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FEEDING HABITS OF "BEAKED" REDFISH (Sebastes Mentalia  
Travin) IN THE NEWFOUNDLAND-LABRADOR AREA

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Studies of feeding habits of "beaked" redfish from the Newfoundland-Labrador area, aboard research and scouting vessels, have been under way since 1956.

The present report is based on the material collected during the period from August 1956 to December 1960. The total of 41421 specimens of "beaked" redfish captured in the Labrador, Newfoundland and New Scotland areas, have been examined for stomach contents using the field analysis method, which involves determination of the degree of stomach filling by a five-point scale and of food compositions. Food has been found in the stomachs of only 12542 specimens, which is just a little more than 30% of the total number of specimens examined.

The data obtained have been processed to produce the figures of the frequency of occurrence of various food components as related to the number of stomachs containing food.

Studies of feeding habits of "beaked" redfish indicated that they should be classed with plankton-eaters. Their diet includes about 40 plankton and bathypelagic species (see table 1). The following species of plankton organisms occur most frequently: *Calanus finmarchicus*, *Themisto libellula*, *Th. abyssorum*, *Meganyctiphanes norvegica*, *Thysanoessa inermis*, *Th. raschii*, *Pandalus borealis*, and some others. The most frequently occurring species of fish are lantern anchovy (*Benthoosema glaciale* *Myctophum punctatum*, *Ceratoscopelus maderensis*) and *Paralepis coregonoides*.

With the increase in length of "beaked" redfish, plankton organisms in their diet are getting gradually replaced with fish (see table 2). Individuals up to 30 cm long feed primarily on euphausiidae, copepoda and gammarus, whereas the most frequent components in the food of individuals from 41 to 45 cm long are fishes (more than 40% of the total diet). At the same time a certain increase in the frequency of occurrence of various plank-

ton animals is observed, which, possibly, has to be explained by the fact that adult individuals are not so well provided with basic food.

There is no difference in the composition of food of male and female "beaked" redfish (see table 2).

The composition of food remains more or less constant all the year round, showing no regular (cyclic) changes. The intensity of feeding of mature individuals, however, changes with season. It decreases abruptly in April and May in connection with deposition of larvae of females. The intensity of feeding of males also decreases at the same time, since by that season they have already got fattened to the highest possible degree being physiologically prepared for mating.

After the end of the period of spawning, the intensity of feeding of females increases, reaching its peak in the autumn and winter season. Males regain their normal intensity of feeding, after the seasonal spring-summer recession, somewhat later than females which, apparently, is to be explained by their sexual activity during the period of mating in May, June and July (see figs. 1 and 2). The intensity of feeding of immature individuals remains high in spring and summer, but may go down in winter time. On the southern slope of the Great Banks, for instance, where immature fish up to 30 cm long, usually make 80% of catches, the highest intensity of feeding is observed in May-July period. (see fig.3).

It has been established from the data collected by the research vessel "Sevastopol" (in March-August) that "beaked" redfish are feeding most actively in the night-time, when they rise above the ground to chase their food. That can be well illustrated by the relationship between the numbers of specimens with filled and empty stomachs caught by night and by day, as well as by the lower degree of digestion of the organisms found in the stomachs of redfish captured by night (see fig. 4). It is therefore evident that the reduction in captures in the night-time is directly connected with feeding migrations of redfish.

Detailed discussion of qualitative compositions of food of "beaked" redfish from individual subareas being beyond the scope of the present paper, we would just like to point out that the major components of their food are extremely uniform. In all the areas investigated two groups of organisms, - euphausiidae and bathypelagic fish, - are the main items of redfish diet. There are, of course, some variations, such as, for instance, more frequent presence of capelin in the food of redfish from the

southern (30) and north-eastern (3L) slopes of the Great Banks, or complete absence of this species in the diet of redfish from Flemish Cape Bank.

The results of observations made in all areas and all seasons, have shown definitely that the qualitative composition of food of "beaked" redfish does not depend upon the depth of their concentration. Only in a few cases there could be observed the tendency toward increase in the frequency of occurrence of fish, mostly of lantern anchovy, in the food composition at greater depths. (see fig. 5).

It can be inferred from the summary results of an analysis of the material collected that the greatest concentrations of "beaked" redfish are to be found at the depths where their favourite food, - euphausiidae and bathypelagic fish, - are most abundant in the given period of time. It can also be assumed that concentrations of "beaked" redfish are more constant when they feed on euphausiidae instead of fish. It is of interest to mention that there is a positive correlation between the amount of feeding fish (the intensity of feeding of a population) and the volume of catches (see fig. 6).

In conclusion let us take a look at the interspecific food relations of "beaked" redfish, *Sebastes marinus*, and cod. We propose the following method of calculating the coefficient of food similarity (CFS), for making comparisons of food compositions of various fish on the basis of frequency of occurrence of food components:

$$CFS = \frac{n \cdot 100}{N}$$

where N - the sum total of higher per cents of frequencies of occurrence of food organisms found in the species being compared;

n - the sum total of lower per cents of frequencies of occurrence of food components common for fish being compared.

