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Feeding of Roundnose Grenadier, Coryphaenoides rupestris Gunn., and its Position in the Trophic System of the North Atlantic

by

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Abstract

Feeding of rock grenadier inhabiting the continental slope of Canada, West Greenland and Iceland, and thalassobathyal zones of Reykjanes ridge, northern part of Mid-Atlantic ridge and Hatton plateau is studied.

Food spectra of rock grenadier inhabiting different parts of the station are compared and changes in feeding of the investigated species with age are demonstrated. Seasonal and local dynamics of rock grenadier is analysed.

Rock grenadier inhabiting the continental slope of North Atlantic is shown to be a consumer of the second order, that is a typical plankton-eater, and the same species found in thalassobathyal of this region belongs to consumers of the third or fourth orders and feeds mainly on the fish of the families <u>Myctophidae</u>, <u>Serrivomeridae</u>, <u>Bathylpgidae</u> and <u>Searriidae</u>.

Differences found in feeding of rock grenadier result to a certain degree from different trophic structure of communities of compared regions, as well as from differences in size and biological condition.

SPECIAL SESSION ON TROPHIC RELATIONSHIPS

Rock grenadier is a well-studied species of the deepwater ichthyofauna of the North Atlantic. The biology of rock grenadier and its feeding, in particular, were studied in different parts of the distribution area. This conforms to the ideas of the existence of local populations of rock grenadier connected to each other. However, with the appearance of papers which confirm, to a certain degree, a population unity of rock grenadier throughout the entire North Atlantic (Alekseev et al., 1979; Marti, 1980; Podrazhanskaya, 1971; Zubchenko, 1981), a new approach to this problem should be given.

In the present paper an attempt is made to show a position of rock grenadier in the trophic system of the North Atlantic.

Materials and Methods

The present paper is based on the field and laboratory analyses of the feeding of rock grenadier carried out by the authors and their colleagues in some areas of the North Atlantic (fig.2). Samples were collected and examined (table 1) according to the traditional methods (Manual for studying of feeding..., 1974).

Local, seasonal and age dynamics of feeding were studied and daily diets calculated for the fish of 8 to 110 cm in length with gonads at all the maturity stages of reproductive products. Food relationships among the fish inhabiting the same depth range as rock grenadier were analysed.

Results and Discussion

Feeding of rock grenadier on the Northwest Atlantic continental slope.

The representives of 74 different taxons were found in the rock grenadier stomachs. However, the numerous species of invertebrates were predominant: euphausiids (<u>Meganyctiphanes norvegica</u>, <u>Nematoscelis megalops</u>); hyperiids (<u>Parathemisto libellula</u>, <u>P</u>. <u>abyssorum</u>); copepods (<u>Calanus hyperboreus</u>, <u>C.finmarchicus</u>) (Podrazhanskaya, 1969).

In different areas of this region rock grenadier fed on shrimps off Iceland and in the north of Grand Bank, on shrimps and hyperiids off West Greenland, on hyperiids off Baffin Island and on the Labrador continental slope, and on the fish on the northwest slope of Grand Bank (table 2). Specific composition within each of these groups was similar all over the continental slope of the Northwest Atlantic, and they varied only in number.

Food organisms found in rock grenadier stomachs were mainly related to the plankton and micronekton forms of the bathyaloceanic complex (Beklemishev, 1969). Only the polychaetes were common representatives of the bottom fauna but these were of little importance for the feeding.

Depending on lengths, three size groups of rock grenadier may be singled out (below 40 cm; 41-100 cm; over 100 cm) varying considerably in composition and amount of food components (table 3).

Hyperiids, copepods and mysids were major food for small rock grenadier. The fish of 41-100 cm in length fed on mysids and hyperiids, however, shrimps and euphausiids were also of great importance for the feeding. The number of cephalopods and fish was insignificant. The food of the larger rock grenadier consisted of shrimps and fish.

Seasonal dynamics of feeding is manifested in increasing in number of fed individuals between spring and autumn. Major feeding of rock grenadier is observed in September-November during biological autumn according to Semenova T.N. (1964). Hepatosomatic indices increase from spring to autumn that is closely coincided with the dynamics of fullness of the stomachs.

Consuming macroplankton bathypelagic crustaceans and fish, the Northwest Atlantic rock grenadier is a consumer of the second or third order, i.e. utilizes the energy branch directly stretching from phytoplankton. Detrital chain is partly used in consuming of shrimps <u>Pandalus borealis</u> which feed on polychaetes (fig.1).

