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Survey for Greenland Halibut in NAFO Divisions 1C-1D, 2000

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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 mainly aimed at Greenland halibut and roundnose grenadier. The paper gives biomass and abundance estimates and length frequencies for Greenland halibut, roundnose and roughed grenadier, together with age and maturity data for Greenland halibut. The biomass of Greenland halibut was estimated as 59 000 tons, which is a slight decrease, compared to 64 000 tons in 1999. The biomass of roundnose grenadier was estimated as 5 600 tons. Only 30 of the 70 planed tows were made due to bad weather.

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.

Materials and Methods

The survey in 2000 took place during the period 26/9-4/10.

Stratification

The survey covered NAFO Div. 1C and 1D between the 3-nm line and the 200-nm line or the midline to Canada at depths between 400 and 1 500 m. (Most of the joint Greenland/Japan surveys also covered Div.1B. This area is, however, covered down to 600 m by the Greenland Shrimp Survey and the area of depths > 600 m in Div. 1B is small). 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 mainly based on Greenland Geological Survey's 10 m depth contour maps. These maps do not cover the western part of the survey area, but here a Canadian map and depth soundings made during previous surveys were used. 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 (5 hauls a day in 14 days). Basically hauls were allocated proportional to stratum area. Analysis of previous years survey showed that Div. 1C depth stratum 601-800 m traditionally had been oversampled, while depth stratum 1001-1200 m and 1201-

1400 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:

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

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

In 15 cases the distance between otter boards could not be measured at depths >800 m because of a defect Scanmar sounds. The distance between otter boards 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. Trawling took place in daytime only (7 a.m. to 7 p.m. local time, 9 to 21 UTC).

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) 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 = 403) 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 30 successful hauls were made, giving a mean coverage of the surveyed area on 1 537 km^2 per haul (Table 1). The number of tows was reduced compared to the 70 planned due to bad weather. Three strata: 1C 401-600 m (3 366 km^2), 1D 401-600 (903 km^2) and 601-800 m (1 940 km^2) were not covered at all. In total 63 species or groups of species were recorded (Appendix 1).

Greenland halibut (*Reinhardtius hippoglossoides*)

Greenland halibut was caught in all hauls and the catches ranged between 6.7 kg at 667 m in Div. 1C and 302.9 kg at 1 212 m in Div. 1D (Fig. 1, Table 2).

The biomass of Greenland halibut in Div. 1C-1D, was estimated at 59 092.4 tons (S.E. 5 543.3) which is not statistically different (95% level) from the estimates from 1997-1999 (Jørgensen 2000, Jørgensen 1999 and Jørgensen 1998b).

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

Three strata which traditionally yield biomasses <1 500 ton were not covered in 2000. The highest densities were found at depths >1 200 m in Div. 1D (Table 3).

The abundance in Div. 1C-1D was estimated at 61.710×10^6 (S.E. 5.976×10^6), which is not statistically different (95% level) from the estimates from 1997-1999.

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

The three strata that were not covered usually yield abundances around 1×10^6 individuals. The highest concentrations were found at 1 001-1 200 m in Div. 1C and at depths >1 200 m in Div. 1D (Table 4). Estimated abundance by age is given in Table 5.

The length ranged from 15 cm to 99 cm. Generally the length distributions in the different depth strata were dominated by a single mode. 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) was dominated by a mode at 45 cm with two smaller modes at 43 and 47 cm. Normally the most dominant mode is around 47-48 cm (Fig. 3).

The age ranged from 1 to 19 years with the youngest fish in shallow water in Div. 1C and the oldest fish in deep water in Div. 1D (Fig. 4). Generally the age increased by depth and the age composition was dominated by ages 5-7. The overall age distribution (weighted by stratum area) was mono-modal with a mode around age 6 (Fig. 5). Mean weight and length at age is given in Table 6.

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 7).

Roundnose grenadier (*Coryphaenoides rupestris*)

Roundnose grenadier was caught in 29 of the 30 hauls, but the catches were low, ranging from <1.0 kg in several hauls to 67.5 kg at 853 m depths in Div. 1C (Fig. 6, Table 2).

The biomass of roundnose grenadier in Div. 1C-1D, was estimated at 5 593.7 tons (S.E. 2 616.8) which is at the same level as in the previous surveys and very low compared to the late-1980s (Jørgensen, 2000; Jørgensen, 1999 Jørgensen, 1998a; Jørgensen 1998b).

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

Most of the biomass was found in Div. 1C at 801-1 000 m, which also had the highest density (Table 8).

The abundance in Div. 1C-1D was estimated at 99.524×10^6 (S.E. 67.311×10^6), which is more than three times the estimate in 1999. However, the increase is not statistically significant (95% level) because of the very high variance on the estimate from 2000. The increase in abundance is caused by a very high number of small fish in 801-1 000 m in Div. 1C, where 75% of the abundance was found (Table 9, Fig. 7)

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

Pre anal fin length ranged from 2.0 to cm 15 cm. Generally the length distributions in the different depth strata were dominated by 1-2 modes. Fish size increased generally with increasing depth (Fig. 7). The overall length distribution (weighted by stratum area) was totally dominated by a single mode around 5 cm (Fig.8).

Roughhead grenadier (*Macrourus berglax*)

Roughhead grenadier was caught in all 30 hauls, but the catches were low, ranging from 0.5 kg to 59.7 kg at 853 m in Div. 1C (Fig. 9, Table 2).

The biomass of roughhead grenadier in Div. 1C-1D was estimated at 7 178.1 tons (S.E. 2 226.5) and the increasing trend seen since 1997 had continued although the increase not is statistically significant (95% level).

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

The biomass is probably slightly underestimated due to the lack of coverage the three shallow strata, but the biomass at shallow water is usually low. About 1/3 of the biomass was found in Div. 1C in depth stratum 801-1 000 m where also the highest density was observed (Table 10).

The abundance in Div. 1C-1D was estimated at 20.282×10^6 (S.E. $7.182 \times 10^{6)}$ and the abundance has increased significantly (95% level) since 1997.

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

Almost ½ the abundance was found in depth stratum 801-1 000 m in Div. 1C (Table 11).

Pre anal fin length ranged from 4 to cm 35 cm. The overall length distribution (weighted by stratum area) was dominated by one clear mode at 13 cm (Fig. 10).

Deep-sea redfish (*Sebastes mentella*)

Deep-sea redfish was caught in 10 the 30 hauls and the catches were very low, ranging from <0.1 kg to 4.8 kg (Fig. 11, Table 2).

The survey did not cover the shallow areas where deep-sea redfish is most common. In previous surveys almost all the biomass has been was found at depths <800 m.

The overall length distribution ranged from 17 to 42 cm with modes at 26 and 28 cm (Fig. 12).

Temperature

The bottom temperature ranged from 2.3°C in depth stratum 601-800 m in Div. 1C to 4.1 °C in depth stratum 801-1 000 m in Div. 1C (Table 2). Mean temperatures by NAFO Div. and depth strata are given in Table 16.

