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Distribution, Biological Characteristics and Percentage of Roughhead Grenadier in the Catches from the Grand Newfoundland Area in May-July 1982

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Abstract

The distribution of roughhead grenadier in the North Atlantic, their relative abundance, length and sex composition in the catches taken by long-lines from different depths in the Newfoundland area in May-July 1982 are given. The highest catches of roughhead grenadier were taken at 400-500 m of depth, while lower ones were recorded deeper, females being prevalent. Bottom organisms are the primary food object; food composition changes with growth of fish. In the northward areas fatness of roughhead grenadier is higher than in the southward ones.Notable fluctuations of weight and fatness under the same length and age of fish were observed. A long life cycle, many-aged population structure and late maturation are typical of roughhead grenadier.

Introduction

Roughhead grenadier, <u>Macrourus berglax</u> Lacépède 1802, are distributed off the North America coast from New York to the Davis Strait, in the Baffin Bay, along the continental slope of the West and East Greenland, off Iceland, at the north-western coast of Norway eastwards to Murman. Northwards they are distributed on the continental slope along the western boundary of the Barents Sea as far as 82°10'N. They were also found between the Northeast Land and Franz Josef Land in the deeps of the shelf. As to the Newfoundland area, roughhead grenadier are abundant on the continental

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slopes 400-800 m deep and show promise as to their commercial value, though not forming dense commercial concentrations. The by-catches of roughhead grenadier taken during bottomtrawl fishing for halibut, redfish or cod often involve tens or hundreds of specimens. The catches of this fish taken by large commercial ships seldom amount to some tons per haul. The French research vessel "Thalassa" caught 540 kg of roughhead grenadier per 0.5 hour of trawling in the Northwest Atlantic (Maucorps, Fontaine, 1979), Parsons (MS 1975, 1976) points out that the highest catches of roughhead grenadier were taken by research vessels at comparatively small depths (up to 500 m) along the eastern and western slopes of the Grand Newfoundland Bank, in Divs. 3L and 3N. Long-line fishery for roughhead grenadier may be considered promising as is proved by the experiments carried out at the coasts of Norway, Great Britain (Bakken et al., MS 1975) and Iceland (Magnússon, MS 1978), as well as by the materials of this paper. Despite numerous catches of roughhead grenadier, they are seldom used for food or fish meal because of very stiff and thick scales.

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Many aspects of roughhead grenadier mode of life have not yet been studied until now. The data from literature are fragmentary and incomplete. The paper aims at analysing the peculiarities of the roughhead grenadier biology ponderable for organization of rational fishery.

Material and methods

The material was collected from the catches taken by bottom-set long-lines "Albatros" from the medium refrigerator trawler SRTM-1257 "Langust" in the area of the Grand Newfoundland and Flemish Cap banks from 26 May to 28 July 1982 (Fig. 1). Small pieces of squid were used as a bait most frequently, while fish - grenadier, cod, wolffish, hake, skates - were utilized more rarely. The bait was plunged to 310-1 000 m; 3 sets of the long-line out of 20 ones were below 700 m. The catches were analysed as to their length, age and sex composition, food composition, relative weight of liver (fatness) and maturity. Fish maturity was determined by 6 - point scale developed by Sorokin for cod (Sorokin, 1957, 1960). The degree of stomach fullness was determined visually by 5 - point scale (0 - empty, 1 - low fullness, 2 - average fullness, 3 - full stomach, 4 - streched stomach).

Roughhead grenadier were measured from the tip of the snout to the end of the tail accurate within 1 cm. In some cases fish were joined in 3-cm length groups (Fig. 4) or in 10-cm length groups (Table 7) to facilitate statistical analysis. Hauls were made within the ranges of 100 m (Table 2). Fish were weighed accurate within 10 g, the liver - within 5 g. While calculating the percentage by fish length the sum of males and females was taken for 100%.