According to this formula, in case of complete difference in the compositions of food of the two given species the CFS will be 0, whereas in case of complete identity it will be 100. The coefficient of food similarity determined for *Sebastes marinus* and "beaked" redfish from the area of Flemish Cape (3M), is 65.0, from the Northern Newfoundland Shelf (3K) - 52.1, and from Southern Labrador (2J) - 61.5. Figure 7 is a graphical representation of similarity of spectra of food. The spectra of

food of *Sebastes marinus* and "beaked" redfish overlap to a considerable extent, *Sebastes marinus* showing, however, a greater tendency toward fish-eating. Same regularity has been revealed by comparisons of the compositions of food of representatives of these two species captured at the same station (see fig. 8). Coefficients of food similarity have then been determined to be 22.3 (area 3M) and 26.5 (area 2J). The spectra of food of "beaked" redfish and cod overlap inconsiderably, so the possibility of their competition in most areas is very slight. The coefficient of food similarity calculated for the spectra of food of redfish and cod from the North-Eastern Slope of the Great Banks is 18.3 (see fig. 9). A similar picture has been revealed by a comparison of the spectra of food of redfish and cod captured simultaneously (see fig. 10).

TABLE I

Organisms found in the food of "beaked" redfish  
 (+ very rare; ++ rare; +++ frequent; ++++ very frequent)

HYDROIDEA	
1. <i>Aglantha digitale</i> (O.F. Müller)	+++
CTENOPHORA	
2. <i>Peurobranchia pileus</i> O. Müller	++
3. <i>Beroe cucumis</i> Fabricius	++
POLICHAETA	
4. <i>Nereis pelagica</i> Linne	+
COPEPODA	
5. <i>Calanus finmarchicus</i> (Gunner)	++++
6. <i>Calanus hyperboreus</i> Kroyer	+++
7. <i>Pareuchaeta norvegica</i> (Boeck)	+++
MYSIDACEA	
8. <i>Amblyops abbreviata</i> (M. Sars)	++
AMPHIPODA	
9. <i>Hyperia galba</i> Montagu	+++
10. <i>Themisto libellula</i> Maudt	++++
11. <i>Themisto abyssorum</i> (Boeck)	++++
12. <i>Pseudolibrotus glacialis</i> Sars	++
EUPHAUSIACEA	
13. <i>Meganyctiphanes norvegica</i> (M. Sars)	++++
14. <i>Thysanöessa inermis</i> (Kröyer)	++++
15. <i>Thysanöessa raschii</i> (M. Sars)	++++
16. <i>Thysanöessa longicaudata</i> (Kröyer)	++
DECAPODA	
17. <i>Pandalus borealis</i> Kröyer	++
18. <i>Sergestes</i> sp.	+
PTEROPODA	
19. <i>Clione limacina</i> Phipps	++
20. <i>Limacina retroversa</i> Flemming	++
CEPHALOPODA	
21. Genus sp.	++
CAETOGNATHA	
22. <i>Sagitta elegans</i> Verrill	++
23. <i>Sagitta maxima</i> conant	+++
APPENDICULARIA	
24. <i>Cikopleura</i> sp.	+
PISCES	
25. <i>Alepocephalus bairdii</i> Goode and Bean	+
26. <i>Mallotus villosus</i> (Müller)	++
27. <i>Bathylagus euriops</i> Goode and Bean	++

28. Maurolicus mülleri Gmelin	+
29. Cyclothone signata Garman	++
30. Stomias ferox Rheinhardt	+
31. Chaulidous sloani Bloch and Schneider	+
32. Paralepis coregonoides Reinhardt	+++
33. Hygophum benoiti (Cocco)	+
34. Benthosema glaciale (Reinhardt)	++++
35. Myctophum punctatum Rafinesque	+++
36. Lampanictus cuprarius Taning	+
37. Ceratoscopelus maderensis (Lowe)	+++
38. Notoscopelus elongatus (Costa)	++
39. Nemichtys scolopaceus Richardson	+
40. Ammodytes americanus DeKay	++

TABLE 2

Feeding habits of various size groups of "beaked" redfish  
(frequency of occurrence of components, %) )

Food components	L e n g t h, c m											
	26		26-30		31-35		34-40		41-45		45	
	: 00	: 00	: 00	: 00	: 00	: 00	: 00	: 00	: 00	: 00	: 00	: 00
	: 00	: ++	: 00	: ++	: 00	: ++	: 00	: ++	: 00	: ++	: 00	: ++
Copepodes	18.0	23.3	31.1	24.2	22.8	20.7	13.1	18.8	9.1	15.0	-	8.7
Euphausiidae	52.5	46.6	50.0	54.1	41.9	45.4	35.4	38.5	29.9	29.5	14.3	30.6
Gammarus	19.7	16.7	24.3	21.0	30.5	21.9	26.6	22.6	13.0	20.1	-	16.4
Other plankton organisms	3.3	20.0	13.2	9.7	22.2	17.8	23.1	24.0	19.5	20.4	14.3	28.4
Shrimps	1.6	10.0	8.0	6.9	8.8	6.3	9.6	9.6	10.4	11.8	-	15.3
Lantern anchovy	11.5	3.3	8.6	8.1	13.1	11.0	17.2	19.9	20.8	28.3	28.6	20.8
Capelin	-	-	0.3	0.8	0.3	0.1	0.8	0.9	-	2.3	-	2.7
Other fish	9.8	10.0	3.1	3.6	6.2	7.5	11.4	10.1	18.2	13.9	57.2	21.4
Total percent of fish	21.3	13.3	12.0	12.5	19.6	18.6	29.4	30.9	39.0	44.5	85.8	44.9
Other food	1.6	-	0.3	1.2	1.1	0.5	1.4	0.8	1.3	0.7	-	-
No. of stomachs containing food	61	30	325	248	1483	966	731	2453	77	1586	7	183

