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Results of a Stratified Random Bottom Trawl Survey in NAFO Subarea 1 in 1989

by

O. Jørgensen

Greenland Fisheries Research Institute
Tagensvej 135, DK-2200 København N, Denmark

by

K. Akimoto

Japan Marine Fishery Resource Research Center
3-27 Kioi-cho, Chiyoda-ku, Tokyo 102, Japan

Introduction

In April/May 1989 a stratified-random bottom trawl survey was carried out at West Greenland by Japan Marine Fishery Resource Research Center (JAMARC) in cooperation with The Greenland Fisheries Research Institute. The survey was part of a joint venture program started in 1987 between JAMARC and the Greenlandic Home Rule. The purpose of the survey was to estimate groundfish biomasses and to collect information on distribution, size composition and biology of major species off West Greenland. In 1989 the main interest was put upon Greenland halibut, (*Reinhardtius hippoglossoides*) and roundnose grenadier, (*Coryphaenoides rupestris*). Besides information on catch distribution, biomass estimates and length distribution on Greenland halibut and roundnose grenadier the paper contains information on age composition, maturity and feeding rate of Greenland halibut.

Materials and Methods

The survey was planned to cover NAFO Divisions 1A (south of 70°N) to 1D at depths between 400 and 1500 m. Each division was subdivided into three depth strata by the 400, 600, 1000, 1500 m isobaths and trawl positions were randomly selected and allocated in proportion to the area of each stratum, but with a minimum of two planned hauls per stratum (Table 1). The survey was conducted by the Japanese research vessel SHINKAI MARU. Trawling was carried out in daytime only. Towing speed was 3.5 kn and towing time was 30 min. The net was equipped with a 140 mm mesh codend with a 30 mm meshliner. Further information about vessel and gear is given in Yamada et al. 1988a. Biomass estimates were obtained by applying the swept area method taking the catchability coefficient of all species as 1.0. The coefficient of variation (CV) is calculated as:

$$CV = \text{Standard error of estimate} \times 100 / \text{estimated biomass}.$$

The gonad index is expressed as weight of gonads to total weight of the fish in percent. Feeding rate is the percentage of stomachs with food to all stomachs examined. In addition to the scientific survey (Cruise 1) data on maturity and feeding rate

were collected during two feasibility surveys (Cruises no. 2 and 5) when SHINKAI MARU was fishing commercially without meshliner in the codend. These two surveys took place in June/July and October/November, respectively. Temperatures and salinity were recorded with a STD at each trawling station and at a number of the NAFO standard hydrographical stations.

Results and Discussion

Div. 1A and 1B and the western part of 1C and 1D (app. 1/3 of the survey area in Div. 1C and 1D) were covered by ice. 61 successful hauls were made in the open part of the survey area, which gives a mean coverage of Div. 1C and 1D of 741 square km per haul. The biomass estimates in Table 2 - 4 include the survey area in Div. 1C and 1D covered by ice.

Bottom temperature. Relatively warm water, around 4°C, covered the Sukkertoppen Bank and temperatures decreased both northward and southward from the Bank (Fig. 1).

Greenland halibut

Biomass. The distribution of catches of Greenland halibut is shown in Fig. 2. The largest catches of Greenland halibut and roundnose grenadier were taken at temperatures between 3 and 3.5°C. The total biomass of Greenland halibut is estimated to 63.300 tons (CV=16%), which is at the same level as in 1987 and 1988 (Table 2). Spawning is assumed to take place in deep water south of 67°N in early spring (Smidt, 1969) and according to Ernst (1987), Greenland halibut migrate to shallower water in the summer period. The survey results from the three years seem to fit into this pattern. In 1987, when the survey took place in July/August, Greenland halibut was found relatively northerly and in shallow water. In September/October 1988 which may be after the feeding period and before the time of spawning the main concentration had moved south and into deeper water. The survey in 1989 was carried out in April/May, which is close to the believed period of spawning, and high concentrations were found near the assumed spawning area. From 1987 to 1989 bottom temperature decreased about 0.2°C in the upper strata, while it remained constant, 3.4°C, in the deep strata, and this decrease in temperature might also have an influence on the distribution pattern.

Length and age distribution. Length distribution in 3-cm groups by sex, division and depth stratum is given in Fig. 3. There is a distinct change in size composition by depth with smaller fish dominating at shallow depths and larger sizes relatively more abundant at greater depths, as observed also in the two previous surveys (Yamada et al., 1988b; Yatsu and Jørgensen, 1989) and off Canada by e.g. Atkinson et al., 1982 and Ernst, 1987. Furthermore, in depth stratum 1001-1500 m there is a tendency toward an increase in size from north to south, i.e. from Div. 1C to 1D. The length distribution for the total survey area shows a mode at 48 cm (Fig. 4), as seen also in 1988 (Yatsu and Jørgensen, 1989). The population is constitutet almost exclusively of fish between 6 and 10 years old, with a dominance of fish aged 7 and 8 years (Fig. 5). Fish older than 12 years are scarce.

