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Evaluation of Redfish Stocks in Divisions 3LN and 3M by the Trawl-Acoustic Survey in 1991

by

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ABSTRACT

Estimates of numbers and biomass of redfish as provided by the instrumental survey done in April-June 1991 are given as well as size composition and distribution of redfish.

Total number and biomass of redfish in Divs. 3LN were estimated at 372.5 mill.fish and 190.9 thou.t, respectively, and were above the 1990 level. Biomass of redfish on the Flemish Cap was 107.7 thou.t, this is below the 1990 estimate and long-term mean. While the estimate for the numbers of 3856.1 mill.fish is the peak one for 1988-1991. This growth of numbers is associated with a rich 1989 year-class.

INTRODUCTION

Redfish in the Northwest Atlantic is one of the prevailing commercial species, and hence, presents a very important object of scientific studies. In view of this, annually estimates of numbers and biomass of redfish in NAFO Divisions are calculated on the basis of data collected in research cruises. Different mathematical methods have been used to have as reliable as possible estimates of the redfish stock size and to establish most efficient fishing using information on catch statistics, fishing effort, ship class etc. However, this year since there were almost no statistical data available, including NAFO circular letters, it was not possible to estimate the stock and evaluate perspectives of its harvesting. Of greatest concern is the lack of data from the Flemish Cap, because this is the area of intensive fishing.

The present paper gives estimates of numbers and biomass of redfish as provided by the instrumental survey done by RV "Vilnius", besides, retrospective data as far back as 1983 are suggested.

MATERIAL AND METHODS

Trawl survey was done by RV "Vilnius" in April-June 1991. Stratified-random technique was used (Doubleday, 1981; Bulatova, Chumakov, 1986). Acoustic survey technique was used as described in Mamylov V.S. (1987). Investigations in divisions were carried out within the following times:

Division	Period	Number of hauls
3L	09-12.05	
	18-25.05	100
	02-06.06	
3M	27.04-08.05	107
3N	17-22.04	82

RESULTS

Div. 3M. In April-May the redfish on the Flemish Cap were distributed in the depth range between 200 and 700 m. Most dense concentrations and largest catch occurred on the western slope, to where shelf waters inflow, and also on the south-western and southern slopes, where such waters were in transformed form. On the eastern and south-eastern slopes catches were small.

During survey time redfish more than 15 cm in length were distributed mainly over the northern, north-eastern and partially over the south-western slope in the depth range from 570 to 610 m in 15-20 m bottom layer. This year redfish were found to be distributed in deeper waters compared to the previous year. Young redfish were distributed (fish smaller than 15 cm) over the western slope (strata 10,11) in the depth range between 290-320 m (Fig.1).

Peak catches amounted to more than 120 thou.fish per tow (stratum 6) at the expense of young redfish of 6-11 cm (Table 1). Catches of large redfish on the western and north-western slopes from deeper than 600 m contained more than 3-4 thou.fish (strata 18,19).

In the survey period catches contained redfish from 7 to 48 cm, with the young fish of 8 cm predominating (Fig.2).

An acoustic survey for redfish on the Flemish Cap estimated its numbers at 1850 mill.fish and biomass at 62.4 thou.t (Table 2). Of these 1450.0 mill.fish and 38.1 thou.t were distributed in the 4 m bottom layer. In calculations the stock was separated into two groups: fish smaller than 15 cm and fish larger than 15 cm. The bio-

mass of small fish was 12.1 thou.t with corresponding numbers of 1620.0 mill.fish, that of large redfish - 50.3 thou.t and numbers of 230.0 mill.fish. Similar survey in 1990 provided a stock size estimate of 228.7 thou.t, i.e. against previous year there was 3.6 time reduction by biomass and 1.5 time increase in number.

