177	290	169	64	97	105	64	24	145	64	145	64
<i>Illex sp.</i>	8	8	1649	1158	64	0	209	0	88	64	72	16	0	8	8	225	474	80	3546	411
Anarhichadidae	7994	7487	8122	10101	9095	14355	15642	19220	20563	14033	10985	5581	4471	5863	5227	5983	10591	9570	9272	8195
Witch flounder	909	338	418	772	820	1045	788	708	507	322	241	378	410	458	209	844	1568	1777	893	596
Greenland halibut	6924	4471	5798	8171	8725	6530	8034	10873	11596	16100	24230	21207	16960	13872	12103	6216	12288	11701	11709	13040
Zoarcidae	563	1142	1206	1978	1359	3474	1874	2179	1705	1729	2059	893	780	1246	812	2067	3683	3080	1801	353
Cod	40837	114050	59365	40250	26715	60966	26466	9699	9015	9964	4986	2855	3064	2694	2493	1592	4069	5243	12505	23886
American plaice	16044	14049	11982	10085	8653	7865	8227	6787	4101	3024	3434	2581	1608	2405	2051	2284	3522	2758	1689	1053
Redfish	188333	162535	126757	76953	130206	72610	162527	87641	119664	165816	70833	98650	177991	77347	121312	93817	250602	453041	766924	464618
Shrimp*	5742	2300	3490	11661	25155	12087	3981	7503	10905	7704	41971	25734	19719	28316	40177	21512	20129	30672	16237	17046
Others	635	209	1142	667	426	0	474	394	692	587	1110	619	1592	1448	933	5653	2726	1681	10881	0
Total	276698	310747	223388	168816	218491	193496	235966	150118	182969	223452	164545	162446	228487	138715	188526	143741	320148	529190	845244	540020

*) Values affected by mesh size cod-end: 40 mm in 1994, 25 mm in 1998 and 30 mm in 1999.

Table 3 – Cod (*Gadus morhua*) mean catch per standard tow by stratum and its standard error in the 2007 survey.

stratum	square miles	hauls	catch (Kg)	s.e.
1	342	4	169.645	325.3425
2	838	10	27.79	28.56
3	628	7	239.6275	436.0125
4	348	4	42.6825	67.725
5	703	8	10.2375	11.585
6	496	6	85.0325	47.88
7	822	9	2.24	3.535
8	646	7	9.66	6.0725
9	314	3	6.3175	5.775
10	951	10	3.395	3.6925
11	806	9	4.4275	3.4825
12	670	8		
13	249	3		
14	602	5		
15	666	8	0.9275	1.715
16	634	7		
17	216	2		
18	210	2		
19	414	5		
total	10555	117	29.70	11.25

Table 4 – Cod (*Gadus morhua*) abundance at age ('0000) by stratum in the 2007 survey.

age	stratum												total	mean weight g	mean length cm	
	1	2	3	4	5	6	7	8	9	10	11	15				
1	115	174	25	66	8	3								391	48	18
2	8	27	1033	44	9	28	7	2		1	4			1162	586	40
3	93	39	231	36	2	69	6	17		4	3			502	1595	56
4	1													2	3401	71
5	31	15	21	4	8	19		4	4	3	3	1		114	4014	75
6	2		1			2								6	5687	84
7	15	3	7	1	2	12				1	1			42	6266	86
8	3		2			2								7	7715	92
9	1					1								1	9767	100
10	1	1												2	8799	96
11																
12																
13																
14																
hauls	4	10	7	4	6	6	5	7	2	6	6	2		65		
total	270	261	1321	151	30	136	13	24	4	10	11	1		2231	2351	42.8

Table 5 – Cod (*Gadus morhua*) biomass (t) by strata in 1988-2007 surveys.

stratum	depth in	year																			
	fathoms	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	70- 80	1345	649	767	5585	76	516	2165	1563	1006	243	125	99	250	86	477	173	1996	1801	4022	6731
2	81-100	10150	10323	2065	5486	5150	9044	8186	3040	3991	2049	1899	1502	740	491	736	102	1668	1272	2796	1103
3	101-140	4471	10276	2391	2459	8473	8435	6092	1146	1054	1132	703	145	360	230	451	90	9	1610	1754	9509
4	"	3130	4843	2446	2900	3443	14171	1885	746	1068	857	140	25	443	488	66	136	168	246	757	1695
5	"	2130	10702	8447	10651	4570	6824	924	1274	936	1149	976	256	425	260	146	303	19	24	518	405
6	"	3230	6789	3286	1531	952	4220	1412	1310	620	1074	613	375	511	749	525	24	155	234	1396	3374
7	141-200	2224	16025	4385	2538	945	6153	857	122	55	1067	78	52	5	12	24	107	18		325	87
8	"	8931	16434	15973	5107	2349	7964	3615	349	93	1610	77	23	74	123	37	111	5		303	385
9	"	184	5261	6340	188	143	998	239	9	103	174		20	41		14	376			115	250
10	"	1338	4898	4193	1558	327	936	506	58	46	301	199	102	107	81	2	24		16	180	135
11	"	2505	13219	3859	1787	224	1678	582	78	41	310	176	255	106	175	18	58	33	40	267	175
12	201-300	335	2469	1587	126		24										71				
13	"	9	2534	734	93																
14	"	107	1121	545	131	67														72	
15		748	8436	2344	108												18				36
16	301-400		66																		
17			5																		
18		2																			
19																					
total		40839	114050	59362	40248	26719	60963	26463	9695	9013	9966	4986	2854	3062	2695	2496	1593	4071	5243	12505	23885
s.e.		5784	12205	8225	6704	5837	17397	7367	2070	1459	1725	646	451	593	380	398	273	780	1624	1962	9047

s.e.: standard error

Table 6 – Cod (*Gadus morhua*) length distribution ('000) in the 2007 survey.

length		length		length		length	
9-11		36-38	2479	63-65	127	90-92	106
12-14	166	39-41	4290	66-68	71	93-95	46
15-17	1672	42-44	3121	69-71	185	96-98	39
18-20	1616	45-47	814	72-74	277	99- 101	21
21-23	456	48-50	516	75-77	343	102-104	13
24-26	7	51-53	1080	78-80	310	105-107	7
27-29	39	54-56	1410	81-83	129	108-110	
30-32	171	57-59	1341	84-86	85	111-113	
33-35	631	60-62	631	87-89	108	total	22307

Table 7 – Cod (*Gadus morhua*) age-length key in 2007.

length cm	age														total	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
12-14	22															22
15-17	161															161
18-20	120															120
21-23	37															37
24-26																
27-29		6														6
30-32		9														9
33-35		22														22
36-38		65														65
39-41		80														80
42-44		83														83
45-47		22	1													23
48-50		3	11													14
51-53			84													84
54-56			137													137
57-59			149													149
60-62			69													69
63-65			13		1											14
66-68				1	9											10
69-71				1	26											27
72-74					38		3									41
75-77				1	43	1	2									47
78-80					32	2	10									44
81-83					9	2	4									15
84-86					1	1	9	1		1						13
87-89					1		11	4								16
90-92						1	13	2								16
93-95							6	1								7
96-98						1	3		1	1						6
99-101							1	2								3
102-104								1	1							2
105-107											1					1
total	340	290	464	3	160	8	62	11	2	3						1343

Table 8 – American plaice (*Hippoglossoides platessoides*) mean catch per standard tow by strata and its standard error in the 2007 survey.

