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Peculiarities of Deepwater Redfish, *Sebastes Mentella*, Distribution by Depths in the Irminger Sea

by

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Abstract

This paper presents the results of PINRO investigations in 1995, 1997 in the pelagial of the Irminger Sea. The data on distribution and biology of deepwater redfish within the range of 0-800m depths have been obtained.

Length composition, mean length variations, sex ratio, redfish feeding by 100m depth ranges in 0-500m, 500-800m layers have been analysed.

By the results of investigations conducted in the Irminger Sea the gradual variation of redfish biological characteristics with depth has been noticed. Mean length of males and females decreased down to 400-600m layer, further mean length of fish increased again. First maturing males and females were observed over all the vertical of redfish distribution. Variations of redfish biological parameters remained both in the local area of experimental work and in the larger part of the feeding area. In the Irminger Sea and the North Newfoundland areas the similar variation of deepwater redfish mean lengths with depth was revealed.

Introduction

Deepwater redfish (Sebastes mentella Travin) from the Irminger Sea is one of the most important objects of present-day fishery in the North-East Atlantic. Investigators from PINRO have been giving much attention to studying the life cycle, distribution, the dynamics of redfish population abundance since 1981. Conducted in 1981-1994 investigations in the upper 500m layer did not cover the whole area of fish vertical distribution (Pavlov, Mamylov and Noskov, 1988; Pavlov et al., 1989; Pedchenko, Melnikov and Shibanov, 1996). In 1995, 1997 PINRO had carried out trawl-acoustic surveys (TAS), by the results of which the data on the biological condition of deepwater redfish in the upper 500m layer, as well as in the deeper ones, were obtained. The differences in fish biological parameters on the different horizonts of distribution were noticed.

Vertical distribution of deepwater redfish was investigated in the areas of the North-West Atlantic. Based on the perennial data for 1958-1965 collected by the Polar Institute, the fish distribution by depths in the North Newfoundland area (Sidorenko, 1967; Savvatimsky, Sidorenko, 1966) was analysed.

This paper is aimed at systematizing and analysing the data for 1995, 1997, revealing common regularities in vertical structure of deepwater redfish aggregations in the areas of the Irminger Sea and the North Newfoundland.

Material and methods

Biological data on deepwater redfish were collected according to methods adopted in PINRO (Anon., 1980. Instructions and directions.). The data were obtained during research and research and fishing cruises in June-July 1995, 1997. The data for 1995 were collected in the southern feeding area (57°00′-59°00′N, 33°00′ - as far as the border of the Greenland fishing zone), where trawlings were conducted by all 100 m ranges within 0-800m interval of depths. In 1997 the data obtained during the Russian TAS onboard RV "Atlantida" served as material to be analysed. In the northern feeding area (61°47′-61°50′N, 33°59′-34°08′W) experimental works in the local part by means of a number of trawlings were carried out in 200-800m layer during two days. Length composition, variations of mean lengths, portion of fish by length groups, sex ratio, redfish feeding by 100 m ranges of depths, by 0-500 m, 500-800 m layers were analysed. The comparative analysis of mean length variation in redfish males and females by 100m depth ranges in the Irminger Sea and the North Newfoundland areas was performed. The material analysed is presented in Table 1.

Results

Redfish males predominated in all the catches during the period of investigations. Sex ratio by different depth ranges was dissimilar. In 1995 the reduction in male portion from 68% in the upper layers to 54% on 700-800m horizon was recorded (Fig.1A). On the contrary, in 1997 the portion of males increased with depth from 69% to 78% (Fig.1B). Comparative analysis of sex ratio by length groups with depth indicated that in 27-39 cm length interval the male portion in 0-500m layer was higher, than in 500-800m layer. The portion of males from 39 cm in the upper layers was lower, than in the deeper ones (Fig.2).

