Northwest Atlantic Fisheries Organization

Serial No. N4967 **NAFO SCR Doc. 04/19**

SCIENTIFIC COUNCIL MEETING – JUNE 2004

Survey for Greenland Halibut in NAFO Divisions 1C-1D, 2003

O.A. Jørgensen

Danish Institute for Fisheries Research
Charlottenlund Slot, 2920 Charlottenlund, Denmark

Abstract

In 1997 Greenland initiated a survey series covering NAFO Divisions 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. The paper gives biomass and abundance estimates and length frequencies for Greenland halibut, roundnose and roughhead grenadier, and deep sea redfish together with age and maturity data for Greenland halibut. The biomass of Greenland halibut was estimated as 68 700 tons compared to 72 000 tons. The biomass of roundnose grenadier was estimated as 774 tons only.

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. The survey traditionally covers 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 2003 covered Div. 1CD and took place during 17/9-24/9.

Stratification

The survey covered NAFO Div. 1C-1D between the 3-nm line and the 200-nm line or the midline to Canada at depths between 400 and 1 500 m. The survey area was stratified in NAFO Divisions and subdivided in 6 depth strata 401-600, 601-800, 801-1 000, 1 001-1 200, 1 201-1 400 and 1 401-1 500 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" (Table 1).

The survey was planned as a Stratified Random Bottom Trawl Survey with in total 70 hauls. Each stratum was allocated at least two hauls. The remaining hauls were allocated in order to minimize the variance in the estimation of the biomass of Greenland halibut, i.e. strata with great variation in the catches of Greenland halibut in the previous years surveys have got relatively more hauls than strata with little variation in the catches. The positions of the hauls were selected at random within each stratum by means of "The Spline Survey Designer Software System".

Vessel and gear

The survey was conducted by the 722 GRT trawler *PAAMIUT*, as in previous years, 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:

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

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

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°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^2 swept prior to further calculations

Otoliths for age determination of Greenland halibut (n = 293) 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 35 successful hauls were made, giving a mean coverage of the surveyed area on 1 317 km^2 per haul (Table 1). The number of tows was reduced compared to the 70 planned mainly due to bad weather. Two strata: 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 68 species or groups of species were recorded (Appendix 2).

Greenland halibut (*Reinhardtius hippoglossoides*)

Greenland halibut was caught in all hauls (Fig. 1) and the biomass was estimated at 68 717 (S.E. 6 4211.9) (Table 2) which was a slight decrease compared to 71 932.4 tons (S.E. 5 613.9) in 2002. Generally the biomass decreased in Div 1D while it increased in Div. 1C. The estimate from 2003 is not statistically different (95% level) from the estimates from 1997-2002. (Jørgensen, 2003; 2002; 2001; 2000; 1999 and 1998b).

Biomass of Greenland halibut in Div. 1CD.

Year	1997	1998	1999	2000	2001	2002	2003
Biomass	56 260.2	70 473.5	64 398.0	59 092.4	77 554.0	71932.4	68 717.2
S.E.	4 399.6	8 391.7	6 912.1	5 543.3	13 013.6	5613.9	6411.9

Weighted mean catch per tow (tons) standardized to catch/km^2 (Fig. 2)

Year	1997	1998	1999	2000	2001	2002	2003
Mean/tow	1.07	1.34	1.27	1.28	1.57	1.56	1.39
S.E.	0.08	0.16	0.14	0.11	0.26	0.12	0.13

The abundance in Div. 1CD was estimated at 72.60×10^6 (S.E. 7.76 $*10^6$) (Table 3) compared to 71.510×10^6 (S.E. 6.223×10^6) in 2002. The abundance decreased in Div. 1D but increased in stratum 601-800 and 801-100 in div. 1C. The estimate from 2003 is not statistically different from the 1997-2002 estimates (95% level)

Abundance of Greenland halibut in Div. 1CD.

Year	1997	1998	1999	2000	2001	2002	2003
Abundance ($*10^6$)	53.613	67.677	61.366	61.710	80.814	71.510	72 556
S.E.	4.118	7.687	6.265	5.976	14.221	6.223	7.764

Estimated abundance by age in Div. 1CD is given in Table 4.

The length ranged from 13 cm to 102 cm. (except for a few larvae 7-9 cm). Generally the length distributions in the different depth strata were dominated by a single mode except in stratum 601-800 where an additional mode around 24 cm was seen. Generally fish size increased with depth and from north to south at the same depth (Fig. 3) as seen in previous surveys (Jørgensen, 1997b). The overall length distribution (weighted by stratum area) was totally dominated by a mode at 48 cm while the mode was at 47 cm in 2002 (Fig. 4).

The age ranged from 1 to 21 years. Generally the age increased by depth and here the age composition was dominated by ages 5-7 (Fig. 5). The overall age distribution (weighted by stratum area) in Div. 1CD was monomodal with a mode around age 6 as seen in previous years (Fig. 6). Mean weight and length at age is given in Table 5.

Females stated maturing at age 7 and 100% maturity was reached at age 12 (Table 6).

Roundnose grenadier (*Coryphaenoides rupestris*)

Roundnose grenadier was caught in all hauls, except three, but the catches was very low (Appendix 1, Fig. 7) and the biomass was estimated at 774.2 tons (S.E. 144.0) compared to 1 593.1 tons (S.E. 462.7) in 2002. The estimate is the lowest in the present survey series and the biomass is hence still very low compared to the late-1980s (Jørgensen, 2002; 2001; 2000; 1999; 1998a and 1998b).

Biomass of roundnose grenadier in Div. 1CD.

Year	1997	1998	1999	2000	2001	2002	2003
Biomass	5 686.5	7 263.3	2 771.8	5 593.7	1 577.2	1593.1	774.2
S.E.	926.4	2 530.2	445.5	2 616.8	516.4	462.7	144.0

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 6.900×10^6 compared to 18.610×10^6 (S.E. 8.910×10^6) in 2002 and by far the lowest in the time series (Table 8)

Abundance of roundnose grenadier in Div. 1CD.

Year	1997	1998	1999	2000	2001	2002	2003
Abundance (*10^6)	32.441	75.243	29.100	99.52	24.698	18.610	6.900
S.E. ($10*^6$)	7.056	27.357	8.963	67.31	8.797	8.910	1.272

Pre anal fin length ranged from 2 to cm 18 cm. Fish size increased generally with increasing depth (Fig. 8). The overall length distribution (weighted by stratum area) was totally dominated by a broad flat mode at 2-8 cm (Fig. 9).

Roughhead grenadier (*Macrourus berglax*)

The biomass of roughhead grenadier was estimated at 5 657.5 tons (S.E. 700.8) (Table 9, Fig. 10, Appendix 1) which is a decrease compared to 7 907.6 tons (S.E. 823.6) in 2002 but at the level for 1998-2001

Biomass of roughhead grenadier in Div. 1CD.

Year	1997	1998	1999	2000	2001	2002	2003
Biomass	2 258.6	4 314.1	5 166.2	7 178.1	4 576.6	7 907.6	5 657.5
S.E.	250.1	377.9	854.1	2 226.5	456.3	823.6	700.8

The highest densities were found between 1001 and 1200 m but the highest biomass was found in Div. 1C at 601-800 m (Table 9).

The total abundance was estimated at 15.366×10^6 (Table 10) which is a decrease compared to 19.620×10^6 (S.E. 1.755×10^6) in 2002 but at the level for 1998-2001

Abundance of roughhead grenadier in Div. 1CD.

Year	1997	1998	1999	2000	2001	2002	2003
Abundance (*10^6)	4.60	11.623	14.074	20.282	13.867	19.620	15.366
S.E. (*10^6)	0.45	1.008	2.040	7.182	1.549	1.755	2.573

Pre anal fin length ranged from 5 to cm 38 cm and the over all length distribution was dominated by modes at 7, 12 and 16 cm. (Fig. 11).

Deep-sea redfish (*Sebastes mentella*)

Deep-sea redfish was caught in 9 of the 35 valid hauls, but the catches were low. The biomass was estimated at 1 493 tons which was almost exclusively found in depth stratum 401-600 m in Div. 1C. where the estimate is based on two hauls only (Appendix 1). Both biomass and abundance were somewhat below the estimates from previous years.

Biomass of deep sea redfish.

Year	1997	1998	1999	2000[1)]	2001	2002[1)]	2003
Biomass	2 464.3	2 408.1	2 484.9		2 063.4		1493.4
S.E.	787.1	503.9	1 007.7		873.5		684.5

1). Poor coverage of relevant depths.

Abundance of deep sea redfish.

Year	1997	1998	1999	2000[1)]	2001	2002[1)]	2003
Abundance	14.690	18.827	12.926		16.337		7.131
S.E.	5.500	4.496	4.093		6.474		3.079

1). Poor coverage of relevant depths.

The length ranged from 10 to 40 cm with a dominant mode around 22 cm and a minor mode at 27 cm (Fig. 12)

Temperature

The bottom temperature ranged fro 2.4 to 5.1 °C and the mean temperature was generally decreasing by depth (Table 11).

References

Jørgensen, O A. 1997b. Movement patterns of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum.) at West Greenland, as inferred from Trawl Survey Distribution and Size Data.. *J. Northw. Atl. Fish. Sci.*; **21**:23-37.

Jørgensen, O A. 1997a. Pelagic occurrence of Greenland halibut, *Reinhardtius hippoglossoides* (Walbaum) in West Greenland waters. *J. Northw. Atl. Fish. Sci.*; **21**:39-50.

Jørgensen O. A. 1998a. Results of the Joint Japan Greenland Trawl Surveys at West Greenland 1987-1995 on Greenland Halibut (*Reinhardtius hippoglossoides*) and Roundnose Grenadier (*Coryphaenoides rupestris*). *NAFO Sci. Council Studies* No 31. 21-56.

Jørgensen O.A. 1998b. Survey for Greenland Halibut in NAFO Division 1C-1D. NAFO SCR Doc. 98/25. Serial No. N3010, 26 pp.

Jørgensen O.A. 1999. Survey for Greenland Halibut in NAFO Division 1C-1D, 1998. NAFO SCR Doc. 99/30. Serial No. N4086, 25 pp.

Jørgensen O.A. 2000. Survey for Greenland Halibut in NAFO Division 1C-1D, 1999. NAFO SCR Doc. 00/10. Serial No. N4232, 26 pp.

Jørgensen O.A. 2001. Survey for Greenland Halibut in NAFO Division 1C-1D, 2000. NAFO SCR Doc. 01/23. Serial No. N4392, 23 pp.