Feeding of rock grenadier in thalassobathyal.

Food composition of rock grenadier in thalassobathyal of Reykjanes Ridge and northern Mid-Atlantic ridge includes more than 90 species of food organisms pertaining to the interzonal macroplankton and micronekton species of sound-scattering layers above the summits of underwater mounts. No bottom and near-bottom organisms are practically found in the food of rock grenadier (Gushchin, 1982).

Major food of rock grenadier in thalassobathyal is represented by the fish of families Myctophidae (<u>Benthosema glaciale</u>, <u>Lampanyctus crocodilus</u>); Serrivomeridae (<u>Serrivomer beani</u>); Bathy lagidae (<u>Bathylagus euryops</u>); shrimps of genera <u>Acanthephyra spp</u>., <u>Pasiphae spp</u>., <u>Gennades spp</u>., <u>Sergestes spp</u>.; cephalopods <u>Mastigoteuthis agassizi</u>, young <u>Gonatus fabricii</u>, <u>Todarodes sagittatus</u>, etc.

Young rock grenadier feed on copepods, young mysids and shrimps, chaetognaths and other mesoplankton organisms (table 4). On attaining of 30-40 cm in length, total proportion of mesoplankton crustaceans in the food mass composition decreases, and small mesoplankton fish <u>Cyclothone spp</u>., young <u>Melamphaes</u> <u>spp</u>. and smaller fish of the family <u>Myctophidae</u> appear in the food composition. The proportion of macroplankton crustaceans, such as mysids, shrimps, amphipods, increases for larger specimens (40-60 cm). The fish of families <u>Myctophidae</u>, <u>Bathylagidae</u>, etc. are of great importance in the diet. Rock grenadier of more than 60 cm in length feed mainly on larger macroplankton and micronekton organisms (fish, squids), although mesoplankton organisms are also found in the food of rock grenadier (Gushchin, 1982).

Seasonal dynamics of rock grenadier feeding is manifested in decreasing of amount of food in the stomach from March to July-August, during the spawning by September-October the amount of food in the stomach increases, and the autumn maximum is recorded, and the winter decrease is then observed.

Rock grenadier of thalassobathyal belong to a consumer of the third or fourth order (fig.1). Rock grenadier production depends mainly on interzonal layer animals and to a less degree on nonmigratory or undermigratory organisms of a stationary trophic complex.

At the same time rock grenadier is consumed by the predators of higher trophic levels: dogfish, <u>Etmopterces spinax</u>, <u>Centro-</u> <u>scyllum fabricii</u>; wolffish, <u>Anarrhichas denticulatus</u>; cutlassfish, <u>Aphanopus</u> <u>carbo</u>; angler, <u>Ceratias</u> <u>holboelli</u>, and toothed whales.

Assuming the point of view of researchers indicating the population unity of rock grenadier of the Northwest Atlantic continental slope and thalassobathyal of Reykjanes Ridge and northern Mid-Atlantic ridge (Alekseev et al., 1979; Marti, 1980; Podrazhanskaya, 1971; Zubchenko, 1981), the distribution area of rock grenadier is divided into the two functional parts, i.e. feeding and reproductive parts. Hence, the migratory scheme is as follows.

Following the spawning in the area of southern extremity of Reykjanes Ridge and northern Mid-Atlantic ridge, young rock grenadier is observed on the Northwest Atlantic continental slope where the fish concentrate mainly on the northern slope of Grand Bank, on the slope of northern Labrador and Baffin Island (Podrazhanskaya, 1971). With the growth the fish move along the slope towards Iceland where the larger rock grenadier aggregate and then perform spawning migration to the south along Reykjanes Ridge.

On the feeding ground of the distribution area, on the Northwest Atlantic continental slope, rock grenadier feed mainly on meso-and microplankton crustaceans. Feeding on crustaceans in this part of the distribution area may be attributed to the following reasons.

According to Stepanov V.N. (1974) in the North Atlantic rock grenadier inhabit the waters of intermediate structural zone which becomes a station for rock grenadier.

In the Northwest Atlantic the intermediate structural zone is represented by the waters of subarctic water masses which form the arcto-boreal fauna with abundant crustaceans (Beklemishev, 1969). This may account for the predominance of crustaceans in the food of rock grenadier. The above-mentioned assumption is confirmed by a comparison of feeding of rock grenadier in a very close area of continental slope where on the northern slope of Grand Bank rock grenadier feed mainly on crustaceans in the subarctic waters while on the north-eastern slope of Grand Bank where the frontal zone being the boundary of arcto-boreal faunas lies (Stepanov, 1974), rock grenadier consume the fish (table 2, fig.2).