## Key to Figures

(Feeding habits of 'beaked' redfish (*Sebastes mentella* Travin in the Newfoundland-Labrador area" by K.P. Yanulov)

- Fig. 1 - Changes in the number of feeding "beaked" redfish during the year (%%). Based on the data collected in 1956-1960.  
A - Actual course; B - supposed course.  
1 - Southern Labrador (2J); 2 - Flemish Cape (3M);  
3 - Northern Newfoundland Shelf (3K);  
4 - North-Western Slope of the Great Banks (3L).
- Fig. 2 - Changes in the number of feeding male and female "beaked" redfish during the year and in the ratio of maturity of males. Based on the data collected in 1959-1960.  
A - Southern Labrador (2J) and Northern Newfoundland Shelf (3K);  
B - North-Western Slope of the Great Banks (3L);  
C - Changes in the ratio of maturity of males (each point represents an average value for 25 specimens).
- Fig. 3 - Changes in the number of feeding "beaked" redfish on the southern slope of the Great Banks during the year (%%).
- Fig. 4 - Number of specimens of "beaked" redfish with food in their stomachs captured by day (1) and by night (2) (%%).  
A - Flemish Cape Bank (3M);  
B - North-western slope of the Great Banks (3L).
- Fig. 5 - Food of "beaked" redfish at various depths (frequency of occurrence, %%).  
A - Southern Slope of the Great Banks (3N), August;  
B - Southern Labrador (2J), November;  
1 - Euphausiidae; 2 - Amphipodes; 3 - Copepodes;  
4 - other plankton organisms; 5 - shrimps;  
6 - lantern anchovy; 7 - other fish.
- Fig. 6 - Relationship between captures of "beaked" redfish (tons per hour) and the number of feeding individuals (intensity of feeding). Based on the results of field analysis.  
1 - Material collected during cruise No. 3 of the "Novorossiisk "RT-99", in November-December 1958 ( - 1200);



- 2 - material collected during cruise No.14 of the research vessel "Sevastopol" in June-August 1959 ( - 2425);
- 3 - material collected during cruise No.16 of the research vessel "Sevastopol" in February-April 1960 ( -1300);
- 4 - material collected during cruise No.17 of the research vessel "Sevastopol" in June-September 1960 ( -3400).

- Fig. 7 - Comparison of compositions of food of "beaked" redfish and *Sebastes marinus* from areas 3M, 3K and 2J (frequency of occurrence, %). Based on the data collected in 1956-1960.
- A - Food of "beaked" redfish; B - Food of *Sebastes marinus*
  - C - Common food.
  - 1 - Euphausiidae; 2 - Copepodes; 3 - Amphipodes;
  - 4 - other plankton organisms; 5 - shrimps;
  - 6 - lantern anchovy; 7 - capelin; 8 - other fish.
- Fig. 8 - Comparison of compositions of food of "beaked" redfish and *Sebastes martinus* captured at the same time and the same stations in areas 3M (March) and 2J (August).
- 1 - copepodes; 2 - sagitta; 3 - euphausiidae;
  - 4 - amphipodes; 5 - shrimps; 6 - lantern anchovy;
  - 7 - other fish.
- Fig. 9 - Comparison of compositions of food of "beaked" redfish and cod from the North-Eastern Slope of the Great Banks (3L).
- A - Food of "beaked" redfish (from the data collected in 1957-1960);
  - B - Food of cod (from the data collected in 1959);
  - C - Common food.
  - 1 - Euphausiidae; 2 - Copepodes; 3 - Amphipodes;
  - 4 - other plankton organisms; 5 - shrimps;
  - 6 - bathypelagic fish; 7 - capelin; 8 - sand-eel;
  - 9 - redfish; 10 - gadoid fish; 11 - other demersal fish; 12 - benthos.
- Fig. 10 - Comparison of compositions of food of "beaked" redfish and cod captured at the same time and the same stations in areas 3M and 3L.
- 1 - Copepodes; 2 - sagitta; 3 - euphausiidae;
  - 4 - Amphipodes; 5 - shrimps; 6 - lantern anchovy;
  - 7 - capelin; 8 - sand-eel; 9 - other fish;
  - 10 - benthos.

