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Results for Greenland halibut survey in NAFO Divisions 1C-1D for the period 1997-2017

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Abstract

Greenland initiated a survey series in 1997 covering NAFO Divisions 1CD at depths between 400 and 1 500 m. The survey is designed as a Stratified Random Bottom Trawl Survey aimed primarily at Greenland halibut (*Reinhardtius hippoglossoides*) and roundnose grenadier (*Coryphaenoides rupestris*). The paper gives biomass and abundance estimates and length frequencies for Greenland halibut, roundnose grenadier, roughhead grenadier (*Macrourus berglax*), and deep sea redfish (*Sebastes mentella*) together with a list over recorded fish species. In 2017, 53 valid hauls out of the 70 planned were conducted. Greenland halibut biomass index shows a slightly increased from 2016 to 2017. Roundnose and roughhead grenadier, and deep sea redfish indices decreased.

Introduction

During 1987-1995 Japan Marine Fishery Resources Research Center (JAMARC) and Greenland Institute of Natural Resources jointly conducted 12 bottom trawl surveys at depths down to 1500 m (Jørgensen, 1998a) and four pelagic surveys (Jørgensen, 1997) at West Greenland as part of a joint venture agreement on fisheries development and fisheries research in Greenland waters. The bottom trawl surveys were aimed primarily at Greenland halibut (*Reinhardtius hippoglossoides*) in NAFO Div. 1B-1D. In 1997, Greenland Institute of Natural Resources continued the bottom trawl surveys series with the Institute's own vessel R/V Paamiut that had been rigged for deep sea trawling. There has unfortunately not been any comparative trawling between the Japanese research vessel Shinkai Maru and Paamiut making comparisons between the surveys difficult. The Paamiut survey traditionally covers NAFO Div.1CD (Table 1), but in 2001 the survey area was expanded to include Div. 1A (to 74°N) and Div. 1B, and in 2004 the northern part of the Baffin Bay (73°N-77°N) (Div. 1A) was surveyed. In 2010, Div.1A was surveyed to 75.30°N (SCR 11/010). In 2013, the survey only covered Div. 1D.

Material and Methods:

Stratification

The survey covered NAFO Divisions 1CD between the 3-nm and the midline to Canada at depths between 400 and 1500 m. The survey area was stratified in NAFO divisions and subdivided in 6 depth strata 401-600, 601-800, 801-1000, 1001-1200, 1201-1400 and 1401-1500 m. The depth



stratification was based on Greenland Geological Survey's 10 m depth contour maps, Canadian maps and depth soundings made during previous surveys. The area of each stratum was measured using "MapInfo Version 4.0". A list of numbers of valid hauls per strata and area is given in Table 2.

The survey was planned as a Stratified Random Bottom Trawl Survey with a total of 70 hauls. A minimum of two randomly placed trawls were conducted per stratum (Bishop, 1994). The remaining hauls were allocated to strata based on the stratum area and on predictions, from past surveys, of the variability in catch. The allocation minimize the standard error of the total survey biomass estimate of Greenland halibut, given the predicted stratum variances. Strata with great variation in the catches of Greenland halibut in the previous years surveys have hence got relatively more hauls than strata with little variation in the catches. In 2004, the placing of stations independently and randomly was replaced by buffered random sampling. The method combines the use of a minimum between-stations-distance rule (buffer zone) with a random allocation scheme (Kingsley *et al.*, 2004). Because the sea bed in Division 1D stratum 601-800 m is muddy and soft, and generally not suitable for trawling, stations are fixed in that stratum.

Vessel and gear

The survey is conducted by the 722 GRT trawler Paamiut, using an Alfredo III trawl with a mesh size on 140 mm and a 30-mm mesh-liner in the cod-end. The ground gear is of the rock hopper type. The trawl doors are Greenland Injector weighing 2700 kg. The Injector otter doors replaced the perfect doors that have been used until 2003. The average net height was, in 2014, 20 cm higher with the new doors compared to the old, but the difference was not statistically significant (95% level) and it was concluded that the net performance has not changed by the introduction of the new doors. Further information about trawl and gear is given in Jørgensen (1998b).

A MarPort net sonda mounted on the head rope measured net height. MarPort sensors measured the distance between the trawl doors. Wingspread, taken as the distance between the outer bobbins, was calculated as:

$$\text{Distance between outer bobbins} = 10.122 + \text{distance between trawl doors} * 0.142$$

This relationship was estimated based in flume tank measurements of the trawl and rigging used in the survey (Jørgensen, 1998b).

Near-bottom temperature were measured, by 0.1°C, by a Seastar sensor mounted on one of the otter doors.

Trawling procedure

Trawls were towed for 30-min at a speed of 3.0 knots, however, tows down to 15 minutes were considered acceptable. Trawl distance was estimated from the start and the end positions of the haul.

Handling of the catch

The catch of each haul was sorted, weighted and reordered by species. All fish species were measured as total length (TL) to 1.0 cm below. Grenadiers were measured as pre anal fin length (AFL) to 0.5 cm below from 1997 to 2008, and 1.0 cm below from 2009 onwards. In case of large catches, subsamples of the catch were measured.

Biomass and abundance

Biomass and abundance estimates were obtained by applying the swept area method (trawled distance * estimated bobbin spread) taking the catchability coefficient as 1.0. All catches were standardized to 1 km² swept prior to further calculations.

In strata with one haul, SD was estimated as: $\frac{Meancatch}{MeanCV} * 100$

Results and discussion

A total of 53 valid hauls were made (Figure 1). Due to bad weather stratum 401-600 m in division 1C was not covered. Haul by haul information on catches of Greenland halibut, roundnose grenadier, roughhead grenadier and deep sea redfish is given in Appendix 1. The distribution of hauls by strata is given in Table 2.

A total of 67 fish species were recorded (Appendix 2).

Greenland halibut:

The Greenland halibut stock in Subareas 0 and 1 is considered to be part of a biological stock complex, which included Subarea 2 and Div. 3KLMNO. Abundance and biomass indices were available from research vessel surveys by Canada in Subarea 0A South (1999, 2001, 2004, 2006, 2008, 2010, 2012, and 2014-2017); Canada in OB (2000, 2001, 2011, 2013, 2014, 2015, 2016, 2017), Greenland in Divisions 1CD from 400 to 1500 m (1987-1995 and 1997-2017 for), and Greenland in Divisions 1A and 1B-F offshore, from 100 to 600 m (1988-2017).

From 1979 to 1994, the assessment included SA 0+1, including Div. 1A inshore. In 1994, it was decided to make a separate assessment for the inshore in Div. 1A and for SA 0-1 Div1 offshore + Div. 1B-F. based on tagging experiments. The TAC has been increasing since then (Jorgensen and Treble, 2016).

The current assessment is based on survey indices. The ICES guidance on data limited stocks (DLS) method 3.3 (ICES 2012a and 2012b, ICES 2014) is applied as approach for the advice on SA0+1 Greenland halibut.

Greenland halibut was caught in all hauls (Figure 2 and Appendix 1). The biomass in 1CD has been almost constant for the whole time series with few fluctuation. A gradual decrease in biomass was observed from 2011 (86 591 t) to 2014 (58 666 t), but then increased in 2015. From 2016 (76 629 t) to 2017 (78898 t) the biomass slightly increased. (Tables 3 and 4, Figure 3).

The survey in 2013 only covered Division 1D. Total biomass and abundance in Division 1C has been estimated by a GLM (model: $\ln\text{biomass} = \text{year} * \text{division}$) using data from 2010-2014 where the distribution of the biomass has been rather stable with 63-69% of the biomass found in division 1D. The 1CD biomass and abundance in 2013 was estimated to 64049 tons and 51160 *10³ indiv., respectively.

In 2017, the highest densities (in weight) were found at 1001-1200 m in 1D (2428 kg/km²) and at 601-800 m in 1C (1 060 kg/km²) (Table 4).

Estimated abundance by age, for 1997 to 2009, is given in Table 6. There has been no updating since 2009 because the age reading has been under revision. GINR plans to restart the readings in the near future.

The abundance in 2017 was estimated in $60010 \cdot 10^3$ indiv. which is in minor increase compare to 2016 ($59679 \cdot 10^3$ indiv.) (Table 7, Figure 4). The highest abundance was also found between 1001-2000 m in 1D ($17328 \cdot 10^3$ indiv.) and between 601-800 m in 1C ($15410 \cdot 10^3$ indiv.).

Estimated abundance by length, for 1997-2017, is given in Table 7. The length ranged from 11 cm to 111 cm. The overall length distribution (weighted by stratum area) was dominated by a mode at 51-54 cm (Table 7, Figure 5). Since 2000, the mode has been slightly increasing (Figure 6).

Roundnose grenadier (*Coryphaenoides rupestris*):

There is not directed fishery for roundnose grenadier. Most of the catches are taken as bycatch in the Greenland halibut fishery subareas 0 and 1 south. Since catches and biomass have been very low for almost two decades the assessment has not been updated since 2016.

Roundnose grenadier has been caught in 42 hauls out of 53 valid hauls (Figure 7, Appendix 1) but catches were very low. The biomass has been very low since 2001 (Tables 8 and 9, Figure 8), and far below the level found in the late 80's. Highest biomass was found from 1997 to 2001, then it sharply decreased by 5, from 7781 t (in 2001) to 1594 (in 2000). Since then, it has maintained low values. The biomass has decreased from 2016 (861 t) to 2017 (510t). The higher density was found between 401-600 m in 1D (181 t), and 1001-1200 in 1C (101 t).

The abundance, in 2017, was estimated at $2887 \cdot 10^3$ indiv. (Table 10) which is almost half of the abundance in 2016 ($6387 \cdot 10^3$ indiv.). (Figure 9, Table 11).

Table 11 and Figure 10 show the length distribution from 1997 to 2017 weighted to the stratum area. Pre anal fin length ranged from 2 to 19 cm. The mode was found at 12 cm.

Roughhead grenadier (*Macrourus berglax*):

There is not directed fishery for roughhead grenadier. Most of the catches are taken as bycatch both in the trawl fishery for Greenland halibut.

Roughhead grenadier was caught in 49 of 53 valid hauls (Figure 11, Appendix 1). The biomass show an increased trend, from 1997 (1239 t) to 2000 (7369 t), then decreased in 2001, and in 2002 it reached the highest value level of the time series (8101 t). Since 2003, it has been decreasing with some fluctuations until 2015. From 2015 to 2017, the biomass decreased (from 3295 t in 2015 to 1544 t in 2017) (Table 12, Table 13, Figure 12). The highest density in 2017 was found between 601-800 m in 1C, and between 1001-1200 in 1D.

The abundance followed a similar trend as the biomass. It increased from 1997 ($5013 \cdot 10^3$ indiv.) to 2000 ($21\ 012 \cdot 10^3$ indiv.). Since then it has been decreasing with fluctuations from 2001 to 2015. It dropped to almost 3 times, from 2015 ($9\ 345 \cdot 10^3$ indiv.) to 2017 ($3425 \cdot 10^3$ indiv.). (Table 14, 15 and Figure 13).

Pre anal fin length ranged from 4 to 37 cm, and the overall length distribution showed minor modes at 7, 9, 12 and 18 cm (Figure 14).

Deep-sea redfish (*Sebastes mentella*):

There is not directed fishery to the deep-sea redfish stock in West Greenland Divisions 1A-F. Abundance and biomass indices were available from surveys carried out by the Greenland Institute of Natural Resources in Divisions 1CD from 400 to 1500 m (1987-1995 and 1997-2017 for) and in Divisions 1A offshore and 1B-F from 100 to 600 m (1988-2017).

Deep-sea redfish was caught in 16 of the 53 valid hauls (Figure 15, Appendix 1).

The biomass was very low from 1997 to 2007 (426 t), then it peaked 2008 (13 256 t). Since then the biomass has fluctuated at a higher level than before 2008. The abundance decreased slightly from 2016 (11336 t) to 2017 (9016 t) (Table 16, 17 and figure 16).

The highest density in 2017 was found between 401 to 800 m in 1D.

The abundance follow a similar trend as the biomass. Until 2017 the abundance was very low, then it increased from $1892 \cdot 10^3$ indiv. in 2007, to $5306 \cdot 10^3$ indiv. in 2008. Since 2009, the abundance has been fluctuating reaching the highest value of the time series in 2014. It decreased by 10 from 2014 ($65975 \cdot 10^3$) to 2017 ($16422 \cdot 10^3$) (Table 18, 19 and Figure 17).

The length distribution ranged from 20 to 46 cm, with any clear mode (Figure 18).

Temperature:

The bottom temperature ranged from 3.31 to 4.72 °C (Appendix 1). The mean temperature decreased in 1D with depth as in previous years (table 19, figure 19 and 20).

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Table 1. Greenland halibut survey bottom trawls in NAFO Divisions 1C-D, 1997-2017.

Year	Vessel	Valid tows 1C	Valid tows 1D	Total Valid tows 1CD	Depth strata covered (m)	Dates
1997	R/V Paamiut	24	39	63	427-1469	September 24-October 08
1998	R/V Paamiut	28	28	56	500-1494	September 23-October 07
1999	R/V Paamiut	15	23	38	576-1457	September 23-October 01
2000	R/V Paamiut	9	22	31	667-1464	September 27-October 04
2001	R/V Paamiut	17	29	46	468-1458	November 05-November 15
2002	R/V Paamiut	9	26	35	637-1490	September 17-September 23
2003	R/V Paamiut	12	23	35	564-1449	September 17-September 24
2004	R/V Paamiut	18	33	51	574-1468	October 28-November 05
2005	R/V Paamiut	23	38	61	412-1485	August 31-September 11
2006	R/V Paamiut	19	42	61	402-1486	October 11-October 22
2007	R/V Paamiut	17	33	50	426-1468	September 19-September 30
2008	R/V Paamiut	21	49	70	417-1458	September 19-October 01
2009	R/V Paamiut	22	46	68	422-1468	September 19-September 30
2010	R/V Paamiut	20	46	66	417-1482	September 07-September 20
2011	R/V Paamiut	22	45	67	484-1472	September 01-September 17
2012	R/V Paamiut	18	32	50	466-1473	September 12-September 22
2013	R/V Paamiut	0	27	27	406-1492	September 12-September 17
2014	R/V Paamiut	20	38	58	404-1464	August 31-September 16
2015	R/V Paamiut	23	44	67	409-1458	August 26-September 05
2016	R/V Paamiut	26	44	70	422-1462	August 31-September 12
2017	R/V Paamiut	15	38	53	450-1476	October 10-October 21

Table 2. Number of valid hauls per strata from 1997 to 2017.

Division	Stratum (m)	Area (km ²)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1C	401-600	3366	3	4	2	0	4	0	2	1	2	2	1	3	2	2	1	2	0	1	2	2	0
	601-800	16120	11	14	7	3	8	4	4	5	8	6	4	5	5	4	5	3	0	5	6	9	6
	801-1000	6066	8	8	6	4	3	4	4	10	11	9	10	11	13	12	14	11	0	12	13	13	7
	1001-1200	611	2	2	0	2	2	1	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2
1D	401-600	903	2	1	0	0	0	0	0	0	2	3	2	2	2	2	2	2	1	1	2	2	2
	601-800	1940	2	2	1	0	0	0	0	2	1	2	0	2	2	2	2	1	1	2	2	3	2
	801-1000	3874	4	4	2	2	3	4	2	3	3	4	5	4	4	5	5	3	4	3	4	4	4
	1001-1200	10140	18	11	11	13	12	10	12	14	13	12	18	18	19	17	14	11	15	20	19	16	16
	1201-1400	6195	8	8	7	7	10	7	7	12	12	14	9	16	15	13	14	9	7	13	11	12	10
	1401-1500	3091	5	2	2	2	3	3	4	4	6	6	5	7	5	5	5	3	3	4	5	4	4
TOTAL	48940	60	52	36	31	42	35	33	50	59	59	49	67	66	64	66	48	27	57	65	68	53	

Table 3. Greenland halibut. Biomass per strata, total biomass (t) with SE, and stratified mean catch per tow (kg) and SE in NAFO divisions 1CD for the period 1997-2017. n.s= not surveyed.

