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Results from Studies on Length and Weight Growth Rate in *Macrourus Berglax* and its Bathymetric Distribution off the Bear Island (the Norwegian Sea) and in the Northwest Atlantic

by

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ABSTRACT

Comparative data on age, length and weight growth rate, as well as on length-age composition of Macrourus berglax, caught off the Bear Island during fishery on Greenland halibut and in the Northwest Atlantic, are given in the paper.

Bottom trawl hauls were performed at 500-800m, grenadier bycatch did not exceed 5%. Mean length of males (52.7-54.1cm) and females (57.0-60.9cm) increased with a growth in fishing depth. Grenadier were aged by scale under polarized transmitted light.

Males 30-72cm long (mean length - 52.4cm) at age 6-18 and females 30-89cm long (mean length - 58.0cm) at age 6-22 occurred in catches. Length composition of males and females is similar to that of fish in the Flemish-Pass area and in the NAFO Divs. 3K, 3L and 3N. Length and weight growth rate in males and females of grenadier in the Bear Island area is lower compared to that of grenadier in the Northwest Atlantic.

MATERIALS AND METHODS

Bottom trawl hauls were done at 500-800m depth in the Norwegian Sea from late June to late August 1997 (78.5/37.6). Minimum mesh size in a codend was 125mm. The area of investigations during Cruise No.4 carried out by "Nerey" (MI-0352) was delimited by 73°30′ - 75°30′N along the continental slope westward the Bear Island (Fig.1).

To study the length composition of catches, grenadier were separately measured by sex from the snout to the end of tail within 1cm accuracy. Results from the fish length measurements were classified into 3cm-groups (30-32, 33-35, etc.).

Scale for ageing were taken from above the lateral line between the dorsal fins. Fish were aged under a polarized transmitted light. Annual rings were counted on lateral side of scale. Length and weight were averaged for each fish age group. Recalculating the length frequencies by the length-age keys, age composition of catches was derived. Inventory of the material analyzed is given in the tables and figures.

RESULTS AND DISCUSSION

Close by the Bear Island, where the investigations were carried out, grenadier occurred in trawl catches taken at 500-800m depth in minor quantity - from 2.4 to 4.7% (Table 1) that was undoubtedly related to a fishing depth. Greenland halibut constituted the bulk of catches, skate and redfish were registered as bycatch. It should be noted that the grenadier

bycatch taken at the same depth in the Flemish-Pass area was similar and increased to 24-25% at 1200-1400m depth (Gorchinsky, Savvatimsky, 1996). No hauls were made deeper than 800m at the Bear Island. With an increase in depths from 500 to 800m the mean length in males grew from 52.7 to 54.1cm and from 57.0 to 60.9cm in females (Table 2). Males 30-72cm long (mean length - 52.4cm) and females 30-89cm long (mean length - 58.0cm) occurred in catches. Length composition of grenadier males and females, given in Fig.1, is similar to that of catches from the Flemish-Pass area (Gorchinsky, Savvatimsky, 1996) and also from the NAFO Divs. 3K, 3L and 3N (Savvatimsky, 1989).

In April-May 1996, in Divs. 3L, 3M and 3N, grenadier were caught by long-lines to 2039m depth, with its mean length increasing in catches from 52.6cm at 700-800m to 58.7cm at maximum depth (Cardenas et al., 1996).

An opposite trend, i.e. a decrease in grenadier mean length with an increase in fishing depth, is noted by most investigators (Atkinson, Power, 1987; Parsons, 1975; 1976).
It is proved by our data for Div.3N where the mean length of fish in catches from 100-200m was 56.5cm and decreased to 44.0cm at 700-800m depth (Savvatimsky, 1989). Summarizing of most materials on vertical distribution of grenadier in Subareas 0, 1, 2, 3 for 1969-1989 has however shown the large specimens of males and females to be preponderant below 1000m (Savvatimsky, 1992). The same was noted during the long-lining of grenadier on the Grand Newfoundland Bank in 1982 (Savvatimsky, 1983, 1984). The mentioned above results from the investigations have indicated that large prespawning grenadier were distributed at low depth, small-size immature specimens - at 500-800m, and at the depth below 1200-1500 there were large foraging fish.