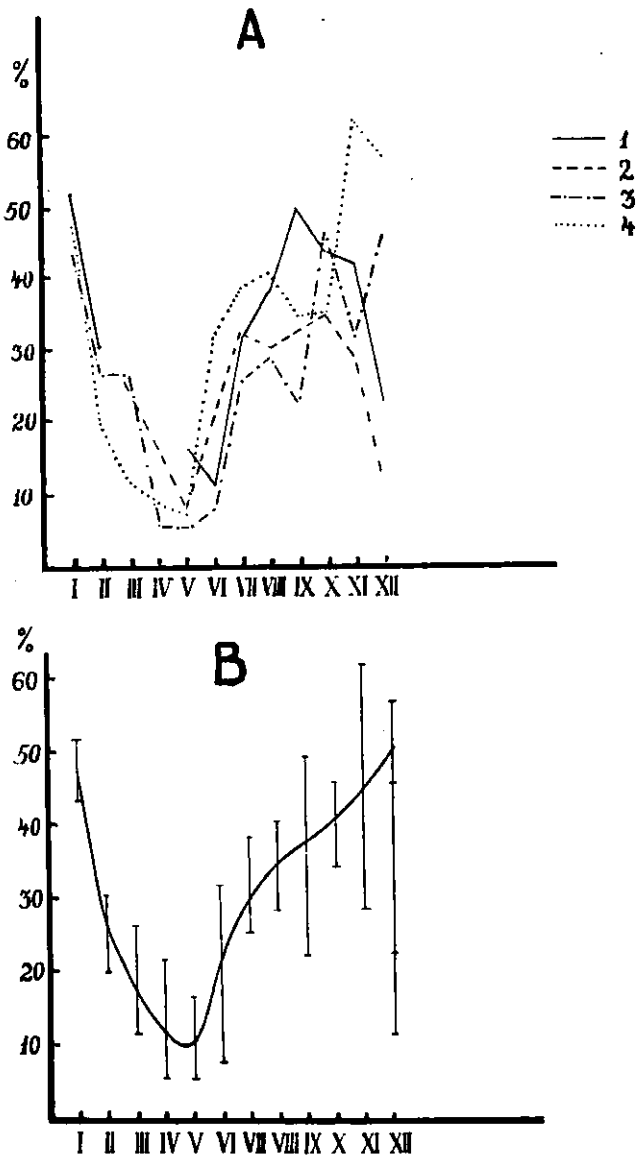


Fig. 1 - Annual changes in the number of feeding individuals of "beaked" redfish (%). Based on the data collected in 1956-1960.

A - Actual course; B - Supposed course

1. Southern Labrador (2J); 2. Flemish Cape (3M);
3. Northern Newfoundland Shelf (3K);
4. North-Western Slope of the Great Banks (3I)

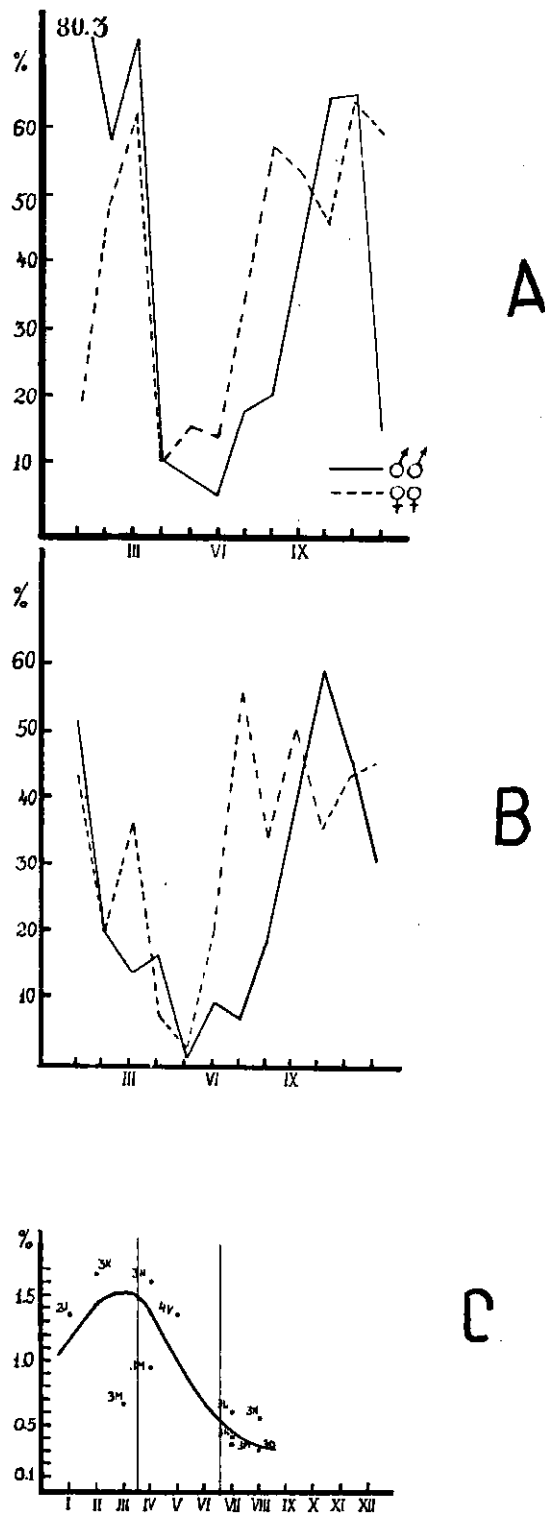


Fig. 2 - Annual changes in the number of feeding male and female individuals of "beaked" redfish and in the ration of maturity of males. Based on the data collected in 1959-1960.  
A - Southern Labrador (2J) and Northern Newfoundland Shelf (3K);  
B - North-Western Slope of the Great Banks (3L);  
C - Changes in the ration of maturity of males (each point represents an average value for 25 specimens)