Jørgensen O.A. 2002. Survey for Greenland Halibut in NAFO Division 1A-1D, 2001. NAFO SCR Doc. 02/30. Serial No. N4637, 31 pp.

Jørgensen O.A. 2003. Survey for Greenland Halibut in NAFO Division 1C-1D, 2002. NAFO SCR Doc. 03/2030. Serial No. N4829, 27 pp.

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

Div.	Depth stratum (m)						Tot.
	401-600	601-800	801-1000	1001-1200	1201-1400	1401-1500	
1C	3366 (2) 2	16120 (7) 4	6066 (9) 4	611 (2) 2	-	-	26163 (20) 12
1D	903 (2) 0	1940 (2) 0	3874 (3) 2	10140 (19) 10	6195 (17) 7	3091 (7) 4	26143 (50) 23
Tot	4269 (4) 2	18060 (9) 4	9940 (12) 6	10751 (21) 12	6195 (17) 7	3091 (7) 4	52306 (70) 35

Table 2. Biomass (tons) of Greenland halibut by Division and depth stratum, 2003.

Division	Depth (m)	Area	Hauls	Mean sq/km	Biomass	SE
1C	401-600	3366	2	0.1245	419.2	379.7
	601-800	16120	4	0.4368	7040.5	2123.4
	801-1000	6066	4	1.8551	11253.1	3091.2
	1001-1200	611	2	2.1405	1307.8	133.5
1D	801-1000	3874	2	1.0168	3939.1	2565.6
	1001-1200	10140	10	2.1729	22033.1	2524.7
	1201-1400	6195	7	2.9846	18489.4	3396.6
	1401-1500	3091	4	1.3701	4235	1547.0
All		49463	35	1.3893	68717.2	6411.9

Table 3. Abundance of Greenland halibut by Division and depth stratum, 2003.

Division	Depth (m)	Area	Hauls	Mean sq/km	Abundance	SE
1C	401-600	3366	2	149.8	5.04E+05	4.38E+05
	601-800	16120	4	857.7	1.38E+07	5.11E+06
	801-1000	6066	4	2112.2	1.28E+07	2.99E+06
	1001-1200	611	2	2109.8	1.29E+06	2.85E+05
1D	801-1000	3874	2	1090.5	4.22E+06	2.56E+06
	1001-1200	10140	10	1991.8	2.02E+07	2.79E+06
	1201-1400	6195	7	2622.7	1.62E+07	2.89E+06
	1401-1500	3091	4	1117.7	3.45E+06	1.52E+06
All		49463	35	1466.9	7.26E+07	7.76E+06

Table 4. Estimated abundance by age from Div. 1C-1D from the surveys in 1997-2003. The Age-length key from 1998 is applied on the 1997 data.

AGE	1997	1998	1999	2000	2001	2002	2003
1	0	0	0	78826	15585	71512	833452
2	536130	609093	184098	109496	281013	214536	3187890
3	1704893	3722237	920490	479059	511722	285367	1468105
4	3023773	4662948	4172888	3074341	4835796	2361529	2417001
5	9961295	14760362	11291344	15090231	20601616	11779876	12348567
6	15370847	19057854	15893794	16838191	26595603	26697300	21816458
7	13558728	14083592	19759852	14711646	17922784	18561065	18499540
8	5436358	5766084	4786548	5026106	4674899	6201987	6534966
9	1200931	1515966	859124	3214208	2550178	1857799	2403542
10	948950	1211419	920490	1040152	780082	1340261	1244102
11	584382	764751	613660	717770	705656	905723	581491
12	466433	527881	675026	350292	369836	166242	224915
13	187646	351921	429562	318336	345397	257412	264203
14	96503	155657	429562	122157	195607	143024	207745
15	262704	236870	184098	230208	225277	263139	67270
16	187646	115051	61366	128242	91540	178780	206590
17	64336	128586	61366	95352	80275	107268	72546
18	16084	0	61366	57045	22628	35756	41219
19	0	0	0	27474	32325	83431	58531
20	0	0	0	0	8081	0	22258
21						0	7419
SUM	53607639	67670271	61304634	61709132	80845900	71512007	72507812

Table 5. Mean weight and mean length-at-age of Greenland halibut, 1995-2003.

	1995		1996		1997		1998		1999		2000		2001		2002		2003	
AGE	weight	length	weight	length	weight	length	weight	length	weight	length	weight	length	weight	length	weight	length	weight	length
1											25.0	13.5	27.9	14.4	20.0	16.0		
2	50.0	20.0			23.3	15.3	38.2	18.7	64.0	21.0	75.0	21.0	85.4	21.0	60.0	21.7	85.0	23.0
3	140.0	27.0	175.0	30.5	58.2	19.8	175.5	28.5	206.1	27.4	145.8	26.3	173.3	26.7	200.0	29.6	192.0	29.4
4	339.4	35.1	378.3	36.4	137.0	26.1	347.5	35.3	342.1	34.4	329.3	33.6	366.4	34.2	341.0	35.5	355.0	35.7
5	495.5	40.1	555.6	41.2	271.8	32.8	551.4	40.9	570.7	40.3	528.0	39.5	574.4	39.7	486.6	39.9	522.5	40.2
6	691.6	45.0	794.1	45.7	443.9	38.0	854.2	46.8	793.4	45.6	764.4	44.5	848.7	44.9	747.0	45.6	762.8	45.4
7	986.6	49.8	1056.0	49.9	736.9	43.9	1218.1	51.9	1195.5	51.4	1073.5	49.8	1158.6	49.9	1132.2	51.7	1116.0	51.2
8	1360.0	54.5	1447.0	55.3	1070.2	49.9	1572.3	56.8	1665.4	57.9	1375.6	53.7	1540.5	54.8	1369.7	55.6	1419.3	55.9
9	1817.0	59.6	2092.2	61.5	1453.7	55.6	2074.8	60.6	2057.1	61.1	1630.8	56.8	1843.6	58.0	1844.1	60.7	1861.0	59.8
10	2163.5	62.7	2740.6	65.8	2042.9	61.2	2293.5	63.1	2440.7	64.1	2076.8	61.5	2258.9	61.8	2037.4	62.5	2115.2	62.6
11	2679.6	66.3	3241.7	68.4	2814.6	66.7	2866.6	66.5	2812.1	66.9	2502.5	63.9	3316.2	65.0	2507.6	66.0	2668.2	66.8
12	3248.6	69.9	4100.2	73.0	3827.7	72.6	3453.2	69.9	4000.1	72.9	3014.4	67.5	3449.6	68.7	3011.4	69.7	3190.0	70.4
13	4133.6	73.4	4994.0	76.4	4840.0	77.3	4537.5	74.7	5678.6	79.5	3612.4	70.4	3866.4	71.3	3557.7	71.6	3177.5	70.6
14	5685.6	79.8	5946.7	80.6	6679.4	84.0	5112.0	77.6	7613.2	86.7	3892.5	72.8	5256.7	77.8	4650.0	78.5	3845.0	75.5
15	6631.1	83.6	7523.7	86.8	7711.1	87.8	7140.6	85.1	8476.7	91.2	5409.0	78.3	6323.5	81.9	5149.2	79.0	4340.0	76.0
16	7533.0	89.0	8663.0	89.9	9166.0	94.6	8385.0	88.9	9925.0	88.5	6873.3	85.5	7203.3	86.0	6786.0	84.8	5746.7	81.3
17	10413.6	94.6	9208.3	91.9	10796.7	97.8	10684.0	95.4			8492.0	91.8	8954.0	92.4	8520.0	90.3	6200.0	84.0
18	11180.0	97.0	10127.3	95.3					12500.0	99.0	8590.0	92.3	8760.0	93.0	9385.0	93.0		
19	11566.7	98.3	11168.2	98.5			12850.0	99.0			9645.0	91.5	11500.0	102.0	8553.3	90.3		
20	11326.7	100.3	11100.0	95.0									14400.0	105.0				
21	13100.0	103.5	11250.0	98.3														
22	13700.0	104.0													13350.0	105.0		
24	15300.0	115.0																

Table 6. Maturity-at-age in percent, females, Div. 1C-1D, 2003. 1 immature, 2 maturing.

	Maturity		
	1	2	
	Pct	Pct	N
Age			
2	100.0		2
3	100.0		3
4	100.0		13
5	100.0		14
6	100.0		14
7	80.0	20.0	20
8	53.9	46.2	13
9	37.5	62.5	16
10	28.6	71.4	14
11	46.7	53.3	15
12		100.0	3
13	8.3	91.7	12
14		100.0	4
15		100.0	11
16		100.0	5
17		100.0	3
18		100.0	2
19	33.3	66.7	3
22		100.0	1

Table 7. Biomass of (tons) roundnose grenadier by Division and depth stratum, 2003.

Div.	Stratum(m)	Area	Hauls	Mean	Biomass	SE
1C	401-600	3366	2	0.0003	0.9	0.9
	601-800	16120	4	0.0011	17.9	10.6
	801-1000	6066	4	0.0139	84.0	34.4
	1001-1200	611	2	0.0169	10.3	8.4
1D	801-1000	3874	2	0.0029	11.4	6.8
	1001-1200	10140	10	0.0086	86.7	16.0
	1201-1400	6195	7	0.0560	347.1	109.0
	1401-1500	3091	4	0.0699	215.9	84.8
All		49463	35	0.0157	774.2	144.0

Table 8. Abundance of roundnose grenadier by Division and depth stratum, 2003.

Div.	Stratum(m)	Area	Hauls	Mean	Abundace	SE
1C	401-600	3366	2	6.4	2.14E+04	2.14E+04
	601-800	16120	4	45.6	7.34E+05	6.16E+05
	801-1000	6066	4	350.2	2.12E+06	8.97E+05
	1001-1200	611	2	420.6	2.57E+05	2.06E+05
1D	801-1000	3874	2	45.1	1.75E+05	1.29E+05
	1001-1200	10140	10	106.0	1.07E+06	2.45E+05
	1201-1400	6195	7	292.6	1.81E+06	4.94E+05
	1401-1500	3091	4	226.7	7.01E+05	2.67E+05
All				139.5	6.90E+06	1.27E+06

Table 9. Biomass (tons) of roughhead grenadier by Division and depth stratum, 2003.

