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Assessment of Redfish Stock on the Flemish Cap Based on Data from the Russian Trawl Survey in 2001

by

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Abstract

Presented in the paper are estimates of the total abundance and biomass of redfish from *Sebastes* genus derived on the basis of data from the trawl survey on the Flemish Cap in May/June 2001. The survey covered an area of 15 760 mile² with the depth of up to 1 280 m stratified as adopted by NAFO.

Data on the size and age composition and distribution of *S. mentella* and *S. fasciatus* are presented.

In 2001 the stock of *S. mentella* and *S. fasciatus* on the Flemish Cap (Div. 3M) was estimated by the trawl survey at 155.5 x 10⁶ fish or 20 400 tons. The total abundance of redfish from *Sebastes* genus was estimated at 157.9 x 10⁶ fish, their biomass was 21 100 tons. These results are comparable with estimates for 1995.

Size distribution of *S. mentella* and *S. fasciatus* in catches by bottom research trawl in 2001 contained fish from 6 to 43 cm. Small immature redfish of 8 to 11 cm in length from strong 1999-2000 year classes dominated the catch.

Male and female redfish were represented in catch by individuals aged from 3 to 15 years. The age of juvenile redfish varied from 2 to 4 years, 2-3-year-old fish predominated.

Introduction

From 1990 the international fishery for redfish had been going down until in 1997-1999 the catch of redfish was taken, primarily, as by-catch in the Greenland halibut fishery (Table 1). From 2000 the redfish fishery in Div. 3M has been expanding. Provisional catch reported from the Russian fishery on the Flemish Cap in 2001 was 1 300 tons.

There are three species of redfish from *Sebastes* genus found on the Flemish Cap: *S. mentella*, *S. fasciatus* and *S. marinus*. Estimate for the mixed stock of *S. mentella* and *S. fasciatus* and a total estimate for all redfish of *Sebastes* genus are given.

Results presented in this paper were provided by the trawl survey conducted by RV MG-1360 "Mozdok" on the Flemish Cap in May/June 2001.

Materials and Methods

In 2001 the trawl survey was conducted using a stratified random method (Doubleday, 1981; Bulatova and Chumakov, 1986). Hauls were done to as deep as 1 280 m in accordance with stratification of the division suggested in the paper by Bishop (1994).

Hauls were performed on a 24-hour basis. A fine-meshed insertion (a=10-12 mm) was used in the codend of a standard bottom research trawl, drawing 1625A. A total of 90 half-hour valid hauls were done (Fig. 1). The trawl survey covered an area of 15 760 mile².

As it was difficult to identify precisely the species of redfish, they were split into two groups. The first group included *S. mentella* and *S. fasciatus* and the second one *S. marinus*.

Biological materials were collected and processed according to methods adopted by PINRO and NAFO.

Before 1995 redfish assessment surveys on the Flemish Cap covered the strata with the depth range from 127 to 731 m, in 1996 down to 915 m.

Table 2 presents data from Russian surveys on the Flemish Cap in 1987-2001.

Results and Discussion

Beaked redfish were found in catches over the whole area on the Flemish Cap covered by the survey, except strata 530 and 532 (Table 3). In strata with depth from 127 to 366 m the average catch of redfish per valid haul was, as a rule, less than 10 kg. In 2001, *S. mentella* and *S. fasciatus* were distributed mainly in strata with depth from 367 to 914 m. Highest densities were recorded for strata 514 (165.3 kg) and 518 (180.3 kg). In strata with deeper depth only single individuals of beaked redfish were found.

Sebastes marinus was found to be distributed, predominantly, in depth less than 549 m, its catch per one valid haul did not exceed 3.3 kg (Table 4).

Analysis of historic data from Russian research surveys has shown that from 1991 on a major part of the stock of *S. mentella* and *S. fasciatus* has been gradually changing its distribution moving to deeper waters on the Flemish Cap (Tables 5, 6). The distribution of *S. marinus* did not change much over 1987 to 2001 (Tables 7, 8).

Size distribution of *S. mentella* and *S. fasciatus* in catches by bottom research trawl in 2001 was from 6 cm to 43 cm (Fig. 2). Small immature redfish of 8-11 cm in length from strong 1999-2000 year-classes dominated the catch (37.3%). Male and female redfish were represented in catch by individuals-at-age from 3 to 15 years (Fig. 3). Juvenile redfish had the length of 6 to 15 cm, 2-3-year-olds predominated.