Maturity. In April/May (Cruise 1) and in June/July (Cruise 2) few females were maturing while in October/November (Cruise 5) almost all females above app. 55 cm and males above app. 40 cm had begun to mature (Fig. 6). The average gonad index in October/November was slightly higher than observed in the survey in September/October 1988 (Yatsu and Jørgensen, 1989). This picture corresponds well to an assumed spawning period in late winter/early spring. However, only one spent female (caught in Div. 1D at 1.459 m) was observed during the survey.

Feeding rate. The feeding rate was rather similar in the scientific and the two feasibility surveys and was low except for specimens larger than 80 cm (Fig.7). This higher feeding rate is probably caused by a longer digestion time of the larger prey (fish) taken by large fish.

Roundnose grenadier

Biomass. Roundnose grenadier was almost exclusively taken south of 64°45'N, but the catches were low (Fig. 8). Total biomass was estimated to 5.900 tons (CV=34%), which is a dramatic decline compared to 1988 when the total biomass was estimated to 45.500 tons (Table 3). The decrease in biomass could be caused by feeding migration because later in the year there was an increase in the catches during the commercial fishery by SHINKAI MARU. The temperature in depth stratum 1001-1500 m, where almost all the biomass is concentrated, was the same, 3.4°C, in 1988 and 1989.

Length distribution. The length distribution (anal fin length) for roundnose grenadier is given in Fig. 9. Both in Div. 1C and 1D there is a mode at 4 cm and in Div. 1D furthermore two smaller modes at 8 and 12 cm are found, which is very different from the distribution in 1988 when almost all specimens were between 7 and 12 cm with a single mode at 9 cm.

Other species

Estimated biomasses of other species are given in Table 4.

References

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Yatsu, A., and O. Jørgensen. 1989. Distribution, abundance, size, age, gonad index and stomach contents of Greenland halibut, Reinhardtius hippoglossoides, off West Greenland in September/October 1988. NAFO SCR Doc., 89/31.

Table 1. Areas of depth strata in sq. km, size of depth strata in percent relative to total stratification area and no of successful hauls. 1A: south of 70oN. No of planned hauls in brackets.

NAFO Division	401-600 meters	601-1000 meters	1001-1500 meters	Total
1A	1683	793	1271	3747
%	2.96	1.39	2.24	6.59
Hauls	(3) 0	(2) 0	(2) 0	(7) 0
1B	5120	2649	23	7792
%	9.00	4.66	0.04	13.70
Hauls	(8) 0	(4) 0	(0) 0	(12) 0
1C	3131	17611	603	21345
%	5.51	30.97	1.06	37.54
Hauls	(5) 4	(27)18	(2) 2	(34)24
1D	888	5451	17643	23982
%	1.56	9.59	31.03	42.18
Hauls	(2) 2	(8) 4	(27)31	(37)37
Total	10822	26504	19540	56866
%	19.03	46.61	34.37	100.0
Hauls	(18) 6	(41)22	(31)33	(90)61

Table 2. Greenland halibut. Biomass in -000 tons in 1987, 1988 and 1989, respectively, together with biomass in kg/km2 (1AN, 1AS and 1B data from 1988, 1C and 1D data from 1989) distributed on NAFO-divisions and depth strata 1AN: 70oN - 73oN. 1AS: 68o50'N - 70oN. - no hauls.

NAFO-div.		Depth strata 1) 401-600 m	601-1000 m	1001-1500 m	Total
	1987	-	-	-	-
1AN	1988	3.0	2.0	0.8	5.8
	1989	-	-	-	-
	kg/km2	290	754	780	
	1987	0.0	-	-	0.0
1AS	1988	0.3	2.8	0.7	3.8
	1989	-	-	-	-
	kg/km2	175	3594	551	
	1987	5.0	2.5	-	7.5
1B	1988	2.9	2.5	-	5.4
	1989	-	-	-	-
	kg/km2	561	925	-	
	1987	0.8	34.8	-	35.6
1C	1988	0.1	15.7	1.1	16.9
	1989	0.5	10.1	0.9	11.5
	kg/km2	169	574	603	
	1987	-	10.4	-	10.4
1D	1988	-	8.1	22.8	30.9
	1989	0.2	2.3	49.3	51.8
	kg/km2	238	425	2793	
	1987				53.5
Total	1988				62.8
	1989				63.3

1) 1AN 201-600 m.

Table 3. Roundnose grenadier. Biomass in -000 ton in 1987, 1988 and 1989, respectively, together with biomass in kg/km2 (1989) distributed on NAFO-divisions and depth strata. - no hauls.