Div.	Stratum(m)	Area	Hauls	Mean	Biomass	SE
1C	401-600	3366	2	0.0731	246.1	28.9
	601-800	16120	4	0.1043	1681.3	628.2
	801-1000	6066	4	0.1060	643.1	92.9
	1001-1200	611	2	0.1803	110.1	16.9
1D	801-1000	3874	2	0.0664	257.1	79.3
	1001-1200	10140	10	0.1270	1287.7	181.4
	1201-1400	6195	7	0.1641	1016.5	178.5
	1401-1500	3091	4	0.1344	415.5	125.3
All		49463	35	0.1144	5657.5	700.8

Table 10. Abundance of roughhead grenadier by Division and depth stratum, 2003

Div.	Stratum(m)	Area	Hauls	Mean	Abundace	SE
1C	401-600	3366	2	241.6	8.13E+05	4.23E+04
	601-800	16120	4	315.0	5.08E+06	2.39E+06
	801-1000	6066	4	322.6	1.96E+06	2.02E+05
	1001-1200	611	2	488.0	2.98E+05	5.34E+04
1D	801-1000	3874	2	211.1	8.18E+05	4.97E+05
	1001-1200	10140	10	325.0	3.30E+06	5.38E+05
	1201-1400	6195	7	380.7	2.36E+06	5.31E+05
	1401-1500	3091	4	241.9	7.48E+05	2.56E+05
All		49463	35	310.7	1.54E+07	2.57E+06

Table 11. Mean temperature, S.E and number of observations by NAFO Division and depth stratum.

Div.	Depth stratum (m)																	
	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
1C	4.9	.12	2	2.7	.19	4	4.0	.08	4	3.8	.01	2						
1D							3.7	.05	2	3.6	.03	10	3.6	.03	7	3.6	.04	4

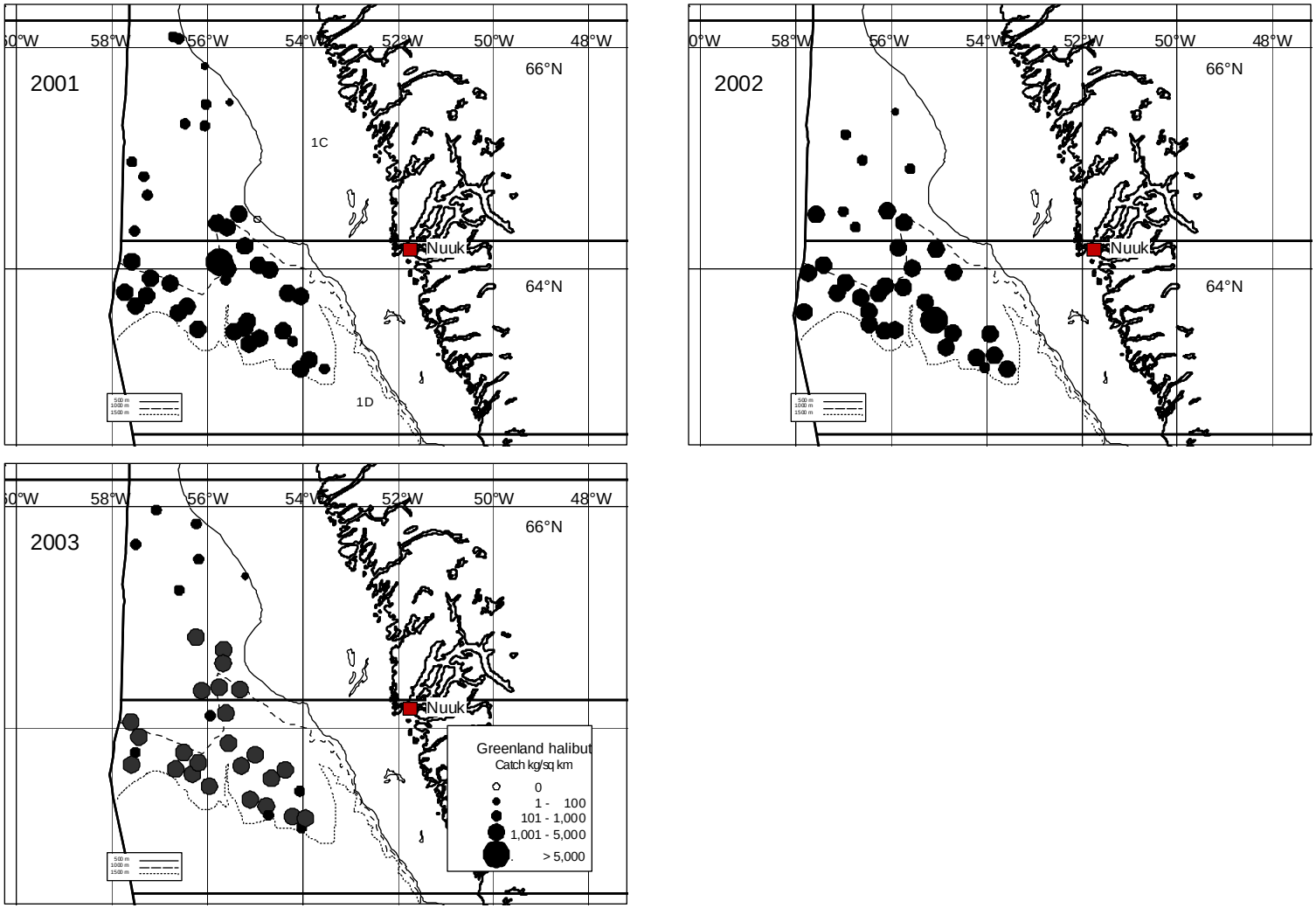

Fig. 1. Distribution of catches of Greenland halibut in 2001-2003 in kg km^{-2}

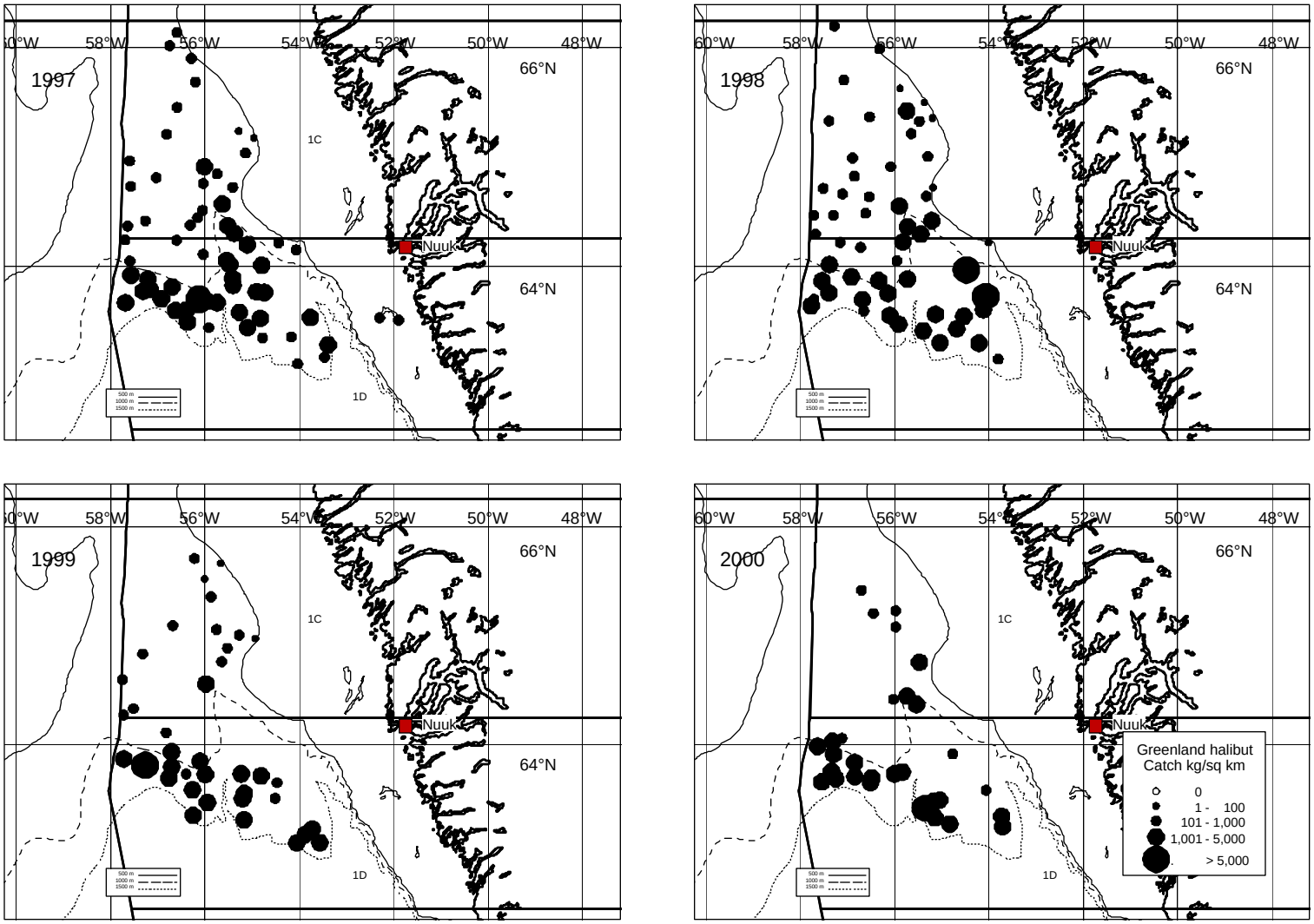

Fig. 1. cont. Distribution of catches of Greenland halibut during 1997-2000 in kg km^{-2}

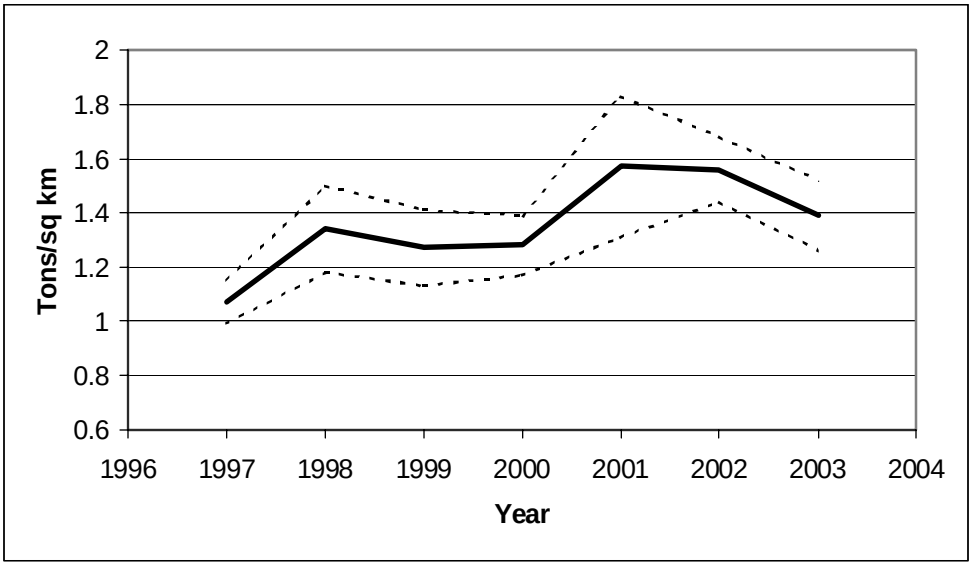

Fig. 2. Mean catch of Greenland halibut per sq. km (tons) standardized by stratum area with +/- S.E.