<u>stratum</u>	<u>square miles</u>	<u>hauls</u>	<u>catch (Kg)</u>	<u>s.e.</u>
1	342	4	10.89	8.26
2	838	10	3.27	2.26
3	628	7	2.12	2.63
4	348	4	5.78	6.11
5	703	8	1.51	1.84
6	496	6	2.63	2.10
7	822	9	0.32	0.44
8	646	7	1.17	0.98
9	314	3		
10	951	10	0.33	0.46
11	806	9	0.35	0.58
12	670	8		
13	249	3		
14	602	5		
15	666	8	0.05	0.12
16	634	7		
17	216	2		
18	210	2		
19	414	5		
total	10555	117	1.31	0.20

Table 9 – American plaice (*Hippoglossoides platessoides*) abundance at age ('00) by stratum in the 2007 survey.

age	stratum											total	mean weight g	mean length cm	
	1	2	3	4	5	6	7	8	10	11	15				
1	67	457		331	824	319		74					2072	8	10
2											34	32	67	73	21
3	67										34	32	133	120	23
4	25	24	140	8		16		74				65	352	337	33
5	145	148	41	107	71	243	166	42	37	57			1058	565	38
6	386	234	89	99	83	122	24	60	41	57			1194	596	39
7	208	86	31	44	33	51	12	5	12	11			493	668	40
8	112	86	50	59	46	67	17	15	20	16			486	953	45
9	125	81	21	19	30	41	5	7	11	5			345	881	44
10	200	87	54	30	30	34	5	12	16	5			473	916	44
11	338	212	57	32	32	59	5		20	5			758	754	42
12	616	225	122	58	56	78		26	39				1220	739	42
13	608	282	116	136	103	99	9	33	37	9			1432	881	44
14	325	174	85	62	38	83		28	27				821	843	43
15	370	178	86	26	27	25	5	13	15	5			750	843	43
16+	410	534	225	512	204	170	38	204	27	37			2359	1492	52
hauls	4	9	5	3	4	6	4	5	4	3	2	49	755		
total	4001	2808	1116	1522	1579	1405	285	592	300	276	129	14013	10574	38.4	

Table 10 – American plaice (*Hippoglossoides platessoides*) survey biomass (t) by strata in 1988-2007.

stratum	year																			
	1988	1989	1990	1991	1992	1993	1984	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	1306	1000	505	1078	709	1079	661	2230	1462	381	156	372	345	1043	141	1292	1507	1038	714	284
2	2845	3602	1375	2663	1714	1267	1199	1335	943	740	1587	1810	976	835	1262	713	768	796	354	209
3	1367	1118	1668	1247	631	444	325	252	168	495	284	97	21	93	75	17	427	101	74	101
4	2199	461	817	320	557	572	853	489	268	203	343	53	100	85	128		395	359	109	153
5	2599	3093	1830	1407	837	1291	1230	549	500	619	744	73	56	112	189	82	72	45	63	81
6	479	1130	954	501	601	305	808	123	32	13	35	40	25	37	63	29	26	71	61	99
7	1174	531	837	389	639	319	316	249	72	83	47	19	15	28	52	30	84	31	37	20
8	417	164	263	251	727	487	171	132	56	123	165	3		45	43	14	55	175	163	58
9	103	163	343		373	205	20	500	55	36					1	9	77	18		
10	2323	1491	2000	1308	1406	1459	2236	708	415	287	36	72	45	95	36	54	45	87	97	24
11	1186	1168	1316	401	372	292	303	109	68	32	29	37	23	27	59	29	69	35	19	22
12	9	19	45	17	11	15	33	12	32	7				4		11				
13	3		20					3												
14	8	8	7	389	29		24	15	4		4	9								
15	23	99	3	97	37	109	40	68	23	7	7					6		4		3
16	5			4	9	12	5													
17																				
18																				
19				15	4	5	3	11												
total	16046	14047	11983	10087	8656	7861	8227	6785	4098	3026	3437	2585	1606	2404	2049	2286	3525	2760	1691	1053
s.e.	1845	2048	1276	1180	954	1040	1373	1083	912	708	751	869	332	429	729	748	740	684	346	161

Table 11 – American plaice (*Hippoglossoides platessoides*) length distribution ('00) in the 2007 survey.

length	ind	male	female	length	male	female	length	male	female	length	male	female
8-9	64	66	69	22-23			36-37	1058		50-51		1013
10-11	1078	530	131	24-25			38-39	1076	135	52-53		612
12-13	134			26-27	67		40-41	1604	417	54-55		602
14-15				28-29			42-43	1009	471	56-57		328
16-17				30-31			44-45	532	333	58-59		
18-19				32-33	135	278	46-47	198	468	60-61		74
20-21			134	34-35	590		48-49	131	676			

Table 12 – American plaice (*Hippoglossoides platessoides*) age-length key in 2007.**MALE**

Length cm	age																total			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+		not id.		
8-9	3																		3	
10-11	26																		26	
12-13	2																		2	
...																				
20-21		1	1																2	
...																				
26-27			1																1	
...																				
32-33				2	2														2	6
34-35				1	2	1	1		1		1			1					1	9
36-37					2	4		1			2	2	2	1	1				1	16
38-39					3	5	1			1		4	2	1	1				1	18
40-41					3	4	2		1	1	3	2	6	2	3	2			1	30
42-43					2	2	2	2		1	2	5	2	1	1	1			1	22
44-45					1	1	1		1	1		2	1	2	3					13
46-47								1		1	1	2	3	1			1			10
48-49								2	1	1	1	1	1	2			3			12
50-51								1	1	1	1		2			1	8			15
52-53													1	1	1	6				9
54-55													1			8				9
56-57																5				5
58-59																				
60-61																1				1
total:	31	1	2	3	15	17	7	7	5	7	11	18	21	12	11	35		6		209

FEMALE

Length cm	age																total			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+		not id.		
8-9	1																			1
10-11	2																			2
...																				
20-21		1	1																	2
...																				
32-33				2															2	4
...																				
38-39					2															2
40-41					3	3														6
42-43					2	2	1	1											1	7
44-45					1	1	1					1	1							5
46-47								1		1	1	2	1	1						7
48-49								2	1	1		1	1	2			2			10
50-51								1	1	1	1		2			1	8			15
52-53													1	1	1	6				9
54-55													1			8				9
56-57																5				5
58-59																				
60-61																1				1
total:	3	1	1	2	8	6	2	5	2	3	2	4	7	4	2	30		3		85

Table 14 – Redfish (*Sebastes marinus*) length distribution ('0000) in the 2007 survey.