The analysis of deep-water redfish mean length variation with depth by 100 m ranges showed the length heterogeneity in the vertical structure of feeding aggregations. In 1995 in the upper 100m layer large fish with mean 36.8 cm length of males and 37.9 cm of females occurred. Fish length gradually diminished down to 500-600 m layer, after that increasing and reaching 36.9 cm and 37.6 cm, respectively, in 700-800 m layer (Fig.3A). More pronounced similar character of redfish mean length variability depending on depth was noticed during the experimental work in the local part in 1997 (Fig.3B). Material having been analysed showed that apart from the geographical position of areas (in the southern feeding area - in 1995, and in the northern one - in 1997), the decrease in redfish mean length with depth up to 400-600 m horizons was observed, further mean length increased again, independently of fish sex.

The similar variation of mean length by vertical is, probably, a regularity for another deepwater fish species. The same variation of mean length with depth both in roughhead (Savvatimsky, 1992 a) and in rock grenadier (Savvatimsky, 1922 b) was noticed.

By the data of I.N.Sidorenko (1967), the same variation of mean length by vertical was noted in redfish from the North Newfoundland Bank area in the Nort-West Atlantic. Females had the most similar mean length variations (Fig.4).

Statistical analysis of the length structure of deepwater redfish aggregations showed that in upper 200m layer one size males and females with 5.6-6.2% coefficients of length variations were, mainly, distributed. Redfish length variability had significantly increased with depth and variability coefficients reached 12% (Fig.5A). It is explained by the presence of large mature as well as small including maturing for the first time fish in the lower layers. In 1997 the dependence of increasing length variation coefficients with depth maintained. At the same time variation coefficients of females were in 1.5 times higher, than those ones of males, as compared to 1995 (Fig.5B).

Comparative analysis of sex maturation ogives in 1995 did not reveal any significant differences in deepwater redfish sex maturation rates by two layers surveyed (Table 2). The data from the investigations during the experimental work in the local part in 1997 indicate somewhat delayed sex maturation rate of fish distributing in 500-800 m layer (Table 3). Relatively small volume of material do not allow us to state it definitely. To obtain the correct data it is necessary to continue observations in the local part by the vertical structure of redfish aggregations.

In 1995 redfish feeding intensity was extremely low that was not typical of the feeding period. Mean index stomach fullness of redfish males and females was only 0.48 in the upper 500m layer decreasing down to 0.22 in 600-800m layer. Redfish food composition changed with depth increasing, the portion of squids, shrimp, euphausiids diminished while that one of fishes (Myctophidae sp., Paralepidae sp.) increased up to 63%. Redfish feeding analysis was complicated because of the great portion of stomachs everted. By the data from the experimental works in the local part of the northern sea in 1997 the redfish fed intensively, mean index of stomach fullness was equal to 1.86 in 200-500m layer, to 1.11 - in 500-800m layer. With depth increasing the portion of Calanus and squids in redfish feeding did not change, the portion of shrimp and fishes increased (Table 4).

Conclusion

In 1995, 1997 males, the portion of which varied from 54 to 78%, prevailed all over the deepwater redfish distribution vertical. The analysis of fish abundance distribution by length groups showed, that in 27-39 cm interval the portion of males was higher in 0-500m layer, than in 500-800m one. From 39 cm length the portion of males in the upper 500m layer was lower, than in the deeper layers.

In depth enhancing down to 400-600m mean lengths of redfish males and females diminished, coefficient of length variation increased from 5.9 to 12.3%. Further fish length grew again and variation coefficients reached 16.7%. For this, length variation coefficients in females were equal to those ones in males or in 1.5 times higher.

First maturing males and females were observed both in the upper 500m layer and in the deeper ones. Results from the experimental works in the local part revealed somewhat delayed rate of sex maturation of redfish distributed in 500-800m layer.

In depth enlarging redfish feeding intensity reduced in 1,5-2 times. In the upper 500m layer redfish fed on Calanus, euphausiids, squids. In 500-800m layer the portion of shrimp and fish objects in redfish feeding grew.