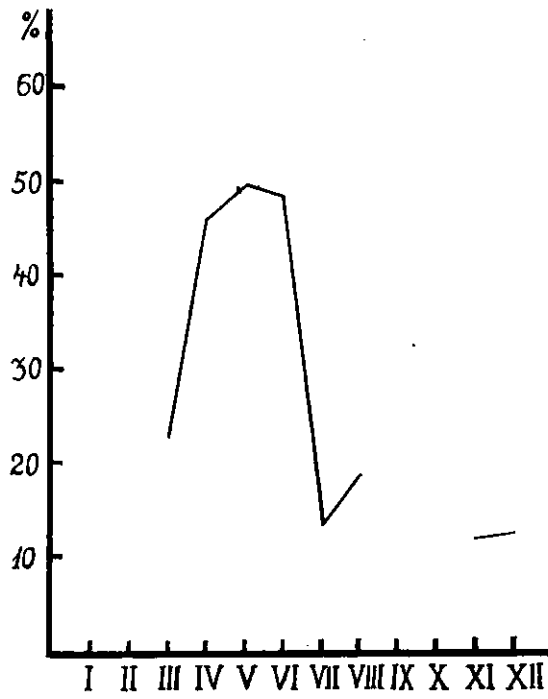


Fig. 3 - Annual changes in the number of feeding individuals of "beaked" redfish on the Southern Slope of the Great Banks (%)

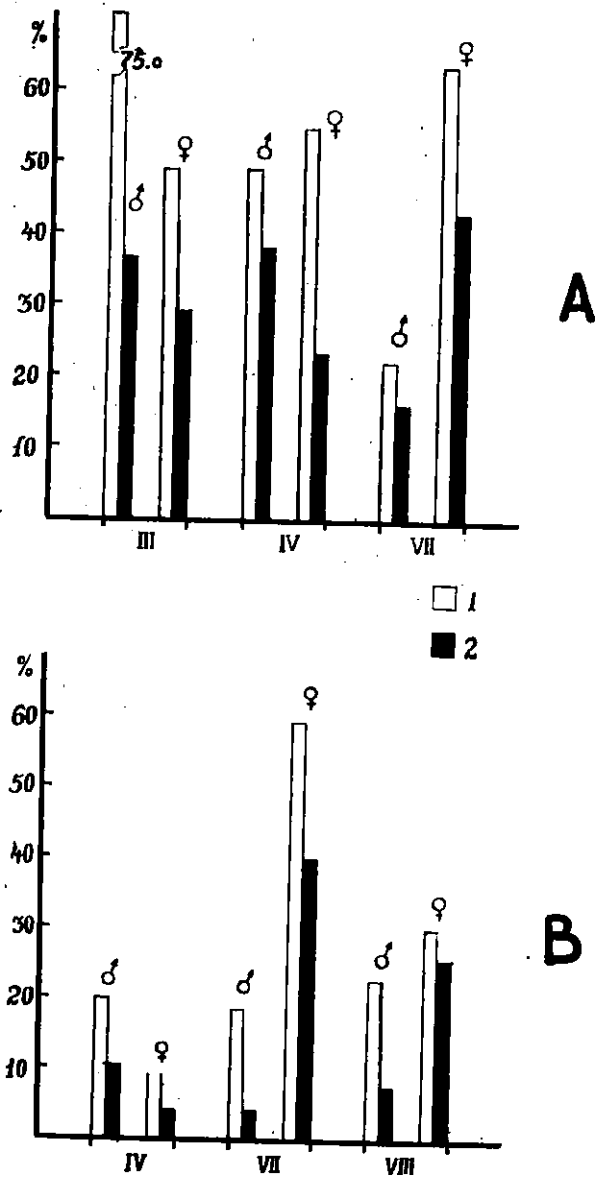


Fig. 4 - Number of specimens of "beaked" redfish with food in their stomachs captured by day (1) and by night (2) (%)

A - Flemish Cape Bank (3M);

B - North-Western Slope of the Great Banks (3L)