Increase in size at depth is also typical of other deep sea fish species, in particular, of roundnose grenadier (Atkinson, Power, 1987a; Savvatimsky, 1987) and Greenland halibut (Bowering, 1987; Cardenas et al., 1996; Gorchinsky, 1996; Gorchinsky, Savvatimsky, 1994). This is probably due to more efficient consumption of food by large fish at high depth.

By results from age determination, the age keys were separately obtained for males and females of grenadier from the Bear Island area (Tables 3 and 4), in which the mean length and weight of fish from each age group are shown. Fig.2 shows age composition of catches derived by these keys. Grenadier males at age 6-18 and females at age 6-22 occurred in catches. Males at age 12-13 and females at age 12-15 made up the bulk of catches. Length and weight growth rate for both males and females has occurred to be lower compared to the other areas of the North Atlantic, for instance, in the area of the Flemish-Pass (Gorchinsky, Savvatimsky, 1996), Baffin Land, Labrador and Newfoundland (Savvatimsky, 1994) (Figs. 3,4,5 and 6). Age sample from the area close to Bear Island is minor and the differences obtained in grenadier growth rate need to be proved by more representative data. If this is confirmed, the lower growth rate of grenadier from the Bear Island area probably results from more severe conditions of its habitat in the northeastern margin of the area.

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Table 1. Relative number of M. berglax in bottom catches on the Western slope of the Bear Island, Jun-Aug, 1997

Depth, m	Number of catches	Mean total catch, kg/h	Mean M. Berglax catch, kg/h	Mean M. Berglax catch, %
501-600	11	246.4	5.8	2.37
601-700	116	368.2	9.9	2.69
701-800	59	339.7	16.2	4.75
501-800	186	352.0	11.6	3.31

Table 2. Mean length of males and females of M. berglax on the Western slope of the Bear Island, Jun-Aug, 1997

Depth, m	Males		Females		Total	
	mean length, cm	number of specimens	mean length, cm	number of specimens	mean length, cm	number of specimens
501-600	52.7	52	57.0	86	55.4	138
601-700	50.2	207	54.5	199	52.3	406
701-800	54.1	272	60.9	267	57.5	539
501-800	52.4	531	58.0	552	55.3	1083

Table 3. Age-length key of M.berglax males on the Western slope of the Bear Island. July, 1997.

L\A	6	7	8	9	10	11	12	13	14	15	16	17	18	NN	W, g
30	1	1												2	140.0
33		1	2											3	173.3
36				3										3	236.7
39				1										1	285.0
42					1									1	410.0
45					1	3	4			1				9	511.1
48							4	2	1					7	622.9
51							1	2	1	1	2			7	788.6
54							2		2	2	1	1		8	870.0
57							2	2			1			5	1033.0
60									2	3			1	6	1195.0
63										1	2			3	1221.7
66												1		1	1340.0
NN	1	2	2	4	2	3	13	6	6	8	6	2	1	56	
W, g	140.0	150.0	180.0	248.8	475.0	501.7	684.2	769.2	910.8	958.8	1076.7	1165.0	1300.0	56	731.9
L, cm	32.00	32.50	34.00	37.75	44.50	46.33	50.23	52.67	55.83	56.38	57.33	61.00	62.00	56	50.5

Table 4. Age-length key of M. berglax females on the Western slope of the Bear Island in July, 1997.