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

Div.	Depth stratum (m)						Tot.
	401-600	601-800	801-1000	1001-1200	1201-1400	1401-1500	
1C	3366 (4) 0	16120 (12) 3	6066 (8) 3	611 (2) 2	-	-	26163 (26) 8
1D	903 (2) 0	1940 (3) 0	3874 (5) 2	10140 (18) 11	6195 (12) 7	3091 (4) 2	26143 (44) 22
Tot	4269 (6) 0	18060 (15) 3	9940 (13) 5	10751 (20) 13	6195 (12) 7	3091 (4) 2	52306 (70) 30

Table 2. Catch weight and - numbers (not standardised to kg/km^2) of Greenland halibut, roundnose and roughhead grenadier, *Sebastes mentella* and American place by haul. Depth in m, swept area in km^2 and bottom temperature in °C.

								Greenland halibut		Roundnose grenadier		Roughhead grenadier		Sebastes mentella	
tat. No	Month	Day	Depth	SWEPAREA	Div.	Stra..	Temp.	Number	Kg	Number	Kg	Number	Kg	Number	Kg
1	9	27	667.0	0.04540	1C	8	2.3	12	6.7	2	0.0	2	0.5	2	0.6
2	9	27	720.0	0.06829	1C	8	3.8	33	19.6	14	0.3	17	5.5	16	3.8
3	9	27	788.5	0.08385	1C	8	3.8	77	49.2	215	6.4	17	4.8	21	4.8
4	9	27	822.5	0.08554	1C	10	3.9	87	69.7	220	7.5	33	10.0	2	1.1
5	9	27	853.0	0.05136	1C	10	4.1	92	65.3	1746	67.6	196	59.7	4	0.0
6	9	28	915.0	not valid	1C	10	3.6	17	11.4	924	47.3	42	11.4	0	0.0
7	9	28	1036.0	0.07411	1C	12	.	226	209.5	71	4.0	45	16.3	1	0.3
8	9	28	1052.0	0.07523	1C	12	.	163	159.9	59	3.5	20	6.0	1	0.1
9	9	28	939.5	0.07695	1C	10	.	82	70.0	21	1.0	22	5.5	1	0.3
10	9	29	877.5	0.03694	1D	10	3.6	15	15.6	12	0.5	8	2.5	1	0.1
11	9	29	945.5	0.07337	1D	10	3.7	130	113.1	8	1.0	9	4.7	0	0.0
12	9	29	1026.0	0.07675	1D	12	3.5	168	143.1	9	1.3	17	14.6	1	0.2
13	9	29	1089.0	0.06608	1D	12	3.5	156	139.7	2	0.1	16	7.6	0	0.0
14	9	30	1455.0	0.07111	1D	15	3.2	178	197.7	87	28.4	15	6.9	0	0.0
15	9	30	1463.5	0.07374	1D	15	3.3	208	240.9	67	22.0	48	19.9	0	0.0
16	9	30	1341.5	0.07599	1D	14	3.2	66	79.9	12	1.9	18	6.8	0	0.0
17	9	30	1383.5	0.07075	1D	14	3.3	171	164.5	16	4.0	19	12.2	0	0.0
18	10	1	1151.5	0.06989	1D	12	3.4	233	228.5	6	1.2	42	18.8	0	0.0
19	10	1	1347.0	0.07337	1D	14	3.3	128	131.4	24	7.0	16	9.3	0	0.0
20	10	1	1272.0	0.07040	1D	14	3.4	203	181.6	9	2.0	41	22.7	0	0.0
21	10	1	1065.0	0.06711	1D	12	3.5	106	96.4	6	0.3	30	9.2	0	0.0
22	10	1	1172.5	0.08517	1D	12	3.4	109	100.4	0	0.0	24	8.9	0	0.0
23	10	2	1212.0	0.04850	1D	14	3.2	245	302.9	52	13.8	28	17.7	0	0.0
24	10	2	1129.0	0.05084	1D	12	3.4	80	89.4	33	3.0	21	6.3	0	0.0
25	10	2	1118.5	0.01927	1D	12	3.4	32	32.5	17	2.8	17	4.6	0	0.0
26	10	2	1319.5	0.06540	1D	14	3.3	89	130.3	31	11.6	24	8.0	0	0.0
27	10	2	1310.5	0.05992	1D	14	3.3	97	117.6	52	18.4	17	4.6	0	0.0
28	10	3	1107.0	0.06969	1D	12	3.4	102	126.0	5	0.2	17	11.0	0	0.0
29	10	3	1053.0	0.04543	1D	12	3.4	76	85.3	15	0.6	17	7.9	0	0.0
30	10	3	1082.0	0.06607	1D	12	3.4	37	52.6	15	1.9	15	5.2	1	0.2
31	10	4	1176.0	0.04410	1D	12	3.4	23	28.7	3	0.2	20	6.7	0	0.0

Table 3. Biomass (tons) of Greenland halibut by Division and depth stratum, 2000.

Division	Depth (m)	Area	Hauls	Mean sq/km	Biomass	SE
1C	601-800	16120	3	0.3404	5488.0	2088.5
	801-1000	6066	3	0.9987	6058.1	844.0
	1001-1200	611	2	2.4762	1513.0	214.3
1D	801-1000	3874	2	0.9819	3803.9	2167.8
	1001-1200	10140	11	1.6764	16999.2	2153.5
	1201-1400	6195	7	2.564	15884.2	3963.1
	1401-1500	3091	2	3.0236	9346.1	752.0
ALL		46097	30	1.2819	59092.4	5543.3

Table 4. Abundance of Greenland halibut by Division and depth stratum, 2000

Division	Depth (m)	Area	Hauls	Mean sq/km	Abundan.	SE
1C	601-800	16120	3	555.3	9.0E+06	3.1E+06
	801-1000	6066	3	1291.4	7.8E+06	1.5E+06
	1001-1200	611	2	2608.2	1.6E+06	2.7E+05
1D	801-1000	3874	2	1088.9	4.2E+06	2.6E+06
	1001-1200	10140	11	1654.1	1.7E+07	2.4E+06
	1201-1400	6195	7	2277.9	1.4E+07	3.3E+06
	1401-1500	3091	2	2662.0	8.2E+06	4.9E+05
ALL		46097	30	1338.7	6.2E+07	6.0E+06

Table 5. Estimated abundance by age from Divisions 1C-1D from the surveys in 1997-2000. The Age-length key from 1998 is applied on the 1997 data.

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

Table 6. Mean weight and mean length-at-age of Greenland halibut, 2000-1995.

	2000		1999		1998		1997		1996		1995	
AGE	Weight	length	weight	length	weight	length	weight	length	weight	length	weight	length
1	25.00	13.50										
2	75.00	21.00	64.00	21.00	38.22	18.70	23.33	15.33			50.00	20.00
3	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	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	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	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	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	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	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	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	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	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	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	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	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	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	8492.00	91.80			10684.00	95.40	10796.67	97.83	9208.33	91.94	10413.64	94.64
18	8590.00	92.25	12500.00	99.00					10127.27	95.27	11180.00	97.00
19	9645.00	91.50			12850.00	99.00			11168.18	98.45	11566.67	98.33
20									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 7. Maturity-at-age in percent, females, Divisions 1C-1D, 2000.

	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 8. Biomass of (tons) roundnose grenadier by Division and depth stratum, 2000.

Division	Depth (m)	Area	Hauls	Mean sq/km	Biomass	SE
1C	601-800	16120	3	0.0269	433.7	398.8
	801-1000	6066	3	0.4723	2865.1	2563.1
	1001-1200	611	2	0.0503	30.7	2.3
1D	801-1000	3874	2	0.0136	52.6	0.2
	1001-1200	10140	11	0.0267	270.8	131.1
	1201-1400	6195	7	0.1392	862.3	278.4
	1401-1500	3091	2	0.3489	1078.4	156.2
ALL		46097	30	0.1214	5593.7	2616.8

Table 9. Abundance of roundnose grenadier by Division and depth stratum, 2000.

