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#### Feeding and Food Relations of Some Fish Species in the Labrador and Newfoundland areas

by

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#### Abstract

The analysis of stomach content of 15 fish species caught at the Labrador and Newfoundland coast showed essential differences and similarity in their feeding by areas and months.

The coincidence of food spectra of cod, Greenland halibut, beaked redfish and American plaice is great, but food competition between them is hardly possible because of different dwelling depths.

## Introduction

The investigation of selective relation of fish to some food organisms is a starting point in the analysis of interspecific and intraspecific relations of fish. This problem is of great importance because the occurrence of competition is possible in case when different fish species have similar demands. Some investigators determined the values of food similarity of fish, as well as food competition between them at different stages of their development having utilized the results of fish studies. (Zheltenkova, 1969, 1972, 1973). Few papers on feeding of Northwest At lantic fish are available, just some of them touch upon food relations between these fish species (Podrazhanskaya, 1968, 1969; Konstantinov and Podrazhanskaya, 1972; Yanulov, 1963).

In this paper an attempt is made to connect two links - "food

organisms" - "fish" - by means of some indices. The aim of the contribution is to give a brief quantitative characteristic of feeding of some Northwest Atlantic fish species which are the most important in commercial respect and to clear out food similarity between them.

# Material and methods

The data of field analysis of fish feeding taken in the areas of the South Labrador and the Grand Bank of Newfoundland by the FRV "Persey - III" from May till August 1978 were the material for the paper.

While analysing the initial data the following values were calculated:

1. The frequency of occurrence of food components in fish stomachs calculated by a number of filled stomachs.

2. The degree of stomach filling by the 5-division scale: O-empty; 1-some organisms are found; 2-slight filling of the stomach; j-full stomach; 4-walls of the stomach are streched.

3. The average stage of stomach filling calculated as the arithmetic mean of the stage of filling of every examined stomach.

4. The coefficient of food similarity by K.P. Yanulov's formula (1962)

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

where N is the sum of the greatest and n - the sum of the smallest values of occurrence frequency of all food objects in fish compared. CFS is equal to zero when food components are quite different, and it is equal to 100 when food components are quite similar.

In all 22137 specimens (Table 1) relating to 15 species were investigated:

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cod - <u>Gadus morhua morhua</u>
beaked redfish - <u>Sebastes mentella</u>
redfish - <u>Sebastes marinus</u>
American plaice - <u>Hippoglossoides plattessoides</u>
witch flounder - <u>Glyptocephalus cynoglossus</u>
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rusty dab - Limanda ferruginea

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Greenland halibut - <u>Reinhardtius hippoglossoides</u> roughhead grenadier - <u>Macrurus berlax</u> northern wolffish - <u>Anarhichas latifrons</u> Atlantic wolffish - <u>Anarhichas lupus</u> spotted wolffish - <u>Anarhichas minor</u> white hake - <u>Urophycis tenuis</u> blue whiting - <u>Micromesistius poutassou</u> longhorn sculpin - <u>Myoxocephalus ostdecemspinosus</u>

thorny skate - Raja radiata

Fish species of the following areas were investigated: 1) the South Labrador (2J), 2) the Notre Dame Bay (3K), 3) St.John's area (3L), 4) the South Newfoundland (3N), 5) the Southwest New foundland (3 0), 6) the Flemish Cap Bank (3M).

### Results and discussion

Food of cod at the Labrador and Newfoundland coasts in spring summer is very diverse. Comparison of data in feeding of cod from different areas shows its high food plasticity. Depending on food stock of the area cod feed on both bottom crustacea (shrimp, crab, <u>Amphipoda</u>), and pelagic ones (<u>Themisto</u>, euphausiids) as well as fish (capelin, sand eel, lanternfish). Dissection of cod stomachs from the South Labrador area (2J) and the Notre Dame Bay (3K) showed that there was little food in the stomachs and it consisted mainly of invertebrates - <u>Themisto</u>, shrimp, etc., because capelin and sand eel stocks in the Labrador waters at this time are poor. In the eastern and western Newfoundland waters (3L, 3N, 3O) cod consume a lot of capelin and sand eel, and <u>Themisto</u> and lantern fish arethe main component of their food on the Flemish Cap Bank.

Redfish feed mainly on plankton organisms (<u>Copepoda</u>) and lanternfish. Besides <u>Amphipoda</u>, mainly <u>Hyperiidae</u> (<u>Themisto</u>) as well as euphausiids were found in redfish stomachs. The greatest amount of organisms found in redfish stomachs are pelagic. Not one of food organisms can be considered purely benthic. Redfish are typical plankton-eaters. There is slight difference in food of redfish in different areas. Thus, beaked redfish feed on copepodes on the Flemish Cap Bank (3M) more intensively than on the Grand Bank of Newfoundland, and in the area of St. John's (3L) capelin are found in their stomachs occasionally.

