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On the Issue of Redfish Management in Division 3O

by

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Abstract

The present paper gives total estimates of abundance and biomass of redfish *S. mentella* and *S. fasciatus* resulted from trawl surveys in 1983-1993 in Division 3O.

The redfish abundance in Div. 3O varied from 93.7 to 2661 million individuals and biomass ranged between 13.5 and 212.6 thousand metric tons. The redfish stock in the NAFO Regulatory Area fluctuated from 3.5 to 290.4 million individuals in abundance and from 0.6 to 46.7 thousand tons in biomass. Percentage of the redfish stock in the NRA of the total in the Division made up 2.1-59.4% in abundance and 1.9-62.2% in biomass.

In 1983-1993, in Div.3O strong year-classes were observed during surveys in 1983, 1988 and 1991. The most abundant year-classes were found in the 1983 survey when young redfish of 14-18 cm in length at age 3-4 accounted for 35.4% of the total redfish abundance.

In Div.3O mature redfish males first occurred being 19 cm long and females at length of 23 cm. 50% maturity was observed at length of 24 cm for males and 25 cm for females. 100% maturity corresponded to the length of 29 cm for males and 31 cm for females.

Mean daily commercial catches in 2000-2003 ranged from 15.9 to 21.4 tons without any prominent upward or downward trend. Despite catch per one-hour tow from 2000 to 2003 showed a decrease it was not essential. Catches were dominated by redfish of 22-25 cm long. Notwithstanding an increase in catches, the redfish length distribution had not undergone great changes.

To set boundaries of biological redfish stocks in Div.3L, 3N and 3O is quite problematic at present, therefore, redfish in Div.3O as a separate management unit seems to be the most acceptable.

Since at present no detrimental effect of the enhanced fishery on the redfish stock in Div. 3O is observed, TAC of 19-20 thousand tons based on catch statistics for the recent 3 years is the most appropriate as a management measure.

Historical review of the fishery

In the period 1960-2003, international catch of the redfish in Div. 3O varied from 3 to 35 thousand tons (Table 1). Prior to 1986, catches yielded 13 thousand tons on average. In 1987, the catch increased up to 27 thousand tons, and

in 1988 reached its maximum for the whole period having constituted 35 thousand tons. Afterwards, the catch began to decrease and made up only 3 thousand tons. In 1998, the fishery began to enhance again and in 2001, the catch increased to 20 thousand tons. In 1994-1995, in Div. 3O the most active were vessels of Portugal, which proportion amounted to 63-69%. In 1999-2000, the main catch was taken by Portuguese and Spanish vessels.

Historically, Canada had no considerable interest in fishing for the 3O redfish. However, in 1974, a TAC of 16 thousand tons was set in the 200-mile EEZ of Canada for Canadian fishermen. In 1978, it was increased to 20 thousand tons and had retained at this level until 1987. In 1988, this TAC was reduced to 14 thousand tons and in 1994 down to 10 thousand tons. This level has been kept until the present. Besides, according to Canadian regulations it is prohibited to catch redfish less than 22 cm in length. For the whole period of being, the internal Canadian TAC has never been taken out by 100%. Realization of the TAC mostly did not exceed 10-15%. Only in 1998, Canadian catch constituted 89.7% of the TAC in the amount of 10 thousand tons.

Since 2000, the fishery for the Div. 3O redfish, catch of which has not been limited to the present, has greatly enhanced due to increase of fishing effort mostly by Russian fleet. The redfish catch by Russian vessels for the recent 3 years has reached 10-11 thousand tons, which constitutes more than 50% of the total catch.

Prior to 1993, USSR/Russia dominated in catching redfish in Div.3O. From 1965 to 1975, proportion of catch taken by Russian fleet exceeded 90% (Table 2). On average, before 1993 percentage of Russian catch was 72.6%. Since 2001, more than 50% of the catch has fallen to Russia. In this relation it is worth noting that the fishery was conducted all year round by mostly 2-3 vessels of STM-type.