NAFO-div.		Depth strata 401-600 m	601-1000 m	1001-1500 m	Total
1C	1987	2.0	27.9	-	29.9
	1988	0.0	1.7	1.7	3.4
	1989	0.0	0.0	0.0	0.0
	kg/km2	0.5	2.5	2.9	
1D	1987	-	13.5	-	13.5
	1988	-	9.8	32.3	42.1
	1989	0.1	0.1	5.7	5.9
	kg/km2	98.7	19.8	321.9	
Total	1987				43.4
	1988				45.5
	1989				5.9

Table 4 Biomass estimates and coefficient of variation(C.V.) off West Greenland

English name	Scientific name	Biomass (ton)	C.V. (%)
Greenland halibut	Reinhardtius hippoglossoides	63,300	16
Roundnose grenadier	Coryphaenoides rupestris	5,900	34
Beaked redfish	Sebastes mentella	3,100	13
Greenland shark	Somniosus microcephalus	2,400	89
Roughhead grenadier	Macrourus berglax	2,100	10
Dogfish	Squalidae	1,800	29
Other codfishes	Gadiformes	1,600	12
Halibut	Hippoglossus hippoglossus	1,000	39
Octopus	Octopoda	1,000	19
Spiny eel	Notacanthidae	800	15
Northern catfish	Anarchias denticulatus	600	27
Skates	Rajidae	300	19
Atlantic cod	Gadus morhua	300	48
Eels	Anguilliformes	300	9
American plaice	Hippoglossoides platessoides	200	52
Other shrimps		200	13
Golden redfish	Sebastes marinus	200	28
Shrimp	Pandarus borealis	200	56
Sculpins	Cottidae	100	21
Eelpouts	Zoarcidae	+	27
Other crustacea		+	49
Blue ling	Molva sp.	+	39
Squids		+	33
Spotted catfish	Anarchias minor	+	87
Hagfish	Myxine	+	33
Cusk	Brosme brosme	+	71
Snailfishes	Liparidae	+	53
Arctic cod	Boreogadus saida	+	97
Capelin	Mallotus villosus	+	100
Other fishes		400	11
Total		85,800	