Russian research on the Flemish Cap over years has shown that the dynamics of abundance of redfish in this area is characterized by significant variability related to the strength of year-classes. The same variability of the proportion of poor and strong year-classes was noted before for the Flemish Cap cod (Konstantinov and Noskov, 1997).

Over 1971 to 2001 strong year-classes of redfish in Div. 3M were noted in 1969-1970, 1972-1973, 1979-1980, 1985-1986, 1989-1990, 1999-2000 (Fig. 4, 5, 6). Our analysis showed that in the 1970s strong year-classes appeared with periodicity of 2-4 years. Later on this time interval increased and the last strong year-class emerged 9-10 years after the appearance of previous strong year-class. It should be mentioned that 1969-1970 year-classes assessed as abundant in 1971 were subsequently recorded only by surveys conducted in 1974-1975. The fate of 1977-1978 year-classes, which did not show in surveys in later years, still remains unclear.

In our view, the strength of a year-class is related to production conditions, of which, water circulation plays a key role. A hydrographic regime on the Flemish Cap is impacted by the Flemish Cap branch of the Labrador current, which forms anticyclonic eddy (Elizarov and Prokhorov, 1958; Buzdalin and Elizarov, 1962). Anticyclonic circle of currents due to convergence of water to the axis of vortex sets a boundary for the distribution area of ichthyoplankton, where juvenile fish settling down to the near-bottom water layer become aggregated above

shallows. With a relatively small size of the bank surrounded by deep oceanic water this factor is of no less importance in fish production.

It has been established earlier, that the strength of cod year-classes is related to the dynamic state of the vortex and increases with the growth of anticyclonic current (Borovkov *et al.*, 1978). Variation of strength of year-classes of the Flemish Cap cod was related to changes in the intensity and position of the vortex axis, which were, in turn, dependent on the dynamic state of the Flemish Cap current.

In recent years the spawning stock of redfish on the Flemish Cap was low. In 2000 the spawning stock was 17.6% of the total stock (Avila de Melo *et al.*, 2001). However, in 1999-2000 a strong year-class appeared. In our view, the production of a strong year-class of redfish in Div. 3M is governed by hydrographic conditions to a larger extent than by status of the spawning stock. The growth of anticyclonic current, most likely, contributed to enhanced strength of year-classes while its weakening to a larger transport of larval and juvenile redfish beyond the bank. In turn, the appearance of strong year-classes could, apparently, be regarded as an "indicator" of hydrographic conditions.

The biomass of *S. mentella* and *S. fasciatus* was estimated by the trawl survey in 2001 at 20 400 tons, and abundance at 155.5×10^6 fish (Table 9). These estimates are comparable with the estimates for 1995.

Total stock of redfish from *Sebastes* genus varied over 1987 to 1996 from 71.9 to 2008.0 $\times 10^6$ fish or from 15 900 to 110 700 tons. In 2001 the total stock was 21 100 tons or 157.9×10^6 fish. It should be noted, that the 2001 survey covered a larger area. The proportion of redfish in strata with depth 732-914 m was 12.8% in deeper strata (914-1 280 m) the biomass was 1.2%.

Data provided by various surveys (Vaskov, 1997; Saborido and Vazquez, 2001) suggest that there is significant year-to-year variation between estimates of the redfish stock. A major reason behind it is, in our opinion, a complexity associated with assessment of the pelagic component of the stock. The Spanish trawl survey in 2000 showed an increase in the stock of redfish on the Flemish Cap (Fig. 7). Total biomass of all redfish from *Sebastes* genus increased from 82 900 tons in 1999 to 149 200 tons and corresponds to the 1998 level. In general, as data from the EU surveys conducted in 1988-2000 suggest the redfish stock in this area has been showing an increasing trend in recent years.

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TABLE 1. Nominal catches by country (tons) of redfish in Div. 3M, 1990-2000.

STATLANT 21A.

Country	Year										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Canada		2		10							5
Cuba	8390	1772	2304	945						2	
Faroe Is.			19	61	12	15	1				
Greenland			1	55	25	4	2		2		
France									2		
Germany	8232	6237	3443	295							
Iceland					10						1
Japan	4164	1431	1424	967	488	553	678	212	439	320	31
Norway					8						
Portugal	23330	3788	3198	4782	5632	1284	281	83	259	97	924
Spain	3832	472	204	100	610	165	113	129	262	268	302
USSR	69162	24763									
Russia			2937	2035	2980	3560	52		7	108	1864
U. Kingdom		5							1		
S. Korea	16664	2936	8350	2962							
Latvia			7441	5099	94	304					13
Estonia				2188	47	863	13				626
Lithuania			2149	2112	8						0
Total	133774	41406	31470	21611	9914	6748	1140	424	972	795	3766

TABLE 2. A list of Russian trawl surveys in 1987-2001.