Notwithstanding a notable decline of redfish stock over the Flemish Cap, reported before, estimates of numbers and biomass by the trawl survey in 1991 were 26 times and 2.5 times, respectively, higher than in 1990 (Table 2). Absolute numbers were estimated at 2006.1 mill.fish while biomass at 45.4 thou.t. On the one hand, such

were discrepancies between estimates due to differences in survey times. In 1990 the survey was done in June-July, while in 1991 in April-May, because of specific conditions over the bank. Secondly, in 1991 considerable quantities of the young from the 1989 year-class were registered, which were distributed during the survey time very close to the bottom and were accessible for sampling with a bottom trawl. Eventually small fish accounted for 94.9% in number and 31.2% by biomass.

Division 3LN. Analysis of results from Div. 3N has provided evidence of unusual distribution of redfish in 1991 compared to previous years. Before, maximum densities were found every year on the southern slope of this division and minimum ones on the northern. In 1991 it was directly the opposite. Acoustic findings have shown peak densities and, hence, the bulk of the stock to be distributed over the northern slope in strata 727, 728 (Fig. 3). A sharp boundary between almost zero and largest densities went along 44°30'N. No redfish were recorded by the echo sounder in the southern part of Div. 3N in the pelagial.

During survey time main concentrations of redfish in this division were distributed between 366 and 547 m. Largest catch in number was taken in strata 725, 728 (Table 3).

Fish of 17-20 cm and 25-27 cm prevailed (Fig. 4). Smaller individuals prevailed in the shallower part of the division, in catch from deeper than 500 m redfish of mainly 30-40 cm occurred. On the whole, redfish smaller than 23 cm constituted more than a half of the total number.

Trawl-acoustic survey in Div. 3L in 1991 showed, that 98% of the total biomass of redfish were distributed

in the north-eastern part of the division and mainly in stratum 734 (Fig.5). Over a fairly small part of this stratum the density of redfish reached 4500 t per sq.mile. The fish dwelt in dense "conglomerate" 20-30 m above the bottom, with the thickness of about 130 m and width of 1.5 miles. The above concentration was distributed within 200-mile fishing zone of Canada. One more coverage of the same area 15 days later showed, that the fish were scattered over a vaster area and were found very close to the bottom. In Div. 3L the redfish occurred in catches from deeper than 200 m. Main concentrations were found in strata with the depth from 548 to 728 m, a half of the surveyed stock was recorded in stratum 734 (Table 4). The rest of the biomass was distributed over the slope of 3L, more or less evenly, gradually declining towards the southern part of division. In contrast to the southern slope of the Grand bank larger redfish dwell in this division (Fig.6). Fish of 23-30 cm prevail.

The trawl survey showed that the stock of redfish in Div. 3N was in 1991 at the level of the previous year. Numbers and biomass of redfish in Div. 3L in 1991 were bigger than in 1990. Despite this, redfish stock in the two divisions was below the long-term mean level, as indicated by bottom catches.

Acoustic survey in Div. 3N provided results similar to 1990. Acoustic data showed a notable growth of redfish stock in Div. 3L, which exceeded the long-term mean level.

Total numbers in Divs. 3LN were estimated by the trawl-acoustic survey, at 372.5 mill.fish and biomass at 190.9 thou.t (Table 5). These indices were 2.7 times and 4.8 times, respectively, above the level of the previous year. Historic survey data show that stock estimates exhibit year-to-year variations, very significant sometimes. In our opinion, such variations are, first of all, caused by complex migratory processes. Research surveys done by Canadian researchers in 1990 (Power and Baird, 1991) in Div. 3L showed an increasing trend in stock estimates from winter season (12.5 thou.t) towards summer season (67.4 thou.t) and their decline towards autumn season (16.6 thou.t). Variations of the stock size on the Flemish Cap are, primarily, associated with the production of strong year-classes.

CONCLUSIONS

Data provided by the trawl-acoustic survey have shown a growth of redfish stock in Divs. 3LN against 1989-1990. A peculiar feature of this year distribution of redfish in these divisions was its unusual pattern.