Division	Depth (m)	Area	Hauls	Mean sq/km	Abundan.	SE
1C	601-800	16120	3	937.7	1.5E+07	1.3E+07
	801-1000	6066	3	12283.1	7.5E+07	6.6E+07
	1001-1200	611	2	871.2	5.3E+05	5.3E+04
1D	801-1000	3874	2	216.9	8.4E+05	4.2E+05
	1001-1200	10140	11	231.9	2.4E+06	8.7E+05
	1201-1400	6195	7	464.7	2.9E+06	8.6E+05
	1401-1500	3091	2	1066.1	3.3E+06	4.9E+05
ALL		46097	30	2159.0	1.0E+08	6.7E+07

Table 10. Biomass (tons) of roughhead grenadier by Division and depth stratum, 2000.

Division	Depth (m)	Area	Hauls	Mean sq/km	Biomass	SE
1C	601-800	16120	3	0.0496	799.5	329.3
	801-1000	6066	3	0.4503	2731.4	2161.5
	1001-1200	611	2	0.1499	91.6	42.8
1D	801-1000	3874	2	0.0659	255.2	7.0
	1001-1200	10140	11	0.1583	1604.7	175.0
	1201-1400	6195	7	0.1822	1128.6	269.6
	1401-1500	3091	2	0.1835	567.1	267.1
ALL		46097	30	0.1557	7178.1	2226.5

Table 11. Abundance of roughhead grenadier by Division and depth stratum, 2000

Division	Depth (m)	Area	Hauls	Mean sq/km	Abundan.	SE
1C	601-800	16120	3	165.2	2.7E+06	1.0E+06
	801-1000	6066	3	1496.1	9.1E+06	7.0E+06
	1001-1200	611	2	436.5	2.7E+05	1.0E+05
1D	801-1000	3874	2	169.6	6.6E+05	1.8E+05
	1001-1200	10140	11	398.8	4.0E+06	6.1E+05
	1201-1400	6195	7	362.0	2.2E+06	3.7E+05
	1401-1500	3091	2	430.9	1.3E+06	6.8E+05
ALL		46097	30	440.0	2.0E+07	7.2E+06

Table 12. 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				3.3	..5	3	4.0	.1	3	.	.	.						
1D							3.7	.05	2	3.4	.01	11	3.3	.03	7	3.3	.05	2

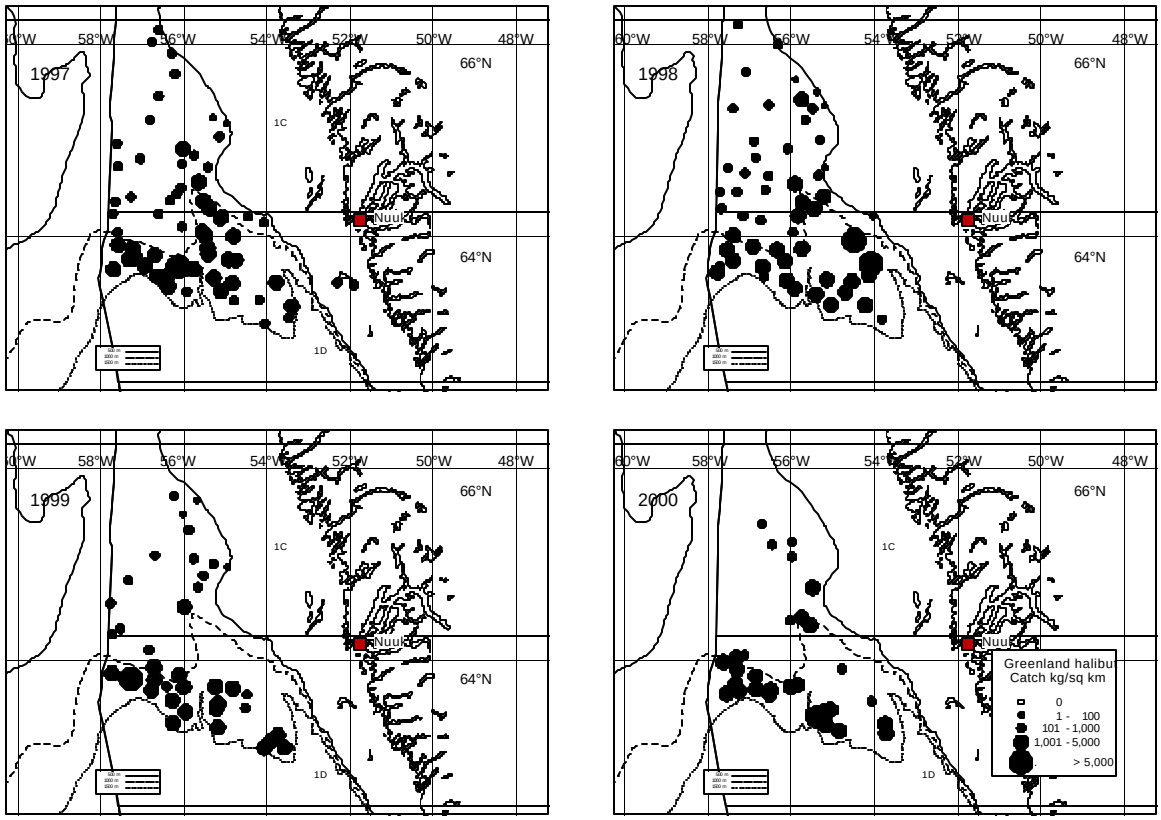

Fig. 1. Distribution of catches of Greenland halibut during 1997 – 2000 in kg km^2

