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Evolution of Yields and Mean Lengths of the Catch of Greenland Halibut in Divisions 3LMNO of the NAFO Regulatory Area.

by

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Abstract

From the data supplied by observers on board the Spanish commercial fleet, we will analyze yields and mean lengths of Greenland halibut in two areas, North and South, clearly distanced within the NAFO Regulatory Area, quarterly in the period 1992-1994.

We found patterns of seasonality in both yields and mean lengths, in the two areas of the study, which will indicate seasonal displacements of immature specimens of the population.

Introduction

From 1990 to January 1995, the team of distant fisheries of the Instituto Español de Oceanografía carried out studies of the new Spanish deep water fishery in divisions 3LMNO of the NAFO Regulatory Area, whose target species is Greenland halibut (Reinhardtius hippoglossoides).

This fleet works at between 800 m and 1800 m depth and at the beginning of the fishery was concentrated to the northwest of Flemish Cap, in the northern area of Flemish Pass (divisions 3LM); from 1991 the fishing area was extended towards more southerly latitudes, part of the fleet moving to Division 3NO (Junquera et al., 1992).

The studies were carried out through embarcation of scientific observers on a third of the Spanish fleet displaced in the area, who collected biological information on the populations on which the fishery depends, particularly Greenland halibut (lengths, weights, maturity, feeding,...) and of the fishing activities themselves (location, catches,...) throughout the fishing trip.

From these data a study through time of yields and mean lengths in two areas, north and south of the area where the Spanish fleet works, was proposed, with the aim of observing the general evolution and seasonality of these parameters.

Material and Methods

The years corresponding to the period of study, 1992-1994, were treated quarterly searching for possible patterns of seasonality. Two limits of latitude were fixed within the area of work of the fleet, to clearly separate the areas to study; one to the north of 47°30' N and other to the south of 45°00' N, divided into three depth strata: 800-900 m., 1 000-1 199 m. and 1 200-1 399 meters.

The data used come from a total of 19 554 hauls considered valid, carried out by the Spanish fleet in these years. The hauls in which there were important incidents were rejected, such as serious breakages or any other kind of anomaly that prevented the bottom trawl gear from working normally.

Given the intensity of sampling, the distribution of controlled hauls must correspond quite well to the number of hauls carried out by the fleet each quarter. Good yields usually have the effect of concentrating the fleet around them. Then, an indirect way of following the concentrations of the target species may be through the distribution of hauls of the fleet which targets it. To observe the displacement of the fleet throughout the period of study, we represent quarterly the number of hauls made by area and by depth strata analyzed.

Quarterly yields, by area and by depth strata were estimated as the result of dividing the Greenland halibut catch by trawling time, expressed in minutes, this latter calculated as the sum of the differences between the time the manoeuvre of raising the gear was started and the time when the trawl gear was firmly placed on the sea bottom in all valid hauls (Table 1).

In the calculation of mean lengths a total of 4 839 samplings were used, in which a total of 1.070.833 specimens were measured (Table 2).

Results

Greenland halibut makes up more than 60% of the total catch of the fishery, and 65% in the period 1992-1994 in the depth strata and areas analyzed, for which the CPUE of the fleet can be considered as targeting this species.

A decreasing trend is observed in yields from the beginning of the fishery in the three depth strata analyzed, both in the area to the north of 47°30' N and in that to the south of 45°00' N (Figures 1-a, 2-a).

The evolution of yields in the septentrional area presents maximums in the first quarter and minimums in the third quarter of each year. These quarterly differences of maximums and minimums are clearly more pronounced in the deeper strata (Figure 1-a). In the meridional area, to the south of 45°00' N, the trend in the different depth strata is more difficult to see, although it seems clear that minimum yields are found in the fourth quarter of each year in the three depth strata studied, while maximums appear to be situated in the third quarter (Figure 2-a).

The distribution of hauls of the fleet shows grouping in the northern area in the first quarter of each year, particularly at between 800-1199 m depth (Figure 1-b), where as in the southern area, the number of hauls increases in the third and fourth quarters of the year, mainly at depths of over 1000 m, which coincides with the pattern shown by yields (Figure 2-b).

Mean lengths also tend to diminish slightly in the period of study (Figures 1-c, 2-c), this trend being stronger in the shallowest stratum (800-999 m) in the southern area.

In the northern area, mean lengths present maximums in the third quarter of each year and minimums occur between the first and second quarter. As in the case of yields of the shallowest stratum (800-999 m) it follows a less marked quarterly trend (Figure 1-c). In the southern area, mean lengths present maximums in the first quarter and minimums in the third (Figure 2-c).