Annual rings on roughhead grenadier otoliths become distinct only after special treatment (Savvatimsky et al., 1977). On this account the age was determined by scales and with the use of polarized light (Savvatimsky, 1971). Annual rings were counted on the lateral side of the scales taken in the region between dorsal fins just above the lateral line. Average length and weight were determined for fish of each age group. Yearly length and weight increments were calculated as the difference between the estimated length and weight of fish from two adjoining year classes.

The relation between the length and weight of roughhead grenadier is charted by average values used for determining the coefficients for the formula $W = aL^b$, where W - weight of fish in grams, L - length in cm. Length frequencies (Fig. 2) and fatness curves (Fig. 4) are smoothed. Smoothing of length frequencies was performed by the formula $B = \frac{a + 2b + c}{4}$, where a, b, c - preceding, medium and subsequent members of the frequency, B - the calculated one. In the text, tables and figures the investigated areas are named after NAFO designation.

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Results

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Long-line fishery was carried out mainly in the south of Divs. 3L and 3N, here the highest catches (more than 100 spec. per one thousand of hooks) of roughhead grenadier were taken (Fig. 1). Composition of catches is rather vari able - 16 fish species. The bulk of catches by weight is composed of roughhead grenadier, thorny skate, Northern wolffish and Atlantic halibut, and by number - of roughhead grenadier and thorny skate (Table 1). The by-catch low by number (3.7%) and weight (4.3%) was composed of <u>Gadus morhua</u> Linnaeus, <u>Anarbichas minor</u> Olafsen, <u>Raja laevis</u> Mitchill, <u>Sebastes mentella</u> Travin, <u>Brosme brosme</u> (Müller), <u>Macrozoarces</u> <u>americanus</u> (Bloch and Schneider), <u>Antimora rostrata</u> Günther, <u>Hydrolagus affinis</u> (Capello), <u>Centroscillium fabricii</u> (Reinhardt).

On the average 34.7 spec. of roughhead grenadier per one thousand of hooks were caught for one laying (out of 20) of the long-line, the average weight of one specimen being 1,405 g. The greatest amount (averaging 64.67 spec.) of roughhead grenadier per one thousand of hooks was taken at 400 -500 m of depth (Table 2).

The number of grenadier caught decreases under the increasing depth of fishing. The amount of Greenland halibut and Northern wolffish in the catches from all depths was about the same, whereas the highest amount of skates was taken from the depth of 300-500 m. In this paper the biological characteristics of roughhead grenadier alone are given.

The difference in length and sex composition of the roughhead grenadier catches from various depths was observed. The average length and weight of roughhead grenadier at the depth ranging from 300 to 700 m were about the same. (length 61.94 cm, weight 1,390). Below 700 m grenadier specimens were larger, almost all of them being females (Table 3). At 300-700 m of depth immature females amounted to 62.9%. and at 800-1000 m they totalled 41%, and the rest were maturing (gonad maturity stage III) and post-spawning (VI-II). Out of 966 measured specimens males amounted only to 6.2% and were much smaller than females (Table 4).

In Divs. 3N and 30 fish were somewhat larger than in northward Divisions. Thus, the average length of females in Divs. 3N and 30 was 64.7 cm, and that in Divs. 3L and 3M - 61.1 cm. However, the distribution pattern of the relative amount both of males and females by length is similar in these two areas (Fig. 2) enabling to assume existance of a single population of roughhead grenadier in the survey area.

No difference in the weight of males and females of the same length was detected in Divs. 3L, 3M, 3N, 3O (43 males and 495 females were weighed). The correlation between the grenadier length and weight is shown in Fig. 3 illustrating notable fluctuations in the weight of fish under the same length and their increase following the growth of fish length.

In Div. 3N there was a higher amount of maturing and post-spawning females (gonad maturity stages III and VI-II). Immature females (maturity stage II) in the catches amounted to 61% in Div.3L and 36.2% in Div.3N (Table 5).

Apparently, southern and south-eastern slopes of the Grand Newfoundland Bank are the area of roughhead grenadier reproduction.