In the reproductive ground of the distribution area - Reykjanes Ridge and Northern Mid-Atlantic ridge - rock grenadier is observed in the waters of transformed water masses formed by the interaction of the North Atlantic and subarctic water masses (Mamaev, 1960; Stepanov, 1974) with a number of "zones of microproductivity" above the summits of underwater mounts (Bezrukov, Natarov, 1976; Shomura, Barkley, 1979). These "zones of microproductivity" produce the greatest effect in combination with a number of frontal zones (Andriyashev, 1979) that is indicative of thalassobathyal of this area. Thus the fauna with abundant widespread tropical oceanic species arises here (Gushchin, Kukuev, 1981) with a complex structure of trophic chains, and so, rock grenadier belong here to a consumer of the third or fourth order and feed mainly on the fish. It is noteworthy that rock grenadier is larger here than on the Northwest Atlantic continental slope.

Thus the Northwest continental slope fauna with abundant cmstaceans is used for feeding of the young rock grenadier, and as a result this permits to rationally utilize the food resources of the North Atlantic mesopelagial.

Conclusions

- 1. Rock grenadier take a niche of non-specialized pelagic predator.
- 2. Differences found in feeding within the distribution area result to a certain degree from different structure of communities of compared regions and to a less degree from differences in size and biological condition.

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Table 1 Bulk of materials used

	-			
Analysis		Amount	of mate spec.	rials,
	i			·····
Weight analysis of feeding:				
Northwestern Atlantic			1607	
Reykjanes Ridge, northern Mid-Atlantic			· · ·	
ridge			1560	
Northeastern Atlantic (Hatton)			25	
Field analysis of feeding:				
Northwestern Atlantic	5 - 5		13248	
Reykjanes Ridge, northern Mid-Atlantic				
ridge		. 1	02700	
Northeastern Atlantic (Hatton)		,	265	
Analysis of feeding for fish of deep-				
water ichthyocene to determine food			н 19	
relationships:				
Northwestern Atlantic (field analysis)			5371	
Reykjanes Ridge and northern Mid-Atlanti	C			
(field analysis)	4.		3240	14 L

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Food Areas 冶 Northeas-tern slope of Grand Ban organisms northern Mid-Atlan-tic ridge West Greenland northern Reykjanes southern Reykjanes Ridge Northern Newfound-land Northern Labrador Southern Labrador Gibce fracture Central Labrador 1 Iceland Baffin Island Hatton dge 뇞 18.4 Mysidae 0.1 21.0 0.03 3.8 11.9 3.1 _ 3.1 8.4 3.2 -----Decapoda 51.4 12.9 2.1 2.3 4.4 13.2 84.5 18.5 7.8 55.9 12.7 19.8 18.9 76.6 Hyperiidae 0.9 17.2 49.0 35.8 25.4 3.8 0.8 0.4 _ ò.6 1.4 0.1 1 Euphausiacea 35.4 9.8 5.4 6.4 4.6 12.6 1.7 -0.4 1.2 0.4 0.3 Copepoda 0.1 1.6 5.1 8.5 0.8 6.5 1.5 4.6 0.5 0.1 0.2 1.4 0.2 Ostracoda 0.4 0.3 0.3 0.004 -----Isopoda 0,1 0.03 _ 0.4 0.02 Crustacea 7:5 2:3 0.6 4.3 0.7 _ Crustacea 87.9 59.9 84.9 52.8 Total 84.3 57.7 91.5 27.3 76.3 14.6 18.6 36.2 23.5 Cephalopoda 2.5 8.7 5.4 9.3 2.9 8.2 3.3 1.1 9.0 7.0 24.6 4.3 5.5 Myctophidae 2.1 22.5 0.3 1.6 69.6 12.1 10.4 8.8 10.6 28.6 Bathylagidae _ 7.9 1.7 8.8 33.1 Serrivomeridae 18.3 1.8 19.0 7.9 Chauliodontidae 1 4.0 2.4 5.4 3.4 Searsiidae 12 11.8 4.3 1.4 Paralepididae _ 10.9 _ -_ -Malacosteidae 5.7 5.8 Cottidae 2.8 _ -_ ---Scorpaeaidae 0.6 -----7.2 -_ Melamphaidae --_ 2.0 -1.9 3.5 0.7 -Ostichthys 4.7 5.5 3.8 7.9 2.4 17.7 0.3 0.6 7.7 10.2 4.3 6.5 4.7 Ostichthys total 8.3 6.5 33.7 2.7 28.6 0.8 70.2 68.9 52.0 57.0 65.8 12.1 Scyphozoca _ -----<u>.</u> _ 3.5 4.0 1.7 8.9 Tunicata 0.8 1.9 -1.2 0.9 1.3 3.1 0.3 0.3 0.06 0.01 Chaetognathe 0.3 1.8 0.6 1.3 5.8 2.4 0.2 0.06 0.004 0.2 0.03 Polychaeta 0.03 0.3 2.5 0.8 0.1 1.4 0.01 0.02 0.02 _ Food nonidentified 3.4 8.1 0.5 0.2 1.1 1.4 2.5 0.3 0.6 1.6 1.2 Total index of 35 7 fullness %00 43 28 64 20 20 36 34 <u>3</u>5 39 27 32