Year	Vessel	Valid tows	Area, sq.miles	Dates
1987	MB-1202 "Persey-III"	131	10555	21.06 - 07.07
1988	MB-1202 "Persey-III"	124	10555	04.06 - 16.06
1989	MB-1202 "Persey-III"	129	10555	24.06 - 08.07
1990	MB-1202 "Persey-III"	119	10555	21.06 - 03.07
1991	MG-1362 "Vilnus"	100	10555	27.04 - 08.05
1992	MG-1366 "K.Shajtanov"	53	10555	15.04 - 20.04
1993	MG-1362 "Vilnus"	69	10555	27.06 - 07.07
1995	MI - 0708 "Olenica"	58	10555	20.05 - 29.05
1996	MI - 8339 "Olaine"	76	11961	30.04 - 12.05
2001	MG-1360 "Mozdok"	90	15760	10.05 - 04.06

* No investigations were carried out in 1994, 1997-2000.

TABLE 3. Results from the trawl survey for Beaked Redfish (*S. mentella* and *S. fasciatus*) in Div. 3M, 2001.

Stratum	Depth, m	Area, mile ²	Nos of tows	Mean catch / 1 valid tow		Abundance '000	Biomass, tons
				fish	kg		
501	127-146	342	3	6,3	0,1	159,6	2,5
502	147-183	838	3	37,3	0,4	2321,6	24,8
503	185-256	628	3	81,0	1,5	3768,0	69,8
504	185-256	348	3	16,7	0,5	430,5	12,9
505	185-256	703	3	37,4	1,2	1947,6	62,5
506	185-256	496	3	251,4	5,1	9236,6	187,4
507	258-366	822	3	65,0	2,4	3957,8	146,1
508	258-366	646	3	62,6	2,8	2995,5	134,0
509	258-366	314	3	179,4	18,4	4172,7	427,9
510	258-366	951	3	44,1	6,3	3106,6	443,8
511	258-366	806	3	376,6	6,0	22484,4	358,2
512	367-549	670	3	92,7	15,6	4600,7	774,2
513	367-549	249	3	378,9	68,7	6988,6	1267,1
514	367-549	602	3	1028,7	165,3	45872,4	7371,2
515	367-549	666	3	206,1	10,6	10167,6	522,9
516	550-731	634	3	133,4	35,6	6264,8	1671,9
517	550-731	216	2	105,0	27,8	1680,0	444,8
518	550-731	210	3	763,1	180,3	11870,4	2804,7
519	550-731	414	4	149,0	31,8	4569,3	975,2
520	732-914	525	3	40,3	13,5	1567,2	525,0
524	732-914	253	3	29,7	9,3	556,6	174,3
528	732-914	530	3	126,7	38,4	4974,1	1507,6
533	732-914	98	2	210,5	56,9	1528,1	413,1
521	915-1097	517	3	1,0	0,5	38,3	18,2
525	915-1097	226	2	1,0	0,6	16,7	10,1
529	915-1097	488	3	4,0	1,4	114,6	50,9
532	915-1097	238	3	0,0	0,0	0,0	0,0
534	915-1097	486	3	2,3	1,0	84,0	36,0
522	1098-1280	533	3	0,3	0,1	13,2	4,3
526	1098-1280	177	2	0,5	0,1	6,6	1,7
530	1098-1280	1134	3	0,0	0,0	0,0	0,0
Total		15760	90			155494,1	20443,1

TABLE 4. Results from the trawl survey for *S. marinus* in Div. 3M, 2001.