The results from the investigations conducted in the *Irminger Sea* indicated a gradual variation of redfish biological characteristics with depth. The peculiarities having been revealed have remained both in the local part of the experimental work and in the spacious part of the feeding area, aside from their geographic location. There were no separate groups of deepwater redfish with well-pronounced differences in length-sex composition, sexual maturation rates having been revealed in the vertical structure of feeding aggregations.

The common similarity of vertical length sructure of deepwater redfish aggregations in the Irminger Sea and North Newfoundland areas was revealed. The comparative analysis of mean lengths by 100m depth ranges showed the same character of their variation. Redfish females had the most similar length variation.

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Table 1 Analysed data from the Irminger Sea for 1995, 1997.

Years			1995	1997
Measurement, spec.				
	males		8348	365
	females		5616	189
Analysis of maturity, spec.		males	1643	299
		females	1148	145
Feeding, spec.			805	118

Table 2. Rate of Irminger Sea Redfish maturation in 1995

Layer,m	0 - 500 m				600 - 800 m			
Length, cm	Adult fishes ratio, %		No. of fishes		Adult fishes ratio, %		No. of fishes	
	Males	Females	Males	Females	Males	Females	Males	Females
22	-	-	-	-	-	-	1	1
23	-	-	-	-	-	-	-	-
24	-	-	1	-	-	-	2	5
25	-	-	-	4	-	-	7	10
26	-	-	1	1	-	-	7	10
27	-	-	7	1	33,3	-	6	7
28	-	-	12	5	12,5	-	8	10
29	14,3	50,0	7	4	22,2	-	9	11
30	18,8	-	16	13	28,6	-	7	4
31	58,8	50,0	17	4	66,7	60,0	12	5
32	87,8	66,7	49	15	92,3	50,0	13	3
33	100,0	78,9	34	19	100,0	75,0	29	12
34	100,0	91,1	217	45	96,3	100,0	27	12
35	100,0	100,0	274	100	95,6	100,0	23	21
36	100,0	97,8	215	135	100,0	100,0	15	22
37	100,0	100,0	170	136	100,0	100,0	17	34
38	100,0	100,0	132	105	100,0	100,0	11	21
39	100,0	100,0	60	70	100,0	100,0	9	15
40	100,0	100,0	37	67	100,0	100,0	17	23
41	100,0	100,0	6	21	100,0	100,0	23	21
42	100,0	100,0	10	12	100,0	100,0	20	17
43	100,0	100,0	8	4	100,0	100,0	27	21
44	100,0	100,0	1	3	100,0	100,0	26	18
45	100,0	100,0	3	1	100,0	100,0	23	24
46	100,0	100,0	1	3	100,0	100,0	12	19
47	-	100,0	-	1	100,0	100,0	6	20
48	100,0	100,0	2	1	100,0	100,0	7	7
49	-	-	-	-	-	100,0	-	3
50	-	-	-	-	-	100,0	-	1

Table 3. Rate of Irminger Sea Redfish maturation in 1997

Layer,m	200 - 500 m				500 - 800 m			
Length, cm	Adult fishes ratio, %		No. of fishes		Adult fishes ratio, %		No. of fishes	
	Males	Females	Males	Females	Males	Females	Males	Females
25	-	-	-	2	-	-	-	-
26	-	-	4	2	-	-	-	1
27	-	-	4	3	-	-	-	2
28	-	-	3	2	-	-	-	1
29	-	-	2	2	-	-	-	4
30	40,0	-	5	3	50,0	-	2	2
31	100,0	25,0	7	4	50,0	-	2	2
32	100,0	100,0	9	4	83,3	66,6	6	3
33	100,0	100,0	20	3	100,0	100,0	8	8
34	100,0	100,0	31	1	100,0	100,0	12	1
35	100,0	100,0	37	7	100,0	100,0	15	3
36	100,0	100,0	23	11	100,0	100,0	7	9
37	100,0	100.0	15	18	100,0	100,0	9	2
38	100,0	100,0	13	6	100,0	100,0	13	4
39	100,0	100,0	4	8	100,0	100,0	5	2
40	100,0	100,0	1	5	100,0	100,0	4	3
41	100,0	100,0	1	4	100,0	100,0	9	3
42	-	-	-	-	100,0	100,0	10	1
43	-	-	-	-	100,0	100,0	10	1
44	-	-	-	-	100,0	100,0	5	1
45	-	-	-	-	100,0	100,0	1	4
46	-	-	-	-	100,0	100,0	2	1
47	-	-	-	-	-	100,0	-	2

