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**Results of a Stratified Random Bottom  
Trawl Survey off West Greenland in 1995**

by

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Introduction

Since 1987 Japan Marine Fishery Resource Research Center (JAMARC) and Greenland Institute of Natural Resources have conducted cooperative trawl surveys off West and East Greenland (Yamada et al., 1988a: Yamada et al., 1988b: Yastu and Jorgensen, 1989: Jorgensen and Akimoto, 1990: Jorgensen and Akimoto, 1991: Yano and Jorgensen, 1992: Satani et al., 1993: Ogawa et al., 1994: Yokawa et al., 1995). In 1995 one stratified random bottom trawl survey was carried out off West Greenland. The aim of the survey was to estimate stock sizes of groundfishes and to obtain information on distribution, size composition and biology of Greenland halibut (*Reinhardtius hippoglossoides*), beaked redfish (*Sebastes mentella*) and roundnose grenadier (*Coryphaenoides rupestris*) on the continental slope between Div. 1A (south of 70°N) - 1D.

Materials and Methods

One stratified random bottom trawl survey was conducted by the R/V Shinkai Maru (3395 GRT) in August 1995. The survey was planned to cover Div. 1A (South of 70°N) to Div. 1D at depths between 400 to 1500 m. Each division was subdivided into three depth strata by 400, 600, 1000 and 1500 m isobaths and trawl positions were randomly selected and allocated in proportion to the area of each stratum, but with a minimum of tow planned haul per stratum.

Trawl operations were made in daytime only. Towing duration and speed were 30 minutes and 3.5 knot. The net was equipped with a 140 mm mesh codend with a 30 mm mesh liner. Wing spread was approximately 40 m. Detailed information on the vessel and gear is given in Yamada et al. (1988a). The swept method was applied to for biomass estimation, assuming the catchability coefficient as 1.0. The coefficient of variation (C.V.) is standard error of estimate divided by estimated biomass.

Greenland halibut and beaked redfish were measured as total length to cm below and roundnose grenadier as anal fin length to 0.5 cm below. Size compositions were made in 1.0 cm groups for Greenland halibut and beaked redfish, and 0.5 cm groups for roundnose grenadier. The size composition in a stratum was calculated as the average of standardized size composition of each station (fish/km<sup>2</sup> swept area). Size composition by Division was calculated as the average of the size composition of each stratum, using the stratum area as weighting factor.

## Results

Trawl operations were successfully made at 91 stations out of 100 planned. Due to bad bottom condition and shortage of time no hauls were made in depth stratum 400-600 m in Div. 1A and 1D (3.5% of the total area, Table 1). Biomass estimates for 35 species or species groups are shown in Table 2.

### 1. Greenland halibut

#### (1) Biomass and distribution

Greenland halibut was the most abundant species and was caught at all stations (Fig. 1). The biomass for Divs. 1A-1D was estimated as 40,800 tons (C.V. =9%) which is an increase (30%) compared to 31,300 tons in 1994. The increase is, however, not statistically significant (95% confidence level). The 1995 estimate includes Div. 1A (0.1% of the biomass) which was not covered in 1994. Compared to 1994 the biomass increased 153%, 37% and 13% in Divs. 1B, 1C and 1D, respectively.

The biomass at depths between 601 and 1000 m in Divs. 1BCD increased (65%) from 11,700 tons in 1994 to 19,400 tons, and it accounted for 48% of the total. On the other hand, the biomass at depths between 1001 and 1500 in Divs. 1BCD showed a slight decrease (4%) from 18,000 tons in 1994 to 17,200 tons. In 1995, 42% of the biomass was found in the deep stratum compared 57% in 1994.

#### (2) Size composition

The size composition is given by division in Fig. 2. In Div. 1B, two notable modes at 12-15 and 18-23 cm respectively were observed. In 1994 the corresponding modes were seen at 11-13 and 16-19 cm. Further, two indistinct modes at 26-27 and 31-34 cm were observed as in 1994. The number of fish per km<sup>2</sup> in the smallest mode was 4 times higher than that in 1994, while the number of fish per km<sup>2</sup> of three other modes were 2.5-3 times higher than those in 1994.

The size compositions of Div. 1C and 1D was mono-modal with those modes at 49-50 cm in Div. 1C and 47-48 cm in Div. 1D. The positions of these two peaks were similar to those in 1994. The number of the fish per km<sup>2</sup> in these two mode increased about 10% compared to 1994.