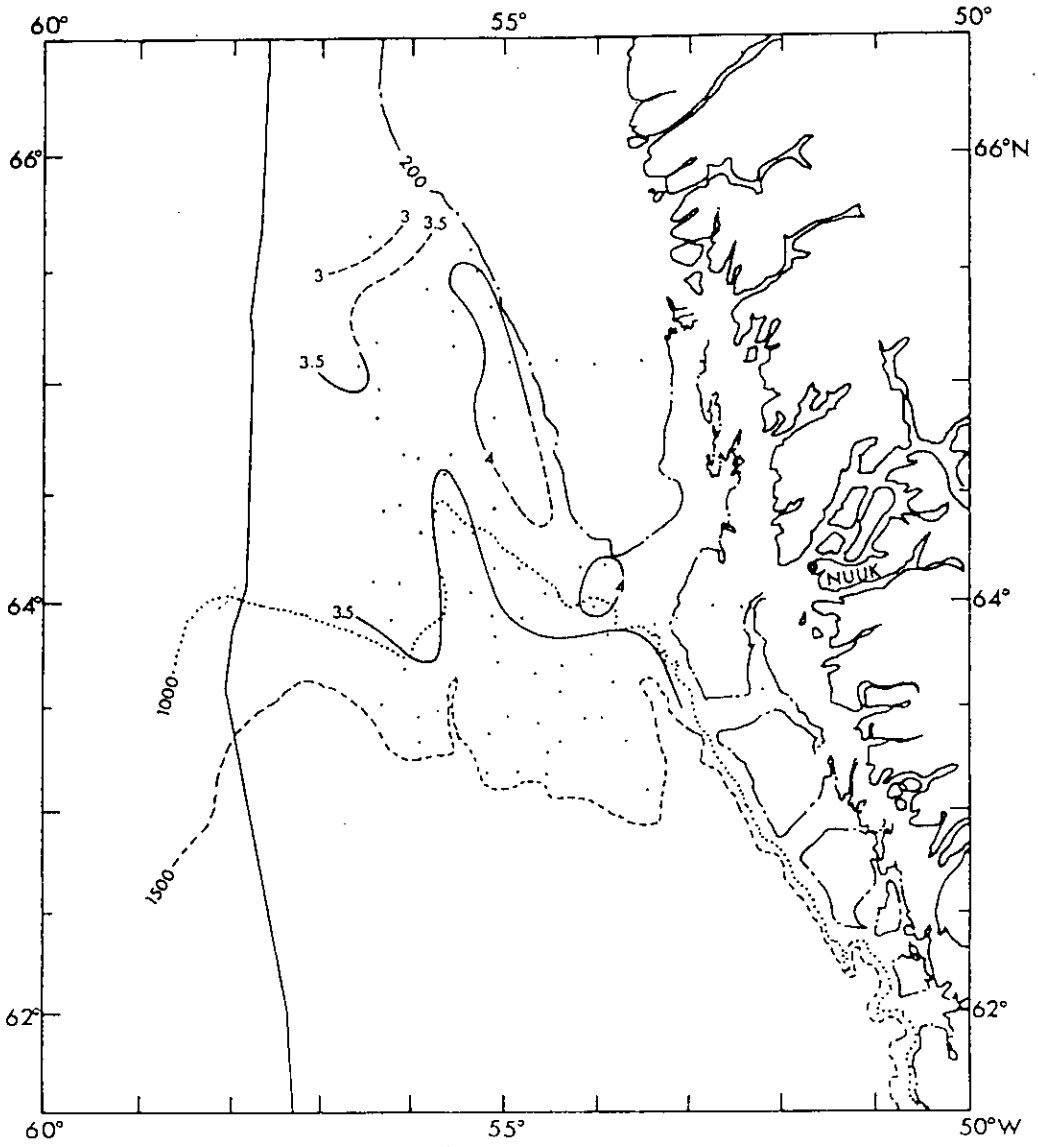


Fig. 1. Bottom temperature off West Greenland

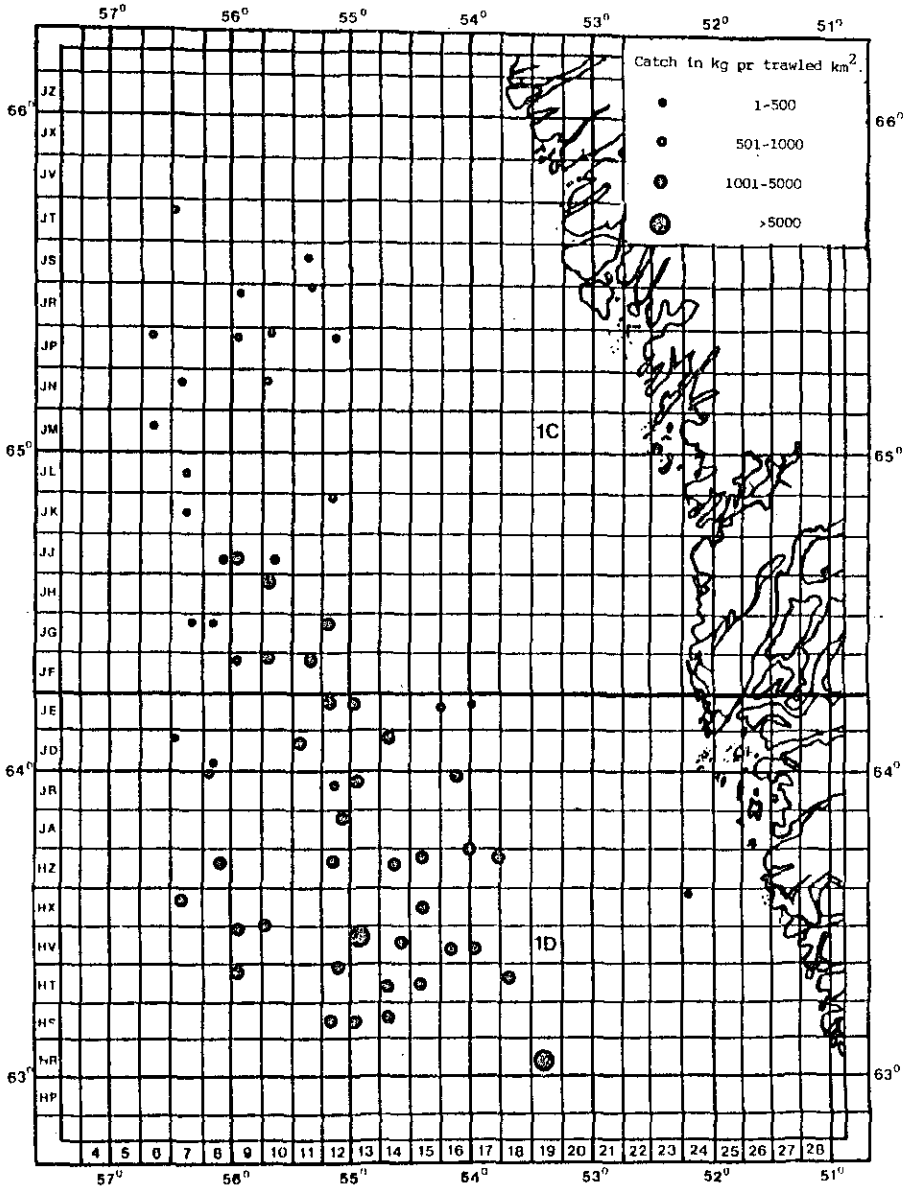
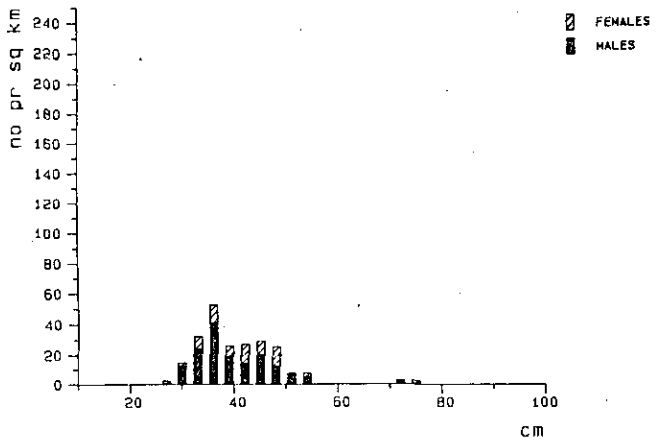
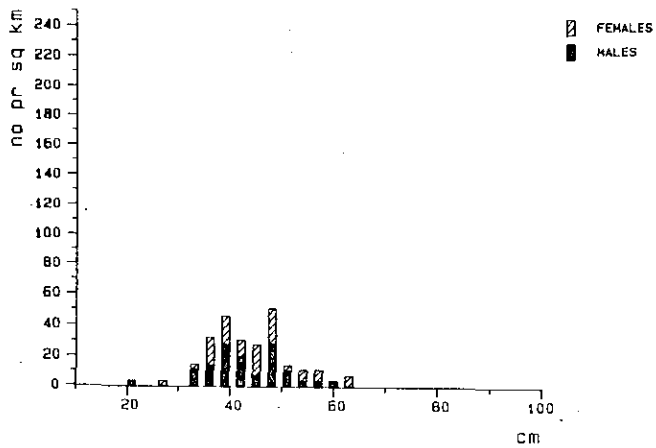


Fig. 2. Greenland halibut. Catch in kg pr trawled km2.

