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Survey for Greenland Halibut in NAFO Divisions 1A-1D, 2001

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Abstract

In 1997 Greenland initiated a survey series covering NAFO Div. 1CD at depths between 400 and 1 500 m. The survey is designed as a Stratified Random Bottom Trawl Survey aimed mainly at Greenland halibut and roundnose grenadier. In 2001 the survey area was expanded to include NAFO Div. 1A and 1B. The paper gives biomass and abundance estimates and length frequencies for Greenland halibut, roundnose and roughed grenadier and deep-sea redfish, together with age and maturity data for Greenland halibut. The biomass of Greenland halibut was estimated as 140 000 tons of which 77 600 tons was found in Div. 1CD, compared to 59 000 tons in 2000. The biomass of roundnose grenadier was estimated as only 1 600 tons.

Introduction

During the period 1987-1995 Japan Marine Fishery Resources Research Center (JAMARC) and Greenland Institute of Natural Resources jointly conducted 12 bottom trawl surveys (Jørgensen, 1998a) and 4 pelagic surveys (Jørgensen, 1997a) at West Greenland as part of a joint venture agreement on fisheries development and fisheries research in Greenland waters. The bottom trawl surveys were primarily aimed 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 PAAMIUT, which had been rigged for deep sea trawling. There has unfortunately not been any comparative trawlings between the Japanese research vessel SHINKAI MARU and PAAMIUT making comparisons between the surveys difficult. During the period 1997-2000 the surveys covered NAFO Div. 1CD, but in 2001 the survey area was expanded to include Div. 1A (to 74°N) and Div. 1B.

Materials and Methods

The survey in 2001 was divided in two. Div. 1A and the northern part of Div. 1B was covered during 28/9-11/10, while the survey in the southern part of Div. 1B and Div. 1CD took place during 1/11-15/11.

Stratification

The survey covered NAFO Div. 1A (74°N) – Div. 1D between the 3-nm line and the 200-nm line or the midline to Canada. The area between 70°N and 74°N (Div. 1AN) was covered at depths between 1 and 1 500 m and was stratified in four depth strata 1-200, 201-500, 501-1 000 and 1 001-1 500 m, because existing maps (Grønlands Vestkyst map 1000) did not allow for a more detailed stratification. The area between 66°15'N and 70°N was stratified in the NAFO areas 1AS (68°50N-70°N) and 1B (66°15'N-68°50'N) and further subdivided in 7 depth strata: 201-400, 401-600, 601-800, 801-1 000, 1 001-1 200, 1 201-1 400 and 1 401-1 500 m. Div. 1C and 1D was subdivided in the same depth strata but without the strata 201-400 m. The depth stratification in Div. 1AS-1D 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" (Table 1).

The surveys were planned as a Stratified Random Bottom Trawl Survey with in total 140 stations in Div. 1AN-1B and 70 hauls in 1C. Basically hauls were allocated proportional to stratum area, but in Div. 1AN-1B more effort was put in depth strata expected to be potential nursery areas for Greenland halibut or contain larger Greenland halibut. Hence only 5 hauls were allocated to stratum 1-200 in 1AN and none in Div. 1AS-1B. Analysis of previous years surveys in Div. 1CD showed that Div. 1C depth stratum 601-800 m traditionally had been oversampled, while depth stratum 1 001-1 200 m and 1 201-1 400 m in Div. 1D had been undersampled. More hauls were, hence, allocated to the two latter strata, than their area justified, in order to reduce the variance of the estimated biomass and abundance of Greenland halibut. The positions of the hauls were selected at random within each stratum.

Vessel and gear

The survey was 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 was of the rock hopper type. The trawl doors were Greenland Perfect (370×250 cm) weighing 2 400 kg mounted with extra 20 kg. Further information about trawl and gear is given in Jørgensen, 1998b. A Furuno net sonde mounted on the head rope measured net height. Scanmar sensors measured the distance between the trawl doors. Wingspread, taken as the distance between the outer bobbins, was calculated as:

distance between outer bobbins=10.122 + distance between trawl doors × 0.142

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

In a few cases the distance between otter boards could not be measured at depths >800 m because of defect Scanmar sounders. The distance between otterbords were then estimated form a linear regression based on pervious hauls at depth >800 m at both West- and East Greenland: Distance between otter boards = 114.4 + fishing depth (m) ×0.01.

Trawling procedure

Towing time was usually 30 min, but towing times down to 15 min were accepted. Average towing speed was 3.0 kn. Towing speed was estimated from the start and end positions of the haul, or in a few cases based on GPS observations (mean of records made every 5 min. during the haul). Trawling took place day and night.

Near-bottom temperatures were measured, by 0.1^{o}C, by a Seamon sensor mounted on a trawl door.

Handling of the catch

After each haul the catch was sorted by species and weighed to nearest 0.1 kg and the number of specimens recorded. Most fish species were sexed and measured as total length (TL) to 1.0 cm below. Grenadiers were measured as pre anal fin length (AFL) to 0.5 cm below. In case of large catches subsamples of the catch were measured. Subsamples always comprised of at least 200 specimens.

Biomass and abundance estimates were obtained by applying the swept area method (estimated trawling speed * estimated bobbin spread*trawling time) taking the catchability coefficient as 1.0. All catches were standardised to 1 km$^{?}$ swept prior to further calculations

Otoliths for age determination of Greenland halibut (n = 1 011) were soaked in water and read in transparent light. Age distributions were estimated using age/length keys and survey length frequencies pooled in 3-cm groups.

Results and Discussion

In total 121 successful hauls were made, giving a mean coverage of the surveyed area on 15 607 km^2 per haul (Table 1). The number of tows was reduced compared to the 210 planned mainly due to problems in finding suitable trawling ground in eastern and northern part of Div. 1AN, where the bottom was very soft and muddy, and bad weather during the second part of the survey (Div. 1BCD). Two strata: Div. 1D 401-600 (903 km^2) and 601-800 m

(1 940 km^2) were not covered at all. Haul by haul information on catches, position, depth, temperature etc. is given in Appendix 1.

In total 115 species or groups of species were recorded (Appendix 2).

The calculation of the survey area in Div. 1AN is based on rather inaccurate charts and hence the estimated biomasses and abundances most be considered with caution.

Greenland halibut (*Reinhardtius hippoglossoides*)

Greenland halibut was caught in all strata except stratum 1-200 m in Div. 1A. The total biomass in Div. 1AN-1D was estimated at 140 439.2 tons (S.E. 14 408.1) (Fig. 1, Table 2). The highest densities (4.1 tons km^{-2}) was found in Div. 1D at 801-1 000 m, but high densities were also seen in Div. 1AS at the same depth.

The biomass of Greenland halibut in Div. 1C-1D, was estimated at 77 554.0 tons (S.E. 13 013.5) which is an increase from 59 092.4 tons in 2000 but not statistically different (95% level) from the estimates from 1997-2000 (Jørgensen, 2001; Jørgensen, 2000; Jørgensen, 1999; Jørgensen, 1998b).

Biomass of Greenland halibut in Div. 1CD.

Year	1997	1998	1999	2000	2001
Biomass	56 260.2	70 473.5	64 398.0	59 092.4	77 554.0
S.E.	4 399.6	8 391.7	6 912.1	5 543.3	13 013.6

Two strata which traditionally yield biomasses <1 000 ton were not covered in 2001.

The abundance in Div. 1A-1D was estimated at 2.354×10^8 (S.E. 2.373×10^7), with the highest concentration in Div. 1AS 801-1 000 m (6 423.8 km^{-2}) (Table 3).

The abundance in Div. 1CD was estimated at 80.814×10^6 which is an increase, however statistically in significant (95% level), compared to the estimates from 1997-2000.

Abundance of Greenland halibut in Div. 1CD.

Year	1997	1998	1999	2000	2001
Abundance	53.613×10^6	67.677×10^6	61.366×10^6	61.710×10^6	80.814×10^6
S.E.	4.118×10^6	7.687×10^6	6.265×10^6	5.976×10^6	14.221×10^2

The two strata that were not covered usually yield abundances less than 1×10^6 individuals. The highest concentration in Div. 1CD was found at 801-1 000 m in Div. 1D (Table 3). Estimated abundance by age in Div. 1CD is given in Table 4.

The increase in biomass and abundance was seen in most depth strata but most pronounced in Div. 1D at depths between 801 and 1 200 m. The increase included several year-classes indicating, that at least extend, that some of the increase was caused by changed catchability in the survey.

The length ranged from 6 cm (larvae) to 105 cm. Generally the length distributions in the different depth strata were dominated by a single mode. Generally fish size increased with depth and from north to south at the same depth (Fig. 2) as seen in previous surveys (Jørgensen, 1997b). The overall length distribution (weighted by stratum area) for Div.1AN-1B was dominated of several modes at 15, 25, 30, 36 and 42 cm, while the distribution in 1CD was totally dominated by a mode at 45 cm (Fig. 3).

The age ranged from 0 to 20 years with the youngest fish in shallow water in Div. 1AB and the oldest fish in deep water in Div. 1D (Fig. 4). Generally the age increased by depth and here the age composition was dominated by ages 5-7. The overall age distribution (weighted by stratum area) in Div. 1CD was monomodal with a mode around age 6 (Fig. 5). Mean weight and length at age is given in Table 5.

Females stated maturing at age 7 and 50 % of the females were mature at age 10 and 100% maturity was reached at age 16 (Table 6) as seen in previous years.

Roundnose grenadier (*Coryphaenoides rupestris*)

Besides two observations from 1AN and 1B all roundnose grenadier were caught in Div. 1CD, but the catches were low (Fig. 6, Appendix 1).

The biomass of roundnose grenadier in Div. 1C-1D, was estimated at 1 577.2 tons (S.E. 516.4) which is the lowest estimate in the present survey series and very low compared to the late-1980s (Jørgensen, 2001; Jørgensen, 2000, Jørgensen, 1999; Jørgensen, 1998a; 1998b).

Biomass of roundnose grenadier in Div. 1CD.

Year	1997	1998	1999	2000	2001
Biomass	5 686.5	7 263.3	2 771.8	5 593.7	1 577.2
S.E.	926.4	2 530.2	445.5	2 616.8	516.4

Most of the biomass was found in Div. 1D at 1201-1500 m, which also had the highest density (Table 7).

The abundance in Div. 1C-1D was estimated at 24.698×10^6 (S.E. 8.797×10^6), which is about 25% of the estimate in 2000, but decrease was statistically insignificant (95% level) because of the very high variance on the estimate from 2000 (Table 8)

Abundance of roundnose grenadier in Div. 1CD.

Year	1997	1998	1999	2000	2001
Abundance	32.441×10^6	75.243×10^6	29.100×10^6	99.524×10^6	24.698×10^6
S.E.	7.056×10^6	27.357×10^6	8.963×10^6	67.311×10^6	8.797×10^6

Pre anal fin length ranged from 2 to cm 20 cm. Fish size increased generally with increasing depth (Fig. 7). The overall length distribution (weighted by stratum area) was totally dominated by a broad mode at 4-7 cm (Fig.8).

Roughhead grenadier (*Macrourus berglax*)

The total biomass of roughhead grenadier was estimated at 5026.1 tons (S.E. 471.0) and the catches were low (Fig. 9, Appendix 1). Most of the biomass was found in Div. 1C-1D where it was estimated at 4 576.6 tons (S.E. 456.3) which is a decrease compared to 2000, but at the same level as in the previous years.

Biomass of roughhead grenadier in Div. 1CD.

Year	1997	1998	1999	2000	2001
Biomass	2 258.6	4 314.1	5 166.2	7 178.1	4 576.6
S.E.	250.1	377.9	854.1	2 226.5	456.3

The biomass is probably slightly underestimated due to the lack of coverage the two shallow strata, but the biomass at shallow water is usually low. Most of the biomass was found at deep water in Div. 1D where also the highest densities were observed (Table 9).

The total abundance was estimated at 15.636×10^6 (S.E. 1.585×10^6), but most of the abundance was found in Div 1CD where it was estimated at 13.867×10 (S.E. 1.549×10^6), which is a decrease compared to 2000, but at the same level as in 1998-1999 (Table 10).

Abundance of roughhead grenadier in Div. 1CD.

Year	1997	1998	1999	2000	2001
Abundance	4.60×10^6	11.623×10^6	14.074×10^6	20.282×10^6	13.867×10^6
S.E.	0.45×10^6	1.008×10^6	2.040×10^6	7.182×10^6	1.549×10^6

Pre anal fin length ranged from 1 to cm 35 cm. The smaller fish were generally found in the in Div. 1AB (Fig. 10).

Deep-sea redfish (*Sebastes mentella*)

The total biomass of Deep-sea redfish was estimated at 4 005.1 tons (S.E. 1004.1) and most of the biomass was found at 201-800 m in Div. 1BC. Appendix 1, Table 11, Fig. 11). The biomass in Div. 1CD was estimated at 2 063.4 tons (S.E. 873.5), which is at the same level as in previous years.

Year	1997	1998	1999	2000[1)]	2001
Biomass	2 464.3	2 408.1	2 484.9		2 063.4
S.E.	787.1	503.9	1 007.7		873.5

1). Poor coverage of relevant depths in 2000.

The total abundance was estimated at 43.720×10^6 (S.E. 9.239×10^6) of which about 2/3 was found at 201-600 m in Div. 1B and 401-600 in Div. 1C. The abundance in Div. 1CD was estimated at 16.337×10^6 (S.E. 6.474×10^6), which is at the same level as seen in previous years (Table 12).

Year	1997	1998	1999	2000[1)]	2001
Abundance	14.690×10^6	18.827×10^6	12.926×10^6		16.337×10^6
S.E.	5.500×10^6	4.496×10^6	4.093×10^6		6.474×10^6

1). Poor coverage of relevant depths in 2000.

The overall length distribution ranged from 5 to 48 cm. In Div. 1AB several modes at 7, 11 and 17 cm, while the length distribution in Div. 1CD was dominated of modes at 18 and 22 cm (Fig. 12).

Temperature

In Div. 1AN the mean bottom temperature increased from 0.7 °C at 1-200 to 2.5°C at 201-500 m to decrease again by depth. In all other Divisions the temperature was declining by depth, most pronounced in Div. 1AS and Div. 1B (Table 13).

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Table 1. Area (sq. km) of depth strata by NAFO Division and number of stations planned ( ) and conducted.