### 2. Beaked redfish

#### (1) Biomass and distribution

Beaked redfish was mainly caught at depths less than 601 m in Divs. 1BC and in depth stratum of 601-1000 m in Div. 1C as in the survey in 1994 (Table 4, Fig. 3). The estimated biomass increased from 400 tons in 1994 to 600 tons (C.V. =41%). This was mainly due to an increase in biomass in depth stratum of 401-600 m in Div. 1C. Very few fish were observed in Div. 1A. The distribution of the catches was as in 1994, but beaked redfish were observed at more trawl stations (Figs. 3, 4).

(2) Size composition

Relative high density of small-sized fish was observed in Div. 1B as in 1994 (Fig. 4). The size distribution in Div. 1C was comparable to that in 1994. Only a few large sized fishes (more than 30 cm) were observed in the survey area. Throughout the survey area, the number of the fish per km<sup>2</sup> increased slightly compared to 1994, but the level is still low compared to previous surveys.

3 Roundnose grenadier

(1) Distribution and biomass

The estimated biomass increased (125%) from 3,000 tons in 1994 to 6,700 tons (C.V. =18%) in 1995. As in the survey in 1994, more than 80% of the total biomass were found in depth stratum of 1001-1500 m in Div. 1D (Table 5, Fig. 5). The estimated biomass in the depth stratum of 601-1000 m in Div. 1C increased about 4.5 times, but it was caused one large catch at near the border between depth strata 601-1000 m and 1001-1500 m (Fig. 5).

(2) Size composition

There was observed one mode with a notable peak at 7.0-7.5 cm in Div. 1C, and two modes with peaks around 4.5 cm and 11.5-12.5 cm in Div. 1D (Fig. 6). The positions of each mode was comparable to that in 1994, although the number of fish per km<sup>2</sup> was higher especially in Div. 1C.

Discussion

Although the estimated biomass of Greenland halibut, beaked redfish and roundnose grenadier increased compared to 1994, they are still at a low compared to previous surveys (Fig. 7). A increase in the abundance of small sized Greenland halibut in Div. 1B and their relative large size compared to 1994 could reflect improvement in environmental condition in the survey area. The fact that the estimated biomass for most of the species/species groups caught during the survey also showed increasing tendencies (Fig. 1) could support this idea.

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- Yokawa, K., H. Shimizu, and O. Jorgensen. 1995. Results of a stratified random bottom trawl survey off west Greenland in 1994. NAFO SCR Doc. 95/23.

Table 1. The extent of survey area by NAFO Division and depth stratum. Their number of hauls planned and number of successful hauls in the brackets.

NAFO DIV.	Depth(m)			Total
	401-600	601-1,000	1,001-1,500	
IA				
Area (Km <sup>2</sup> )	1,683	793	1,271	3,747
Proportion (%)	2.96	1.39	2.24	6.59
Hauls successful/(planned)	0(3)	2(2)	2(2)	4(7)
IB				
Area (Km <sup>2</sup> )	5,120	2,649	23	7,792
Proportion (%)	9.00	4.66	0.04	13.70
Hauls successful/(planned)	9(9)	5(5)	0	14(14)
IC				
Area (Km <sup>2</sup> )	3,131	17,611	603	21,345
Proportion (%)	5.51	30.97	1.06	37.54
Hauls successful/(planned)	3(5)	30(31)	2(2)	35(38)
ID				
Area (Km <sup>2</sup> )	888	5,451	17,643	23,982
Proportion (%)	1.56	9.59	31.03	42.18
Hauls successful/(planned)	0(2)	8(8)	30(31)	38(41)
Total				
Area (Km <sup>2</sup> )	10,882	26,504	19,540	56,866
Proportion (%)	19.03	46.61	34.37	100
Hauls successful/(planned)	12(19)	45(46)	34(35)	91(100)

Table 2. biomass estimate (x1000 tons) of each species or species group with the coefficient of variation (C.V.) in survey.