Discussion

The fact that both yields and mean lengths present a falling trend throughout the period 1992-1994, it is a warning sign that the Scientific Council of NAFO recognized, recommending a reduction in the level of effort (Anon., 1993; 1994; 1995; 1996).

In both areas the great fall in mean lengths in the period of the study comes about in the shallowest stratum. The fact that year classes, which begin their recruitment in the shallowest stratum, have been strong since 1990 (Bowering et al., 1996) may aggravate the fall in mean length.

The northern area presents maximum annual yields in the first quarter of the year and in the southern area these are found in the third quarter. In both areas these maximum yields are corroborated by the concentration of hauls of the commercial fleet. Thus, maximum yields coincide with falls in the mean length of the catch indicating the arrival in the area of specimens of lengths below the mean. One explanation for this phenomenon is that maximum yields were marking the incorporation of recruits to these areas. Nevertheless, the fact that the is a delay of six months between north and south would appear to disprove this hypothesis.

Minimum yields coincide with increases in mean length, which would indicate that specimens of lengths smaller than the mean abandon the area.

The fact that maximum yields in the south coincide with minimums in the north and that minimum yields in the south in turn coincide with increases in the north may suggest a possible seasonal migration in latitude by immature specimens, which would move up to the north in winter and drop down to the south in summer, possibly searching for the seasonality of some their preys, or for some other reason. However, it should be borne in mind that Junquera and Saborido-Rey (1995) found significant differences in the lengths at first maturity (L_{50}) in divisions 3LM and 3NO, which would correspond to our northern and southern areas respectively, and these differences seem to rule out the possibility that these are the same fish.

Another possibility is that these are movements into and out of the 200 mile Canadian E.E.Z., but here we also come up against the paradox of a seasonal delay between our two areas of study.

In the northern area, apart from this entrance and exit of immature specimens, a seasonal vertical movement is also observed in which specimens with a length below the mean go down to greater depths in the winter months, thus causing the most pronounced seasonal changes in the deepest strata. This phenomenon is not so clearly seen in the southern area.

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Table 1. No. of valid hauls (H) and vessels (V) distributed by quarter (Q), depth strata and area.

DEPTH 800-999 m.

Area	Q	Q1-92	Q2-92	Q3-92	Q4-92	Q1-93	Q2-93	Q3-93	Q4-93	Q1-94	Q2-94	Q3-94	Q4-94
>47°30'N	H	647	1237	695	333	1037	628	349	139	259	178	290	336
	V	18	19	16	14	25	22	9	7	16	15	10	11
<45°00'N	H			58	100	4	224	408	199	75	131	217	205
	V			5	7	2	8	12	9	6	10	12	13

DEPTH 1000-1199 m.

Area	Q	Q1-92	Q2-92	Q3-92	Q4-92	Q1-93	Q2-93	Q3-93	Q4-93	Q1-94	Q2-94	Q3-94	Q4-94
>47°30'N	H	1781	1448	476	135	943	612	70	50	552	325	99	148
	V	19	21	15	12	26	21	8	5	16	13	9	10
<45°00'N	H	1		27	90	5	241	467	434	160	201	133	188
	V	1		6	6	3	8	12	9	8	11	11	12

DEPTH 1200-1399 m.

Area	Q	Q1-92	Q2-92	Q3-92	Q4-92	Q1-93	Q2-93	Q3-93	Q4-93	Q1-94	Q2-94	Q3-94	Q4-94
>47°30'N	H	477	725	48	3	207	96	3	20	170	110	11	76
	V	19	18	8	2	15	7	2	2	11	8	3	5
<45°00'N	H			6	9	2	22	161	447	129	290	61	146
	V			2	2	1	5	9	7	7	9	5	6

Table 2. No. of length samplings (S) and specimens measured (N) distributed by quarter (Q), depth strata and area.

DEPTH 800-999 m.

	Q	Q1-92	Q2-92	Q3-92	Q4-92	Q1-93	Q2-93	Q3-93	Q4-93	Q1-94	Q2-94	Q3-94	Q4-94
>47°30'N	S	268	363	159	89	228	170	76	10	58	47	65	91
	N	63257	102301	39812	23814	44038	33524	12483	1336	9397	8557	12863	19926
<45°00'N	S			12	25	1	38	76	17	14	18	37	49
	N			3173	6595	219	7278	11804	2606	1930	2822	7828	8815

DEPTH 1000-1199 m.