Division

1AN	Depth	0-200	201-500		501-1000		1001-1500			
	Area	11227	46098		27334		6167			90826
	Stations	3 (5)	10 (36)		20 (30)		8 (20)			41 (91)
1AS	Depth	1-200	201-400	401-600	601-800	801-1000	1001-1200	1201-1400	1401-1500	
	Area	8523	13562	1370	828	919	1441	1092	516	28251
	Stations		3 (7)	2 (3)	2 (3)	3 (3)	2 (3)	3(3)	2(2)	17 (24)
1B	Depth	0-200	200-400	400-600	600-800	800-1000	1000-1200	1200-1400	1400-1500	
	Area	23815	19052	5376	3716	671	63			52693
	Stations		7 (8)	6 (6)	5 (6)	3 (5)				21 (25)
Total										
	Area									171770
	Stations									79 (140)
1C	Depth	1-200	201-400	401-600	601-800	801-1000	1001-1200	1201-1400	1401-1500	
	Area			3366	16120	6066	611			26163
	Stations			3 (4)	7 (12)	3 (8)	2 (2)			15 (26)
1D	Depth	1-200	201-400	401-600	601-800	801-1000	1001-1200	1201-1400	1401-1500	
	Area			903	1940	3874	10140	6195	3091	26143
	Stations			0 (2)	0 (3)	2 (5)	12 (18)	10 (12)	3 (4)	27 (44)
Total										
	Area									52306
	Stations									42 (70)

Table 2. Biomass (tons) of Greenland halibut by Division and depth stratum, 2001.

Division	Depth (m)	Area	Hauls	Mean sq/km	Biomass	SE
1AN	001-200	11227	3	0	0	0
	200-500	46098	10	0.1535	7078.3	3084
	501-1000	27334	20	1.0264	28054.5	4647.8
	1001-1500	6167	8	0.8953	5521.5	690.1
1AS	201-400	13562	3	0.0352	477.7	247.7
	401-600	1370	2	0.2759	384.7	312.9
	601-800	828	2	1.9374	1604.2	898
	801-1000	919	3	3.5576	3269.5	648
	1001-1200	1441	2	1.9215	2768.9	897.8
	1201-1400	1092	3	1.0255	1119.8	243.9
	1401-1500	516	2	0.399	205.9	86.4
1B	201-400	19052	7	0.0617	1175.1	405.1
	401-600	5376	6	0.6546	3519.1	869.9
	601-800	3716	5	1.6404	6095.8	1810.9
	801-1000	671	3	2.3998	1610.3	430
1C	401-600	3366	3	0.1558	524.4	401.5
	601-800	16120	7	0.4727	7620	1720.3
	801-1000	6066	3	1.6995	10309	6015.5
	1001-1200	611	2	2.2132	1352.2	177.8
1D	801-1000	3874	2	4.0953	15865.1	10841.4
	1001-1200	10140	12	2.1203	21499.9	2570.3
	1201-1400	6195	10	2.3584	14610.6	1565.7
	1401-1500	3091	3	1.8676	5772.7	1849.6
All		188832	121	0.744	140439.2	14408.1

Table 3. Abundance of Greenland halibut by Division and depth stratum, 2001

Division	Depth (m)	Area	Hauls	Mean sq/km	Abundance	SE
1AN	001-200	11227	3	0	0.00E+00	0.00E+00
	200-500	46098	10	877.3	4.04E+07	1.31E+07
	501-1000	27334	20	2148.9	5.87E+07	1.24E+07
	1001-1500	6167	8	877.1	5.41E+06	6.90E+05
1AS	201-400	13562	3	424.7	5.76E+06	2.72E+06
	401-600	1370	2	936.6	1.30E+06	4.64E+05
	601-800	828	2	4057.9	3.36E+06	1.51E+06
	801-1000	919	3	6423.8	5.90E+06	1.08E+06
	1001-1200	1441	2	2690.7	3.88E+06	1.62E+06
	1201-1400	1092	3	1067.5	1.17E+06	3.48E+05
	1401-1500	516	2	337.7	1.74E+05	7.99E+04
1B	201-400	19052	7	312.9	5.96E+06	1.08E+06
	401-600	5376	6	1697.3	9.12E+06	2.55E+06
	601-800	3716	5	3051.7	1.13E+07	3.69E+06
	801-1000	671	3	3075.6	2.06E+06	3.60E+05
1C	401-600	3366	3	257.5	8.67E+05	6.11E+05
	601-800	16120	7	643.3	1.04E+07	2.56E+06
	801-1000	6066	3	2180	1.32E+07	7.76E+06
	1001-1200	611	2	2143.7	1.31E+06	1.48E+05
1D	801-1000	3874	2	4464.1	1.73E+07	1.10E+07
	1001-1200	10140	12	1979.8	2.01E+07	2.83E+06
	1201-1400	6195	10	2081.2	1.29E+07	1.59E+06
	1401-1500	3091	3	1546.9	4.78E+06	2.06E+06
All		188832	121	1246.8	2.35E+08	2.37E+07

Table 4. Estimated abundance by age from Div. 1C-1D from the surveys in 1997-2001. The Age-length key from 1998 is applied on the 1997 data.

AGE	1997	1998	1999	2000	2001
1	0	0	0	78826	15585
2	536130	609093	184098	109496	281013
3	1704893	3722237	920490	479059	511722
4	3023773	4662948	4172888	3074341	4835796
5	9961295	14760362	11291344	15090231	20601616
6	15370847	19057854	15893794	16838191	26595603
7	13558728	14083592	19759852	14711646	17922784
8	5436358	5766084	4786548	5026106	4674899
9	1200931	1515966	859124	3214208	2550178
10	948950	1211419	920490	1040152	780082
11	584382	764751	613660	717770	705656
12	466433	527881	675026	350292	369836
13	187646	351921	429562	318336	345397
14	96503	155657	429562	122157	195607
15	262704	236870	184098	230208	225277
16	187646	115051	61366	128242	91540
17	64336	128586	61366	95352	80275
18	16084	0	61366	57045	22628
19	0	0	0	27474	32325
20	0	0	0	0	8081
SUM	53607639	67670271	61304634	61709132	80845900

Table 5. Mean weight and mean length-at-age of Greenland halibut, 2000-1995.

	2001		2000		1999		1998		1997		1996		1995	
AGE	weight	length	weight	length	weight	length	weight	length	weight	length	weight	length	weight	length
1	27.92	14.44	25.00	13.50										
2	85.44	21.00	75.00	21.00	64.00	21.00	38.22	18.70	23.33	15.33			50.00	20.00
3	173.33	26.71	145.83	26.25	206.07	27.43	175.50	28.50	58.18	19.82	175.00	30.50	140.00	27.00
4	366.39	34.19	329.25	33.60	342.12	34.38	347.50	35.27	136.96	26.13	378.26	36.35	339.43	35.09
5	574.43	39.73	527.97	39.46	570.71	40.29	551.38	40.94	271.82	32.82	555.56	41.22	495.53	40.13
6	848.72	44.90	764.39	44.49	793.40	45.57	854.15	46.77	443.93	38.04	794.10	45.72	691.59	45.00
7	1158.57	49.86	1073.54	49.75	1195.50	51.41	1218.13	51.94	736.89	43.87	1055.95	49.90	986.56	49.82
8	1540.51	54.76	1375.59	53.65	1665.37	57.89	1572.34	56.81	1070.18	49.85	1447.01	55.34	1360.00	54.51
9	1843.63	57.98	1630.83	56.83	2057.06	61.06	2074.80	60.56	1453.73	55.61	2092.16	61.45	1816.98	59.63
10	2258.89	61.80	2076.77	61.45	2440.69	64.14	2293.45	63.10	2042.90	61.23	2740.63	65.84	2163.50	62.70
11	3316.20	65.04	2502.50	63.86	2812.08	66.88	2866.55	66.48	2814.55	66.68	3241.67	68.43	2679.63	66.30
12	3449.64	68.68	3014.44	67.50	4000.12	72.87	3453.21	69.89	3827.69	72.58	4100.21	72.98	3248.64	69.91
13	3866.43	71.25	3612.35	70.41	5678.64	79.50	4537.50	74.70	4840.00	77.29	4994.00	76.43	4133.57	73.36
14	5256.67	77.80	3892.50	72.75	7613.16	86.68	5112.00	77.60	6679.44	84.00	5946.67	80.56	5685.56	79.78
15	6323.50	81.90	5409.00	78.30	8476.67	91.20	7140.59	85.06	7711.11	87.78	7523.68	86.76	6631.05	83.63
16	7203.33	86.00	6873.33	85.50	9925.00	88.50	8385.00	88.87	9166.00	94.60	8663.04	89.93	7533.00	89.00
17	8954.00	92.40	8492.00	91.80			10684.00	95.40	10796.67	97.83	9208.33	91.94	10413.64	94.64
18	8760.00	93.00	8590.00	92.25	12500.00	99.00					10127.27	95.27	11180.00	97.00
19	11500.00	102.00	9645.00	91.50			12850.00	99.00			11168.18	98.45	11566.67	98.33
20	14400.00	105.00									11100.00	95.00	11326.67	100.33
21											11250.00	98.33	13100.00	103.50
22													13700.00	104.00
24													15300.00	115.00

Table 6. Maturity-at-age in percent, females, Div. 1C-1D, 2001.

	Immature	Maturing	
Age	Pct	Pct	N
2	100		1
3	100		3
4	100		11
5	100		17
6	100		26
7	95.45	4.55	22
8	91.67	8.33	12
9	84.62	15.38	13
10	46.67	53.33	15
11	41.18	58.82	17
12	30.77	69.23	13
13	35.71	64.29	14
14	14.29	85.71	7
15	10	90	10
16		100	6
17		100	5
18		100	4
19		100	2

Table 7. Biomass of (tons) roundnose grenadier by Division and depth stratum, 2001.

Division	Depth (m)	Area	Hauls	Mean sq/km	Biomass	SE
1AN	001-200	11227	3	0	0	0
	200-500	46098	10	0	0	0
	501-1000	27334	20	0.0001	1.4	1.4
	1001-1500	6167	8	0	0	0
1AS	201-400	13562	3	0	0	0
	401-600	1370	2	0	0	0
	601-800	828	2	0	0	0
	801-1000	919	3	0	0	0
	1001-1200	1441	2	0	0	0
	1201-1400	1092	3	0	0	0
	1401-1500	516	2	0	0	0
1B	201-400	19052	7	0	0	0
	401-600	5376	6	0	0	0
	601-800	3716	5	0.0011	4.2	4.2
	801-1000	671	3	0	0	0
1C	401-600	3366	3	0	0	0
	601-800	16120	7	0.0015	24.7	16.4
	801-1000	6066	3	0.0479	290.8	270.3
	1001-1200	611	2	0.0083	5.1	0.5
1D	801-1000	3874	2	0.0057	22.2	2.6
	1001-1200	10140	12	0.019	193.1	51.3
	1201-1400	6195	10	0.0918	568.9	319.6
	1401-1500	3091	3	0.1528	472.4	297.5
All		188832	121	0.0084	1582.8	516.4

Table 8. Abundance of roundnose grenadier by Division and depth stratum, 2001.

Division	Depth (m)	Area	Hauls	Mean sq/km	Abundance	SE
1AN	001-200	11227	3	0	0.00E+00	0.00E+00
	200-500	46098	10	0	0.00E+00	0.00E+00
	501-1000	27334	20	1	2.87E+04	2.87E+04
	1001-1500	6167	8	0	0.00E+00	0.00E+00
1AS	201-400	13562	3	0	0.00E+00	0.00E+00
	401-600	1370	2	0	0.00E+00	0.00E+00
	601-800	828	2	0	0.00E+00	0.00E+00
	801-1000	919	3	0	0.00E+00	0.00E+00
	1001-1200	1441	2	6.1	8.82E+03	8.82E+03
	1201-1400	1092	3	0	0.00E+00	0.00E+00
	1401-1500	516	2	0	0.00E+00	0.00E+00
1B	201-400	19052	7	0	0.00E+00	0.00E+00
	401-600	5376	6	0	0.00E+00	0.00E+00
	601-800	3716	5	15.7	5.85E+04	5.85E+04
	801-1000	671	3	0	0.00E+00	0.00E+00
1C	401-600	3366	3	13	4.39E+04	4.39E+04
	601-800	16120	7	71.5	1.15E+06	7.31E+05
	801-1000	6066	3	1187.8	7.21E+06	6.72E+06
	1001-1200	611	2	179.8	1.10E+05	2.54E+04
1D	801-1000	3874	2	242.5	9.40E+05	5.47E+05
	1001-1200	10140	12	402.1	4.08E+06	1.16E+06
	1201-1400	6195	10	1483.5	9.19E+06	5.36E+06
	1401-1500	3091	3	640.3	1.98E+06	1.13E+06
All		188832	121	131.3	2.48E+07	8.80E+06

Table 9. Biomass (tons) of roughhead grenadier by Division and depth stratum, 2001.

Division	Depth (m)	Area	Hauls	Mean sq/km	Biomass	SE
1AN	001-200	11227	3	0.000	0.0	0.0
	200-500	46098	10	0.000	0.0	0.0
	501-1000	27334	20	0.007	178.9	51.2
	1001-1500	6167	8	0.022	132.7	95.9
1AS	201-400	13562	3	0.000	0.0	0.0
	401-600	1370	2	0.000	0.0	0.0
	601-800	828	2	0.010	8.0	5.2
	801-1000	919	3	0.029	26.3	11.0
	1001-1200	1441	2	0.019	26.8	5.0
	1201-1400	1092	3	0.000	0.0	0.0
	1401-1500	516	2	0.000	0.0	0.0
1B	201-400	19052	7	0.000	0.0	0.0
	401-600	5376	6	0.012	63.0	38.9
	601-800	3716	5	0.003	9.7	9.7
	801-1000	671	3	0.006	4.0	1.1
1C	401-600	3366	3	0.007	22.8	15.6
	601-800	16120	7	0.025	394.4	127.1
	801-1000	6066	3	0.038	231.9	134.6
	1001-1200	611	2	0.140	85.6	1.9
1D	801-1000	3874	2	0.152	588.5	353.3
	1001-1200	10140	12	0.136	1381.9	180.7
	1201-1400	6195	10	0.178	1103.6	123.7
	1401-1500	3091	3	0.248	767.9	31.1
All		188832	121	0.027	5026.0	471.0

Table 10. Abundance of roughhead grenadier by Division and depth stratum, 2001

Division	Depth (m)	Area	Hauls	Mean sq/km	Abundance	SE
1AN	001-200	11227	3	0	0.00E+00	0.00E+00
	200-500	46098	10	0	0.00E+00	0.00E+00
	501-1000	27334	20	44.1	1.20E+06	3.14E+05
	1001-1500	6167	8	15.6	9.61E+04	6.52E+04
1AS	201-400	13562	3	0	0.00E+00	0.00E+00
	401-600	1370	2	0	0.00E+00	0.00E+00
	601-800	828	2	89.8	7.43E+04	3.76E+04
	801-1000	919	3	139.8	1.28E+05	5.23E+04
	1001-1200	1441	2	62.4	9.00E+04	3.70E+04
	1201-1400	1092	3	0	0.00E+00	0.00E+00
	1401-1500	516	2	0	0.00E+00	0.00E+00
1B	201-400	19052	7	0	0.00E+00	0.00E+00
	401-600	5376	6	19.7	1.06E+05	6.05E+04
	601-800	3716	5	12.1	4.50E+04	3.41E+04
	801-1000	671	3	38.3	2.57E+04	4.58E+03
1C	401-600	3366	3	11	3.71E+04	1.98E+04
	601-800	16120	7	107.8	1.74E+06	4.40E+05
	801-1000	6066	3	302.3	1.83E+06	3.71E+05
	1001-1200	611	2	427.9	2.61E+05	1.48E+04
1D	801-1000	3874	2	523.6	2.03E+06	1.34E+06
	1001-1200	10140	12	400	4.06E+06	4.42E+05
	1201-1400	6195	10	358.7	2.22E+06	2.49E+05
	1401-1500	3091	3	547.2	1.69E+06	8.44E+04
All		188832	121	82.8	1.56E+07	1.58E+06

