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Distribution and Biological Characteristics of Rock Grenadier (*Coryphaenoides rupestris*)  
as Shown by Trawl Surveys in the Northwest Atlantic in 1989-1991

by

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**ABSTRACT**

The paper presents the distribution of grenadier over the area and by depth, size and age compositions, sex ratio of fish in catch from NAFO SA 0, 2, 3. Percentages of grenadier, Greenland halibut and redfish in catch from different depth are given. In 1991, as indicated by the trawl survey, the mean length of grenadier was 50.0 cm and average age - 8.2. As in previous years a sharp increase of the mean length and relative number of females with depth was noted. In 1990 and 1991 the percentage of grenadier in catch was much lower, than in 1971-1977, while its catch size decreased about 10 times. A reduction of the catch per effort was one of the reasons behind the decline of the total catch. Strong correlations were found between the percentage of grenadier in catch from 500-1200 m and total catch of this species (correlation coefficients between 0.86 and 0.95), as well as catch per effort and total catch (correlation coefficients from 0.60 to 0.83).

**INTRODUCTION**

Fishery for rock grenadier in the Northwest Atlantic was initiated in 1967. Before 1978 the total catch amounted to tens thousands tonnes per year, and it dropped drastically in 1979. Gradually, catch per unit effort declined. In 1989-1991 the catch still remained at a low level. Trawl surveys for bottom fish, conducted on a yearly basis in autumn and winter seasons on the Baffin Land, Labrador and Grand Newfoundland bank showed no grenadier concentrations of commercial importance in the depth range from 500 to 1500 m. The purpose of the present paper is to analyse results from the 1991 survey and compare them with

materials for previous years to study the reasons of catch decline.

#### MATERIAL AND METHODS

The paper uses materials from bottom trawl surveys, carried out annually in autumn and winter seasons. Size frequencies and percentage series, shown in figures, as well as catch per hour tow in kg by 100 m depth intervals during 1971-1977, 1990 and 1991, given in the Table, have been smoothed by the formula:

$$B = \frac{a + 2b + c}{4}$$
, where a, b, c are preceding, middle and subsequent member in the series, B - estimated member. Before, linear and exponential ( $Y = a + bx$ ,  $Y = \exp(a + bx)$ ) relations were established between the catch of grenadier from 501-1200 m and total catch of this species in SA 0,2,3 in 1972-1988 (Savvatimsky, 1991). The present paper suggests also relations between catch per effort and total catch. Age composition in SA 0,2 and Div. 3K for 1983-1991 was calculated from size frequencies for corresponding years using a combined age key for 1969-1990 (Savvatimsky, 1991).

#### RESULTS AND DISCUSSION

From 18 to 25 September 1991 a total of 31 bottom trawl tows were done in Div. 3K to study the vertical distribution of commercial species. Those tows were done by RV "Kapitan Shaitanov" in the depth interval from 500 to 1500 m and every 100 m. Like in 1990, no grenadier occurred in catch in less than 700 m depth, it accounted for about 50% in catch from 1200 m and reached 90% in the depth range from 1401 to 1500 m (Tables 1,2). Bathymetric distribution of three major species - Greenland halibut, rock grenadier and redfish was the same as in 1990 (Savvatimsky, 1991), however, the catch declined almost twice against 1990.

Trawl survey in Div. OB was conducted from 3 to 17 November 1991 in the range of depth from 201 to 1500 m. Rock grenadier occurred only as a small by-catch in Greenland halibut catch and accounted for about 2% only in 1301-1400 m depth. Grenadier catch did not exceed 25 kg per hour tow. No grenadier were found in the catch north of 64°24'N.

In Div. 2G a trawl survey by RV "Kapitan Shaitanov" was conducted from 26 September to 15 October and 17-21 November and covered the depth range from 200 to 1500 m. Grenadier catch did not exceed 1.1 t (depth 1100-1360 m).

In Div. 2H the survey was conducted from 21 November to 4 December. Grenadier occurred in catch from 380 to 1310 m, the catch did not exceed 150 kg.

Thus, the trawl survey provided evidence, that in 1991 no grenadier concentrations were distributed in traditional depth range over all areas covered.

In 1991 the mean length of grenadier in Divs. OB, 2GH and 3K was 50.0 cm (Table 3), average age - 8.2 years (Table 4). These indices are closely related to the fishing depth. As in previous years, size of males and females and relative number of female grenadier increased with depth in all surveyed areas (Table 3, Fig. 1). Such changes were also indicated by trawl surveys in 1988 and 1989 (Savvatimsky, 1989; 1990). It is worth noting, that in SA 2, where rock grenadier occurred in small numbers in shallower depth (301-400 m) these indices first decreased with depth (to 501-600 m), then increased. This is also evident from Fig. 2, where the mean length is smoothed.