A large growth of redfish numbers on the Flemish Cap was noted, which occurred at the expense of rich 1989 year-class, that will recruit the commercial stock in 1994-1995.

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Table 1. Results from the trawl survey for Redfish in Div 3M in April-May, 1991.

Stratum	Depth, m	Area, mile sq.	Nos of tows	Mean catch/1 valid tow fish	Abundance, '000	Biomass, tons	
1	127-146	342	3	4,0	0,04	101,3	1,1
2	147-183	838	7	11,0	0,4	682,8	22,4
3	184-255	628	5	25,2	0,4	1172,3	19,5
4	"	348	3	7,0	0,6	180,4	14,2
5	"	703	6	83,0	1,0	4322,1	54,2
6	"	496	5	56,0	1,2	2057,5	43,9
7	256-364	822	6	2590,5	23,7	157732,7	1444,0
8	"	646	6	6,5	1,0	311,0	45,4
9	"	314	4	1512,0	12,0	35168,0	279,8
10	"	951	7	3247,4	25,3	228763,3	1783,7
11	"	806	6	24826,5	190,8	1482233,9	11393,3
12	365-546	670	5	162,8	32,4	8079,7	1609,4
13	"	249	4	48,3	22,1	689,9	408,1
14	"	602	8	238,9	61,9	10652,1	2758,1
15	"	666	7	367,1	88,8	13112,4	4382,0
16	547-728	634	6	105,3	50,4	4946,8	2364,4
17	"	216	3	28,0	18,6	448,0	296,9
18	"	210	4	1654,0	533,1	25728,9	8292,8
19	"	414	5	800,3	333,7	24557,9	10234,2
Total			100			2006141,0	45447,4

Table 2. Estimates provided by the trawl- acoustic survey for redfish in Divs. 3M for 1983-1991

Year	Trawl survey		Acoustic survey		Total	
	Numbers, fish $\times 10^{-6}$	Biomass, thou.t	Numbers, fish $\times 10^{-6}$	Biomass, thou.t	Numbers, fish $\times 10^{-6}$	Biomass, thou.t
1983	644,0	154,9				
1984	376,7	132,3				
1985	177,3	51,9				
1986	1200,2	309,5				
1987	463,2	106,4				
1988	183,1	47,0	1632,1	332,0	1815,2	379,0
1989	283,8	83,3	1947,3	282,6	2231,1	365,9
1990	74,7	17,7	1331,4	228,7	1406,1	246,4
1991	2006,1	45,4	1850,0	62,3	3856,1	107,7

Table 3. Results from the trawl survey for Redfish in Div 3N in April, 1991.

Stratum	Depth, m	Area, mile sq.	Nos of tows	Mean catch/ 1 valid tow	Abundance, '000	Biomass, tons	
				fish	kg		
360	56-82	2992	6	0,3	0,1	73,9	13,7
358	184-274	225	5	25,2	2,4	420,0	39,2
378	"-	139	3	1,7	0,2	17,1	2,1
357	275-365	164	4	155,0	10,1	1883,0	123,0
379	"-	106	3	41,0	6,4	321,9	50,3
380	"-	116	3	1,0	0,1	8,6	0,9
723	366-547	155	3	203,3	24,7	2334,6	284,0
725	"-	105	3	526,7	72,0	4096,3	559,8
727	"-	160	3	42,0	6,3	497,8	74,3
724	548-728	124	3	47,7	9,3	437,8	85,5
726	"-	72	3	354,0	104,1	1888,0	555,3
728	"-	156	3	350,7	136,8	4052,1	1580,8
Total			42			16031,1	3368,9

Table 4. Results from the trawl survey for Redfish in Div 3L in May-June, 1991.