Table 11. Biomass (tons) of *S. mentella* by Division and depth stratum, 2001

Division	Depth (m)	Area	Hauls	Mean sq/km	Biomass	SE
1AN	001-200	11227	3	0	0	0
	200-500	46098	10	0.005	229.6	174.7
	501-1000	27334	20	0.0049	134.3	105.2
	1001-1500	6167	8	0	0	0
1AS	201-400	13562	3	0.003	40.7	15.8
	401-600	1370	2	0.0548	75	13.7
	601-800	828	2	0.0295	24.4	23.4
	801-1000	919	3	0	0	0
	1001-1200	1441	2	0	0	0
	1201-1400	1092	3	0	0	0
	1401-1500	516	2	0	0	0
1B	201-400	19052	7	0.0217	413.8	213.2
	401-600	5376	6	0.1781	957.7	394.1
	601-800	3716	5	0.0175	65	43.2
	801-1000	671	3	0.0018	1.2	1.2
1C	401-600	3366	3	0.3147	1059.4	449.7
	601-800	16120	7	0.0612	986.7	748.8
	801-1000	6066	3	0	0	0
	1001-1200	611	2	0	0	0
1D	801-1000	3874	2	0	0	0
	1001-1200	10140	12	0.001	10.2	5.9
	1201-1400	6195	10	0	0	0
	1401-1500	3091	3	0.0023	7.2	7.2
All		188832	121	0.021	4005.2	1004.1

Table 12. Abundance of *S. mentella* by Division and depth stratum, 2001.

Division	Depth (m)	Area	Hauls	Mean sq/km	Abundance	SE
1AN	001-200	11227	3	0	0.00E+00	0.00E+00
	200-500	46098	10	52.5	2.42E+06	1.65E+06
	501-1000	27334	20	43.3	1.18E+06	1.02E+06
	1001-1500	6167	8	0	0.00E+00	0.00E+00
1AS	201-400	13562	3	29	3.93E+05	1.28E+05
	401-600	1370	2	893.9	1.22E+06	7.26E+05
	601-800	828	2	216.9	1.80E+05	1.69E+05
	801-1000	919	3	0	0.00E+00	0.00E+00
	1001-1200	1441	2	0	0.00E+00	0.00E+00
	1201-1400	1092	3	0	0.00E+00	0.00E+00
	1401-1500	516	2	0	0.00E+00	0.00E+00
1B	201-400	19052	7	637.1	1.21E+07	5.13E+06
	401-600	5376	6	1778.2	9.56E+06	3.57E+06
	601-800	3716	5	75.9	2.82E+05	1.71E+05
	801-1000	671	3	4.4	2.98E+03	2.98E+03
1C	401-600	3366	3	3075.1	1.04E+07	4.60E+06
	601-800	16120	7	363	5.85E+06	4.55E+06
	801-1000	6066	3	0	0.00E+00	0.00E+00
	1001-1200	611	2	0	0.00E+00	0.00E+00
1D	801-1000	3874	2	12.7	4.93E+04	2.77E+02
	1001-1200	10140	12	4.7	4.73E+04	2.61E+04
	1201-1400	6195	10	1.6	9.64E+03	9.64E+03
	1401-1500	3091	3	9.3	2.87E+04	2.87E+04
All		188832	121	231.5	4.37E+07	9.24E+06

Table 13. Mean temperature, S.E and number of observations by NAFO Division and depth stratum.

Div-	Depth											
	1-201			201-500			501-1000			1001-1500		
	°C	SE	n	°C	SE	n	°C	SE	n	°C	SE	n
1AN	0.7	,38	3	2.5	.14	10	1.7	.10	20	0.3	.08	8

Div.	Depth																				
	201-400			401-600			601-800			801-1000			1001-1200			1201-1400			1401-1500		
	°C	SE	n	°C	SE	n	°C	SE	n	°C	SE	n	°C	SE	n	°C	SE	n	°C	SE	n
1AS	3.7	.19	3	3.3	.35	2	2.1	.55	2	1.4	.12	3	0.9	.10	2	0.4	.12	3	0.1	.00	2
1B	4.2	.24	7	3.9	.33	6	1.7	.13	5	1.1	.03	3									
1C				4.4	.76	3	4.0	.17	7	3.9	.12	3	3.6	.00	2						
1D										3.7	.05	2	3.7	.03	12	3.6	.03	10	3.5	.03	3

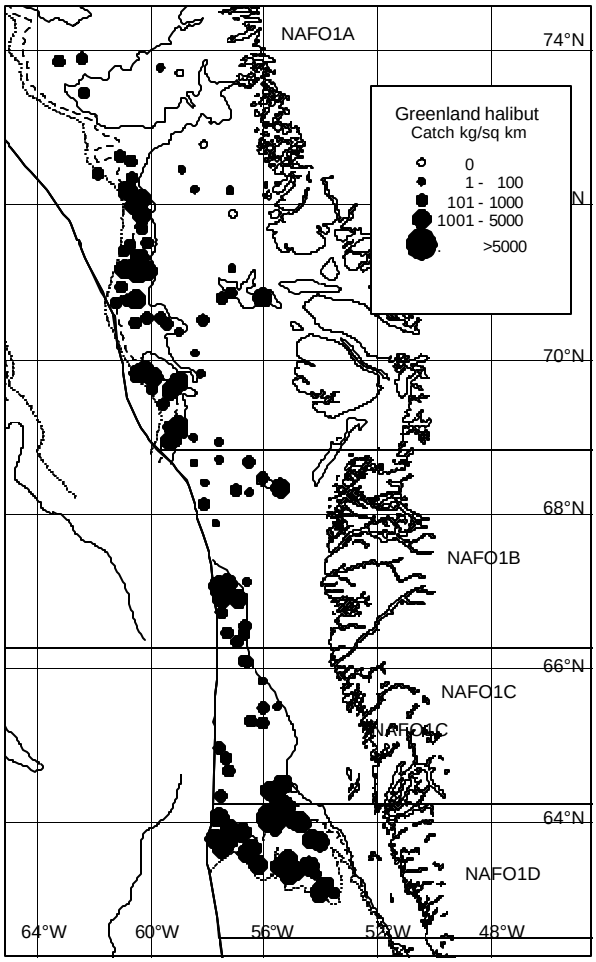

Fig 1. Distribution of catches of Greenland halibut in 2001 in kg km^{-2}

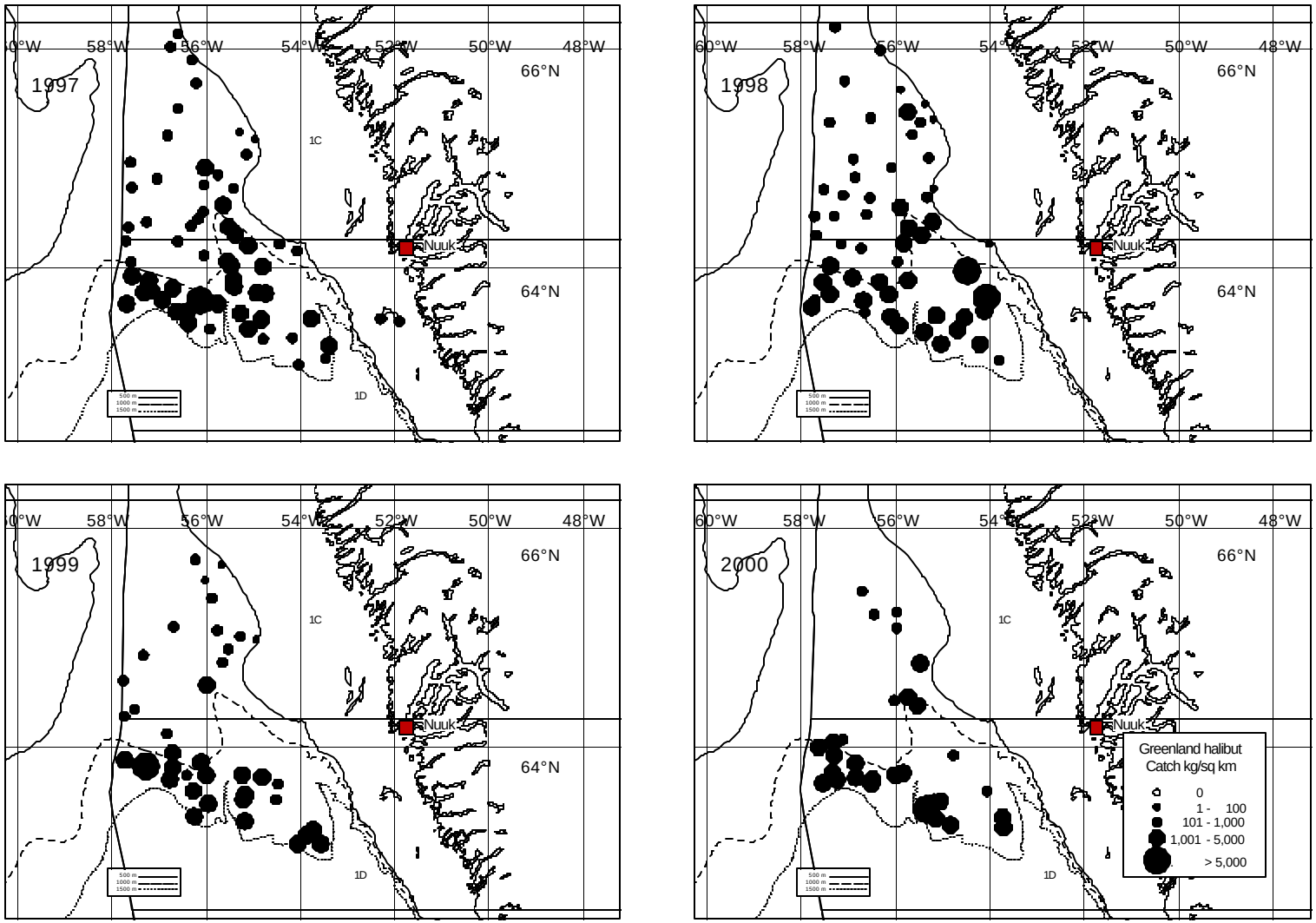

Fig. 1. cont. Distribution of catches of Greenland halibut during 1997-2000 in kg km^{-2}

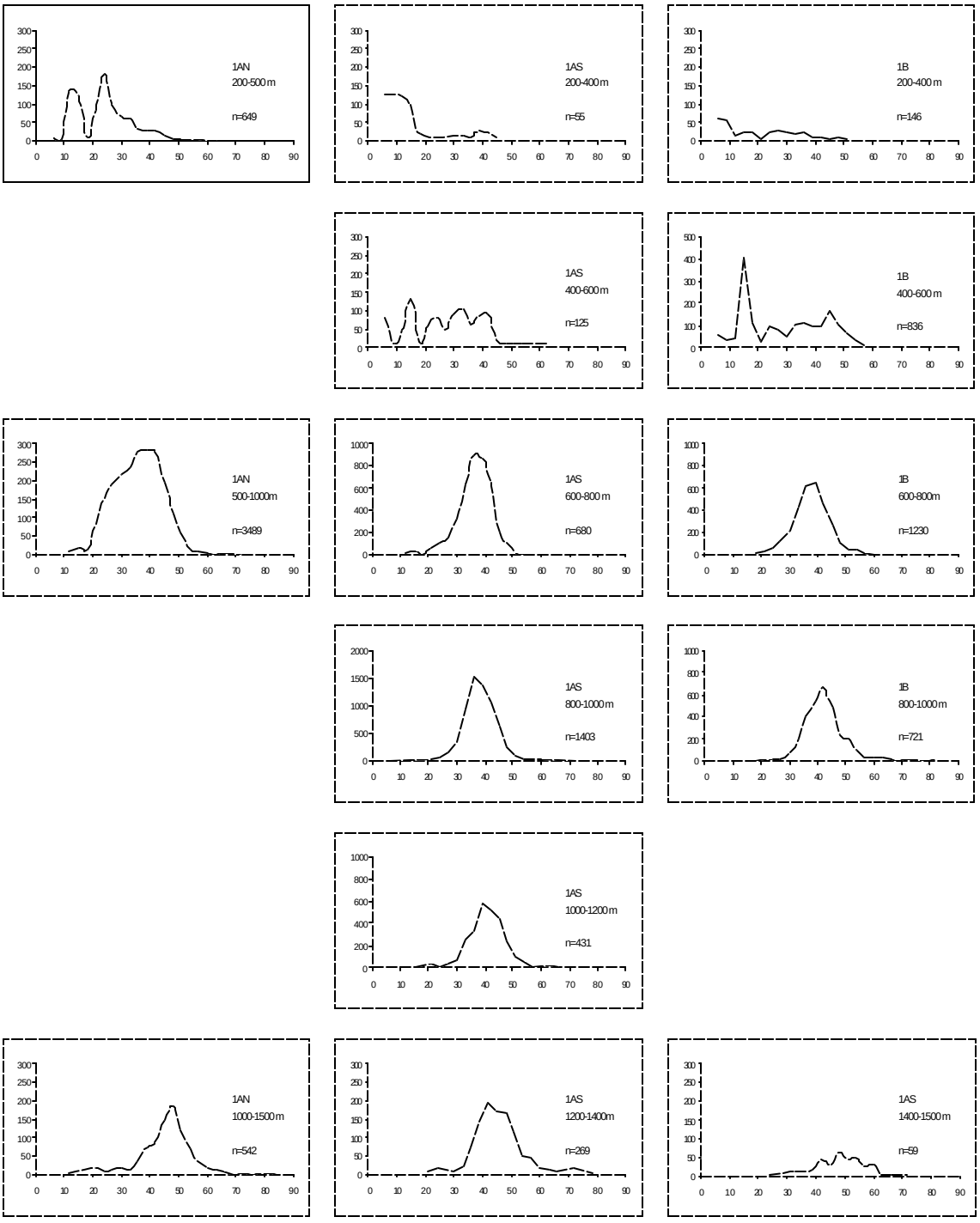

Fig. 2. Length distribution in numbers/km^2 of Greenland halibut (3 cm groups) by NAFO Division and depth stratum. Note different scales on y-axis and that 1AS depth stratum 1 401-1 500 is placed in the bottom right panel.