Scientific Research

Stock assessment. Russian research conducted in 1983-1993 showed a wide year-to-year variation in the redfish stock estimates in Div. 3O (Vaskov, 2003). The redfish biomass varied from 13.5 to 212.6 thousand tons (Table 3). Proportion of the redfish stock in the Regulatory Area fluctuated from 1.9 to 62.2% and made up 17.6% on average. Length of the redfish occurred in catches ranged from 11 to 52 cm with individuals of 23-25 cm long being predominant.

Canadian research carried out during spring and fall surveys in 1991-2003 (Power, 2003a) indicated the redfish biomass to vary from 15.5 to 234.6 thousand tons (Table 4). In recent years, a downward trend in the stock has been observed. Percentage of the redfish stock in the Regulatory Area ranged between 4.9 and 52.8% and amounted to 17.5-21.9% on average. The redfish length during the spring survey varied from 5 to 37 cm; catches were dominated by individuals of 21-22 cm in length.

Recruitment. Russian surveys in Div.3O carried out during 1983-1993 showed that individuals of 10-13 cm in length recruited to the redfish stock in 1983, 1988 and 1991 (Fig. 1). They corresponded to strong year-classes of 1978-1979, 1984 and 1988, respectively. The most abundant year-classes were observed during the survey in 1983 when young redfish of 14-18 cm long at age 3-4 accounted for 35.4% of the total redfish abundance.

Canadian surveys registered the appearance of a weak year-class in 1999. However, in the opinion of Canadian scientists, low abundance of this year-class did not give grounds for good recruitment in the future.

Maturity rate. As was shown by Russian investigations in 2001-2003 carried out by NAFO observers onboard fishing vessels, catches in Div.3O were dominated by *S. fasciatus* (up to 85%). The main criteria to separate *S. mentella* and *S. fasciatus* were as follows:

- number of rays of anal fin (7 rays in *S. fasciatus*);
- unity of parietal and nuchal spines (united in *S. mentella*);
- number of vertebrae (30 or less in *S. fasciatus*; 31 or more in *S. mentella*).

Therefore, the present paper gives data on maturity rate of *S. fasciatus*.

In Div.3O mature redfish males first occurred at length of 19 cm and females at length of 23 cm. 50% maturity was observed at length of 24 cm for males and 25 cm for females (Fig. 2). 100% maturity corresponded to the length of 29 cm for males and 31 cm for females.

Canadian research showed that 50% maturity was observed at the length of 21 cm for males and 28 cm for females (Power, 2003a).

Fishing mortality. At the Scientific Council Meeting in June 2003 it was noted that current fishing mortality or absolute level of the stock could not be determined. However, it was registered that in 2001-2002 fishing mortality became to increase.

The Effect of Fishery on the Stock in 2000-2003

The decrease in the international fishery in 1994-1995 was probably related to the reduction of Russian catch. In 1996-1998, Russian fishery was not carried out. Since 2000 Russian fleet has resumed the redfish fishery in this area. In 2001-2003, Russian catch stabilized at the level of 11 thousand tons.

Main Russian vessels targeted the redfish in Div. 3O were of STM-type. Such vessels had 1898 register tons and engine power of 1760 kW (2400 hp). The largest catch in Div. 3O during 2000-2003 was taken by those vessels (Table 5). Mean daily catches in that period varied from 15.9 to 21.4 tons without any prominent upward or downward trend. Despite catch per one-hour tow in the period 2000-2003 decreased, that reduction was not essential. Based on a fairly short period of the redfish fishery it is difficult for the time being to determine a trend in fishing mortality variation.

Data obtained from observers onboard fishing vessels indicated that in 2003 as in 1999-2002 (Vaskov, 2002) redfish of 22-25 cm in length dominated the catches (Fig. 3). Despite the catch increase, the redfish length distribution had not undergone essential changes.

