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West Greenland Groundfish Biomasses Estimated from a Stratified-random Trawl Survey in 1987

by

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Introduction

For stocks off West Greenland (Subarea 1) stock assessments have been made for cod and shrimp only, while for other species assessments have not been possible due to the insufficient data. In July/August 1987, a stratified random bottom trawl survey was carried out jointly by Japan Marine Fishery Resource Research Center (JAMARC) and Greenland Trawling Company of the Greenland Home Rule (GTC). The purposes of the survey were to estimate groundfish biomasses and to collect information on the distribution, size composition and biological characteristics of the main species off West Greenland.

Materials and Methods

The survey covered NAFO Div. 1A south of 70°N to 1F, from the 3-mile limit to the 1000 m depth contour line, the 200-mile limit or the mid-line against Canada. In the northern area (Div. 1ABC), Each division is divided into 6 strata by 100, 200, 300, 400, 600 and 1000 m depth contours. In the southern area (Div. 1DEF), each division is divided into 4 strata by 200, 400, 600 and 1000 m, due to the lack of reliable 100 and 300 m depth contours in the bathymetric charts. Fig. 1 shows a stratification scheme of the survey. Each stratum was subdivided into a number of units (7.5 minute lat. x 15.0 minute long.). A total of 93 trawl stations in Div. 1ABC and 46 in Div. 1DEF were allocated in proportion to the area of each stratum with a minimum of 3 stations per stratum. At each stratum, the allocated trawl stations were ran-

domly selected. Area (km^2), percentage of area and number of trawl stations of each stratum are given in Table 1 for Div. 1ABC and Table 2 for Div. 1DEF. No stations were allocated to stratum 25, due to its very small area.

The survey was carried out by R/V Shinkai Maru, a 3,393 tons stern trawler having an overall length 100 meters and 5,000 hp. The trawl gear used was designed for rough sea bottom. It has a 54 m head rope and a 66 m ground rope rigged through tires, and a 140 mm mesh size cod-end with a 30 mm mesh size liner. Trawl operations were carried out during day-time only. Duration of tows was 30 minutes with a speed of about 3.5 knots. For each haul the distance between the trawl doors and the height of the net opening were recorded by Otter Graph (Kaijo Denki Co. Ltd., Tokyo) and Net Recorder (Furuno Electric Co. Ltd., Tokyo), respectively. The spread between the tips of wing nets was calculated by the following equation : DW = 0.40 x DT, where DW is distance between wing tips (m), DT is distance between trawl doors (m) and 0.40 = net length (63 m) / (hand rope length (94 m) + net length). The area swept per haul was calculated as the product of the distance towed and the width between the tips of wing nets. For tows for which the distance between trawl doors could not be estimated, the value was calculated by the following equation which was estimated by the data obtained during the survey : DT = 10.9 + 13.0 ln(WL), where WL is warp length (m), (r=0.80). The catch at each haul was sorted into species and weighed to the nearest 0.1kg.

Biomass estimates were obtained by applying the "swept area" method, assuming the catchability coefficient as 1.0.

Results and Discussion

During the survey 117 successful hauls were made (Tables 1 and 2), which gives a coverage of 1241 km^2 per haul in the northern area and 1465 km^2 per haul in the southern area. In four strata no hauls could be made due to too rough bottom conditions for trawl and/or ice coverage. The area not covered is 3456 km^2 corresponding to 2.3% of the trawl survey area. These strata were excluded from the biomass estimation.

Table 3 shows the biomass estimates for each species. Cod biomass was estimated as 427,600 tons (CV = 56%), which is in the same order of size as found in the Federal Republic of Germany survey (464,300 tons with 23% of CV) in October/November 1987. However the precision of the German estimate is much higher. This is to be expected as the number of stations by strata in this survey were allocated proportional to the areas of strata, whereas the German survey is designed specifically for cod and, hence more effort is distributed in areas where cod are usually caught (Anon., 1988).