L\A	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	NN	W, g
30	2	1	1															4	126.3
33		2	1															3	178.3
36			2	1	1													4	236.3
39																		0	0.0
42							1											1	480.0
45					1	3	3											7	529.3
48							2	1	1									4	585.0
51							1	1	1									3	793.3
54							2	1	1		1							5	870.0
57								1	1	2	1		1					6	1115.0
60								1		1								2	1237.5
63								1	2	1	2	2	2					10	1460.5
66												2	1					3	2021.7
69												1	2					3	2151.7
72											1	1	1	1				4	2485.0
75												2	1					3	2866.7
78													1		1	1		3	3101.7
81																		0	0.0
84																1		1	4000.0
87																		0	0.0
90																	1	1	4450.0
NN	2	3	4	1	2	3	9	6	6	4	5	8	9	1	1	2	1	67	
W, g	112.5	176.7	178.8	255.0	350.0	490.0	657.8	981.7	1052.5	1153.8	1433.0	2096.3	2214.4	2530.0	3185.0	3580.0	4450.0	67	1310.8
L, cm	30.50	32.67	34.50	38.00	41.00	45.67	49.33	56.67	57.00	59.75	62.20	69.88	69.33	73.00	79.00	82.00	91.00	67	57.0

Table 5. Length frequency converted to age-length key of M. berglax males on the Western slope of the Bear Island in July, 1997.

L\A	6	7	8	9	10	11	12	13	14	15	16	17	18	NN	W, g
30	2	2												4	140.0
33		1	3											4	173.3
36				9										9	236.7
39				8										8	285.0
42					17									17	410.0
45					6	19	26			6				58	511.1
48							53	27	13					93	622.9
51							15	30	15	15	30			106	788.6
54							23		23	23	12	12		93	870.0
57							34	34			17			84	1033.0
60									11	17			6	33	1195.0
63										6	12			18	1221.7
66												3		3	1340.0
NN	2	3	3	17	23	19	151	90	63	67	71	15	6	530	
%	0.4	0.6	0.5	3.2	4.4	3.6	28.5	17.1	11.8	12.7	13.3	2.8	1.0	100.0	

Table 6. Length frequency converted to age-length key of M. berglax females on the Western slope of the Bear Island in July, 1997.

L\A	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	NN	W, g
30	3	1	1															5	126.3
33		5	2															7	178.3
36			2	1	1													3	236.3
39																		0	0.0
42							11											11	480.0
45					5	14	14											33	529.3
48							25	13	13									50	585.0
51							22	22	22									65	793.3
54							26	13	13		13							65	870.0
57								15	15	30	15		15					90	1115.0
60								32		32								63	1237.5
63								6	11	6	11	11	11					56	1460.5
66												22	11					33	2021.7
69												7	13					20	2151.7
72											6	6	6	6				23	2485.0
75												7	3					10	2866.7
78													3		3	3		8	3101.7
81																		0	0.0
84																2		2	4000.0
87																		0	0.0
90																	1	1	4450.0
NN	3	6	5	1	5	14	98	99	73	67	45	52	62	6	3	5	1	545	
%	0.5	1.1	0.9	0.1	1.0	2.6	17.9	18.2	13.5	12.3	8.2	9.6	11.4	1.1	0.5	0.9	0.2	100	