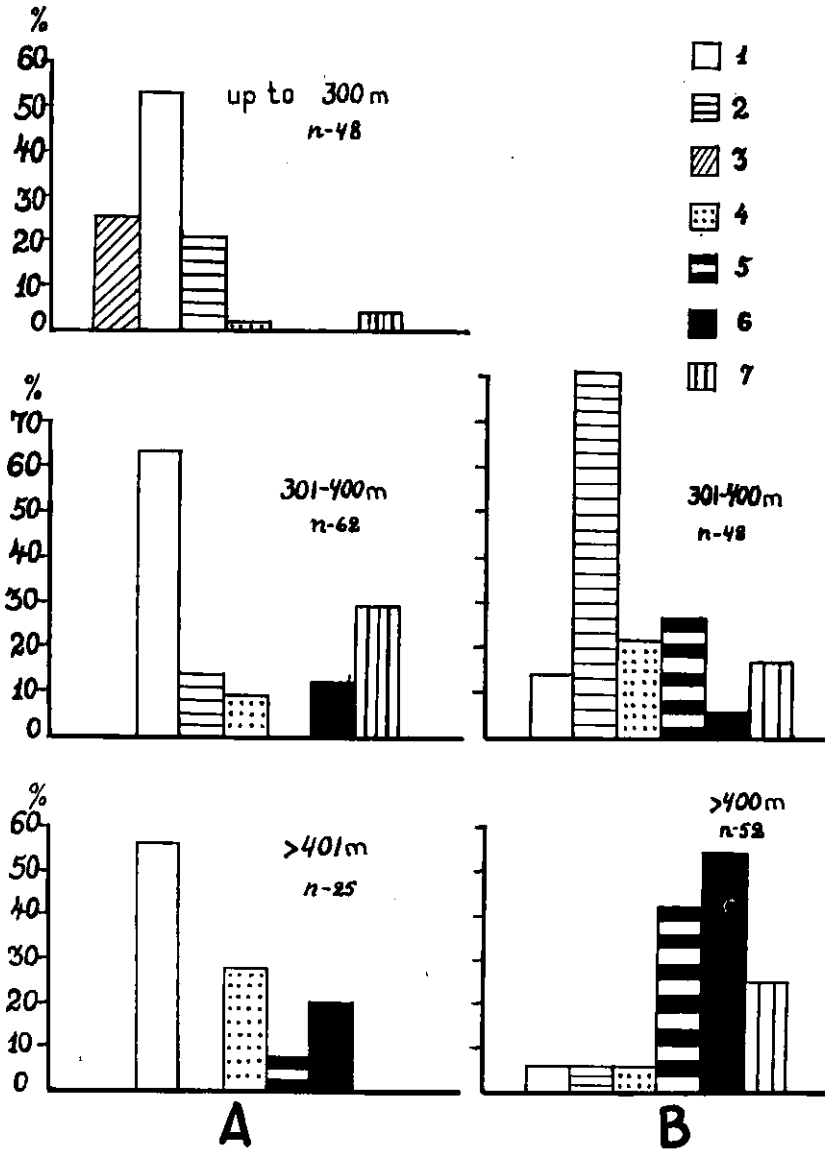


Fig. 5 - Food of "beaked" redfish at various depths (frequency of occurrence, %)

A - Southern Slope of the Great Banks (3N), August;  
B - Southern Labrador (2J), November

1 - Euphausiidae; 2 - Amphipodes; 3 - Copepodes;  
4 - Other plankton organisms; 5 - Shrimps;  
6 - Lantern anchovy; 7 - Other fish

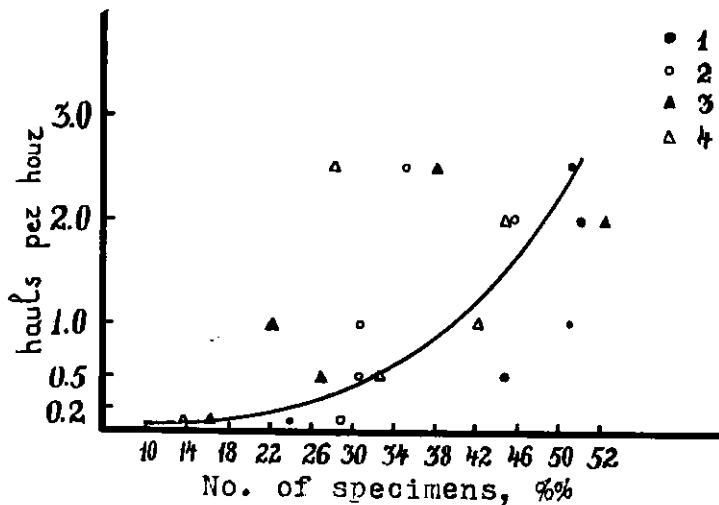


Fig. 6 -Relationship between captures of "beaked" redfish (tons per hour) and the number of feeding individuals (intensity of feeding). Based on the results of field analyses.

1. Material collected during cruise No. 3 of the RT-99 "Novorossiisk", in November-December 1958 ( -1200);
2. Material collected during cruise No. 14 of the r/v "Sevastopol", in June-August 1959 ( -2425);
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4. Material collected during cruise No. 17 of the r/v "Sevastopol", in June-September 1960 ( -3400)