length	male	female	length	male	female	length	male	female
14	1	6	27	1102	1194	40	1	5
15	64	90	28	1059	1826	41		7
16	333	130	29	832	1142	42		27
17	652	484	30	444	553	43	1	5
18	1220	678	31	203	493	44		2
19	1430	858	32	52	208	45		
20	1486	1262	33	19	39	46		1
21	1779	1461	34	62	65	47		
22	1703	1693	35	75	38	48		1
23	1225	1785	36	32	7	49		
24	1507	1657	37	45	10	50		
25	1482	1592	38	68	10	51		1
26	1860	1325	39		7	52		

Table 15 – Redfish (*Sebastes mentella*) length distribution ('0000) in the 2007 survey.

length	male	female	length	male	female	length	male	female
14	58	10	23	731	802	32	9	17
15	152	59	24	953	688	33	5	13
16	269	211	25	817	657	34	5	18
17	878	512	26	536	684	35	3	11
18	1734	1808	27	165	270	36	2	5
19	4785	3830	28	94	91	37	1	1
20	4895	3425	29	52	93	38		1
21	2428	2250	30	39	34	39		
22	1535	1452	31	24	33	40		1

Table 16 – Redfish (*Sebastes fasciatus*) length distribution ('00000) in the 2007 survey.

length	male	female	length	male	female	length	male	female
13		2	21	1146	1020	29	1	70
14	59	14	22	595	589	30	6	85
15	201	109	23	444	442	31		28
16	525	470	24	253	312	32		19
17	1046	848	25	85	198	33		33
18	1880	1505	26	72	200	34		7
19	2319	1840	27	44	172	35		1
20	1650	1584	28	8	115	36		

Table 17– Juvenile redfish (*Sebastes sp.*) length distribution ('00000) in the 2007 survey.

length		length	
7	17	13	5061
8	295	14	3870
9	2356	15	2240
10	5182	16	346
11	2960	17	82
12	2811	18	4

Table 18 – Greenland halibut (*Reinhardtius hippoglossoides*) mean catch per standard tow by strata and its standard error in the 2007 survey.

stratum	Sq. miles	hauls	catch (Kg)	s.e
1	342	4		
2	838	10		
3	628	7	0.46	0.79
4	348	4	0.28	0.58
5	703	8	1.72	1.77
6	496	6	2.00	1.68
7	822	9	11.64	10.03
8	646	7	8.79	7.56
9	314	3	20.34	17.29
10	951	10	7.72	4.06
11	806	9	8.19	4.67
12	670	8	24.41	11.74
13	249	3	20.69	20.49
14	602	5	19.15	8.98
15	666	8	59.92	61.95
16	634	7	46.85	29.96
17	216	2	24.73	4.60
18	210	2	54.04	69.53
19	414	5	33.02	15.26
20	525	4	51.01	13.27
21	517	4	18.85	10.27
22	533	4	13.56	5.60
23	284	3	22.87	10.40
24	253	2	30.52	17.80
25	226	2	25.32	14.70
26	177	2	48.62	28.21
27	171	2	25.87	11.97
28	530	6	70.75	49.39
29	488	6	40.01	20.63
30	1134	11	54.62	62.93
31	203	2	22.44	0.56
32	238	2	57.35	10.66
33	98	2	22.17	0.58
34	486	5	60.01	22.54
35	92			
36	112			
37	102			
38	194			
39	133			
total	17051	174		

Table 19 – Greenland halibut (*Reinhardtius hippoglossoides*) length distribution ('000) in the 2007 survey.

length	ind.	male	female	length	ind.	male	female	length	ind.	male	female
10-11	15			32-33		79	50	54-55		72	333
12-13	7	14	27	34-35		189	103	56-57		50	296
14-15	13	98	78	36-37	7	208	217	58-59		40	106
16-17			50	38-39	7	589	395	60-61	6	15	106
18-19			13	40-41	7	751	865	62-63			39
20-21		7	34	42-43	22	876	1116	64-65			8
22-23		21	42	44-45		800	1504	66-67			
24-25		43	103	46-47		703	1556	68-69			42
26-27		96	126	48-49		509	1339	70-71			7
28-29		28	48	50-51		339	1032	72-73			
30-31		33	14	52-53		223	688	74-75			

Table 20 – Greenland halibut (*Reinhardtius hippoglossoides*) survey biomass (t) by strata in 1988-2007.

strata	depth	year																			
		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	70- 80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2				
2	81-100	0	3	6	0	0	0	0	121	0	2	6	3	0	15	10	0	12	7	9	
3	101-140	26	31	8	8	18	3	0	21	108	90	367	347	244	384	140	55	852	416	325	22
4	"	144	20	0	15	27	10	0	5	0	23	41	197	207	157	58	105	347	91	182	8
5	"	74	98	0	28	42	1	2	21	36	98	173	409	307	268	66	92	254	280	231	92
6	"	31	18	15	12	8	15	0	31	106	228	361	301	178	265	104	21	466	332	61	75
7	141-200	85	63	58	189	246	94	214	904	1148	1423	2607	2356	1570	982	429	414	1032	596	778	729
8	"	151	222	62	180	379	140	46	333	359	1065	989	1993	1317	1124	878	507	811	934	910	432
9	"	180	165	53	76	323	30	43	178	160	254	471	354	245	355	138	140	464	63	550	487
10	"	108	82	58	172	362	31	235	526	716	862	1369	1528	1602	1743	744	286	753	1058	850	560
11	"	45	61	22	106	229	234	236	492	671	627	1227	1320	1088	1021	338	277	631	1063	290	503
12	201-300	405	647	288	761	619	933	1219	1147	2124	2248	3077	3661	2174	1582	1086	673	902	1020	978	1246
13	"	64	124	218	44	24	143	152	127	298	484	554	978	382	291	521	61	447	310	219	392
14	"	368	302	284	787	847	0	620	410	902	1589	1461	1080	491	877	1081	885	1658	539	573	878
15	"	435	169	525	973	643	1378	1492	1768	1448	2689	4055	2987	2687	1616	1233	607	1084	1121	1783	3041
16	301-400	1374	1363	2543	2527	1827	2175	1524	1861	2098	1770	3356	1143	2016	1328	2182	633	1166	1357	1752	2263
17	"	266	120	127	415	40	0	742	742	258	525	737	603	498	170	204	148	223	429	639	407
18	"	106	50	506	354	58	0	386	958	191	557	775	932	179	574	694	1062	578	434	606	865
19	"	3064	934	1026	1522	3036	1342	1126	1230	971	1564	2603	1015	1774	1120	2194	248	608	915	971	1042
total		6926	4472	5799	8169	8728	6529	8037	10875	11594	16098	24229	21207	16959	13872	12100	6214	12292	10966	11708	13040
s.e.		768	392	809	817	1389	956	678	1226	882	1136	1348	1520	923	776	662	611	796	62	609	1572

Table 21 – Greenland halibut (*Reinhardtius hippoglossoides*) abundance at age by strata in the 2007 survey.