Size composition and relative number of grenadier in catch are closely related to its vertical distribution. The percentage of grenadier in catch in 1990 and 1991 was much smaller, than in 1971-1977 (Fig. 3), and its catch from traditional fishing depth declined about 10 times for the same period (Table 6). This can not be explained by intensive fishing, because the total catch in 1975-1979 was low and a reduction of catch per effort took place later than a decline of the total catch. Nevertheless, a reduction of catch per effort was one of the reasons behind a decline of the total catch. Strong correlations were established between the percentage of grenadier in catch from 501-1000, 1001-1200 and 501-1200 m and total catch in SA 0,2,3 in 1972-1988 (Savvatimsky, 1991). Correlation coefficients were from 0.86 to 0.95 (Table 7). A comparison of mean catch per hour tow for grenadier in trawl surveys in the same period and total catch gave correlation coefficients from 0.60 to 0.83 (Table 8), which was indicative of a strong relation between these indices.

A comparison of standardized catch per effort and total catch of grenadier in SA 2+3 in 1972-1989 (data provided by Atkinson, 1991) for linear relation gave a correlation coefficient 0.786, and 0.716 for exponential relation.

Thus, a decline of the total catch of grenadier was a

consequence of the reduction of percentage of this species in catch and lower catch per effort in traditional fishing depths. The reasons behind the absence of grenadier concentrations of commercial importance in depths accessible to bottom trawl are still not clear.

#### REFERENCES

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Table 1

Distribution and composition of catches from various depth in the trawl survey by RV "Kapitan Sheitanov" in 1991

Subarea or Div.	Depth, m	Mean catch, kg/hr	No. of catches	Catch composition by weight, %			
				Greenl. halibut	Redfish (S.ment.)	Rn. grenadier	Others
OB	20I - 300	1,0	3	100,0	-	-	-
	30I - 400	3,6	9	100,0	-	-	-
	40I - 500	14,9	10	90,3	8,7	-	1,0
	50I - 600	26,1	7	83,9	15,0	-	1,1
	60I - 700	73,2	5	83,3	15,7	0,3	0,7
	70I - 800	45,0	1	100,0	-	-	-
	80I - 900	75,0	4	98,0	0,7	1,1	0,2
	90I - 1000	81,3	3	100,0	-	-	-
	100I - 1100	119,5	6	98,7	-	0,6	0,7
	110I - 1200	134,0	2	94,8	-	-	5,2
	120I - 1300	82,5	2	95,8	-	3,6	0,6
	130I - 1400	107,0	1	76,6	-	23,4	-
	2	10I - 200	1,8	6	100,0	-	-
20I - 300		16,4	17	72,3	13,3	-	14,4
30I - 400		34,8	25	53,8	25,4	2,0	18,8
40I - 500		64,9	27	56,1	36,5	0,7	6,7
50I - 600		60,3	16	52,6	43,2	0,8	3,3
60I - 700		47,4	12	65,6	28,5	5,6	0,3
70I - 800		92,2	5	57,1	5,4	37,1	0,4
80I - 900		86,1	14	80,8	2,3	16,1	0,8
90I - 1000		85,3	8	50,2	0,9	48,0	0,9
100I - 1100		205,6	16	47,8	0,7	50,8	0,7
110I - 1200		334,7	10	24,0	-	75,2	0,8
120I - 1300		169,9	14	26,1	-	72,5	1,4
130I - 1400		239,0	9	21,4	-	78,6	-
3K	20I - 300	31,0	1	16,1	-	-	83,9
	30I - 400	-	-	-	-	-	-
	40I - 500	262,0	1	100,0	-	-	-
	50I - 600	203,7	3	10,1	86,9	-	3,0
	60I - 700	221,7	3	27,5	71,0	-	1,5
	70I - 800	258,7	3	58,9	23,6	15,1	2,4
	80I - 900	286,0	3	67,8	-	32,2	-
	90I - 1000	286,3	3	54,2	-	45,8	-
	100I - 1100	410,3	3	39,7	-	27,3	33,0
	110I - 1200	168,0	3	53,0	-	47,0	-
	120I - 1300	191,0	3	22,0	-	78,0	-
	130I - 1400	142,0	3	18,1	-	81,9	-
	140I - 1500	87,3	3	8,4	-	91,6	-
0,2,3K	10I - 200	1,8	6	100,0	-	-	-
	20I - 300	14,2	22	67,0	11,9	-	21,1
	30I - 400	26,4	35	55,9	24,4	2,0	17,7
	40I - 500	57,0	38	63,8	30,1	0,6	5,5
	50I - 600	67,6	26	41,1	55,4	0,5	3,0
	60I - 700	80,0	20	53,8	43,2	2,1	0,9
	70I - 800	142,4	9	59,7	16,2	22,5	1,6
	80I - 900	112,6	21	78,3	1,3	20,0	0,4
	90I - 1000	127,6	14	59,0	0,3	40,4	0,3
	100I - 1100	209,5	25	52,9	0,4	38,4	8,3
	110I - 1200	274,6	15	32,1	-	66,9	1,0
	120I - 1300	141,6	22	29,0	-	69,9	1,1
	130I - 1400	206,5	13	23,1	-	76,9	-
140I - 1500	87,3	3	8,4	-	91,6	-	