	Q	Q1-92	Q2-92	Q3-92	Q4-92	Q1-93	Q2-93	Q3-93	Q4-93	Q1-94	Q2-94	Q3-94	Q4-94
>47°30'N	S	650	432	103	27	212	146	10	7	142	78	23	36
	N	146111	123972	24455	6749	43659	27957	1416	1192	26193	13933	4004	7053
<45°00'N	S	1		10	21		40	73	63	20	23	32	42
	N	110		2582	4224		6967	9248	7993	2362	3197	5776	6821

DEPTH 1200-1399 m.

	Q	Q1-92	Q2-92	Q3-92	Q4-92	Q1-93	Q2-93	Q3-93	Q4-93	Q1-94	Q2-94	Q3-94	Q4-94
>47°30'N	S	172	245	13	2	39	17		2	31	18	2	18
	N	43959	71644	2716	420	8569	4272		305	5449	3004	377	3202
<45°00'N	S				1		3	19	58	19	40	7	31
	N				390		558	2802	8500	2160	6514	912	4778

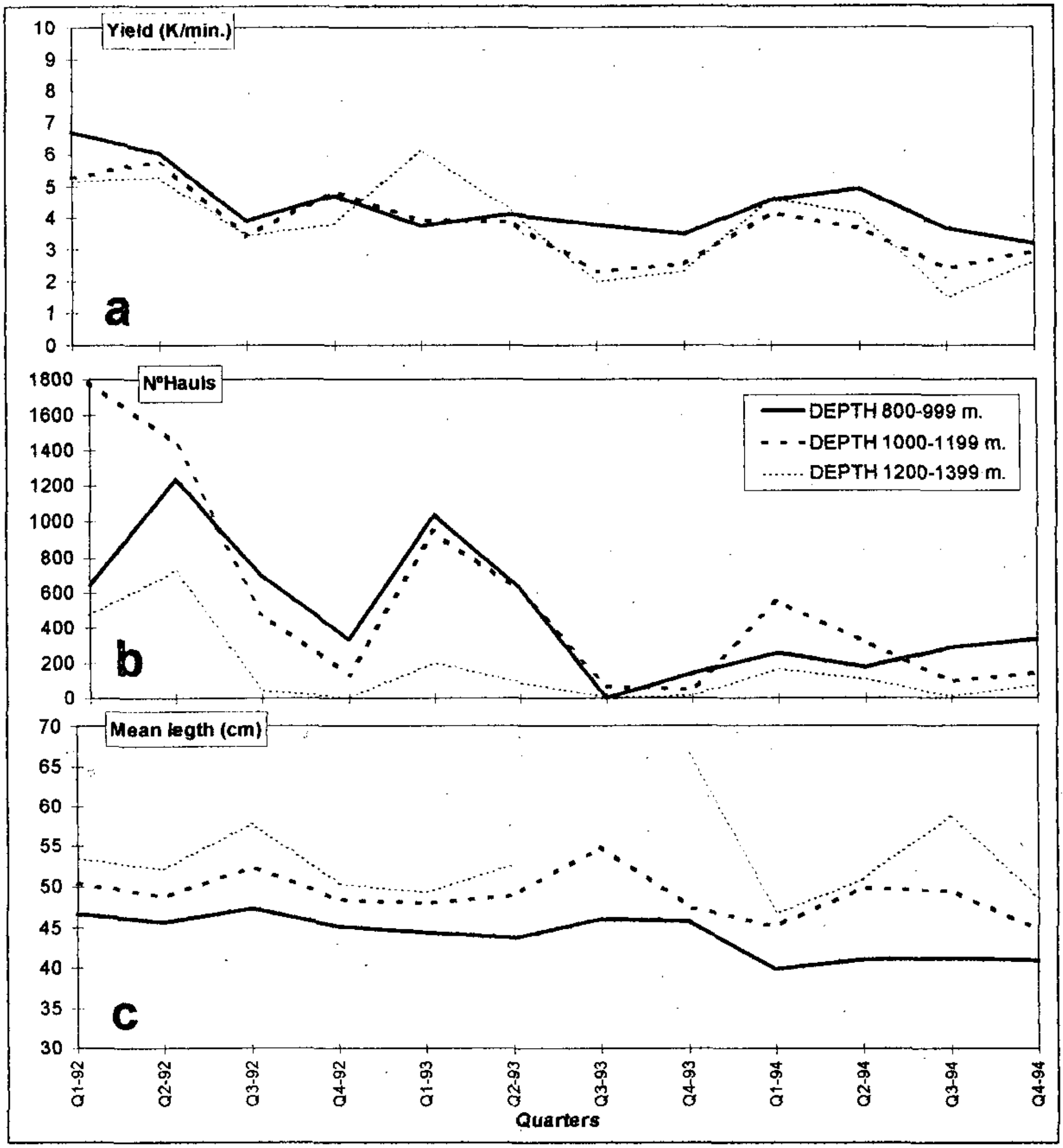

Fig 1. North zone Yields (a), No of hauls (b) and Mean length (c) by quarters and depth strata.