age	stratum																	total	mean	mean
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		weight	length
																		g	cm	
1			7	19	36			148	55	13	36	9	13					336	25	15
2				1	21	12		8	2	10	15		6					74	82	22
3				6	129	62		39	68	85	40		27					456	138	26
4			4		64	13	2	41	31	43	9	4	39	14		7	5	275	310	34
5	5		18	16	282	163	47	155	206	426	87	100	646	367	23	77	146	2765	521	40
6	8		45	40	355	275	198	293	308	699	155	299	1434	989	131	300	399	5928	702	44
7	6	6	43	9	219	129	228	163	155	339	152	336	1089	910	131	290	427	4632	968	49
8	8		6	7	53	12	44	51	15	89	34	87	276	248	54	98	134	1217	1276	53
9	1			6	7		8	14	2	21	5	21	59	44	12	26	21	247	1549	56
10				9	1		4	2	4	13	2	21	28	26	9	31	14	165	1827	60
11				2					1	1	2	11	6	6	9	18	6	62	2219	63
12											7	13	1	5	7	4	1	38	2692	67
13											2	1			1	1		5	2871	69
14											2							2	3103	71
15																				
16+																				
total	28	7	124	115	1166	666	532	915	848	1740	547	901	3624	2610	376	852	1154	16204	12750	44.3

Table 22 – (continued)

FEMALE

length	age																not id.	tot		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16+				
12-13	5																			5
14-15	9																			9
16-17	8																			8
18-19																				
20-21																				
22-23		4	2																	6
24-25		1	11																	12
26-27			19																	19
28-29			7																	7
30-31				1																1
32-33				4	2															6
34-35				3	15	1														19
36-37				4	29	2														35
38-39				1	20	7														28
40-41					14	15														29
42-43					4	26	2												1	33
44-45					4	25	8													37
46-47						16	16	1												33
48-49						8	24	2												34
50-51						1	29	2												32
52-53							18	13	1											32
54-55							7	23	3											33
56-57								18	9	2										29
58-59							1	6	13	11										31
60-61									5	20	5	1								31
62-63										5	10	1								16
64-65										3	6	4	1							14
66-67										1	9	3	2							15
68-69											5	10	1							16
70-71												5	3	3						11
72-73												1		1	1					3
74-75												1	3							4
76-77														1	1					2
78-79														3						3
80-81															1	1				2
82-83																2				2
84-85																1				1
total:	22	5	39	13	88	101	105	65	31	42	35	26	10	8	3	4		1		598

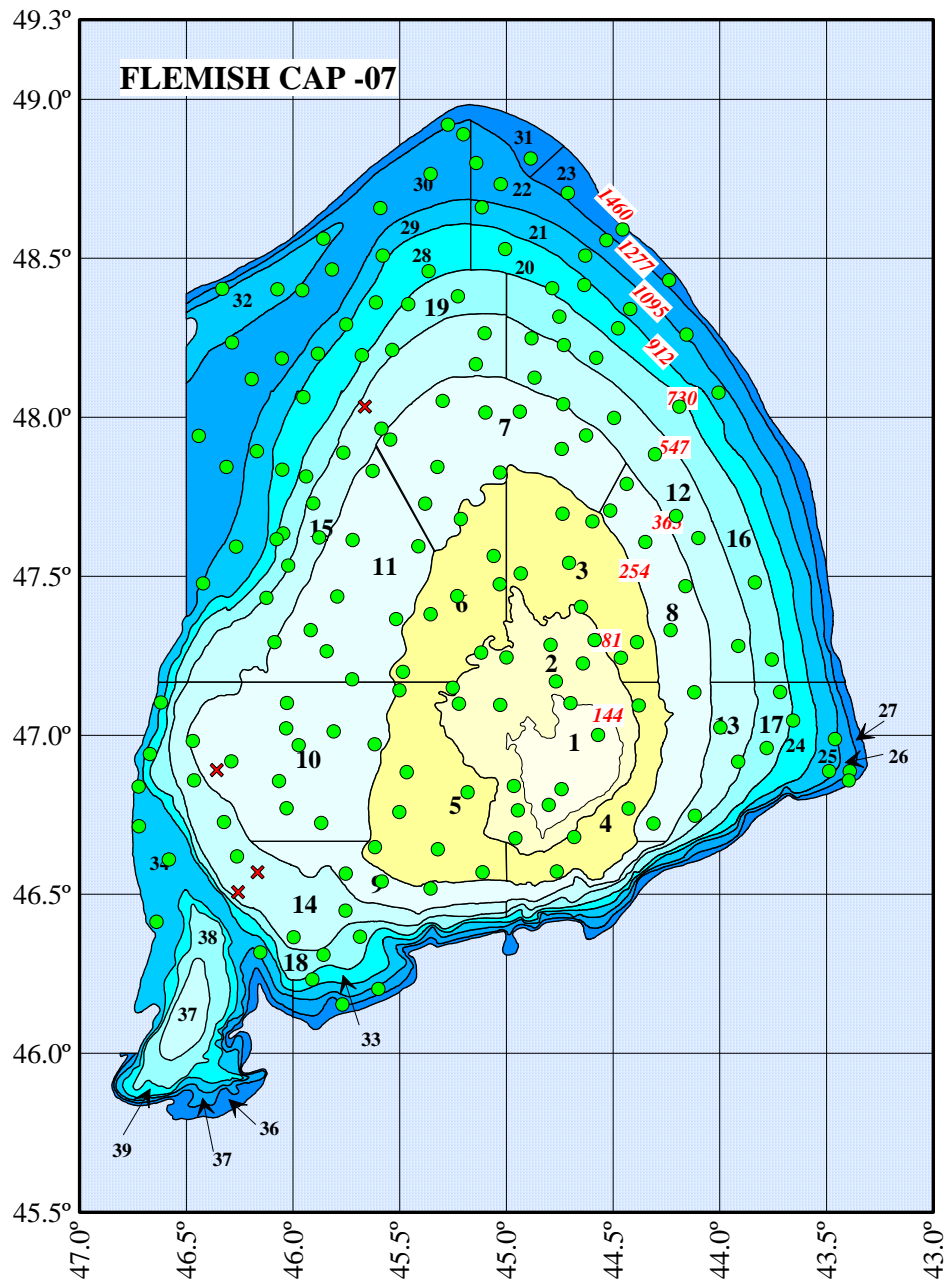


Figure 1 - Haul positions for the Flemish Cap survey 2007.