Stratum	Depth, m	Area, mile sq.	Nos of tows	Mean catch/1 valid tow fish	Mean catch/1 tow kg	Abundance, '000	Biomass, tons
366	184-274	1394	4	3,3	1,0	335,6	102,5
369	"	961	3	0,3	0,01	23,7	0,4
389	"	821	4	1,3	0,3	76,0	15,6
346	275-365	865	3	30,7	8,6	1964,9	551,8
368	"	334	3	52,7	16,2	1303,0	400,7
387	"	718	3	48,7	17,0	2588,4	901,6
388	"	361	3	14,7	2,0	392,2	54,2
392	"	145	4	11,5	1,8	123,5	18,9
729	366-547	90	3	13,7	2,4	91,1	15,7
731	"	117	3	95,0	18,4	823,4	159,0
733	"	312	3	177,0	39,7	4090,7	918,5
735	"	160	3	52,7	12,0	624,2	142,7
730	548-728	93	3	34,3	10,6	236,5	73,3
732	"	96	3	296,3	94,8	2107,3	674,0
734	"	160	3	844,3	573,5	10006,9	6797,3
736	"	114	3	115,3	35,9	973,9	302,9
Total			51			25761,3	11129,1

Table 5. Estimates provided by the trawl-acoustic survey for redfish in Divs. 3LN for 1983-1991

Year	Trawl survey		Acoustic survey		Total	
	Numbers, fish x 10 ⁻⁶	Biomass, thou.t	Numbers, fish x 10 ⁻⁶	Biomass, thou.t	Numbers, fish x 10 ⁻⁶	Biomass, thou.t
1983	428,9	125,0				
1984	720,3	199,4				
1985	245,1	85,9				
1986	133,4	46,8				
1987	182,1	60,8				
1988	167,3	40,0	654,9	118,1	822,2	158,1
1989	44,7	10,9	100,0	18,3	145,2	29,2
1990	23,1	7,1	116,2	32,5	139,3	39,6
1991	41,8	14,5	330,7	176,4	372,5	190,9