English name	Scientific name	Biomass(C.V.)
G. halibut	<i>Reinhardtius hippoglossoides</i>	40.78( 8.7)
Roundnose grenadier	<i>Coryphaenoides rupestris</i>	6.70(17.9)
Beaked redfish	<i>Sebastes mentella</i>	0.61(40.8)
Other fishes		2.91(14.2)
Pink shrimp	<i>Pandarus borealis</i>	0.79(42.6)
Dogfish	<i>Squalidae</i>	1.46(28.3)
Roughhead grenadier	<i>Macrourus berglax</i>	1.13(12.7)
Skates	<i>Rajidae</i>	0.36(35.6)
Other codfishes	<i>Gadiformes</i>	0.79(14.3)
Halibut	<i>Hippoglossus hippoglossus</i>	0.06(74.2)
Octopus	<i>Octopoda</i>	1.66(20.4)
Spiny eel	<i>Notocanthidae</i>	0.58(15.6)
Greenland shark	<i>Somniosus microcephalus</i>	0.07(70.7)
Northern catfish	<i>Anarhichas denticulatus</i>	0.46(32.1)
American plaice	<i>Hippoglossoides platessoides</i>	0.05(34.1)
Eels	<i>Anguilliformes</i>	0.38(11.6)
Other shrimps		0.46( 6.5)
Ratfish	<i>Hydrolagus affinis</i>	0.25(59.0)
Eelpouts	<i>Zoarcidae</i>	0.08(29.8)
Golden redfish	<i>Sebastes marinus</i>	0.02(80.2)
Grenadier	<i>Coryphaenoides guentheri</i>	-
Sculpins	<i>Psychrolutidae</i>	0.03(32.4)
Spotted catfish	<i>Anarchias minor</i>	-
Other crustacea		-
Polar cod	<i>Boreogodus saida</i>	0.18(90.9)
Grenadiers	<i>Macrouridae</i>	0.08(45.1)
Squids	<i>Teuthoidea and Sepioidea</i>	0.01(12.5)
Snailfishes	<i>Liparidae</i>	0.05(13.8)
Atlantic cod	<i>Godus morhua</i>	-
Hagfish	<i>Myxine glutinosa</i>	0.01(38.0)
Sculpins	<i>Cottidae</i>	-
Blue ling	<i>Molva dipterygia</i>	-
Pricklebacks	<i>Stichaeidae</i>	-
Lumpsuchers	<i>Cyclopterydae</i>	-
Other mollusks		-
<b>Total</b>		<b>61.91(7.0)</b>

Table 3. Biomass estimates (x1000 tons) of Greenland halibut by strata.

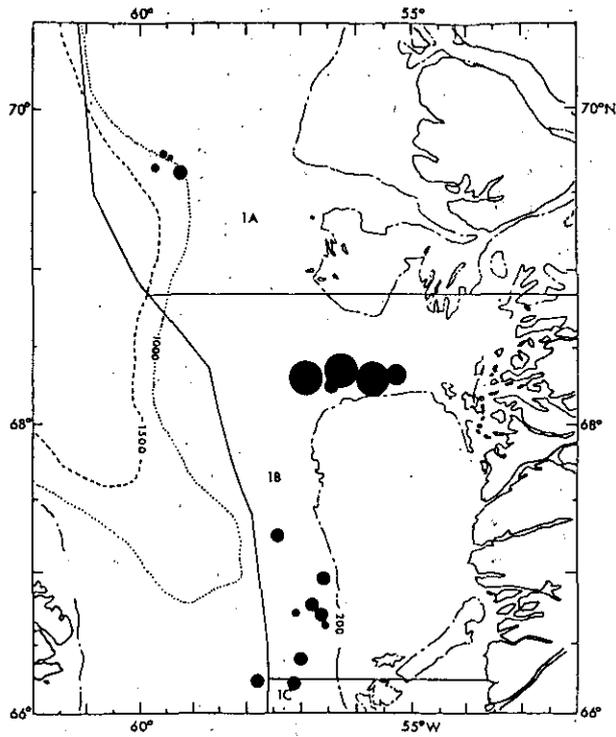
NAFO DIV.	Depth statum(m)			Total
	401-600	601-1000	1001-1500	
IA	0.18	0.18		0.37
IB	3.82	0.66		4.48
IC	0.11	12.50	1.75	14.36
ID		6.09	15.48	21.58
Total	4.12	19.43	17.23	40.78

Table 4. Biomass estimates (x1000 tons) of beaked redfish by strata.