Table 2 Distribution and composition of catches from various depth in trawl survey in Sub. OB, 2 and 3K in 1990, 1991

Year	Depth, m	Mean catch, kg/hr	No. of catches	Catch composition by weight, %			
				Greenl. halibut	Redfish (S. ment.)	Grenadier	Others
1990	201 - 300	1.7	6	90.0	-	-	10.0
	301 - 400	11.2	11	78.0	16.3	-	5.7
	401 - 500	26.2	13	53.5	44.4	-	2.1
	501 - 600	104.7	12	21.9	73.6	-	4.5
	601 - 700	188.5	10	30.4	67.6	-	2.0
	701 - 800	149.0	4	79.5	9.4	3.2	7.9
	801 - 900	159.1	8	79.3	1.3	10.1	9.3
	901 - 1000	160.0	13	84.4	-	13.4	2.2
	1001 - 1100	289.6	11	70.5	-	27.0	2.5
	1101 - 1200	266.5	29	73.5	-	26.0	0.5
	1201 - 1300	454.0	6	36.0	-	63.9	0.1
	1301 - 1400	314.4	7	30.6	-	69.0	0.4
1401 - 1500	327.0	3	6.2	-	93.1	0.7	
1991	101 - 200	1.8	6	100.0	-	-	-
	201 - 300	14.2	22	67.0	11.9	-	21.1
	301 - 400	26.4	35	55.9	24.4	2.0	17.7
	401 - 500	57.0	38	63.8	30.1	0.6	5.5
	501 - 600	67.6	26	41.1	55.4	0.5	3.0
	601 - 700	80.0	20	53.8	43.2	2.1	0.9
	701 - 800	142.4	9	59.7	16.2	22.5	1.6
	801 - 900	112.6	21	78.3	1.3	20.0	0.4
	901 - 1000	127.6	14	59.0	0.3	40.4	0.3
	1001 - 1100	209.5	25	52.9	0.4	38.4	8.3
	1101 - 1200	274.6	15	32.1	-	66.9	1.0
	1201 - 1300	141.6	22	29.0	-	69.9	1.1
1301 - 1400	206.3	13	23.1	-	76.9	-	
1401 - 1500	87.3	3	8.4	-	91.6	-	

Table 3 Length composition of research catches of roundnose grenadier in the NW Atlantic (Sub. O, 2 and 3K) in 1983-1991 (%)

Length, cm	1983	1984	1985	1986*	1987*	1988	1989	1990*	1991
18 - 20	0.2	-	-	-	-	-	-	-	-
21 - 23	0.5	-	-	-	-	-	-	-	-
24 - 26	0.8	-	-	-	-	-	-	-	-
27 - 29	1.6	0.1	0.4	0.0	0.0	1.4	0.1	1.1	1.1
30 - 32	2.4	0.0	0.9	0.0	0.0	1.9	0.3	2.9	2.9
33 - 35	3.5	0.0	1.1	0.0	0.0	2.3	0.3	3.4	3.4
36 - 38	4.4	0.0	1.6	0.0	0.0	2.9	0.3	4.4	4.4
39 - 41	4.7	0.0	2.2	0.0	0.0	3.6	0.3	5.5	5.5
42 - 44	5.9	0.0	2.2	0.0	0.0	4.4	0.3	6.6	6.6
45 - 47	8.0	0.0	3.9	0.0	0.0	5.5	0.3	8.0	8.0
48 - 50	7.6	0.0	7.9	10.2	10.0	10.0	10.0	10.0	10.0
51 - 53	8.3	0.0	8.4	9.2	8.8	8.8	8.8	8.8	8.8
54 - 56	9.2	0.0	11.2	10.5	9.9	9.9	9.9	9.9	9.9
57 - 59	6.9	0.0	11.0	9.0	8.8	8.8	8.8	8.8	8.8
60 - 62	8.2	0.0	10.4	6.8	7.9	7.9	7.9	7.9	7.9
63 - 65	8.0	0.0	10.1	7.0	8.4	8.4	8.4	8.4	8.4
66 - 68	5.2	0.0	7.5	4.4	5.9	5.9	5.9	5.9	5.9
69 - 71	4.6	0.0	5.6	3.4	4.4	4.4	4.4	4.4	4.4
72 - 74	3.3	0.0	3.9	3.3	3.3	3.3	3.3	3.3	3.3
75 - 77	2.4	0.0	2.0	1.7	1.1	1.1	1.1	1.1	1.1
78 - 80	1.1	0.0	0.8	0.7	0.3	0.3	0.3	0.3	0.3
81 - 83	0.9	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0
84 - 86	0.4	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
87 - 89	0.2	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
90 - 92	0.2	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
93 - 95	0.1	0.2	0.2	0.0	0.1	0.0	0.0	0.0	0.0
96 - 98	+	-	-	-	-	-	-	-	-
99 - 101	-	-	-	-	-	-	-	-	-
102 - 104	+	-	-	-	-	-	-	-	-
Mean length, cm	56.3	58.3	52.2	54.3	51.4	46.5	51.9	49.3	50.0
No. of fish	13296	11796	5837	6679	9996	11931	12797	15035	12340