Division	Stratum(m)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1C	401-600	354	256	117	n.s	700	n.s	419	194	57	323	0
1C	601-800	5477	6160	6030	5827	7203	4066	7040	8743	5675	8970	4435
1C	801-1000	4727	8721	5661	5152	10275	6028	11253	13070	9685	11602	9893
1C	1001-1200	1366	2278	n.s	1519	1350	1734	1308	2789	2615	1542	1784
1D	401-600	330	39	n.s	n.s	n.s	n.s	n.s	n.s	335	252	244
1D	601-800	721	747	455	n.s	n.s	n.s	n.s	435	1855	1551	n.s
1D	801-1000	3189	5854	6819	3793	11192	5667	3939	6058	5378	6619	7113
1D	1001-1200	23948	24475	20987	18101	20280	29136	22033	24275	25893	25363	29212
1D	1201-1400	11310	18538	17774	16597	14621	19910	18489	13509	23035	15029	15560
1D	1401-1500	6252	3579	7548	9436	5802	5798	4235	5134	6396	6308	6117
Biomass		57674	70647	65391	60426	71424	72339	68717	74207	80924	77559	74358
S.E.		4751	8349	6460	6056	10776	5982	6412	5191	8602	6160	9456
TOTAL	MeanCatch	1102.62	1350.64	1287.44	1310.84	1443.98	1569.27	1389.27	1443.63	1547.13	1482.8	1476.35
S.E.		91	160	127	131	218	130	130	101	164	118	188

Division	Stratum(m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1C	401-600	587	83	167	85	52	n.s	845	449	163	n.s
1C	601-800	8160	6179	8357	9290	9010	n.s	9587	13240	13732	17101
1C	801-1000	12447	9890	13003	15040	11098	n.s	9806	19194	13760	14118
1C	1001-1200	2381	1571	3227	1845	2428	n.s	1553	1456	1557	1730
1D	401-600	52	157	27	95	102	38	17	424	374	127
1D	601-800	884	1356	1429	995	5382	1023	1557	1136	1366	1847
1D	801-1000	8658	7878	9593	5469	6634	6543	7732	8192	6065	5417
1D	1001-1200	32358	18664	20686	32492	17661	22192	15745	21562	20920	24629
1D	1201-1400	12800	17089	12257	16448	9768	7941	7231	10446	12804	9996
1D	1401-1500	5654	6541	6352	4833	2894	3508	4592	2404	5888	3933
Biomass		83981	69409	75097	86591	65028	41245	58666	78502	76629	78898
S.E.		5610	4735	5423	5211	10418	4621	4336	6611	4811	6072
TOTAL	MeanCatch	1605.58	1326.97	1435.72	1655.48	1243.22	1577.69	1121.59	1500.83	1465.03	1612.11
S.E.		107	91	104	100	199	177	83	126	92	124

Table 4. Mean catch (kg/km²), biomass (tons) with S.E. of Greenland halibut in Division 1 CD by depth stratum in 2017. n.s = stratum not surveyed.

Division	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE
1C	401-600	-	n.s	n.s	n.s	n.s
1C	601-800	16120	6	1060.83	17101	3491
1C	801-1000	6066	7	2327.38	14118	2363
1C	1001-1200	611	2	2830.68	1730	225
1D	401-600	903	2	140.3	127	49
1D	601-800	1940	2	952	1847	1456
1D	801-1000	3874	4	1398.17	5417	869
1D	1001-1200	10140	16	2428.93	24629	3224
1D	1201-1400	6195	10	1613.51	9996	1777
1D	1401-1500	3091	4	1272.51	3933	1616
TOTAL		48940	53	1612.1	78898	60715

Table 5. Mean number (num/km²), abundance ('000s) with S.E. of Greenland halibut in Division 1 CD by depth stratum in 2017. n.s = stratum not surveyed.

Division	Stratum (m)	Area (sq.km)	Tow number	Mean Number	Abundance	SE
1C	401-600	-	n.s	n.s	n.s	n.s
1C	601-800	16120	6	955.96	15410	3414
1C	801-1000	6066	7	1802.93	10937	1895
1C	1001-1200	611	2	2066.69	1263	92
1D	401-600	903	2	124.71	113	81
1D	601-800	1940	2	583.47	1132	975
1D	801-1000	3874	4	994.73	3854	682
1D	1001-1200	10140	16	1708.89	17328	2307
1D	1201-1400	6195	10	1177.54	7295	1456
1D	1401-1500	3091	4	899.04	2779	1094
TOTAL		48940	53	1228.23	60111	5032

Table 6. Number by age and year for Greenland halibut, weighted by survey area. No data from 2008, and 2010-2017.

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	0	0	0	78826	15585	71512	833452	314358	200672	132147	0	-	
2	536130	609093	184098	109496	281013	214536	3187890	255511	201882	641030	99520	-	613665
3	1704893	3722237	920490	479059	511722	285367	1468105	274564	569831	524114	268062	-	773577
4	3023773	4662948	4172888	3074341	4835796	2361529	2417001	4465950	1749900	2959669	802718	-	704747
5	9961295	14760362	11291344	15090231	20601616	11779876	12348567	14877198	12218823	13324592	12509462	-	7823793
6	15370847	19057854	15893794	16838191	26595603	26697300	21816458	30067732	19867351	20210890	18237159	-	12339572
7	13558728	14083592	19759852	14711646	17922784	18561065	18499540	14298142	21303055	15509156	19469186	-	22722253
8	5436358	5766084	4786548	5026106	4674899	6201987	6534966	6252194	12674030	13224793	11815872	-	9358562
9	1200931	1515966	859124	3214208	2550178	1857799	2403542	1724259	385774	731747	360855	-	3065130
10	948950	1211419	920490	1040152	780082	1340261	1244102	944766	1881136	1342871	1960085	-	2058523
11	584382	764751	613660	717770	705656	905723	581491	392534	158664	362986	0	-	1095209
12	466433	527881	675026	350292	369836	166242	224915	230820	1044342	958082	1030110	-	741972
13	187646	351921	429562	318336	345397	257412	264203	158687	36861	122337	26403	-	558339
14	96503	155657	429562	122157	195607	143024	207745	163836	410090	459693	502253	-	346258
15	262704	236870	184098	230208	225277	263139	67270	218713	85460	114617	27483	-	199826
16	187646	115051	61366	128242	91540	178780	206590	71775	13547	102977	182091	-	50494
17	64336	128586	61366	95352	80275	107268	72546	96352	118365	28973	49422	-	26348
18	16084	0	61366	57045	22628	35756	41219	6650	35465	0	26001	-	
19	0	0	0	27474	32325	83431	58531	37874	45452	0	0	-	
20	0	0	0	0	8081	0	22258	0			46549	-	
21	0	0	0	0	0	0	7419	0				-	
TOTAL	53607639	67670272	61304634	61709132	80845900	71512007	72507812	74851915	73000702	70750676	67413231	-	62478267

Table 7. Length distribution (3cm groups) and total abundance estimated number (000's) with SE (weighted by survey area), and stratified mean number with SE, for Greenland halibut, in Division 1CD, for the period 1997-2017.

Length Class (3cm)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
6	0	0	46	0	0	0	0	0	0	0	0	0	0	7	13	9	0	0	16	6	0
9	0	55	97	0	0	0	59	0	87	62	4	21	29	98	0	163	0	204	0	8	20
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0
15	20	34	0	90	0	0	458	166	50	34	0	39	0	0	195	0	0	0	42	98	30
18	158	43	0	0	0	80	187	0	0	36	5	0	0	0	5	7	0	0	0	74	0
21	211	97	141	121	84	61	1097	215	160	314	48	0	75	49	74	73	0	0	0	399	0
24	613	620	390	66	209	103	1053	7	72	469	47	300	465	0	7	5	0	0	104	286	30
27	750	938	596	256	138	74	1690	95	233	133	90	202	514	0	127	8	0	52	98	276	103
30	659	865	554	255	302	99	1068	89	186	109	93	233	329	8	57	232	0	9	163	470	31
33	1053	723	934	557	374	270	755	78	249	299	85	139	96	64	188	112	42	110	117	267	95
36	1679	1822	1871	1505	1307	1156	901	486	484	612	619	235	326	249	303	287	94	28	281	520	120
39	3162	3667	3938	3395	4165	2165	1565	1725	1225	1980	1004	1049	776	588	1121	655	362	529	364	650	458
42	5417	6928	5813	7840	10929	6415	5425	5534	4238	4920	3765	3214	2753	2729	2993	2734	938	953	1303	1507	1144
45	6889	10351	9058	12834	17076	13181	12338	13027	9603	8815	8086	6754	7680	10415	5619	2947	3499	3895	3977	3597	
48	9591	11602	10449	12057	16826	17999	15929	19015	17438	15253	14732	16115	12861	13571	15296	10887	5763	7972	9751	7855	8338
51	9754	11020	9903	10155	10664	13858	13880	16536	17047	15516	15135	17619	15464	15831	17362	11079	8093	11020	15291	13001	14119
54	6760	8413	7780	5810	5598	7736	7886	8901	11602	10454	10861	12200	10606	11589	12150	10016	6265	9389	14288	13122	13757
57	3707	4118	4221	3027	2431	3434	3436	3660	5735	5364	6108	6570	5487	6052	6655	5385	3704	4706	8202	7855	9442
60	1477	2227	1545	1973	1417	1930	1819	1536	2053	2585	2818	2734	2600	2558	3305	2900	1714	2709	3220	4117	4116
63	1069	1294	1230	792	825	956	901	821	1212	1056	1109	1805	1182	1398	1573	1209	734	984	1491	1727	1700
66	631	836	887	646	489	804	663	481	814	659	532	738	633	667	976	959	554	641	865	1177	936
69	486	536	383	472	389	461	367	262	511	463	433	568	422	435	575	632	435	558	514	707	628
72	267	320	253	174	321	251	252	246	342	309	352	412	241	206	473	403	169	283	465	401	448
75	98	291	281	159	218	131	201	106	254	241	151	292	226	255	316	233	157	309	291	258	303
78	114	191	222	108	55	93	144	143	174	143	120	146	162	103	116	111	89	291	176	219	110
81	81	97	101	153	131	113	94	103	100	113	108	126	124	171	184	135	142	201	153	120	150
84	122	176	163	102	100	100	120	63	70	126	53	140	96	120	109	118	114	124	118	140	120
87	159	96	185	81	88	175	48	33	108	156	55	58	66	72	75	54	18	45	62	94	58
90	54	43	226	137	36	112	51	65	103	63	68	69	53	83	119	64	55	113	152	154	35
93	69	32	36	12	80	56	51	24	30	32	41	65	29	47	63	64	25	107	47	63	20
96	44	73	60	54	28	39	40	3	77	22	121	53	40	103	34	38	14	55	95	20	28
99	38	0	25	18	22	12	46	0	26	45	0	20	33	44	57	41	37	9	36	31	54
102	8	47	11	0	26	10	33	11	36	11	47	0	18	65	35	21	12	25	31	22	54
105	8	46	0	0	10	8	0	18	9	0	10	18	5	16	0	63	24	16	15	15	52
108	0	0	0	0	0	0	0	0	15	0	0	13	0	12	7	0	0	0	3	7	0
111	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	13	14
Abundance	55148	67671	61399	62849	74338	71882	72557	73449	73034	71182	67429	73284	62465	64870	74978	54316	32501	44941	61649	59679	60110
S.E.	4566	7639	6016	6230	12193	6153	7765	5448	7534	5550	8492	5144	4422	5389	4724	10123	3038	3388	6069	3729	5032
MeanNumber	1054.36	1293.71	1208.84	1363.34	1502.89	1559.34	1466.88	1428.89	1396.3	1360.87	1338.75	1401.04	1194.22	1240.17	1433.44	1038.45	1243.2	859.17	1178.76	1140.92	1228.23
S.E.	87	146	118	135	247	133	157	106	144	106	169	98	85	103	90	194	116	65	116	71	103



Table 8. Roundnose grenadier. Biomass per strata, total biomass (t) with SE, and stratified mean catch per tow (kg) and SE in NAFO divisions 1CD, for roundnose grenadier, for the period 1997-2017.

Division	Stratum (m)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1C	401-600	0	1	2	n.s	1	n.s	1	0	0	0	0
1C	601-800	85	305	262	459	36	42	18	40	145	52	6
1C	801-1000	27	955	538	4931	290	433	84	166	108	282	361
1C	1001-1200	32	54	n.s	31	5	37	10	7	14	7	6
1D	401-600	2	155	n.s	n.s	n.s	n.s	n.s	n.s	1	6	3
1D	601-800	240	14	7	n.s	n.s	n.s	n.s	2	12	15	n.s
1D	801-1000	125	50	15	53	24	11	11	27	21	23	126
1D	1001-1200	2006	1239	476	331	198	244	87	103	96	111	105
1D	1201-1400	1313	3396	867	889	567	197	347	124	148	119	82
1D	1401-1500	1901	1013	645	1087	473	661	216	161	187	48	148
TOTAL	Biomass	5731	7183	2811	7781	1594	1626	774	630	733	662	838
	S.E.	936	2519	456	2820	516	468	144	97	116	182	206
	MeanCatch	109.56	137.32	55.35	168.8	32.23	35.27	15.65	12.25	14.01	12.65	16.64
	S.E.	18	48	9	61	10	10	3	2	2	3	4

Division	Stratum (m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1C	401-600	0	2	2	48	0	n.s	14	0	5	n.s
1C	601-800	26	31	52	141	86	n.s	58	100	117	19
1C	801-1000	29	58	35	106	61	n.s	28	35	95	27
1C	1001-1200	6	5	9	6	8	n.s	5	5	9	2
1D	401-600	3	10	4	12	4	0	0	2	251	181
1D	601-800	30	9	3	18	838	125	235	128	26	64
1D	801-1000	24	598	79	227	436	166	34	88	35	16
1D	1001-1200	71	195	169	120	73	95	71	217	143	101
1D	1201-1400	163	150	148	187	104	82	119	219	136	75
1D	1401-1500	195	94	78	76	24	19	50	20	45	25
TOTAL	Biomass	547	1151	579	940	1634	488	612	813	861	510
	S.E.	81	516	81	244	853	212	230	167	275	187
	MeanCatch	10.46	22.01	11.06	17.97	31.24	18.65	11.7	15.55	16.46	10.42
	S.E.	2	10	2	5	16	8	4	3	5	4

Table 9. Mean catch (kg/km²), biomass (tons) with S.E. of roundnose grenadier, in Division 1 CD, by depth stratum in 2017. n.s = stratum not surveyed.

Division	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE
1C	401-600	-	n.s	n.s	n.s	n.s
1C	601-800	16120	6	1.18	19	17
1C	801-1000	6066	7	4.4	27	7
1C	1001-1200	611	2	3.75	2	2
1D	401-600	903	2	200.29	181	173
1D	601-800	1940	2	33.01	64	61
1D	801-1000	3874	4	4.11	16	5
1D	1001-1200	10140	16	9.96	101	23
1D	1201-1400	6195	10	12.15	75	17
1D	1401-1500	3091	4	7.99	25	13
TOTAL		48940	53	10.42	510	187

Table 10. Mean number (num/km²), abundance ('000s) with S.E. of roundnose grenadier in Division 1 CD by depth stratum in 2017. n.s = stratum not surveyed.

Division	Stratum (m)	Area (sq.km)	Tow number	Mean Number	Abundance	SE
1C	401-600	-	n.s	n.s	n.s	n.s
1C	601-800	16120	6	19.80	319	286
1C	801-1000	6066	7	32.95	200	54
1C	1001-1200	611	2	30.85	19	12
1D	401-600	903	2	1009.40	911	887
1D	601-800	1940	2	251.57	488	410
1D	801-1000	3874	4	30.88	120	47
1D	1001-1200	10140	16	51.57	523	91
1D	1201-1400	6195	10	32.68	202	49
1D	1401-1500	3091	4	33.97	105	60
TOTAL		48940	53	59	2887	1028

Table 11. Length distribution (pre anal fin length, 1 cm groups) and total abundance estimated number (000's) with SE (weighted by survey area), and stratified mean number with SE for roundnose grenadier in Division 1CD for the period 1997-2017.