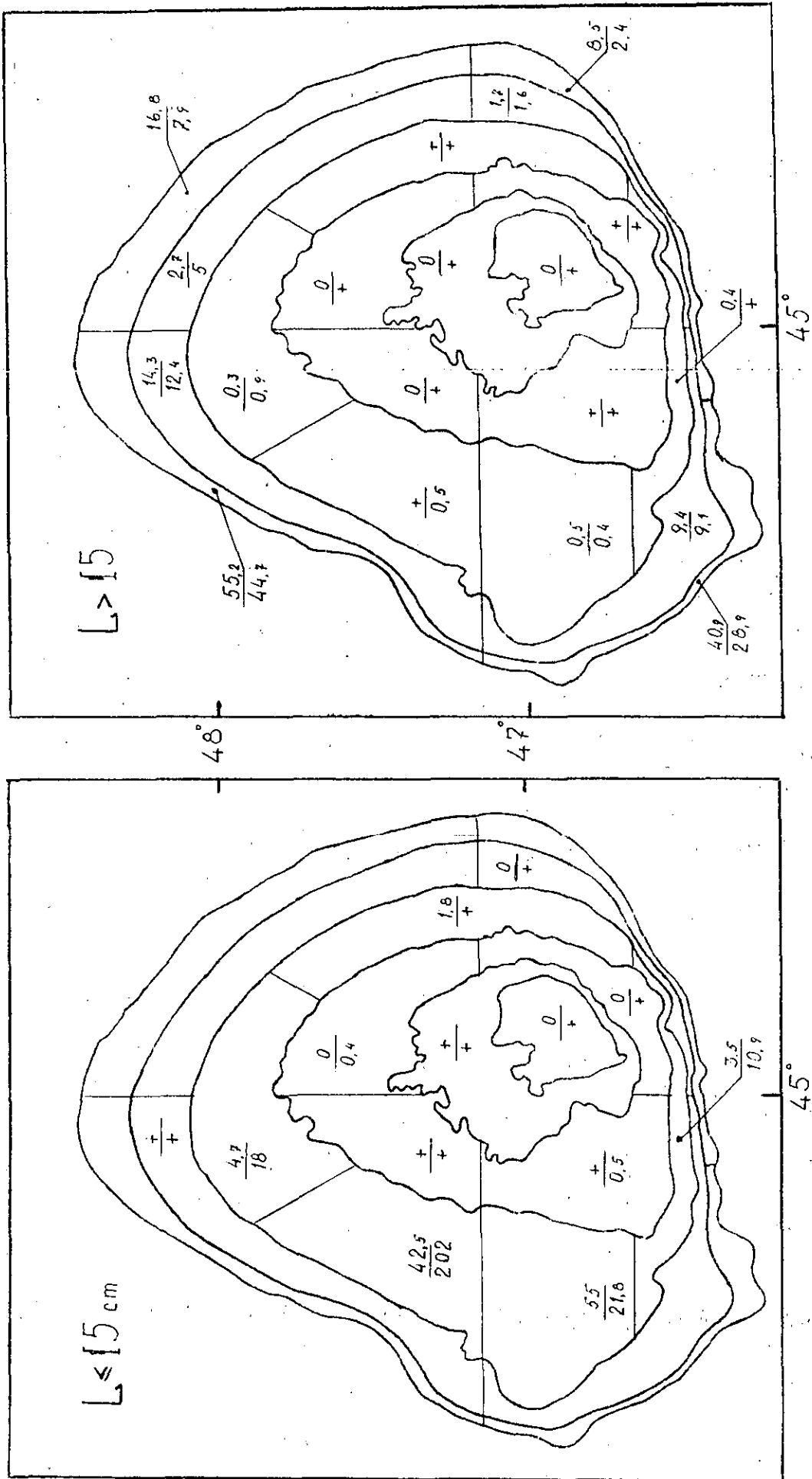


Fig.1. Redfish distribution on the Flemish Cap Bank in 1991. Here and hereinafter figures present redfish concentration densities expressed in average echo-intensity units by strata: in pelagic layer (above the line) and in bottom layer (beneath the line).