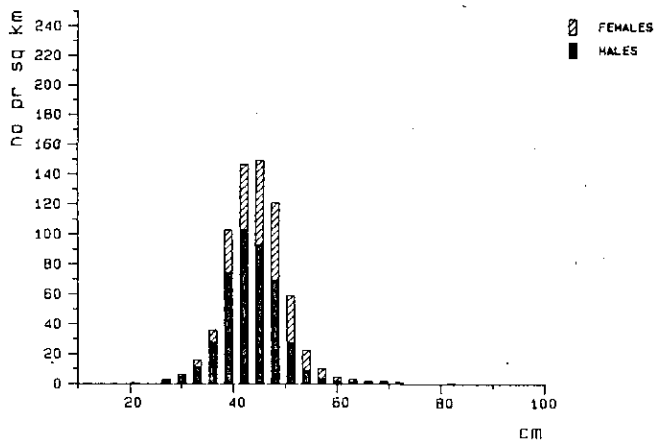
div. 1C, depth stratum 401-600m



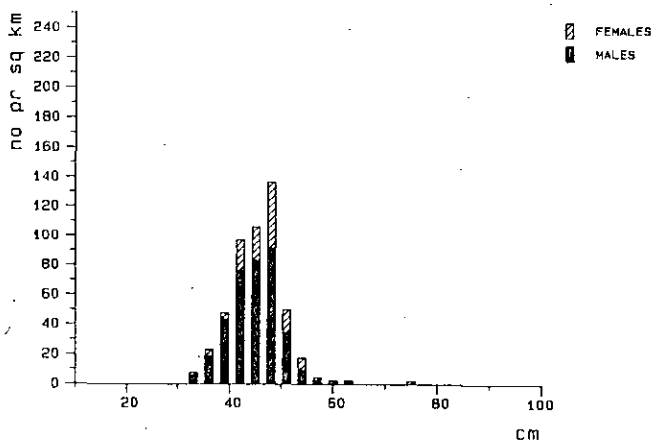
div. 1D, depth stratum 401-600m



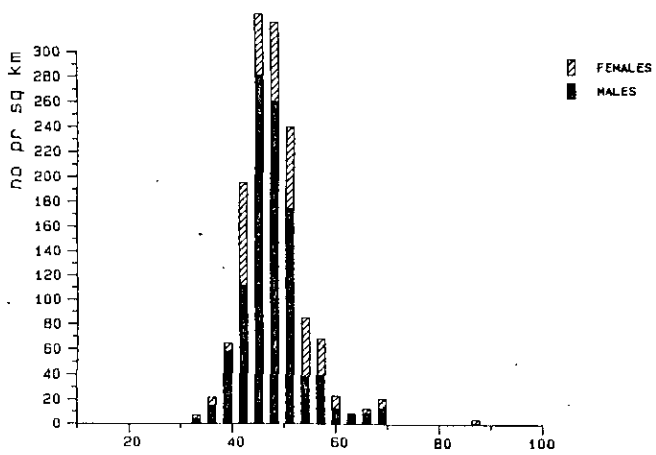
div. 1C, depth stratum 601-1000m



div. 1D, depth stratum 601-1000m



div. 1C, depth stratum 1001-1500m



div. 1D, depth stratum 1001-1500m

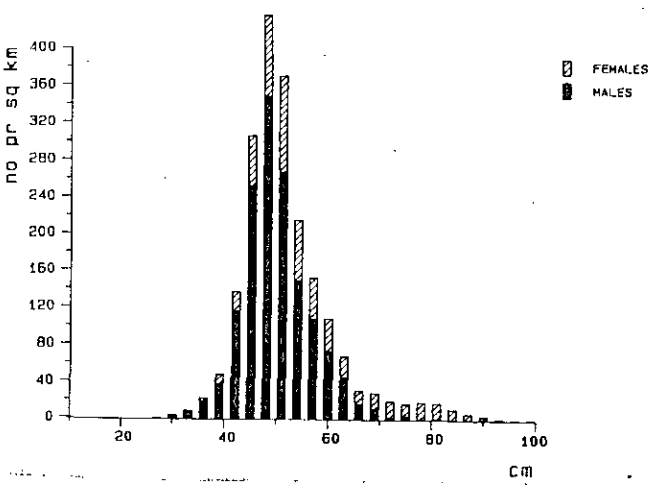


Fig. 3. Greenland halibut. Length distribution in 3-cm groups by sex, division and depth stratum. NB different scales on y-axes.