\* Subarea 1 data included

Table 4 Age composition of research catches of roundnose grenadier in the NW Atlantic (Sub. O, 2 and 3K) in 1983-1991 (%)

Age, years	1983	1984	1985	1986*	1987*	1988	1989	1990*	1991
2	2,2	0,3	1,9	1,6	0,6	1,9	0,6	2,4	2,4
3	2,9	1,1	2,7	2,8	3,6	4,2	3,0	3,6	4,1
4	3,5	1,8	3,5	3,3	6,3	8,9	5,1	6,1	6,5
5	5,9	3,6	6,4	5,6	9,4	13,1	8,4	9,5	8,8
6	7,2	6,1	8,0	6,6	9,0	12,2	8,9	10,9	8,9
7	9,5	9,7	11,9	9,9	10,9	12,7	10,8	12,5	10,8
8	11,1	12,5	13,6	12,2	13,2	13,4	13,2	12,1	12,2
9	11,2	13,4	13,0	12,2	12,6	11,2	12,4	11,1	11,7
10	10,1	12,8	11,8	12,0	11,0	8,9	11,2	10,0	10,7
11	9,1	11,2	8,9	10,0	8,5	5,5	8,7	7,5	8,1
12	8,8	9,8	7,5	8,9	6,6	4,1	7,2	6,0	6,6
13	6,3	6,5	5,1	6,3	3,9	2,1	4,6	3,8	4,1
14	5,0	4,7	2,7	3,7	2,1	1,0	2,8	2,2	2,4
15	3,2	2,8	1,5	2,4	1,1	0,4	1,6	1,2	1,4
16	2,0	1,8	0,8	1,4	0,6	0,2	0,9	0,6	0,7
17	1,2	1,1	0,4	0,9	0,4	0,1	0,6	0,4	0,5
18	0,4	0,5	0,1	0,2	0,1	-	0,1	0,1	0,1
19	0,4	0,3	0,1	0,1	-	-	0,1	-	-
Mean age	9,3	9,8	8,7	9,2	8,3	7,4	8,6	8,1	8,2
No. of fish	13296	11796	5837	6679	9996	11931	12797	15035	12340

\* Subarea 1 data included

Table 5 Mean length of male and female and percentage of female roundnose grenadier at various depth in Sub. OB, 2 and 3K in 1991