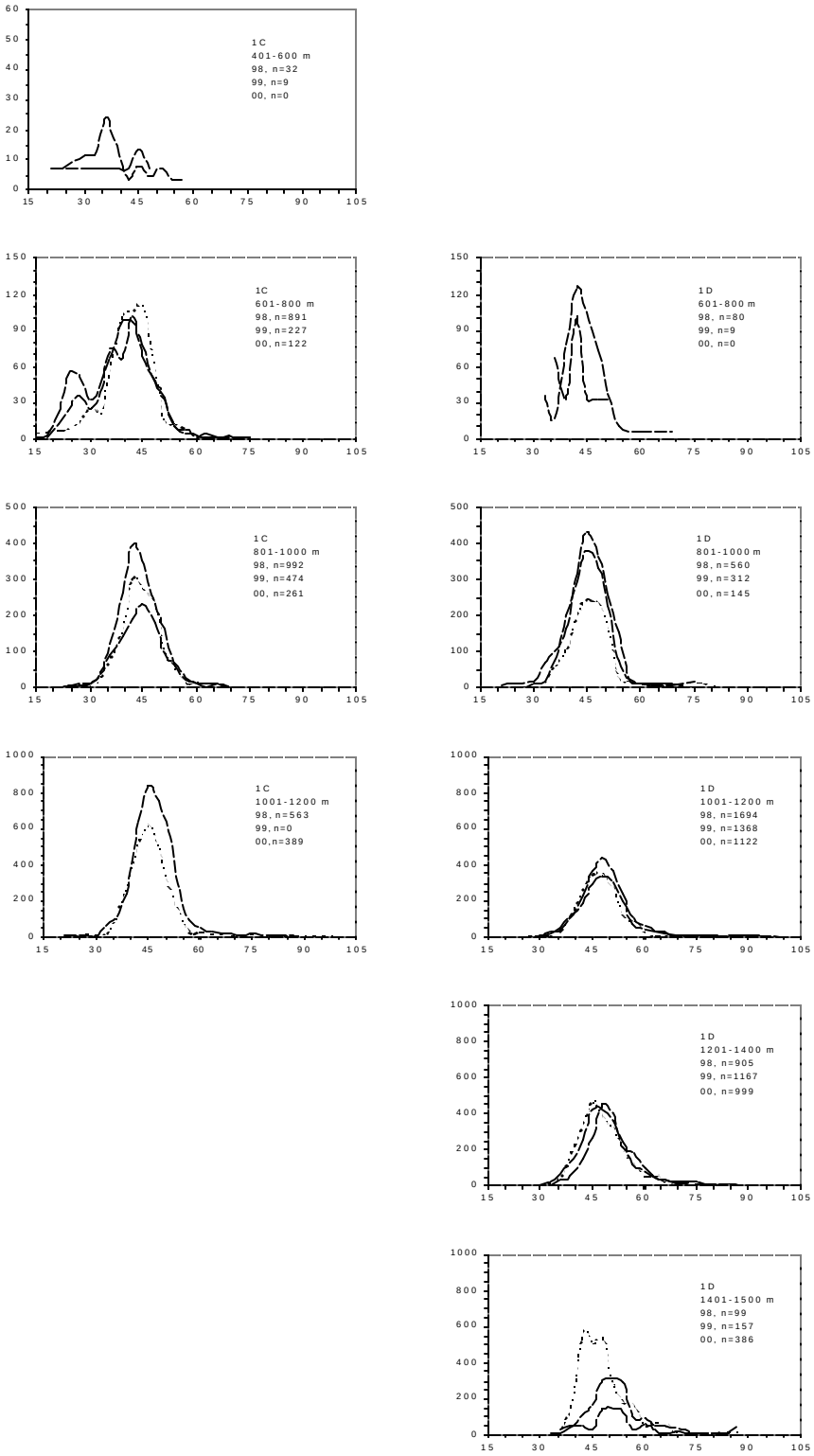

Fig. 2. Length distribution in numbers/km^2 of Greenland halibut (3 cm groups) by year, NAFO Division and depth stratum. Dashed line: 1998, solid line: 1999, dotted line: 2000.

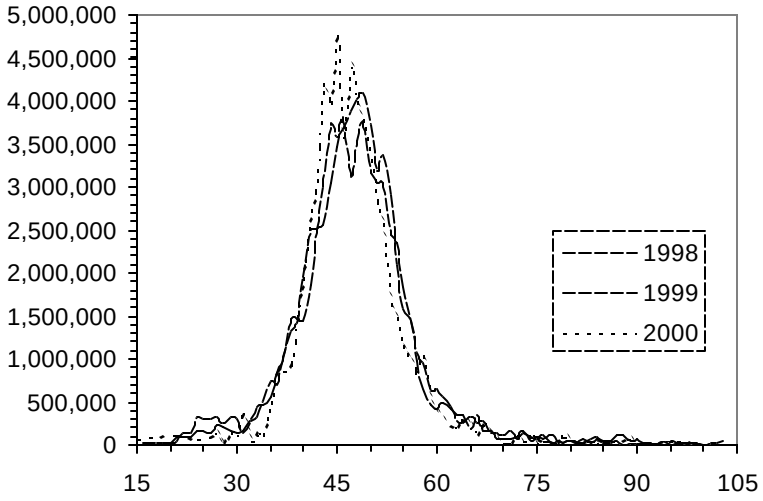

Fig. 3. Overall length distribution of Greenland halibut in numbers (weighted by stratum area) by year.

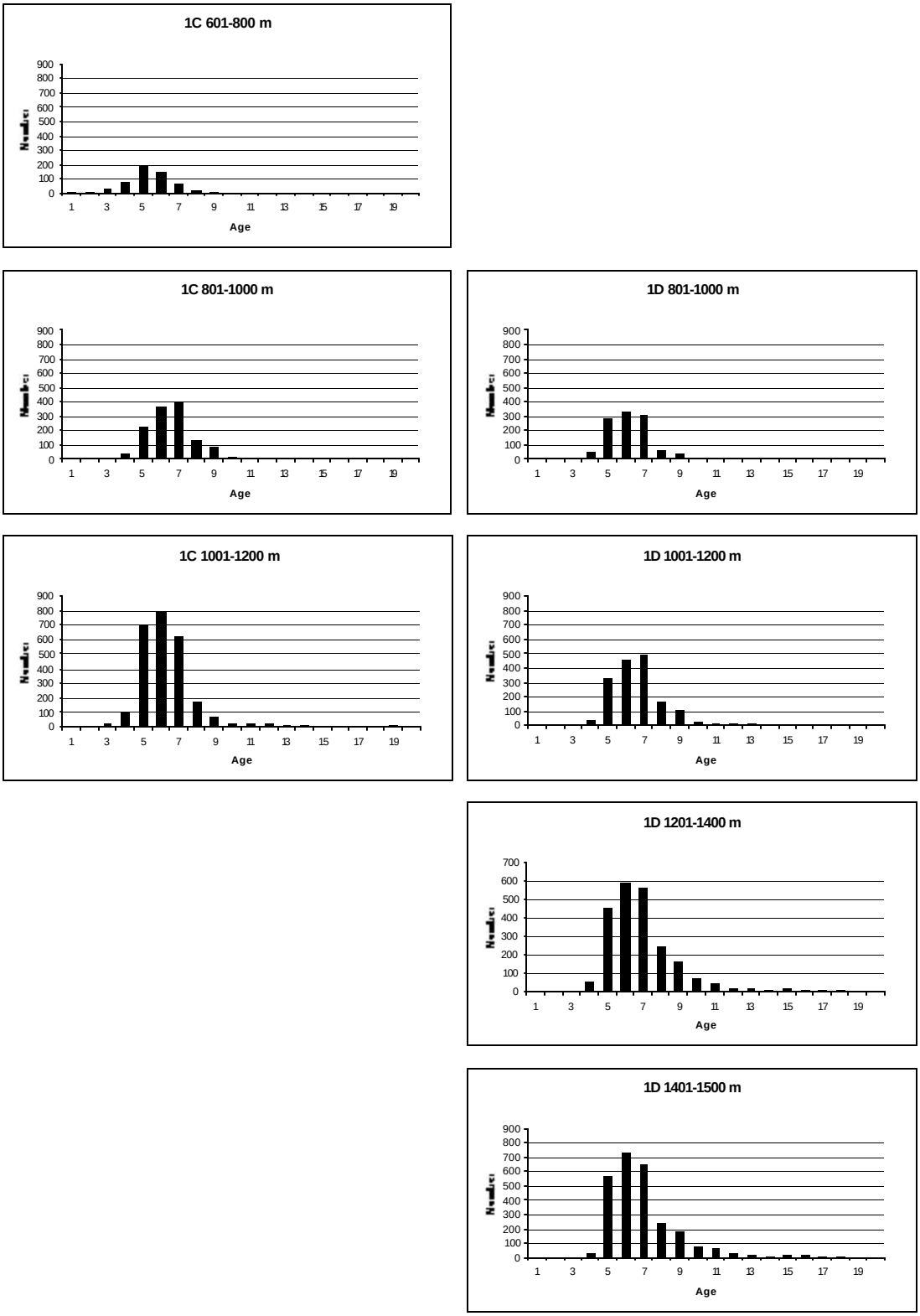

Fig 4. Age distribution (number/km^2) by NAFO Division and depth stratum.