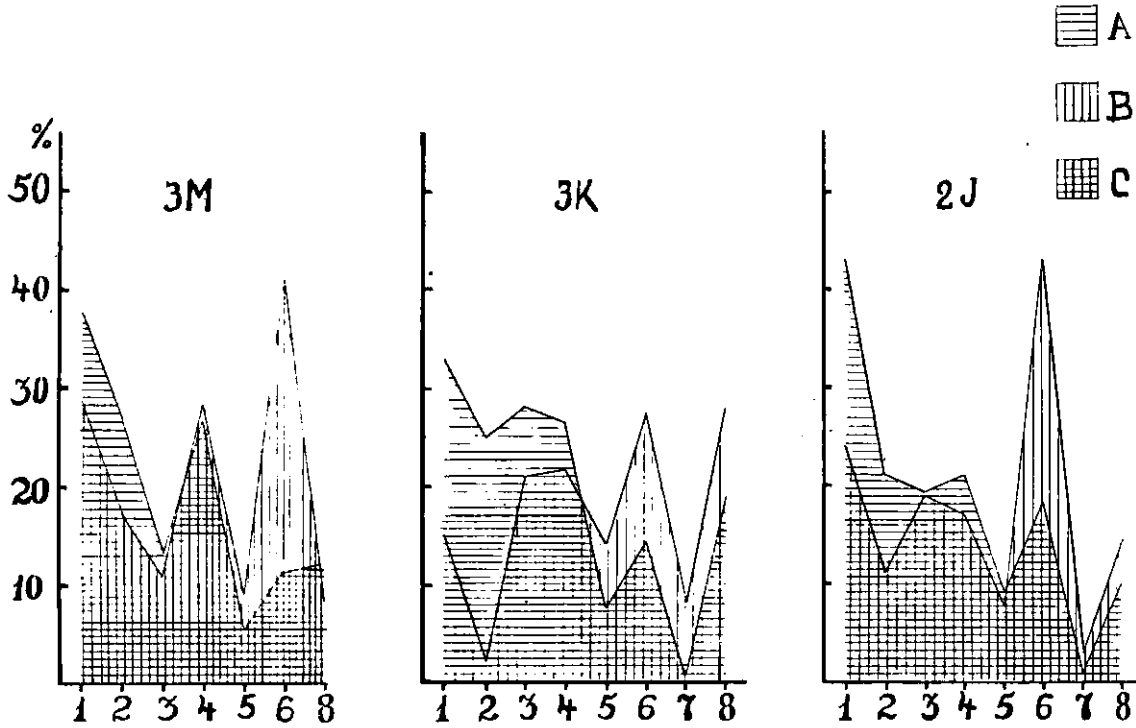


Fig. 7 - Comparison of compositions of food of "beaked" redfish and *Sebastes Marinus* from areas 3M, 3K, and 2J (frequency of occurrence, %). Based on the data collected in 1956-1960

A - Food of "beaked" redfish; B - Food of *Sebastes marinus*;  
C - Common food

1 - Euphausiidae; 2 - Copepodes; 3 - Amphipodes;  
4 - Other plankton organisms; 5 - Shrimps;  
6 - Lantern anchovy; 7 - Capelin; 8 - Other fish



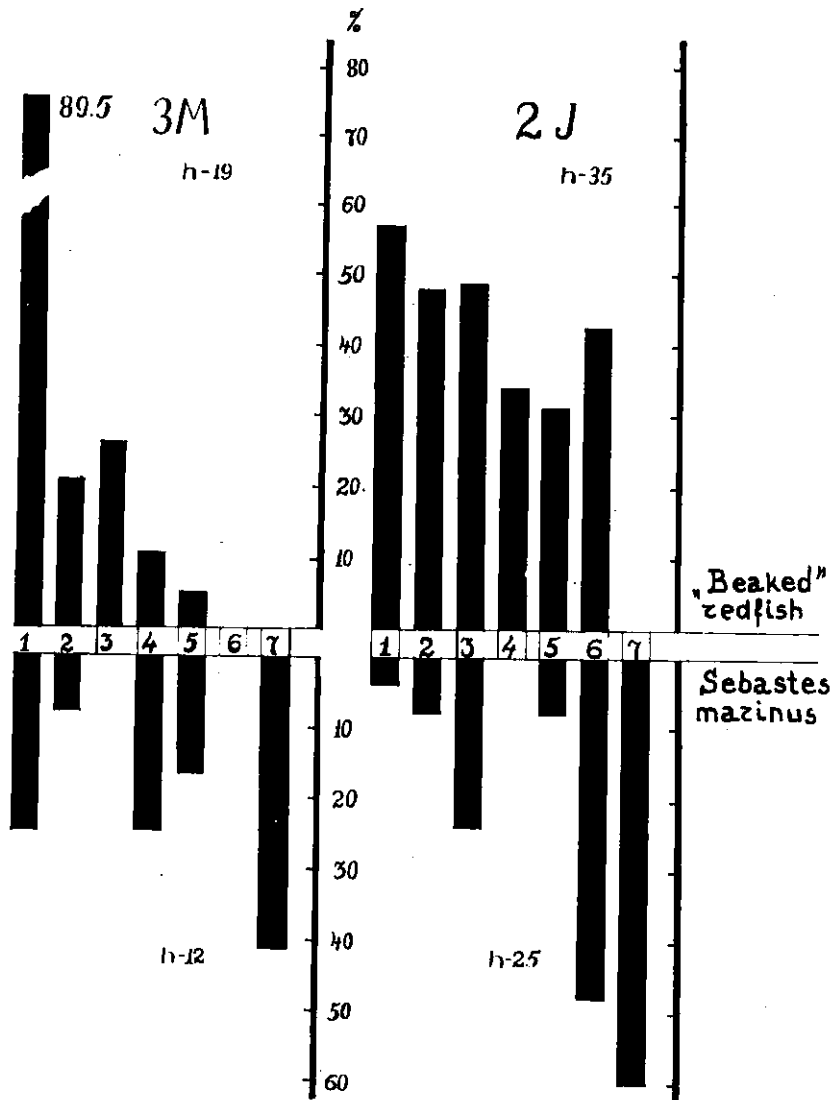


Fig. 8 - Comparison of compositions of food of "beaked" redfish and *Sebastes mazinus* captured at the same time and the same stations in areas 3M (March) and 2J (August)  
1 - Copepoda; 2 - Sagitta; 3 - Euphausiidae  
4 - Amphipodes; 5 - Shrimps; 6 - Lantern anchovy;  
7 - Other fish