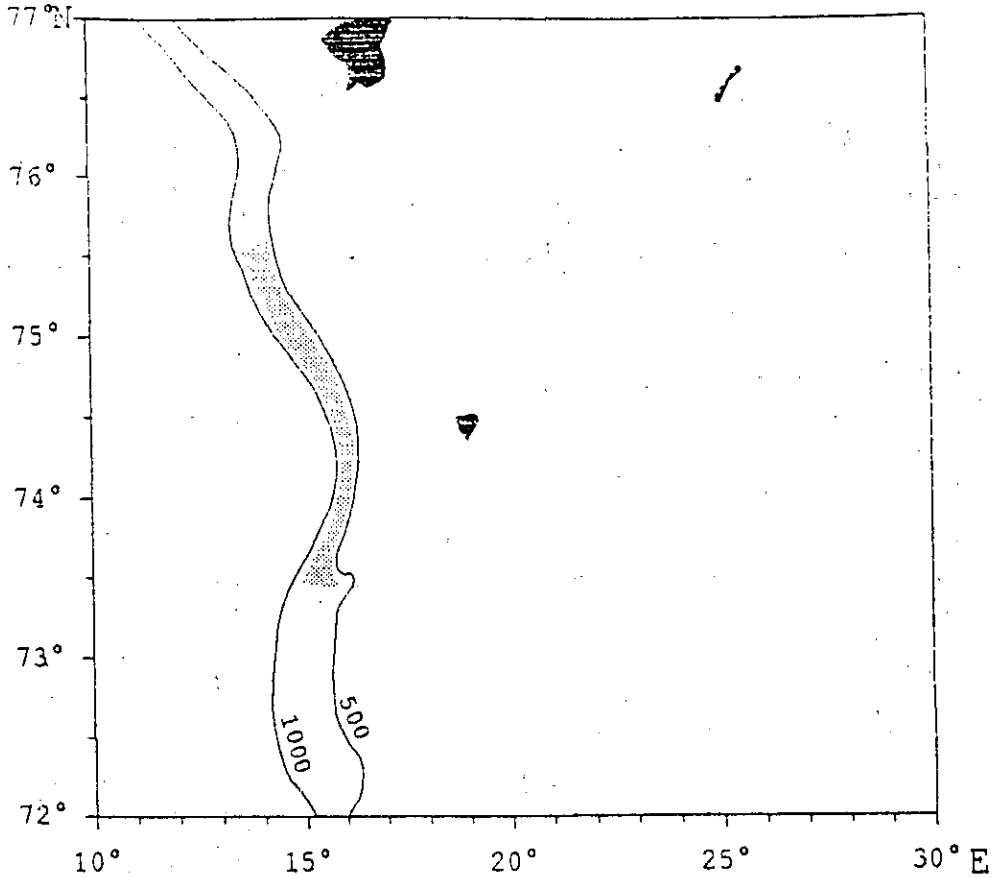

Fig. 1. M. berglax sampling area in June-August 1997.

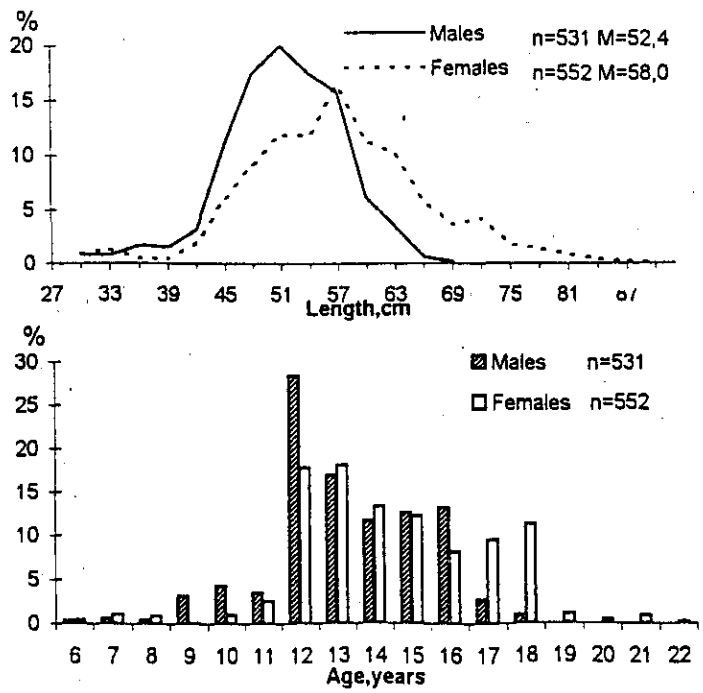

Fig. 2. Length and age composition of M. berglax on the Western slope of the Bear Island, Jun-Aug, 1997

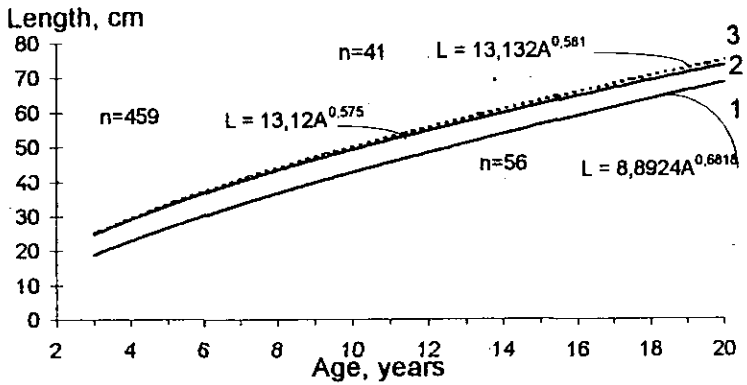

Fig. 3. Linear growth of M. berglax males from the Western slope of Bear Island (1), Divs. 0B, 2GH, 3K (2), Northern Flemish-Pass (3)

