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Variability in Morphometric and Meristic Features of the Roundnose Grenadier (*Coryphaenoides rupestris*), Related to its Linear Growth

by

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Abstract

This paper considers a possibility of a morphologic analysis application in studying the local populations of roundnose grenadier. Variability of 16 morphometric and 8 meristic features depending on length of fish and length of its head is analyzed. It is determined that all the plastic features of fish vary greatly, and also that there exists a difference in plastic features and in number of pyloric caeca in males and females. A change of plastic features occurs irregularly depending on growth of fish length.

A morphometric analysis shows that having found local populations of fish it is necessary to compare the features of fish of the same length separately by sexes.

Introduction

It is known that many morphologic features vary depending on growth of fish, but the meristic ones are less changeable. There is no information on such variations in roundnose grenadier (an important object of deep-water fishery in the North Atlantic), excluding some measurements of their body proportions aimed to determine a systematic belonging of this species. The most comprehensive measurements have been presented by Koefoed (1927) and Parr (1946).

Studying the localization of fish populations for the consequent

determination of abundance dynamics many investigators use the method by which the morphometric and meristic features in samples from different areas are compared. Moreover, sometimes an analysis is being carried out without separating fish by sexes, or lengths of fish compared are not considered, which results in unavoidable errors and wrong conclusions. Before carrying out such investigations on roundnose grenadier it is essential to determine what features and to what extent they vary with growth of this species, and in what particularly the sexual dimorphism becomes apparent.

Materials and Methods

Morphometric and meristic measurements were carried out on fresh fish captured with bottom trawl in the period 2 November - 5 December 1971 in the North Labrador Division (2G). Undamaged males and females from 36 to 95 cm in size distributed evenly in this range of lengths (i.e. 1 male and 1 female per every 1 cm size-class) were taken from the catches. Measurements of fish length were carried out from the front edge of a snout to the end of a tail with the accuracy of 0.5 cm which was difficult to measure because a thin filiform tail was often teared off (Savvatimsky, 1981).

16 linear measurements with 1 mm accuracy and 8 account features were carried out for vevry fish. Those were:

L - length of fish

C - length of a head

H - maximum height of a body

R - maximum circumference of a body

K - maximum width of a body

lID - first dorsal fin insertion length (ID)

lP - pectoral fin insertion length (P)

lIID- distance between the first (ID) and the second (IID) dorsal fins

aD - antedorsal distance

aIID- distance from the snout edge up to the second dorsal fin (IID)

aA - anteanal distance

an - snout length

o - diameter of an orbit (horizontal)

po - postorbital distance of a head

lm - mandible length

oo - interorbital distance (forehead width)

S - barbel length

N - number of pyloric caeca

nID - number of rays in the first dorsal fin (ID)

nP - number of rays in the pectoral fin (P)

nV - number of rays in the ventral fin (V)

n-1,2,3,4 - number of rakers on left gill arches

For a convenient statistical processing all the fish were combined by their length in 3 cm classes (30-32, 33-35 etc.). Mean values of measurements for these classes are given in tables; the same values in a smoothed down form ($B=\frac{a+2b+c}{4}$, where a,b,c are the previous, calculated and consequent terms of the line; B is a computed term) are presented on figures. Computation of the series difference ($M_{diff.}$) for some features was in accordance with a technique developed by I.F.Pravdin (1966).

Grenadier has the shape of a body which slightly differs from the usual or "classic" shape of fishes. For example, the first dorsal fin is located very close to the head, a body tapers just behind the first dorsal fin, the tail fin is absent. That is why some conventional fish measurements were impossible for this species (e.g., measurement of caudal peduncle) or they were changed. A scheme of roundnose grenadier measurements is shown on Fig.1.

Results

It is determined that between males and females of grenadier of the same length there are distinct differences in length of a head, anteanal and antedorsal distances, horizontal diameter of an orbit, postorbital distance of a head and other features, Tables 1,2, Figures 2,3. Difference ($M_{diff.}$) between values of postorbital distance in males and females is 9.32 (in females this interval is significantly greater, Table 3).