Stratum	Depth, m	Area, mile ²	Nos of Tows	Mean catch / 1 valid tow		Abundance '000	Biomass, tons
				fish	kg		
501	127-146	342	3	2.3	0.9	59.1	23.6
502	147-183	838	3	0.7	0.3	41.4	19.9
503	185-256	628	3	0.0	0.0	0.0	0.0
504	185-256	348	3	3.3	0.6	85.9	14.9
505	185-256	703	3	0.7	0.3	34.7	13.3
506	185-256	496	3	3.0	0.5	110.2	17.4
507	258-366	822	3	1.3	0.5	81.2	33.0
508	258-366	646	3	3.3	0.7	159.5	34.0
509	258-366	314	3	4.7	1.1	108.5	25.6
510	258-366	951	3	8.0	2.0	563.6	142.4
511	258-366	806	3	6.7	1.9	398.0	110.6
512	367-549	670	3	0.3	0.1	16.5	3.8
513	367-549	249	3	5.0	1.6	92.2	29.9
514	367-549	602	3	10.7	3.3	475.7	148.0
515	367-549	666	3	3.7	0.9	180.9	42.6
516	550-731	634	3	0.0	0.0	0.0	0.0
517	550-731	216	2	0.0	0.0	0.0	0.0
518	550-731	210	3	0.0	0.0	0.0	0.0
519	550-731	414	4	0.5	0.3	15.3	9.7
520	732-914	525	3	0.0	0.0	0.0	0.0
524	732-914	253	3	0.0	0.0	0.0	0.0
528	732-914	530	3	0.0	0.0	0.0	0.0
533	732-914	98	2	0.0	0.0	0.0	0.0
521	915-1097	517	3	0.0	0.0	0.0	0.0
525	915-1097	226	2	0.0	0.0	0.0	0.0
529	915-1097	488	3	0.0	0.0	0.0	0.0
532	915-1097	238	3	0.0	0.0	0.0	0.0
534	915-1097	486	3	0.0	0.0	0.0	0.0
522	1098-1280	533	3	0.0	0.0	0.0	0.0
526	1098-1280	177	2	0.0	0.0	0.0	0.0
530	1098-1280	1134	3	0.0	0.0	0.0	0.0
Total		15760	90			2422.8	668.7

TABLE 9. Estimates provided by the trawl survey for Redfish in Div. 3M for 1987-2001*.

Year	Sebastes marinus		Sebastes mentella and S. fasciatus		Total	
	Abundance, fish 10 ⁶	Biomass, thou. t	Abundance, fish 10 ⁶	Biomass, thou. t	Abundance, fish 10 ⁶	Biomass, thou. t
1987	12.5	4.3	463.2	106.4	475.7	110.7
1988	29.7	14.4	183.1	47.0	212.8	61.4
1989	15.1	6.8	283.8	83.3	298.9	90.1
1990	6.4	3.0	74.7	17.7	81.1	20.7
1991	1.9	0.1	2006.1	45.4	2008.0	45.5
1992	0.6	0.3	119.5	18.2	120.1	18.5
1993	8.1	2.8	681.7	69.8	689.8	72.6
1995	2.7	0.9	137.9	20.7	140.6	21.6
1996	9.6	5.9	62.3	10.0	71.9	15.9
2001	2.4	0.7	155.5	20.4	157.9	21.1

* No investigations were carried out in 1994, 1997-2000.