As Table 5 demonstrates, maturing and post-spawning females in Div. 3N were on the average larger than in northward Divisions. No fish ready to spawn were found. Spawning most likely occurs in winter and early spring as observed with roughhead grenadier off Iceland (Magnússon, MS 1977). In the Lofoten area they would spawn at that time as well.

In roughhead grenadier, as in other grenadiers, fat accumulates in the liver. The content of fat in fish may be judged of by the relative weight of the liver, as meat contains less than 1% of fat. The ratio of liver weight to total weight of fish, as percentage, is conventionally called fatness. 43 males and 495 females of roughhead grenadier were analysed for fatness. The average length of males was 49.5 cm, their weight - 645 g, those of females - 63.7 cm and 1,557 g, respectively. The average fatness of males was 11.3%, that of females - 7.3% (Table 6), fatness of males being on the average 2% as high as that of females of the same length group.

The average fatness of males and females of roughhead grenadier in Divs. 3L, 3 M was higher than in Divs.3N and 30, this difference remaining for fish of the same length groups (Fig. 4). In the northern and southern parts of the survey area fatness of females declines to 6.5% on the average depending on their length increase from 39 to 70 cm, and it approaches 10% for females 80-89 cm long. Individual fluctuations of fatness are rather significant. For example, fatness of females 66-68 cm long ranged from 2% to 21% testifying to different physiological state of fish.

Basing on scanty scientific data roughhead grenadier may be assigned to bottom benthophage and predatory fish. Out of 495 females taken with the long-line in the Newfoundland area 32.3% of fish were with empty stomachs, 38.2% - with turned out stomachs. No males with stomachs containing food were found. Stomachs of 146 female individuals were with food, however, we have all grounds to suppose that food was partially ejected out of stomachs while the catch being taken up. The average degree of female stomach fullness was 0.72. It is quite probable that this value is underestimated by the above reason.

It was cleared out that small, mainly immature, and large (post-spawning) remales have the average degree of stomach rullness higher than those of the average length (Table '/), which correlates with fatness variation in fish of different length.

Food composition of roughnead grenadier is diverse. Bivalve molluscs (13.4% by occurrence), shrimp (12.4%), fish (11.1%)

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and small starfishes (10.5%) were found in fish stomachs more often than other food components. Such large and stiff food objects as shrimp, sea cucumbers and fish are more accessible to large fish, whereas polychaetes, amphipods, small star fishes - to small ones. There are almost no fish in the diet of small grenadier, while those in the diet of large grenadier amount to 14-16%, skates and redfish unfitted for swallowing being consumed.

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It is rather difficult to determine the age of Atlantic grenadiers including roughhead grenadier by usual methods of microscopy applicable to fish from upper layers of the ocean because annual rings on the scales and otoliths are almost invisible. Rings on the scale of roughhead grenadier become distinct in the polarized transmitted light, but it should be mentioned that very often the annulus is composed of two rings situated close to each other, one of which is, as a rule, narrower than the other. This should be taken into account while counting the annuli and determining the age of fish.

Only fragmentary data on roughhead grenadier are available. Some females 67-89 cm long caught off Iceland in 1967 were 17-25 years old (Savvatimsky, 1971). As Yanulov reported (1962), a female of roughhead grenadier caught at the northern coast of Norway was 16 years old with the length of 70.5 cm. Applying the complicated method of scale impregnation with silver, Kosswig (MS 1979) determined the age of a small amount of roughhead grenadier taken by commercial ships on the Dohrn Bank off East Greenland. Fish 41-86 cm long 8-18 years of age were abundant in the catches, specimens 62-75 cm long aged 12-15 prevailing. Unfortunately, Kosswig did not separate fish by sex, which prevented from finding the difference in growth rates of males and females, whereas Yanulov did not indicate methods of age determination of roughhead grenadier. Nevertheless, basing on the results of their investigations it may be stated that the growth of roughhead grenadier in the Northeast Atlantic is similar to that in the Newfoundland

area. Fish 36-87 cm long taken by long-lines in this area in 1982 were 6-23 years old. The age of 29 males (average length - 48.6 cm, weight - 610.3 g, age - 9.3 years) and 312 females (average length - 64.6 cm, weight - 1,629.3 g, age - 13.3 years) was determined.

