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Feeding Peculiarities of the Main Commercial Fishes on the Flemish Cap and Northern Newfoundland Banks in Spring-Summer 1987

by

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ABSTRACT

The qualitative and quantitative compositions of cod and redfish (Sebastes mentella) feeding on the Flemish Cap Bank (3M) as well as cod and Greenland halibut on the Northern Newfoundland Bank (3K) were studied by the materials collected in the cruise carried out by the RV "Persey-III" (MB-1202) in spring-summer 1987. The intensity of fish feeding in that period depended on prey distribution ; on the whole, it was not high over the areas. A relationship between the fish size and species composition of their prey was well pronounced on the Flemish Cap Bank. Copepoda, Hyperiidae and also the redfish juveniles were the main food components of the commercial fishes.

Species composition of food objects of cod and halibut with an increase of fish size is nearly unaffected on the Northern Newfoundland Bank. Shrimp and capelin are the main objects of their feeding.

INTRODUCTION

The problems on feeding and trophic interrelation of the commercial fishes from the Northwest Atlantic are presented in the papers of the most Soviet investigators (Kashintsev, 1962; Popova, 1962; Turuk, 1978; Bulatova, Turuk, 1979). However, in the recent ten-year period in connection with the

introduction of the 200-mile economical zones the bulk of the Soviet papers on fish feeding in that area was much reduced.

Detailed and systematic studying of peculiarities of the fish feeding in the Northwest Atlantic is presented in the numerous papers of Canadian authors (Lilly, 1979; Lilly, Fleming, 1980; Bowering, Parsons, 1984; Lilly, Evans, 1986). As a rule, special attention in those papers was given to the Flemish Cap Bank as well as to the areas to the south of the Northern Newfoundland Bank. The peculiarities of cod feeding on the Flemish Cap Bank were studied in details, whereas little is known about the redfish feeding.

The peculiarities of distribution, feeding and trophic interrelations between the cod and redfish on the Flemish Cap Bank as well as the cod and Greenland halibut on the Northern Newfoundland Bank in the late of May - early in July 1987 are considered in the paper.

MATERIAL AND METHODS

The data on the field and quantitative-weight analyses for feeding of cod, redfish and Greenland halibut obtained in the cruise conducted by the research vessel "Persey-III" (MB-1202) in March-July 1987 served as the materials for the present paper. Fish were sampled from the bottom trawl catches (Bulatova et al., 1986).

When processing the data on the field analysis the frequency of occurrence of the separate feeding components in percent of the total amount of stomachs (for a scheme design of distribution of the main food objects) and in percent of the total number of food items (when analysing the relationship between the fish size and their food composition).

The quantitative-weight analysis was made according to a standard methods (Anon., 1974). Food objects, both the fishes and invertebrates were identified by species, if it was possible, measured with a precision to 0.1 cm, dried on a filtered paper and weighed with a precision to 0.01 g. Individual and total indices of stomach fullness ($^{O}/_{OOO}$) were de-

termined. The variation coefficients (%) were determined for the total mean (per a haul) indices of stomach fullness.

Table I gives the total bulk of the data processed.

RESULTS

According to the results from the investigations carried out earlier (Turuk, 1978; Chumakov, Podrazhanskaya, 1986; Lilly, Evans, 1986) the most intensive feeding of commercial fishes from the mentioned above areas was observed in summer and autumn.

The feeding of the main commercial fishes off the Flemish Cap (Div. 3M) and Northern Newfoundland (Div. 3K) Banks in spring-summer 1987 was not consistent as evidenced by a high portion of empty stomachs in samples, a wide spectrum of fish feeding as well as a broad range of variation of the total index of stomach fullness - the coefficient of variation of this value exceeds 50% nearly in all cases (Table 2).

Apparently, during our observations the main feeding of fish did not start, nevertheless, the most preferable food objects are already well pronounced. Hyperiidae (Parathemisto gaudichaudi) and redfish juveniles - in cod, Copepoda (Calanus finmarhicus, Calanus hyperboreus, Pareuchaeta norvegica) and Hyperiidae - in redfish were observed on the Flemish Cap Bank. Capelin and shrimp (Pandalus borealis) were especially important in the feeding of both cod and Greenland halibut from Div. 3K.