3M

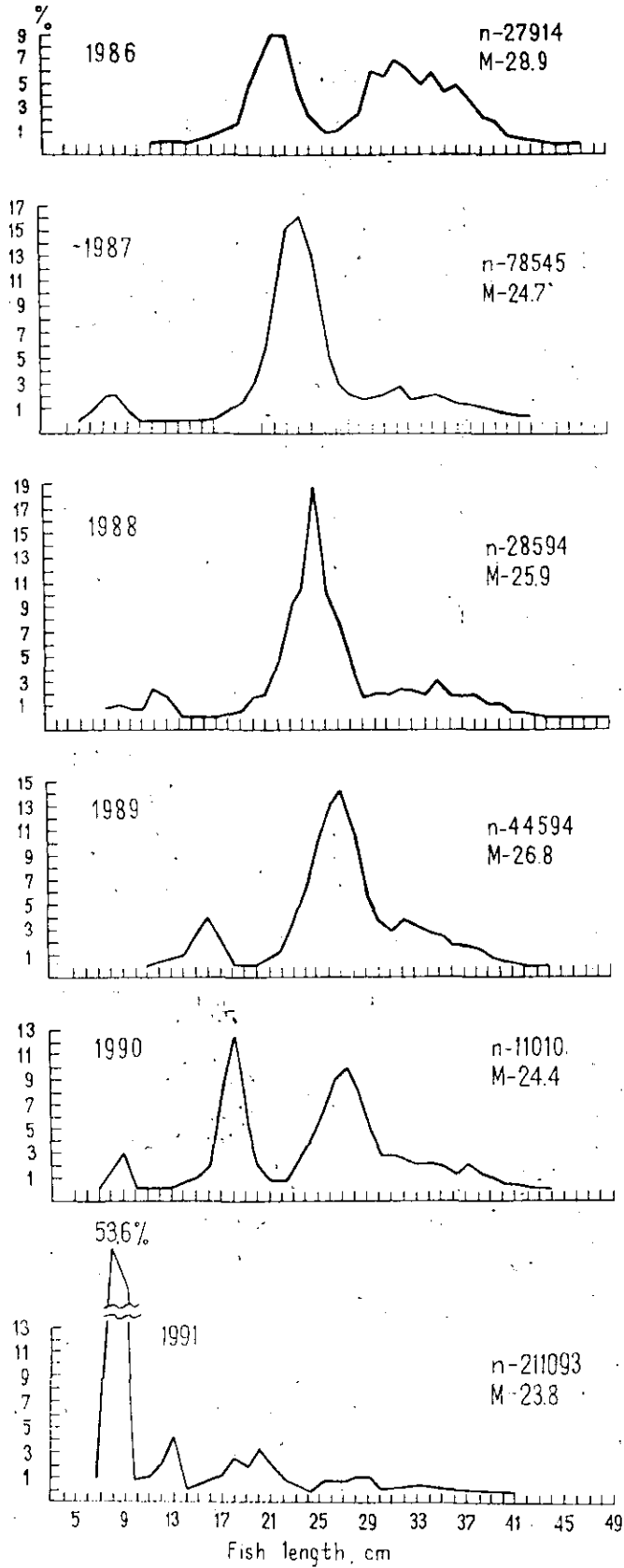


Fig.2. Size composition of redfish in catches taken with a small-meshed trawl in Div. 3M in 1986-1991.