NAFO DIV.	Depth statum(m)			Total
	401-600	601-1000	1001-1500	
IA	-	0.00		0.00
IB	0.18	0.03		0.20
IC	0.29	0.08		0.37
ID		0.02	0.01	0.02
Total	0.46	0.13	0.01	0.60

Table 5. Biomass estimates (x1000 tons) of roundnose grenadier by strata.

NAFO DIV.	Depth statum(m)			Total
	401-600	601-1000	1001-1500	
IA	-	-		-
IB	-	-		-
IC	0.00	1.46	0.08	1.54
ID		0.07	5.06	5.13
Total	0.00	1.54	5.14	6.67



Divs. 1AB

Divs. 1CD

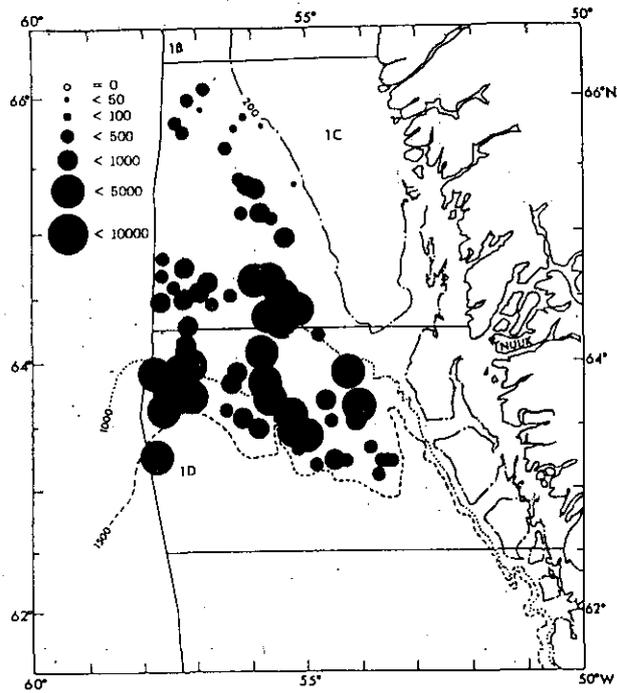


Fig. 1. Catches (Kg/Km<sup>2</sup>) of Greenland halibut.