Stocks or Management Units

Stock definition and separation of redfishes into management units in the Convention Area was done prior to 1976. Based on the analysis of biological data (length, weight, age, growth rate etc.) and in some cases due to legal disputes, 8 stocks and management units were identified (Atkinson, 1986):

- Subarea 2 + Div.3K;
- Divs. 3LN;
- Flemish Cap (Div. 3M);
- Div. 3O;
- Div. 3P;
- Divs. 4 RST;
- Divs. 4VWX;
- Subarea 5.

Further, reasoning from analysis of growth rate, life span, main age-length groups and maximum ages Nikolskaya (Nikolskaya, 1981) showed that the redfish stock in Div. 3L differed from that in Div. 3NO where the stock should be considered single. In this relation, fishing limits (TAC) for Div. 3L and 3NO should be determined separately.

Canadian researchers (Atkinson and Power, 1986) having analyzed data available showed that the redfish stock in Div. 3K is more similar to that in Div. 3L. Along with this, they expressed the opinion that Div. 3O and 3P were separate management units while the issue of the 3N redfish stock identification remained unclear and required further investigation.

Discussion

The issue of a relationship of the redfish stocks in Div. 3L, 3N and 3O remains complicated and unclear at present. If migration pattern of the redfish between the above Divisions and a relationship between variation in biomass and abundance indices had been determined, it would have been reflected in the results from surveys. However, based on both Russian (Table 6) and Canadian (Table 7) (Power, 2003b) survey data it is very difficult to establish such relationship.

The boundary between Div. 3N and Div. 3O is conventional and was set up for the convenience of the stock management. Canadian fall and spring surveys in 1991-2002 showed that the redfish stock in Div. 3O was more similar to that in Div. 3N (Power, 2003c). Length distribution of redfish from both Divisions was alike and in some surveys exactly the same (spring survey in 1995, spring and fall surveys in 2000). A view was also expressed that if the redfish stock in Div. 3NO were single, management of these stocks as separate units would not be detrimental.

At present it is fairly difficult to set boundaries of the biological redfish stocks in Div. 3L, 3N and 3O as specific research into this issue such as tagging are related to certain difficulties. To determine whether the stocks intermingle in Div. 3N or there is a single biological stock does not seem feasible so far and requires further investigation. To identify the redfish stocks in Div. 3LNO and separate them into management units it is necessary to carry out further investigations to elucidate the following questions:

- ratio of each species percentage in catches;
- estimation of abundance and biomass of each species;
- distribution of the stock in the Regulatory Area and EEZ of Canada;
- study of the redfish migration between adjacent Divs. 3LNO.

Therefore, to treat the redfish in Div. 3O as a separate management unit seems to be the most acceptable at present.

Data obtained by Russian NAFO observers showed that the appearance or absence of strong year-classes in Div. 3O practically had no considerable effect on the fishery. The appearance of 1988 year-class of middle strength in the period 2000-2003 in fact did not influence the size composition of the stock as the fishery targeted redfish of 23-25 cm long at age 7-8 (1992-1995 year-classes). Therefore, at present it is very difficult to evaluate the stock recruitment in the future, for instance, due to year-class born in 1999.

Since no adverse effect of the increased fishery on the redfish stock in Div. 3O is observed at present, a probable TAC of 13 thousand tons obtained by averaging of historical catch since 1960 is not fully reasonable. In our opinion, a TAC of 19-20 thousand tons based on catch statistics for the recent 3 years is the most acceptable at present. Should a stable adverse effect of the current level of fishery on the redfish stock is revealed; the above TAC shall be adjusted.

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Table 1. International catch of redfish (tons) in Div. 30 in 1960-2002 (STATLANT21A).