Subarea or Div.	Depth, m	Males		Females		Percent of female
		Mean length, cm	No. of fish	Mean length, cm	No. of fish	
OB	601 - 700	25,0	1	-	-	-
	701 - 800	-	-	-	-	-
	801 - 900	37,0±5,0	5	38,0±10,0	3	37,5
	901 - 1000	-	-	-	-	-
	1001 - 1100	53,2±6,3	5	42,4±3,7	5	50,0
	1101 - 1200	-	-	-	-	-
	1201 - 1300	48,6±6,1	8	50,2±7,3	5	38,5
1301 - 1400	54,3±1,7	27	58,4±1,7	24	47,1	
2	301 - 400	48,1±1,7	28	45,1±1,3	37	56,9
	401 - 500	38,8±1,2	41	39,7±1,7	29	41,4
	501 - 600	30,8±1,7	39	28,9±1,9	45	53,6
	601 - 700	37,1±1,0	111	32,1±0,8	98	46,7
	701 - 800	36,8±0,4	368	37,6±0,7	143	28,0
	801 - 900	33,7±0,3	709	34,8±0,6	312	30,6
	901 - 1000	42,9±0,4	639	44,8±0,6	374	36,9
	1001 - 1100	50,0±0,3	1467	51,0±0,4	705	32,5
	1101 - 1200	52,6±0,3	908	53,5±0,5	442	32,7
	1201 - 1300	56,5±0,3	1062	60,7±0,4	584	35,5
	1301 - 1400	57,7±0,3	601	60,3±0,4	406	40,3
1401 - 1500	-	-	-	-	-	
3K	701 - 800	46,7±0,6	159	46,7±0,8	107	40,2
	801 - 900	37,0±0,5	298	39,5±0,8	120	28,7
	901 - 1000	40,9±0,7	274	38,4±1,0	115	29,6
	1001 - 1100	47,4±0,7	222	48,2±1,0	104	31,9
	1101 - 1200	51,6±0,7	267	54,5±1,1	119	30,8
	1201 - 1300	58,8±0,5	319	61,8±0,7	173	35,2
	1301 - 1400	62,5±0,6	278	67,3±0,9	176	38,8
	1401 - 1500	60,3±0,7	227	64,9±0,9	151	39,9
0,2,3K	301 - 400	48,1±1,7	28	45,1±1,3	37	56,9
	401 - 500	38,8±1,2	41	39,7±1,7	29	41,4
	501 - 600	30,8±1,7	39	28,9±1,9	45	53,6
	601 - 700	37,0±1,0	112	32,1±0,8	98	46,7
	701 - 800	39,8±0,4	527	41,5±0,6	250	32,2
	801 - 900	34,7±0,3	1012	36,1±0,5	435	30,1
	901 - 1000	42,3±0,4	913	43,3±0,5	489	34,9
	1001 - 1100	49,7±0,2	1694	50,6±0,4	814	32,5
	1101 - 1200	52,4±0,3	1175	53,7±0,5	561	32,3
	1201 - 1300	57,0±0,2	1369	61,1±0,3	762	35,4
	1301 - 1400	59,1±0,3	906	62,3±0,4	606	40,1
1401 - 1500	60,3±0,7	227	64,9±0,9	151	39,9	

Table 6 Distribution of mean research bottom catches ( kg/hr) of roundnose grenadier from various depths in Subareas 0, 2, 3 in 1971-1977, 1990, 1991 (smoothed series)

Depth, m	1971 - 1977		1990		1991	
	Catch	No. of catches	Catch	No. of catches	Catch	No. of catches
201 - 300	31,5	55	-	-	-	-
301 - 400	169,3	72	-	-	0,46	35
401 - 500	475,9	191	-	-	0,39	38
501 - 600	683,9	459	-	-	0,68	26
601 - 700	743,6	362	-	-	8,90	20
701 - 800	855,7	453	8,6	4	22,0	9
801 - 900	1427,3	288	14,6	8	32,1	21
901 - 1000	2260,9	109	34,3	13	51,5	14
1001 - 1100	2687,4	83	61,8	11	57,6	25
1101 - 1200	2786,9	37	126,7	29	136,7	15
1201 - 1300	2734,3	15	216,6	6	135,1	22
1301 - 1400	-	-	257,1	7	124,1	13
1401 - 1500	-	-	275,2	3	106,3	3

Table 7 International catch of roundnose grenadier and the percentage of this species in research catches from depth 501-1000, 1001-1200, 501-1200 m in Subareas 0, 2, 3 in 1972-1988 and their correlation.

Year	Total catch, 000t	Roundnose grenadier percentage by weight		
		Depth 501-1000 m	Depth 1001-1200 m	Depth 501-1200 m
1972	30,2	77,9 (189)	100,0 ( 1)	81,6 (190)
1973	18,6	69,6 (312)	99,1 (40)	78,0 (352)
1974	31,1	76,9 (276)	97,7 (33)	82,9 (309)
1975	27,6	78,2 (218)	91,8 (45)	82,1 (263)
1976	23,2	50,2 (249)	89,9 ( 8)	63,0 (257)
1977	16,1	12,4 (197)	78,3 ( -)	12,4 (197)
1978	20,7	42,1 ( 18)	66,7 ( 3)	49,1 ( 21)
1979	7,9	30,4 (159)	60,1 (10)	35,3 (169)
1980	2,1	7,5 ( 66)	16,9 (13)	10,1 ( 79)
1981	7,2	12,1 ( 34)	29,7 ( 4)	9,7 ( 38)
1982	4,4	8,6 (119)	42,6 (32)	10,0 (151)
1983	3,6	7,2 (123)	17,2 (44)	10,1 (167)
1984	3,9	17,6 ( 77)	22,1 (28)	18,9 (105)
1985	5,0	2,4 ( 69)	28,4 (28)	11,1 ( 97)
1986	7,4	22,8 (62)	56,4 (10)	32,4 ( 72)
1987	8,3	17,2 ( 50)	59,6 (30)	29,3 ( 80)
1988	6,4	15,9 ( 78)	52,7 (39)	28,2 (117)

Model  $Y = 2,365 + 0,334X$   $Y = -4,907 + 0,304XY$   $Y = -0,384 + 0,340X$

Correlation coeff. 0,919 0,901 0,948

Model  $Y = \exp(1,421 + 0,026X)$   $Y = \exp(0,686 + 0,027X)$   $Y = \exp(1,1585 + 0,028X)$