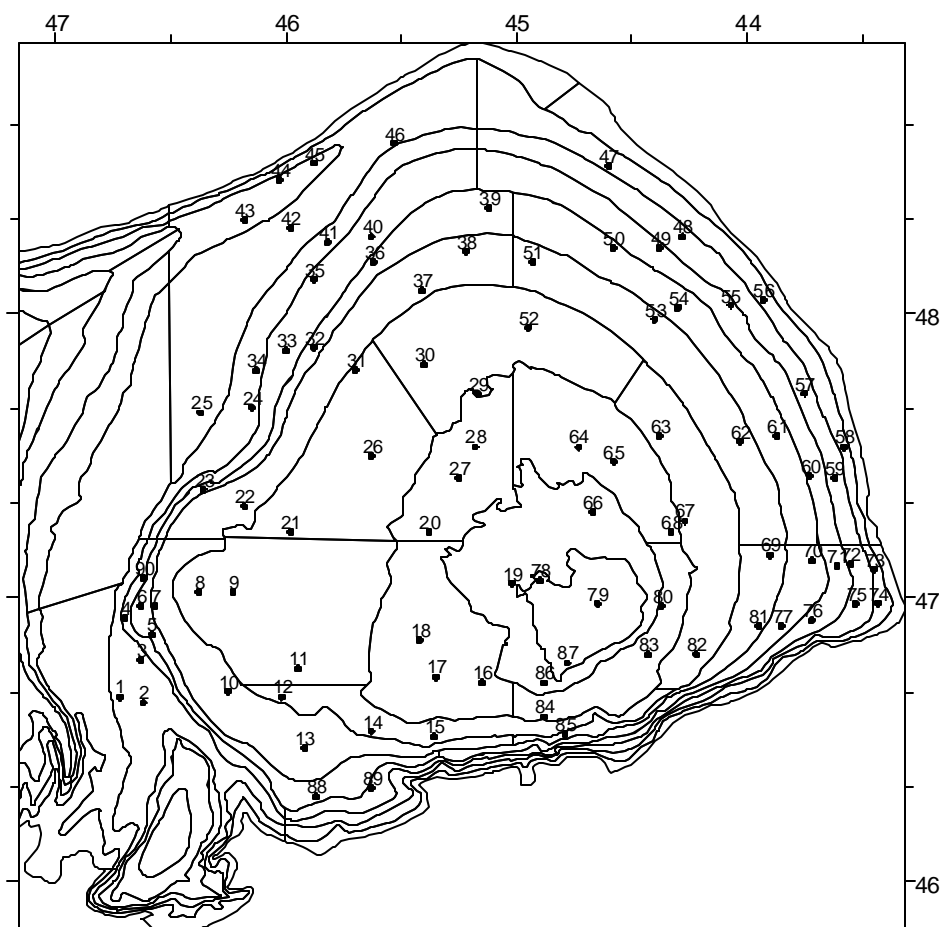


Fig. 1. Position of trawl stations in Div. 3M in 2001.

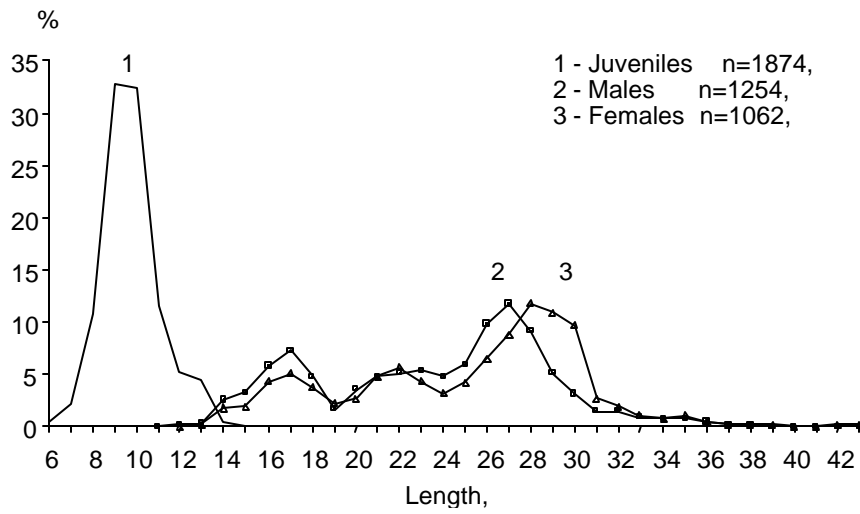


Fig. 2. Length composition of Beaked Redfish in Div. 3M in 2001.

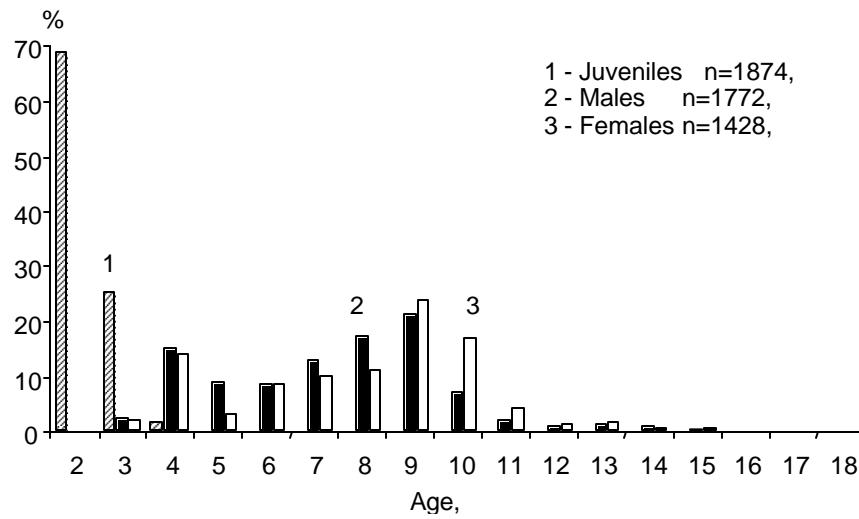


Fig. 3. Age composition of Beaked Redfish in Div. 3M in 2001.