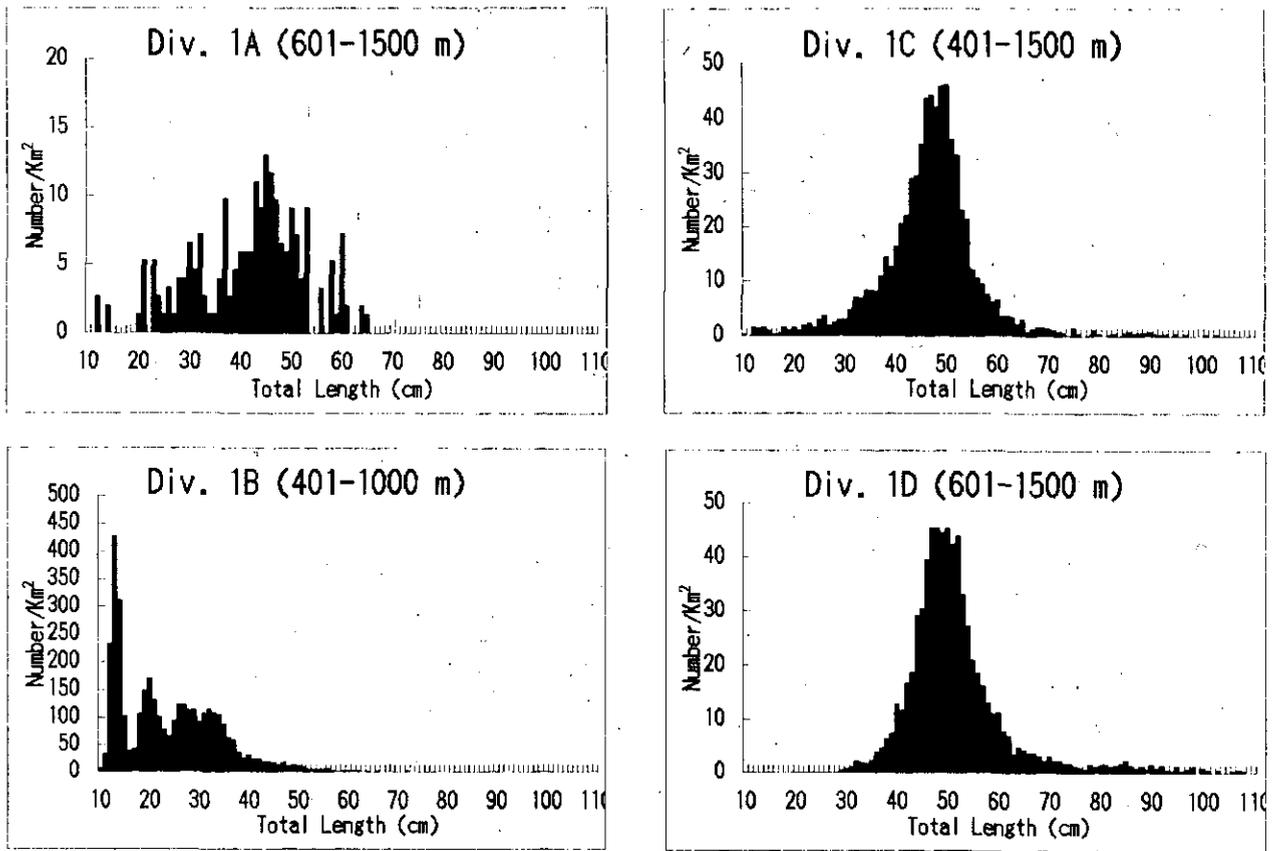
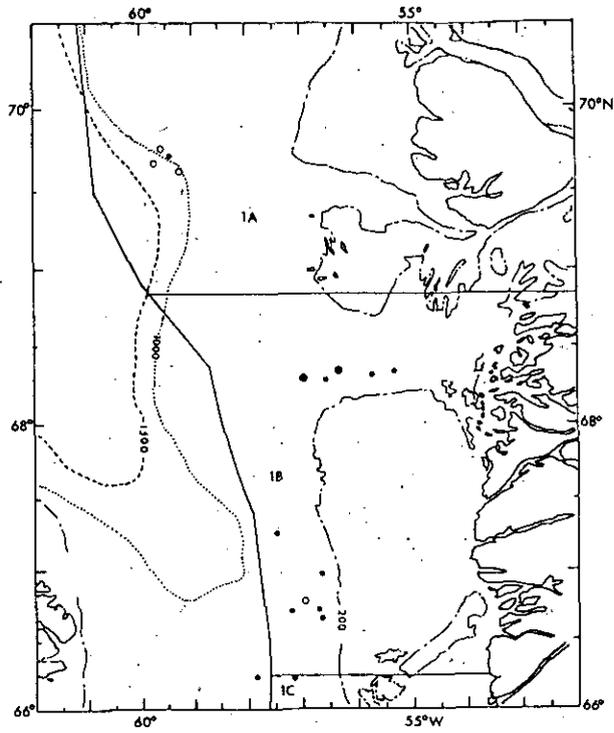


Fig. 2. Size Compositions of Greenland halibat.



Divs. 1CD

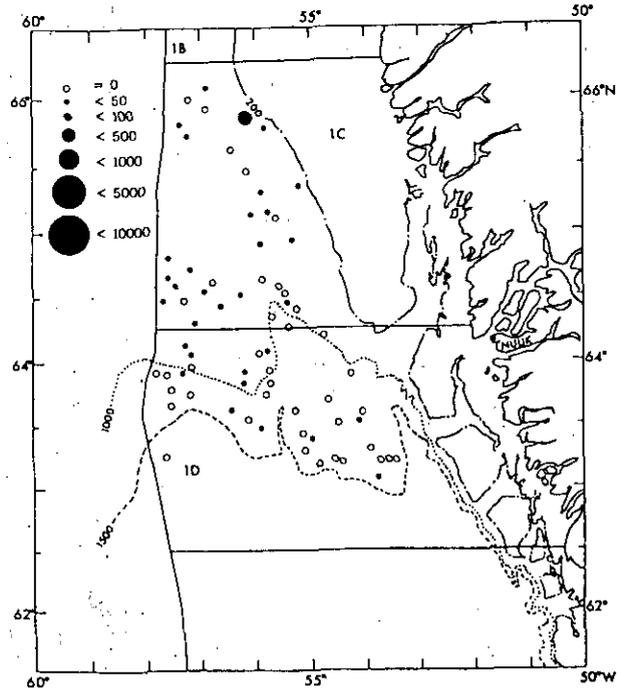


Fig. 3. Catches (Kg/Km<sup>2</sup>) of beaked redfish.