Correlation coeff. 0,861 0,942 0,927

Remark : Figures in brackets refer to numbers of research catches



Table 8 International catch of roundnose grenadier and grenadier mean catches from the trawl survey data from depth 501-1000, 1001-1200, 501-1200 m in Subareas 0, 2, 3 in 1972-1988 and their correlation

Year	Total catch, 000t	Mean catch of roundnose grenadier, kg/hr		
		Depth 501-1000 m	Depth 1001-1200 m	Depth 501-1200 m
1972	30,2	1021,6(189)	545,0 (1)	942,1 (190)
1973	18,6	1382,9(312)	3414,3 (40)	1963,3 (352)
1974	31,1	1157,9(276)	2095,3 (33)	1425,7 (309)
1975	27,6	1256,6(218)	2553,2 (45)	1627,0 (263)
1976	23,2	898,3(249)	1424,5 ( 8)	1048,6 (257)
1977	16,1	97,0(197)	421,8 ( -)	259,4 (197)
1978	20,7	168,2( 18)	68,8 ( 3)	139,8 ( 21)
1979	7,9	249,3(159)	887,8 (10)	355,7 (169)
1980	2,1	135,6( 66)	277,1 (13)	176,0 ( 79)
1981	7,2	109,9( 34)	3,0 ( 4)	88,5 ( 38)
1982	4,4	103,9(119)	183,9 (32)	126,8 (151)
1983	3,6	99,0(123)	320,8 (44)	162,4 (167)
1984	3,9	68,1( 77)	95,8 (28)	76,0 (105)
1985	5,0	5,0(69 )	60,9 (28)	23,6 ( 97)
1986	7,4	139,1(62 )	531,0 (10)	251,1 ( 72)
1987	8,3	35,6(50)	206,8 (30)	84,5 ( 80)
1988	6,4	21,1(78 )	120,9 (39)	54,4 (117)
Model		$Y = 6,312 + 0,0167X$	$Y = 8,365 + 0,00617X$	$Y = 6,779 + 0,0123X$
Correlation coeff.		0,833	0,615	0,718
Model		$Y = \exp(1,744 + 0,00127X)$	$Y = \exp(1,876 + 0,000502X)$	$Y = \exp(1,768 + 0,00096X)$
Correlation coeff.		0,759	0,598	0,718