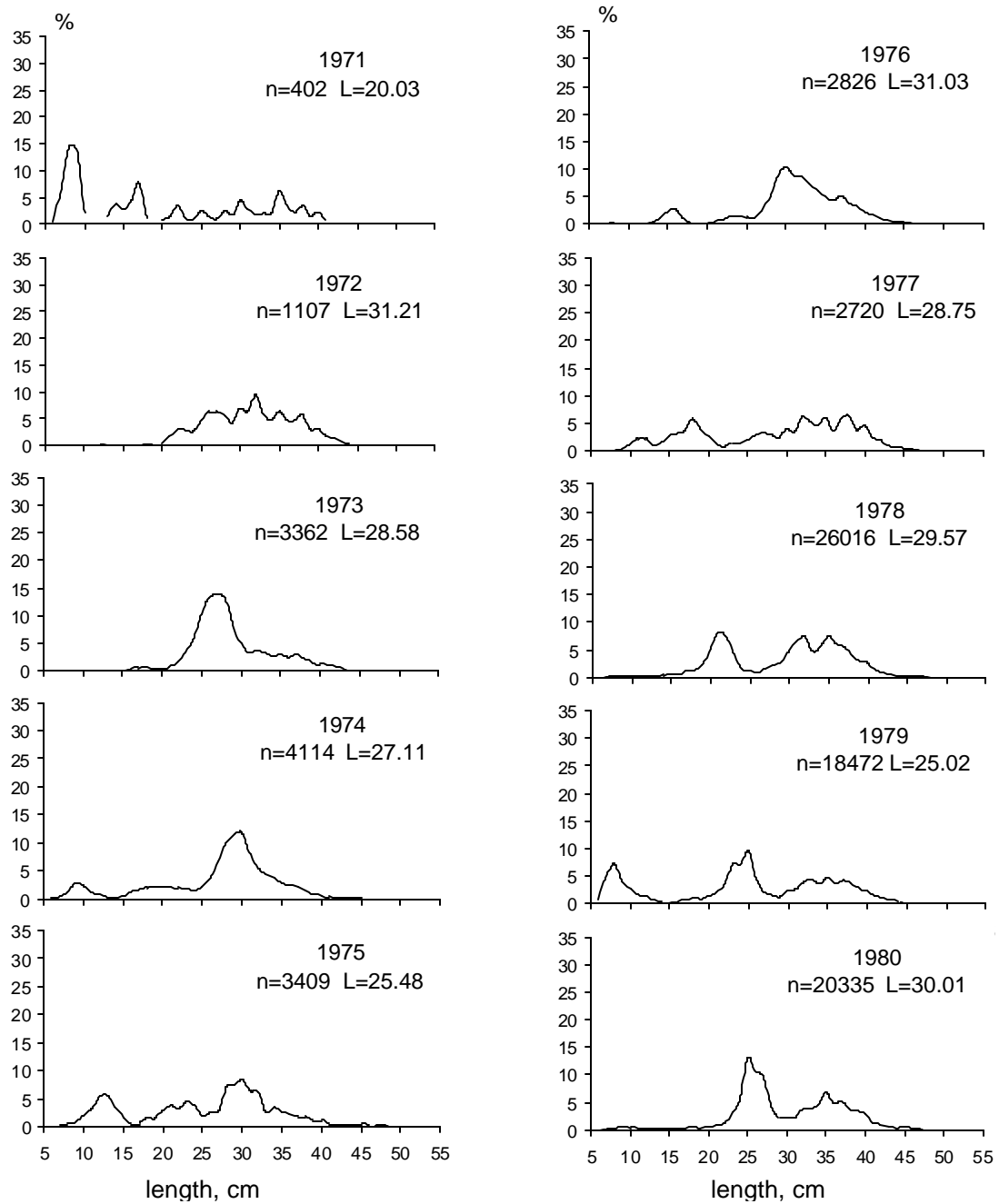


Fig. 4. Length composition of Beaked Redfish in Div. 3M based on data from Russian surveys in 1971-1980.