Country	Year										
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Canada	190	997	1046	2155	1320	203	107	645	52	186	288
Cuba	0	0	0	0	0	0	0	0	0	0	0
France (SP)	30	147	285	549	260	106	41	210	6	3	0
DDR	0	0	0	0	0	179	26	451	0	0	0
Japan	0	0	0	0	0	0	0	0	21	0	51
Poland	0	0	0	25	0	0	452	1	0	345	0
Romania	0	0	0	0	0	0	0	0	0	0	58
Portugal	0	0	0	0	0	0	0	0	0	0	0
Spain	0	0	0	0	0	0	0	0	0	0	0
Russia	200	2536	5901	3568	12786	19300	14667	17707	6364	15344	12795
GBR	1	10	0	2	3	3	5	23	0	0	0
USA	4609	7704	325	2881	1675	0	7	0	2	0	0
S. Korea	0	0	0	0	0	0	0	0	0	0	0
Estonia	0	0	0	0	0	0	0	0	0	0	0
Total	5030	11394	7557	9180	16044	19791	15305	19037	6445	15878	13192

Country	Year										
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Canada	165	508	133	91	103	3664	2972	1841	6404	1541	2577
Cuba	0	0	0	0	0	0	500	368	2517	1487	1368
France (SP)	2	2	0	31	0	16	2	0	0	0	0
DDR	50	8	0	0	0	0	0	0	0	0	0
Japan	1132	66	472	44	7	4	0	3	2	0	0
Poland	225	26	0	0	0	0	0	0	0	0	0
Romania	2	0	0	0	0	0	0	0	664	0	0
Portugal	0	0	36	0	0	1	0	0	134	59	0
Spain	0	0	0	0	0	0	0	1	8	0	0
Russia	18216	15501	8156	12747	15000	11663	7376	4647	8008	14219	8659
GBR	0	6	0	13	0	0	0	0	0	0	0
USA	0	0	0	198	0	0	0	0	0	0	0
S. Korea	0	0	0	0	0	0	0	0	0	0	0
LTU	0	0	0	0	0	0	0	0	0	0	0
Estonia	0	0	0	0	0	0	0	0	0	0	0
Total	19792	16117	8797	13124	15110	15348	10850	6860	17737	17306	12604

Table 1 (continued)

Country	Year										
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Canada	491	7	167	104	141	183	181	27	310	28	1219
Cuba	1651	1460	1316	806	3006	2859	2753	2138	5500	2748	2776
France (SP)	0	2	0	0	0	0	0	0	0	0	0
DDR	0	0	0	0	0	0	0	0	0	0	0
Japan	496	1	1258	661	1162	1074	1606	1724	2812	226	125
Poland	0	0	0	0	0	0	0	0	0	0	0
Romania	0	0	0	0	0	0	0	0	0	0	0
Portugal	5	0	0	0	0	0	22	12	166	3	1468
Spain	0	0	25	630	45	26	4	0	8	0	0
Russia	8717	5670	7262	5905	6099	7152	4921	4517	7622	4427	0
GBR	0	0	0	0	0	0	0	0	0	0	0
USA	0	0	0	104	2	0	0	0	0	0	0
S. Korea	0	0	0	0	0	01726	1805	2638	1666	129	1935
LTU	0	0	0	0	0	0	0	0	0	0	0
Estonia	0	0	0	0	0	0	0	0	0	0	0
Total	11360	7140	10028	8210	10455	13020	11292	11056	18084	7561	13368

Country	Year										Total
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	
Canada	698	1624	177	7255	2554	8972	2344	2206	4869	3000	63745
Cuba	665	0	0	0	0	0	0	0	0	0	33918
France (SP)	0	0	0	0	134	266	0	0	0	0	2092
DDR	0	0	0	0	0	0	0	0	0	0	714
Japan	159	0	264	417	285	355	0	0	0	0	14427
Poland	0	0	0	0	0	0	0	0	0	0	1074
Romania	0	0	0	0	0	0	0	0	0	0	724
Portugal	4794	2918	1935	1635	894	1875	5469	4555	3535	4610	34126
Spain	0	26	22	338	1245	1884	4549	3747	2314	659	15531
Russia	6887	60	416	0	0	0	231	2233	11343	11182	335849
GBR	0	0	0	0	0	0	0	0	0	0	66
USA	0	0	0	0	0	0	0	0	0	0	17507
S. Korea	17	0	0	0	0	0	0	0	0	0	9916
LTU	0	0	0	0	0	0	0	0	0	1	1
Estonia	0	0	0	0	0	0	0	49	0	0	49
Total	13220	4628	2814	9645	5112	13352	12593	12790	22061	19452	529739