Remark : Figures in brackets refer to numbers of research catches

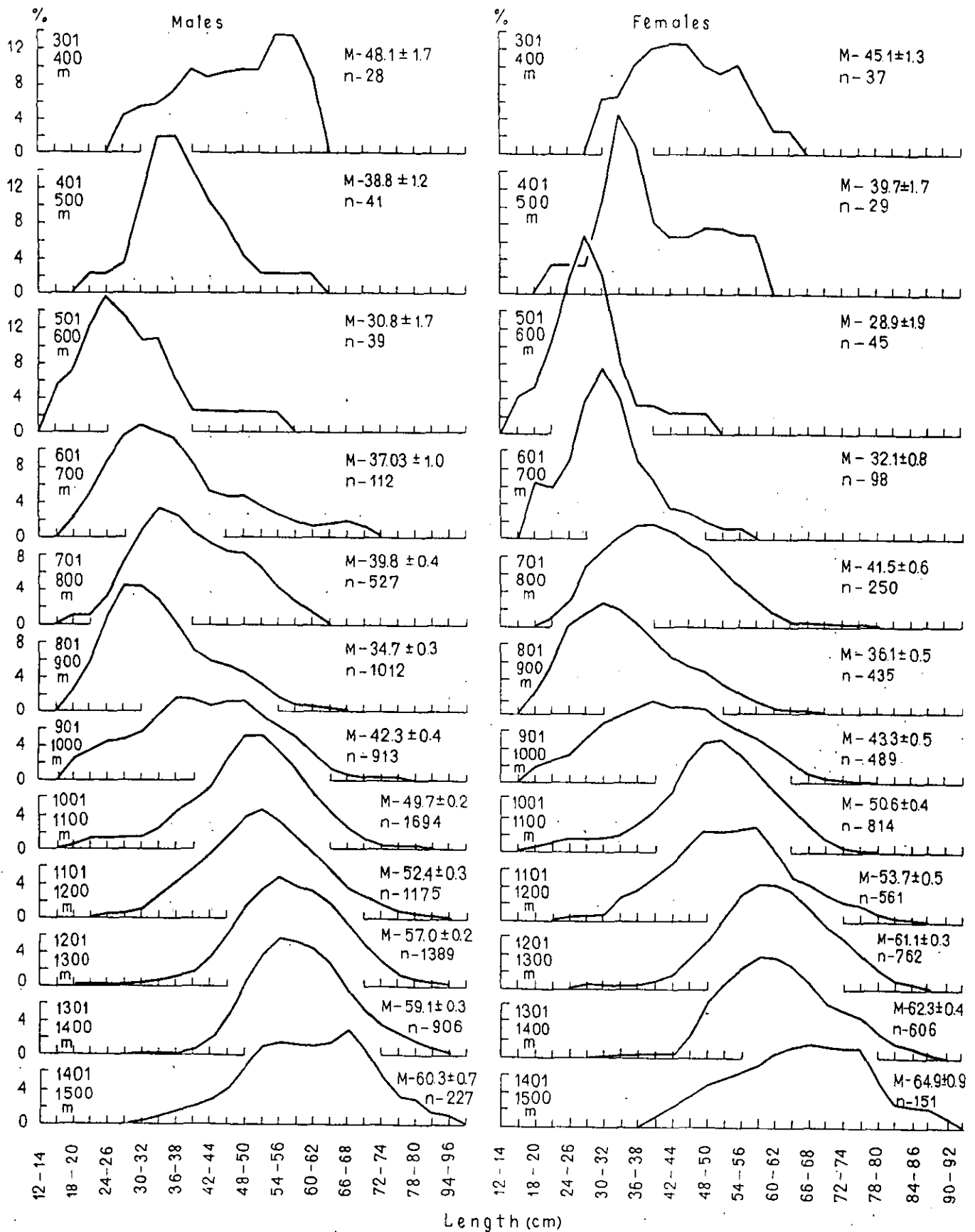


Fig.1. Length composition of male and female roundnose grenadier at various depth in Sub. 0,2 and 3K in 1991 form trawl survey by "Kapitan Shaitanov" (smoothed frequencies, n - number of fish, M - mean length of fish).