Food composition for cod and redfish on the Flemish Cap Bank depended on the size of feeding fish (Fig.1). Hyperiidae (the frequency of occurrence is about 75% of the total number of food items in stomachs) were the main food objects in the feeding of small cod (to 40cm long); the importance of redfish juveniles (the frequency of occurrence - to 50%) and other fish species, in particular juveniles of their own, was growing in the feeding of fish over 50 cm long. Copepoda (the frequency of their occurrence for fishes less than 30 cm long made up 65-74% of the total number of food items) were

the main objects for small redfish. The importance of squid, shrimp and other fish grew for larger redfish.

The bottom peculiarities of the Flemish Cap Bank enable to follow some regularities in the distribution of cod and redfish and when determining the trophic interrelations between these fishes. Cod population occupies the bank shallows and a part of its slopes approximately to 400 m depths. Redfish occur on the slopes from about 200 m depth and over (Fig. 2).With an increase of size of cod and redfish the depth of their occurrence is enhanced; in those areas where the distribution of the fishes is overlapped, large cod and small redfish are observed, the feeding spectrum of which, as it was mentioned above, are essentially distinguished. Thus, these fishes are not the food competitors, whereas the trophic relationship of "predator-prey" between cod and redfish is one of the most typical peculiarities of the Flemish Cap Bank (Lilly, 1979, 1980; Lilly, Evans, 1986). Cod fed on redfish juveniles most intensively in sprin-summer 1987 on the northwest slope of the bank where the dense redfish concentrations belonging, apparently, to the 1984 abundant year class were recorded (Akhtarina, 1987). In the feeding of large cod, occurring in the shallows (to 200 m depth) the juveniles of their own are of great importance. According to the data from Templeman (cited by Lilly, 1979), cod cannibalism was observed on the Flemish Cap Bank in case of a low abundance of small redfish. Relatively high frequency of cod juvenile occurrence in stomachs of large fishes, noted in our paper, apparently, resulted from a high abundance of cod juvenile, belonging to the 1985-1986 strong year classes and not from the low abundance of small redfish.

With an increase of fish size the species composition of their food objects did not essentially vary on the Northern Newfoundland Bank (Fig.I). Apparently, only the prey sizes were unaffected: according to the data from Lilly and Fleming (Lilly and Fleming, 1980) a minimum cod size under which it

can feed on adult capelin is about 35 cm. Smaller specimens prefer capelin juveniles.

During the observations the main portion of capelin shifted to Div. 3L and only its separate concentrations on which both the cod and Greenland halibut fed on intensively were registered in the south and southwest of the Northern Newfoundland Bank. In the north of the area the importance of shrimp in their feeding, especially for cod, was growing (Fig. 3).

As the shrimp and capelin are the main food objects for the cod and Greenland halibut, then, apparently, a competition for food may arise between these fishes from this area. Varied depths of inhabitance as well as different behaviour of the Greenland halibut and cod when feeding are the mechanisms reducing the competition. As a rule, Greenland halibut feed only in pelagial, its spectrum of feeding is narrow and includes fishes and pelagic crustaceans. Compared to the Greenland halibut, a spectrum of cod feeding considerably extended due to the consumption of the bottom animals, principally crabs. Similar peculiarities were observed in the feeding of cod and Greenland halibut in the Labrador area (Bowering, Parsons, 1984).

CONCLUSIONS

In June-July 1987 the intensity of feeding of the main commercial fishes on the Flemish Cap and Northern Newfoundland Banks was closely related with the distribution of food objects. Clear discrepancies in the feeding of different size groups were pronounced on the Flemish Cap Bank. Hyperiidae are the main food objects for small cod. The importance of fish food in cod feeding grows with an increase in its size: redfish juveniles - in the deepwater areas and those of cod - in the shallows.

Copepoda is very important in the feeding of small redfish. With an increase of fish size the importance of large

and mobile prey - squid, shrimp and fish objects - grows in its feeding.

No clear relationship between the fish size and their food composition is pronounced on the Northern Newfoundland Bank; capelin and shrimp are the main food objects in the feeding of both cod and Greenland halibut. Compared to the Greenland halibut the spectrum of cod feeding is broader due to its consumption of the bottom organisms.