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In order to determine the difference in growth of males and females, the length and weight of fish of the same age groups - from 7 to 13 years - were compared. Males were proved to grow much slower than females, i.e. they have smaller length and weight at the same age. Thus, for instance, at an age of 10 males are 51.0 cm long with a weight of 667 g, and females are 54.1 cm long with a weight of 1,100 g, this difference increasing with fish growth (Table 8).

The amount of aged males is insufficient to clarify the linear and weight growth rates. These parameters were estimated for females, the linear and weight growth of which was calculated by the formula $y = ax^{b}$. The coefficients are given in Fig.5. Fisher's ratio test showed that the estimated values are in a good correlation with empiric ones (the estimated F of 113.1 for the linear growth and the estimated F of 258.9 for the weight growth are higher than the table value F = 2.05 at the significance level of 0.05). At an age of 15 a yearly length increment of females is 2.7 cm, a weight increment - 230 g. Length increments decrease while weight increments increase with age. At an age of more than 20 years length of females grows by 2.3 cm a year on the average, their weight - by 320 g.

Individual fluctuations in length and weight of females at a certain age are notable. Thus, at an age of 25 fish were 65-76 cm long with a weight of 1,560-2,540 g. The range of these parameters expands with fish growth (Fig. 5). This seems to be important for fish adaptation as it widens the food spectrum and, consequently, the nutritive base of year classes. Maturation and start of spawning of fish within the same year class occur at different age promoting regular recruitment.

Basing on length frequencies converted to age determination the average age of males was estimated to be 10.1 years, that of females - 12.9 years. The bulk of catches was composed of males aged 10 (23.3% of the total amount of males) and of females aged 10-12 (40.6% of the total amount of females, Table 9).

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Thus, low rates of linear and weight growth and a long life cycle are typical of roughhead grenadier as well as of other Atlantic grenadiers. The commercial part of the population includes a great number of year classes. The bulk of long-line catches is composed of fish of older age groups spawned more than once, that is why the long-line fishery is most reasonable for preserving the recruitment and reproductive part of the population.

Conclusion

Roughhead grenadier is a widely distributed and abundant deep water species of the North Atlantic, showing promise as to their commercial value. Two types of fishery - bottom trawl and bottom-set long-lining are employed. In the Newfoundland area roughhead grenadier amount to 65.8% by number and 48.5% by weight of the total catch taken by long-lines. Fish in longline catches are much larger than in trawl ones which affects the variety and value of fish production. Long-lining is the most reasonable type of fishery for preserving the recruitment and reproductive part of roughhead grenadier population.

In the Newfoundland area the highest concentrations of roughhead grenadier are observed 400-500 m deep. Smaller fish dwell less deep, whereas large fish, females on the main, are concentrated at depths above 500 m. Southern and south-eastern slopes of the Grand Newfoundland Bank are supposed to be the area of roughhead grenadier reproduction.

Bivalve mclluscs, shrimp, fish, starfishes are the primary food object of roughhead grenadier. Food composition varies with fish length growth. Notable fluctuations of length and weight of roughhead grenadier at the same age seem to be important for fish adaptation promoting the increase of nutritive base and its fuller utilizing.

Males have higher fatness than females. The average fatness of roughhead grenadier of the same length is higher in Divs. 3L and 3M as compared with Divs. 3N and 30. Notable individual fluctuations of weight and fatness at the same length are typical of roughhead grenadier.

Like other Atlantic grenadiers, roughhead grenadier have a long life cycle, many-aged population structure and late maturation, that is why they may be damaged by intensive fishery to a greater extent than many other fishes.