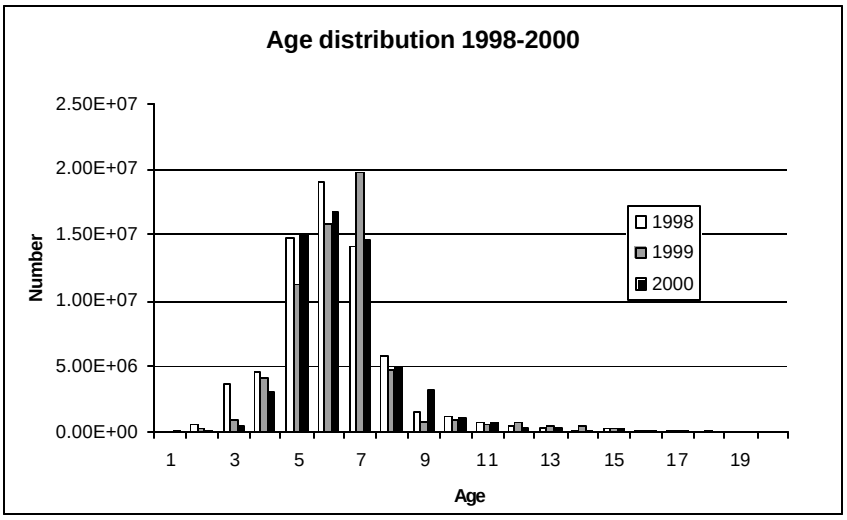

Fig. 5. Overall age distribution (weighted by stratum area) of Greenland halibut in NAFO Divisions 1C-1D in 1998-2000.

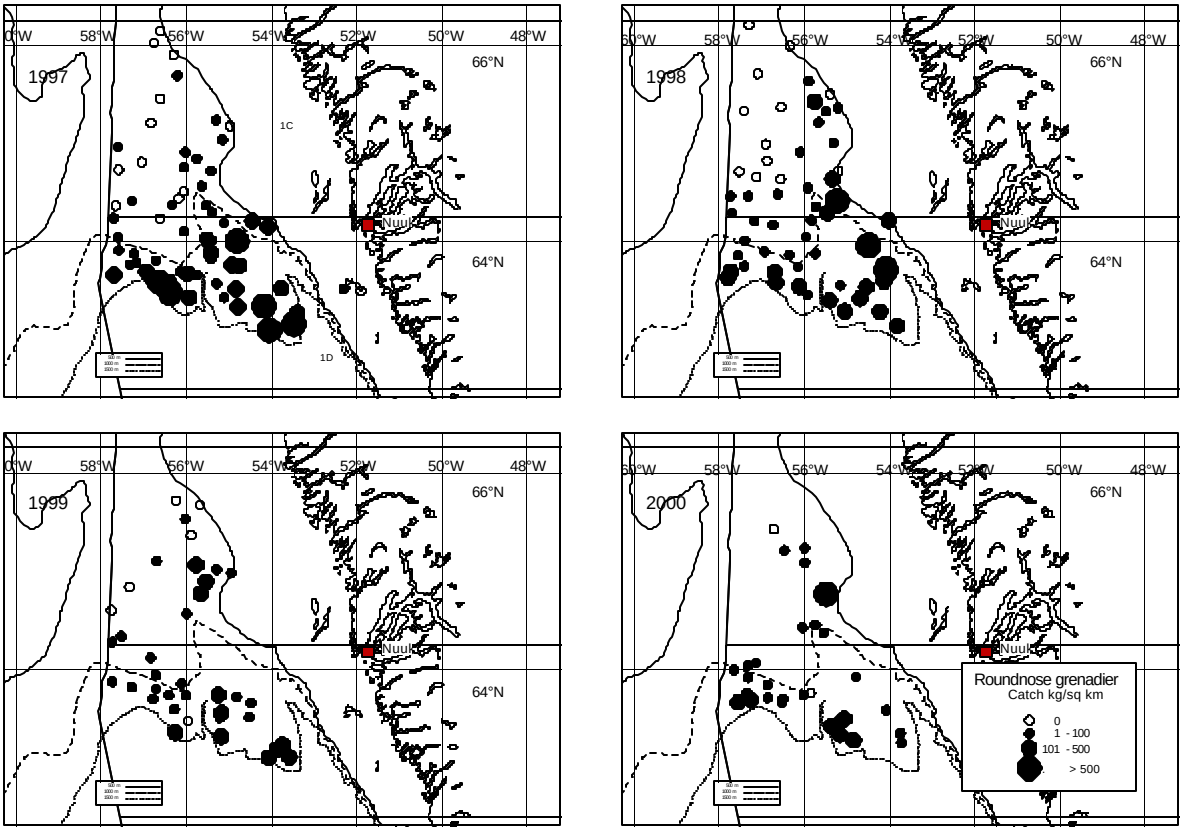

Fig. 6. Distribution of catches of roundnose grenadier during 1997 - 2000.