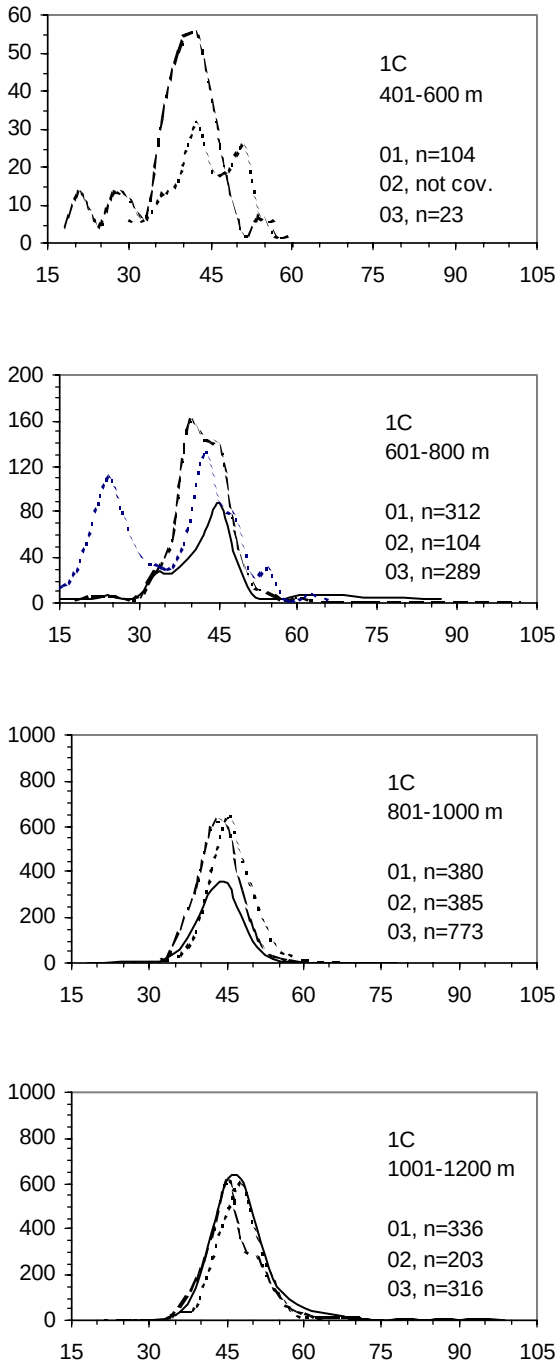

Fig. 3. Length distribution in numbers/km^2 of Greenland halibut (3 cm groups) by year and depth stratum in Div. 1C. Note different scales on y-axis. 2001: Dashed line. 2002: Solid line. 2003. Dotted line.

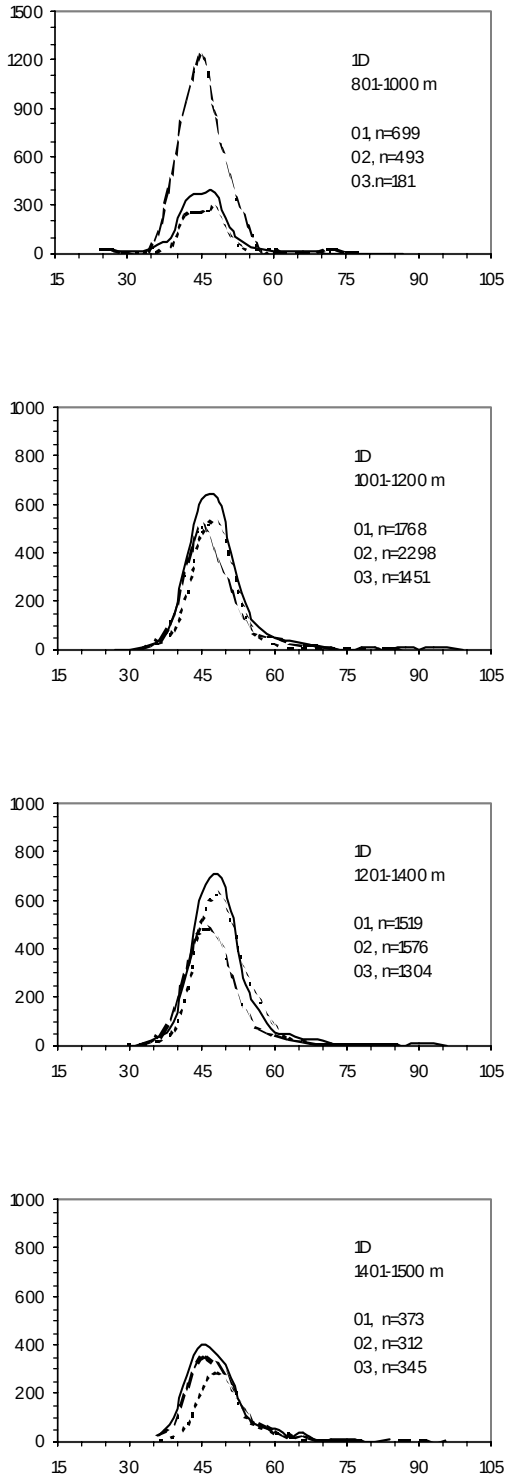

Fig. 3. Length distribution in numbers/km^2 of Greenland halibut (3 cm groups) by year and depth stratum in Div. 1D. Note different scales on y-axis. 2001: Dashed line. 2002: Solid line. 2003. Dotted line.

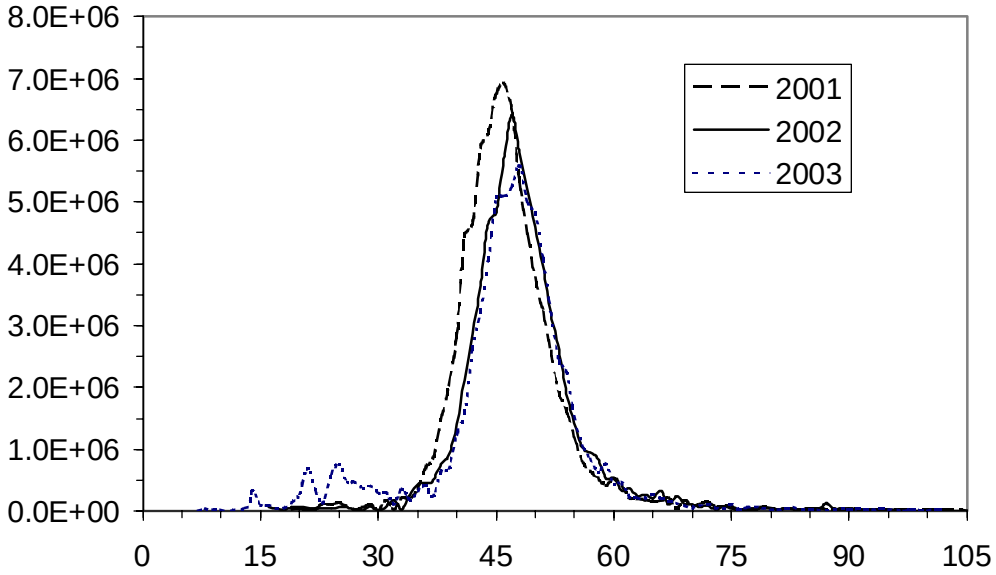

Fig. 4. Overall length distribution of Greenland halibut in numbers (weighted by stratum area) by year.

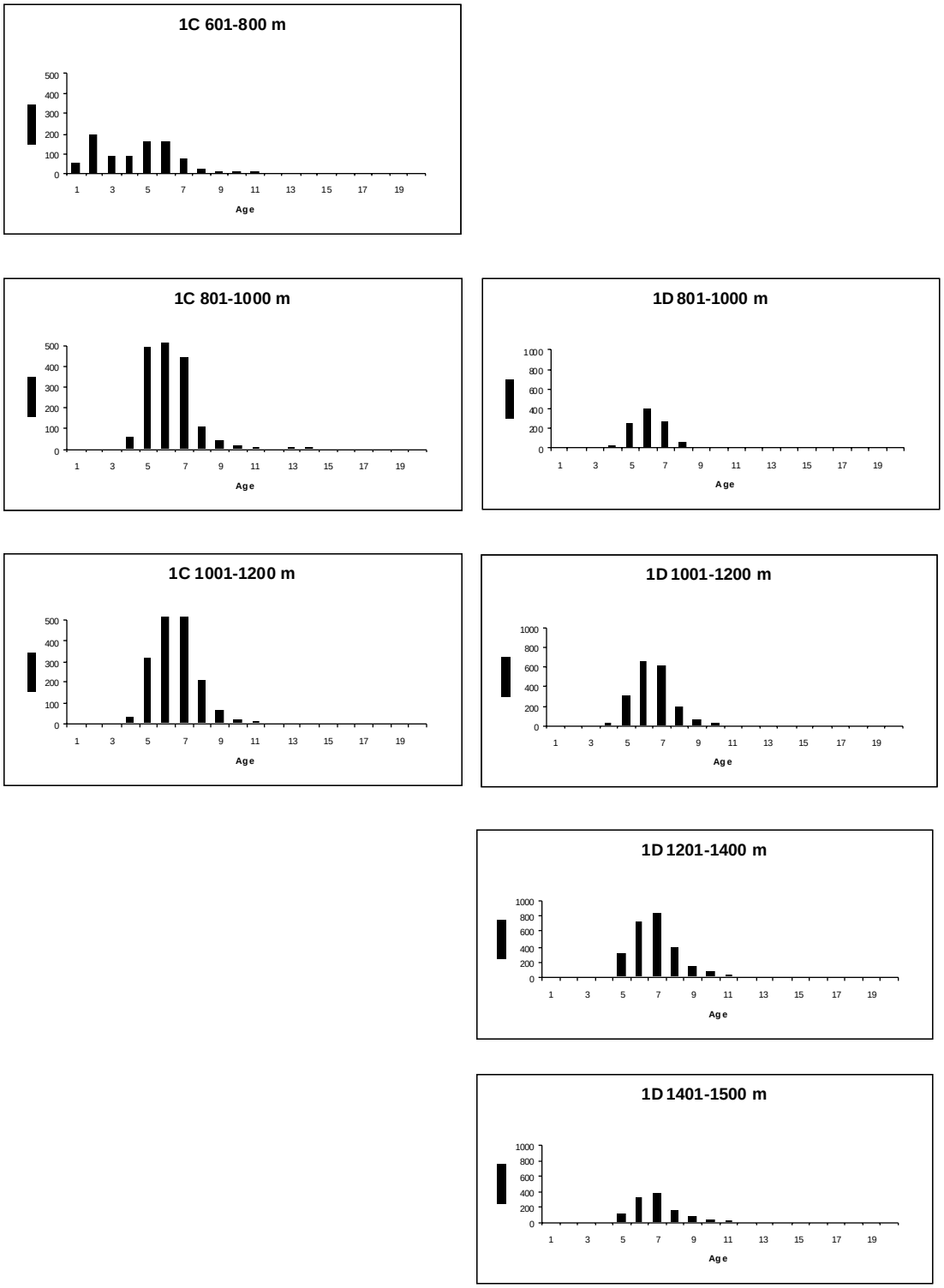

Fig. 5. Age distribution (number km^{-2}) by NAFO Division and depth stratum. Note different scales on y-axis.