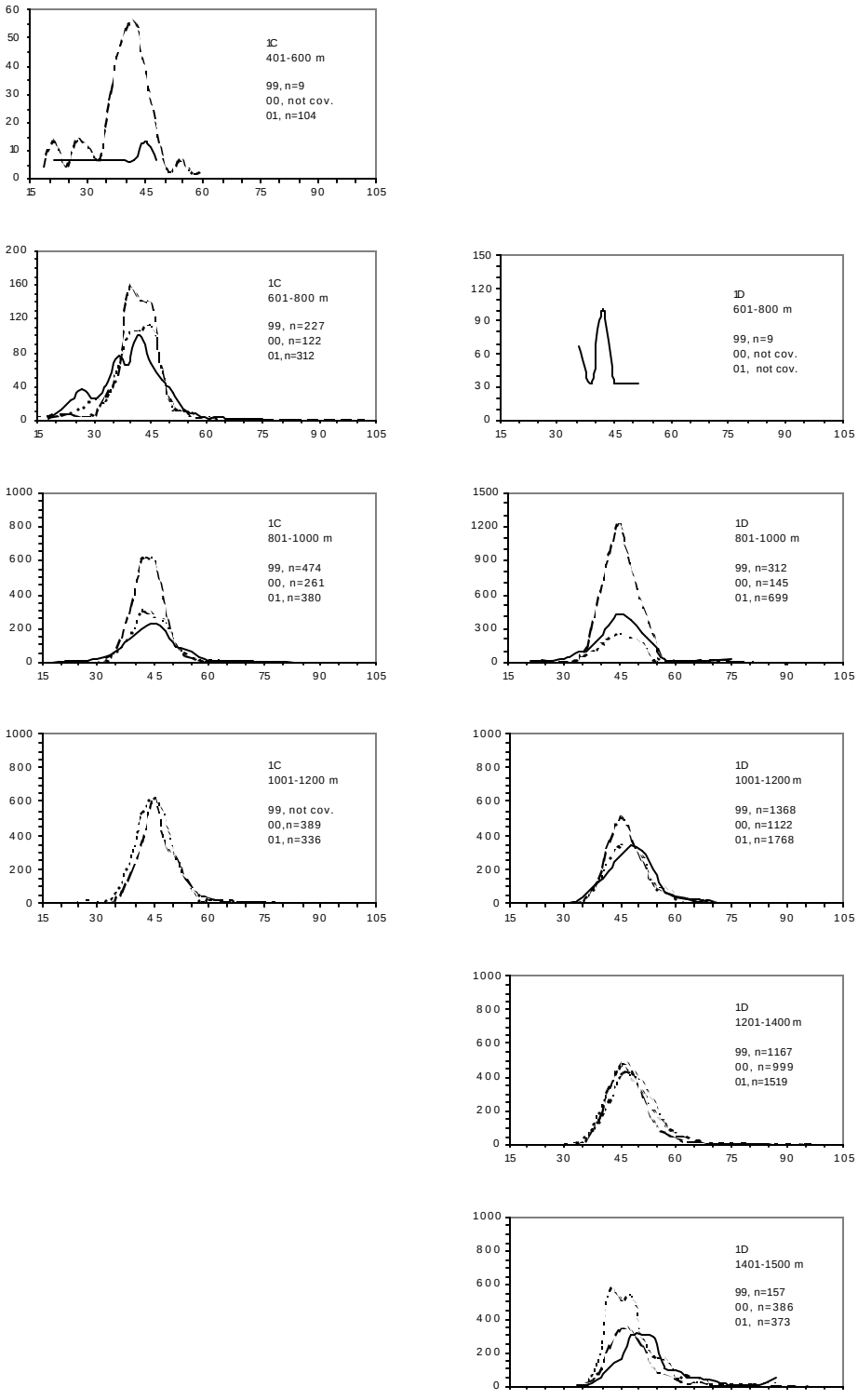

Fig. 2. cont. Length distribution in numbers/km^2 of Greenland halibut (3 cm groups) by year, NAFO Division and depth stratum. Note different scales on y-axis. 1999: Solid line. 2000: Dotted line 2001: Dashed line.

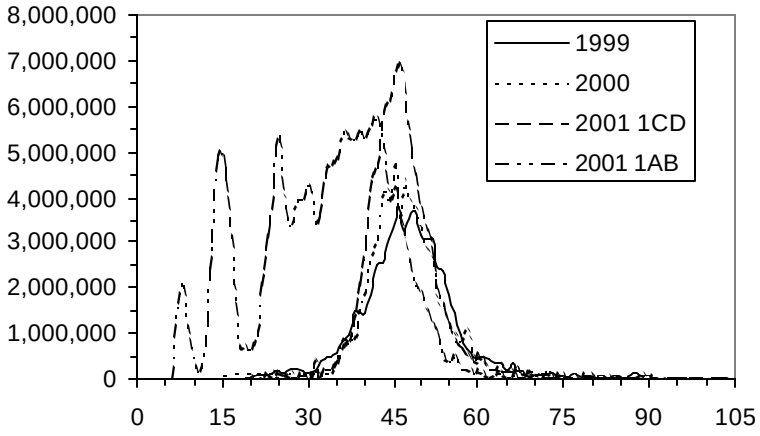

Fig. 3. Overall length distribution of Greenland halibut in numbers (weighted by stratum area) by year.

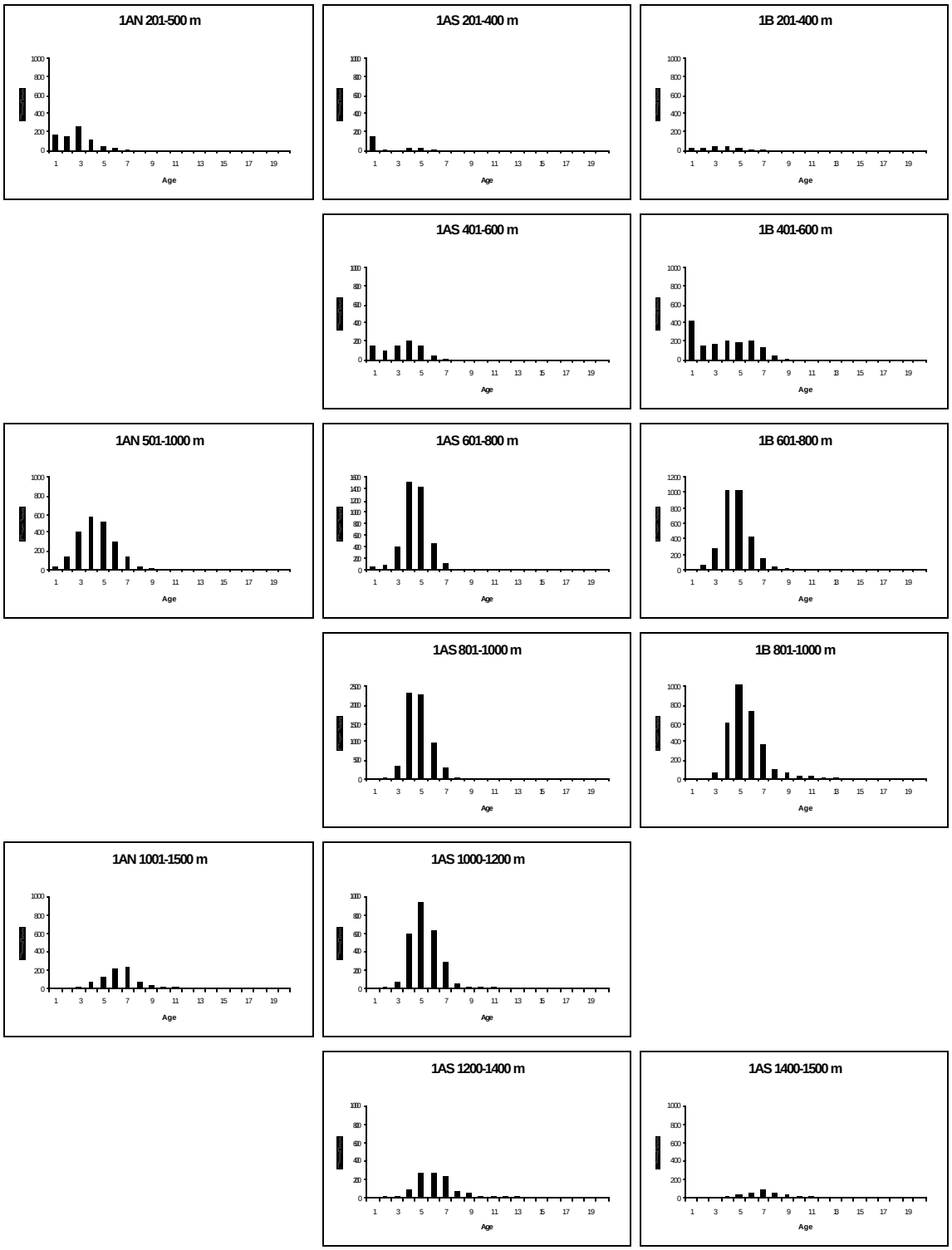

Fig. 4. Age distribution (number km^{-2}) by NAFO Division and depth stratum. Note different scales on y-axis and that 1AS depth stratum 1 401-1 500 is placed in the bottom right panel.

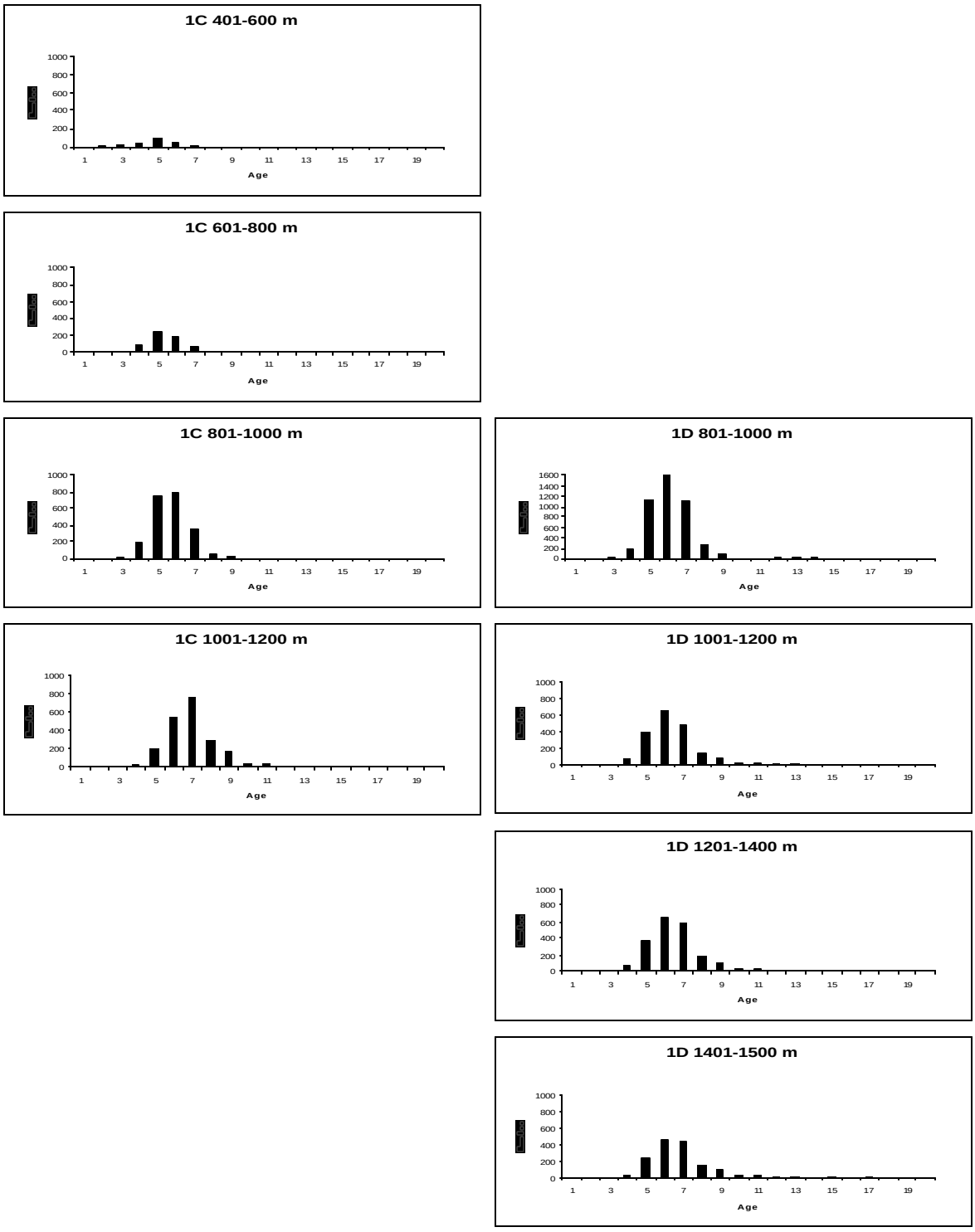

Fig 4. cont. Age distribution (number/km^2) by NAFO Division and depth stratum.

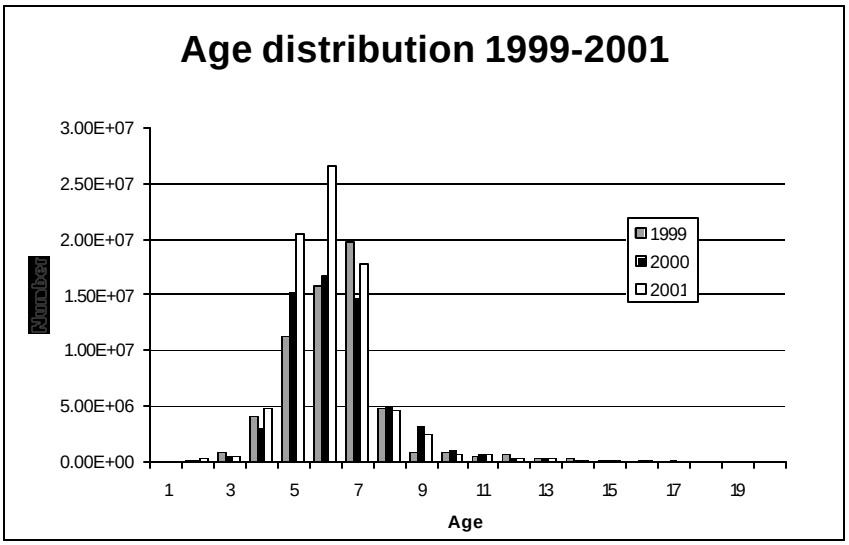

Fig. 5. Overall age distribution (weighted by stratum area) of Greenland halibut in NAFO Div. 1C-1D in 1999-2001.