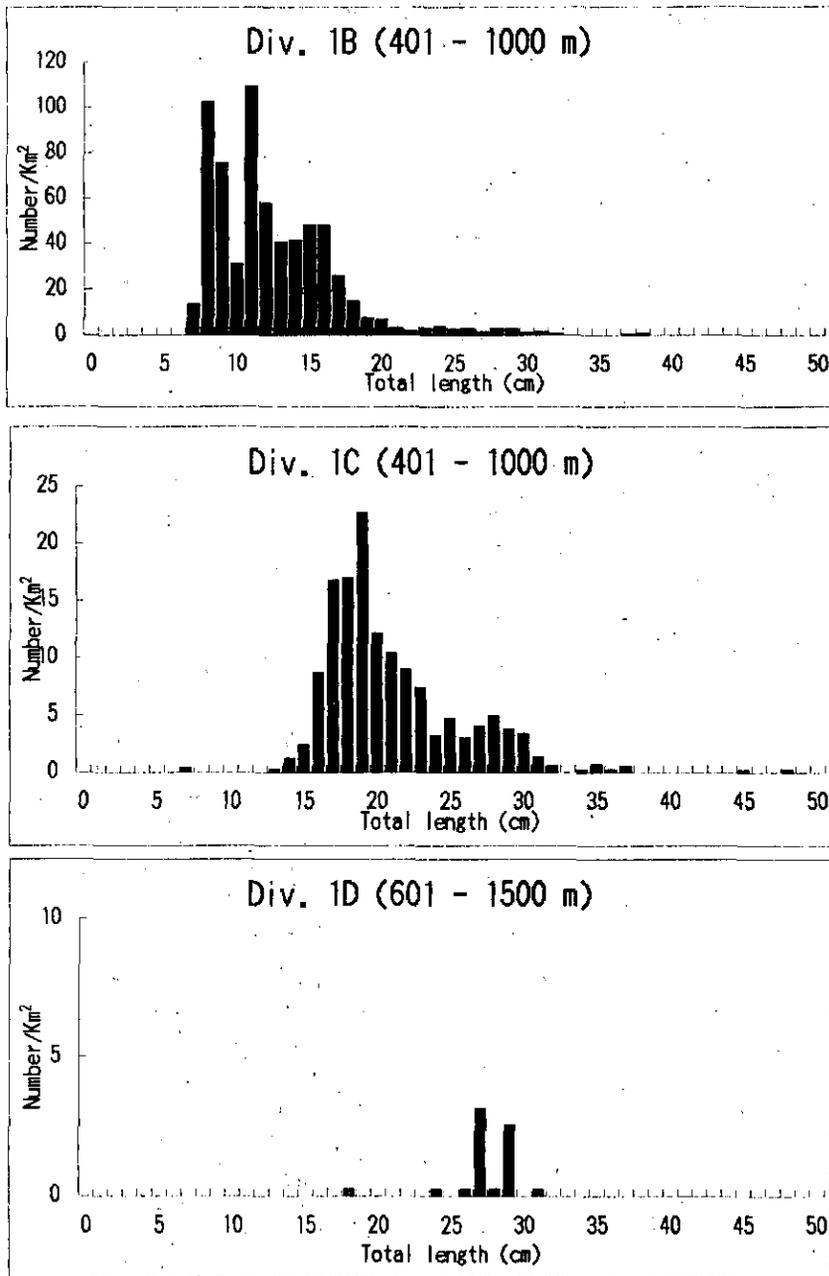
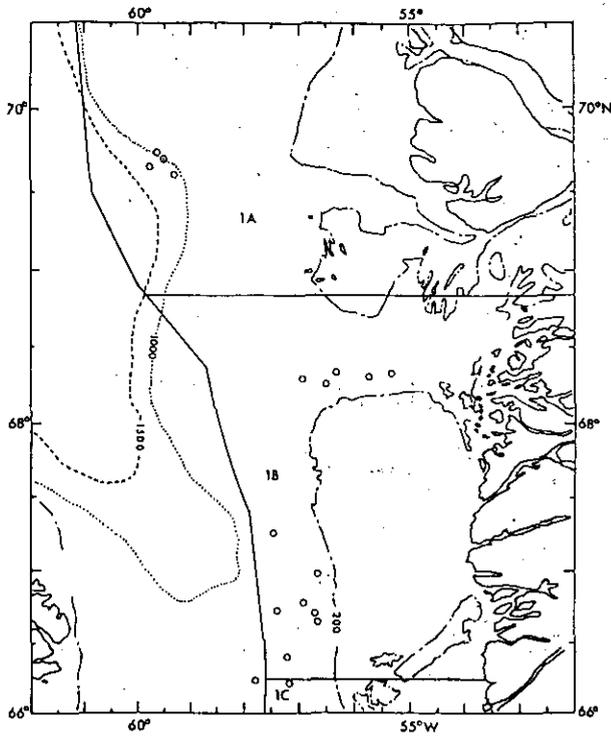