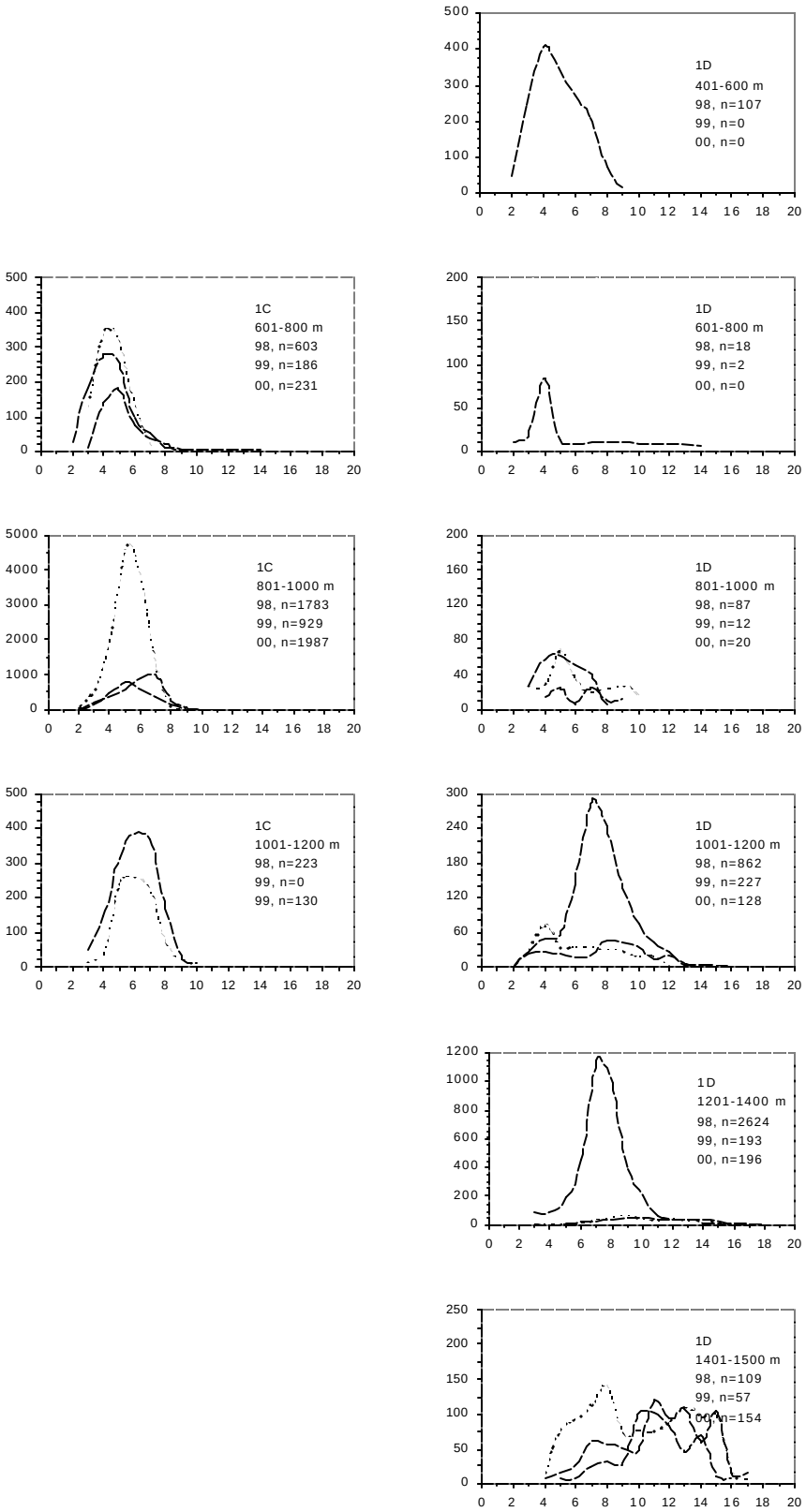

Fig. 7. Length distribution (pre anal fin length) of roundnose grenadier in numbers/km^2 by year and depth strata. Dashed line: 1998, solid line 1999, Dotted line:2000.

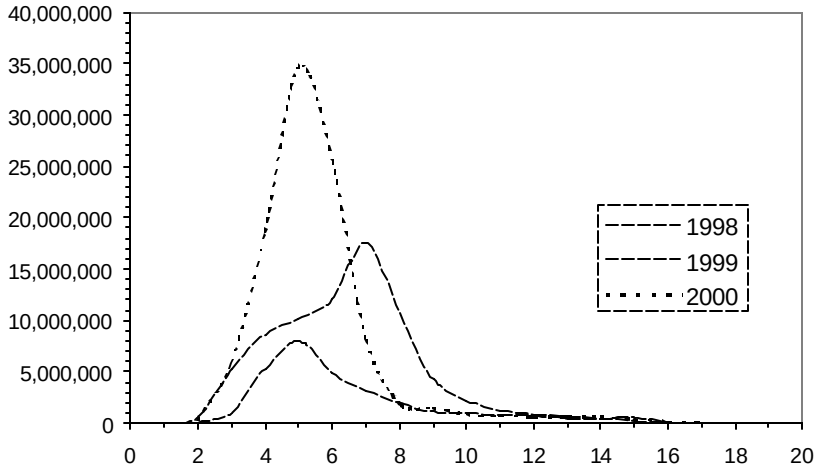

Fig. 8. Overall length distribution of roundnose grenadier (pre anal fin length) in numbers (weighted by stratum area) by year.

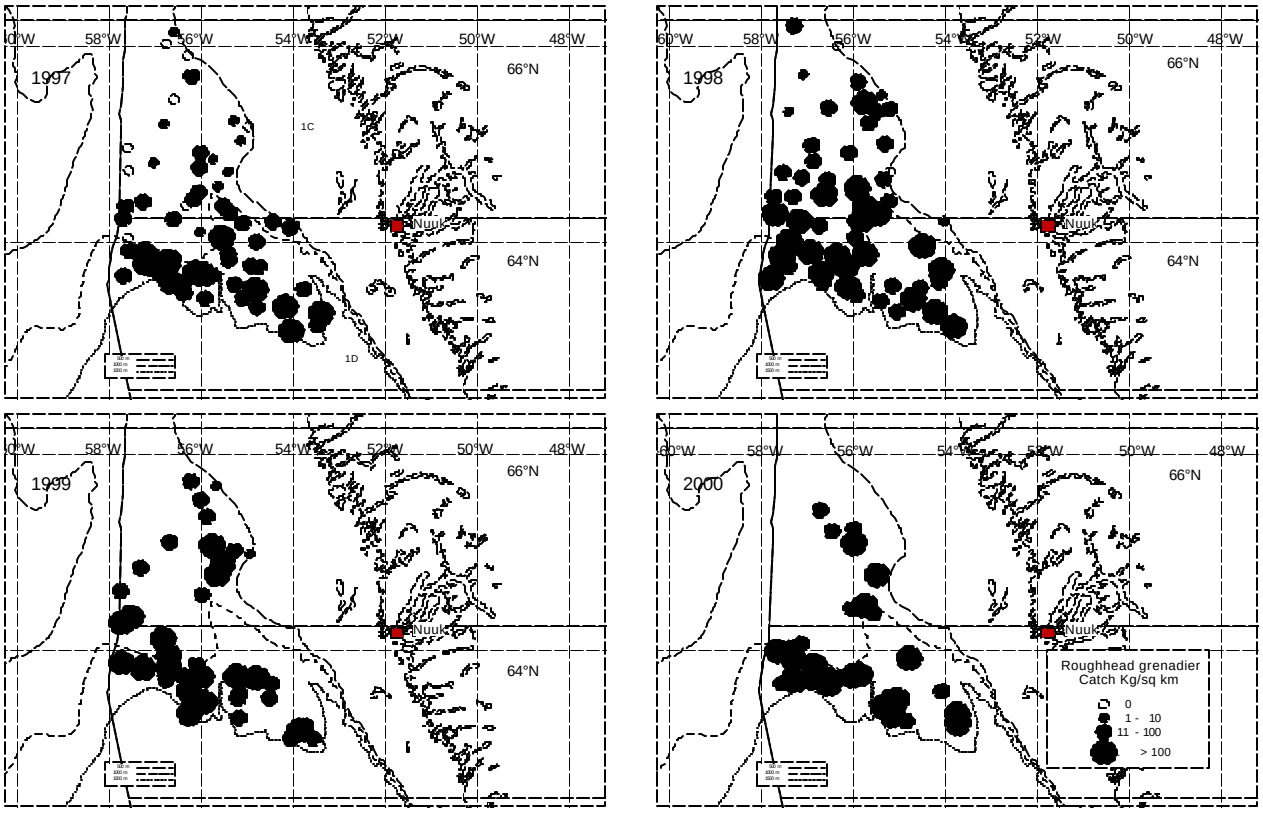

Fig. 9. Distribution of catches of roughhead grenadier during 1997-2000.