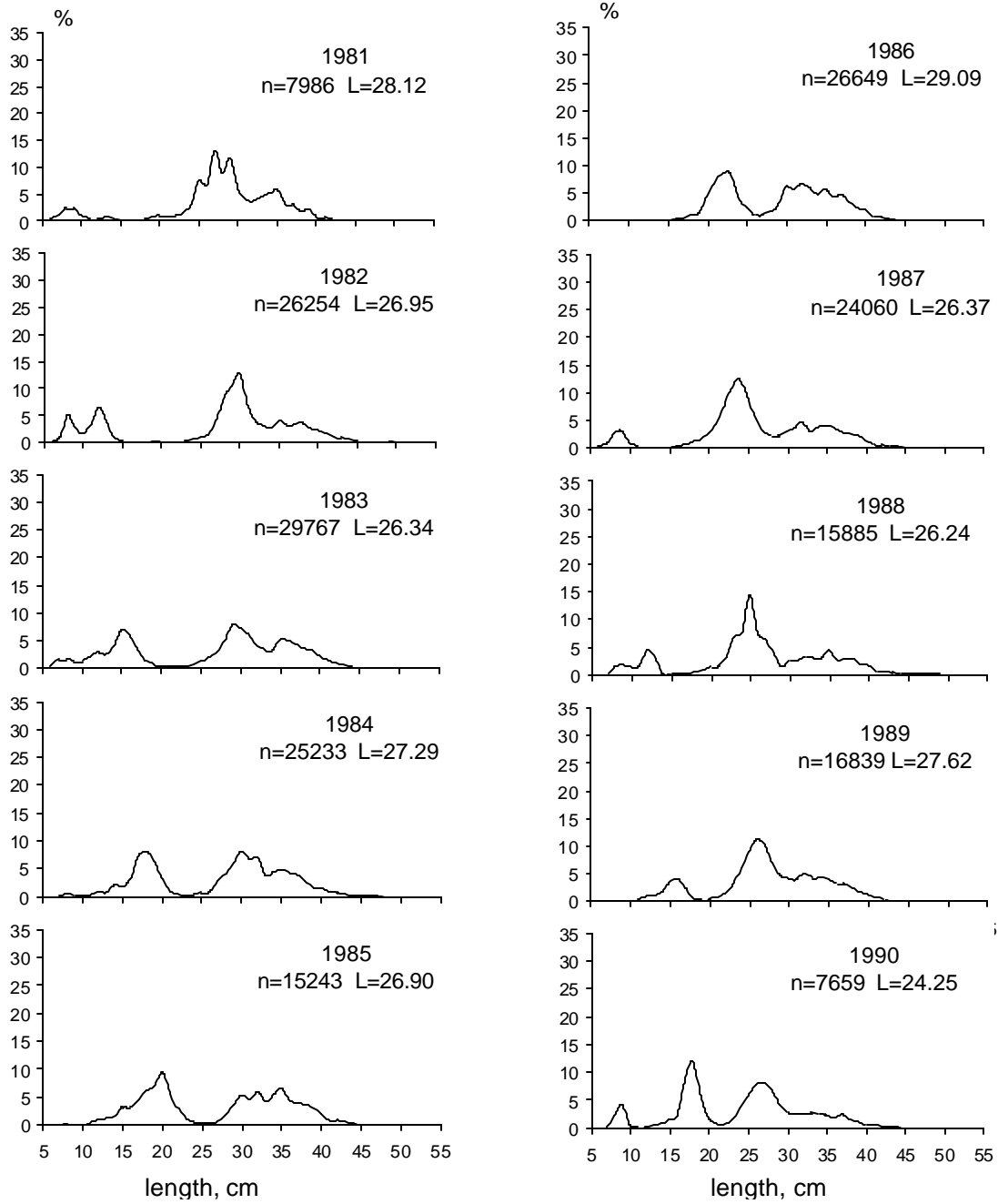


Fig. 5. Length composition of Beaked Redfish in Div. 3M based on data from Russian surveys in 1981-1990.