Length Class (1cm)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	135	503	41	271	156	54	49	0	175	20	29	33	11	0	102	0	0	22	37	17	11
3	480	4854	1022	6232	1493	628	647	535	1354	316	485	234	904	134	535	135	0	238	412	187	34
4	2041	8262	5378	21591	3406	2188	978	2726	2962	1183	1637	352	1829	1118	1545	613	174	436	962	659	174
5	4459	9904	7969	44302	6184	3699	1205	3017	3497	3053	614	3800	1346	2629	3344	539	458	1084	1200	216	216
6	5578	12195	4812	39265	6526	4758	1058	2239	1944	3627	4408	959	3708	1668	2585	8816	738	646	1045	924	284
7	4617	17779	3127	14398	4088	3385	972	896	747	1253	2288	942	3584	937	1753	7763	816	985	1174	558	234
8	5002	10713	1959	5042	1169	1488	412	380	451	462	427	609	1472	617	931	2469	529	908	863	622	223
9	4510	4277	1098	1833	659	910	270	222	215	200	178	341	539	274	518	395	465	812	794	726	289
10	2403	2218	1032	878	241	343	262	131	245	158	120	159	143	205	423	412	292	264	407	536	285
11	1860	1246	756	711	289	383	298	211	234	176	122	174	120	145	169	212	149	218	196	508	240
12	1639	857	759	620	152	360	309	83	115	80	82	105	94	153	97	66	88	90	94	124	467
13	894	619	511	595	189	258	204	87	129	47	27	85	83	65	106	79	100	57	76	176	159
14	634	458	478	590	106	101	121	44	51	27	66	62	49	53	49	36	24	28	99	80	171
15	360	505	268	386	30	105	69	0	0	7	25	39	68	29	0	24	0	26	68	28	61
16	254	106	81	117	54	80	22	0	42	17	47	23	20	20	12	0	12	15	14	29	16
17	118	86	86	22	27	38	0	24	11	7	0	11	38	0	62	0	0	0	0	0	0
18	25	10	34	0	14	13	23	6	0	6	7	17	10	18	6	0	0	6	19	0	0
19	0	11	19	0	0	0	0	0	0	0	0	0	0	0	51	0	0	6	0	6	23
20	8	9	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	7	9	0
21	0	0	0	0	15	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Abundance	35017	74624	29430	136853	24806	18791	6899	10601	12172	10639	13001	4765	16472	6782	11573	24364	3926	5215	7351	6389	2887
S.E.	7964	26529	9097	60292	8765	8845	1272	2529	3747	4016	4502	698	10006	1797	4645	14246	2313	2248	2282	1802	1028
TOTAL MeanCatch	669.52	1426.19	578.02	2968.91	501.63	407.68	139.51	206.34	232.84	203.34	261.34	91.19	316.91	129.7	221.24	465.33	150.27	99.73	140.49	122.13	59
S.E.	152	507	179	1308	177	192	26	49	72	77	89	13	191	34	89	272	88	43	44	34	21



Table 12. Roughhead grenadier. Biomass per strata, total biomass (t) with SE, and stratified mean catch per tow (kg) and SE in NAFO divisions 1CD, for roughhead grenadier, for the period 1997-2017.

Division	Stratum(m)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1C	401-600	3	21	25	n.s	25	n.s	246	43	89	64	19
1C	601-800	70	568	677	874	437	2308	1681	930	1912	1495	966
1C	801-1000	145	625	919	2688	231	624	643	661	596	516	297
1C	1001-1200	31	84	n.s	92	85	166	110	40	116	38	27
1D	401-600	0	7	n.s	n.s	n.s	n.s	n.s	n.s	23	0	19
1D	601-800	63	244	279	n.s	n.s	n.s	154	96	393	n.s	n.s
1D	801-1000	79	575	423	255	429	462	257	139	340	230	359
1D	1001-1200	1239	1130	1379	1713	1361	1876	1288	934	1297	1291	859
1D	1201-1400	574	735	688	1174	1094	1515	1017	757	593	777	584
1D	1401-1500	283	323	740	574	771	1150	416	686	540	395	337
TOTAL	Biomass	2487	4313	5130	7369	4433	8101	5658	4345	5603	5199	3468
	S.E.	448	374	847	1603	381	886	701	477	431	618	375
	MeanCatch	47.55	82.45	100.99	159.87	89.62	175.74	114.38	84.54	107.12	99.39	68.85
	S.E.	9	7	17	35	8	19	14	9	8	12	7

Division	Stratum(m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1C	401-600	37	92	72	0	81	n.s	50	111	106	n.s
1C	601-800	1691	1206	1054	580	931	n.s	427	1270	603	508
1C	801-1000	734	240	339	284	255	n.s	302	379	332	77
1C	1001-1200	26	10	43	26	40	n.s	53	18	16	33
1D	401-600	73	65	34	24	24	38	37	4	42	37
1D	601-800	216	141	93	187	2757	393	182	60	191	73
1D	801-1000	171	293	193	148	359	323	226	136	173	50
1D	1001-1200	648	587	1081	931	954	570	786	670	528	417
1D	1201-1400	624	650	695	599	731	590	540	419	660	235
1D	1401-1500	518	504	421	306	169	340	317	230	222	115
TOTAL	Biomass	4737	3787	4026	3085	4210	2255	2921	3295	2872	1544
	S.E.	1166	297	564	265	1201	578	266	226	282	276
	MeanCatch	90.57	72.4	76.97	58.97	80.5	86.26	55.84	63	54.9	31.55
	S.E.	22	6	11	5	22.96	22	5	4	5	6

Table 13. Mean catch (kg/km²), biomass (tons) with S.E. of roughhead grenadier in Division 1 CD by depth stratum in 2017. n.s = stratum not surveyed

Division	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE
1C	401-600	-	n.s	n.s	n.s	n.s
1C	601-800	16120	6	31.53	508	240
1C	801-1000	6066	7	12.66	77	26
1C	1001-1200	611	2	54.1	33	23
1D	401-600	903	2	40.55	37	16
1D	601-800	1940	2	37.61	73	25
1D	801-1000	3874	4	12.81	50	14
1D	1001-1200	10140	16	41.08	417	72
1D	1201-1400	6195	10	37.98	235	69
1D	1401-1500	3091	4	37.09	115	79
TOTAL		48940	53	31.55	1545	276

Table 14. Mean number (num/km²), abundance ('000s) with S.E. of roughhead grenadier in Division 1 CD by depth stratum in 2017. n.s = stratum not surveyed.

Division	Stratum (m)	Area (sq.km)	Tow number	Mean Number	Abundance	SE
1C	401-600	-	n.s	n.s	n.s	n.s
1C	601-800	16120	6	61.40	990	270
1C	801-1000	6066	7	51.07	310	60
1C	1001-1200	611	2	73.88	45	23
1D	401-600	903	2	111.89	101	4
1D	601-800	1940	2	80.73	157	1
1D	801-1000	3874	4	45.82	178	75
1D	1001-1200	10140	16	94.53	959	127
1D	1201-1400	6195	10	84.29	522	132
1D	1401-1500	3091	4	53.08	164	85
TOTAL		48940	53	69.98	3426	351

Table 15. Length distribution (pre anal fin length, 1 cm groups) and total abundance estimated number (000's) with SE (weighted by survey area), and stratified mean number with SE, for roughhead grenadier, in Division 1CD, for the period 1997-2017.

Length Class (1cm)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	0	0	12	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0
2	0	11	0	0	61	0	0	34	0	0	0	0	7	0	0	0	0	0	8	20	0
3	14	20	0	0	15	24	0	0	11	0	0	7	0	6	0	0	0	43	12	26	0
4	8	56	12	103	69	115	0	12	94	96	78	12	13	21	98	20	13	103	75	34	14
5	30	58	40	0	85	75	83	102	53	96	51	20	17	20	36	10	96	32	82	47	8
6	29	51	12	144	168	57	259	83	18	7	147	52	0	20	27	28	17	74	211	178	78
7	25	319	213	409	370	329	658	224	157	141	57	153	158	57	185	120	76	389	424	172	165
8	34	427	231	212	681	396	215	142	92	90	154	229	130	131	168	259	61	449	368	295	67
9	81	440	724	587	340	1138	353	384	464	259	339	501	255	118	202	148	138	528	766	541	217
10	201	566	1313	954	724	1005	541	609	582	571	338	504	235	210	158	304	127	532	629	283	121
11	253	1074	1303	1540	940	746	1060	665	1320	471	124	474	538	393	303	577	120	597	807	457	195
12	331	1071	1164	2707	1088	1446	1606	877	1027	1202	591	517	782	397	458	328	157	752	945	498	327
13	384	1129	1429	3491	1262	1686	1210	1291	1236	1137	545	811	636	652	567	539	175	472	933	531	190
14	453	1196	1513	2724	1127	2151	1308	1204	1886	1269	497	867	297	499	660	458	175	499	604	410	260
15	429	911	1305	2398	1271	1856	1731	1096	1763	1481	873	814	811	1117	614	714	226	287	505	381	278
16	584	752	968	1532	1419	2519	1727	1275	1372	1280	822	840	836	816	1008	645	403	620	470	565	160
17	508	909	1081	1412	1272	1807	1475	1228	1101	1120	1055	1082	897	968	1009	798	364	537	553	411	281
18	458	580	737	843	815	1735	1065	691	991	952	1085	1006	752	918	787	775	647	630	455	506	331
19	358	559	410	441	650	810	687	428	510	397	478	699	525	702	475	1237	567	502	327	344	184
20	253	418	513	351	290	457	540	254	279	428	316	415	370	220	243	422	194	210	270	302	132
21	38	349	250	249	265	395	309	225	371	158	111	265	278	235	119	31	117	107	268	97	51
22	153	78	134	187	221	219	138	114	149	87	18	134	114	86	82	182	43	87	101	132	24
23	113	194	309	181	122	208	81	59	121	74	29	176	90	139	19	255	107	52	94	109	81
24	49	110	122	88	25	115	58	17	62	82	163	210	85	142	19	62	0	32	134	62	22
25	52	94	67	131	71	119	86	58	40	103	47	97	122	57	52	90	70	43	74	79	15
26	0	63	59	64	31	125	39	44	72	80	40	95	8	35	8	74	103	78	67	56	75
27	45	24	11	140	74	109	37	44	79	37	10	17	28	13	14	46	73	45	19	43	67
28	0	13	14	45	0	80	15	21	49	38	17	114	68	70	5	115	0	42	25	68	15
29	28	38	0	0	29	56	14	17	15	70	67	13	25	27	12	49	12	22	28	40	16
30	21	20	0	26	16	23	10	6	12	50	9	28	30	41	6	15	25	0	39	13	0
31	18	0	0	0	0	0	25	6	40	83	10	5	6	18	0	5	13	22	6	19	0
32	0	11	0	12	14	0	0	22	24	8	4	5	23	0	13	88	0	0	13	19	13
33	9	0	11	0	15	55	11	17	0	18	0	7	10	30	5	15	0	16	0	39	0
34	0	11	12	13	9	12	0	0	8	11	0	7	0	13	13	8	0	0	10	21	0
35	0	0	0	21	19	13	0	0	7	23	10	5	8	0	0	0	24	0	7	0	0
36	0	13	0	0	0	24	0	0	0	7	5	7	12	0	14	0	0	15	14	0	29
37	0	0	0	0	0	44	0	7	0	0	0	16	9	19	0	0	0	0	0	0	4
38	0	0	34	0	0	0	21	0	0	0	0	0	7	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	5	9	0	6	0	13	6	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	13	0	0	7	0	7	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Abundance	5013	11571	14003	21012	12773	19952	15366	11248	14020	11927	8185	10224	8200	8205	7386	8417	4159	7826	9345	6814	3425
S.E.	723	1004	2040	5114	1291	1956	2573	1389	1384	1088	1085	1601	671	1101	650	2707	1152	691	688	604	351
TOTAL Mean Number	95.84	221.21	275.69	455.83	258.23	432.84	310.66	218.81	268.04	228.02	162.51	195.46	156.77	156.87	141.2	160.92	159.09	149.63	178.66	130.28	69.98
S.E.	14	19	40	111	26	42	52	27	26	21	22	31	13	21	12	52	44	13	13	12	7



Table 16. Deep sea redfish. Biomass per strata, total biomass (t) with SE, and stratified mean catch per tow (kg) and SE in NAFO divisions 1CD, for deep-sea redfish, for the period 1997-2017.

Division	Stratum(m)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1C	401-600	686	911	970	n.s	1032	n.s	1137	1983	173	1576	0
1C	601-800	1158	726	1329	733	778	295	323	331	2144	159	200
1C	801-1000	8	6	20	25	0	8	11	8	53	14	28
1C	1001-1200	1	0	n.s	2	0	0	0	0	1	1	0
1D	401-600	102	489	n.s	n.s	n.s	n.s	n.s	n.s	130	35	109
1D	601-800	441	100	197	n.s	n.s	n.s	n.s	4	30	177	n.s
1D	801-1000	20	0	0	5	0	5	22	0	4	0	80
1D	1001-1200	9	5	2	6	10	0	0	4	3	8	2
1D	1201-1400	9	0	3	0	0	4	0	0	6	8	8
1D	1401-1500	0	2	0	0	7	3	0	0	1	3	0
	Biomass	2435	2240	2522	771	1826	315	1493	2330	2546	1982	426
TOTAL	S.E.	780	513	969	259	649	40	684	1259	1683	720	181
	MeanCatch	46.55	42.82	49.66	16.72	36.92	6.82	30.19	45.33	48.68	37.88	8.47
	S.E.	15	10	19	6	13	1	14	24	32	14	4

Division	Stratum(m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1C	401-600	2273	2379	2538	4062	6420	n.s	13669	5827	2133	n.s
1C	601-800	8219	3432	440	3309	607	n.s	5072	3804	3753	345
1C	801-1000	16	9	15	74	14	n.s	61	36	77	20
1C	1001-1200	0	1	3	1	0	n.s	0	1	0	0
1D	401-600	1142	1824	1035	1179	344	4830	1402	117	4164	2676
1D	601-800	1583	37	5	975	6322	20649	1811	161	1152	5898
1D	801-1000	5	90	5	0	43	0	13	18	0	0
1D	1001-1200	6	10	2	13	6	3	13	21	40	68
1D	1201-1400	8	8	5	9	15	5	10	30	6	9
1D	1401-1500	4	7	18	2	3	5	9	1	11	0
	Biomass	13256	7796	4066	9624	13774	25492	22058	10017	11336	9016
TOTAL	S.E.	6468	3917	1329	3623	4450	8268	10284	4457	4829	6418
	MeanCatch	253.43	149.05	77.73	183.99	263.33	975.09	421.72	191.5	216.72	184.23
	S.E.	124	75	25	69	85	316	197	85	92	131

Table 17. Mean catch (kg/km²), biomass (tons) with S.E. of deep-sea redfish in Division 1 CD by depth stratum in 2017. n.s = stratum not surveyed.

Division	Stratum (m)	Area (sq.km)	Tow number	Mean Catch	Biomass	SE
1C	401-600	-	n.s	n.s	n.s	n.s
1C	601-800	16120	6	21.41	345	78
1C	801-1000	6066	7	3.26	20	13
1C	1001-1200	611	2	0	0	0
1D	401-600	903	2	2963.92	2676	2596
1D	601-800	1940	2	3040.06	5898	5869
1D	801-1000	3874	4	0	0	0
1D	1001-1200	10140	16	6.72	68	68
1D	1201-1400	6195	10	1.42	9	5
1D	1401-1500	3091	4	0	0	0
TOTAL		48940	53	184.23	9016	6418

Table 18. Mean number (num/km²), abundance ('000s) with S.E. of deep-sea redfish in Division 1 CD by depth stratum in 2017. n.s = stratum not surveyed

Division	Stratum (m)	Area (sq.km)	Tow number	Mean number	Biomass	SE
1C	401-600	-	n.s	n.s	n.s	n.s
1C	601-800	16120	6	58.1	937	228
1C	801-1000	6066	7	7.7	47	27
1C	1001-1200	611	2	0.0	0	0
1D	401-600	903	2	5359.1	4839	4718
1D	601-800	1940	2	5396.5	10469	10417
1D	801-1000	3874	4	0.0	0	0
1D	1001-1200	10140	16	10.2	103	103
1D	1201-1400	6195	10	4.3	26	14
1D	1401-1500	3091	4	0	0	0
TOTAL		48940	53	335.56	16421	11439

Table 19. Length distribution (1 cm groups) and total abundance estimated number (000's) with SE (weighted by survey area), and stratified mean number with SE for deep-sea redfish, in Division 1CD, for the period 1997-2017.