Table 2 (continued)

Country	Year										
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Canada	4,3	0,1	1,7	1,3	1,3	1,4	1,6	0,2	1,7	0,4	9,1
Cuba	14,5	20,4	13,1	9,8	28,8	22,0	24,4	19,3	30,4	36,3	20,8
France (SP)	0	0	0	0	0	0	0	0	0	0	0
DDR	0	0	0	0	0	0	0	0	0	0	0
Japan	4,4	0	12,5	8,1	11,1	8,2	14,2	15,6	15,5	3,0	0,9
Poland	0	0	0	0	0	0	0	0	0	0	0
Romania	0	0	0	0	0	0	0	0	0	0	0
Portugal	0	0	0	0	0	0	0,2	0,1	0,9	0	11,0
Spain	0	0	0,2	7,7	0,4	0,2	0	0	0	0	0
Russia	76,7	79,4	72,4	71,9	58,3	54,9	43,6	40,9	42,1	58,6	43,7
E GBR	0	0	0	0	0	0	0	0	0	0	0
USA	0	0	0	1,3	0	0	0	0	0	0	0
S. Korea	0	0	0	0	0	13,3	16	23,9	9,2	1,7	14,5
LTU	0	0	0	0	0	0	0	0	0	0	0
Estonia	0	0	0	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100	100

Country	Year										
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total
Canada	5,3	35,1	6,3	75,2	50,0	67,2	18,6	17,2	22,1	15,4	12,0
Cuba	5,0	0	0	0	0	0	0	0	0	0	6,4
France (SP)	0	0	0	0	2,6	2,0	0	0	0	0	0,4
DDR	0	0	0	0	0	0	0	0	0	0	0,1
Japan	1,2	0	9,4	4,3	5,6	2,7	0	0	0	0	2,7
Poland	0	0	0	0	0	0	0	0	0	0	0,2
Romania	0	0	0	0	0	0	0	0	0	0	0,1
Portugal	36,3	63,1	68,8	17,0	17,5	14,0	43,4	35,6	16,0	23,7	6,4
Spain	0	0,6	0,8	3,5	24,4	14,1	36,1	29,3	10,5	3,4	2,9
Russia	52,1	1,3	14,8	0	0	0	1,8	17,5	51,4	57,5	63,4
E GBR	0	0	0	0	0	0	0	0	0	0	0,01
USA	0	0	0	0	0	0	0	0	0	0	3,3
S. Korea	0,1	0	0	0	0	0	0	0	0	0	1,9
LTU	0	0	0	0	0	0	0	0	0	0	0
Estonia	0	0	0	0	0	0	0	0,4	0	0	0
Total	100	100	100	100	100	100	100	100	100	100	100

Table 3. Indices of redfish biomass (tons) in Div. 3O from Russian research in 1983-1993.

Year	Biomass	Biomass in NRA	% of the stock in NRA
1983	212617	40200	18,9
1984	84097	24073	28,6
1985	157318	30337	19,3
1986	122128	12539	10,3
1987	20530	12780	62,2
1988	90475	46738	51,7
1989	27640	806	2,9
1990	98661	1919	1,9
1991	13494	650	4,8
1993	185448	8194	4,4
Mean			17,6

Table 4. Indices of redfish biomass (tons) in Div. 3O from Canadian research in 1991-2003.