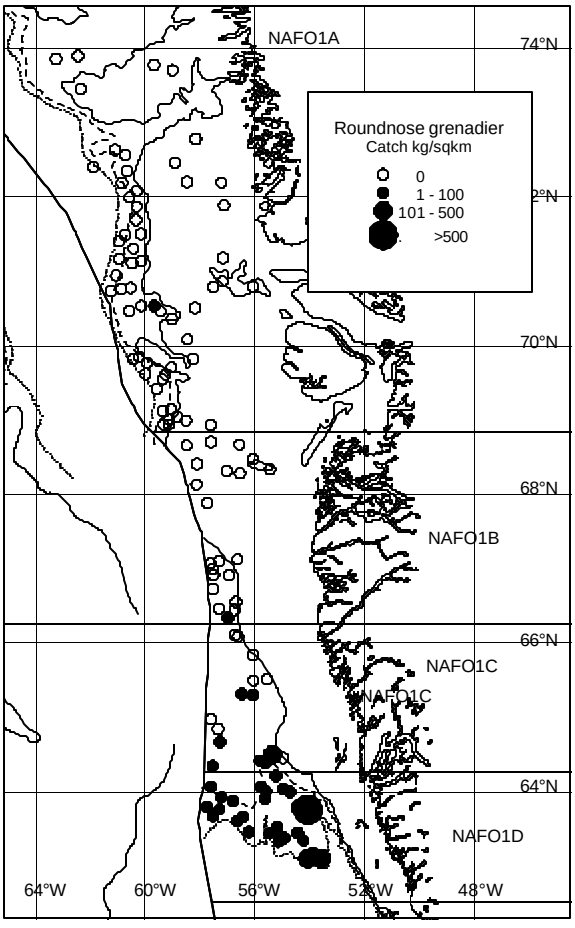

Fig. 6. Distribution of catches of roundnose grenadier in 2001 in kg km^{-2}.

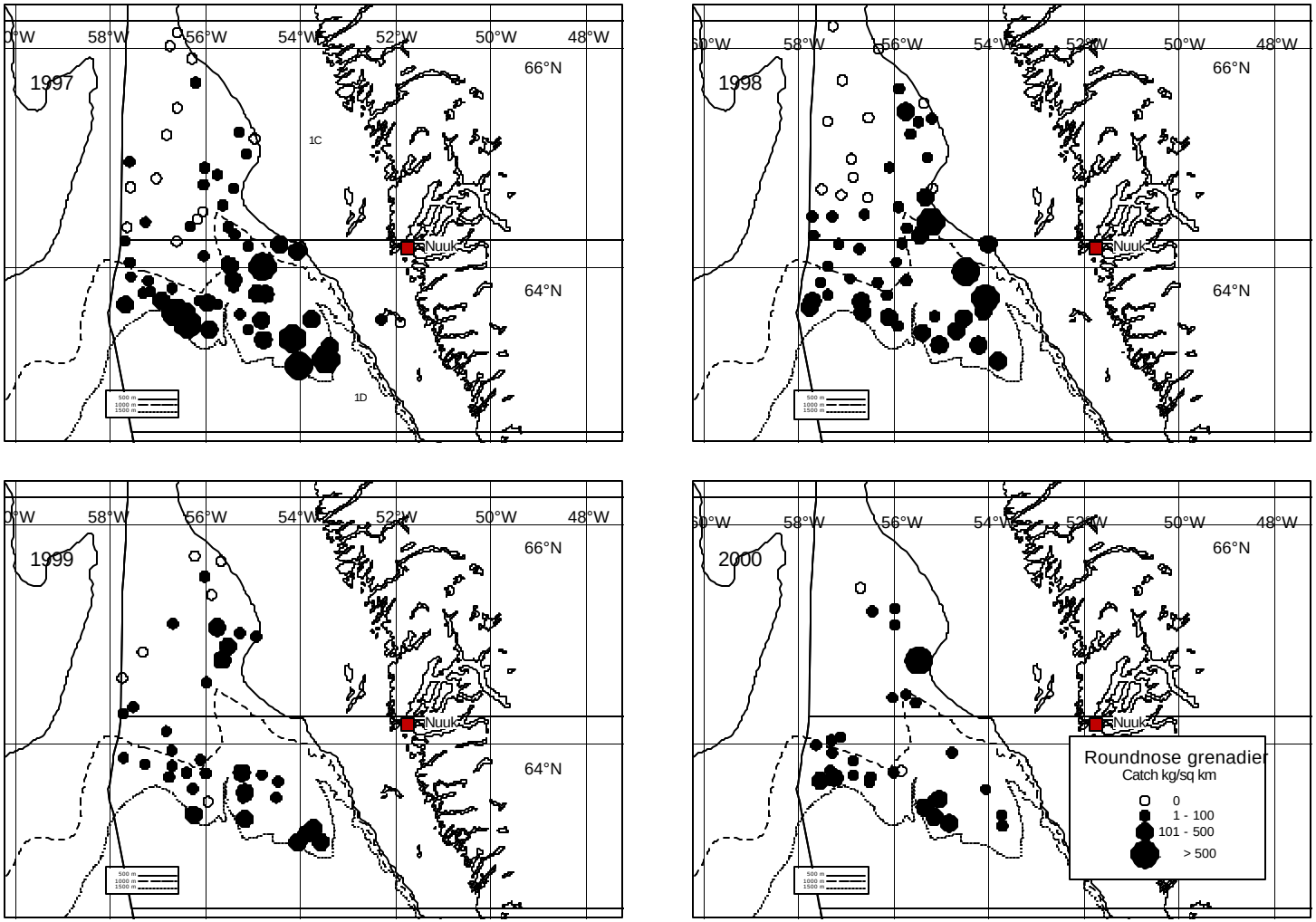

Fig. 6. cont. Distribution of catches of roundnose grenadier during 1997-2000.

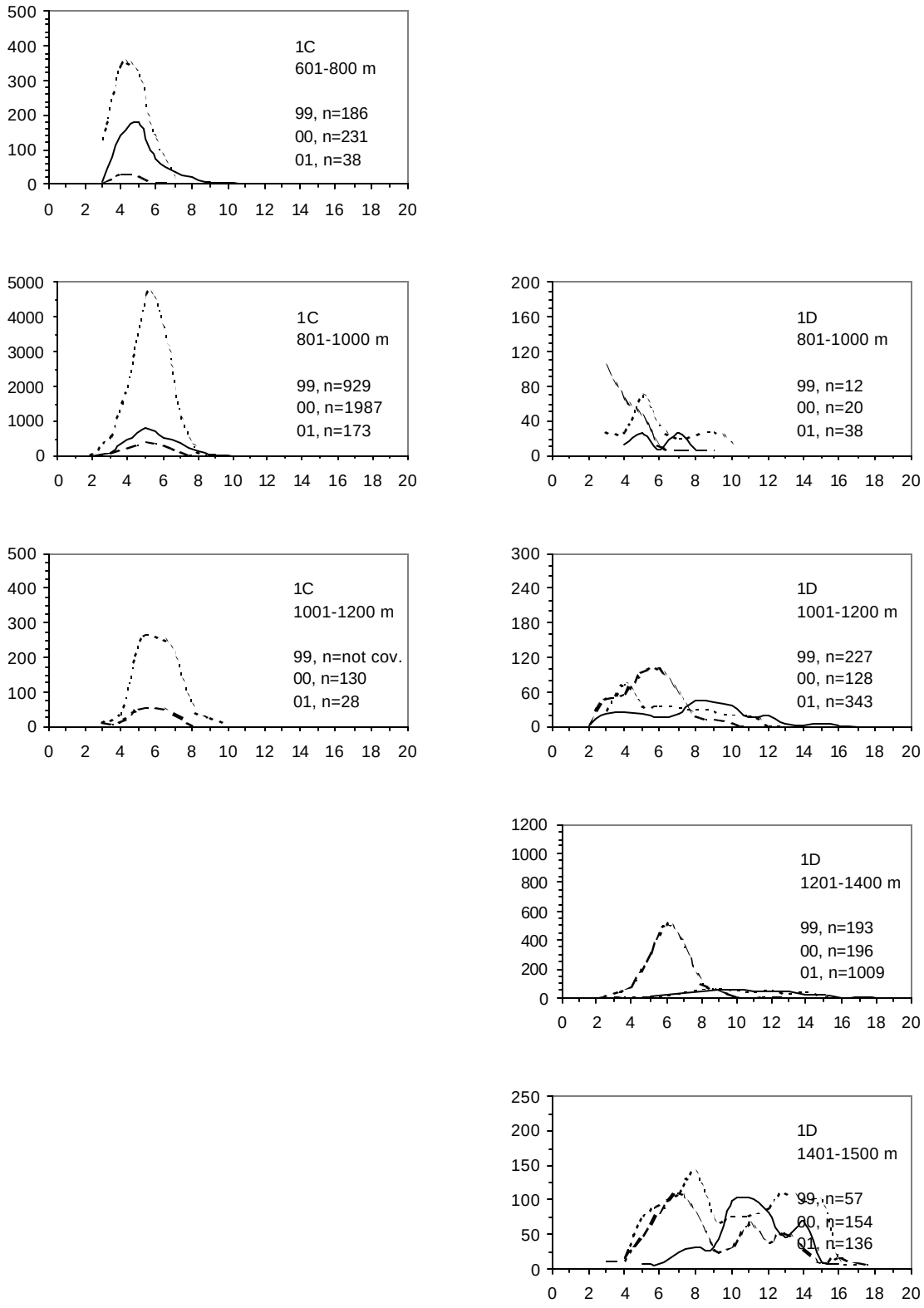

Fig. 7. Length distribution (pre anal fin length) of roundnose grenadier in numbers/km^2 by year and depth strata. Solid line: 1999. Dotted line: 2000. Dashed line: 2001.

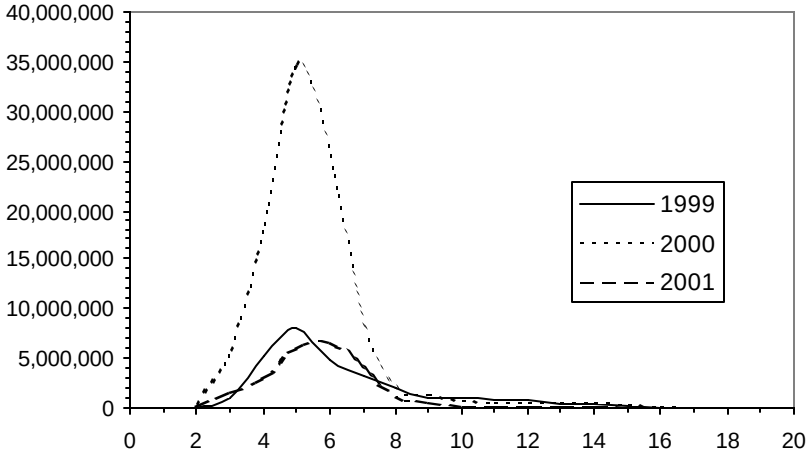

Fig. 8. Overall length distribution of roundnose grenadier (pre anal fin length) in numbers (weighted by stratum area) by year.

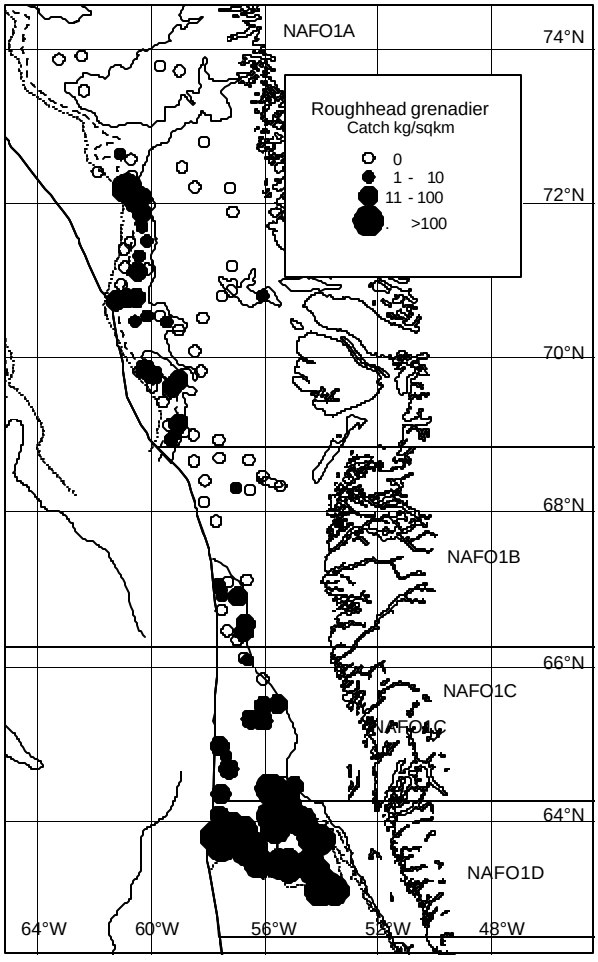

Fig. 9. Distribution of catches of roughhead grenadier in 2001 in kg km^{-2}.