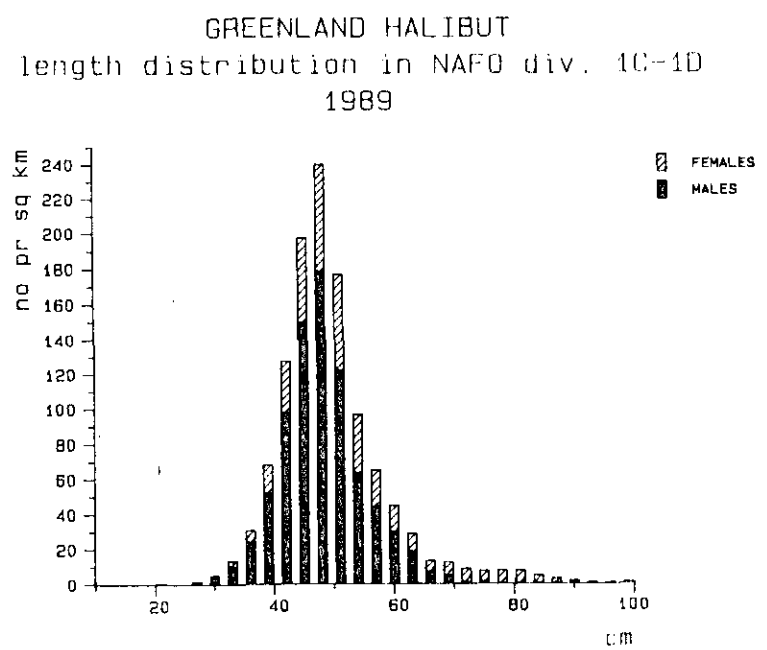


Fig. 4. Greenland halibut. Length distribution in 3-cm groups for the total survey area.

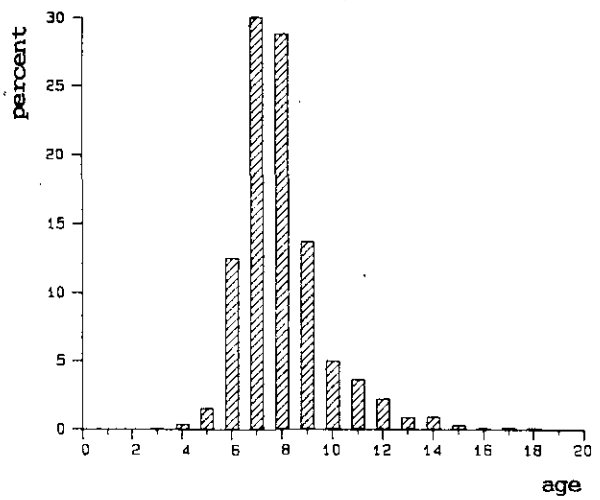


Fig. 5. Greenland halibut. Age distribution.