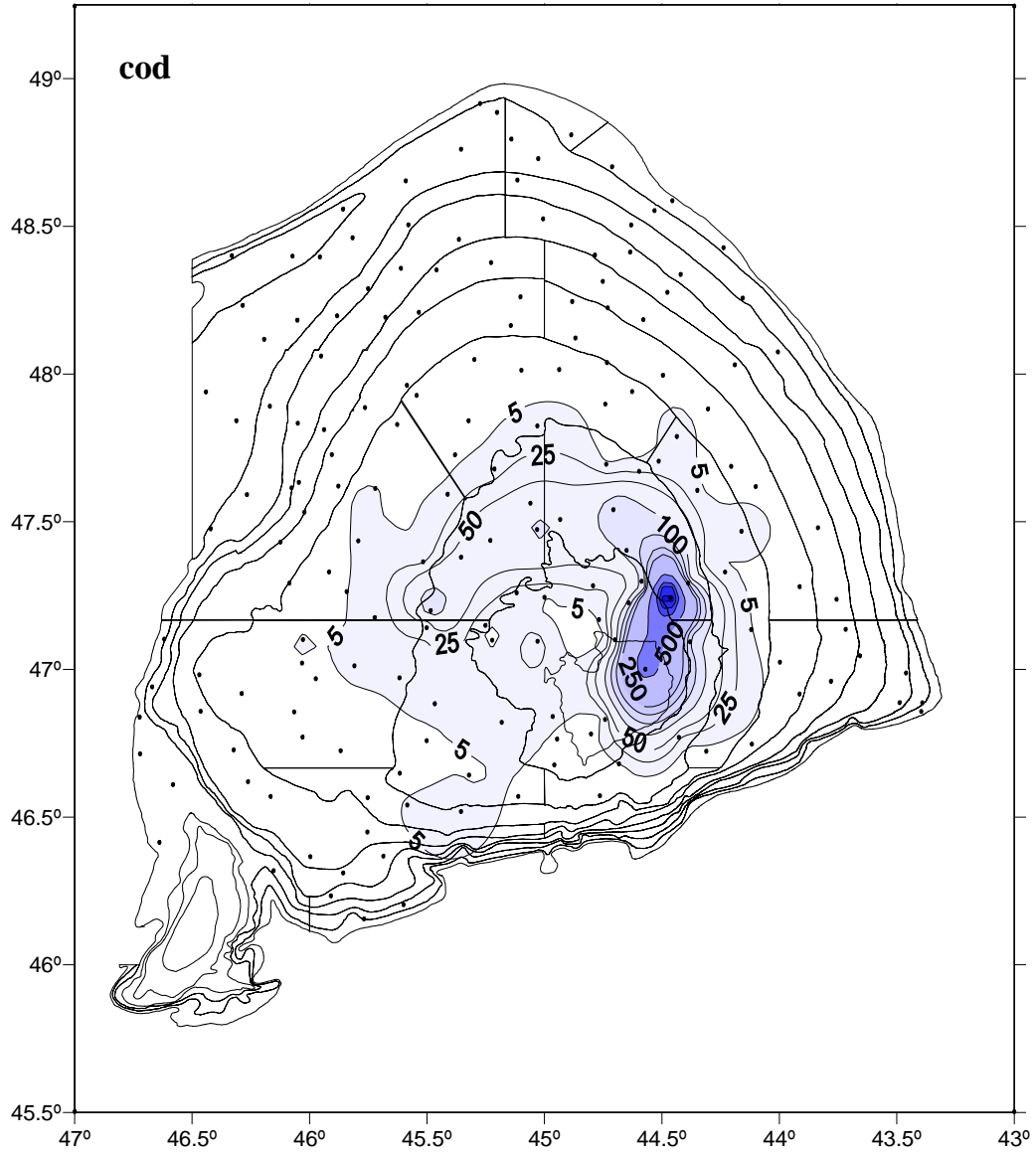


Figure 2 - Cod (*Gadus morhua*) catch distribution in the 2007 survey in Kg.

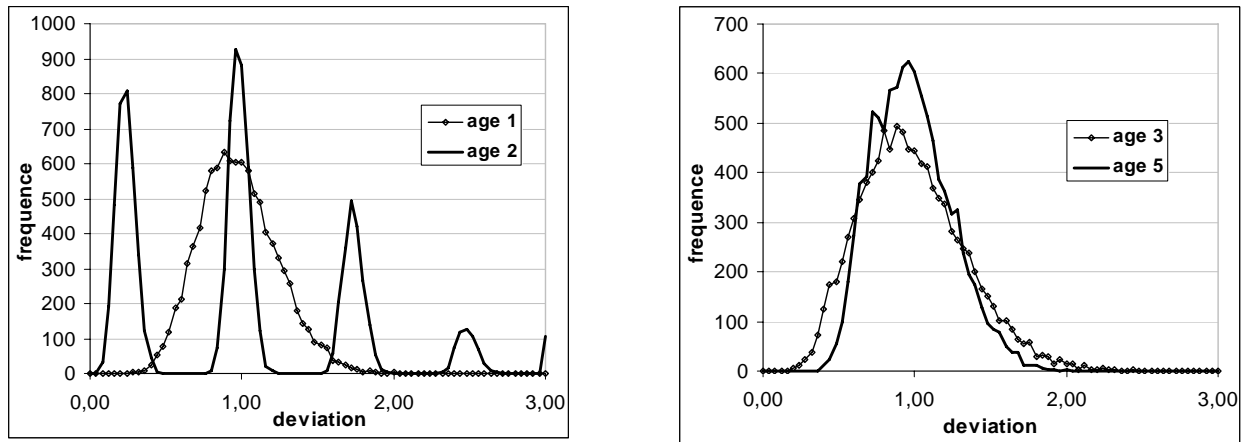


Figure 3 – Distribution of cod abundance estimates for ages 1 to 4.