Table 2 Feeding of rock grenadier in the North Atlantic (% by weight)

% 6.8 25.6 29.2 24.7 18.9 8.8 66.3 81.0 40.0 44.2 14.2 27.2 17.0

125

172

15

25

578

255

338

159

Total stomachs

Empty stomachs

236

156

727

97

79

n

	Fish longth om				
Food organisms	below 41	41–100	over 100		
Polychaeta	-	2.0			
Copepoda	10.2	5.1	0.9		
Mysidacea	8.9	22.8	0.4		
Hyperiidae	66.3	22.8	2.6		
Euphausiacea	4.7	14.9	16.1		
Decapoda	· · · · · · · · · · · · · · · · · · ·	16.4	35.3		
Cephalopoda	en e	6.6	9.2		
Chaetognata	0.4	1.2	-		
Tunicata		0.7	2.3		
Ostichthys		7.5	33.2		
Food nonidentified	9.5	0.02	ан алан алан алан алан алан алан алан а		
Total index of fullness	,%°° 67.5	44.9	36.6		
No. of stomachs examine	∌d,		n Maria de la contra d Contra de la contra d		
sp.	111	1449	47		
Including empty stomack %	is, 5.4	33.6	8.5		

Table 3 Feeding of the Northwest Atlantic grenadier depending on length (% by weight)

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Food components		Length	groups, cm		
	1-20	21-40	41-60	61-80	81-100
Mysidacea	77.0	36.0	12.6	2.9	3.3
Decapoda	-	3.4	22.2	8.4	10.1
Hiperiidae	-	-	2.5	0.6	0.7
Euphausiacea		·	0.7	0.7	0.3
Copepoda	4.2	10.3	3.2	0.4	0.1
Ostracoda	- - -	-	1.2	0.2	0.01
Isopoda	i i, e statek Tur a		2.1	0.01	0.02
Crustacea nonidentifie	d 3.8	1.7	9.2	1.0	0.5
Crustacea total	85.0	51.5	53.9	14.2	15.0
Cephalopoda	-		4.9	12.8	6.0
Myctophidae		10.1	1.1	12.2	26.5
Bathylagidae	_		6.2	11.8	12.1
Chauliodontidae	-			2.0	9.9
Melamphaidae		18.7	14.2	3.5	0.6
Serrivomeridae	-		13.9	13.9	14.1
Malacosteidae		. .	-	5.8	2 ¹ <u>-</u>
Cyclothone	1 - 1 <u>-</u> 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	9.8		0.04	0.03
Searsiidae			0.1	5.7	0.7
Pisces others	0.1	2.4	4.2	14.0	7.5
Pisces total	0.1	41.0	39.8	69.2	71.7
Scyphozoa	_	-		3.3	7.3
Tunicata		_	0.5	0.3	0.01
Chaetognata	14.9	7.0	0.7	0.1	0.01
Mean index of fullness	,%°° 81	75	28	38	36
No. of fish, sp. No. of fed fish, sp.	8 6	52 43	66 63	393 356	282 245

Table 4 Feeding of rock grenadier in thalassobathyal depending on length (% by weight)



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Fig.1

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Food relations of rock grenadier in the North Atlantic.

A - area of the Northwest Atlantic continental slope.

B - area of thalassobathyal of Reykjanes Ridge and northern Mid-Atlantic ridge.



Fig.2 Feeding of rock grenadier in the North Atlantic. 1 - Pisces; 2 - Crustacea; 3 - Cephalopoda; 4 - Scyphozoa.