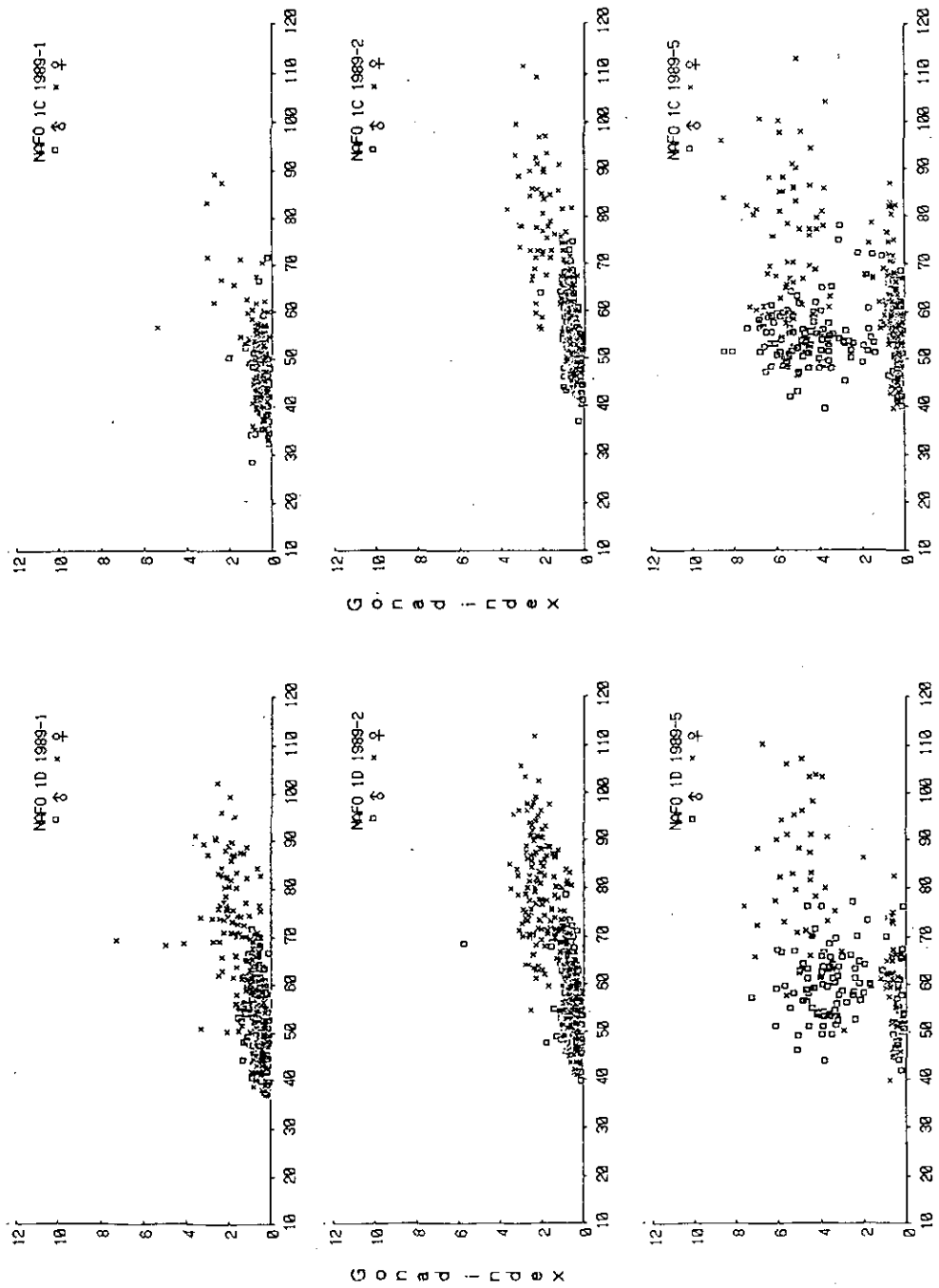


Fig. 6. Relationship between total lenght and gonad index of Greenland halibut by Division and Cruise. The three cruises took place in April/May, June/July and October/November, respectively.

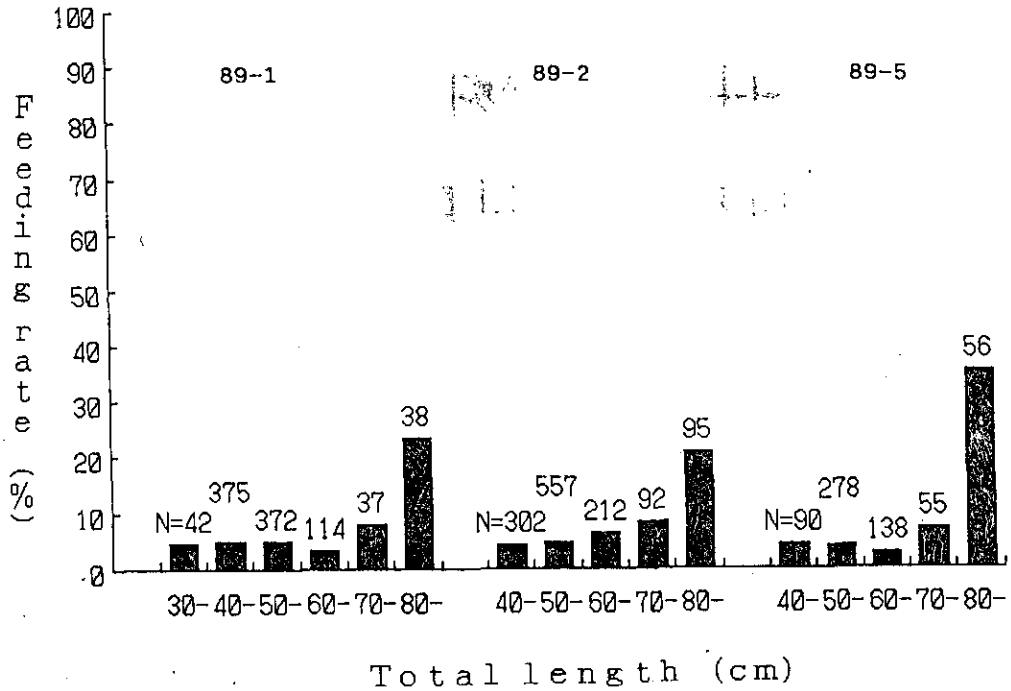


Fig. 7. Feeding rate (%) of Greenland halibut by size and Cruise. The three cruises took place in April/May, June/July and October/November, respectively.