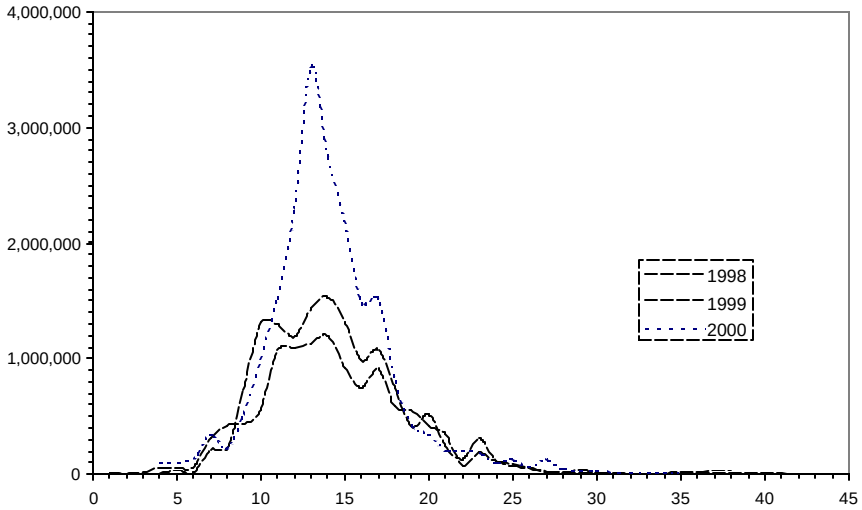

Fig. 10. Overall length distribution (pre anal fin length) of roughhead grenadier in numbers (weighted by stratum area) by year.

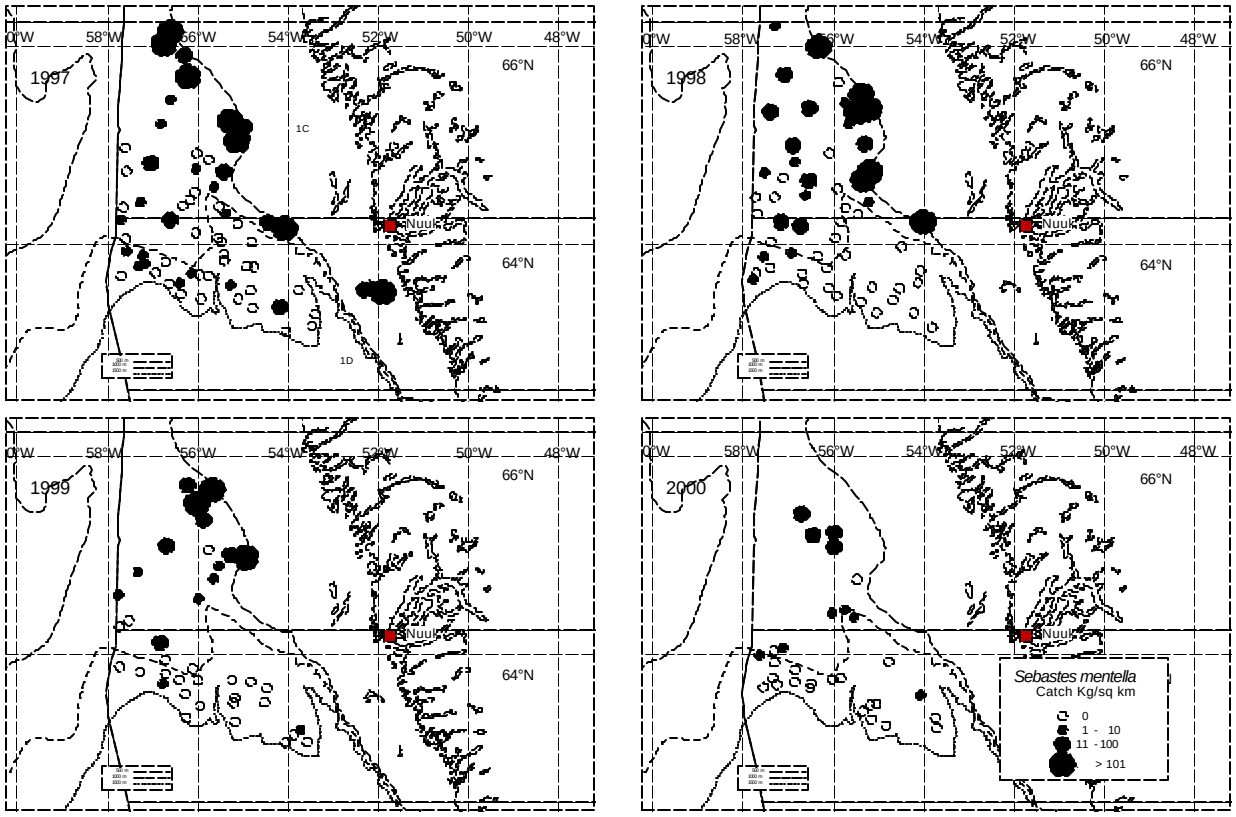

Fig. 11. Distribution of catches of *Sebastes mentella* during 1997-2000.

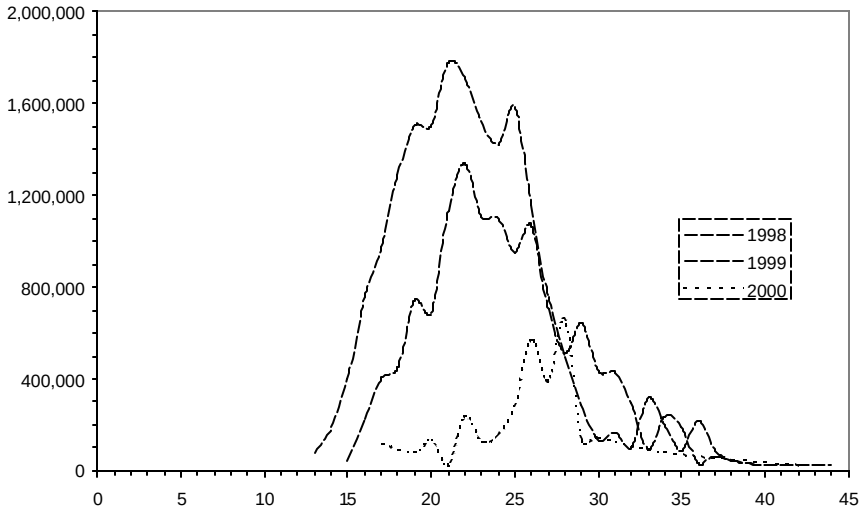

Fig. 12. Overall length distribution of *Sebastes mentella* in numbers (weighted by stratum area) by year.