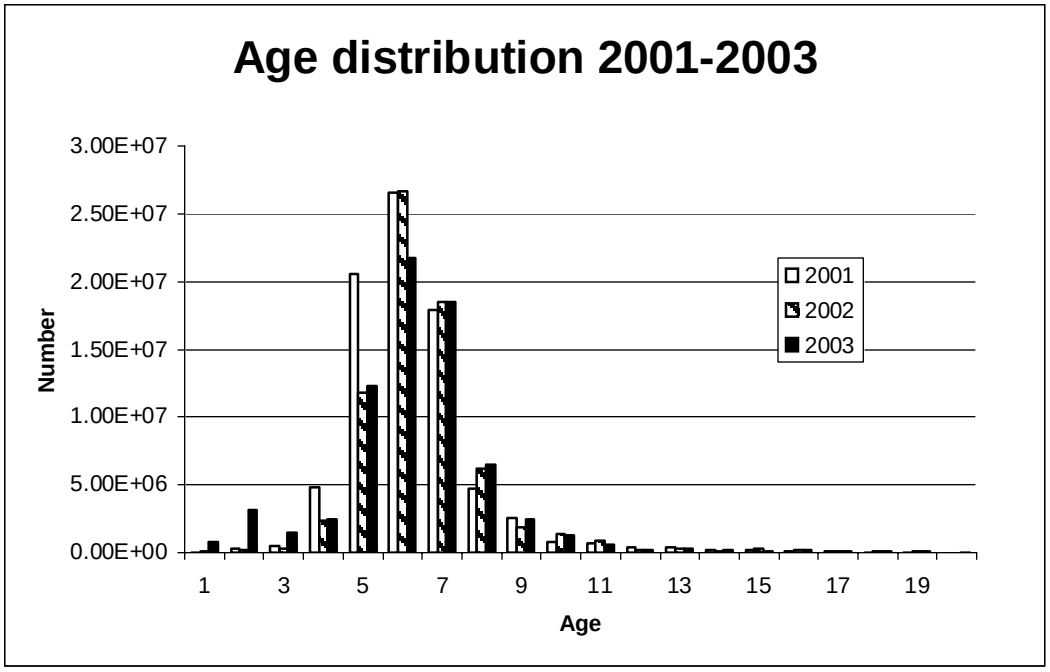

Fig. 6. Overall age distribution (weighted by stratum area) of Greenland halibut in NAFO Div. 1C-1D in 2001- 2003.

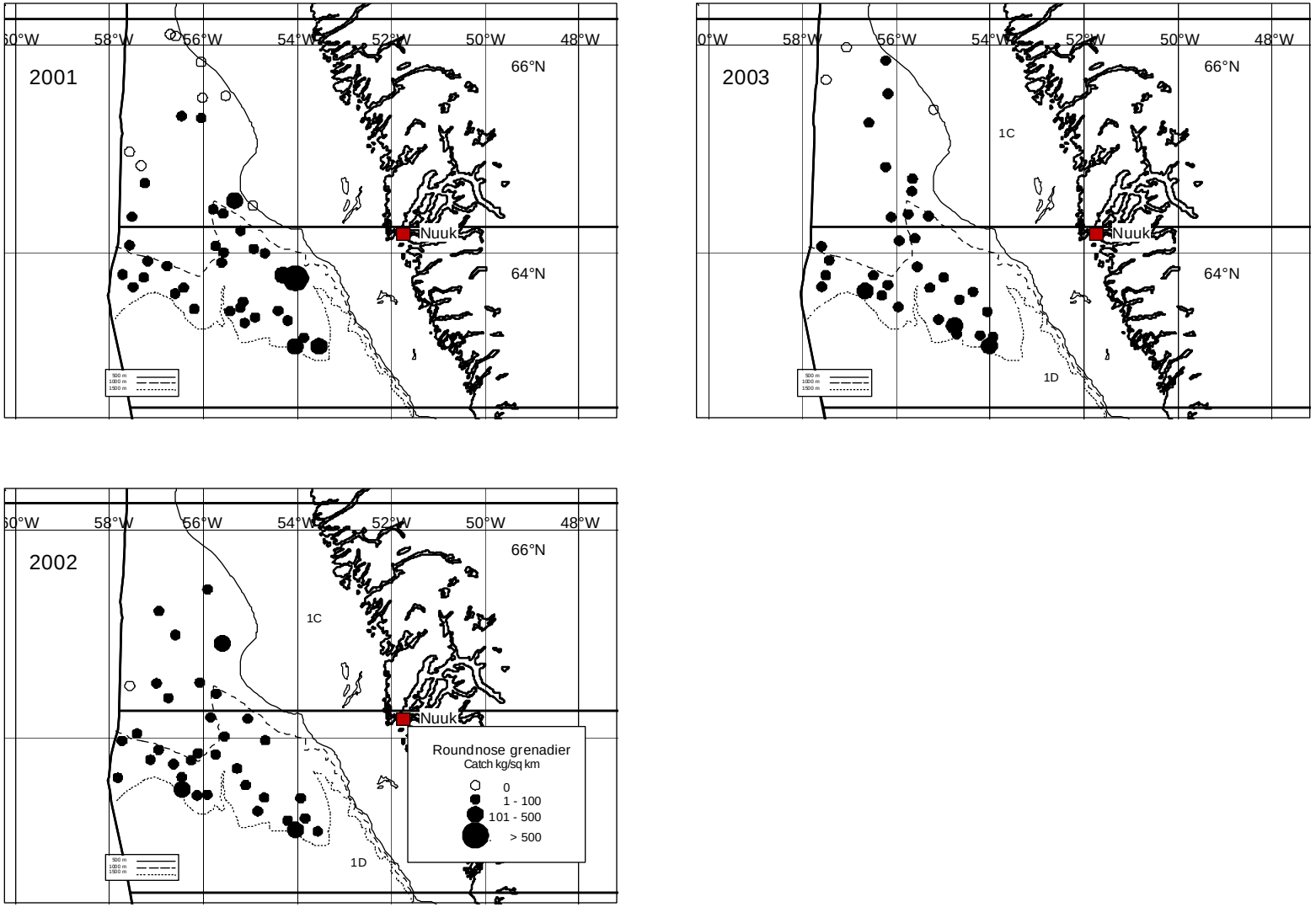

Fig. 7. Distribution of catches of roundnose grenadier in 2001-2003 in kg km^{-2}

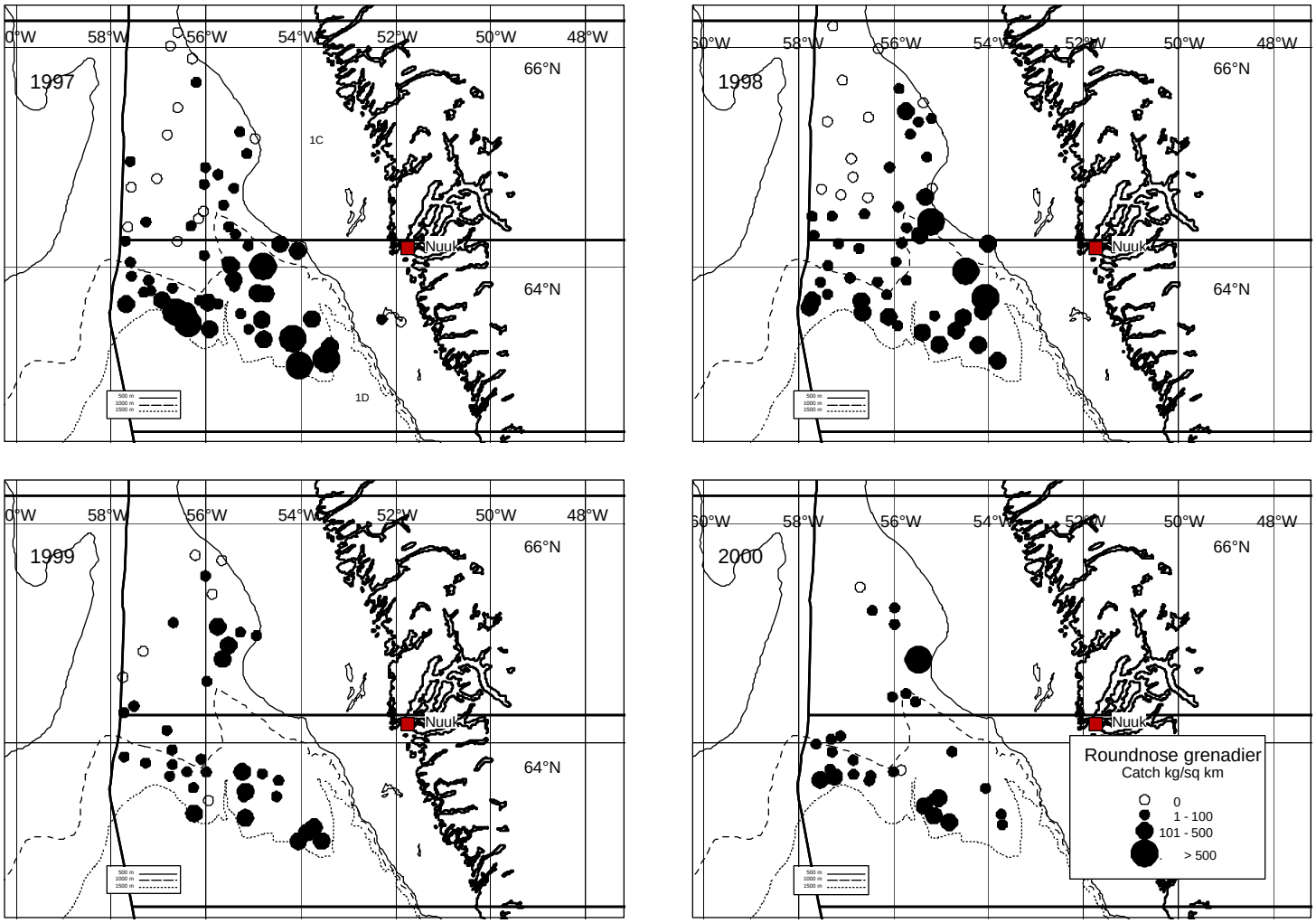

Fig. 7 cont. Distribution of catches of roundnose grenadier during 1997-2000.