Food components observed in the stomachs of cod, redfish, Greenland halibut in Divs. 3M and 3K in June-July 1987

Food objects	3M		3K	
	cod	redfish	cod	Greenland halibut
Class Ctenophora		+		
Class Polychaeta			+	
Class Crustacea				
Order Copepoda				
Calanus finmarchicus		+		
Calanus hyperboreus		+		
Pareuchaeta norvegica		+		
Order Mysidacea				
Erythrops erythrophihalma			+	
Order Cumacea			+	
Order Amphipoda	+			
Neochela sp.			+	
Parathemisto gaudichaudi			+	+
Order Euphausiacea				
Meganyctiphanes norvegica				
Thysanoessa longicaudata		+		
Order Decapoda				
Pandalus borealis	+	+	+	+
Hyas araneus			+	
Class Gastropoda			+	
Class Bivalvia			+	
Class Cephalopoda				
Brachiotheutis riisei				
Rossia pulpebrosa			+	
Class Chaetognatha				
Class Ophiuroidea			+	
Class Pisces				
Family of Scorpaenidae				
Sebastes mentella (juveniles)	+			
Family of Gadidae				
Gadus morhua morhua (juv.)	+			
Family of Osmeridae				
Mallotus villosus villosus			+	+
Family of Anarhichadidae				
Anarchichas spp.	+			
Family of Ammodytidae				
Ammodytes spp.				+
Family of Moridae				
Antimora rostrata				+
Family of Myctophidae		+	+	
Family of Bathyladidae		+		
Family of Chauliodontidae		+		

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Table I. The total bulk of material, number of spec.

Species	Quantitative-weight analysis		Field analysis	
	3M	3K	3M	3K
Cod	33	75	719	624
Redfish	57	-	2136	-
Greenland halibut	-	51	-	1187
Total	90	126	2855	1811

Table 2. Feeding intensity of cod, redfish and Greenland halibut in Divs. 3M and 3K in spring-summer 1987

Food objects	Individual index of stomach fullness, ‰			
	3M		3K	
	Cod	Redfish	Cod	Gr.halibut
Copepoda	-	11.2	-	-
Hyperiidae	46.2	11.5	-	1.8
Euphausiids	0.3	1.5	-	-
Shrimp	4.7	4.7	45.4	23.5
Crabs	-	-	3.9	-
Squid	-	10.2	-	-
Capelin	-	-	5.2	254.6
Redfish juveniles	86.6	-	-	-
Other fishes	1.2	6.2	2.3	52.9
Total index of stomach fullness, ‰	141.3(55.8)	55.8(63.6)	68.7(47.7)	354.0(67.2)
Portion of empty stomachs,%	18.5	57.6	47.0	69.5

Note: coefficient of variation of the total index of stomach fullness , % is given in brackets.