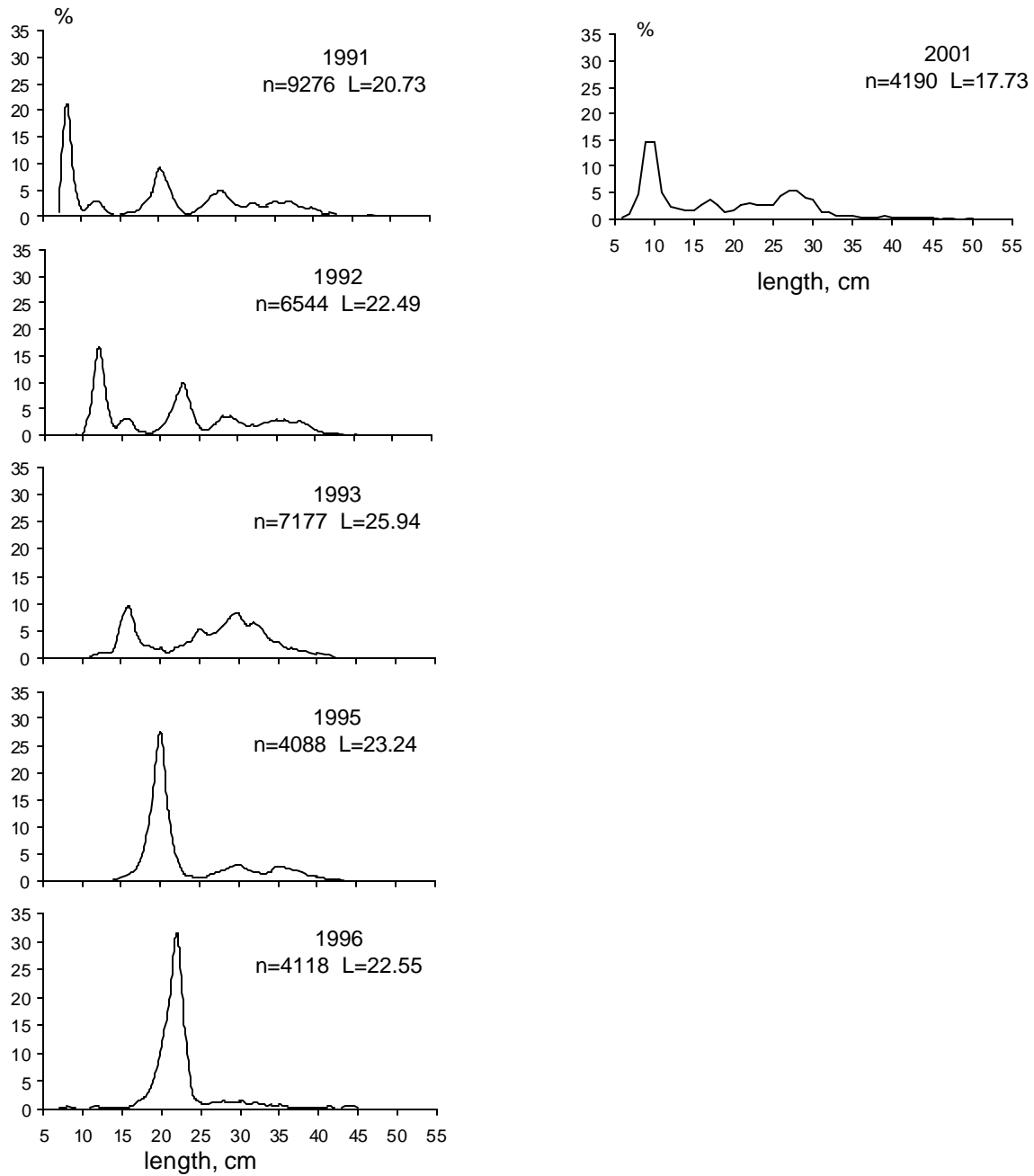


Fig. 6. Length composition of Beaked Redfish in Div. 3M based on data from Russian surveys in 1991-2001.

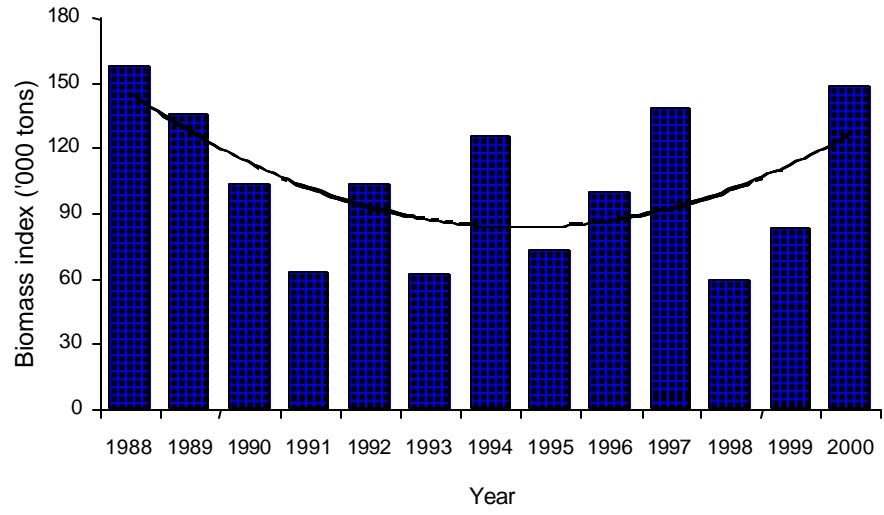


Fig. 7. Biomass indices of redfish from Spanish surveys in Div. 3M, 1988-2000.