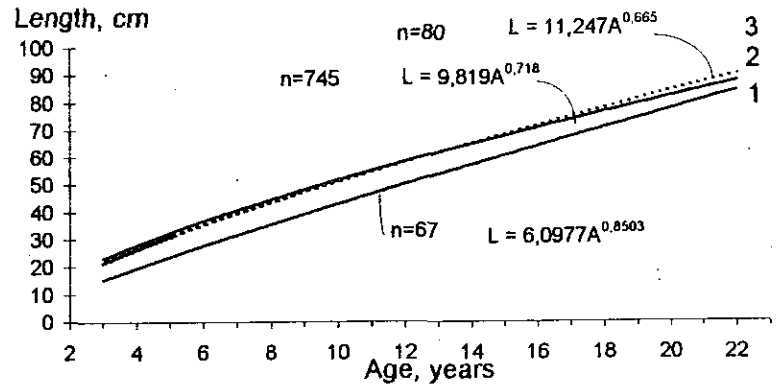

Fig. 5. Linear growth of M. berglax females from the Western slope of Bear Island (1), Divs. 0B, 2GH, 3K (2), Northern Flemish-Pass (3)

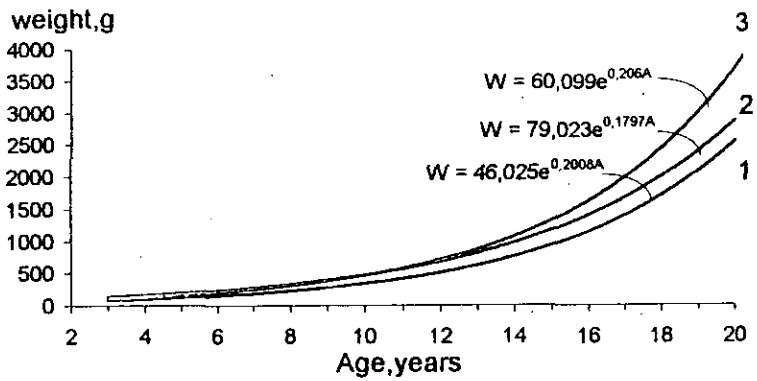

Fig. 4. Growth in weight of M. berglax males from the Western slope of Bear Island (1), Divs. 0B, 2GH, 3K (2), Northern Flemish-Pass (3)

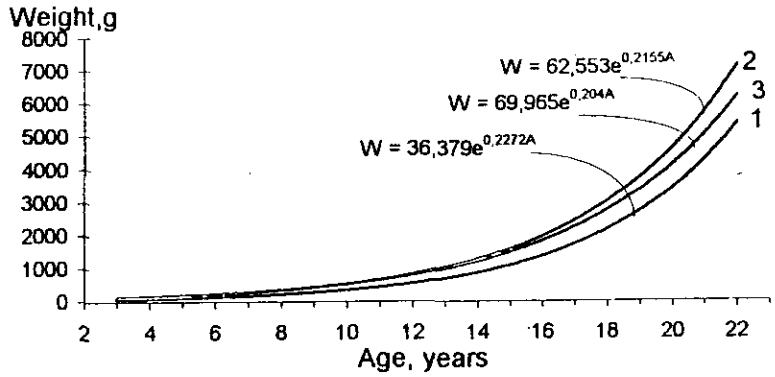

Fig. 6. Growth in weight of M. berglax females from the Western slope of Bear Island (1), Divs. 0B, 2GH, 3K (2), Northern Flemish-Pass (3)