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Table 1 Composition of long-line catches from the area of the Grand Newfoundland bank 26 May to 28 July 1982 (per one thousand of hooks on the average)

Species	Number	~~ ~~ ~~ 0/ /0	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
	1995 ANN 2995 ANN	900 0000 0000	0 <u>-</u>	يم مدير دي مدير مر مدير دي مدير
Macrourus berglax Lacépède, 1802	35,7	65,8	48,5	27,8
Thorny skate <u>Raja radiata</u> Donovan, 1807	I0,8	I9,8	45,3	26,0
Atlantic halibut Hippoglossus hippoglossus (Linneaus, 1758)	I,4	2,5	38,4	22,0
Northern wolffish <u>Anarhichas</u> <u>denticulatus</u> Krøyer, 18	84 2,3	4,2	25,I	I4,3
White hake <u>Urophycis</u> <u>tenuis</u> (Mitchill, 1815)	0,5	I ,0	5,4	3,0
Greenland halibut Reinhardtius hippoglossoides (Walbaum, 1792)	I,6	3,0	4,6	2,6
Other species	2,0	3,7	7,5	4,3
Total	54,3	100,0	I74,8	I00,0

Table 2 Average number of spec. per one thousand of hooks (numerator) and average weight of one spec. in grams (denominator) from long-line catches taken at different depths in the area of the Grand Newfoundland Bank in 1982

Snecies	میں تینے معنی مغیر 0 0 10	Depth, m											
	300-40	0.400-500	500-600	600-700	700-800	800-900	900-1000						
Roughhead	<u>34,83</u>	<u>64,67</u>	<u>19,00</u>	<u>II,50</u>	<u>6,00</u>	<u>7,00</u>	<u>4,00</u>						
grenadier	1352	I346	1420	I325	I590	1840	1830						
Thorny	<u>19,75</u>	<u>12,67</u>	<u>I,I3</u>	<u>7,00</u>	<u>4,00</u>	<u>0,40</u>							
skate	4117	4381	3685	3634	6080	5200							
Atlantic	<u>0,16</u>	<u>2,00</u>	<u>0,80</u>	<u>3,50</u>	<u>5,00</u>	<u>I,00</u>							
halibut	51300	27092	20312	37940	24800	4I940							
Northern	<u>3,83</u>	<u>2,83</u>	<u>3,13</u>	<u>3,00</u>	<u>6,00</u>	<u>2,00</u>	<u>1,00</u>						
wolffish	15633	10687	II473	I4I20	I2380	17638	10150						
White hake			<u>3,33</u> IOO86	0,50 7650	-	1	· · · · · · · · · · · · · · · · · · ·						
Greenland	<u>2,67</u>	<u>I,83</u>	<u>I.33</u>	<u>4,00</u>	<u>1,00</u>	<u>5,00</u>	<u>2,00</u>						
halibut	1313	2028	3850	2867	4150	4253	4060						
Number of layings	6	6	3	2	I	I	I						

Table 3 Average length of roughhead grenadier and relative amount of females in long-line catches taken at different depths in the Newfoundland area in May-July 1982

אנה את את עודה היות	متير متن بور ميد مرير متين مور			
Depth of fishing, m	Average let of females,	ngth Average we cm of female g	ightAmount of s, females, %	Amount of females, spec.
300-700	61,9	I 3 90	93,7	931
700-1000	68,2	I799	97,I	35

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	and the second			
Divisions	Sex A	verage ength, cm	: Amount of : fish, spec.	: Amount of : fish, %
3L, 3M	Males	49,3	38	8,2
	Females	6I,I	425	9I,8
محجر فتبر تعد معر مجرد	Males and females	60,I	463	I00,0
3N, 30	Males	50,7	22	4,4
	Females	64,7	48I	95,6
فقهر فكبر فكبر محمر معن	Males and females	64,I	503	I00,0
3L, 3M	Males	49,8	60	6,2
ar an An Artain	Females	63,0	906	93,8
•	Males and females	62,2	966	I00,0