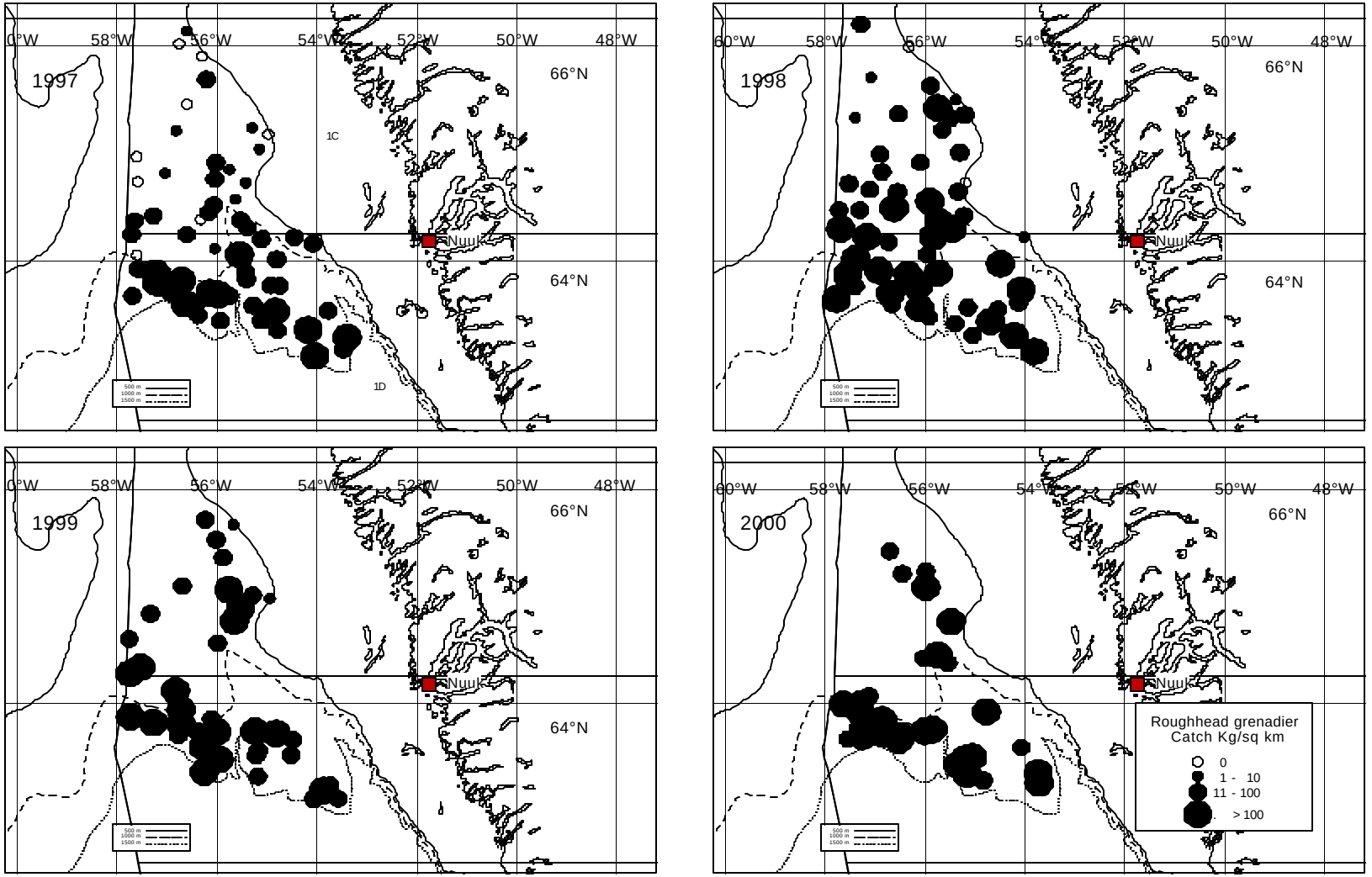

Fig. 9 cont.. Distribution of catches of roughhead grenadier during 1997-2000.

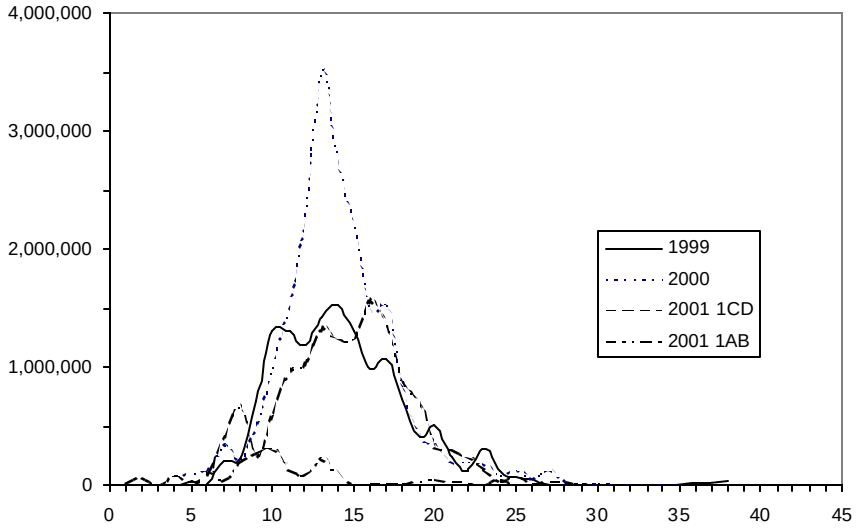

Fig. 10. Overall length distribution (pre anal fin length) of roughhead grenadier in numbers (weighted by stratum area) by year.

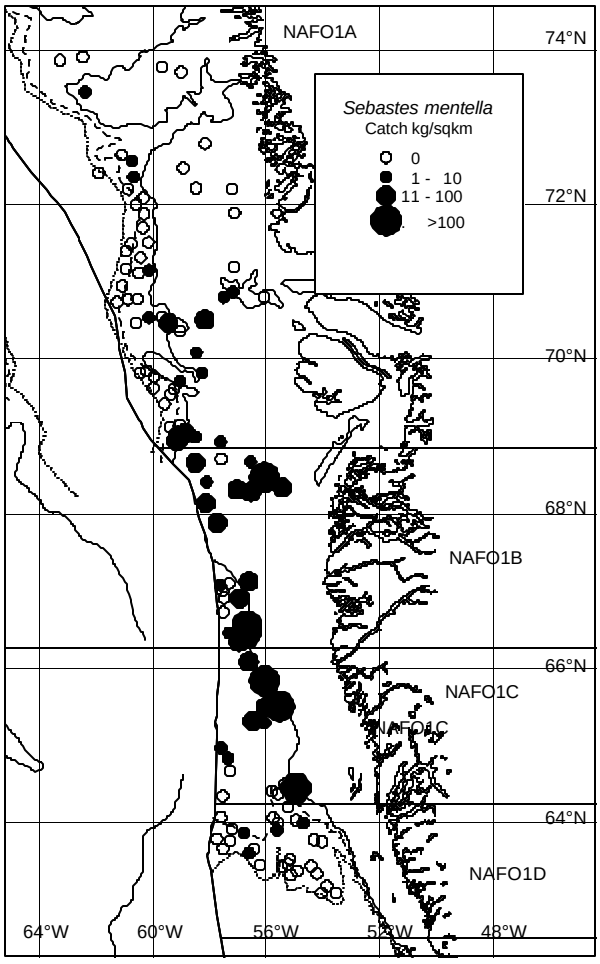

Fig. 11. Distribution of catches of *S. mentella* in 2001 in kg km^{-2}.

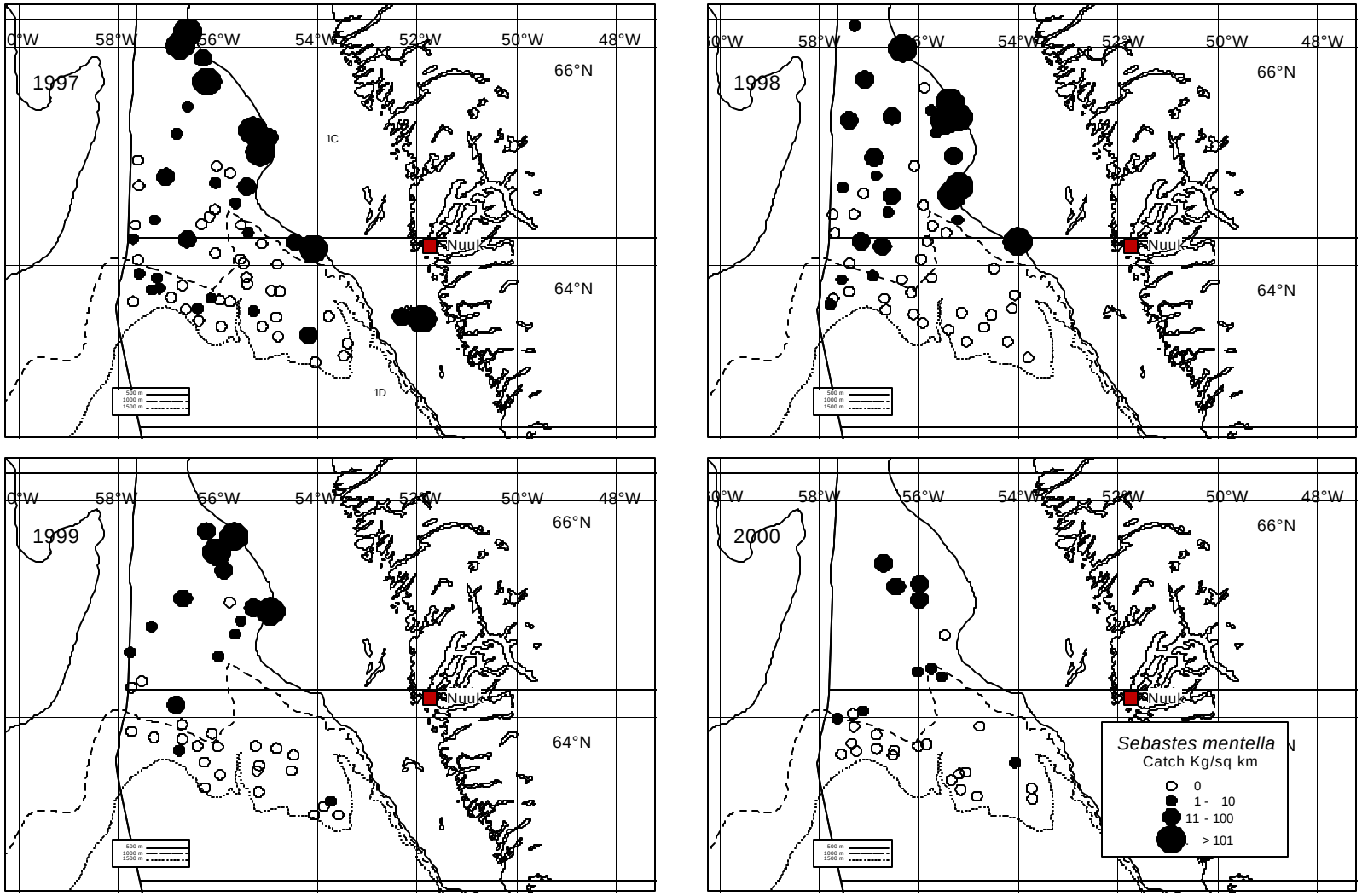

Fig. 11 cont. Distribution of catches of *Sebastes mentella* during 1997-2000.

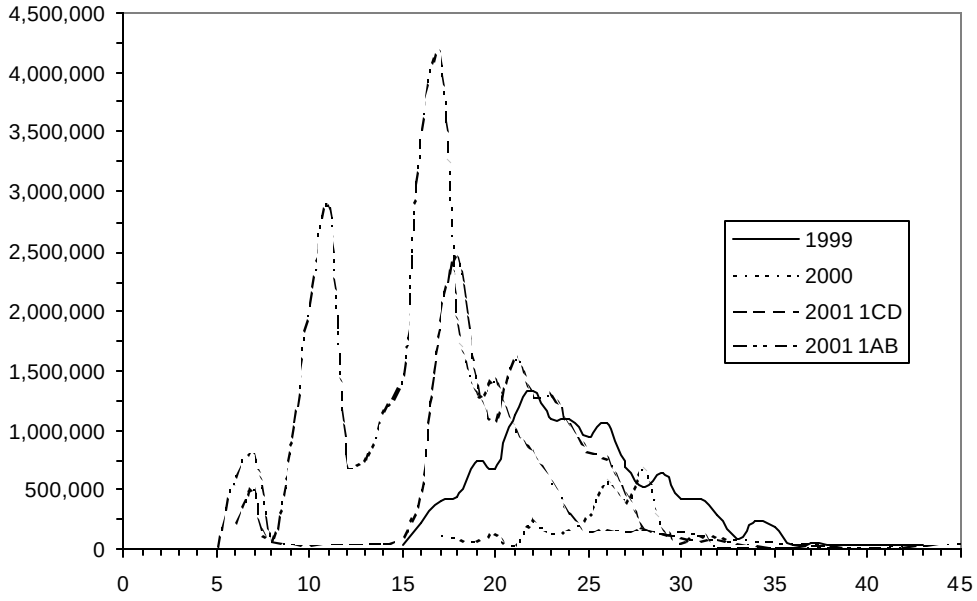

Fig. 12. Overall length distribution of *Sebastes mentella* in numbers (weighted by stratum area) by year.

Appendix 1. Catch weight and - numbers (not standardized to kg/km^2) of Greenland halibut, roundnose and roughhead grenadier and *Sebastes mentella* by haul. Depth in m, swept area in km^2 and bottom temperature in °C. Note, 11 hauls with towing time <15 are not included in the estimations.