Appendix 1. List of species and groups of species recorded in Div. 1CD in 2000 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	ARTS	Species	min wgt	max wgt	min no	max no	min length	max length	min depth	max depth	min temp	max temp
1	ARS	Agentina silus	0.2	0.2	1	1	34.0	34.0	822.5	822.5	3.9	3.9
2	ALA	Alepocephalus agassizzi	0.3	37.8	2	90	17.0	55.0	1310.5	1463.5	3.2	3.3
3	ALB	Alepocephalus bairdii	0.0	0.1	1	1	20.0	27.0	720.0	853.0	3.8	4.1
4	CAD	Anarhichas denticulatus	0.1	5.1	1	10	67.0	72.0	1065.0	1172.5	3.4	3.5
5	ANT	Antimora rostrata	0.0	15.4	1	75	10.0	60.0	788.5	1463.5	3.2	4.1
6	BAM	Bajacalifornia megalops	0.0	0.1	1	1	15.0	27.0	1310.5	1383.5	3.3	3.3
7	BAT	Bathylagus euryops	0.0	5.8	1	79	.	.	667.0	1463.5	2.3	4.1
8	BSP	Bathyraja spinicauda	7.6	7.6	1	1	106.0	106.0	915.0	915.0	3.6	3.6
9	BEG	Benthosema glaciale	0.0	0.1	1	28	.	.	667.0	1463.5	2.3	4.1
10	BOA	Borostomias antarctica	0.0	0.2	1	2	12.0	25.0	720.0	1463.5	3.2	3.8
11	CFB	Centroscyllium fabricii	0.0	18.9	1	32	17.0	79.0	720.0	1455.0	3.2	4.1
12	CHA	Chauliodus sloani	0.0	0.1	1	3	21.0	29.0	1026.0	1455.0	3.2	3.5
13	CHN	Chiasmodon niger	0.0	0.2	1	4	15.0	24.0	788.5	1383.5	3.2	3.9
14	CBB	Coryphaenoides brevibarbis	0.0	0.3	1	21	2.5	6.5	1310.5	1463.5	3.2	3.3
15	CGR	Coryphaenoides guntheri	0.0	6.5	1	64	2.5	13.5	1053.0	1463.5	3.2	3.5
16	RNG	Coryphaenoides rupestris	0.0	67.6	2	1746	2.5	17.5	667.0	1463.5	2.3	4.1
17	COM	Cottunculus microps	0.0	0.2	1	1	10.0	21.0	788.5	1176.0	3.4	4.1
18	COT	Cottunculus thomsonii	0.1	3.0	1	8	16.0	41.0	788.5	1053.0	3.4	4.1
19	CLM	Cyclothone microdon	0.0	0.0	1	4	6.0	6.0	788.5	1463.5	3.2	4.1
20	EUR	Eurypharynx pelecanoides	0.1	0.1	1	1	49.0	53.0	1089.0	1341.5	3.2	3.5
21	WIT	Glyptocephalus cynoglossus	0.3	1.4	1	3	34.0	41.0	853.0	1052.0	4.1	4.1
22	GOB	Gonostoma bathyphilum	0.0	0.0	1	1	13.0	18.0	822.5	1455.0	3.2	3.9
23	HPM	Halophryne mollis	0.0	0.0	1	1	7.5	7.5	1089.0	1089.0	3.5	3.5
24	PLA	Hippoglossoides platessoides	0.2	0.4	1	2	28.0	34.0	667.0	788.5	2.3	3.8
25	HOA	Holtbyrnia anomala	0.0	0.1	1	1	8.0	24.0	788.5	1347.0	3.2	3.8
26	LMC	Lampanyctus macdonaldi	0.0	2.4	1	121	41.0	41.0	667.0	1463.5	2.3	4.1
27	LIK	Liparis koefoedi	0.0	0.1	1	1	14.0	15.0	667.0	822.5	2.3	3.9
28	LPX	Lycenchelys paxillus	0.0	0.0	1	1	27.0	27.0	667.0	667.0	2.3	2.3
29	LYE	Lycodes esmarki	0.5	0.5	2	2	37.0	40.0	853.0	853.0	4.1	4.1
30	LYM	Lycodes mirabilis	0.0	0.0	1	30	24.0	29.0	915.0	1347.0	3.3	3.6
31	LYT	Lycodes terranova	0.1	1.0	1	2	24.0	49.0	822.5	1463.5	3.2	3.9
32	RHG	Macrourus berglax	0.5	59.7	2	196	4.0	35.5	667.0	1463.5	2.3	4.1
33	MAL	Malacosteus niger	0.0	0.1	1	1	16.0	24.0	1065.0	1319.5	3.3	3.5
34	MYP	Myctophum punctatum	0.0	0.0	1	1	9.0	9.0	1053.0	1053.0	3.4	3.4
35	MYI	Myxine ios	0.1	0.1	1	1	48.0	48.0	1107.0	1107.0	3.4	3.4
36	ARJ	Natantia	0.0	0.9	0	86	.	.	667.0	1463.5	2.3	4.1
37	NEG	Neolithodes grimaldi	0.1	3.7	1	2	.	.	853.0	1107.0	3.4	4.1
38	NZB	Nezumia bairdi	0.1	0.5	1	4	6.0	10.5	853.0	1151.5	3.4	4.1
39	NOT	Notacanthus chemnitzii	0.2	4.9	1	7	32.0	91.0	667.0	1463.5	2.3	4.1
40	NOK	Notoscopelus kroeyri	0.0	0.0	1	1	11.0	13.0	720.0	1212.0	3.2	3.8
41	OCT	Octopus	0.1	11.9	1	5	.	.	720.0	1463.5	3.2	3.9
42	ONE	Oneiroides eschrichti	0.5	0.7	1	3	8.0	39.0	915.0	1107.0	3.4	3.6
43	ONA	Onogadus argentatus	0.0	0.6	1	7	6.0	35.0	1065.0	1383.5	3.3	3.5
44	ONN	Onogadus ensis	0.0	8.9	1	22	9.0	45.0	720.0	1463.5	3.2	4.1
45	PRA	Pandalus borealis	0.5	3.6	0	0	.	.	667.0	788.5	2.3	3.8
46	PCD	Paralalepsis coregonoides	0.0	0.1	1	2	24.0	31.0	877.5	1319.5	3.3	3.6
47	PAC	Paraliparis copei	0.0	0.1	1	1	8.0	22.0	1053.0	1383.5	3.3	3.4
48	PAG	Paraliparis garmani	0.0	0.0	1	4	7.0	11.0	667.0	822.5	2.3	3.9
49	POL	Polyacanthonotus rissoanus	0.1	1.0	1	7	39.0	53.0	1026.0	1463.5	3.2	3.5
50	RBT	Raja bathyphila	0.3	4.0	1	2	39.0	84.0	1065.0	1463.5	3.2	3.5
51	RBI	Raja bigelowi	1.4	1.4	1	1	56.0	56.0	1176.0	1176.0	3.4	3.4
52	RFL	Raja fyllae	0.6	1.2	2	7	23.0	39.0	853.0	915.0	3.6	4.1
53	RSP	Raja spinacidermis	0.2	0.2	1	2	29.0	30.0	788.5	853.0	3.8	4.1
54	GHL	Reinhardtius hippoglossoides	6.7	302.9	12	245	15.0	99.0	667.0	1463.5	2.3	4.1
55	SCO	Scopelosarus lepidus	0.1	0.5	1	3	30.0	37.0	945.5	1383.5	3.2	3.7
56	REB	Sebastes mentella	0.0	4.8	1	21	17.0	42.0	667.0	1082.0	2.3	4.1
57	RED	Sebastes sp.	0.0	0.0	1	1	5.0	5.0	915.0	915.0	3.6	3.6
58	SER	Serrivomer beani	0.0	0.4	1	4	41.0	74.0	788.5	1463.5	3.2	3.9
59	SQT	Squit	0.0	0.4	1	5	.	.	720.0	1463.5	3.2	4.1
60	STO	Stomias boa	0.0	0.1	1	9	14.0	28.0	788.5	1319.5	3.2	4.1
61	SYN	Synapobranchus kaupi	0.1	7.6	1	57	18.0	66.0	667.0	1463.5	2.3	4.1
62	TRA	Trachyrynchus murrayi	0.0	0.2	1	1	8.0	14.0	945.5	1053.0	3.4	3.7
63	XEC	Xenodermichthys copei	0.0	0.0	1	1	14.0	14.0	1065.0	1065.0	3.5	3.5