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Preliminary Results of the European Long-line Survey in the NAFO Regulatory Area

by

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Introduction

One of the uncertainties at the time of assessing the state of the Greenland halibut stock in the West Atlantic was the lack of knowledge on the batimetric limits of this species. The commercial fishery, which had surpassed the depths of the research surveys at 1800 m depth, continued to find exploitable concentrations of this species.

With the aim of finding these limits and improving knowledge of the batimetric distribution of this species, Spain and Portugal, financed by the E.U., proposed a long-line survey which would reach 3000 m depth.

Aims:

To study the batimetric distribution by length and sex of Greenland halibut and main accompanying species.

To find the batimetric limits of these species.

To find the evolution of yield with depth.

To study factors which influence the selectivity of long-line.

To tag specimens.

In this paper the preliminary results of this survey are presented.

Material and methods:

The survey was carried out on board the Norwegian long-liner Skarheim, of 246.16 t GTR and 1000 Hp.

Between 18 April and 5 May 1996, a total of 64 hauls were carried out in the NAFO Regulatory Area of Divisions 3LM and N, between the latitudes 43° and 48°N and depths of 562 and 3028 m. A sampling scheme of transepts was used in which the gear was lowered every 300 m depth wherever possible. The gear used was a bottom long-line autoliner, equipped with 1430 No. 4 "Mustad" hooks baited with squid (*Loligo sp*), since it was thought that this bait would remain on the hook better at greater depth. The long-lines remained at the bottom for an average of 6.42 hours, although times varied between 2.33 and 15.17 hours.

To check the effect of the type of bait in the catch composition, two hauls of 2860 hooks were carried out, the first 1430 of which were baited with squid and the rest with mackerel (*Sarda sarda*).

In each of the hauls the catch was separated by species, which were all measured, and part of which were used for biological sampling. In this sampling, details of length, weight, sex, gonad weight, liver weight and pre-anal length were taken. Individual weights were taken using a marine electronic scale with 30 kg capacity and 5 g precision. The weight of the catch was estimated from length distributions and length-weight relationships, which had been obtained from the fit of the biological sampling data to a potential model.

The pre-anal length-total length relationship was calculated for two species of grenadiers, fitting these data to a linear model.

Tagging was carried out using blue Spaghetti T-bar tags, which were implanted in the rear end on the eyed side of the specimen.

Results

Of the 64 hauls carried out during the survey, four were lost when the rope connecting the long-line to the surface broke. The rest of the hauls are presented according to their distribution by strata and divisions in Table 1. The hauls in Division 3L did not surpass 1599 m depth, since in this division work was only carried out in Flemish Pass.

Depth str.	3L	3M	3N	TOTAL	Lost
700-999	3	3	5	11	0
1000-1299	5	4	3	12	0
1300-1599	1	3	4	8	0
1600-1899	0	2	6	8	0
1900-2199	0	1	2	3	6
2200-2499	0	3	4	7	2
2500-2799	0	3	2	5	0
2800-3100	0	5	5	10	2
TOTAL	9	24	31	64	4
Lost	0	4	0	4	

Table 1.- Distribution of hauls by strata and divisions.

The main species caught together with corresponding parameters of length-weight relationships and the number of specimens used in the calculation are shown in Table 2. Two species alone, the roughead grenadier and the blue antimora made up more than 50% of the catch in weight, and the roughead grenadier surpassed 31% despite this species only being caught at less than 2200 m.

COD	SPECIES	% CATCH	a	b	n
Mb	*Macrourus berglax*	31.77	0.00135	3.3412	274
Ar	*Antimora rostrata*	23.15	0.00154	3.4255	255
Ha	*Hydrolagus affinis*	12.91	0.00435	3.0588	205
Rs	*Raja spp*	11.27	0.01115	2.9471	230
Na	*Nematonurus armatus*	8.81	0.00255	3.1487	300
Rh	*Reinhardtius hippoglossoides*	5.28	0.00116	3.5120	181
Cf	*Centroscyllium fabricii*	4.94	0.00395	3.0682	175
Ad	*Anarhichas denticulatus*	0.66	0.01963	2.8590	28
Ot	*Others*	1			

Table 2.- Weight composition of the catch and parameters a and b of the length-weight relationship of each species, together with the number (n) of specimens used in the calculation.