Length Class (1cm)	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2	0	0	0	0	170	0	0	0	0	11	5	0	0	0	0	0	0	0	0	0	0
4	5	0	0	0	444	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0
6	36	0	0	0	0	0	44	0	0	5	0	0	0	0	0	0	0	0	0	0	0
8	16	0	0	0	0	0	0	0	16	0	11	0	18	0	0	0	0	0	0	0	0
10	36	263	0	0	50	0	21	0	129	0	69	28	84	0	0	0	0	0	0	0	0
12	722	1160	274	0	778	0	44	37	226	146	58	1142	266	77	39	0	0	0	0	0	0
14	2727	2282	851	121	4280	53	163	251	646	1472	145	9537	1565	1126	117	0	0	0	22	0	0
16	3046	3005	1432	358	2235	112	832	1929	725	3928	78	6447	7489	1155	432	73	0	0	237	23	0
18	2495	3489	2483	289	2488	340	2209	3575	307	6142	278	5149	6564	3038	2012	588	240	1778	1143	37	0
20	1932	2908	2220	307	2034	71	1801	2958	329	2331	292	5782	3786	3925	5623	3752	1560	5040	2902	454	46
22	1355	2655	2045	893	1262	223	896	2652	1048	668	175	5369	4484	3068	7204	8186	4560	9005	5924	1829	180
24	514	1227	1234	1230	565	298	708	862	655	220	218	5483	3858	2293	5877	9703	6735	16562	6504	3705	1080
26	419	410	1091	271	201	0	173	556	516	318	76	4030	2598	1367	5459	5947	7083	14085	5595	4291	1806
28	617	244	742	0	127	134	99	282	464	160	402	2480	1718	935	2308	3982	5009	10408	3687	4008	2413
30	307	415	343	90	52	165	49	128	510	82	27	2716	931	307	1267	3081	3182	4980	2944	3350	2871
32	205	250	231	0	14	0	0	123	714	32	16	2117	777	348	955	505	1942	1924	916	2569	2938
34	47	89	63	0	28	0	65	0	459	26	9	1570	536	79	561	1153	3763	520	474	2292	2259
36	21	18	32	0	11	0	25	0	375	0	19	789	311	99	321	1222	4164	686	338	1136	1321
38	13	0	0	18	0	0	0	0	72	27	0	231	18	14	170	743	6506	472	269	641	1132
40	0	22	22	0	0	0	0	0	30	0	0	178	0	0	79	294	1561	229	92	272	253
42	0	0	0	0	0	0	0	0	47	0	0	13	18	0	0	147	260	194	73	67	77
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	46
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0
Abundance	14513	18437	13063	3577	14739	1396	7129	13353	7268	15568	1892	53061	35039	17831	32424	39376	46565	65975	31120	24697	16422
S.E.	5435	3852	4082	937	4670	332	3079	7173	3159	8569	762	17663	17720	3171	12978	12774	13196	33357	12674	9945	11439
MeanNumbe	277.48	281.9	257.18	75.07	297.14	30.27	144.16	259.74	138.94	297.64	37.57	1014.44	669.89	340.96	619.87	752.8	1781.18	1261.33	601.71	472.17	335.56
S.E.	104	74	80	20	94	7	62	140	60	164	15	338	339	61	248	244	505	638	242	190	234



Table 20. Mean temperature, S.E. and number of observations by NAFO Division and depth stratum in 1CD.

Division	Depth stratum (m)	n	Mean °C	S.E.
1C	401-600	-	-	-
1C	601-800	6	3.6	0.1
1C	801-1000	7	3.7	0.05
1C	1001-1200	2	3.6	0.03
1D	401-600	2	4.7	0
1D	601-800	2	4.1	0.37
1D	801-1000	4	3.6	0.03
1D	1001-1200	16	3.5	0.01
1D	1201-1400	10	3.5	0.02
1D	1401-1500	4	3.4	0.01

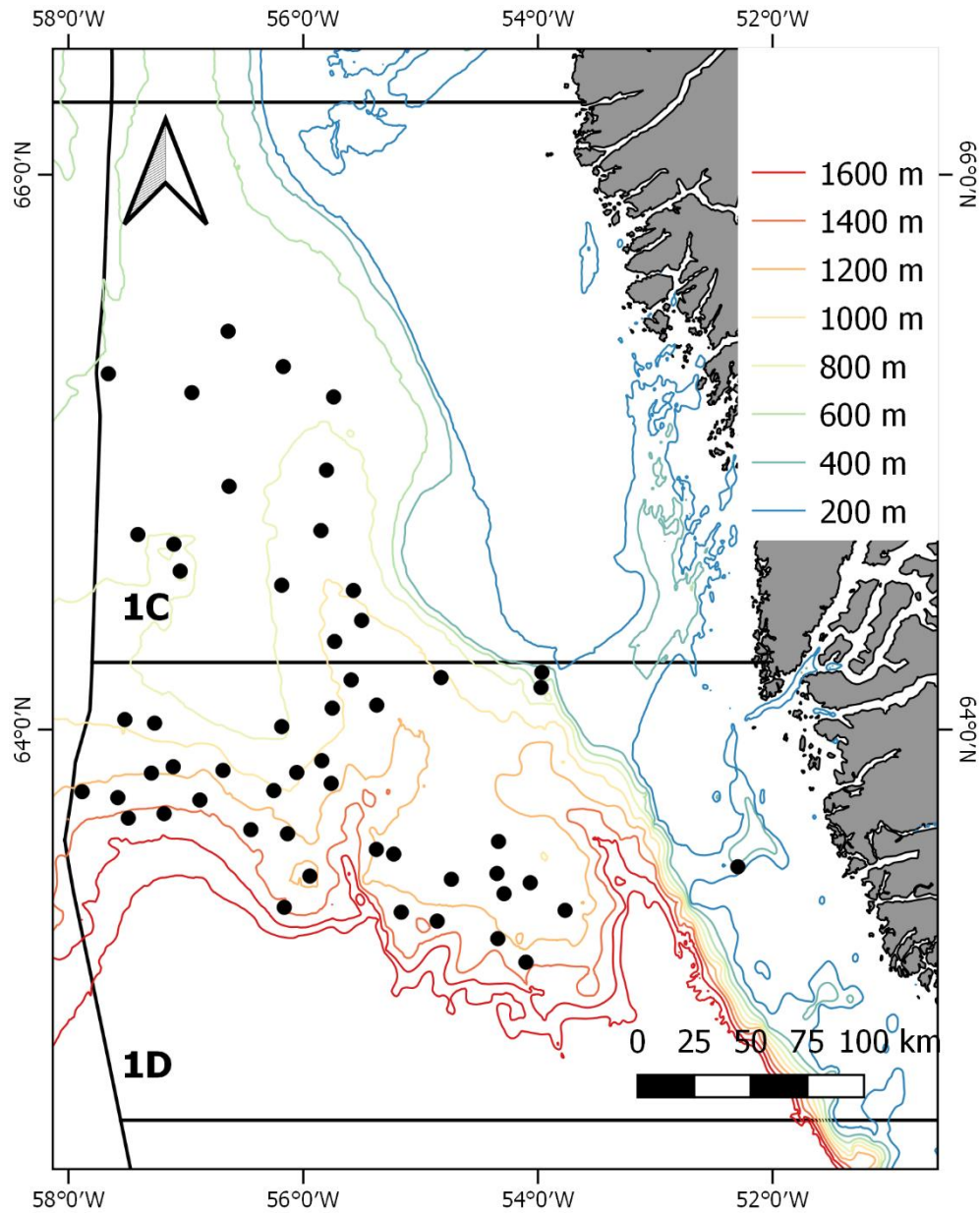


Fig. 1. Hauls positions for the West Greenland halibut 2017 survey. Coordinate system is WGS84/Pseudo Mercator EPSG: 3857- Grid in latitude /longitude.

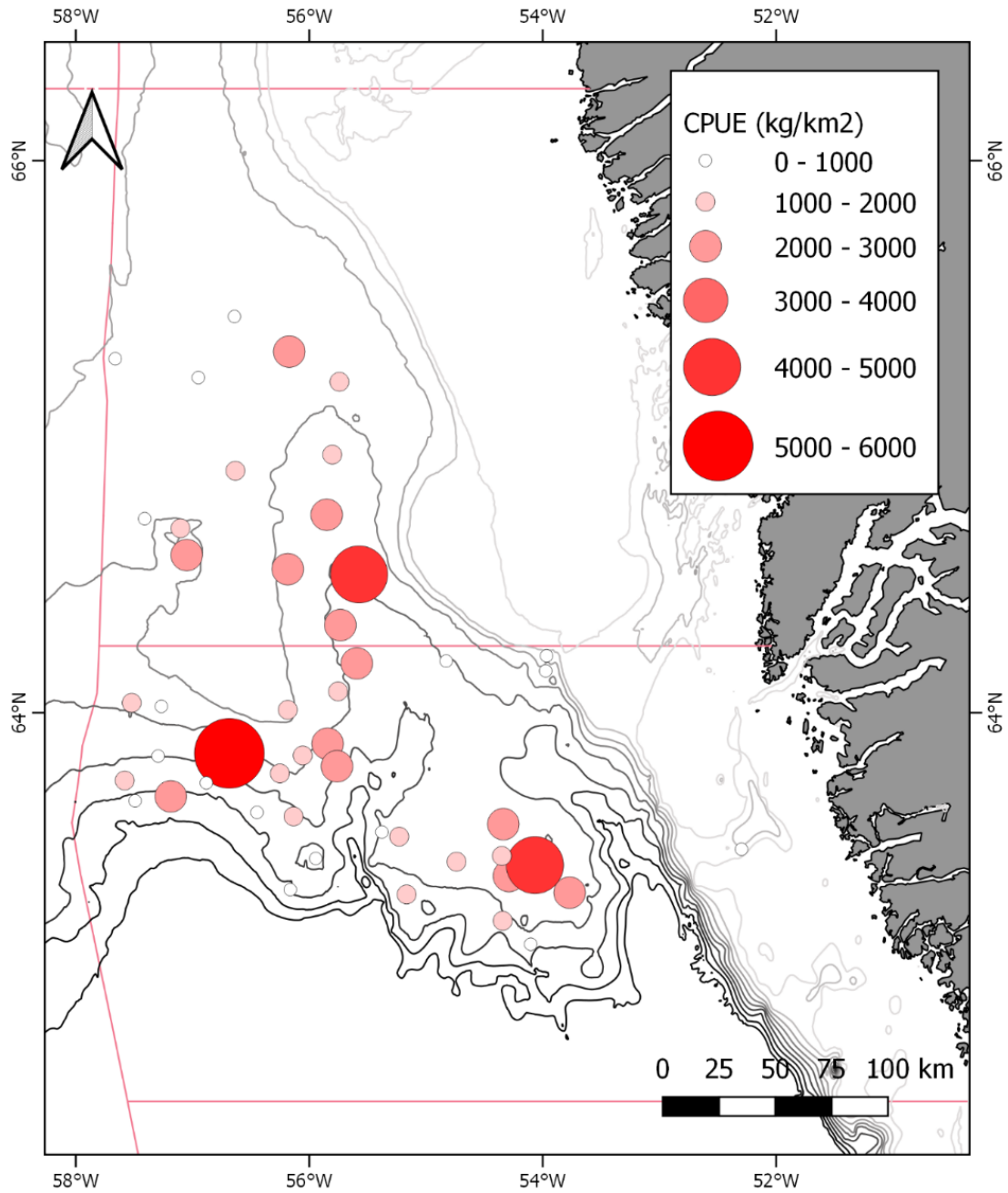


Fig. 2. Distribution of catches (kg/km²) of Greenland halibut in 2017.

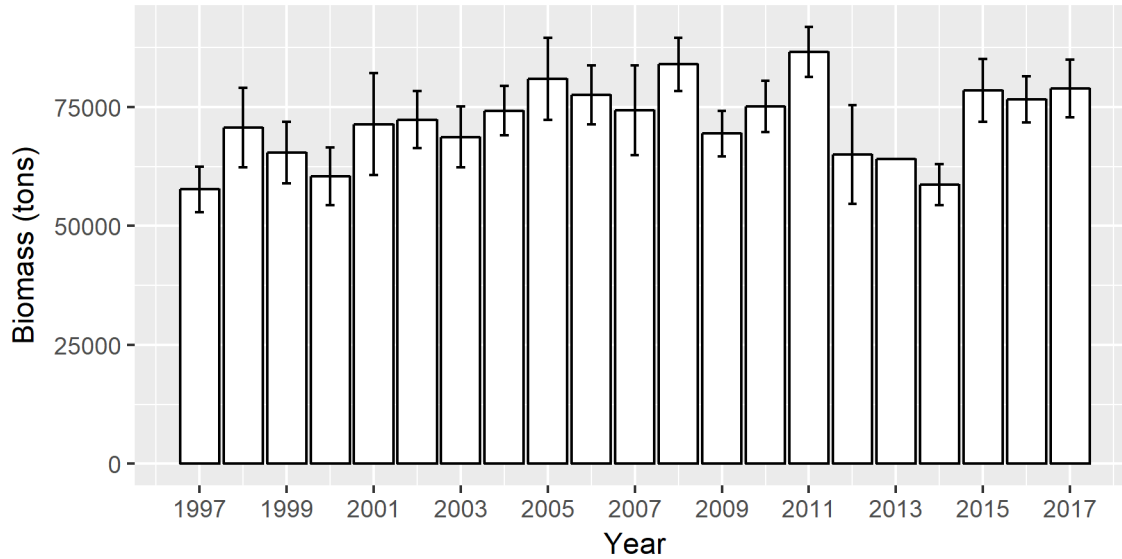


Fig. 3. Greenland halibut biomass calculated by swept area method in tons and +/- S.E. by year for the period 1997-2017. The biomass in Division 1C, in 2013, has been estimates by a GLM including data from 2010-2014. (Biomass 2013 = 64 049 t).

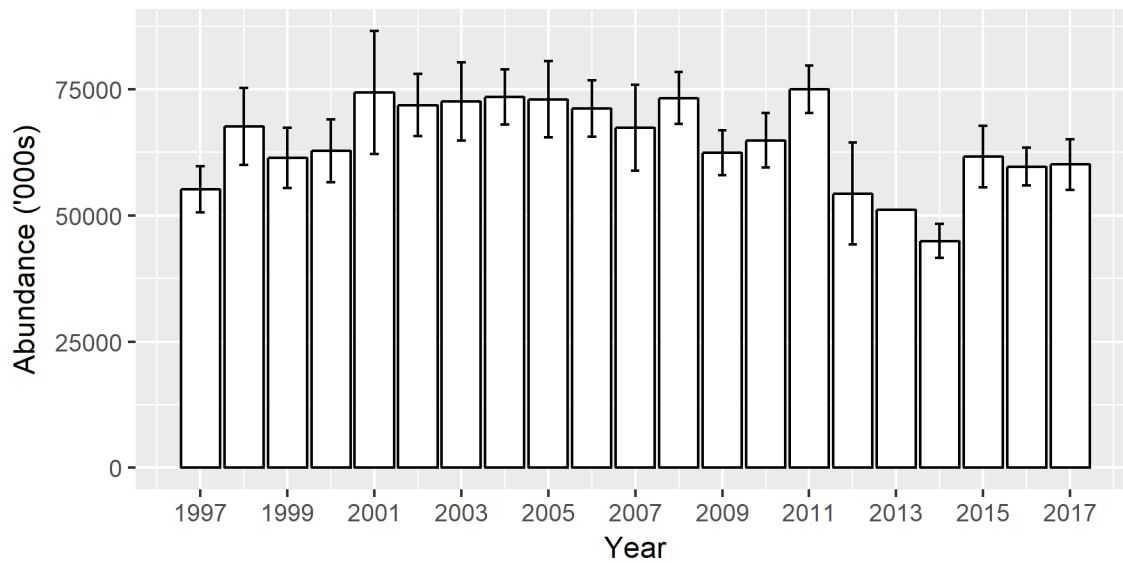


Fig. 4. Greenland halibut abundance calculated by swept area method in ('000s) and +/- S.E. by year for the period 1997-2017. The biomass in Division 1C, in 2013, has been estimated by a GLM including data from 2010-2014. (Abundance 2013 = 51 160 *10³ indiv.).