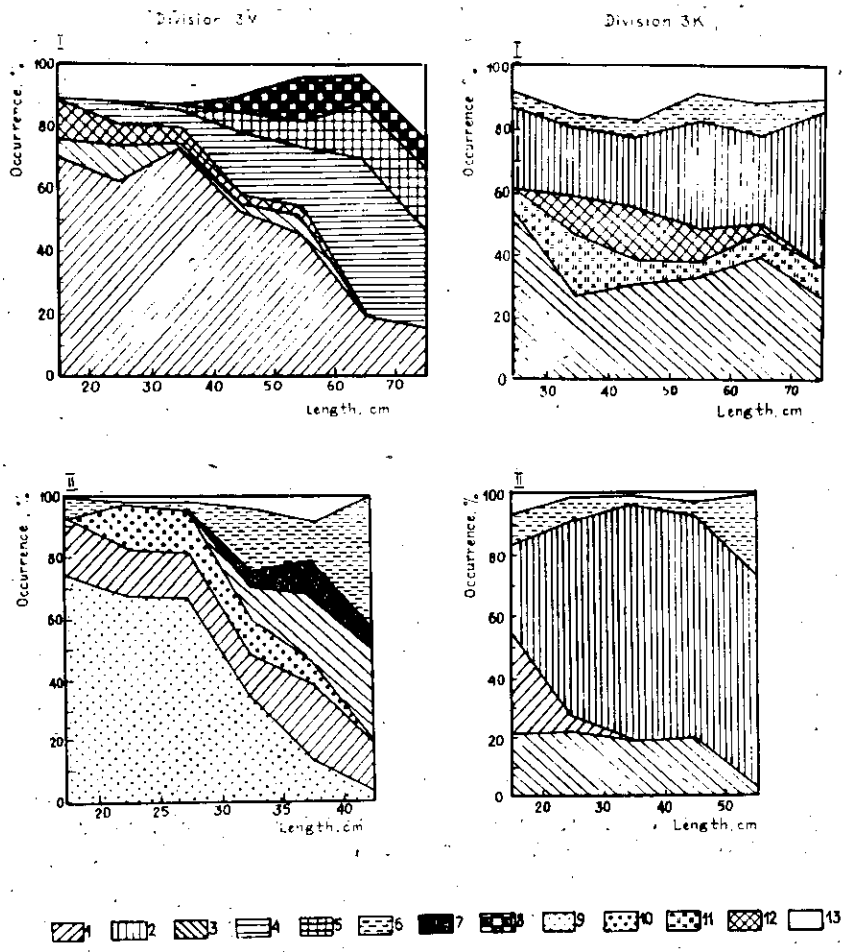

Fig.1. Variation of food composition of the main commercial fishes of the Northwest Atlantic in connection with the growth(frequency of occurrence in % of the number of food items).

Div. 3M: I - cod, II - redfish.
Div. 3K: I - cod, II - halibut.
Conventional signs: I - Hyperiidae;
2 - capelin; 3 - shrimp; 4 - redfish juveniles;
5 - cod juveniles; 6 - other fishes;
7 - squid; 8 - Ctenophora; 9 - Copepoda;
10 - euphausiids; II - crabs;
12 - other crustaceans; 13 - other food.

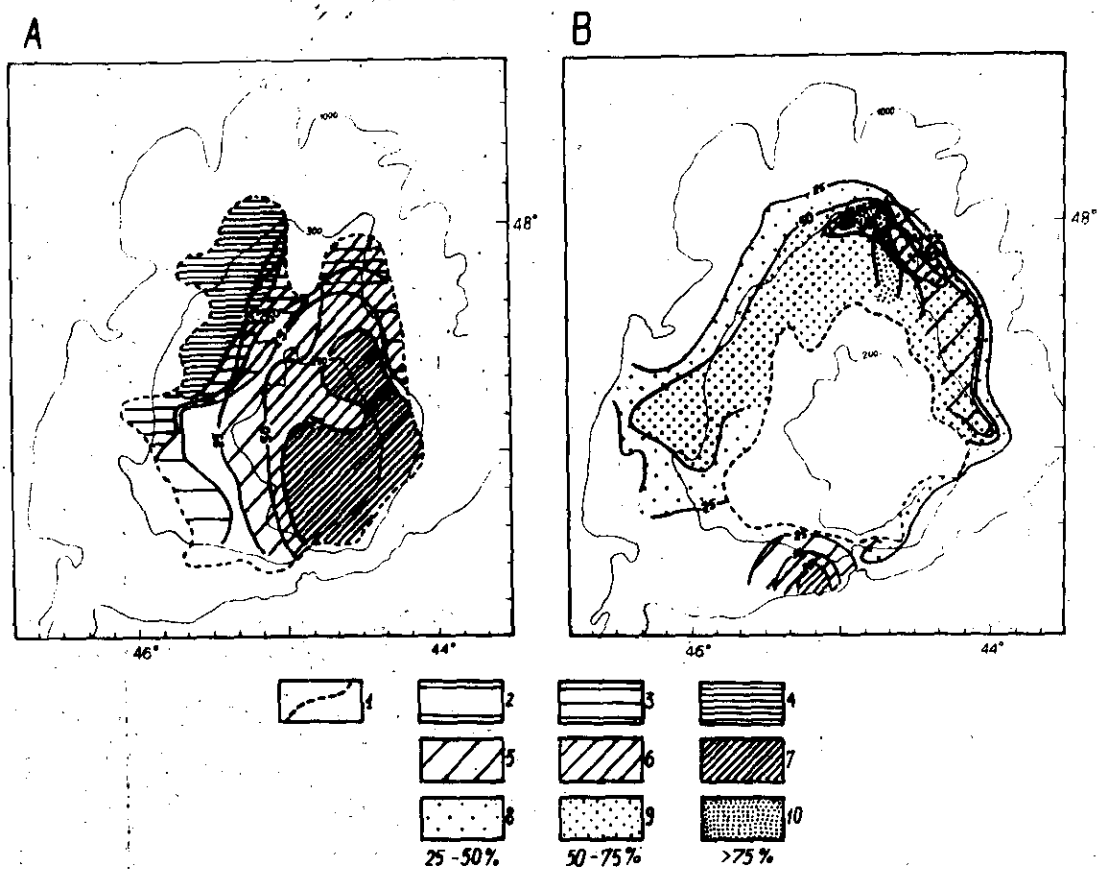

Fig. 2. Distribution of the main food objects of cod and redfish in Div. 3M (May -June 1987).