Table 4. Observations on the stomach content of Redfish in the Irminger Sea in 1995, 1997

	1995				1997			
	0-500		600-800		200-500		500-800	
	No.	%	No.	%	No.	%	No.	%
Total	800		1941		264		174	
everted	624	78,0	1312	67,6	191	72,4	129	74,2
empty	130	16,2	567	29,2	22	8,3	28	16,1
w. content	46	5,8	62	3,2	51	19,3	17	9,7
mean index of fullness	0,48		0,22		1,86		1,11	
	frequ.	%	frequ.	%	frequ.	%	frequ.	%
Copepods	-	-	1	1,8	13	18,3	5	20,8
Euphaus.	12	28,6	9	15,8	1	1,4	-	-
Amphip.	3	7,1	-	-	20	28,2	4	16,7
Squids	14	33,3	7	12,2	33	46,5	11	45,8
Shrimps	13	31,0	3	5,3	1	1,4	1	4,2
Fish remn.	-	-	36	63,1	-	-	3	12,5
Other	-	-	1	1,8	3	4,2	-	-

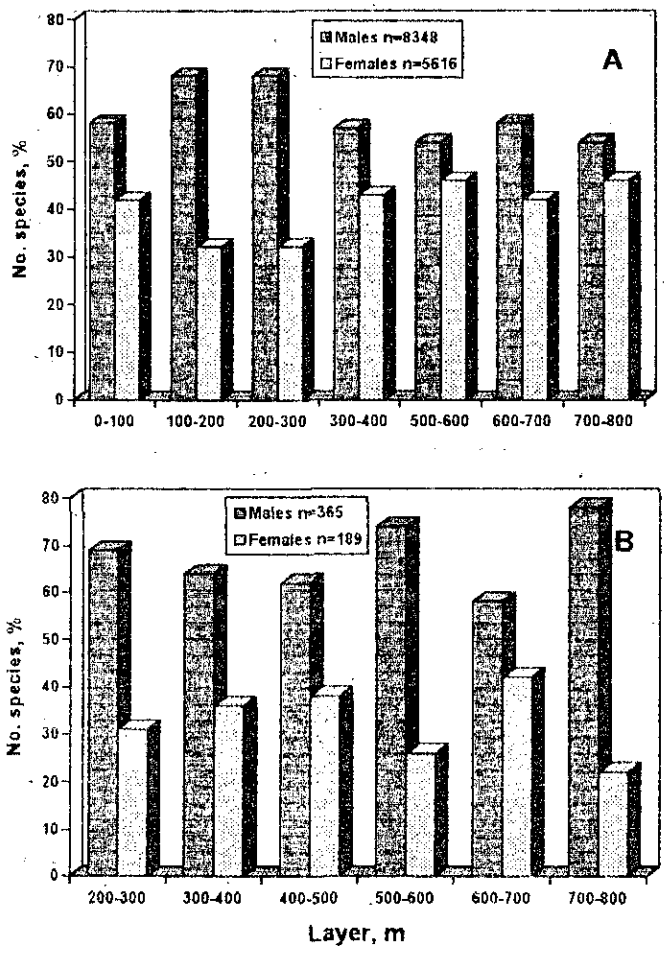

Figure 1. Percentage of males and females of the Irminger Sea deepwater redfish by 100-m depth range in 1995 (A), 1997 (B).