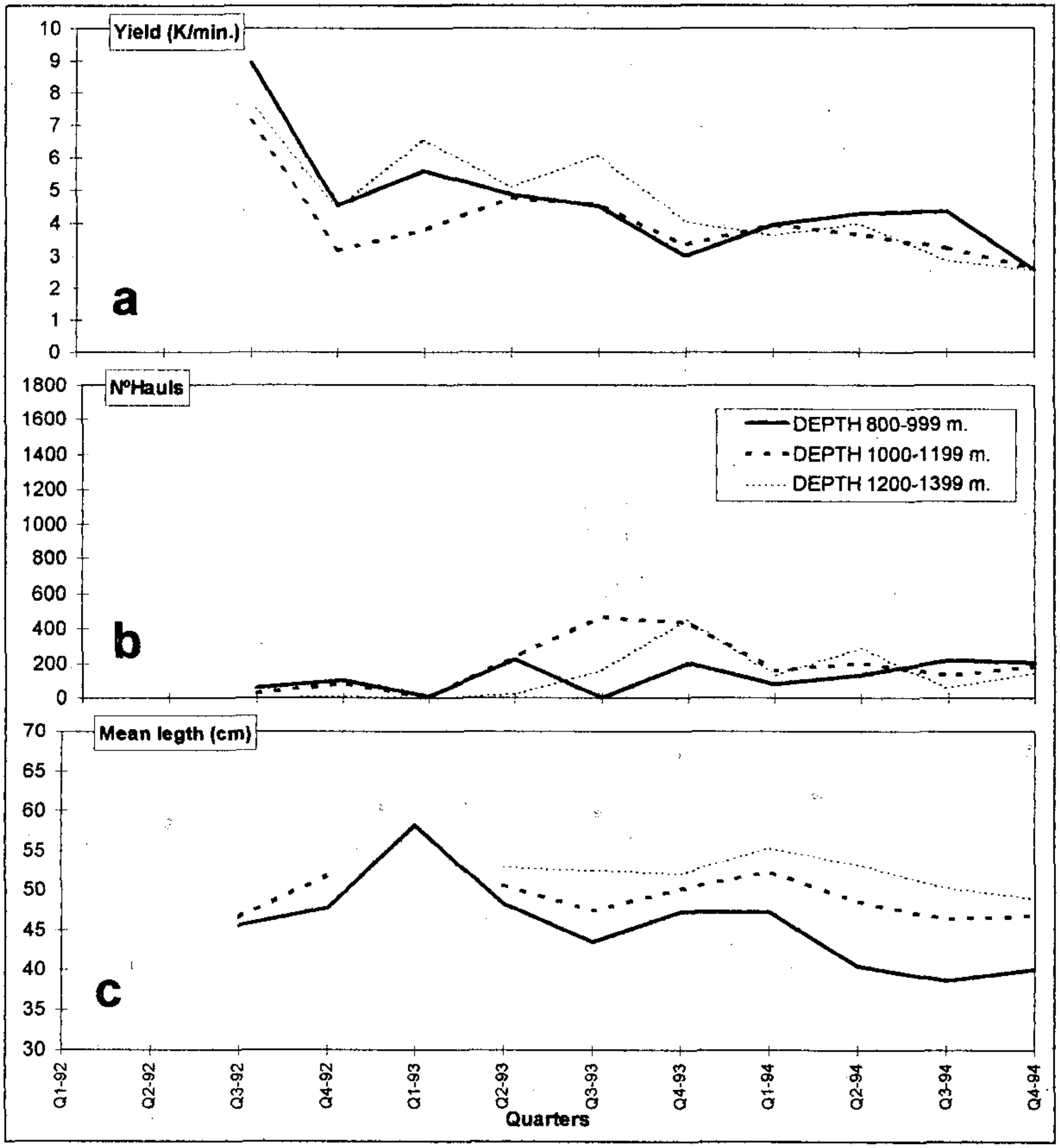

Fig 2. South zone Yields (a), No of hauls (b) and Mean length (c) by quarters and depth strata.