Females of the same length as males have greater distance between dorsal fins, anteanal and antedorsal distance and length of a snout. Males have larger diameter of orbits and length of mandibles than those of females.

As for meristic features the number of rays in the first dorsal, pectoral and ventral fins is equal in males and females and it doesn't change with growth of fish. A number of pyloric caeca and that of rakers on all the four gill arches is greater in females than in males (Table 4,5; Figures 4,5).

Almost all the plastic features of grenadier vary with growth of fish. The most varying parts are: length of a head, anteanal and antedorsal distances, horizontal diameter of an orbit , postorbital distance of a head and others. The value of head length difference (in per cent) relatively to lengths of small (36-65 cm) and large (66-97cm) males was 10.54 which testifies to a significant difference in this feature (Table 6).

Variations of different plastic features with growth of fish length occurs irregularly, for example, postorbital distance of a head both in males and females of grenadier up to 45-59 cm increases sharply and then more slowly (Fig.3).

The materials presented show that examining local populations of roundnose grenadier by a morphometric method it would be necessary to compare fish of the same length separately by sexes, otherwise, results of the analysis would be incomparable.

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Table 1 Morphologic features of roundnose grenadier males having different lengths

Fish length, cm	In per cent from length of a fish										In per cent from length of a head						
	C	H	R	K	eID	eP	I-IID	aD	aIID	aA	an	O	po	lm	OO	S	n
36-38	I6,7	I2,8	3I,4	6,8	4,5	I,6	I0,3	I7,7	32,0	22,7	23,6	29,9	47,2	4I,0	37,0	4,7	2
39-4I	I7,5	I3,6	33,8	8,2	4,4	I,5	9,0	I8,7	3I,0	2I,8	23,5	28,0	48,6	42,6	36,8	7,4	I
42-44	I7,2	I3,4	33,2	7,5	4,7	I,8	9,6	I7,6	3I,6	22,6	23,6	29,8	47,0	40,9	37,5	4,4	4
45-47	I7,5	I3,6	33,2	7,9	5,I	I,6	8.7	I8,0	30,8	22,5	23,9	28,3	47,2	40,9	37,8	5,0	2
48-50	I6,8	I3,8	32,2	7,7	4,5	I,8	9,3	I7,7	3I,0	2I,8	22,8	30,5	48,8	42,3	37,4	6,I	3
5I-53	I6,4	I3,5	3I,8	7,8	4,5	I,7	9,7	I7,2	3I,0	2I,8	22,0	29,0	49,8	42,4	37,7	5,I	3
54-56	I6,6	I3,2	3I,8	7,8	4,5	I,8	9,4	I6,9	30,4	22,6	23,4	28,9	49,0	43,9	36,9	6,6	3
57-59	I6,8	I3,7	83,0	7,7	4,4	I,7	9,7	I7,I	3I,5	22,I	23,9	28,0	52,2	40,6	36,2	6,I	3
60-62	I6,6	I3,5	32,6	7,9	4,5	I,7	I0,2	I7,0	3I,0	22,2	24,2	27,9	48,4	4I,0	38,0	5,4	4
63-65	I6,4	I3,3	32,2	8,I	4,3	I,7	8,6	I6,6	29,0	2I,6	23,I	28,5	49,0	40,8	36,4	5,4	3
66-68	I5,I	I3,0	3I,4	7,3	4,3	I,7	9,2	I6,4	29,4	2I,4	23,6	28,9	50,5	44,6	37,I	6,9	3
69-7I	I5,4	I3,I	3I,9	7,2	4,3	I,7	II,I	I6,2	3I,2	2I,5	23,8	27,9	49,2	42,4	36,6	5,6	3
72-74	I5,5	I3,I	3I,8	7,8	4,4	I,8	9,5	I6,3	29,6	2I,4	24,2	27,3	48,0	42,7	38,4	6,9	4
75-77	I5,4	I3,I	3I,4	7,4	4,7	I,6	9,9	I6,4	30,6	2I,2	23,7	28,6	48,3	42,0	37,I	6,4	3
78-80	I5,4	I3,I	30,8	8,I	4,0	2,0	9,6	I6,2	29,4	20,9	23,I	28,6	50,5	42,4	39,3	6,3	3
8I-83	I5,2	I3,3	3I,5	8,0	4,6	2,0	I0,6	I5,6	30,7	20,8	23,5	27,0	50,0	42,0	39,3	5,9	3
84-86	I5,0	I3,0	30,4	7,7	4,4	I,7	I0,4	I5,8	30,2	2I,0	24,3	29,0	50,7	43,6	37,6	6,8	3
87-89	I4,8	I2,8	3I,0	6,9	4,7	I,6	I0,9	I5,2	30,3	2I,0	23,2	25,6	50,3	42,6	38,8	7,8	I
90-92	I4,9	I3,2	30,8	7,8	4,0	I,7	9,6	I4,7	27,8	I9,3	23,2	26,I	50,8	42,6	35,8	7,5	I
93-95	I4,7	I2,7	29,9	6,9	4,5	I,7	9,8	I5,6	29,3	20,8	24,3	25,8	50,8	42,9	37,9	7,2	I
96-98	II,4	I2,4	30,0	7,7	4,3	I,7	I0,2	I5,0	29,I	2I,0	23,6	27,8	50,8	42,9	39,3	7,2	I