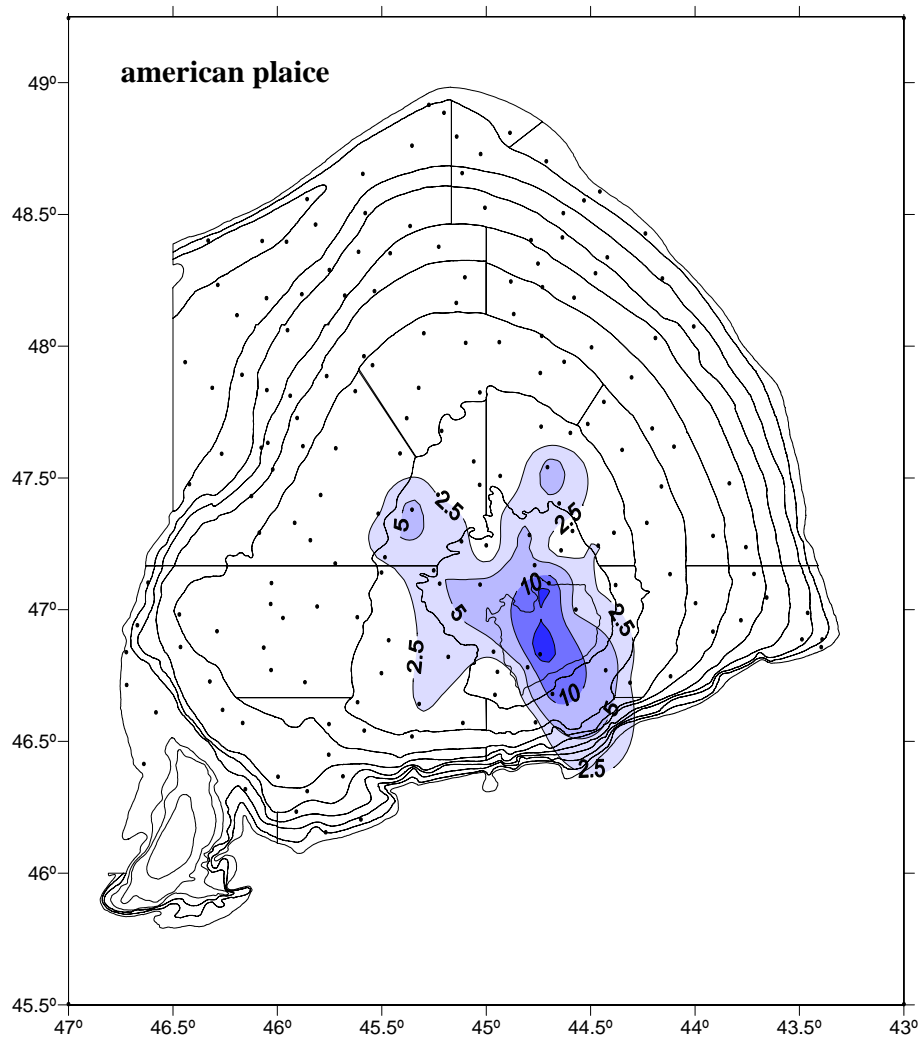


Figure 4 - American plaice (*Hippoglossoides platessoides*) catch distribution in the 2007 survey in Kg.

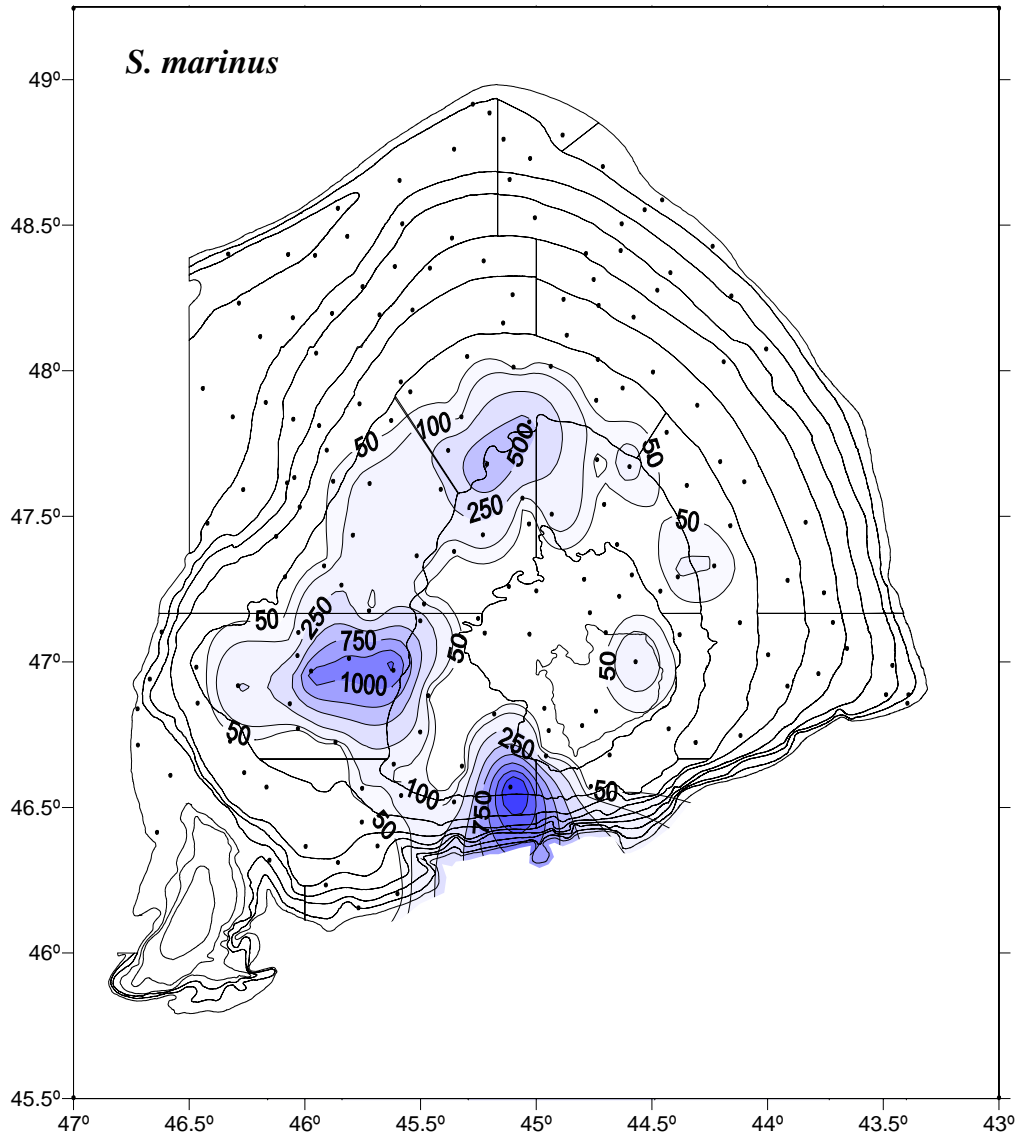


Figure 5 - Redfish (*Sebastes marinus*) catch distribution in the 2007 survey in Kg.