Year	Spring survey			Fall survey		
	Biomass	Biomass in NRA	% of the stock in NRA	Biomass	Biomass in NRA	% of the stock in NRA
1991	15278	1553	10,2	34618	4473	12,9
1992	15961	2347	14,7	56247	14818	26,3
1993	83874	23733	28,3	51782	3584	6,9
1994	172264	8478	4,9	53324	5008	9,4
1995	234648	14641	6,2	125578	46022	36,6
1996	102695	54177	52,8	22974	3565	15,5
1997	15699	410	2,6	154622	37798	24,4
1998	159313	18024	11,3	75676	11459	15,1
1999	122550	19914	16,2	42100	11585	27,5
2000	83508	36624	43,9	60004	8700	14,5
2001	26183	3048	11,6	37286	8567	23,0
2002	20126	3151	15,7	33976	8396	24,7
2003	31202	2940	9,4			
Mean			17,5			21,9

Table 5. Catch rates of STM-type vessels (1760 kW) during the redfish fishery in Div. 3O.

Parameters	Year			
	2000	2001	2002	2003*
Total catch of all species	2574	12075	13044	12091
Russian catch of redfish	2233	11343	11182	10794
Catch by STM	366	10236	8200	6641
Catch per vessel/day	15,9	21,4	16,5	20,1
Catch per 1-hour tow	1,7	1,6	1,5	1,5

* Provisional data from PINRO

Table 6. Indices of redfish biomass (tons) in Div. 3LNO from Russian research in 1983-1993.

Year	Division		
	3L	3N	3O
1983	138025	139928	212617
1984	89118	147466	84097
1985	47999	64083	157318
1986	61836	15641	122128
1987	40839	37144	20530
1988	15391	23779	90475
1989	7653	5781	27640
1990	7027	2259	98661
1991	16999	3370	13494
1993	3678	23188	185448

Table 7. Indices of redfish biomass (tons) in Div. 3LN from Canadian research in 1978-2003.

Years	Division 3L				Division 3N		
	Spring survey	Summer survey	Fall survey	Winter survey	Spring survey	Summer survey	Fall survey
1978		311163					
1979		227788					
1980	61502						
1981		261384					
1984		277711					
1985	127888	161038	98233	90245			
1986			17119	36568			
1990		92840	20743	18202			
1991	6267	37572	13665		4375	47624	24221
1992	7404		13424		2662		122990
1993	6461	20838	6011		16112	129808	13222
1994	2302		7173		1860		24584
1995	3284		50078		2572		40650
1996	16825			4691	5987		11277
1997	9277			19544	5651		51116
1998	27596			18522	31806		93703
1999	21314			38861	40182		33125
2000	36150			24917	51692		75544
2001	2658			28569	15415		103997
2002	9110			11793	21849		38235
2003					17414		