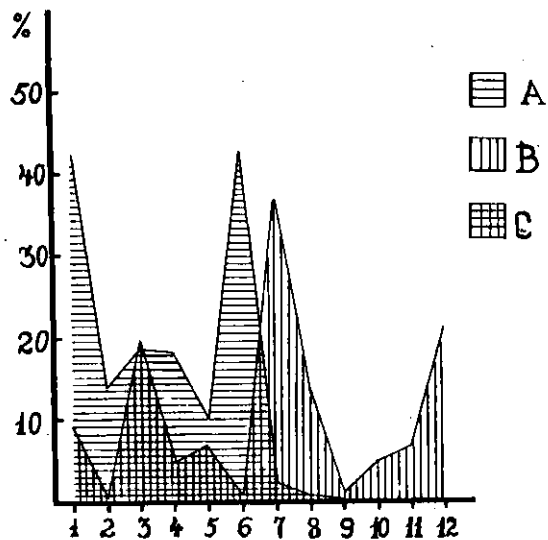


Fig. 9 - Comparison of compositions of food of "beaked" redfish and cod from the North-Eastern Slope of the Great Banks (3L)

A - Food of "beaked" redfish (from the data collected in 1957-1960);

B - Food of cod (from the data collected in 1959);

C - Common food

1. Euphausiidae; 2 - Copepodes; 3 - Amphipodes;

4 - Other plankton organisms; 5 - Shrimps;

6 - Bathypelagic fish; 7 - Capelin; 8 - Sand-eel;

9 - Redfish; 10 - Gadoid fish; 11 - Other demersal fish;

12 - Benthos

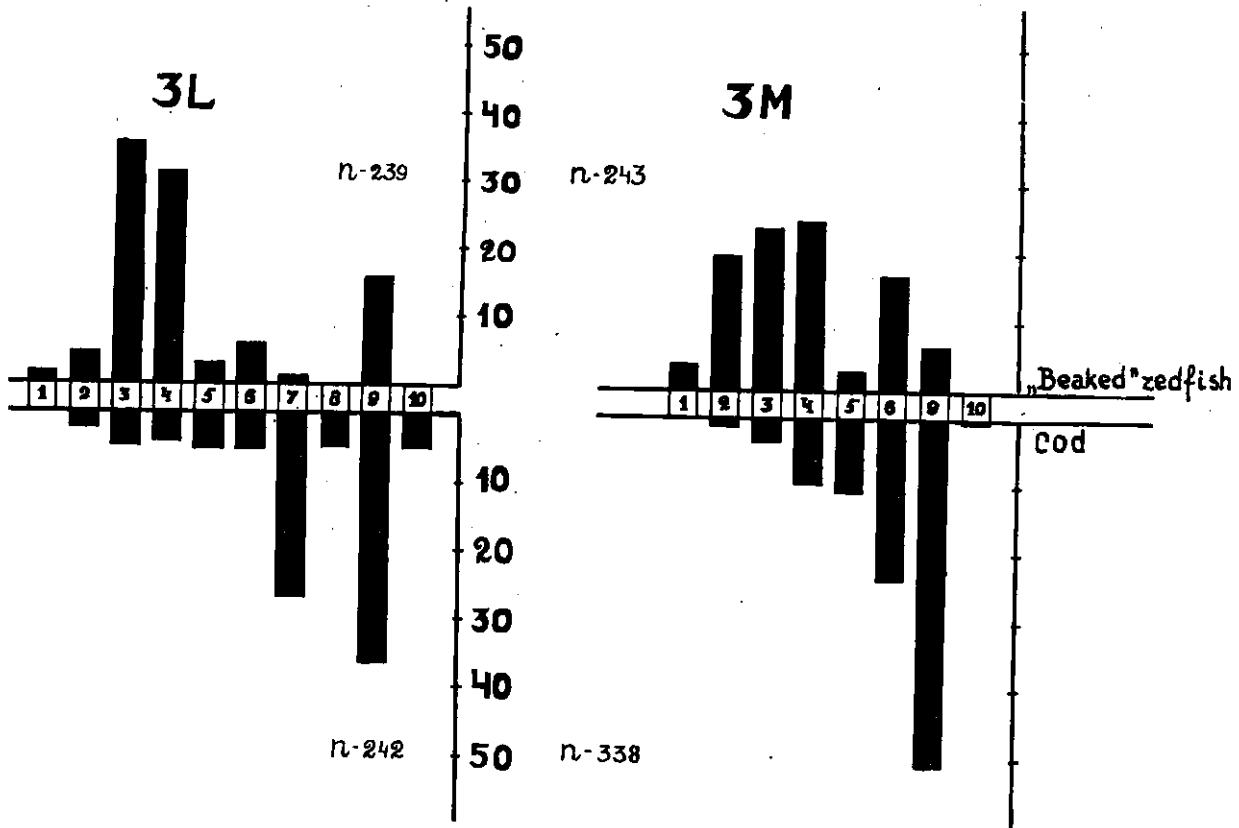


Fig. 10 - Comparison of compositions of food of "beaked" redfish and cod captured at the same time and same stations in areas 3M and 3L

- 1 - Copepodes; 2 - Sagitta; 3 - Euphausiidae;
- 4 - Amphipodes; 5 - Shrimps; 6 - Lantern anchovy;
- 7 - Capelin; 8 - Sand-eel; 9 - Other fish; 10 - Benthos