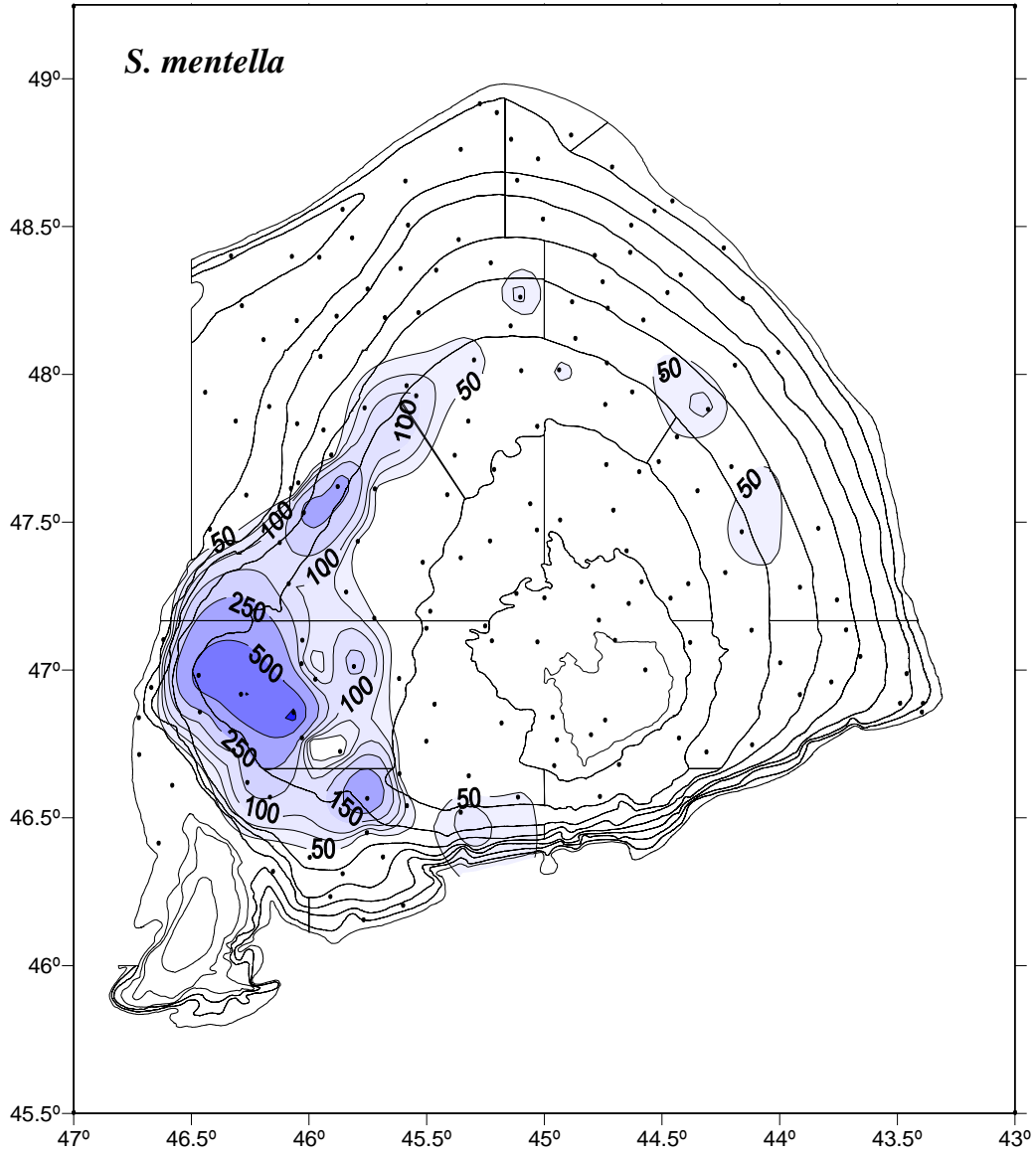


Figure 6 - Redfish (*Sebastes mentella*) catch distribution in the 2007 survey in Kg.

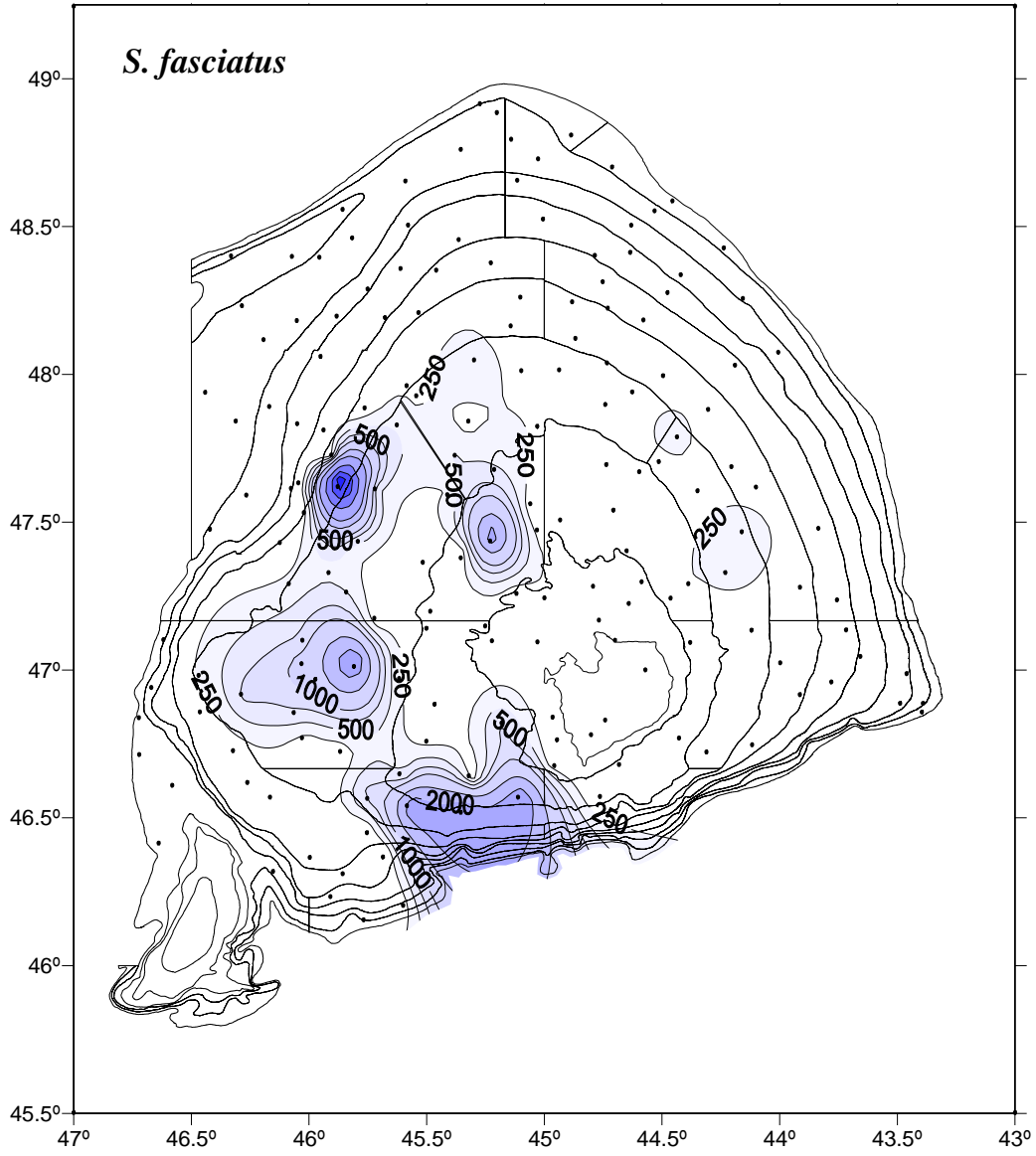


Figure 7 - Redfish (*Sebastes fasciatus*) catch distribution in the 2007 survey in Kg.