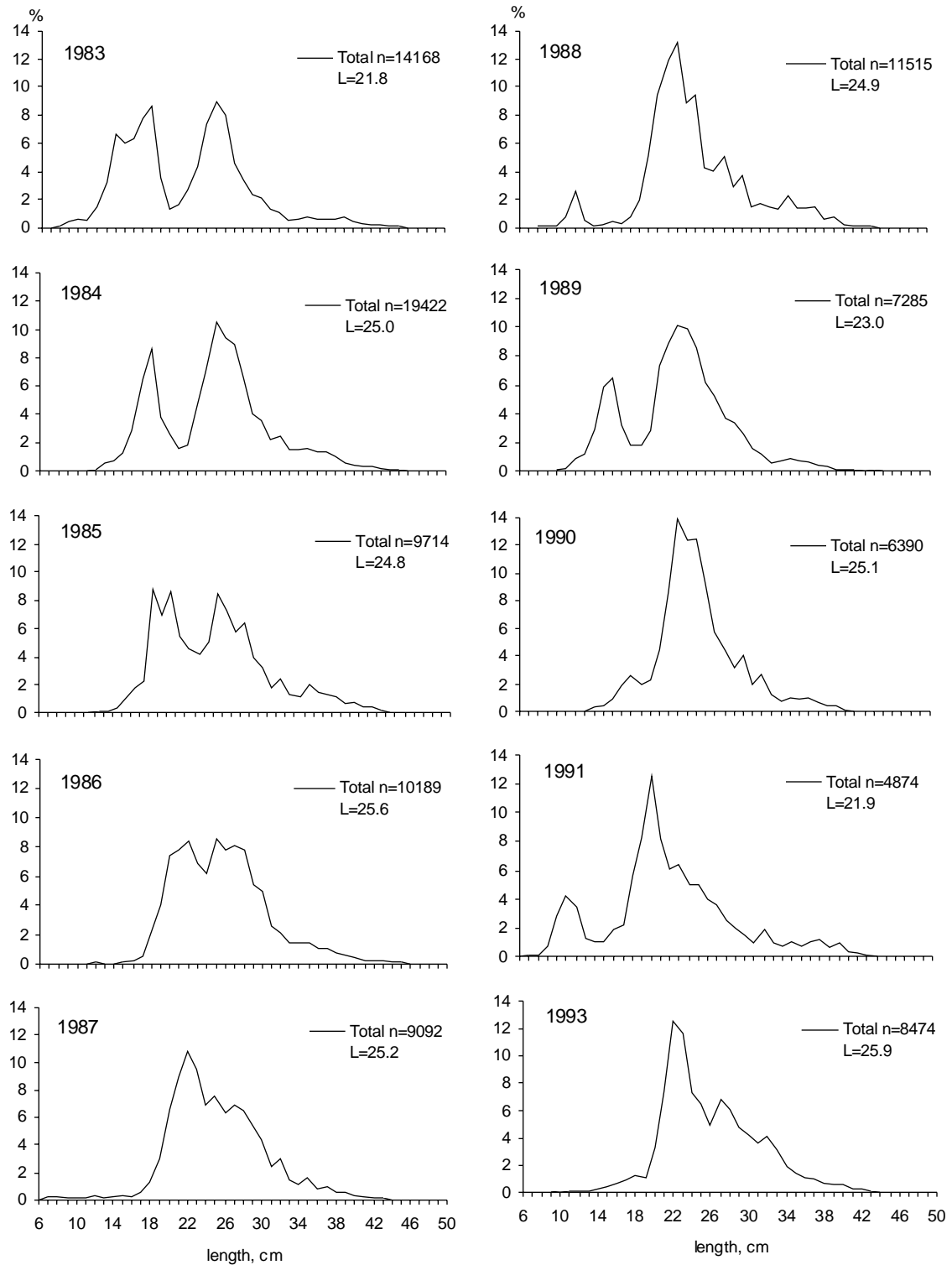


Fig. 1. Length composition of redfish in Div. 30 based on data from Russian surveys in 1983-1993.

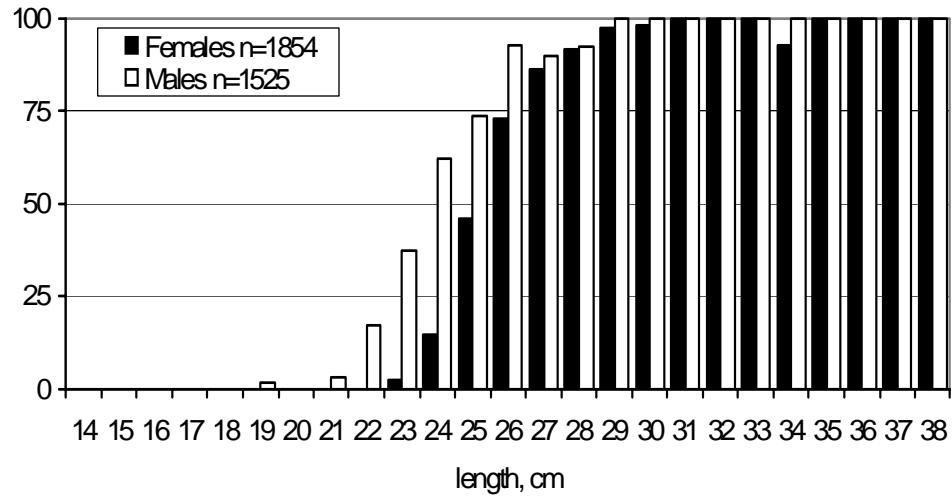


Fig. 2. Maturity rate of *S. fasciatus* in Div. 30.