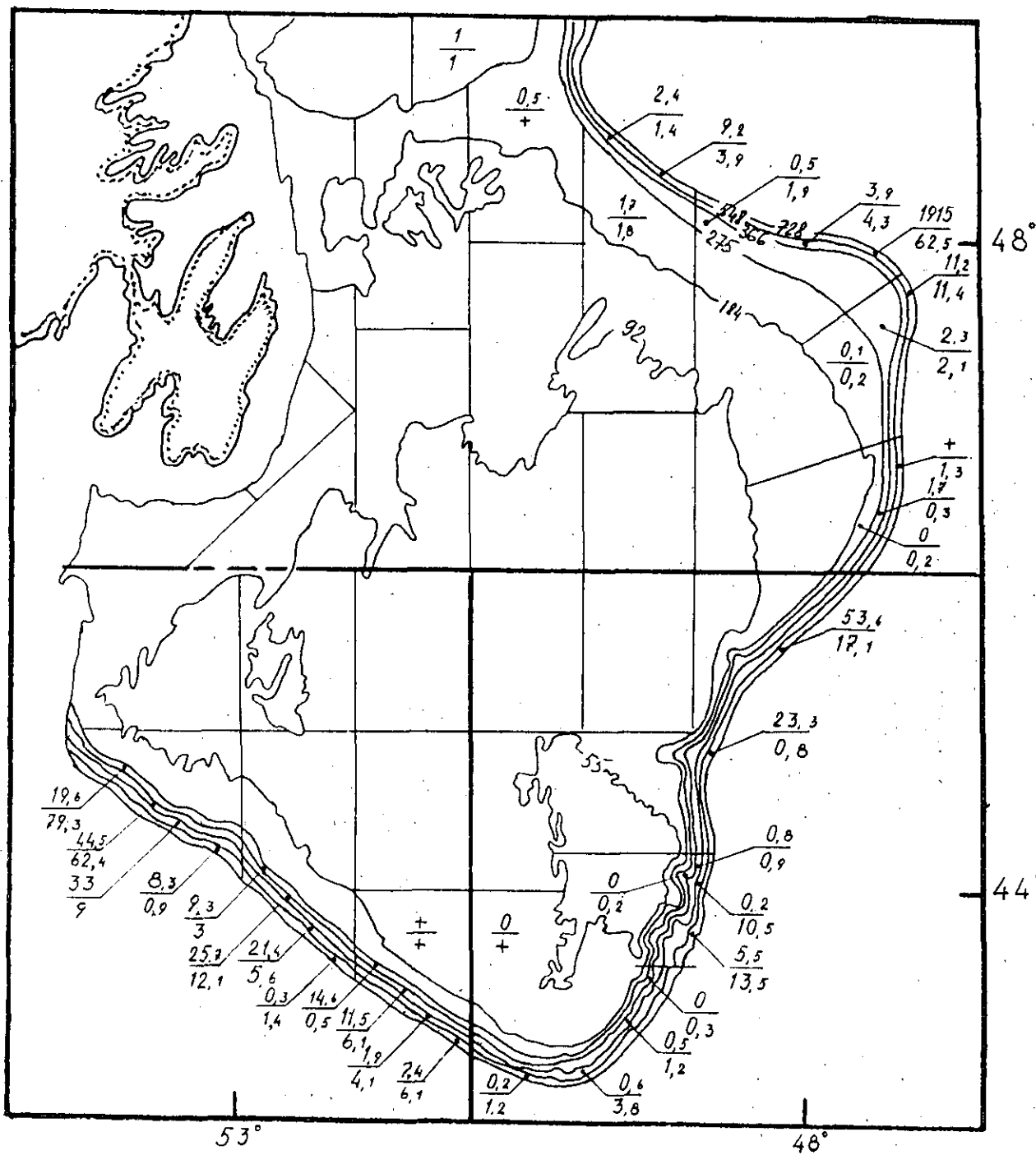


Fig.3. Redfish distribution on the Grand Bank in 1991.

3N

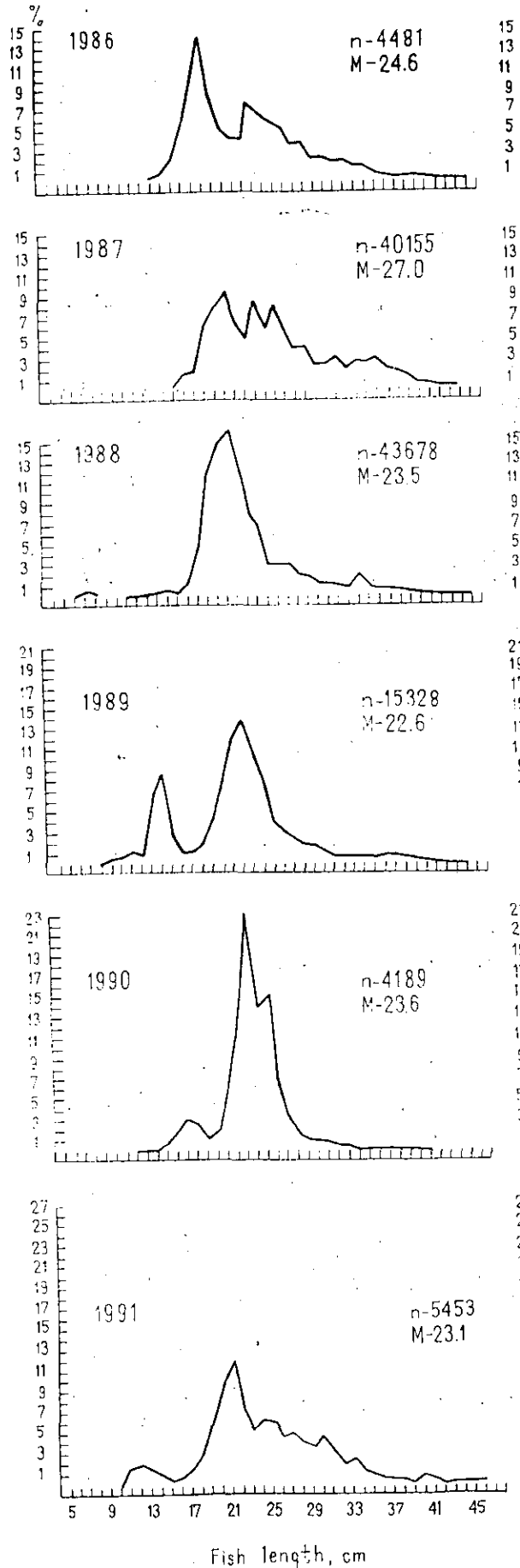


Fig.4. Size composition of redfish in catches taken with a small-meshed trawl in Div. 3N in 1986-1991.