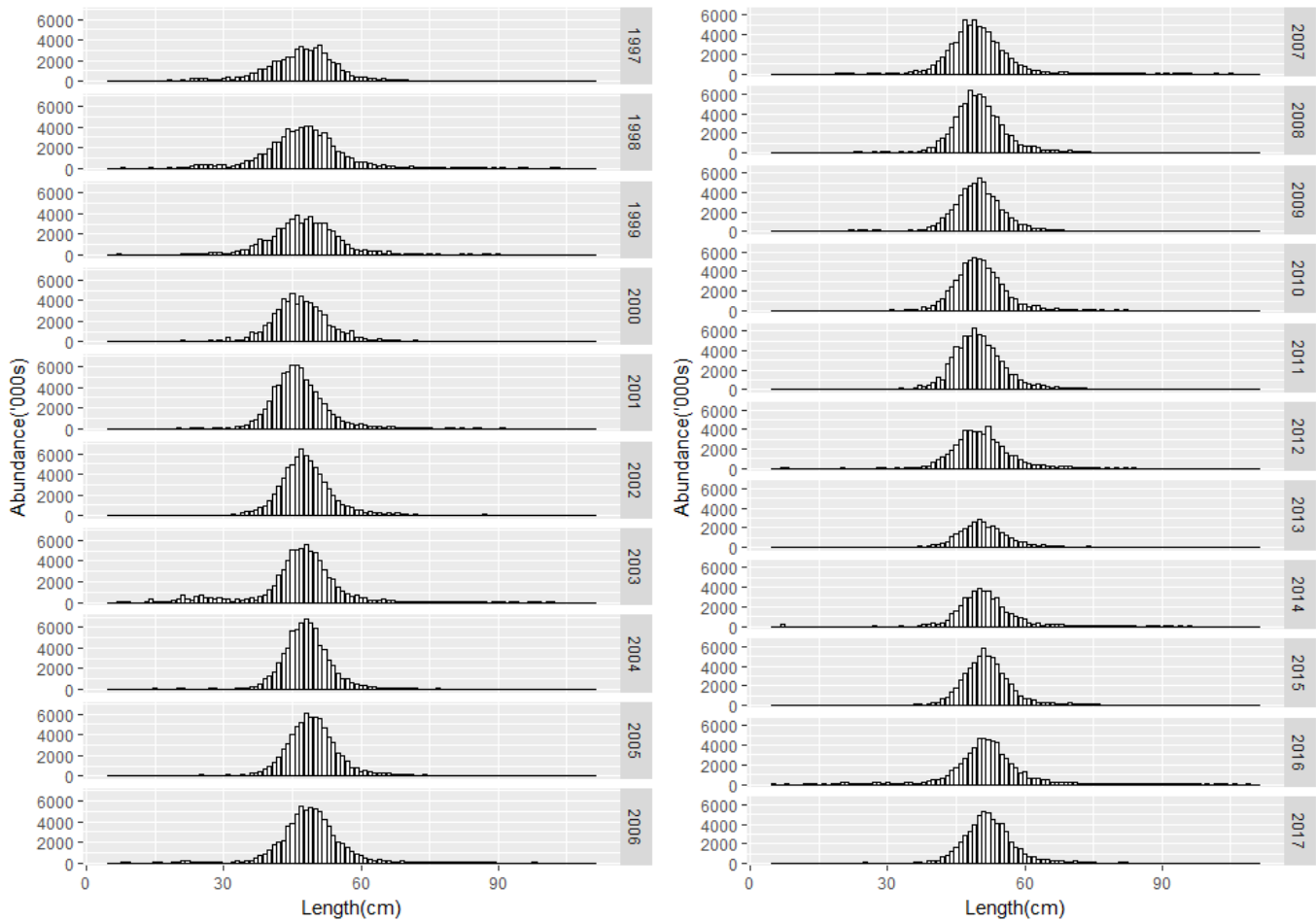


Fig.5. Greenland halibut length distribution (cm), in numbers ('000s) per swept area, on NAFO 1CD: 1997-2017. In 2013, only the Division 1D was surveyed

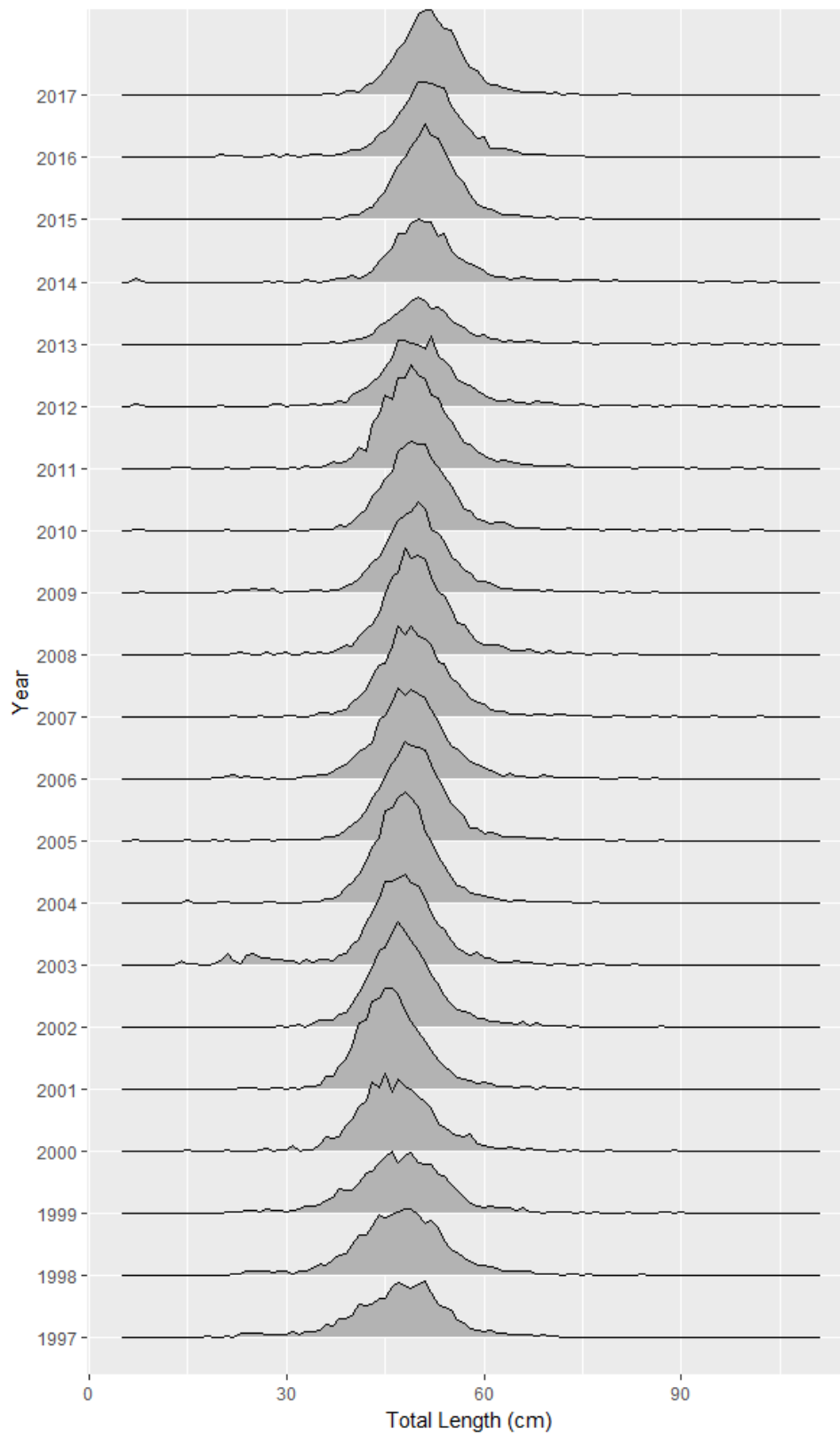


Fig. 6. Greenland halibut length distribution (weighted to stratum area), NAFO Div. 1CD, for the period 1997-2017.

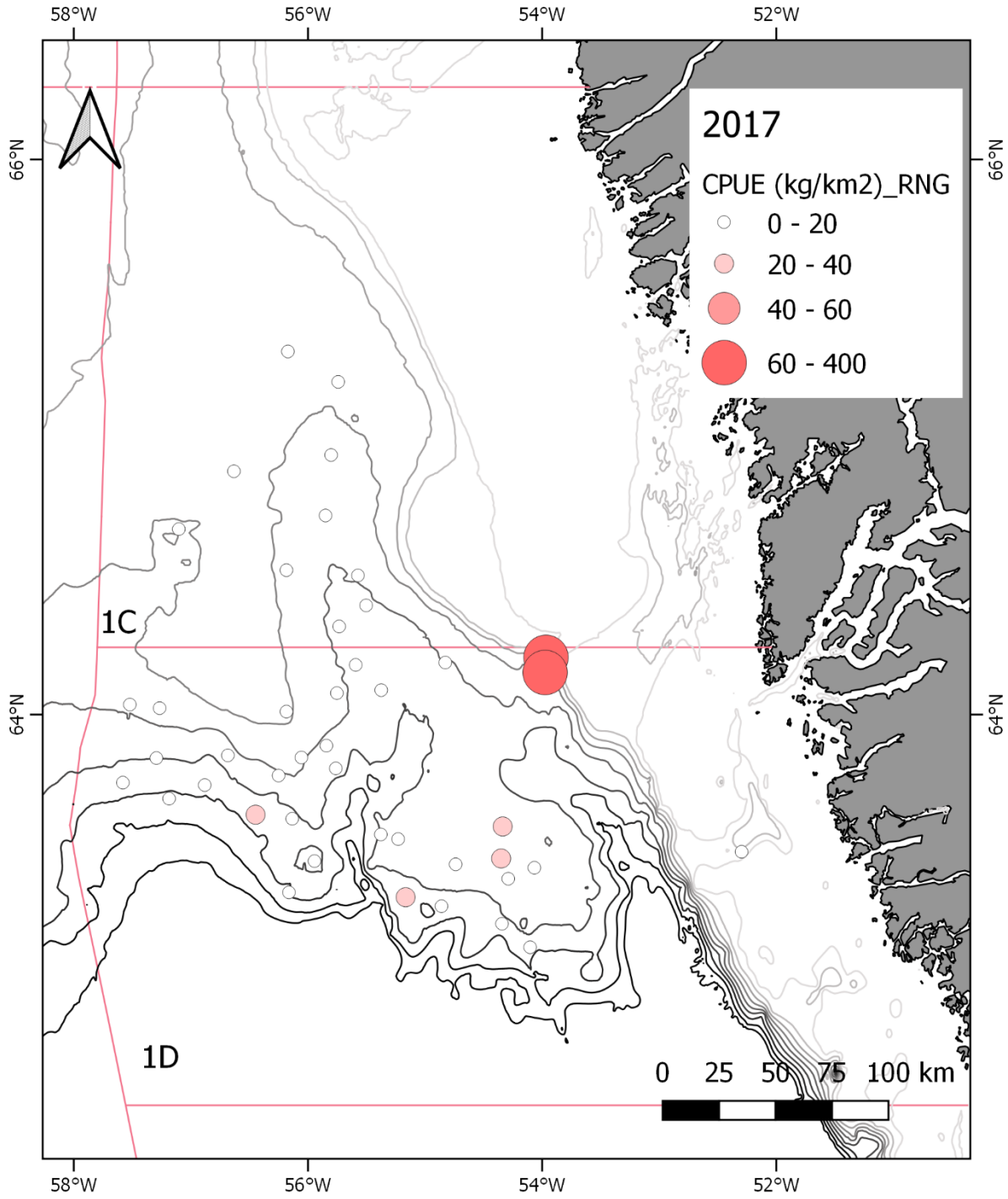


Fig. 7. Distribution of catches (kg/km²) of roundnose grenadier in 2017.

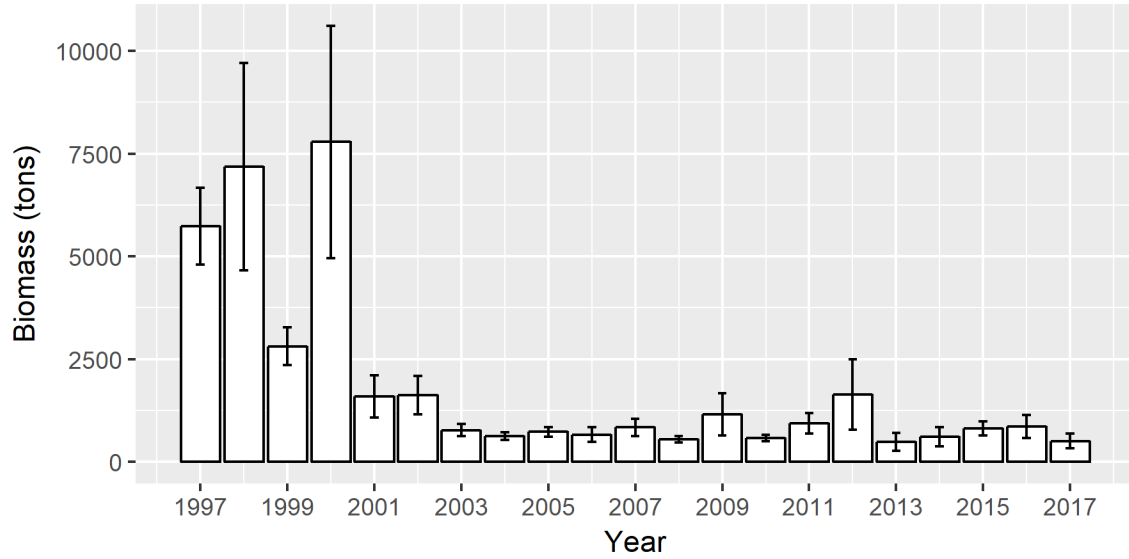


Fig. 8 Roundnose grenadier biomass calculated by swept area method in tons and +/- S.E. by year for the period 1997-2017. In 2013, only the Division 1C was surveyed.

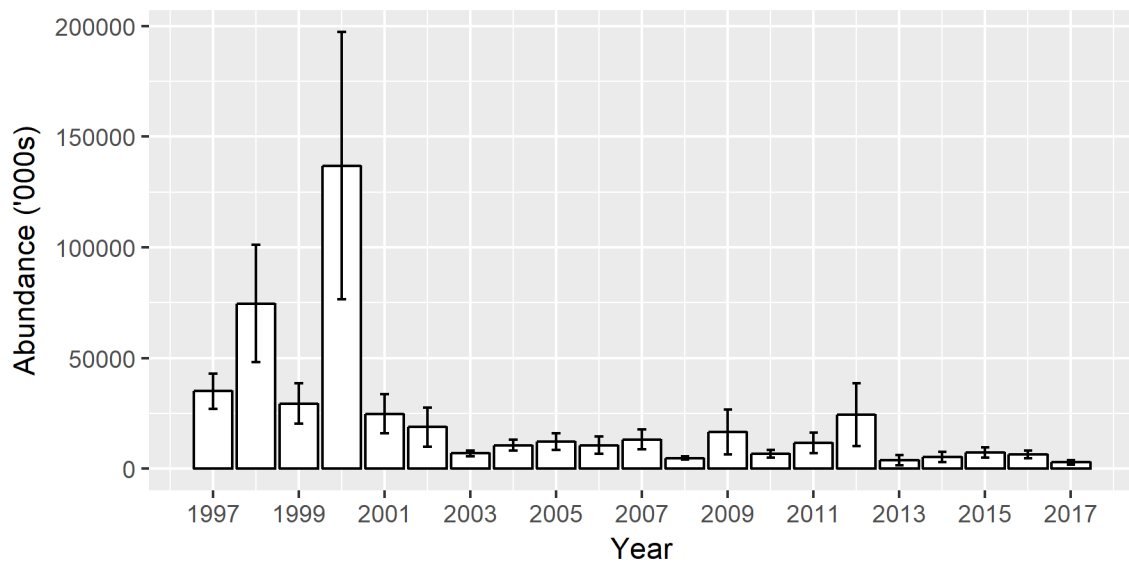


Fig. 9. Roundnose grenadier abundance calculated by swept area method in ('000s) and +/- S.E. by year for the period 1997-2017. In 2013, only the Division 1D was surveyed.