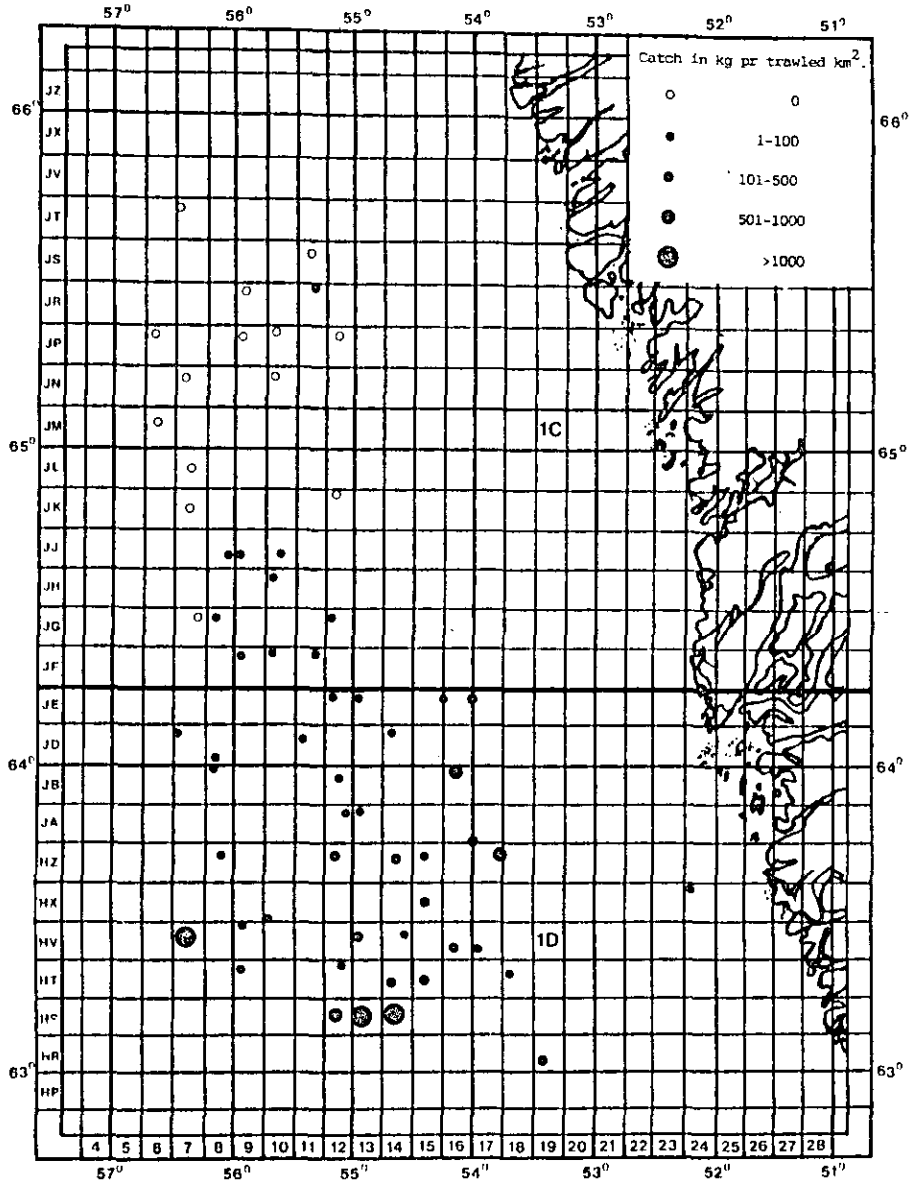


Fig. 8. Roundnose grenadier. Distribution of catches in kg pr trawler km2.

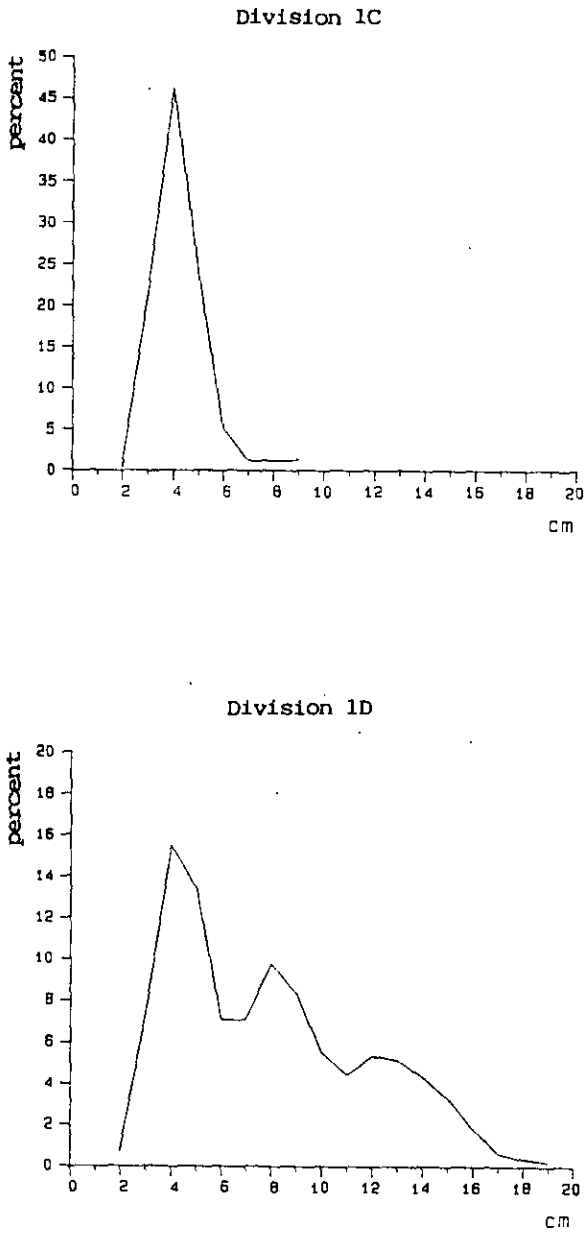


Fig. 9. Roundnose grenadier. Length distribution in percent pr division.