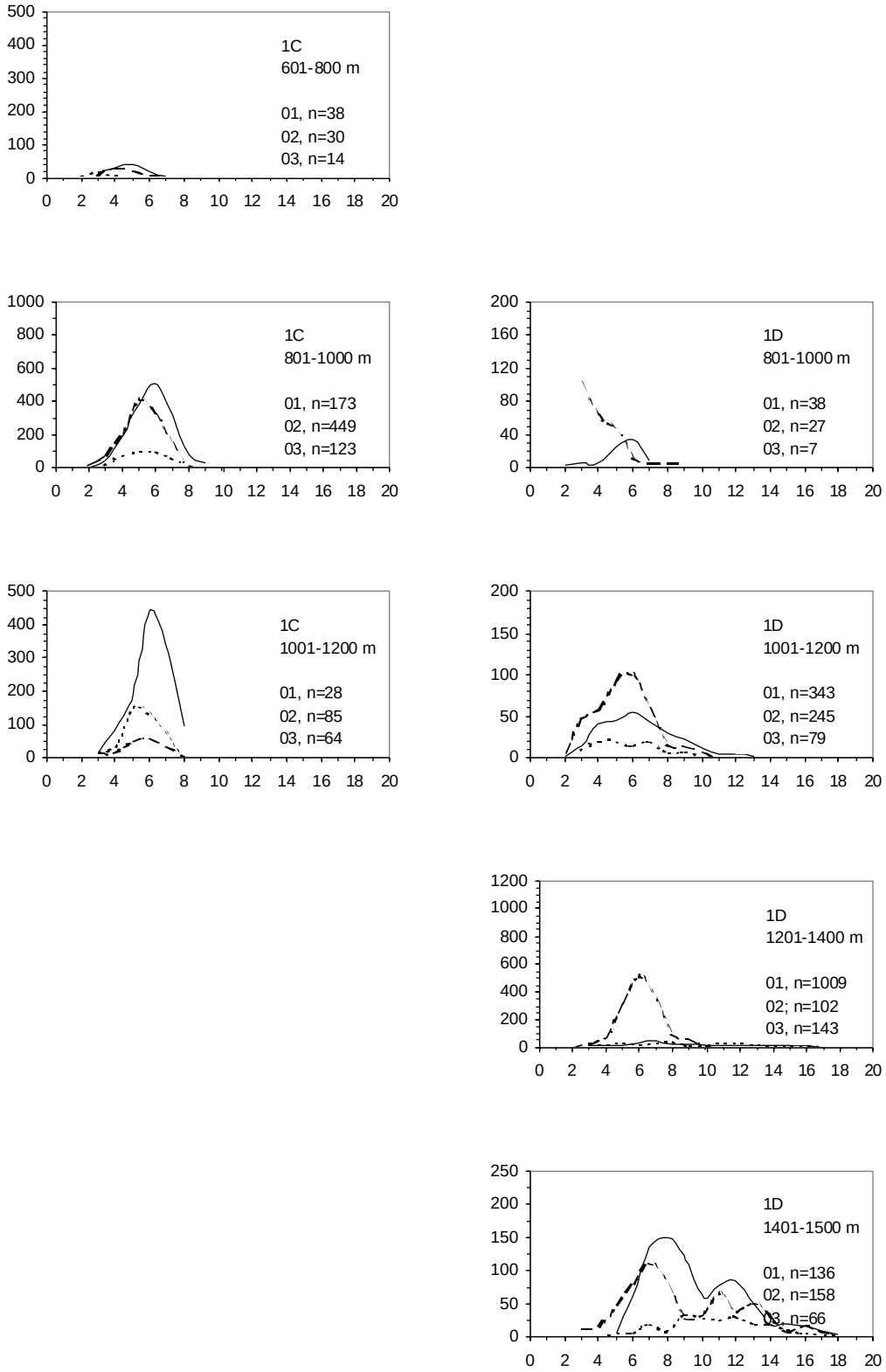

Fig. 8. Length distribution (pre anal fin length) of roundnose grenadier in numbers/km^2 by year and depth strata. Dashed line: 2001. Solid line: 2002. Dotted line: 2003

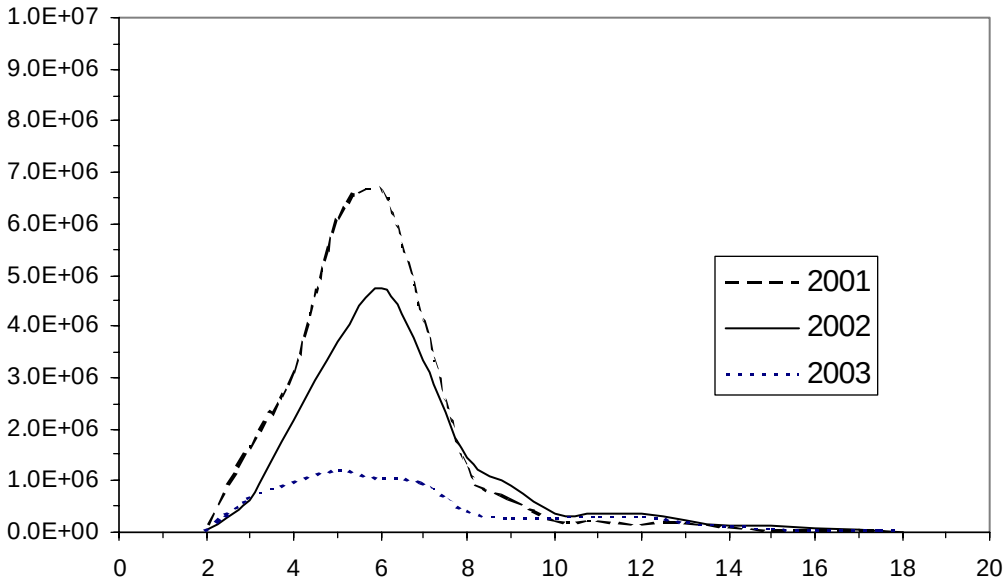

Fig. 9. Overall length distribution of roundnose grenadier (pre anal fin length) in numbers (weighted by stratum area) by year.

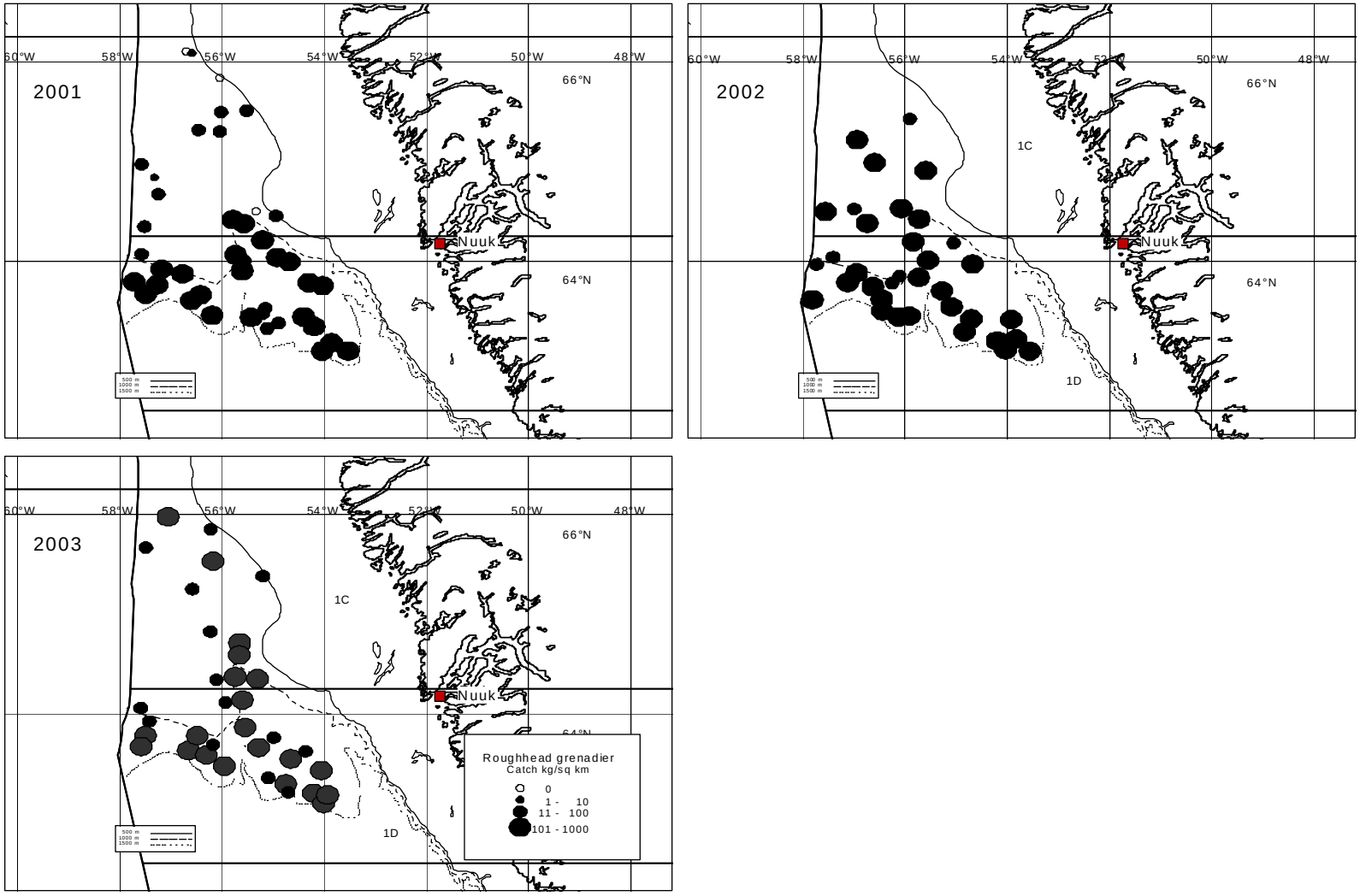

Fig. 10. Distribution of catches of roughhead grenadier in 2001-2003 in kg km^{-2}.