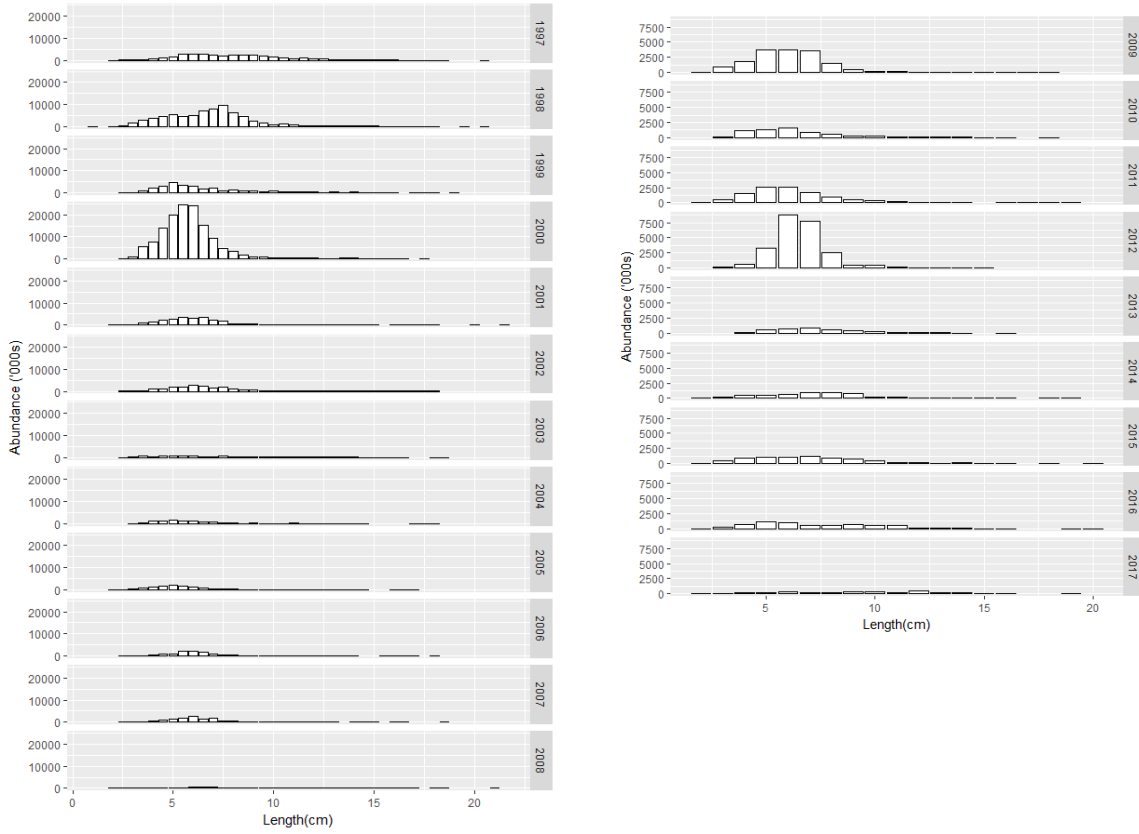


Fig. 10. Roundnose grenadier length distribution (cm,) in numbers ('000s) per swept area, on NAFO 1CD: 1997-2017. In 2013, only the Division 1D was surveyed

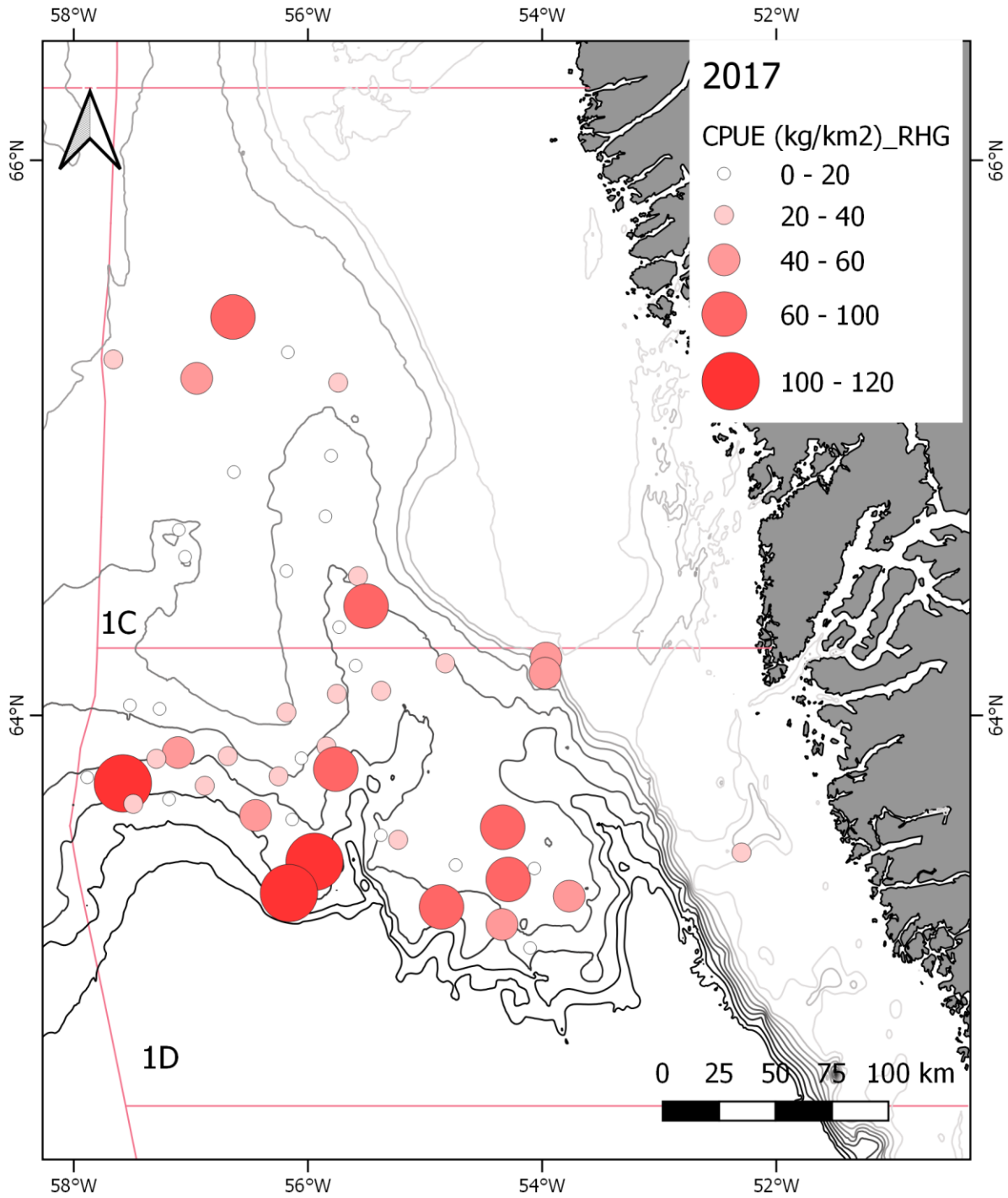


Fig. 11. Distribution of catches (kg/km²) of roughhead grenadier in 2017.

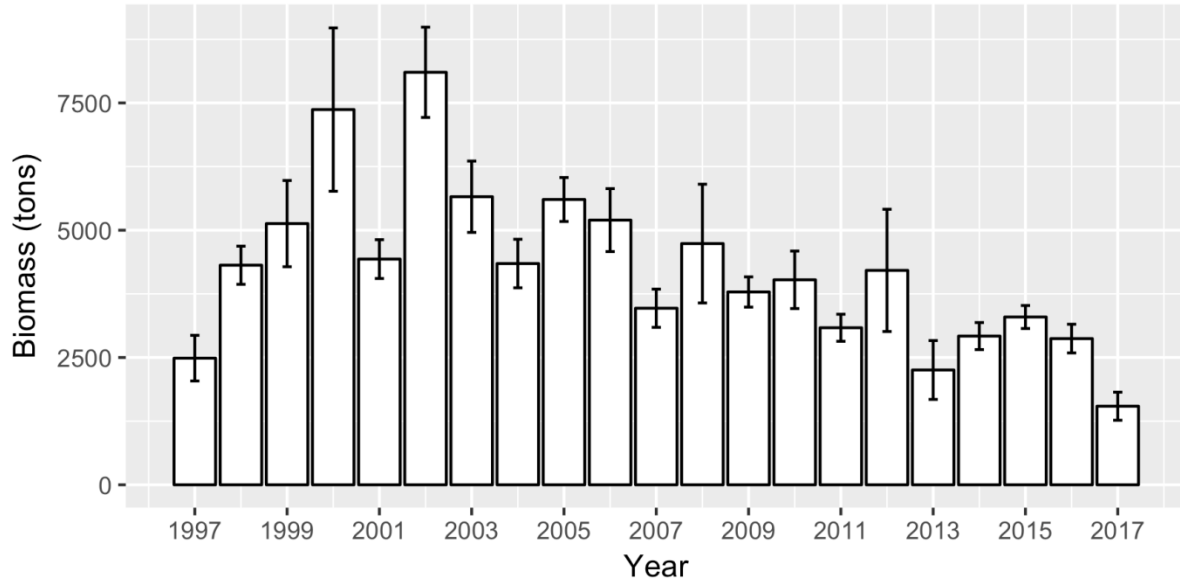


Fig. 12. Roughhead grenadier biomass (tons) calculated by swept area method in tons and +/- S.E. by year for the period 1997-2017. In 2013, only the Division 1D was surveyed

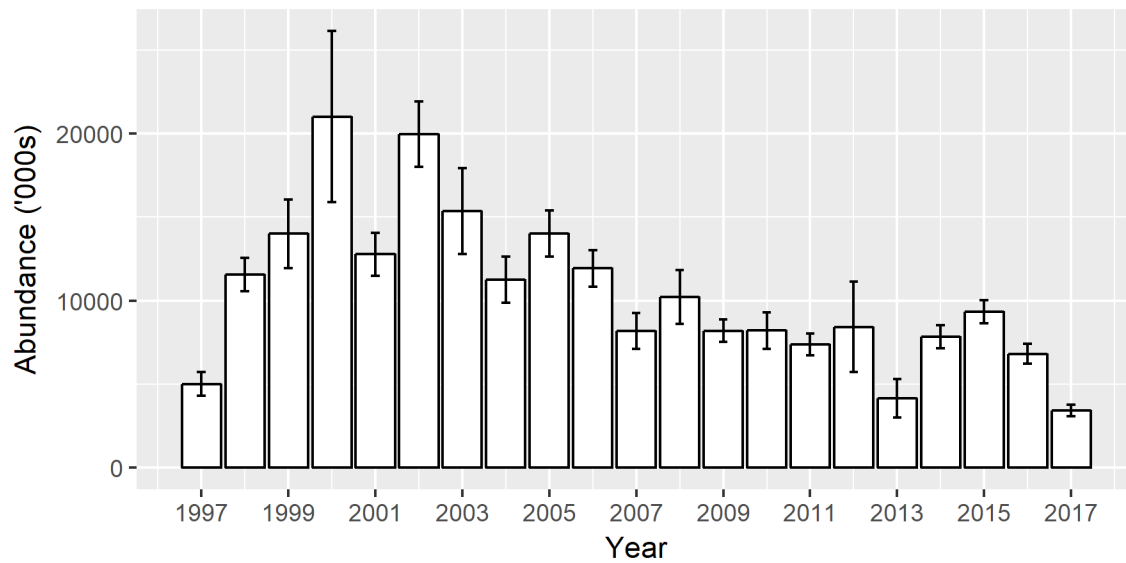


Fig. 13. Roughhead grenadier abundance calculated by swept area method in ('000s) and +/- S.E. by year for the period 1997-2017. In 2013, only the Division 1C was surveyed.

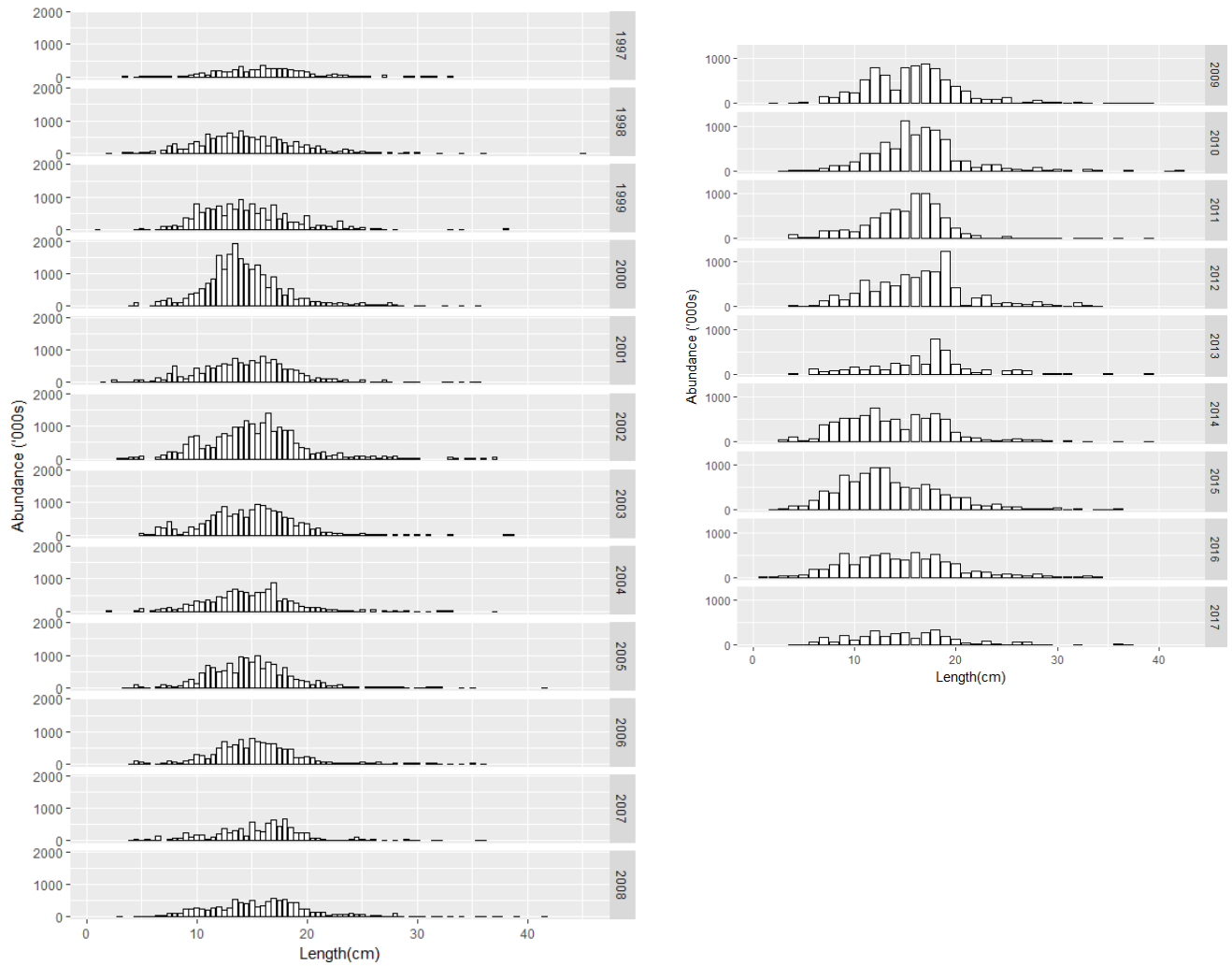


Fig. 14. Roughhead grenadier length distribution (cm) in numbers ('000s) per swept area, on NAFO 1CD: 1997-2017. In 2013, only the Division 1C was surveyed