								Grl. halibut		Roundnose gre.		Roughhead gre.		*S. mentella*	
St. No	Month	Day	Depth	S. AREA	Div.	Duration	Temp.	Number	Weight	Number	Weight	Number	Weight	Number	Weight
1	9	29	517.0	0.0926	1AN	30	2.4	167.0	43.7	0.0	0.0	0.0	0.0	5.0	0.3
2	9	29	489.0	0.0878	1AN	30	2.5	183.0	54.8	0.0	0.0	0.0	0.0	4.0	0.2
3	9	29	602.0	0.0818	1AN	30	2.2	792.4	200.3	0.0	0.0	1.0	0.1	0.0	0.0
4	9	29	302.0	0.0383	1AN	17	3.0	16.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
5	9	29	182.5	0.0727	1AN	29	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	9	30	336.0	0.0578	1AN	23	2.6	17.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0
7	9	30	323.5	0.0733	1AN	30	2.8	72.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0
8	9	30	290.0	0.0892	1AN	30	2.1	67.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0
9	9	30	145.0	0.0514	1AN	22	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	10	1	151.0	0.0749	1AN	30	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	10	1	328.5	0.0367	1AN	15	2.0	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
12	10	1	681.5	0.0918	1AN	30	1.5	69.0	36.1	0.0	0.0	0.0	0.0	0.0	0.0
13	10	1	716.5	0.0873	1AN	30	1.4	53.0	33.7	0.0	0.0	0.0	0.0	0.0	0.0
14	10	2	469.0	0.0495	1AN	18	2.1	72.0	11.7	0.0	0.0	0.0	0.0	1.0	0.1
15	10	2	401.5	0.0216	1AN	10	2.1	3.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
16	10	2	585.0	0.0088	1AN	5	2.0	4.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
17	10	2	724.5	0.0761	1AN	30	1.4	141.0	64.8	0.0	0.0	1.0	0.1	0.0	0.0
18	10	2	673.0	0.0914	1AN	30	1.7	137.0	71.3	0.0	0.0	0.0	0.0	1.0	0.3
19	10	3	587.0	0.0380	1AN	19	2.4	25.0	12.1	0.0	0.0	0.0	0.0	1.0	0.3
20	10	4	1331.0	0.0830	1AN	30	0.1	44.0	53.5	0.0	0.0	0.0	0.0	0.0	0.0
21	10	4	1279.0	0.0581	1AN	24	0.6	80.0	74.6	0.0	0.0	5.0	7.4	0.0	0.0
22	10	4	904.0	0.0789	1AN	30	1.3	234.0	142.9	0.0	0.0	5.0	1.9	0.0	0.0
23	10	4	1179.0	0.0841	1AN	30	0.6	101.0	111.5	0.0	0.0	2.0	1.9	0.0	0.0
24	10	4	866.0	0.0709	1AN	30	1.4	227.0	160.8	0.0	0.0	8.0	1.4	0.0	0.0
25	10	4	903.5	0.0763	1AN	30	1.2	107.0	64.5	0.0	0.0	5.0	0.8	0.0	0.0
26	10	4	423.0	.	1AN	2	3.0	4.0	0.5	0.0	0.0	1.0	0.1	0.0	0.0
27	10	4	682.0	0.0837	1AN	30	2.2	132.0	58.0	0.0	0.0	2.0	0.2	0.0	0.0
28	10	5	1293.5	0.0813	1AN	30	0.4	67.0	60.2	0.0	0.0	0.0	0.0	0.0	0.0
29	10	5	1456.0	0.0893	1AN	30	0.0	57.0	43.4	0.0	0.0	0.0	0.0	0.0	0.0
30	10	5	950.5	0.0917	1AN	30	1.1	299.0	205.3	0.0	0.0	1.0	0.1	0.0	0.0
31	10	5	658.5	0.0822	1AN	30	2.0	252.0	84.0	0.0	0.0	0.0	0.0	1.0	0.2
32	10	5	955.5	0.0833	1AN	30	1.2	307.0	199.1	0.0	0.0	7.0	1.4	0.0	0.0
33	10	5	1379.5	0.0849	1AN	30	0.2	95.0	98.9	0.0	0.0	0.0	0.0	0.0	0.0
34	10	5	1369.0	0.0785	1AN	30	0.1	59.0	58.6	0.0	0.0	0.0	0.0	0.0	0.0
35	10	6	1277.5	0.0677	1AN	26	0.4	39.0	52.2	0.0	0.0	1.0	1.5	0.0	0.0
36	10	6	875.5	0.0553	1AN	18	1.3	67.0	42.5	0.0	0.0	10.0	1.2	0.0	0.0
37	10	6	742.5	0.0925	1AN	30	1.5	187.0	102.3	0.0	0.0	11.0	1.4	0.0	0.0
38	10	6	387.0	0.0177	1AN	6	3.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	10	6	484.0	.	1AN	2	2.6	8.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
40	10	6	487.0	0.0831	1AN	29	3.0	214.0	35.2	0.0	0.0	0.0	0.0	30.0	3.2
41	10	6	338.0	0.0714	1AN	30	3.3	2.0	0.2	0.0	0.0	0.0	0.0	7.0	0.5
42	10	7	418.0	0.0315	1AN	21	2.3	5.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0
43	10	7	577.0	0.0774	1AN	30	2.2	48.0	21.7	0.0	0.0	6.0	0.2	58.0	6.0
44	10	7	674.0	0.0954	1AN	30	1.9	41.0	21.8	2.0	0.1	0.0	0.0	0.0	0.0
45	10	7	671.5	0.0767	1AN	30	1.9	98.0	52.3	0.0	0.0	4.0	0.7	1.0	0.3
46	10	7	681.5	0.0759	1AN	30	1.8	106.0	41.2	0.0	0.0	5.0	0.4	0.0	0.0
47	10	7	935.0	0.0830	1AS	30	1.2	490.2	288.0	0.0	0.0	12.0	2.2	0.0	0.0
48	10	8	1249.0	0.0822	1AS	30	0.6	140.0	120.6	0.0	0.0	0.0	0.0	0.0	0.0
49	10	8	1034.0	0.0794	1AS	30	1.0	303.0	202.1	0.0	0.0	7.0	1.2	0.0	0.0
50	10	8	1422.0	0.0893	1AS	30	0.1	44.0	50.6	0.0	0.0	0.0	0.0	0.0	0.0
51	10	8	1061.0	0.0817	1AS	30	0.8	128.0	106.1	1.0	0.0	3.0	1.8	0.0	0.0

52	10	8	709.5	0.0814	1AS	30	1.5	479.0	245.9	0.0	0.0	11.0	1.3	1.0	0.1
53	10	8	330.0	0.0380	1AS	18	3.3	31.0	2.7	0.0	0.0	0.0	0.0	1.0	0.2
54	10	9	1222.0	0.0938	1AS	30	0.5	69.9	70.5	0.0	0.0	0.0	0.0	0.0	0.0
55	10	9	1450.0	0.0821	1AS	30	0.1	15.0	19.0	0.0	0.0	0.0	0.0	0.0	0.0
56	10	9	1298.0	0.0782	1AS	30	0.2	59.0	67.1	0.0	0.0	0.0	0.0	0.0	0.0
57	10	9	914.5	0.0636	1AS	23	1.5	551.0	306.5	0.0	0.0	15.0	3.2	0.0	0.0
58	10	9	625.5	0.0902	1AS	30	2.6	201.0	76.9	0.0	0.0	4.0	0.3	38.0	5.2
59	10	9	827.0	0.0771	1AS	30	1.6	362.0	183.5	0.0	0.0	3.0	0.7	0.0	0.0
60	10	9	591.0	0.0715	1AS	30	2.9	92.0	36.7	0.0	0.0	0.0	0.0	26.0	3.2
61	10	9	422.5	0.0541	1AS	22	3.6	33.0	2.6	0.0	0.0	0.0	0.0	77.0	3.5
62	10	10	327.0	0.0707	1AS	30	3.8	11.0	0.8	0.0	0.0	0.0	0.0	1.0	0.1
63	10	10	301.5	0.0430	1AS	16	3.9	13.0	1.0	0.0	0.0	0.0	0.0	2.0	0.1
64	10	10	323.0	0.0334	1B	15	3.9	13.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0
65	10	10	344.0	0.0726	1B	30	4.2	31.0	12.8	0.0	0.0	0.0	0.0	1.0	0.1
66	10	10	490.5	0.0841	1B	30	4.5	212.0	80.4	0.0	0.0	0.0	0.0	130.0	8.5
67	10	10	530.0	0.0794	1B	30	4.4	225.0	102.4	0.0	0.0	0.0	0.0	47.0	4.3
68	10	10	363.5	0.0726	1B	30	3.5	11.0	3.4	0.0	0.0	0.0	0.0	124.0	6.1
1	11	2	293.0	0.0739	1B	30	5.4	37.0	2.3	0.0	0.0	0.0	0.0	114.0	1.7
2	11	3	422.5	0.0790	1B	30	4.4	83.0	34.2	0.0	0.0	1.0	0.1	52.0	5.5
3	11	3	317.5	0.0770	1B	30	3.8	6.0	0.1	0.0	0.0	0.0	0.0	44.0	2.2
4	11	3	331.0	0.0886	1B	30	3.8	29.0	6.2	0.0	0.0	0.0	0.0	11.0	0.3
5	11	3	411.5	0.0837	1B	30	4.3	238.0	52.6	0.0	0.0	0.0	0.0	43.0	2.8
6	11	3	298.5	0.0601	1B	25	4.6	19.0	4.4	0.0	0.0	0.0	0.0	30.0	0.7
7	11	3	274.5	0.0190	1B	10	2.4	8.0	1.4	0.0	0.0	0.0	0.0	16.0	0.2
8	11	3	669.5	0.0204	1B	10	1.0	82.0	44.6	0.0	0.0	0.0	0.0	3.0	0.2
9	11	3	851.0	0.0750	1B	30	1.0	177.0	112.1	0.0	0.0	3.0	0.7	1.0	0.4
10	11	4	860.5	0.0778	1B	30	1.1	321.0	283.0	0.0	0.0	2.0	0.3	0.0	0.0
11	11	4	759.5	0.0763	1B	30	1.8	397.0	212.3	0.0	0.0	0.0	0.0	0.0	0.0
12	11	4	822.0	0.0814	1B	30	1.1	223.0	168.2	0.0	0.0	4.0	0.4	0.0	0.0
13	11	4	686.5	0.0756	1B	26	1.4	130.0	61.8	0.0	0.0	1.0	0.0	0.0	0.0
14	11	4	673.0	0.0845	1B	30	1.7	484.0	243.7	0.0	0.0	4.0	1.1	12.0	5.0
15	11	4	647.5	0.0787	1B	30	1.4	99.0	65.1	0.0	0.0	0.0	0.0	1.0	0.1
16	11	4	551.5	0.0897	1B	30	2.5	48.0	32.3	0.0	0.0	6.0	3.3	412.4	40.4
17	11	5	584.5	0.0774	1B	30	3.4	31.0	20.2	0.0	0.0	3.0	2.5	214.0	27.9
18	11	5	659.5	0.0889	1B	30	2.1	120.0	79.2	7.0	0.5	0.0	0.0	20.0	2.4
19	11	5	597.0	0.1497	1C	56	3.0	91.0	58.4	0.0	0.0	3.0	0.7	54.0	8.3
20	11	5	624.5	0.0472	1C	15	3.2	45.0	28.7	0.0	0.0	0.0	0.0	2.0	0.3
21	11	5	580.5	0.0204	1C	8	4.5	1.0	0.5	0.0	0.0	2.0	0.1	42.0	4.1
22	11	5	558.0	0.0790	1C	30	4.6	13.0	6.1	0.0	0.0	0.0	0.0	373.2	30.7
23	11	5	638.5	0.0585	1C	28	4.6	4.0	4.0	0.0	0.0	9.0	3.5	120.0	19.7
24	11	5	733.5	0.0945	1C	30	4.1	34.0	23.9	2.0	0.0	7.0	1.8	11.0	1.3
25	11	5	771.5	0.0767	1C	30	4.2	100.0	73.6	24.0	0.5	18.0	3.5	5.0	0.8
26	11	6	707.0	0.0715	1C	30	4.3	61.0	39.7	11.0	0.3	7.0	1.4	15.0	4.0
27	11	6	739.0	0.0641	1C	24	3.8	37.0	29.3	0.0	0.0	6.0	1.1	2.0	0.1
28	11	6	784.0	0.0798	1C	30	3.8	31.0	32.6	1.0	0.0	8.0	0.8	2.0	0.3
29	11	6	813.0	0.0872	1C	30	3.7	66.0	48.3	4.0	0.1	17.0	3.3	0.0	0.0
30	11	6	844.5	0.0885	1C	30	3.8	93.0	77.0	10.0	0.5	27.0	6.8	0.0	0.0
31	11	6	768.5	0.0249	1C	10	3.8	12.0	8.9	7.0	0.1	7.0	1.4	0.0	0.0
32	11	6	822.0	0.0271	1D	9	3.9	16.0	10.8	4.0	0.2	5.0	0.7	0.0	0.0
33	11	6	943.5	0.0790	1D	30	3.6	129.0	102.5	8.0	0.4	14.0	4.8	1.0	0.0
34	11	7	1254.5	0.0779	1D	30	3.6	157.0	160.8	5.0	2.0	41.0	11.6	0.0	0.0
35	11	7	1457.5	0.0865	1D	30	3.5	248.0	263.1	16.0	4.5	52.0	20.5	0.0	0.0
36	11	7	1349.5	0.0833	1D	30	3.5	178.1	170.9	13.0	1.5	39.0	16.3	0.0	0.0
37	11	7	1077.0	0.0830	1D	30	3.6	228.0	196.4	9.0	0.6	36.0	10.3	0.0	0.0
38	11	7	1083.5	0.0826	1D	30	3.6	316.0	277.0	8.0	1.0	47.0	12.3	2.0	0.3
39	11	8	1443.5	0.0719	1D	30	3.5	75.0	106.9	27.0	4.4	38.0	19.3	2.0	0.5
40	11	8	1295.0	0.0736	1D	28	3.5	123.0	140.6	2.0	0.3	19.0	9.1	0.0	0.0
41	11	8	1239.0	0.0882	1D	28	3.5	209.0	228.0	5.0	0.9	23.0	22.7	0.0	0.0

42	11	10	1223.5	0.0643	1D	22	3.7	87.0	158.6	21.0	1.3	13.0	8.6	1.0	0.0
43	11	10	1141.0	0.0853	1D	30	3.8	117.0	169.2	47.0	1.5	17.0	8.1	0.0	0.0
44	11	10	1136.0	0.0403	1D	17	3.8	70.0	93.1	40.0	1.4	9.0	2.0	0.0	0.0
45	11	10	1321.0	0.0613	1D	24	3.7	156.0	174.3	20.0	1.7	13.0	6.0	0.0	0.0
46	11	10	1172.5	0.0412	1D	20	3.7	47.0	52.8	34.0	1.7	12.0	3.8	0.0	0.0
47	11	11	1451.0	0.0684	1D	30	3.4	50.0	73.5	93.0	23.6	35.0	16.4	0.0	0.0
48	11	11	1264.0	0.0634	1D	27	3.6	92.0	114.1	43.0	2.4	27.0	19.4	0.0	0.0
49	11	11	1247.0	0.0794	1D	30	3.6	67.0	76.5	174.0	10.3	26.0	12.7	0.0	0.0
50	11	11	1079.5	0.0192	1D	10	3.8	3.0	7.0	5.0	0.5	2.0	1.9	0.0	0.0
51	11	11	1119.5	0.0931	1D	30	3.8	73.0	90.4	104.0	5.1	55.0	24.1	0.0	0.0
52	11	11	1148.0	0.0962	1D	30	3.8	178.0	183.2	57.0	3.2	28.0	10.5	0.0	0.0
53	11	14	1029.0	0.0768	1C	30	3.6	146.0	147.6	17.0	0.7	31.0	11.0	0.0	0.0
54	11	14	1055.5	0.0796	1C	30	3.6	190.0	199.4	11.0	0.6	36.0	10.9	0.0	0.0
55	11	14	887.5	0.0467	1C	19	4.1	221.0	171.6	159.0	6.4	19.0	0.0	0.0	0.0
56	11	14	468.0	0.0767	1C	30	5.6	0.0	0.0	3.0	0.0	1.0	1.2	318.0	38.4
57	11	14	1133.0	0.0789	1D	30	3.6	137.0	150.3	17.0	0.9	52.0	16.9	0.0	0.0
58	11	15	987.0	0.0782	1D	30	3.7	570.2	538.8	30.0	0.5	68.0	19.0	1.0	0.0
59	11	15	1062.5	0.0841	1D	30	3.6	136.0	155.9	10.0	0.3	25.0	8.4	0.0	0.0
60	11	15	1105.0	0.0893	1D	30	3.6	79.0	77.3	9.0	0.5	40.0	9.1	1.0	0.2
61	11	15	1181.5	0.0813	1D	30	3.6	230.0	245.9	7.0	0.4	38.0	17.4	0.0	0.0
62	11	15	1132.0	0.0486	1D	19	3.7	157.0	176.0	1.0	0.1	16.0	6.2	1.0	0.3
63	11	15	1258.0	0.0798	1D	25	3.6	220.0	238.5	167.0	8.3	29.0	13.3	0.0	0.0
64	11	15	1307.5	0.0627	1D	25	3.7	230.0	245.2	558.8	33.9	34.0	12.0	0.0	0.0

Appendix 2. List of species and groups of species recorded in Div. 1AN-D in 2001 with observed minimum and maximum catch weight (kg), minimum and maximum number, minimum and maximum length (cm), minimum and maximum depth (m)and minimum and maximum bottom temperature (°C), respectively (Weight <50 g given as 0.0 kg)