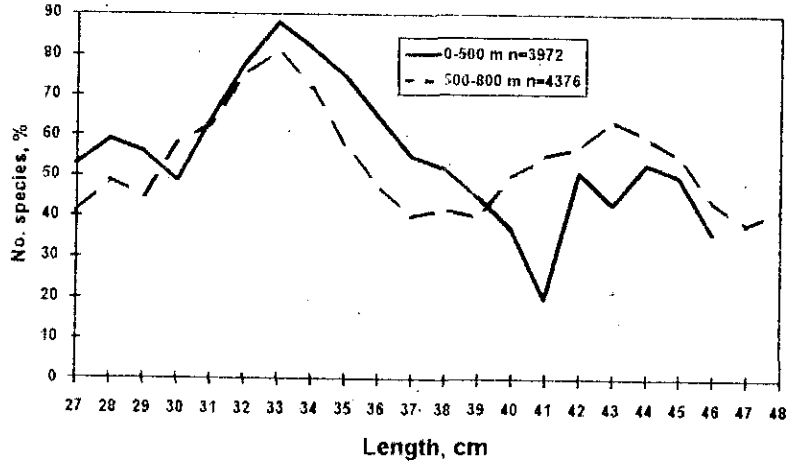

Figure 2. Percentage of males of the Irminger Sea deepwater redfish by size groups at 0-500 m, 500-800 m depths in 1995.

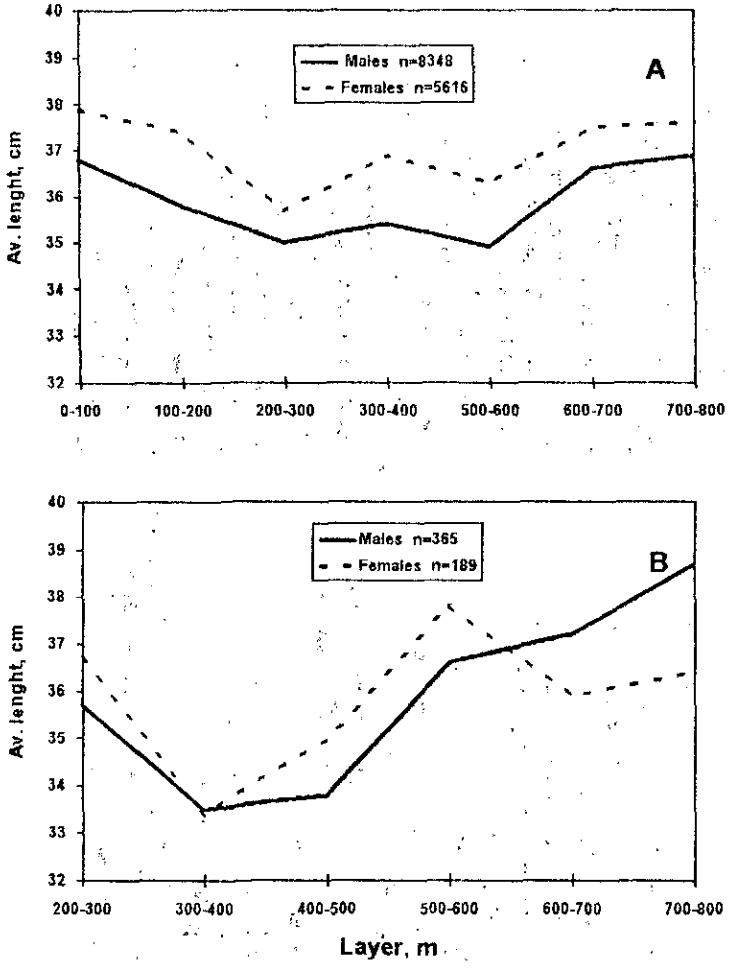

Figure 3. The mean length of males and females of the Irminger Sea deepwater redfish by 100-m depth range in 1995 (A), 1997 (B).