Fig. 4. Size compositions of beaked redfish.



Divs. 1AB

Divs. 1CD

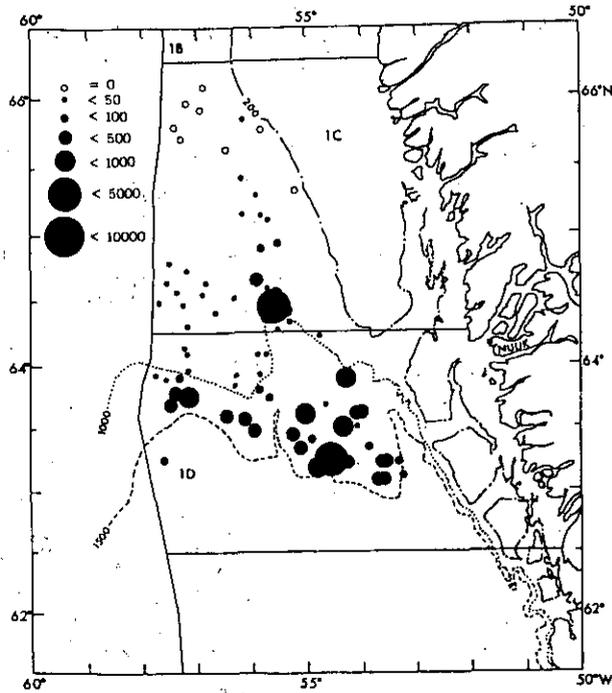


Fig. 5. Catches (Kg/Km<sup>2</sup>) of roundnose grenadier.

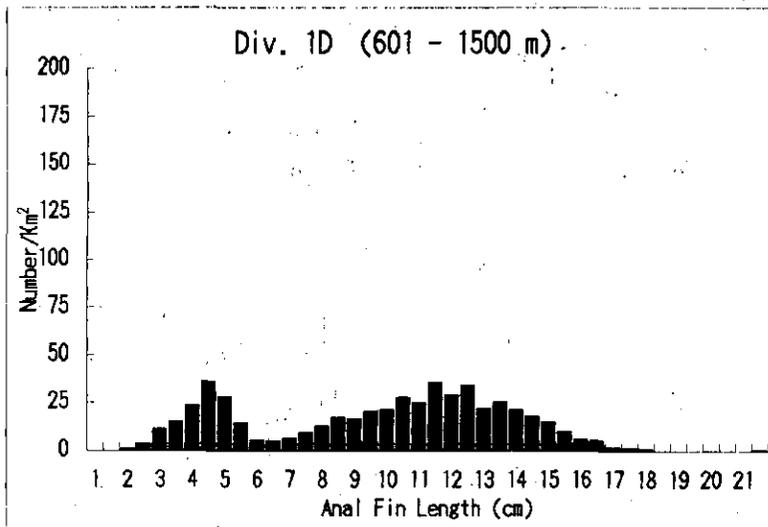
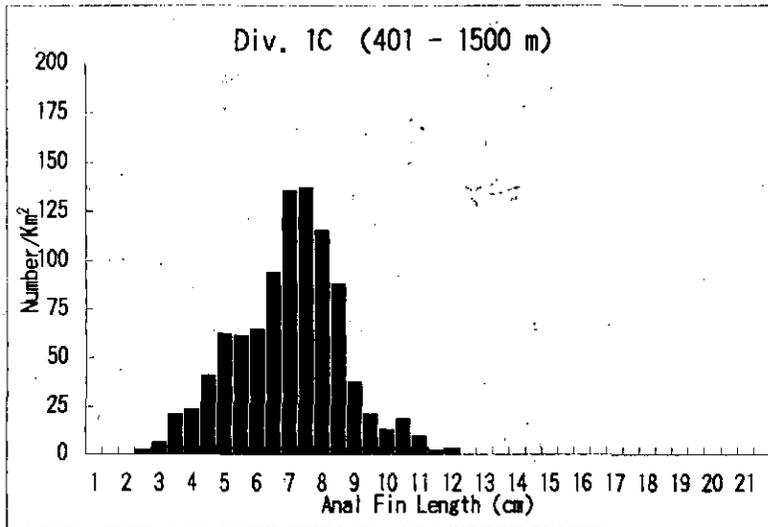