Conventional signs: I - boundaries of distribution of cod (A), redfish (B); 2-4 - frequency of occurrence of redfish juveniles (%); 5-7 - Hyperiidae; 8-10 - Copepoda.

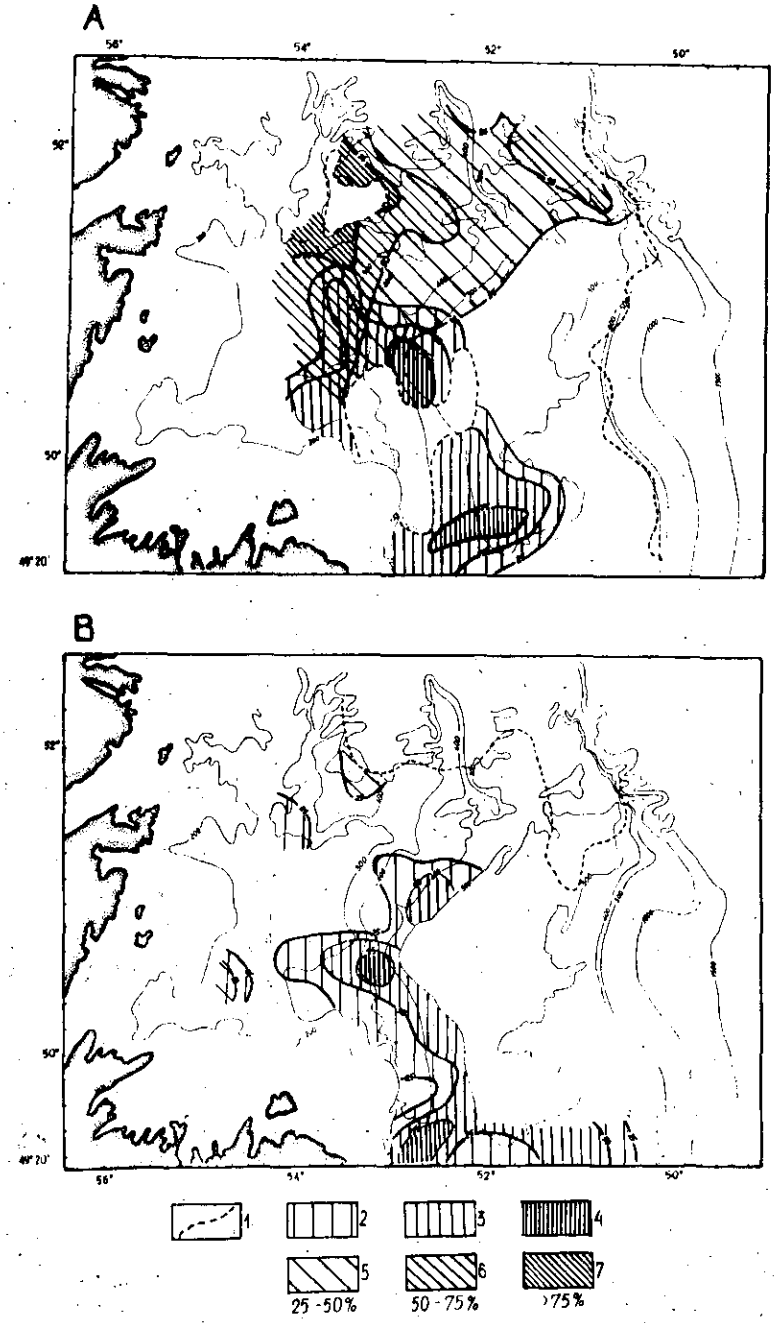

Fig.3. Distribution of the main food objects of cod and halibut in Div. 3K (May-July 1987).

Conventional signs: I - boundaries of distribution of cod (A) and halibut (B); 2-4 - frequency of occurrence (%) of capelin; 5-7 - shrimp.