The shrimp biomass estimate, 1,100 tons, is clearly underestimated because total catch in Subarea 1 south of 71°N in 1986 was 44,600 tons (NAFO, 1987).

The biomass estimates for Sebastes mentella and S. marinus were 8,100 tons and 4,000 tons, respectively. According to Atkinson (MS 1987), the biomass estimates were 8,000 tons for Sebastes mentella and 2,050 tons for S. marinus in southern part of 1A south of 70°N to 1D, which are similar values to the present ones. These values seems however to be an underestimates when one compare to landings of 3,000 tons in 1986 (NAFO, 1987) and 1,050 tons (preliminary) in 1987 (the landings consisted mainly of S. mentella), and to an estimated discard of 16,000 tons redfish in the shrimp fishery (Riget et al., 1988).

The catchability coefficient was taken as 1.0 for all estimates. This value is known to vary from species to species and with age in each species, and the underestimates of shrimp and redfish biomasses are probably due to a real catchability coefficient less than 1.0. The coefficient is obviously unreasonable for some species categories e.g. sandlance and seasnails which can not be picked up from the sea bottom by the heavy gear.

References

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Table 1. Area (km^2), percentage of area, and number of planned trawl stations for each stratum (numbers in parenthese; successful hauls).

Division		Depth zone (m) 0-100	100-200	200-300	300-400	400-600	600-1000	TOTAL
	Stratum	1	2	3	4	5	6	
1 A	Area	693	6818	8338	3815	1222	525	21411
	%	0.6	6.2	7.6	3.5	1.1	0.5	19.6
	No.of st.	3(3)	5(5)	6(6)	3(3)	3(2)	3(0)	23(19)
	Stratum	7	8	9	10	11	12	
1 B	Area	10939	11339	8186	10660	5087	1915	48126
	%	10.0	10.4	7.5	9.8	4.7	1.8	44.1
	No.of st.	7(7)	8(8)	6(6)	8(8)	5(5)	3(3)	37(37)
	Stratum	13	14	15	16	17	18	
1 C	Area	4441	11331	3446	1243	3131	16066	39658
	%	4.1	10.4	3.2	1.1	2.9	14.7	36.3
	No.of st.	4(3)	7(7)	3(3)	3(3)	3(3)	13(13)	33(32)
	Area	16073	29488	19970	15718	9440	18506	109195
TOTAL	%	14.7	27.0	18.3	14.4	8.7	17.0	100.0
	No.of st.	14(13)	20(20)	15(15)	14(14)	11(10)	19(16)	93(88)

Table 2. Area (km^2), percentage of area, and number of planned trawl stations for each stratum (numbers in parenthese; successful hauls).

Division		Depth zone (m) 0-200	200-400	400-600	600-1000	TOTAL
	Stratum	19	20	21	22	
1 D	Area	8060	3492	888	5451	17891
	%	19.0	8.2	2.1	12.8	42.1
	No.of st.	5(5)	3(3)	3(0)	11(7)	22(15)
	Stratum	23	24	25	26	
1 E	Area	6648	2545	196	691	10080
	%	15.7	6.0	0.5	1.6	23.7
	No.of st.	4(3)	3(2)	0(0)	3(0)	10(5)
	Stratum	27	28	29	30	
1 F	Area	8808	3330	1211	1156	14505
	%	20.7	7.8	2.9	2.7	34.2
	No.of st.	5(5)	3(2)	3(2)	3(0)	14(9)
	Area	23416	9367	2295	7298	42476
TOTAL	%	55.4	22.1	5.4	17.2	100.0
	No.of st.	14(13)	9(7)	6(2)	17(7)	46(29)

Table 3. Biomass estimates and coefficient of variation (C.V.) for each species category.