Table 4 Average length and amount of males and females of roughhead grenadier in long-line catches in Divs. 3L, 3M, 3N and 30 in 1982 Table 5 Characteristics of roughhead grenadier females of different maturity in long-line catches in Divs. 3L, 3M, 3N, 30 in 1982

Divs.	Average maturity	: Average : length, : cm	Average weight, g	Average fatness, %	Amount of fish, spec.	Amount fish,	of %
3L, 3M	Π Ш УІ-Π Total	54,9 66,8 70,9 6I,0	935 1615 2063 1358	8,I 7,9 7,6 7,8	I82 I2 I05 299	60,9 4,0 35,I I00,0	مبجر جازر
3N, 30	Π Ψ УΙ-Π Total	55,I 69,9 75,4 67,8	918 1870 2448 1864	6,8 5,3 6,9 6,8	71 10 115 196	36,2 5,1 58,7 I00,0	
3L, 3M, 3N, 30	П Ш УІ-П Total	55,0 68,2 73,2 63,7	93I 173I 2264 1559	7,7 6,6 7,2 7,3	253 22 220 495	5I,I 4,4 44,5 IOO,O	

Table	6	Lengt	h,	weigh	t and	d f	atness	of	roughhead	grenad	ier
		males a	nd	femal	es f	rom	long-1	line	catches	in	
		Divs.	3L,	3M,	3N,	30	in May-	-Jul	y 1982		

Sex	Divs		Lengt	h of f	ish, cm	Weig	ght of	fish,g:	Fatness,	**** <i>~**</i> ******************************	Amount
-	9 9 9 9	•	min.	max.	avera	remin	max.	averagé	minimay	c. avera	ge fish
Males	3L, 3N,	3M 30	41 46	56 58	49,I 50,8	370 430	960 II20	629 699	4,8 24 7,0 IS	4,3 II,4 9,6 II,I	33 IO
	3L, 3N,	3M 30	4I	58	49,5	370	II20	645	4,8 24	4,3 II,3	43
Female	98 3L 3N,	,31 31	M 36 0 42	82 87	6I,0 67,8	260 340	3I60 4060	1355 1864	2,0 23 I,7 23	3,5 7,8 3,5 6,8	8 299 8 196
	3L, 3N,	31 31	M, 0 36	87	63,7	260	4060	I557	I,7 23	3,5 7,3	495

Table 7 Frequency of occurrence (in % of total amount of stomachs including empty) of different food components in stomachs of roughhead grenadier females from long-line catches in Divs. 3L, 3M, 3N, 30 in May-July 1982

Food composition	Length of females, cm :4I-50:5I-60:6I-70:7I-80 :8I-90:4I-90										
Molluscs	2I,9	I2,2	3,9	I6,5	35,7	13,4					
Shrimp	9,4	6,5	6,5	25,3	2I,4	I2,4					
Starfishes	I2,5	I4,0	7,8	7,6	7,I	10,5					
Digested fish		7,5	I4,3	I6,4	I4,3	II,I					
Digested food	1	4,7	9,I	8,9	I4,3	6,9					
Polychaetes	9,4	4,7	3,9	2,5		4,2					
Sea cucumbers				3,8		0,I					
Detritus	3,I	I,9	- 1000	I,3		I,3					
Amphipods Crabs		0,9 0,9	I,3 -	,	enst.	0,6 0.3					
Sea-urchins			I.3	·		0.3					
Grenadier	-	-	_	I,3	_	0,3					
Sand eel		·	I,3			0,3					
Skate		-	-	I,3	-	0,3					
Redfish	-	-	an an Maria		7,I	0,3					
Average degree of stomach fullness	0,75	0,58	3 0,6I	I,04	I,36	0,72					
Number of stomachs containing food	14	42	33	50	II	I 46					
Number of empty stomachs	I 9	65	44	29	3	I 60					