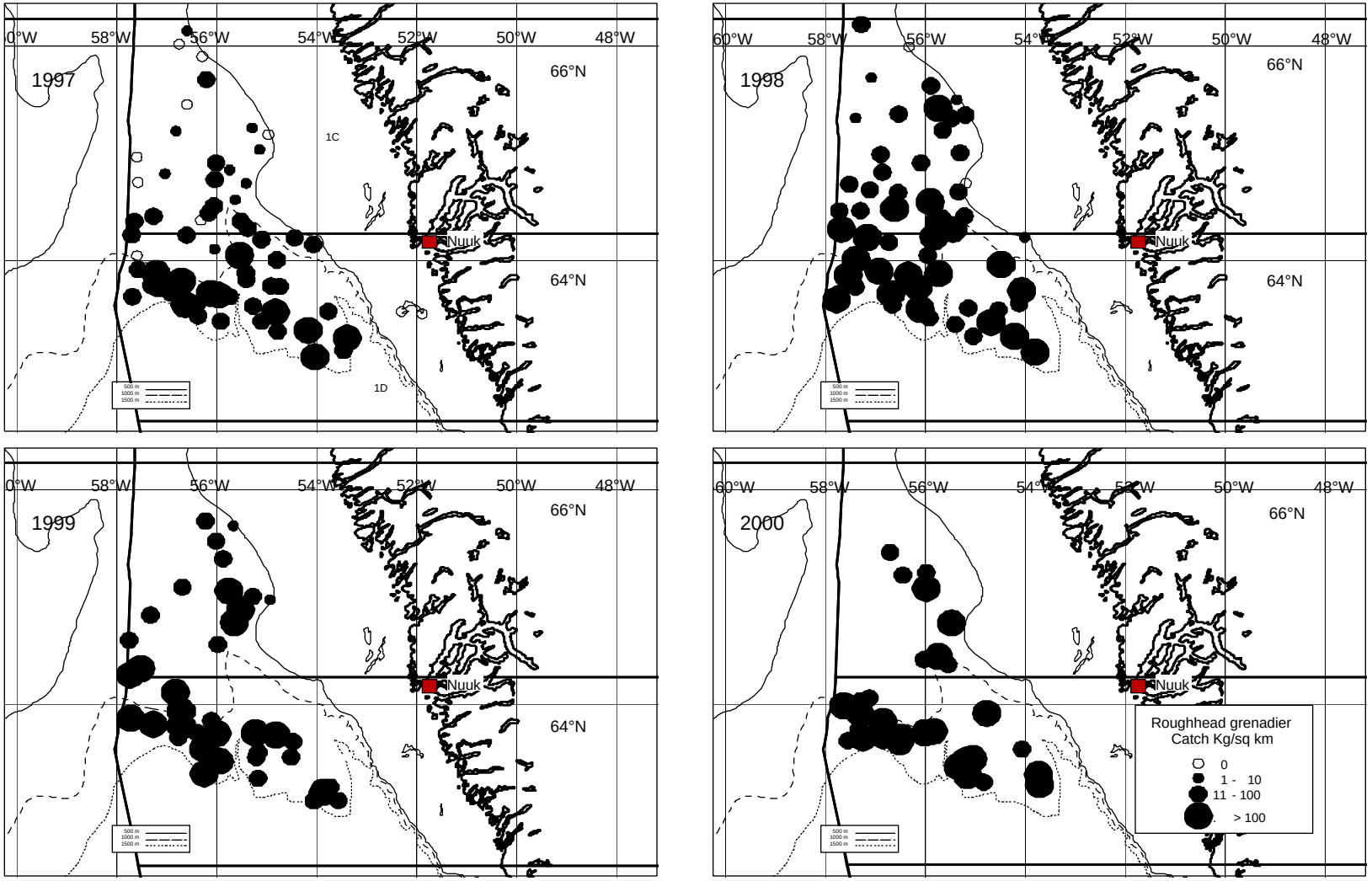

Fig. 10 cont.. Distribution of catches of roughhead grenadier during 1997-2000.

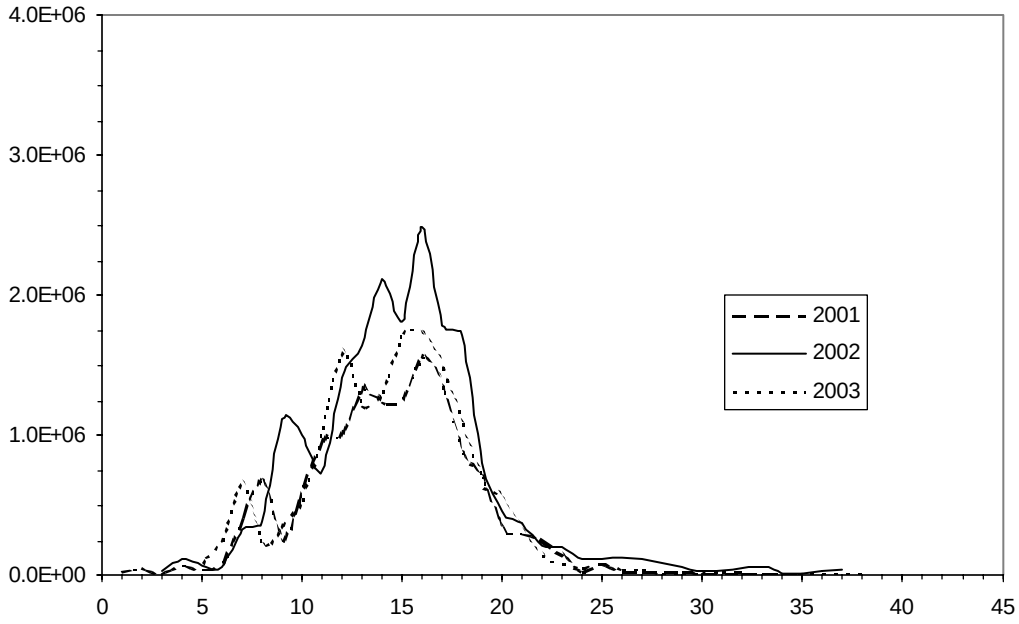

Fig. 11. Overall length distribution (pre anal fin length) of roughhead grenadier in numbers (weighted by stratum area) by year.

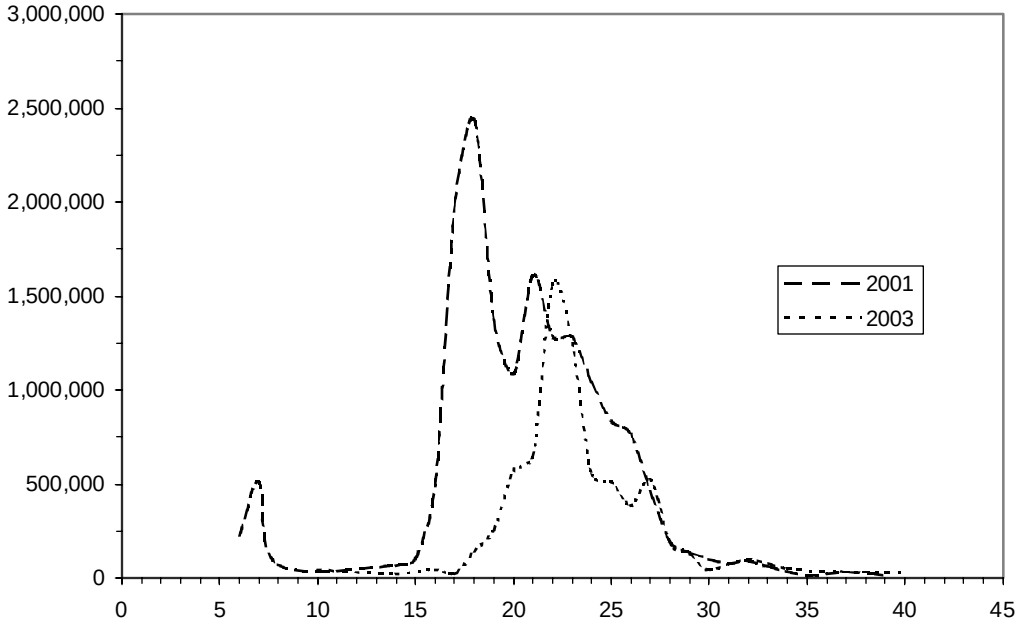

Fig. 12. Overall length distribution (pre anal fin length) of deep sea redfish in numbers (weighted by stratum area) by year. (No obs. in 2002)

Appendix 1. Catch weight and - numbers (not standardised 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.