Obs	ART	species	minwgt	maxwgt	minno	maxno	minlen	maxlen	mindepth	maxdepth	mintemp	maxtemp
1	ARS	Agentina silus	0.0	0.0	3	3	11.0	11.0	293.0	293.0	5.4	5.4
2	ALA	Alepocephalus agassizzi	0.0	2.3	1	1	16.0	62.0	1239.0	1457.5	0.0	3.5
3	ALB	Alepocephalus bairdii	4.2	4.2	1	1	80.0	80.0	1321.0	1321.0	3.7	3.7
4	CAD	Anarhichas denticulatus	0.0	23.2	1	3	9.0	121.0	327.0	1181.5	1.2	4.5
5	CAA	Anarhichas lupus	0.2	0.2	2	2	9.0	27.0	298.5	298.5	4.6	4.6
6	CAS	Anarhichas minor	0.0	3.7	1	3	9.0	65.0	301.5	468.0	2.3	5.6
7	ANT	Antimora rostrata	0.1	24.0	1	73	11.0	65.0	739.0	1457.5	3.4	4.2
8	ARZ	Arctozenius rissoi	0.0	0.0	1	3	21.0	26.0	468.0	1247.0	3.6	5.6
9	ARA	Artediellus atlanticus	0.0	0.7	1	31	6.0	17.0	151.0	724.5	0.6	5.6
10	ARU	Artediellus unicatus	0.0	0.0	1	1	.	.	328.5	328.5	2.0	2.0
11	BAM	Bajacalifornia megalops	0.2	0.2	1	1	30.0	30.0	1247.0	1247.0	3.6	3.6
12	BAT	Bathylagus euryops	0.0	2.6	1	45	4.0	21.0	411.5	1457.5	0.1	4.5
13	BEG	Benthosema glaciale	0.0	0.6	1	258	4.0	8.0	336.0	1456.0	0.0	5.6
14	POC	Boreogadus saida	0.0	32.2	1	2315	4.0	24.0	145.0	1222.0	0.1	5.4
15	BOA	Borostomias antarctica	0.0	0.2	1	2	8.0	30.0	647.5	1443.5	1.4	4.2
16	USK	Brosme Brosme	0.3	0.5	1	1	33.0	36.0	468.0	580.5	4.5	5.6
17	CRM	Careproctus micropus	0.0	0.0	1	2	5.0	10.0	1061.0	1456.0	0.0	0.8
18	CAR	Careproctus reinhardti	0.0	0.3	1	3	5.0	80.0	151.0	1277.5	0.4	3.0
19	CFB	Centroscyllium fabricii	0.1	14.6	1	10	17.0	83.0	580.5	1307.5	3.4	4.6
20	CHO	Ceratias holboelli	0.0	2.2	1	1	14.0	62.0	768.5	1062.5	3.6	3.8
21	CHA	Chauliodus sloani	0.0	0.2	1	3	14.0	30.0	739.0	1451.0	3.4	4.2
22	CHN	Chiasmodon niger	0.0	0.1	1	2	12.0	22.0	768.5	1457.5	3.5	4.1
23	CRQ	Chionocetes opilio	1.1	1.1	1	1	.	.	293.0	293.0	5.4	5.4
24	CBB	Coryphaenoides brevibarbis	0.0	0.0	6	6	3.5	4.5	1349.5	1349.5	3.5	3.5
25	CGR	Coryphaenoides guntheri	0.0	1.9	1	46	1.0	70.0	1062.5	1457.5	3.4	3.8
26	RNG	Coryphaenoides rupestris	0.0	33.9	1	559	2.0	21.5	468.0	1457.5	0.8	5.6
27	COM	Cottunculus microps	0.0	0.8	1	11	4.0	23.0	328.5	1450.0	0.1	5.6
28	COT	Cottunculus thomsonii	0.0	0.9	1	2	11.0	33.0	638.5	1105.0	3.6	4.6
29	CCO	Cryptosares couesi	0.1	0.1	1	1	18.0	18.0	1083.5	1083.5	3.6	3.6
30	LUM	Cyclopterus lumpus	0.1	2.3	1	1	11.0	37.0	323.0	943.5	3.4	4.6
31	CLM	Cyclothone microdon	0.0	0.0	1	10	4.0	9.0	330.0	1450.0	0.1	3.8
32	EPR	Eumesogrammmus praecisus	0.0	0.0	1	1	19.0	19.0	182.5	182.5	1.4	1.4
33	EDR	Eumicrotremus derjungini	0.0	0.1	1	5	4.0	8.0	151.0	328.5	0.6	2.0
34	EUM	Eumicrotremus spinosus	0.1	0.2	2	6	6.0	19.0	182.5	759.5	1.4	5.4
35	COD	Gadus morhua	0.0	7.7	1	10	37.0	52.0	274.5	551.5	2.4	5.6
36	GRC	Gadus ogac	1.1	1.1	1	1	42.0	42.0	363.5	363.5	3.5	3.5
37	WIT	Glyptocephalus cynoglossus	0.4	0.6	1	1	40.0	44.0	768.5	1295.0	3.5	3.8
38	GOB	Gonostoma bathyphilum	0.0	0.1	1	2	18.0	21.0	987.0	1254.5	3.6	3.7
39	PLA	Hippoglossoides platessoides	0.0	6.9	1	65	4.0	40.0	274.5	844.5	1.0	5.4
40	HAL	Hippoglossus hippoglossus	26.5	41.5	1	2	96.0	158.0	490.5	813.0	3.7	4.5
41	HOA	Holtbyrnia anomala	0.0	0.0	1	1	8.0	9.0	1136.0	1443.5	3.5	3.8
42	HMC	Holtbyrnia macrops	0.0	0.0	1	2	14.0	17.0	739.0	1349.5	3.5	3.8
43	HAF	Hydrolagus affinis	8.9	8.9	1	1	108.0	108.0	1443.5	1443.5	3.5	3.5
44	ICE	Icelus sp.	0.0	0.0	2	5	6.0	8.0	145.0	182.5	0.1	1.4
45	ICS	Icelus spatula	0.0	0.0	4	4	.	.	151.0	151.0	0.6	0.6
46	LMC	Lampanyctus macdonaldi	0.0	5.5	1	303	1.0	17.0	551.5	1457.5	2.1	4.3
47	LAS	Lampedena speguligera	0.0	0.0	1	1	12.0	12.0	822.0	1264.0	3.6	3.9
48	EUD	Leptagonus decagonus	0.0	0.7	1	26	6.0	19.0	145.0	724.5	0.1	4.5
49	LEM	Leptoclinus maculatus	0.0	0.1	1	18	9.0	14.0	145.0	490.5	0.1	4.5
50	LIF	Liparis fabricii	0.0	15.1	1	423	4.0	20.0	274.5	1456.0	0.0	4.5
51	LIG	Liparis gibbus	0.0	0.2	1	5	4.0	19.0	151.0	602.0	0.6	3.3
52	LIP	Liparis sp.	0.2	0.8	4	17	4.0	19.0	182.5	716.5	1.4	1.4
53	LIT	Liparis tunicatus	0.0	0.0	1	1	7.0	7.0	317.5	317.5	3.8	3.8
54	KCT	Lithodes maja	1.0	2.2	1	2	.	.	411.5	1457.5	3.4	4.3
55	ING	Lycenchelys ingolfanus	0.0	0.0	1	1	26.0	26.0	707.0	707.0	4.3	4.3
56	LPX	Lycenchelys paxillus	0.1	0.1	1	1	25.0	25.0	844.5	844.5	3.8	3.8
57	LMA	Lycodes MacAllister	0.1	0.1	1	1	25.0	25.0	822.0	822.0	1.1	1.1
58	LAD	Lycodes adolfi	0.0	0.2	1	11	9.0	20.0	716.5	1456.0	0.0	1.4
59	LYE	Lycodes esmarki	0.1	0.4	1	1	27.0	43.0	468.0	1061.0	0.8	5.6
60	LYN	Lycodes eudipleurostictus	0.0	1.4	1	17	9.0	36.0	301.5	914.5	1.0	4.5
61	LLU	Lycodes luetkeny	1.0	1.0	1	1	56.0	56.0	914.5	914.5	1.5	1.5
62	LYM	Lycodes mirabilis	0.0	0.0	1	1	25.0	30.0	739.0	1443.5	3.5	3.8
63	LPA	Lycodes paamiuti	0.0	0.5	1	14	12.0	26.0	330.0	1450.0	0.1	3.3
64	LYR	Lycodes reticulatus	0.0	0.4	1	15	10.0	21.0	151.0	328.5	0.6	2.0
65	LSE	Lycodes seminudus	0.0	0.6	1	6	10.0	39.0	336.0	724.5	1.4	4.4
66	ELZ	Lycodes sp.	0.1	0.2	3	3	12.0	22.0	681.5	681.5	1.5	1.5
67	LYT	Lycodes terranova	0.3	1.3	2	3	19.0	52.0	844.5	1443.5	3.5	3.8
68	LYV	Lycodes vahli	0.0	0.7	1	35	14.0	35.0	293.0	530.0	2.6	5.4
69	RHG	Macrourus berglax	0.0	24.1	1	68	1.5	85.0	422.5	1457.5	0.4	5.6
70	MAL	Malacosteus niger	0.0	0.1	1	2	14.0	20.0	943.5	1451.0	3.4	3.6
71	CAP	Mallotus villosus	0.0	0.7	1	34	13.0	18.0	182.5	411.5	1.4	4.6

72	MEJ	Melanocetus johnsoni	0.1	0.1	1	1	14.0	14.0	1457.5	1457.5	3.5	3.5
73	WHB	Micromesistius poutassou	0.1	0.1	1	1	28.0	28.0	468.0	468.0	5.6	5.6
74	BLI	Molva dypterygia	0.2	0.2	1	1	40.0	40.0	558.0	558.0	4.6	4.6
75	MYC	Myctophidae	0.0	0.0	1	3	6.0	6.0	551.5	624.5	2.5	3.4
76	MYP	Myctophum punctatum	0.0	0.0	1	1	5.0	5.0	1136.0	1349.5	3.5	3.8
77	ARJ	Natantia	0.0	3.1	0	150	.	.	145.0	1349.5	0.1	5.6
78	NEG	Neolithodes grimaldi	0.4	2.1	1	1	.	.	1083.5	1105.0	3.6	3.6
79	NZB	Nezumia bairdi	0.1	0.6	1	5	5.0	10.0	768.5	1254.5	3.6	3.8
80	NOT	Notacanthus chemnitzii	0.0	6.4	1	7	29.0	94.0	551.5	1457.5	0.5	4.3
81	NOK	Notoscopelus kroeyri	0.0	0.0	1	3	7.0	14.0	597.0	1451.0	1.1	4.1
82	OCT	Octopus	0.0	24.8	1	85	.	.	323.5	1457.5	0.0	4.3
83	OND	Oneirodes sp.	0.0	0.0	1	1	9.5	9.5	1451.0	1451.0	3.4	3.4
84	ONE	Oneiroides eschrichti	0.4	0.4	4	4	13.0	29.0	724.5	724.5	1.4	1.4
85	ONA	Onogadus argentatus	0.0	0.4	1	3	8.0	33.0	422.5	1293.5	0.4	4.1
86	ONN	Onogadus ensis	0.0	9.4	0	23	10.0	43.0	530.0	1457.5	0.0	4.4
87	PAB	Paraliparis bathybius	0.1	1.5	2	28	15.0	27.0	1179.0	1456.0	0.0	0.6
88	PAC	Paraliparis copei	0.0	0.0	1	2	12.0	18.0	1443.5	1451.0	3.4	3.5
89	PAG	Paraliparis garmani	0.0	0.3	1	37	6.0	90.0	638.5	987.0	3.7	4.6
90	POL	Polyacanthonotus rissoanus	0.2	0.4	1	2	50.0	56.0	1239.0	1457.5	3.5	3.7
91	RBT	Raja bathyphila	0.4	1.0	1	1	45.0	59.0	1083.5	1443.5	3.5	3.6
92	RBI	Raja bigelowi	0.5	0.5	1	1	45.0	45.0	1223.5	1223.5	3.7	3.7
93	RFL	Raja fyllae	0.0	0.4	1	1	16.0	42.0	551.5	739.0	2.5	4.1
94	RHB	Raja hyperborea	0.1	34.2	1	24	15.0	79.0	517.0	1456.0	0.0	2.6
95	RLT	Raja lintea	1.2	1.2	4	4	12.0	44.0	290.0	290.0	2.1	2.1
96	RRD	Raja radiata	0.0	5.8	1	18	9.0	47.0	182.5	955.5	1.0	5.4
97	RSP	Raja spinacidermis	0.4	0.4	1	1	46.0	46.0	1148.0	1148.0	3.8	3.8
98	GHL	Reinhardtius hippoglossoides	0.0	538.8	1	792	2.1	105.0	274.5	1457.5	0.0	5.4
99	RHO	Rhodichtlys regina	0.0	0.7	1	5	14.0	21.0	1179.0	1422.0	0.1	0.6
100	ROM	Roulina maderensis	0.1	0.1	1	1	20.0	20.0	1133.0	1133.0	3.6	3.6
101	SAS	Sagamichthys sachakenbergi	0.0	0.0	1	1	12.0	12.0	580.5	580.5	4.5	4.5
102	SCB	Scopelogadus beani	0.0	0.0	1	1	12.0	13.0	768.5	1077.0	3.6	3.8
103	SCO	Scopelosarus lepidus	0.1	0.5	1	2	25.0	41.0	768.5	1457.5	3.4	3.8
104	REG	Sebastes marinus	0.8	4.0	1	2	34.0	59.0	338.0	638.5	2.3	4.6
105	REB	Sebastes mentella	0.0	40.4	1	412	5.0	48.0	274.5	1443.5	1.0	5.6
106	SEK	Serasia koefoedi	0.0	0.0	1	1	15.0	15.0	1247.0	1247.0	3.6	3.6
107	SER	Serrivomer beani	0.0	0.4	1	4	36.0	73.0	739.0	1457.5	3.4	3.8
108	SQT	Squit	0.0	0.9	1	18	.	.	274.5	1457.5	0.2	5.6
109	STO	Stomias boa	0.0	0.2	1	3	14.0	27.0	768.5	1451.0	0.1	4.2
110	SYN	Synapobranchus kaupi	0.0	9.9	1	74	15.0	540.0	551.5	1457.5	2.1	4.6
111	TRA	Trachyrynchus murrayi	0.5	1.5	1	3	18.5	23.0	1132.0	1247.0	3.6	3.7
112	TRN	Triglops nybelini	0.0	2.4	1	299	4.0	17.0	151.0	827.0	0.6	5.4
113	TRP	Triglops pingeli	0.0	0.3	10	11	4.0	18.0	151.0	302.0	0.6	3.0
114	TRI	Triglops sp.	0.0	0.0	1	1	5.0	11.0	301.5	422.5	3.9	4.4
115	XEC	Xenodermichthys copei	0.0	0.0	1	1	15.0	17.0	638.5	1321.0	3.7	4.6