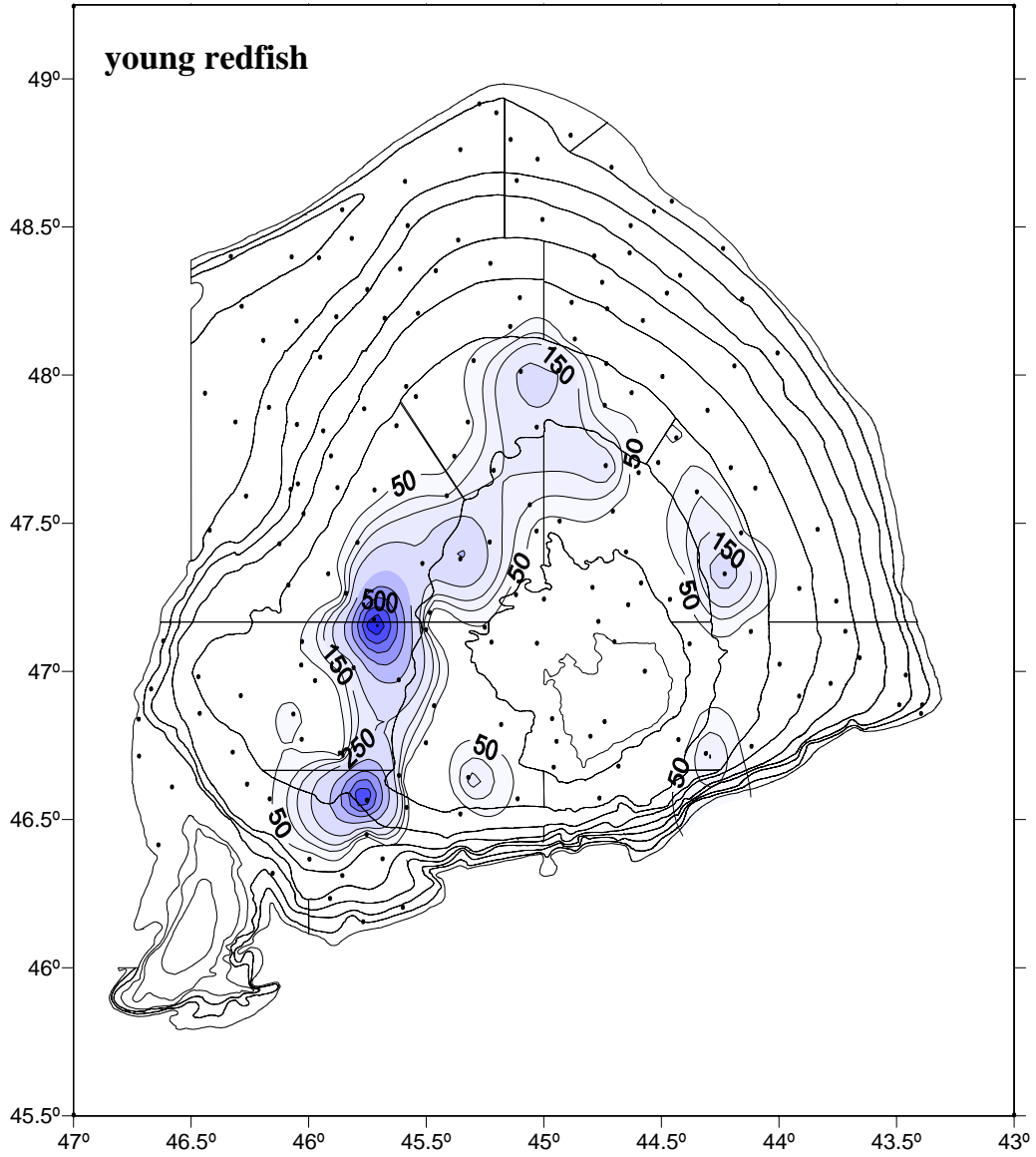


Figure 8 – Juvenile redfish (*Sebastes sp.*) catch distribution in the 2007 survey in Kg.

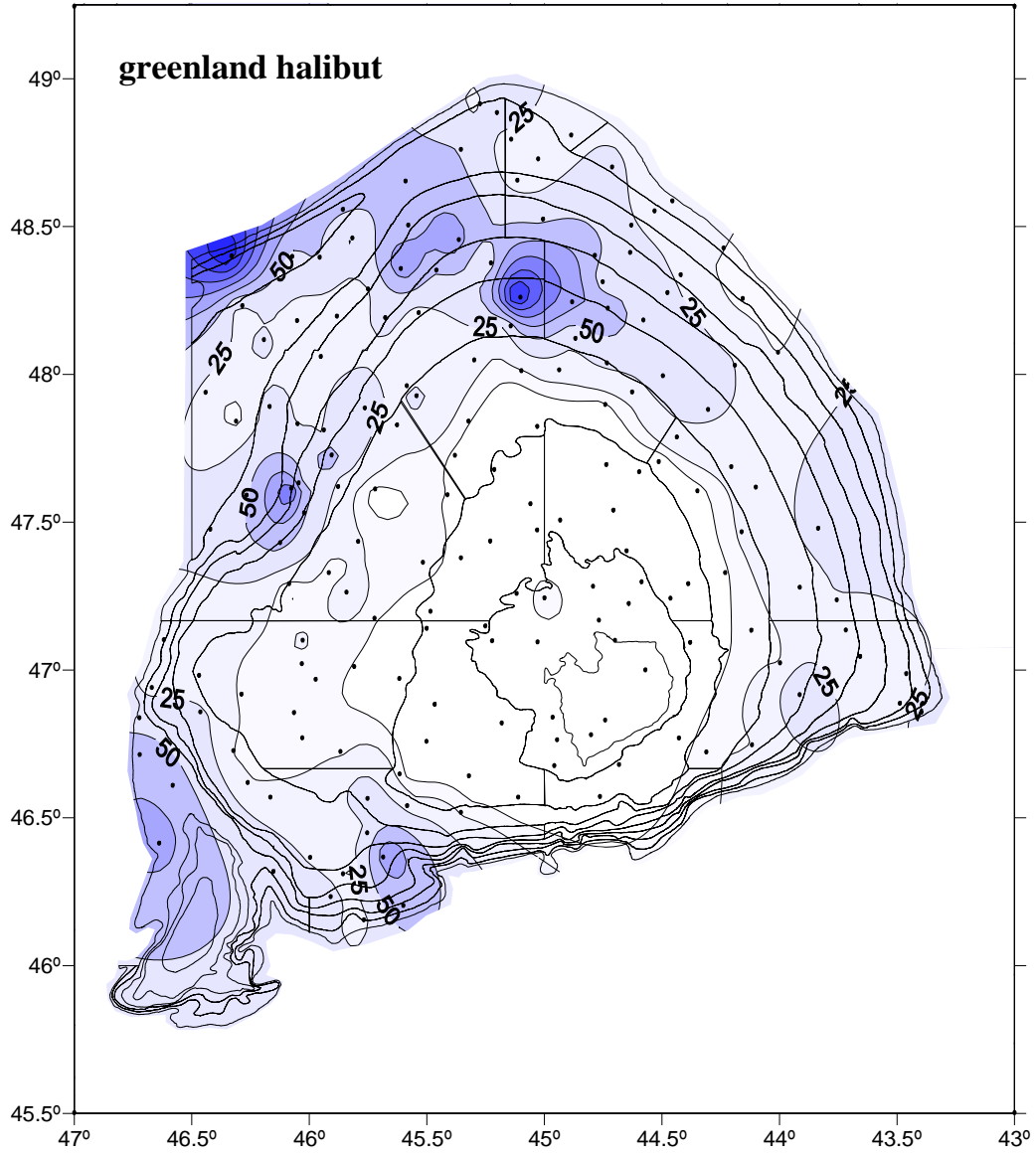


Figure 9 - Greenland halibut (*Reinhardtius hippoglossoides*) catch distribution in the 2007 survey in Kg.