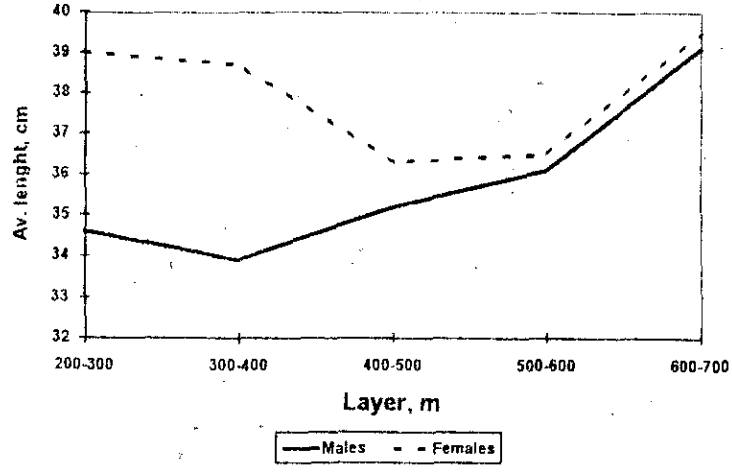

Figure 4. The mean length of males and females of North Newfaundland Bank (Div. 3K) redfish by 100-m depth range in 1958-1965 (Sydorenko, 1967).

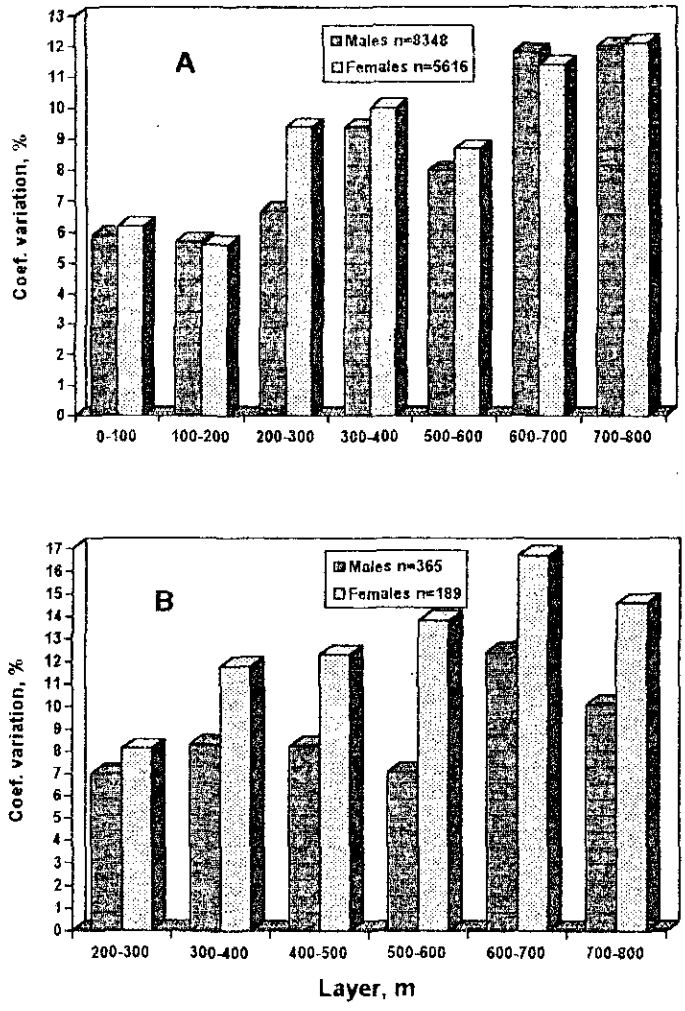

Figure 5. Variation coefficients of length in males and females of the Irminger Sea deepwater redfish by 100-m depth range in 1995 (A), 1997 (B).