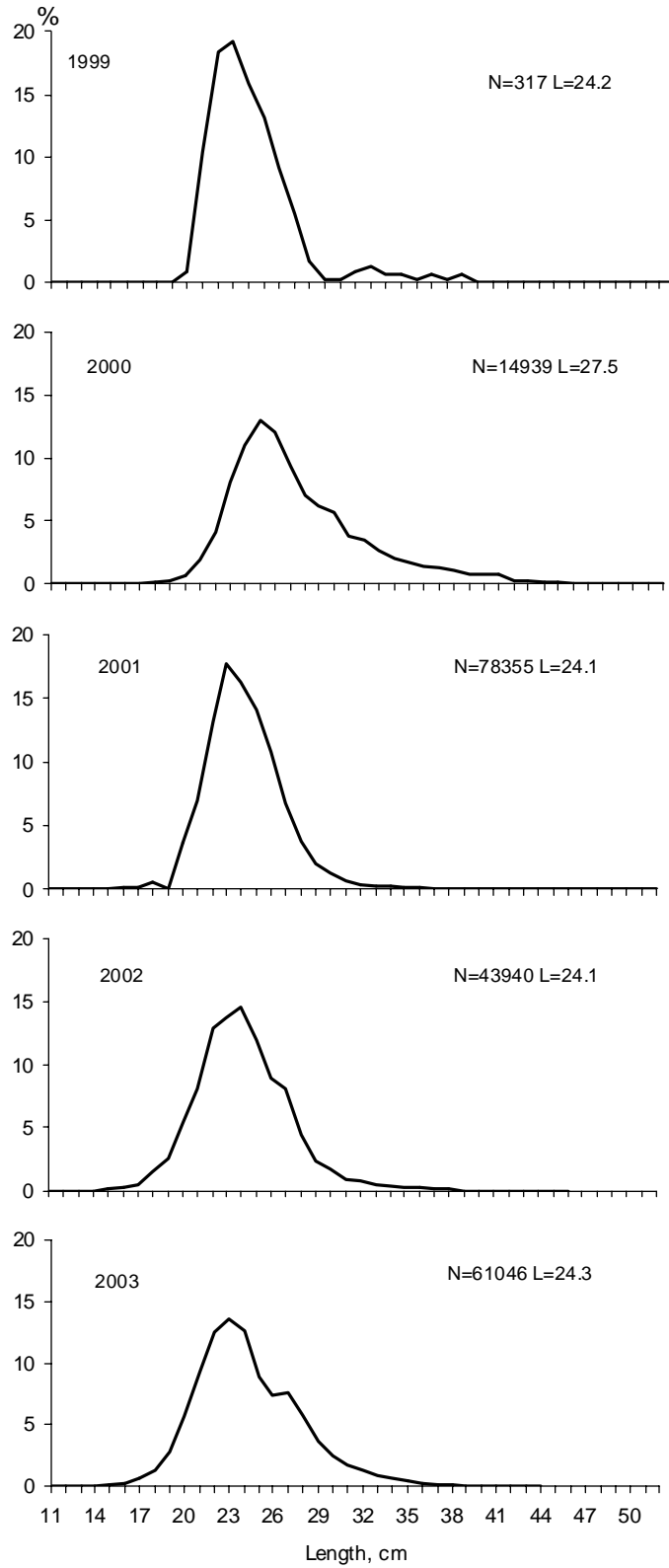


Fig. 3. Length distribution of redfish in Div. 30 in 1999-2003.