Species category	Scientific name	Biomass (1000ton)	C.V. (%) *
Cod	Gadus morhua	427.6	56
Greenland halibut	Reinhardtius hippoglossoides	58.4	14
Roundnose grenadier	Coryphaenoides rupestris	43.6	36
Shrimp	Pandarus borealis	11.0	38
Beaked redfish	Sebastes mentella	8.1	21
American plaice	Hippoglossoides platessoides	7.0	13
Golden redfish	Sebastes marinus	4.0	17
Spotted catfish	Anarchichas minor	3.6	27
Skates	Rajiformes	3.4	15
Atlantic halibut	Hippoglossus hippoglossus	3.0	34
Dogfishes	Squaliformes	2.9	23
Northern catfish	Anarchichas denticulatus	2.2	34
Sculpins	Cottidae	2.2	18
Atlantic catfish	Anarchichas lupus	2.0	26
Other shrimps	Mainly Crangonidae	1.8	40
Crabs	Brachyura	0.7	28
Spiny eel	Notacanthus chemnitzu	0.7	17
Eelpouts	Zoarcidae	0.6	26
Polar cod	Boreogadus saida	0.6	17
Greenland cod	Gadus ogac	0.3	29
Lanternfishes	Myctophidae	0.2	38
Sandlance	Ammodytes spp.	0.2	53
Cephalopods	Cephalopoda	0.2	11
Spiny lumpsucher	Eumicrotremus spinosus	0.1	21
Seasnails	Liparididae	0.1	16
Blennies	Lumpenus spp.	0.1	17
Alligatorfishes	Aspidophoroides spp.	0.1	21
Capelin	Mallotus villosus	0.1	44
Others		3.0	15
ALL SPECIES		587.7	41

*: $C.V.(\%) = \frac{\text{Standard error of estimate}}{\text{Biomass estimate}} \times 100$

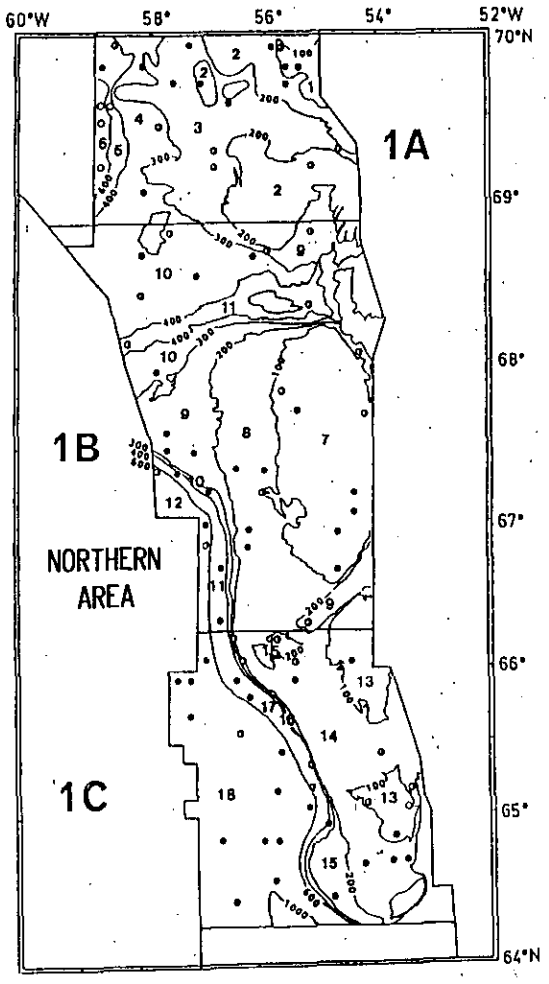

Fig. 1.

Stratification scheme and trawl stations during Shinkai Maru survey off West Greenland in 1987. Numerals in figures denote the stratum number. Trawl stations are represented by three type circles (succeeded trawl stations, ●; succeeded trawl station with changing a position predetermined, ⊙; unsuccessful trawl station, ○).