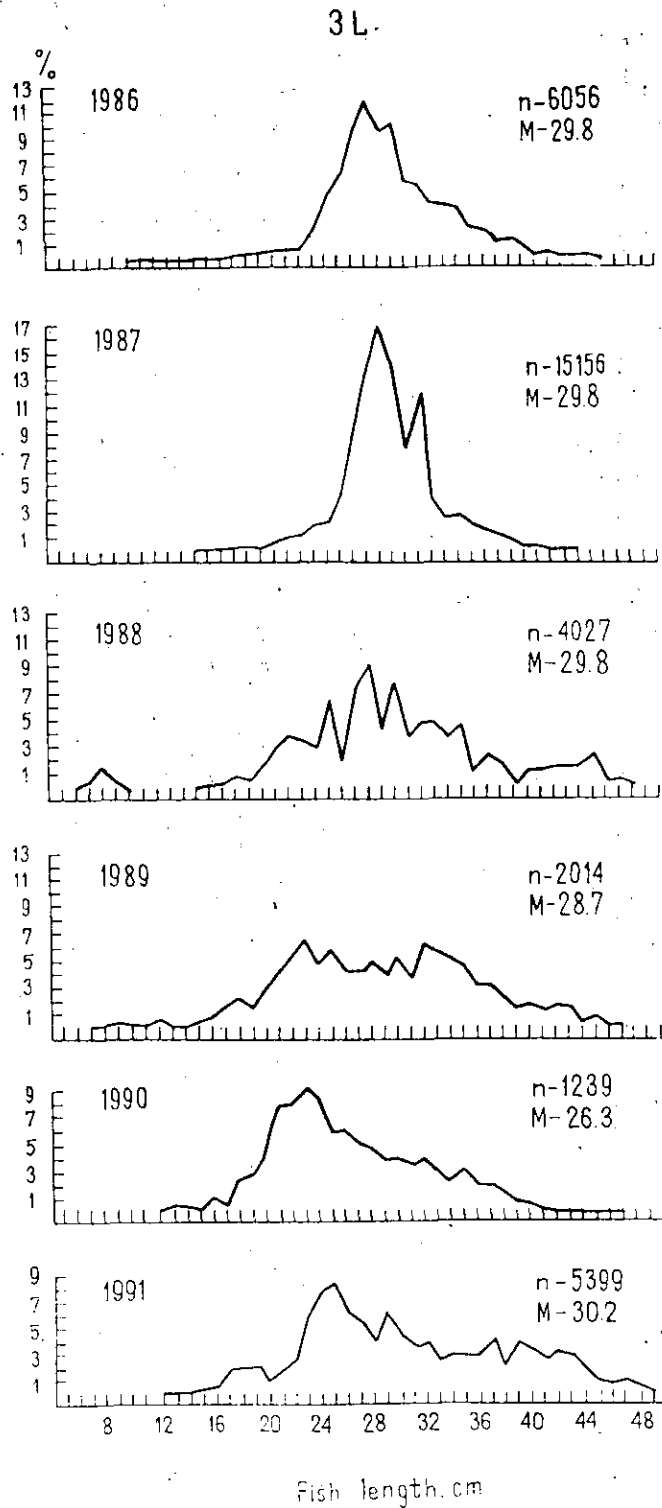


Fig.5. Size composition of redfish in catches taken with a small-meshed trawl in Div. 3L in 1986-1991.