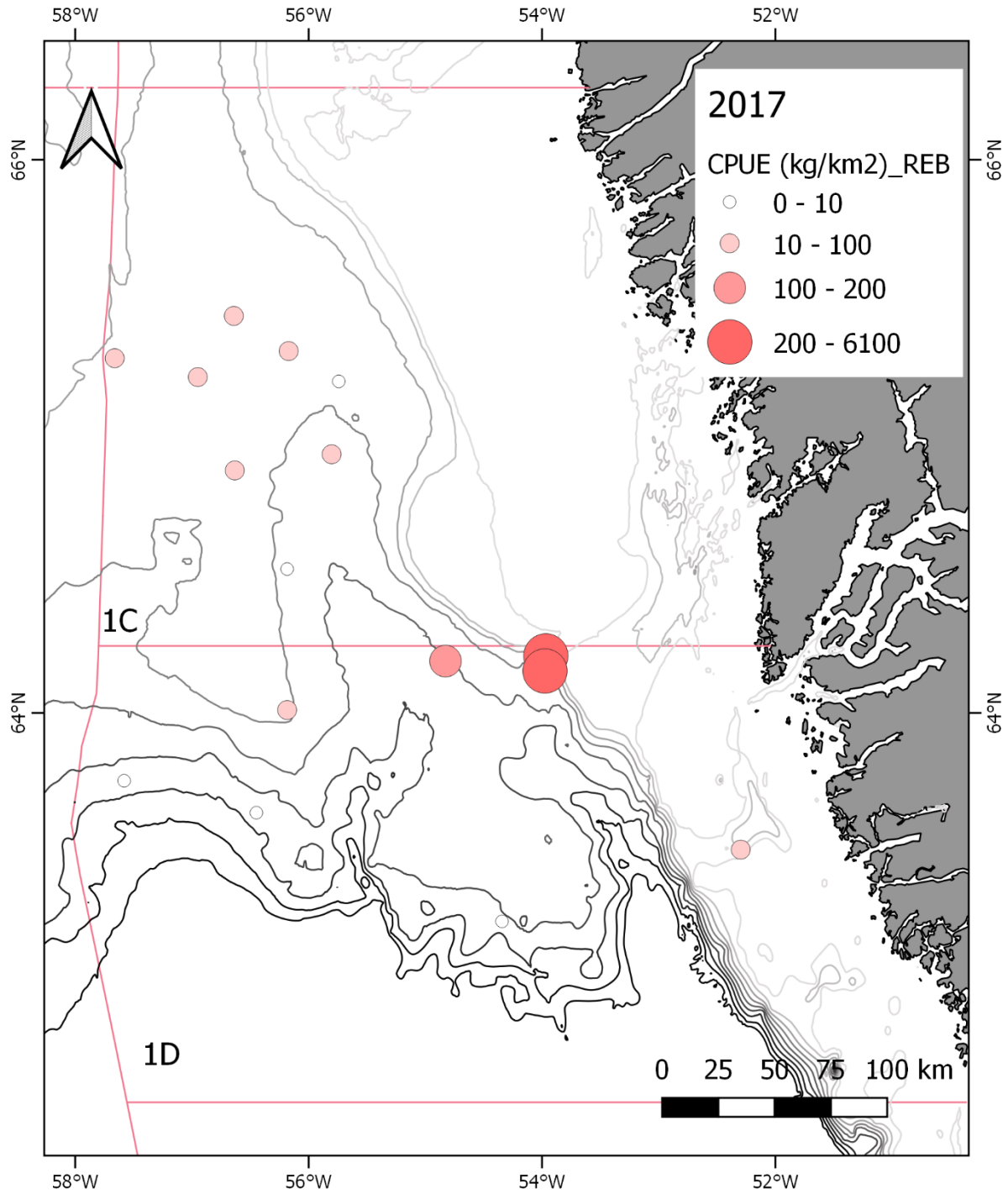


Fig. 15. Distribution of catches (kg/km²) of deep-sea redfish in 2017.

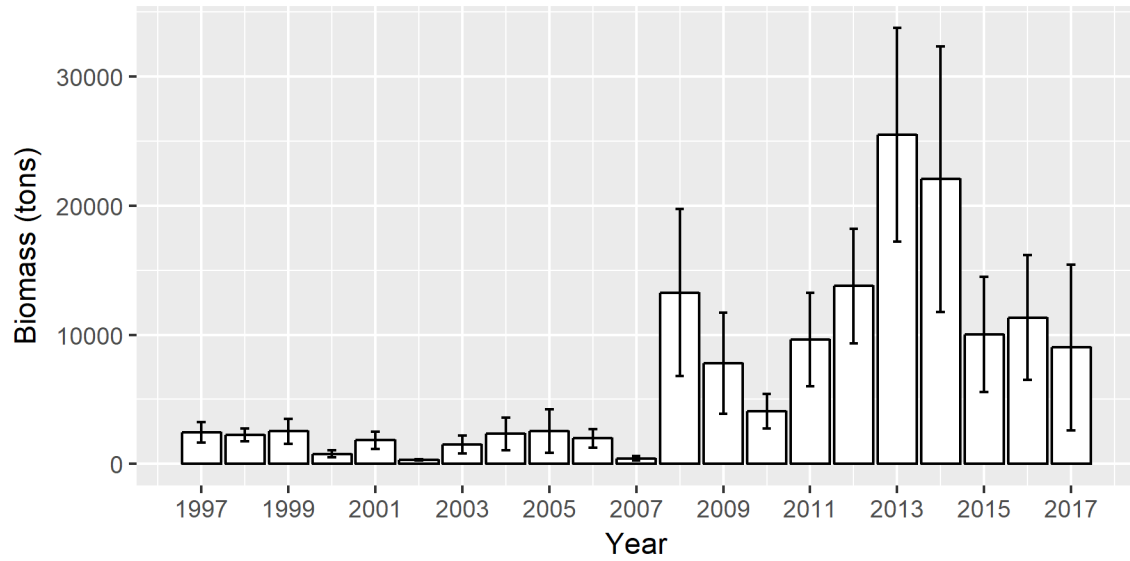


Fig. 16. Deep-sea redfish biomass (tons) calculated by swept area method in tons and +/- S.E. by year for the period 1997-2017. In 2013, only the Division 1D was surveyed

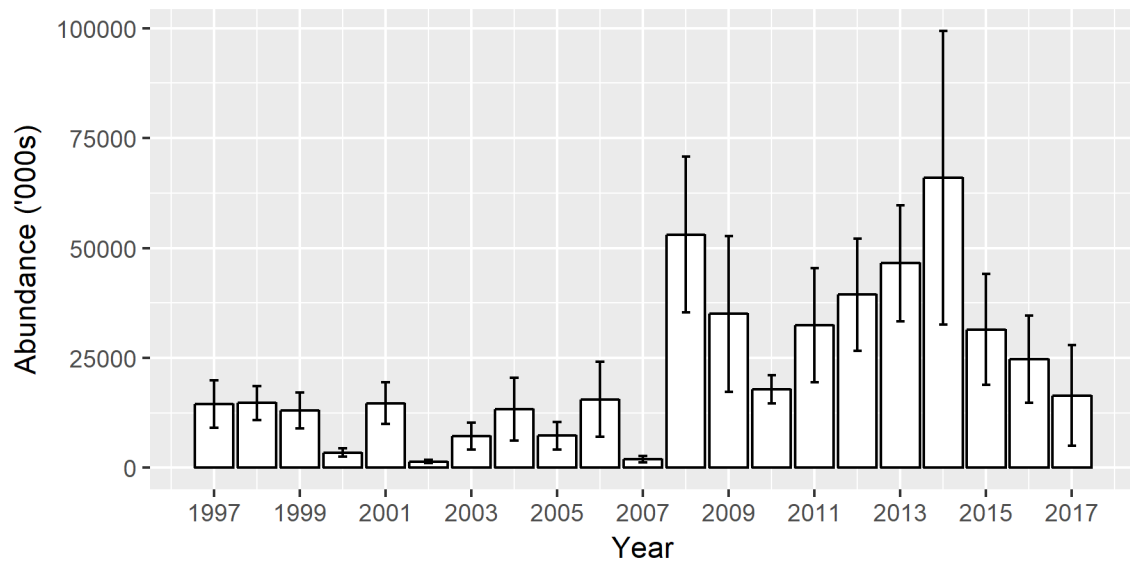


Fig. 17. Deep-sea redfish abundance calculated by swept area method in ('000s) and +/- S.E. by year for the period 1997-2017. In 2013, only the Division 1D was surveyed.

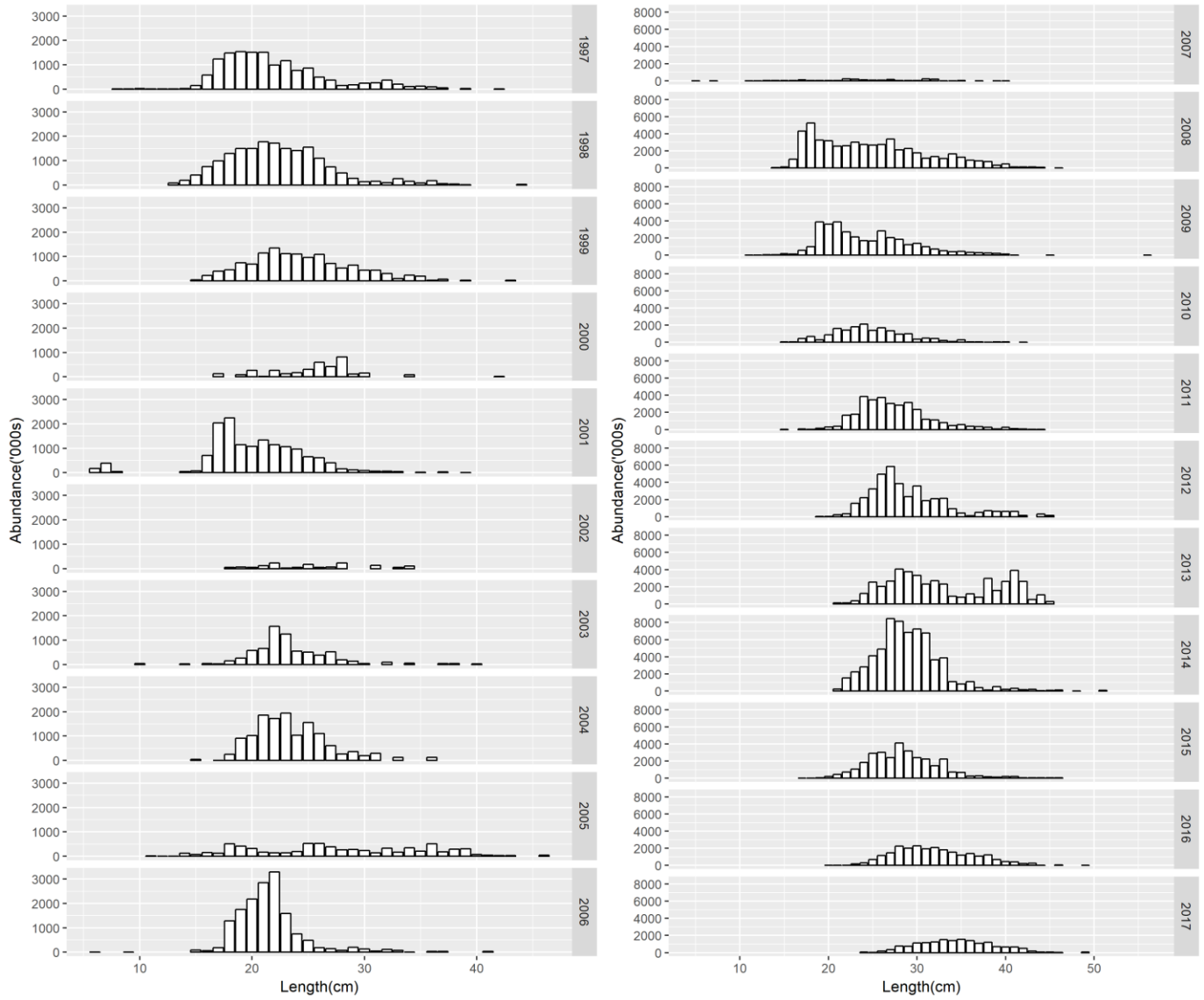


Fig. 18. Deep-sea redfish length distribution (cm,) in numbers ('000s) per swept area, on NAFO 1CD: 1997-2017. In 2013, only the Division 1D was surveyed.

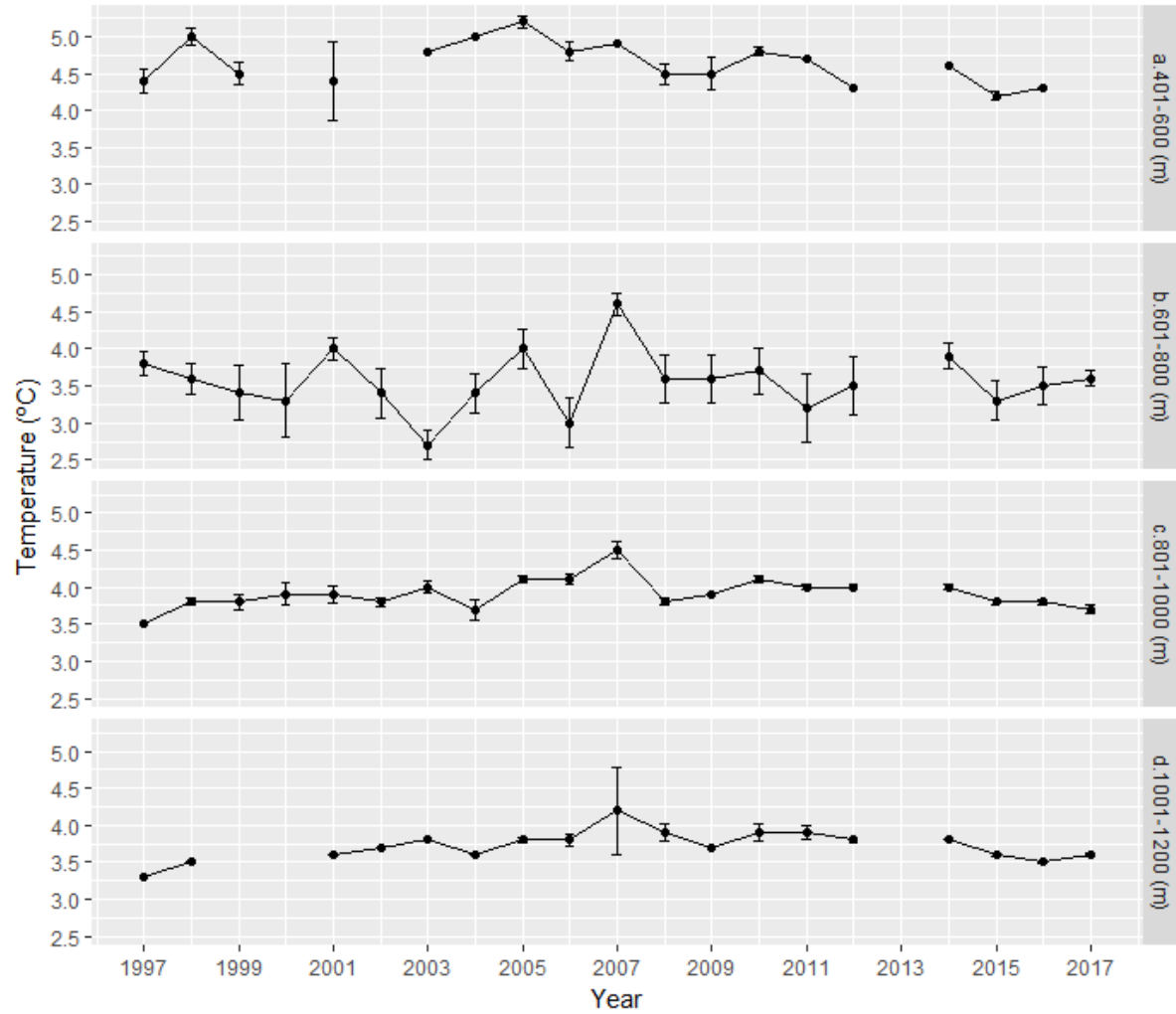


Fig. 19. Mean temperatures with S.E. in NAFO division 1C by depth and stratum for the period 1997-2017.