Table 2 Morphologic features of roundnose grenadier females having different lengths

Fish length, cm	In per cent from length of a fish										In per cent from length of a head						n
	C	H	R	K	eID	eP	I-IID	aD	aIID	aA	an	o	po	lm	OO	S	
36–38	I8,2	I3,2	30,8	6,3	4,7	I,6	I0,3	I8,2	32,I	22,9	24,6	29,0	46,4	40,6	40,6	5,8	I
39–4I	I8,0	I4,I	34,2	7,5	4,8	I,8	8,4	I7,8	30,4	23,I	24,5	29,2	46,8	4I,2	39,8	5,6	3
42–44	I7,I	I4,0	34,0	8,0	5,0	I,8	I0,0	I8,I	32,0	22,7	24,I	29,I	49,I	42,3	40,5	4,6	3
45–47	I7,2	I4,I	33,8	8,3	4,5	I,8	9,7	I8,I	3I,5	22,5	24,2	27,4	49,I	4I,5	40,6	5,2	4
48–50	I6,9	I3,6	32,5	7,4	4,5	I,7	I0,2	I7,2	3I,2	22,3	24,9	28,5	47,8	4I,0	38,6	4,4	3
5I–53	I6,5	I4,I	33,3	8,0	5,0	I,8	9,9	I6,8	3I,2	22,4	23,3	28,8	48,6	40,9	40,5	5,4	3
54–56	I7,0	I4,0	33,5	8,I	4,4	I,9	I0,4	I7,3	3I,6	22,4	23,2	27,I	5I,I	42,I	39,3	3,9	3
57–59	I6,7	I3,6	32,6	7,6	4,2	I,8	I0,6	I7,0	3I,5	22,3	24,4	27,2	48,5	4I,6	32,2	5,5	3
60–62	I7,2	I4,0	33,3	7,8	4,4	I,8	8,8	I8,4	30,5	22,5	23,9	27,I	49,0	4I,7	40,5	5,4	3
63–65	I7,0	I4,0	33,6	7,7	4,8	I,7	I0,5	I7,3	32,0	22,7	25,2	26,4	48,8	42,0	39,3	6,8	3
66–68	I6,3	I3,8	32,9	7,I	4,5	I,6	I0,2	I6,5	3I,I	22,3	23,9	26,9	48,9	42,2	40,4	5,5	3
69–7I	I6,4	I3,9	32,9	7,5	4,5	I,7	I0,7	I6,5	3I,I	22,3	23,3	26,7	50,3	4I,6	39,8	5,5	3
72–74	I6,5	I3,8	32,8	7,3	4,4	I,7	I0,6	I6,9	3I,5	23,0	25,5	26,9	47,9	42,7	38,2	5,3	3
75–77	I6,4	I3,5	3I,8	7,0	4,5	I,7	I0,4	I6,8	3I,0	2I,9	24,3	26,5	49,5	42,2	39,8	5,I	3
78–80	I6,3	I3,5	32,4	7,7	4,I	I,9	I0,3	I6,6	3I,0	22,3	24,3	26,4	5I,3	43,0	39,I	5,2	3
8I–83	I5,8	I3,4	32,9	8,0	4,I	I,8	I0,6	I6,I	30,7	23,3	24,0	26,3	5I,6	43,8	4I,0	6,2	3
84–86	I5,8	I4,0	34,I	9,0	4,3	I,8	II,0	I6,4	3I,5	22,3	24,I	25,8	50,I	39,0	39,0	6,2	3
87–89	I5,I	I3,4	32,0	8,I	4,I	I,8	I2,I	I5,9	3I,8	2I,7	23,8	26,6	52,6	44,4	39,6	5,5	3
90–92	I5,I	I3,7	32,8	7,9	4,4	I,8	I0,9	I5,7	30,5	22,3	25,3	25,3	50,9	43,2	4I,8	6,2	2
93–95	I4,6	I3,6	32,4	7,8	4,3	I,8	I0,0	I4,9	29,I	2I,I	24,0	26,2	5I,6	44,0	4I,5	5,8	2