							Grl. halibut		Roundnose gre.		Roughhead gre.		*S. mentella*	
St. No	Date	Depth	S. Area	Div.	Duration	Temp.	Number	Weight	Number	Weight	Number	Weight	Number	Weight
1	17/9	565	0.0511	1C	22	5.06	1	0.6	0	0.0	13	3.3	37	7.0
2	17/9	727	0.0818	1C	30	3.25	42	30.6	13	0.2	61	15.5	12	2.9
3	17/9	591	0.0786	1C	30	4.82	22	18.7	1	0.0	18	6.4	200	42.4
4	17/9	677	0.0825	1C	30	2.62	110	64.0	0	0.0	22	12.4	8	2.0
5	18/9	622	0.0907	1C	30	2.70	131	41.7	0	0.0	14	4.5	7	0.6
6	19/9	672	0.0429	1C	18	2.36	6	6.0	1	0.1	4	1.2	3	0.6
7	19/9	846	0.0837	1C	30	3.94	107	87.1	7	0.2	27	7.2	1	0.2
8	20/9	928	0.0829	1C	30	4.25	188	153.2	35	1.5	29	9.6	0	0.0
9	20/9	980	0.0801	1C	30	3.91	276	263.9	59	2.2	31	11.6	0	0.0
10	20/9	1049	0.0724	1C	26	3.82	119	139.2	6	0.2	29	11.1	0	0.0
11	20/9	1040	0.0765	1C	30	3.81	197	180.4	58	2.3	44	15.9	0	0.0
12	20/9	886	0.1386	1C	30	3.99	202	171.6	22	1.1	32	10.8	1	0.7
15	20/9	956	0.0846	1D	30	3.74	148	142.0	1	0.1	7	3.9	0	0.0
16	20/9	1087	0.0664	1D	30	3.78	134	131.6	3	0.2	11	5.5	0	0.0
17	20/9	1295	0.0813	1D	30	3.65	73	62.3	7	0.7	62	15.9	0	0.0
18	21/9	1438	0.0784	1D	30	3.55	117	137.3	7	1.6	16	10.5	0	0.0
19	21/9	1438	0.0792	1D	30	3.66	185	206.9	32	8.8	38	19.5	0	0.0
22	21/9	1136	0.0759	1D	30	3.73	204	223.6	3	0.3	22	10.9	0	0.0
23	21/9	1353	0.0872	1D	30	3.55	347	412.3	15	3.8	18	9.2	0	0.0
24	22/9	1164	0.0805	1D	30	3.69	170	171.7	5	0.3	18	4.6	0	0.0
25	22/9	1190	0.0384	1D	17	3.52	30	45.5	3	0.4	13	6.4	0	0.0
27	23/9	1259	0.0336	1D	15	3.67	91	96.1	12	1.5	5	1.5	0	0.0
29	23/9	1287	0.0707	1D	30	3.41	165	192.2	38	9.8	17	9.2	0	0.0
30	23/9	1449	0.0732	1D	30	3.52	15	36.1	5	1.8	7	4.1	0	0.0
31	23/9	1260	0.0815	1D	29	3.54	98	128.4	16	5.2	24	18.1	0	0.0
32	23/9	1432	0.0637	1D	23	3.50	28	39.9	22	7.9	12	6.5	0	0.0
33	23/9	1249	0.0639	1D	26	3.58	209	258.9	6	0.4	26	11.4	0	0.0
35	23/9	1082	0.0948	1D	30	3.64	80	87.4	17	1.1	33	15.3	0	0.0
36	23/9	1118	0.0763	1D	26	3.48	125	135.2	5	0.1	48	14.2	0	0.0
37	24/9	1104	0.0606	1D	22	3.74	67	112.7	5	0.5	8	4.2	0	0.0
38	24/9	1242	0.0811	1D	30	3.56	321	339.4	49	7.1	49	22.1	0	0.0
39	24/9	1195	0.0688	1D	30	3.69	190	215.3	11	0.8	10	4.1	0	0.0
42	24/9	1151	0.0726	1D	30	3.61	229	232.2	5	1.3	36	15.5	0	0.0
43	24/9	921	0.0766	1D	30	3.64	33	27.2	6	0.4	26	6.7	1	0.9
44	24/9	1056	0.0789	1D	30	3.60	222	205.3	22	1.0	38	10.2	0	0.0

Appendix 2. List of species and groups of species recorded in Div. 1C-D in 2003 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	mindepth	maxdepth	mintemp	maxtemp
1	ALA	Alepocephalus agassizzi	0.200	14.200	1	17	1163.5	1449.0	3.50	3.69
2	CAD	Anarhichas denticulatus	0.020	24.000	1	2	846.0	1431.5	3.41	4.25
3	ANT	Antimora rostrata	0.280	20.500	2	44	846.0	1449.0	3.41	4.25
4	BAM	Bajacalifornia megalops	0.080	0.170	1	2	1103.5	1151.0	3.61	3.74
5	BAT	Bathylagus euryops	0.020	5.090	1	88	622.0	1449.0	2.62	4.25
6	BSP	Bathyraja spinicauda	5.750	26.000	1	1	1287.0	1437.5	3.41	3.66
7	BEG	Benthosema glaciale	0.000	0.080	1	29	564.5	1449.0	2.36	5.06
8	POC	Boreogadus saida	0.010	0.020	1	1	622.0	727.0	2.36	3.25
9	BOA	Borostomias antarctica	0.000	0.440	1	7	885.5	1437.5	3.52	4.25
10	CFB	Centroscyllium fabricii	0.370	13.050	1	138	727.0	1294.5	3.25	4.25
11	CHO	Ceratias holboelli	0.460	0.460	1	1	1449.0	1449.0	3.52	3.52
12	CHL	Chaenophryne longiceps	0.050	0.050	1	1	1189.5	1189.5	3.52	3.52
13	CHA	Chauliodus sloani	0.020	0.300	1	7	846.0	1431.5	3.48	4.25
14	CHN	Chiasmodon niger	0.010	0.150	1	4	591.0	1438.0	3.50	4.82
15	CBB	Coryphaenoides brevibarbis	0.010	0.020	1	3	1287.0	1352.5	3.41	3.55
16	CGR	Coryphaenoides guntheri	0.034	1.190	1	17	1039.5	1449.0	3.41	3.82
17	RNG	Coryphaenoides rupestris	0.040	9.800	1	59	591.0	1449.0	2.36	4.82
18	COM	Cottunculus microps	0.150	0.960	1	6	622.0	920.5	2.36	3.64
19	COT	Cottunculus thomsonii	0.220	0.550	1	5	727.0	1039.5	3.25	4.25
20	LUM	Cyclopterus lumpus	0.080	0.730	1	1	885.5	1352.5	3.52	3.99
21	CLM	Cyclothone microdon	0.000	0.000	1	8	955.5	1431.5	3.50	3.78
22	WIT	Glyptocephalus cynoglossus	0.470	0.470	1	1	920.5	920.5	3.64	3.64
23	GOB	Gonostoma bathyphilum	0.000	0.030	1	1	885.5	1294.5	3.61	3.99
24	PLA	Hippoglossoides platessoides	0.040	4.266	1	36	564.5	727.0	2.36	5.06
25	HOA	Holtbyrnia anomala	0.070	0.190	1	2	1352.5	1438.0	3.55	3.55
26	HMC	Holtbyrnia macrops	0.010	0.010	1	1	1431.5	1431.5	3.50	3.50
27	HAF	Hydrolagus affinis	16.500	22.200	1	2	1352.5	1437.5	3.55	3.66
28	LMC	Lampanyctus macdonaldi	0.000	2.450	1	143	591.0	1449.0	2.36	4.82
29	LEM	Leptoclinus maculatus	0.540	0.540	49	49	727.0	727.0	3.25	3.25
30	LIF	Liparis fabricii	0.010	0.410	1	16	622.0	727.0	2.36	3.25
31	LIP	Liparis sp.	0.001	0.001	1	1	955.5	955.5	3.74	3.74
32	KCT	Lithodes maja	0.890	0.890	13	13	591.0	591.0	4.82	4.82
33	LYE	Lycodes esmarki	0.190	0.190	1	1	676.5	676.5	2.62	2.62
34	LYN	Lycodes eudipleurostictus	0.220	0.220	3	3	622.0	622.0	2.70	2.70
35	ELZ	Lycodes sp.	0.030	0.160	1	4	622.0	885.5	2.70	3.99
36	RHG	Macrourus berglax	1.184	22.050	4	62	564.5	1449.0	2.36	5.06
37	MAA	Magnisudis atlantica	0.100	0.100	1	1	846.0	846.0	3.94	3.94
38	MAL	Malacosteus niger	0.030	0.050	1	1	1103.5	1352.5	3.55	3.74
39	MMI	Maulisa microlepis	0.001	0.001	1	1	1294.5	1294.5	3.65	3.65
40	BLI	Molva dypterygia	0.870	0.870	2	2	564.5	564.5	5.06	5.06
41	MYP	Myctophum punctatum	0.000	0.000	1	1	1189.5	1189.5	3.52	3.52
42	NEG	Neolithodes grimaldi	1.850	5.550	1	3	885.5	1118.0	3.48	3.99
43	NZA	Nezumia aequalis	0.330	0.830	2	5	920.5	1055.5	3.60	3.64
44	NZB	Nezumia bairdi	0.310	0.530	2	4	885.5	1438.0	3.55	3.99
45	NOT	Notacanthus chemnitzii	0.300	7.150	1	8	727.0	1449.0	3.25	4.25
46	NOK	Notoscopelus kroeyri	0.010	0.010	1	1	1260.0	1260.0	3.54	3.54
47	OCT	Octopus	0.032	11.900	1	9	591.0	1438.0	2.62	4.82
48	ONA	Onogadus argentatus	0.000	0.240	1	4	622.0	1039.5	2.36	3.94
49	ONN	Onogadus ensis	0.190	4.400	1	7	622.0	1438.0	2.62	3.99
50	PAC	Paraliparis copei	0.000	0.074	1	12	676.5	1287.0	2.62	4.25
51	POL	Polyacanthonotus rissoanus	0.060	0.460	1	2	1055.5	1437.5	3.55	3.66
52	RBT	Raja bathyphila	0.560	2.190	1	1	1055.5	1438.0	3.54	3.69
53	RFL	Raja fyllae	0.120	0.480	1	1	591.0	622.0	2.70	4.82
54	RRD	Raja radiata	1.100	1.100	1	1	676.5	676.5	2.62	2.62
55	GHL	Reinhardtius hippoglossoides	0.600	412.250	1	347	564.5	1449.0	2.36	5.06
56	SCB	Scopelogadus beani	0.080	0.080	0	0	920.5	920.5	3.64	3.64
57	SCO	Scopelosarus lepidus	0.080	0.910	1	6	920.5	1449.0	3.41	3.82
58	REG	Sebastes marinus	0.630	0.800	1	1	564.5	591.0	4.82	5.06
59	REB	Sebastes mentella	0.210	42.350	1	200	564.5	920.5	2.36	5.06
60	RED	Sebastes sp.	0.000	0.006	1	2	928.0	1287.0	3.41	4.25
61	SSI	Serasidae	0.000	0.000	1	1	1163.5	1163.5	3.69	3.69
62	SER	Serrivomer beani	0.020	0.400	1	4	920.5	1449.0	3.48	4.25
63	GSK	Somniosus microcephalus	10.550	10.550	1	1	1103.5	1103.5	3.74	3.74
64	SQT	Squit	0.000	2.000	1	10	591.0	1449.0	2.36	4.82
65	STO	Stomias boa	0.000	0.070	1	3	727.0	1449.0	3.25	4.25
66	SYN	Synapobranchus kaupi	0.010	9.000	1	34	591.0	1449.0	2.36	4.82
67	TRA	Trachyrynchus murrayi	0.150	0.710	1	2	885.5	1249.0	3.52	3.99
68	XEC	Xenodermichthys copei	0.05	0.05	1	1	1449.0	1449.0	3.52	3.52