Rh (Greenland halibut)

The mean of catches in the strata of Greenland halibut was 26 kg per 1430 hooks, and no haul surpassed 150 kg per 1430 hooks. This species was caught at up to 2039 m depth. The mean length of specimens caught was 66.47 cm. When the evolution of this parameter is analyzed with depth, it is seen that there is a clear tendency to increase, from the stratum closest to the surface, at which mean length is around 50 cm, to the 1300-1599 m depth range, at which point it stabilizes at 75-80 cm. The maximum yields appear in the 1300-1599 m stratum (Table 3). Females made up 91.76% of the catch.

Depth str.	Mean L.	Yield	Number	Hauls
700-999	47.87	7.48	6	11
1000-1299	62.78	18.70	6	12
1300-1599	80.04	52.92	9	8
1600-1899	79.09	30.10	5	8
1900-2199	76.00	1.56	>1	3
2200-2499		0.00	0	5
2500-2799		0.00	0	5
2800-3100		0.00	0	8

Table 3.- Evolution of mean length and mean yields in weight and number for Greenland halibut.

Mb (Roughead grenadier)

The mean of catches in the strata where roughead grenadier were found was 164 kg per 1430 hooks, and in no haul did it surpass 535 kg per 1430 hooks. This species was caught at up to 2039 m of depth. The mean length of specimens caught was 54.39 cm. When the evolution of this parameter is analyzed with depth, it is seen that there is a tendency to increase, from the shallowest stratum, in which mean length is around 53 cm, to the 1900-2199 m depth range, the deepest stratum at which it is caught, and at which it reaches around 59 cm. The maximum yields appear in the 1000-1299 m stratum (Table 4). Females made up 71.4% of the catch. The pre-anal length (Lp)-total length (Lt) relationship was:

$$Lt = 57.614 + 0.183 \cdot Lp$$

Depth str.	Mean L.	Yield	Number	Hauls
700-999	52.60	73.77	87	11
1000-1299	53.79	258.67	282	12
1300-1599	55.61	119.70	115	8
1600-1899	57.18	106.51	93	8
1900-2199	58.74	50.07	40	3
2200-2499		0.00	0	5
2500-2799		0.00	0	5
2800-3100		0.00	0	8

Table 4.- Evolution of mean length and mean yields in weight and number for roughead grenadier.

Rs (Skates)

At least five species of this genus were treated together. The mean of catches of skates was 35 kg per 1430 hooks, and in no haul did it surpass 330 kg per 1430 hooks. This group of species was caught at all depth strata, although individually the specific composition varied from some strata to others. The mean length of specimens caught was 85.04 cm. When the evolution of this parameter is analyzed with depth, it is seen that there is a tendency to increase, from the shallowest stratum, in which mean length is around 60 cm, to the 1300-1599 m depth range, at which point it reaches around 96 cm, and from which it continues without any tendency. The maximum yields appear in the 1600-1899 m stratum (Table 5).

Depth str.	Mean L.	Yield	Number	Hauls
700-999	60.10	3.37	2	11
1000-1299	78.91	39.13	9	12
1300-1599	96.11	69.00	9	8
1600-1899	85.75	85.41	15	8
1900-2199	87.20	35.02	6	3
2200-2499	67.27	7.61	5	5
2500-2799	89.81	35.65	5	5
2800-3100	88.48	14.47	8	8

Table 5.- Evolution of the mean length and mean yields in weight and number for skates.

Ar (Blue antimora)

The mean of catches in the strata where blue antimora were found was 102 kg per 1430 hooks, and in no haul did it surpass 381 kg per 1430 hooks. This group of species was caught at all depth strata. The mean length of specimens caught was 50.04 cm. When the evolution of this parameter is analyzed with depth, it is seen that there is a tendency to increase, from the shallowest stratum, in which mean length is around 43 cm, to the 1300-1599 m depth range, at which point it reaches around 51 cm, and from this depth this value remains more or less constant. The maximum yields appear in the 1600-1899 m stratum (Table 6).