Table 3 Mean value of the series - M and its error - m, mean square deviation - G and a coefficient of variation - C in computation the difference - $M_{diff.}$; values of interorbital distance - oo in relation to length of a head - C in males and females of roundnose grenadier

Sex	Fish length, cm	M ± m	G	C	Number of fish	$M_{diff.}$
Males	36-97	37.57±0.18	1.315	3.5	54	9.32
Females	38-95	39.89±0.174	1.314	3.29	57	

Table 4 Meristic features of roundnose grenadier males having different lengths

Fish length, cm	N	nID	nP	nV	n-1	n-2	n-3	n-4	n
36-38	24.5	II,5	I7,5	7,5	20,5	I8,0	I5,5	I5,0	2
39-4I	29,0	II,0	I7,0	8,0	I9,0	I7,0	I5,0	I3,0	I
42-44	28,7	I2,5	I8,0	8,0	I9,0	I7,0	I5,0	I4,7	4
45-47	30,0	I2,5	I8,0	8,0	I9,0	I7,5	I5,5	I4,5	2
48-50	27,7	II,7	I7,7	8,0	I8,3	I8,3	I5,7	I5,0	3
5I-53	28,0	I2,0	I7,3	8,3	I9,0	I7,7	I5,0	I4,3	3
54-56	25,7	I2,3	I7,0	7,7	I9,0	I8,0	I6,3	I4,7	3
57-59	29,0	I3,0	I7,7	8,0	I9,7	I7,7	I6,0	I5,0	3
60-62	28,0	I2,0	I7,8	8,0	I9,0	I8,5	I7,0	I5,5	4
63-65	28,3	I2,7	I6,7	8,0	I8,3	I7,7	I6,3	I5,0	3
66-68	27.6	I2,3	I7,0	8,0	I9,3	I7,3	I5,3	I5,0	3
69-7I	28,0	I2,3	I7,7	8,0	I9,7	I8,3	I5,7	I5,0	3
72-74	29,2	I2,2	I7,0	8,0	I9,2	I9,0	I7,5	I5,2	4
75-77	25,7	I2,7	I7,7	8,0	20,7	I8,3	I6,0	I4,3	3
78-80	29,7	I2,0	I7,3	8,0	I9,0	I9,0	I6,0	I5,0	3
8I-83	29,0	I2,3	I7,0	8,0	20,7	I9,0	I6,7	I5,3	3
84-86	26,7	I2,7	I7,3	8,3	20,7	I9,3	I7,3	I6,3	3
87-89	3I,0	I2,0	I7,0	7,0	I9,0	I8,0	I6,0	I5,0	I
90-92	29,0	II,0	I7,0	8,0	2I,0	I9,0	I5,0	I5,0	I
93-95	20,0	I3,0	I7,0	8,0	I9,0	I8,0	I6,0	I5,0	I
96-98	26,0	I3,0	I7,0	8,0	I7,0	I7,0	I5,0	I5,0	I
36-98	27,7	I2,2	I7,3	7,9	I8,3	I8,I	I5,8	I4,9	64