Table 8

Longth and weight of roughhead grenadier males (numerator) and females (denominator) at different age from long-line catches in the area of the Grand Newfoundland Bank in May-July 1982

· · ·		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1						
Age	یہ دیرے میں جی میں میں •	Length, cn	· · · · · · · · · · · · · · · · · · ·	Wei	ght, g		Amount of	
	i min.	i max.	average	min.	max.	average	fish	
7	<u>41,0</u> 43,0	<u>45,0</u> 45,0	<u>42,8</u> 44,0	<u>370</u> 340	<u>500</u> 580	<u>424</u> 460	7	
8	<u>46,0</u> 43,0	<u>48,0</u> 51,0	<u>46,6</u> 47,6	<u>380</u> 320	<u>540</u> 720	<u>472</u> 554	5 I4	
9	<u>47,0</u> 45,0	<u>51,0</u> 50,0	<u>48,7</u> 49,6	<u>470</u> 460	7 <u>40</u> 910	<u>583</u> 666	6 20	
IO	<u>49,0</u> 50,0	<u>53,0</u> 59,0	<u>51,0</u> 54,1	<u>600</u> 640	<u>730</u> 1100	<u>667</u> 819	<u>6</u> 33	
II	<u>49,0</u> 51,0	<u>52,0</u> 64,0	<u>50,3</u> 57,I	<u>610</u> 660	<u>840</u> 1350	<u>717</u> 985	<u>4</u> 30	
12	<u>51,0</u> 53,0	<u>54 0</u> 68,0	<u>52,5</u> 60,2	770 740	<u>960</u> 1710	<u>865</u> II96	<u>2</u> 34	
13	<u>58,0</u> 58,0	<u>58,0</u> 70,0	<u>58,0</u> 65,3	<u>1120</u> · 960	<u>1120</u> 1970	<u>1120</u> 1510	<u> </u>	

Table 9 Age composition of roughhead grenadier from

long-line	catches	in	the	area	of	the	Grand	Newfoundland
Bank in l	May-July	198	32		· · ·			

Age	یو دیرو همو مدید میرد ۹ ۹	Males	هي ري في مي من مخه م	نتیس فتریم دیس تریم 0 0	Females	فللمر سور الارد طرير للون
	Average length, cm	Amount of fish, spec.	Amount of 'fish, %	Average length, cm	Amount of fish, spec.	Amount : of fish, : %
6	-			40,0	2	0,2
7	43,0	7	II,7	48,2	I2	I,3
8	46,6	IO	16,7	48,0	36	4,0
9	49,0	9	I5,0	50,4	62	6,8
IO	5I,2	I4	23,3	54,3	I24	I3,7
II	50,7	9	15,0	57,4	II7	I3,0
I2	54,4	9	15,0	59,9	126	I3,9
I 3	58,0	2	3,3	65 , I	7I	7,8
I4		-	-	67,5	73	8,I
I5	· ·	-	1. 1.	70,0	66	7,3
I6	-	-	 .	72,4	69	7,6
17		· · · · · ·	2	74,9	51	5,6
18	-		на страна на страна на на страна на страна на на на на на на на на на на на на	76,6	38	4,2
I 9	-	-	· -	78,8	38	4,2
20	-	. —	- ⁻	0,I8	II	I,2
21	-	-	-	80,8	7	0,8
22			—	83,5	2	0,2
23			-	88,0	I	0,I
Tota	1 49,8	60	I00,0	63,0	906	I00,0



Fig. 1. Distribution of long-line catches of roughhead grenadier in the Newfoundland area in May-July 1982 (number of spec. per one thousand of hooks).



Length (cm)



Fig. 2. Length composition of males (solid line) and females (broken line) of roughhead grenadier in long-line catches from Divs. 3L, 3M, 3N, 30 in May-July 1982 (by smoothed frequencies).



Fig. 3. Relation between length and weight of roughhead grenadier from long-line catches in the Newfoundland area in May-July 1982 (males and females).









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