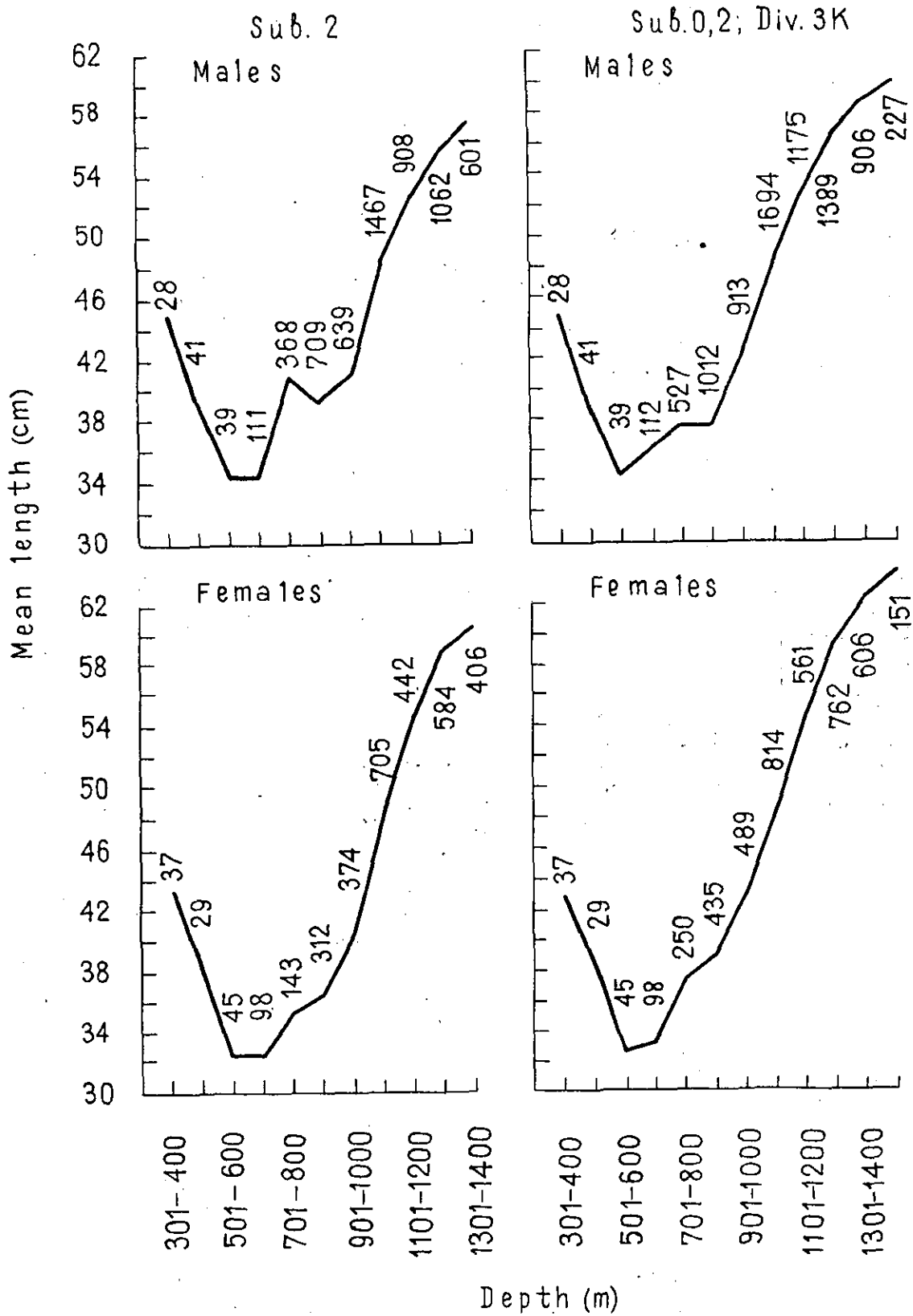


Fig. 2. Mean length of male and female roundnose grenadier at various depth in Sub. 0,2 and 3K in 1991 (smoothed series, figures over the curves are number of fish).

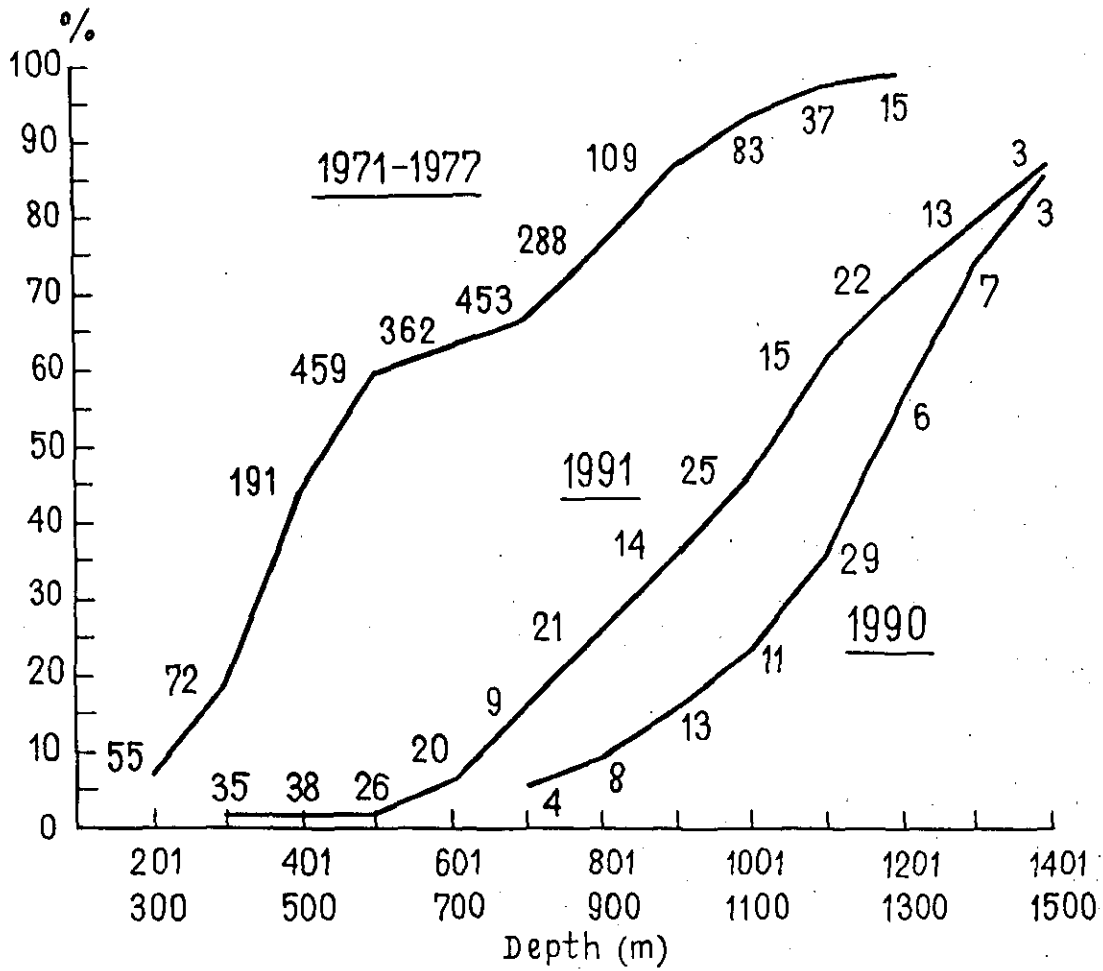


Fig.3. Roundnose grenadier percentage by weight in bottom trawl research catches from various depths in Sub. 0,2 and 3K in 1971-1977, 1990 and 1991 (smoothed series, figures over the curves are number of catches).