Table 5 Meristic features of roundnose grenadier females having different lengths

Fish length, cm	N	nID	nP	nV	n-1	n-2	n-3	n-4	n
36-38	22,0	I2,0	I7,0	8,0	2I,0	I9,0	I7,0	I5,0	I
39-4I	27,3	I2,0	I9,0	7,7	20,3	I8,3	I6,3	I5,0	3
42-44	36,7	I2,3	I7,7	8,0	I9,3	I8,0	I6,0	I4,7	3
45-47	28,0	II,5	I7,5	7,7	I9,7	I8,0	I6,7	I5,7	4
48-50	29,0	I2,0	I7,3	8,0	I9,0	I8,3	I6,3	I5,0	3
5I-53	32,3	I2,0	I7,0	7,7	I9,0	I7,0	I6,6	I4,3	3
54-56	32,0	I2,3	I6,7	7,7	I8,7	I8,7	I7,3	I6,0	3
57-59	30,3	I2,3	I8,0	8,0	I9,7	I8,3	I7,3	I5,3	3
60- 62	28,3	I2,3	I7,7	7,7	I9,7	I9,3	I7,3	I6,0	3
63-65	30,3	I2,7	I8,3	8,0	I9,7	I8,7	I6,0	I5,0	3
66-68	29,0	I2,7	I8,7	8,0	20,7	I8,7	I7,0	I6,0	3
69-7I	32,0	II,7	I8,0	7,7	2I,3	I9,3	I6,3	I6,0	3
72-74	28,0	I2,0	I8,0	8,3	20,0	I8,3	I6,0	I5,0	3
75-77	33,3	I2,3	I7,7	8,0	20,7	I9,0	I6,3	I6,0	3
78-80	3I,0	II,7	I7,7	7,7	20,0	I9,0	I7,3	I5,7	3
8I-83	38,0	I2,0	I8,3	7,3	20,3	I9,3	I7,7	I6,7	3
84-86	28,3	I2,3	I7,0	7,7	I9,3	I8,3	I6,7	I6,0	3
87-89	32,0	I3,0	I7,7	8,0	I9,7	I9,7	I7,0	I6,7	3
90-92	27,5	I2,5	I8,5	8,0	20,5	20,0	I8,0	I7,0	2
93-95	29,5	I2,5	I8,0	8,0	20,0	I8,0	I6,5	I5,5	2
36-95	30,7	I2,2	I7,8	7,9	I9,9	I8,7	I6,8	I5,3	58

Table 6 Mean value of the line - M and its error - m, mean square deviation - G and a coefficient of variation - C in computation the difference - $M_{diff.}$ in a ratio head length-C and length-l in small and large males of grenadier

Fish length, cm	M ± m	G	C	Number of fish	$M_{diff.}$
36-65	16.76 ± 0.11	0.587	3.50	28	10.54
66-97	15.24 ± 0.094	0.481	3.156	26	