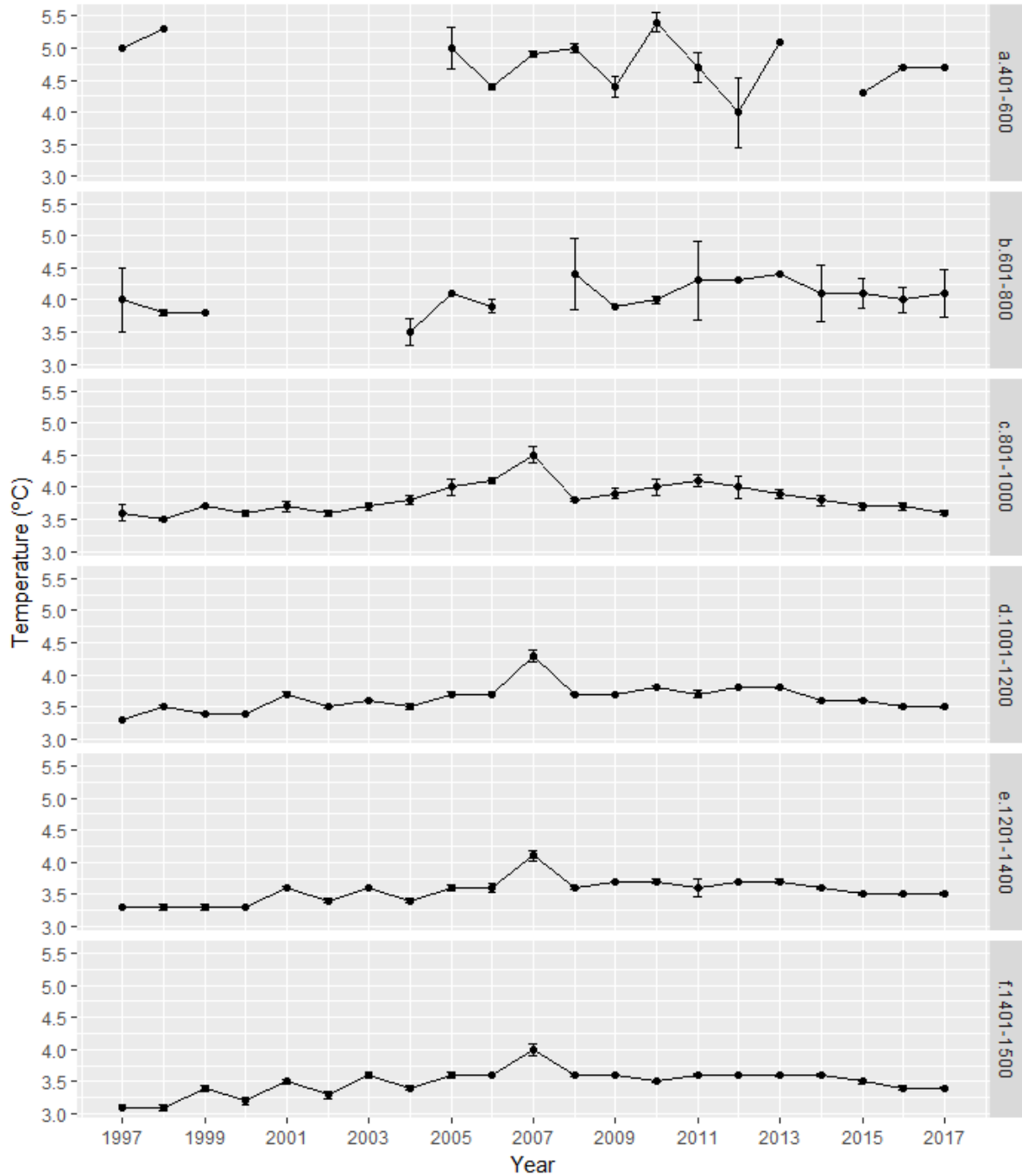


Fig. 20. Mean temperatures with S.E. in NAFO division 1D by depth and stratum for the period 1997-2017.

Appendix 1. Catch weight and numbers (not standardized to kg/km²) of Greenland halibut, roundnose and roughhead grenadier and deep-sea redfish, by haul, in 2017. Depth in meters, swept area in km² and bottom temperature in °C.

St. No	Swept Area	Division	Depth	Bottom Temp.	Greenland halibut (<i>Reinhardtius hippoglossoides</i>)		Roundnose grenadier (<i>Coryphaenoides rupestris</i>)		Rounghead greanadier (<i>Macrourus berglax</i>)		Deepwater redfish (<i>Sebastes mentella</i>)	
					Weight (kg)	Number	Weight (kg)	Number	Weight (kg)	Number	Weight (kg)	Number
1	0.0858	539.5 1D	4.7	7.4	3	33.6	170.9	5	10	500.9	908	
3	0.0864	658 1D	4.5	17.4	7	5.5	40	4.4	7	524.1	930.3	
4	0.092	1028.5 1D	3.6	57.3	36	0	1	3.7	12	9.9	15	
7	0.0872	634.5 1C	3.4	72.7	59	0	0	2.6	5	3	9	
9	0.0884	628.5 1C	3.8	64.7	60	0	0	4.8	9	2.3	7	
10	0.0912	684.5 1C	3.3	51.3	53	0	0	8.5	10	1.6	5	
11	0.0832	750 1C	3.7	166.7	160	0.5	9	0.3	3	1.9	4	
12	0.0866	801.5 1C	3.7	106.1	90	0.4	6	2.7	7	0.4	1	
14	0.0935	866 1C	3.6	146.8	112	0.7	5	0.3	2	1.4	3	
15	0.0944	686 1C	3.8	126.8	111	0.1	1	0.8	6	2.5	6	
18	0.0342	819 1C	4	54.8	42	0.1	1	0.1	1	0	0	
19	0.0943	794 1C	3.9	83.9	66	0	0	0	0	0	0	
20	0.0886	828 1C	3.8	242.6	187	0	0	0.5	4	0	0	
24	0.0971	870 1C	3.8	236.4	169	0.6	4	0.6	3	0.3	1	
28	0.0789	934.5 1C	3.6	191.4	146	0.1	1	1.2	5	0	0	
30	0.0808	987 1C	3.7	347.1	279	0.6	2	2	7	0	0	
31	0.0839	1040 1C	3.6	268.4	186	0.1	1	7.6	3	0	0	
33	0.0804	1049.5 1C	3.6	197.9	154	0.5	4	1.4	9	0	0	
34	0.0437	1073 1D	3.5	102.8	74	0.2	2	0.5	4	0	0	
36	0.0799	1129.5 1D	3.5	294.4	206	1	4	2.8	10	0	0	
37	0.0915	985 1D	3.6	158.2	98	0	2	2.1	9	0	0	
38	0.0746	769.5 1D	3.7	127	81	0.1	3	1.8	6	1.1	2	
39	0.085	1045.5 1D	3.6	195.3	142	0.6	5	2.7	7	0	0	
41	0.0602	962 1D	3.5	73.7	57	0.3	4	0.5	3	0	0	
42	0.0816	1169.5 1D	3.5	189.4	143	0.3	3	6.5	14	0	0	
44	0.0826	1080 1D	3.5	112.7	77	0.5	3	2.7	5	0	0	
46	0.0812	1092.5 1D	3.5	432.8	326	1.2	6	2.5	6	0	0	
47	0.0708	1165.5 1D	3.5	236	182	0	0	3.7	9	0	0	
49	0.0849	944.5 1D	3.6	71.7	47	0.5	2	0.5	1	0	0	
50	0.086	966.5 1D	3.6	154.3	121	0.4	1	1.2	2	0	0	
54	0.0789	1217 1D	3.6	73.7	57	0.1	1	3	10	0	0	
56	0.0852	1334 1D	3.5	129.3	95	1.3	5	9.8	17	0.2	1	
57	0.0815	1260.5 1D	3.4	265.8	220	0	0	1.5	3	0	0	
59	0.0893	1459.5 1D	3.4	88.1	74	0	0	1.9	3	0	0	
60	0.0477	1476.5 1D	3.4	133.7	91	0.1	1	0.2	1	0	0	
62	0.0792	1350.5 1D	3.4	69.7	33	1	1	2.3	7	0	0	
64	0.0763	1355.5 1D	3.4	75.3	55	2	5	3.7	11	0.4	1	
65	0.0784	1264 1D	3.5	112.3	92	0.5	1	0.5	1	0	0	
68	0.0805	1189 1D	3.5	76	52	0.5	5	8.6	16	0	0	
72	0.0814	1420 1D	3.4	68.6	46	0.9	2	9.2	11	0	0	
74	0.0504	1240 1D	3.5	39.1	26	0.7	2	0.3	1	0	0	
75	0.0761	1147 1D	3.4	104.7	76	0.8	3	1.8	3	0	0	
79	0.0769	1129.5 1D	3.6	96.5	68	0.6	4	0.8	3	0	0	
83	0.0406	1367.5 1D	3.5	50.2	32	0.9	1	0	0	0	0	
86	0.035	1306 1D	3.6	109	76	0.5	1	2.5	5	0	0	
87	0.0559	1295.5 1D	3.5	111.2	81	0.4	4	2.6	4	0.3	1	
89	0.0443	1416 1D	3.4	20.2	13	0.8	4	0.5	1	0	0	
92	0.0442	1063 1D	3.5	125.8	78	0	0	2.4	5	0	0	
93	0.0443	1142.5 1D	3.5	95.3	66	0.7	4	3	4	0	0	
95	0.0388	1087.5 1D	3.5	167	97	0.5	2	0.5	3	0	0	
97	0.0405	1138 1D	3.6	73.8	55	1	6	0	0	0	0	
99	0.0433	1102.5 1D	3.5	124.1	91	1.5	3	3	4	0	0	
101	0.0373	449.5 1D	4.7	7.2	8	0.3	1	0.9	4	3.3	5	

Appendix 2. List of species and groups of species recorded in NAFO Division 1CD in 2017 with observed maximum catch weight (kg), maximum per tow, minimum and maximum depth (m), minimum and maximum bottom temperature (°C) and most northern observation, respectively.

Obs	code	species	max. Weight(kg)	max. Number	min. Depth(m)	max. Depth(m)	min. Bottom temp.	max. Bottom temp.	max. NorthPosition
1	ALA	Alepocephalus agassizii	4	11	1088	1476	3.6	3.4	63.7349
2	ALB	Alepocephalus bairdii	4.7	15	658	658	4.5	4.5	64.1567
3	CAD	Anarhichas denticulatus	22.1	3	540	1296	4.7	3.4	65.325
4	CAS	Anarhichas minor	2.1	1	450	450	4.7	4.7	63.482
5	ANC	Anoplogaster cornuta	0.1	1	966	1217	3.6	3.6	64.0372
6	ANT	Antimora rostrata	19.6	39	686	1476	3.8	3.4	65.325
7	ARZ	Arctozenius rissoi	0.1	1	1080	1080	3.5	3.5	63.7708
8	ARS	Argentina silus	25.2	65	540	540	4.7	4.7	64.213
9	BAM	Bajacalifornia megalops	0.2	1	1166	1416	3.5	3.4	63.8603
10	BAT	Bathylagus euryops	20.2	105	628	1476	4	3.3	65.4505
11	BEG	Benthoosema glaciale	0.1	28	628	1476	4.5	3.3	65.4505
12	BOA	Borostomias antarcticus	0.3	5	686	1476	3.8	3.4	64.9537
13	USK	Brosme brosme	1.5	1	658	658	4.5	4.5	64.1567
14	CFB	Centroscyllium fabricii	10.9	7	628	1334	4.5	3.3	65.4505
15	CHO	Ceratias holboellii	0.9	1	628	1260	3.8	3.4	65.232
16	CHA	Chauliodus sloani	0.1	2	628	1460	3.8	3.4	65.232
17	CHH	Chiasmodon harteli	0.1	1	966	1073	3.6	3.5	64.1848
18	CHN	Chiasmodon niger	0.1	3	794	1460	3.9	3.4	64.72
19	CGR	Coryphaenoides guentheri	1.2	9	1088	1476	3.6	3.4	63.7978
20	RNG	Coryphaenoides rupestris	33.6	171	450	1476	4.7	3.4	65.325
21	LUM	Cyclopterus lumpus	0.9	1	1189	1476	3.5	3.4	63.7349
22	CLM	Cyclothone microdon	0	6	770	1416	3.9	3.4	64.72
23	XXX	Deleted Species	3.9	0	684	684	3.3	3.3	65.4505
24	EPR	Eumesogrammus praecisus	0.1	1	1063	1063	3.5	3.5	63.3153
25	EUR	Eurypharynx pelecyanoides	0	1	1166	1166	3.5	3.5	63.8603
26	COD	Gadus morhua	8.7	17	450	684	4.7	3.3	65.4505
27	ONA	Gaidropsarus argentatus	0	1	628	628	3.8	3.8	65.232
28	ONN	Gaidropsarus ensis	2.5	3	628	1476	3.8	3.4	65.2996
29	GOF	Gonatus fabricii	0.2	1	966	966	3.6	3.6	64.0372
30	GOB	Gonostoma bathyphilum	0.1	2	684	1356	3.5	3.3	65.4505
31	PLA	Hippoglossoides platessoides	6.5	27	450	686	4.7	3.3	65.4505
32	HOA	Holtbyrnia anormala	0.2	2	987	1476	3.7	3.4	64.5153
33	HMC	Holtbyrnia macrops	0.1	1	1217	1217	3.6	3.6	63.8366
34	HAF	Hydrolagus affinis	17.1	2	1368	1420	3.5	3.4	63.3269
35	LAS	Lampadena speculigera	0	1	802	802	3.7	3.7	65.2167
36	LMC	Lampanyctus macdonaldi	1.5	95	628	1476	4	3.3	65.4505
37	LSP	Lampanyctus sp.	0.5	35	658	1306	4.5	3.6	65.325
38	LEP	Lepidion eques	28	2	658	1063	4.5	3.5	64.3274
39	LIF	Liparis fabricii	0.1	3	628	750	3.8	3.3	65.4505
40	LPA	Lycodes paamiuti	0.2	1	1028	1028	3.6	3.6	64.1936
41	RHG	Macrourus berglax	9.8	17	450	1476	4.7	3.3	65.4505
42	MAL	Malacosteus niger	0.1	1	1170	1460	3.6	3.4	63.8366
43	CAP	Mallotus villosus	0	1	628	628	3.8	3.8	65.232
44	BLI	Molva dipterygius	2.3	1	658	658	4.5	4.5	64.1567
45	LIN	Molva molva	2.6	1	540	540	4.7	4.7	64.213
46	MYP	Myctophum punctatum	0	1	934	1476	3.6	3.4	64.7344
47	NEM	Nemichthys scolopaceus	0	1	686	686	3.8	3.8	64.895
48	NZB	Nezumia bairdii	0.2	1	540	540	4.7	4.7	64.213
49	NOT	Notacanthus chemnitzii	3.9	4	686	1476	3.9	3.4	65.325
50	NOK	Notoscopelus kroeyeri	0	3	819	1476	4	3.4	64.6848
51	PAC	Paraliparis copei	0	1	1264	1264	3.5	3.5	63.6075
52	PAG	Paraliparis garmani	0	2	628	870	3.8	3.8	65.232
53	POL	Polyacanthonotus rissoanus	0.5	2	985	1476	3.6	3.4	64.0799
54	RFL	Raja fyllae	0.8	1	1130	1130	3.6	3.6	63.4342
55	RHB	Raja hyperborea	10.6	1	1476	1476	3.4	3.4	63.6836
56	RRD	Raja radiata	0.1	1	634	634	3.4	3.4	65.2996
57	GHL	Reinhardtius hippoglossoides	432.8	326	450	1476	4.7	3.3	65.4505
58	ROM	Rouleina maderensis	0.1	1	1217	1217	3.6	3.6	63.8366
59	SCO	Scopelosaurus lepidus	2	14	770	1476	4	3.4	65.2167
60	REG	Sebastes marinus	11.5	7	540	540	4.7	4.7	64.213
61	REB	Sebastes mentella	524.1	930	450	1356	4.7	3.3	65.4505
62	SER	Serrivomer beani	0.5	3	628	1476	3.8	3.4	65.325
63	REJ	Shrimp	0.8	0	450	1476	4.7	3.3	65.4505
64	STO	Stomias boa	0	2	686	1476	3.8	3.4	64.9537
65	SYN	Synapobranchus kaupii	1.5	8	540	1476	4.7	3.3	65.4505
66	TRA	Trachyrhynchus murrayi	0.5	2	962	1170	3.6	3.5	64.0799
67	XEC	Xenodermichthys copei	0	1	1240	1240	3.5	3.5	63.5479