Fig. 6. Size compositions of roundnose grenadier.

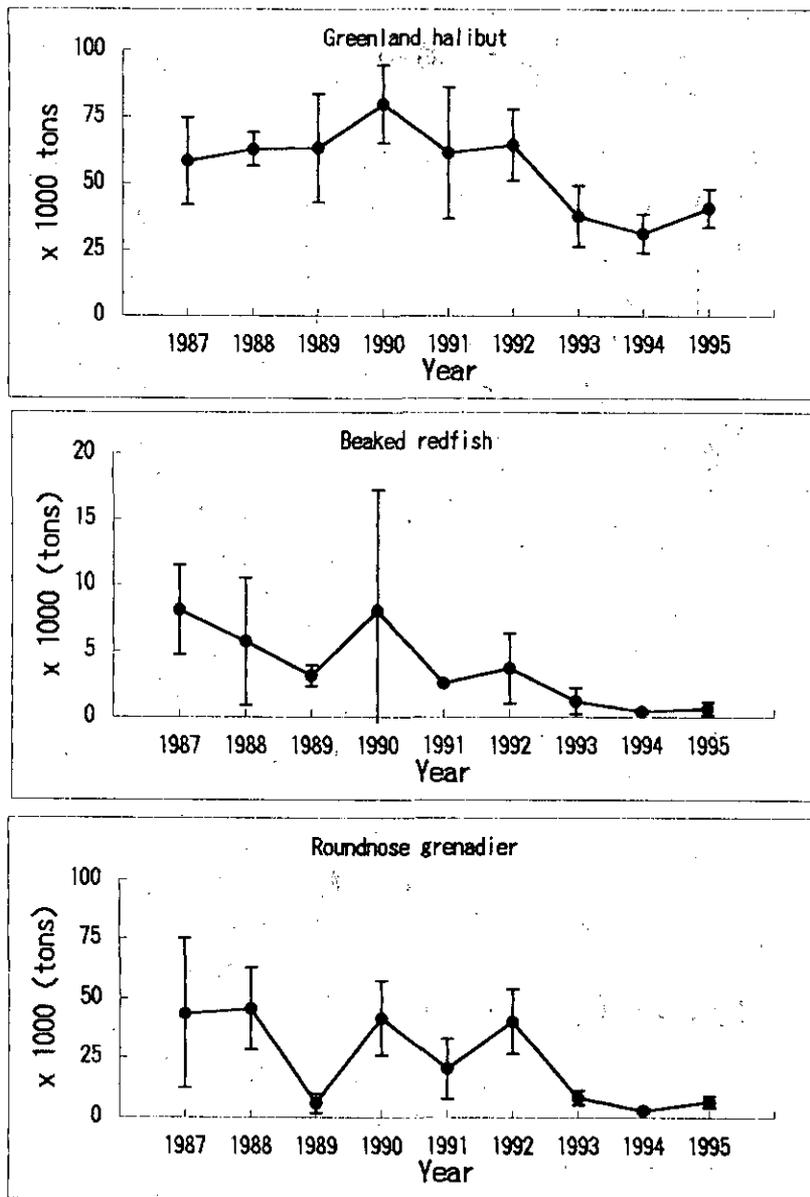


Fig. 7. Estimated biomass of Greenland halibut, beaked redfish and roundnose grenadier in Divs. 1BCD with approximate 95% confidence intervals. Values for 1987 do not contain the data for the depth strata of 1001-1500 m, and values for 1995 contain the data for depth strata of 401-1000 m in Div. 1A.