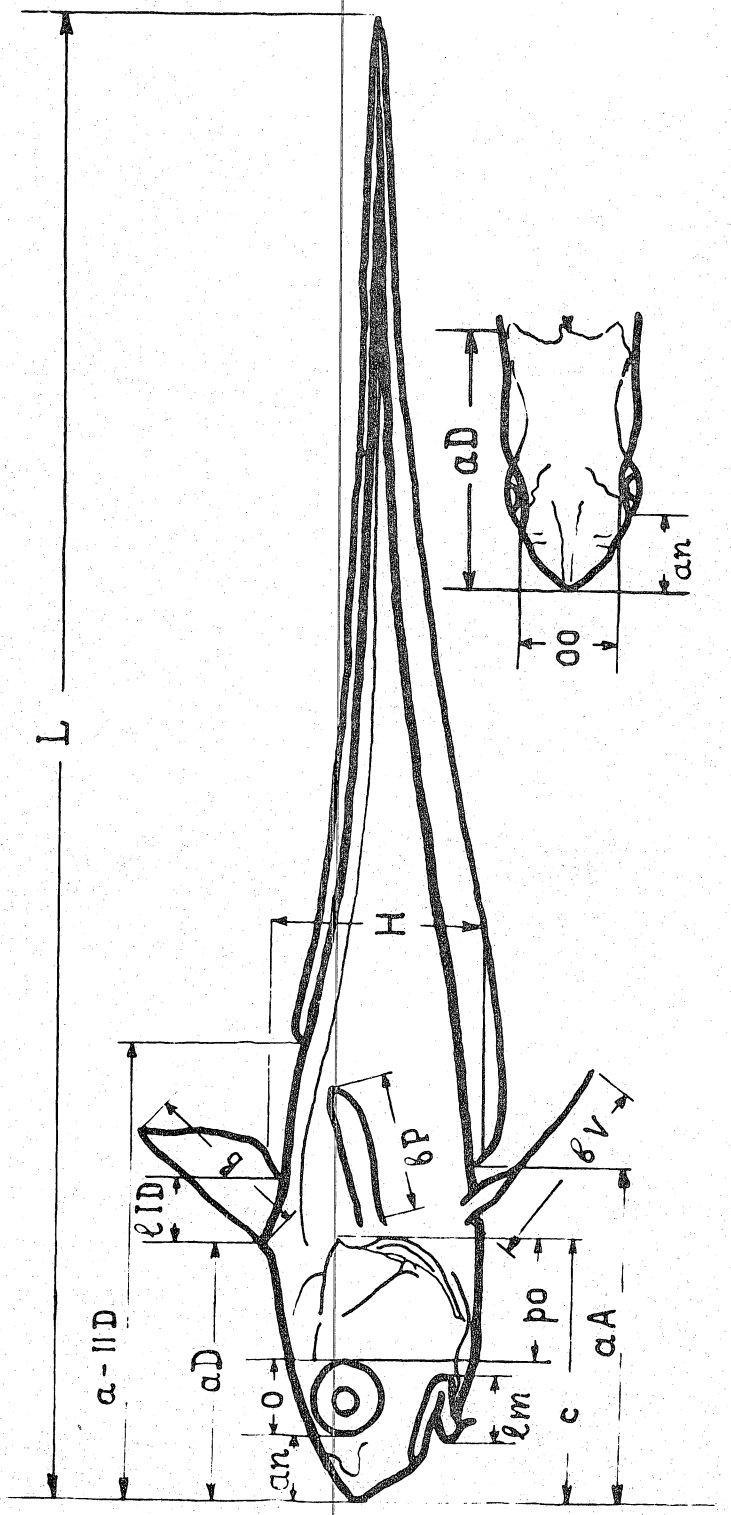

Fig. 1. Scheme of roundnose grenadier measurements

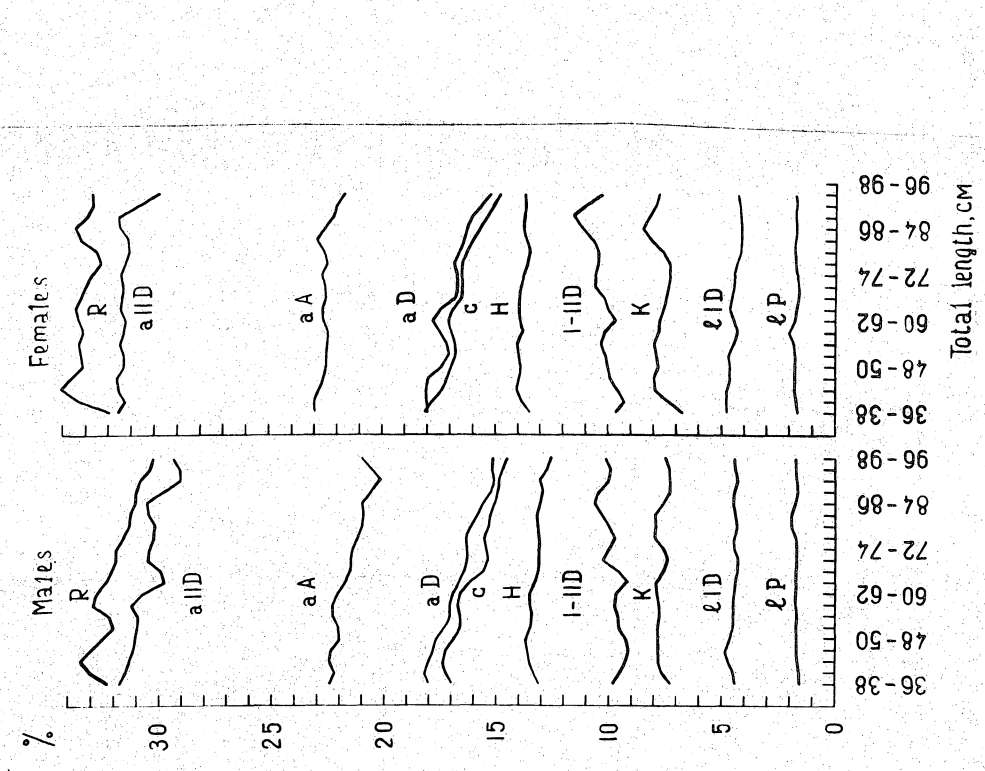

Fig. 2. Variation of morphologic features in roundnose grenadier males