Depth str.	Mean L.	Yield	Number	Hauls
700-999	42.59	7.75	12	11
1000-1299	44.22	30.63	39	12
1300-1599	50.63	193.50	167	8
1600-1899	51.09	242.25	205	8
1900-2199	50.91	161.90	141	3
2200-2499	51.14	60.91	54	5
2500-2799	50.86	83.02	75	5
2800-3100	51.18	25.62	22	8

Table 6.- Evolution of mean length and yields in weight and number for blue antimora.

Na (Armed grenadier)

This species begins to appear in the catch from 2000 m depth, and seems to substitute the roughead grenadier, coinciding with the disappearance of Greenland halibut catches. The mean of catches in the strata where armed grenadier were found was 81 kg per 1430 hooks, and in no haul did it surpass 257 kg per 1430 hooks. The mean length of specimens caught was 50.25 cm. This parameter seems to tend to decrease slightly with depth. Yields reach a maximum in the deepest stratum (Table 7). The pre-anal length (Lp)-total length (Lt) relationship was:

$$Lt = 50.427 + 0.0461 \cdot Lp$$

Depth str.	Mean L.	Yield	Number	Hauls
700-999		0.00	0	11
1000-1299		0.00	0	12
1300-1599		0.00	0	8
1600-1899	53.00	0.34	0.5	8
1900-2199	51.22	3.80	6	3
2200-2499	51.26	46.40	73	5
2500-2799	50.67	89.30	144	5
2800-3100	49.81	117.01	197	8

Table 7.- Evolution of mean length and yields in weight and number for armed grenadier.

Ha (Smalleyed rabbitfish)

This species was caught at between 1000 and 2800 m depth. The mean of catches in the strata where smalleyed rabbitfish were found was 96 kg per 1430 hooks, and in no haul did it surpass 900 kg per 1430 hooks. The mean length of specimens caught was 109.62 cm. This parameter does not seem to show any tendency with depth. Maximum yields appear in the 1900-2199 m stratum (Table 8).

Depth str.	Mean L.	Yield	Number	Hauls
700-999		0.00	0	11
1000-1299	110.85	4.56	0	12
1300-1599	112.36	70.26	9	8
1600-1899	99.20	70.25	13	8
1900-2199	115.54	372.60	42	3
2200-2499	113.06	6.64	0	7
2500-2799	103.49	11.40	2	5
2800-3100		0.00	0	10

Table 8.- Evolution of mean length and yields in weight and number for smalleyed rabbitfish.

Tagging

A total of 98 specimens were tagged in the shallowest strata (up to 1000 m of depth), whose length distribution is shown in Table 9.

Length	Number
30	1
33	3
36	4
39	6
42	20
45	12
48	7
51	2
54	7
57	8
60	3
63	9
66	4
69	2
72	4
75	1
78	3
81	1
84	1
Total	98

Table 9.- Length composition of Greenland halibut tagged.

Bait comparison

The only species caught in great enough numbers to permit the study of the effect of the bait used were the roughead grenadier and the blue antimora (Tables 10 and 11). In both cases it is observed that the use of mackerel brings about an increase in the mean length and a fall in yields, implying a significant fall in the number of specimens of these species caught. This is due to the fact that the automatic baiting machine, which cuts the bait transversally at each certain distance, produces slightly more voluminous sections in the case of mackerel than of squid, and the two previously mentioned species have a relatively small mouth. Other species with larger mouth sizes, such as Greenland halibut, should be less affected by the different bait sizes.

	Mean Length			Yield	
	Squid	Mack		Squid	Mack
700-999	54.20	57.90	700-999	229.96	122.22
1000-1299	54.44	63.53	1000-1299	312.69	239.22

Table 10.- Comparison between mean lengths and yields of roughead grenadier caught with baits of squid and mackerel in the first two depth strata.

	Mean Length			Yield	
	Squid	Mack		Squid	Mack
700-999	40.02	41.20	700-999	25.06	11.30
1000-1299	38.38	44.61	1000-1299	20.89	17.34

Table 10.- Comparison between mean lengths and yields of blue antimora caught with baits of squid and mackerel in the first two depth strata.