and females depending on their length.

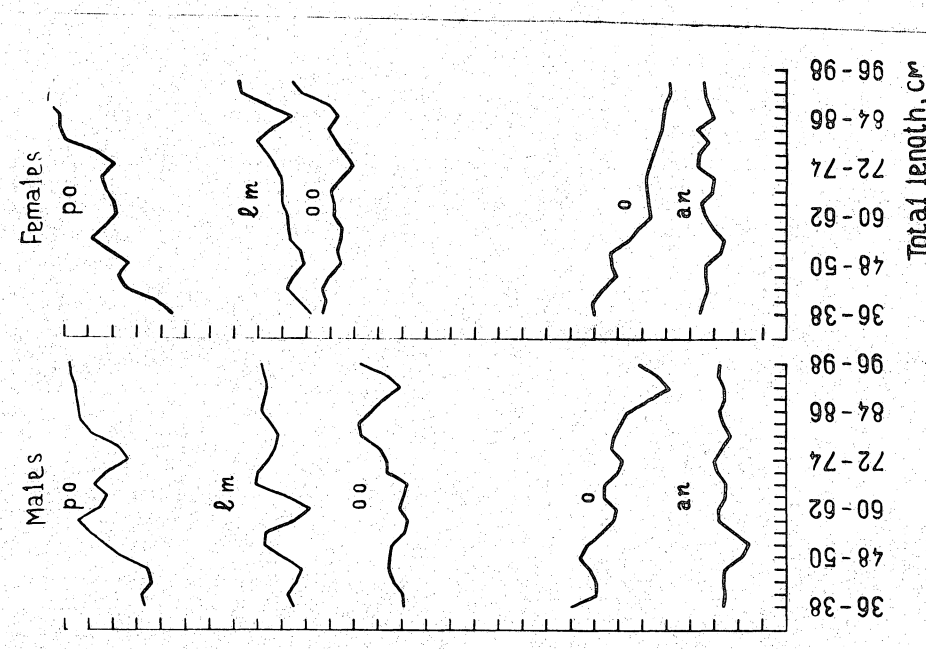

Fig. 3. Variations of morphologic features in grenadier males and females of different length relating to their head length.

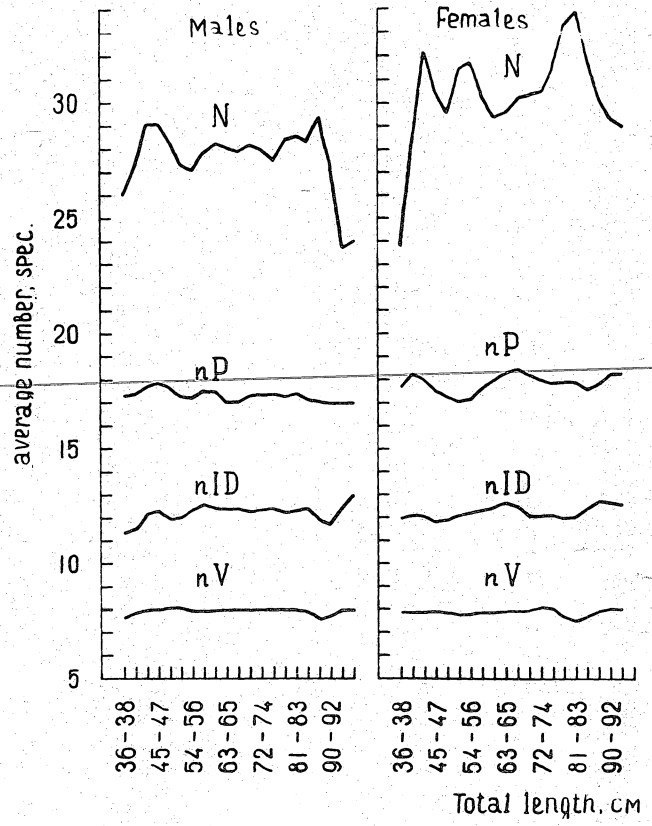

Fig. 4. Variation of meristic features in grenadier males and females depending on growth of their length.

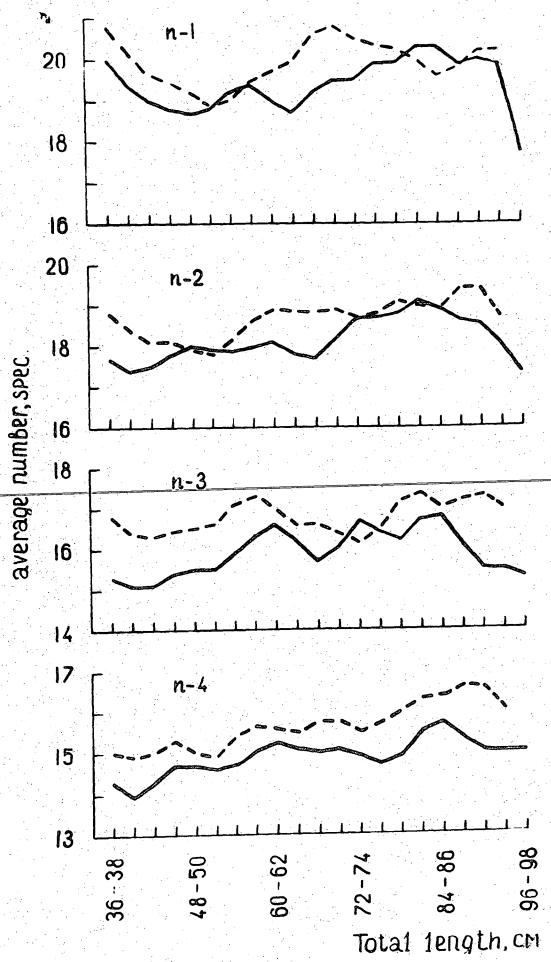

Fig. 5. Number of rakers on gill arches of grenadier of different length (full line - males, dotted line - females).