In contrast to redfish, <u>Pleuronectidae</u> (American plaice, witch flounder and rusty dab ) and also three species of <u>Anarhichadidae</u> are benthophages. Their stomachs are filled with benthos: worms, <u>Isopoda</u>, molluscs, <u>Ophiura</u> and hedgehog. Worms and molluscs are the main component of <u>Anarhichadidae</u> food; wolffishes feed on more coarse bottom food (<u>Ophiura</u>, starfish, hedgehog).

Greenland halibut feed mainly in the bathypelagial. Capelin and sand eel are the main objects of Greenland halibut feeding. As to invertebrates Greenland halibut feed on <u>Themisto</u>, euphausiids, shrimp.

Bottom organisms (polychaetes, <u>Mysidacea</u>, <u>Isopoda</u>, <u>Ophiura</u>) and bottom shrimp and squid are predominant in food of rough head grenadier.

The main food of thorny skate and <u>Gobiidae</u> includes polychaete worms, shrimp, <u>Isopoda</u>, crab and to a lesser degree - sand eel. Blue whiting feed mainly on copepodes and <u>Themisto</u>; white hake on euphausiids and squid. Food components of the main commercial fish species in the Labrador and Newfoundland areas are given in Figs. 1 and 2.

The coefficients of food similarity calculated for fish caught in the Labrador and Newfoundland areas are given in Table 2. In spite of apparent difference in food spectra of considered fish species, they concentrate on certain food components, and there arises the possibility of competition between them during some months.

Due to the importance of sand eel as a food object cod have great food similarity with Greenland halibut (CFS = 62.0) and American plaice (37.0) in the South Labrador area in July and in St. John's area in May (CFS are 64.0, 53.6, respectively).

Feeding on <u>Themisto</u> and shrimp, cod have similar food with beaked redfish and Greenland halibut in the Notre Dame Bay (CFS = 64.0, 49.7) and in the South Labrador area (54.8, 64.0).

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In the Southwest Newfoundland cod have considerable food similarity with beaked redfish (31.1) and white hake (37.9) during summer (June) feeding on euphausiids and <u>Themisto</u>.

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Great food similarity is registered in cod and beaked redfish (24.8) and in cod and blue whiting (31.1) on the Flemish Cap Bank in July. Beaked redfish and redfish also have similar food (copepodes) (CFS = 67.5).

<u>Anarhichadidae</u> and <u>Pleuronectidae</u> have similar bottom food everywhere. CFS varies from 51.7 to 75.9.

Thus, food spectra of cod and other fish species of the Northwest Atlantic are rather similar and in most areas the coefficient of food similarity is high. However, it does not prove the existence of food competition. The competitive relations between cod and beaked redfish are unlikely to appear, because redfish keep mainly to the 300-500 m depth, while cod - up to 250-300 m.

Cod and Greenland halibut feed on the same food organisms (shrimp, sand eel), but in connection with the fact that the latter species predominate mainly at great depths (400-800 m), food competition is also excluded here notwithstanding the similarity of food spectra.

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Table 1. Number of stomachs dissected to investigate feeding in the Newfoundland and Labrador areas in May-August 1978.

Species area	od	Beake red- fish	ad <sub>Red-</sub> fish	Ame- rican plaic	Witch floun- der	Dab	Green land hali- but	Nor- ther gre- nadi	Nor - n: thern :wolf- erfish	Spotte :wolf- :fish	al At- lantic wolf- fish	White hake	Blue whit ing	: Long- - horn bcul- : pit	Thor- ny skate	Total
South Labrador (2J)	786	575	7	1129	-	-	75I	88	<b>2</b> 50	40	6 <b>20</b>	-		-	-	<b>424</b> 6
Notre Dame Bay (3K)	47I	II55	-	893	527	-	783	5	109	23	407	<u> </u>	-	·	×. <del>-</del>	4373
St.John's area (3L)	838	731	25	1150	44	50	572	20	4	2	57		-	-	-	3493
South Newfound-I land (3N)	135	775	. –	1597	48	<b>3</b> 66	<b>I</b> 67	414	2	I	17	-	-	24	93	4639
South- west New- foundland	.7 <b>2</b> 6 (30)	<b>33</b> 6	• - ·	878	33	470	Ĭ	-	-	-	6	88		-	-	<b>2</b> 5 <b>3</b> 8
Flemish	783	74I	327	627	12	-	42	-	51	21	226	-	18	·	-	2848
Cap Bank Total 4	(3M) 739	4313	359	6274	664	886	<b>23</b> I6	5 <b>2</b> 7	416	87	1333	88	<b>I</b> 8	.24	93	22137

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Table 2. Coefficient of food similarity (%) for some fish species in the Labrador and Newfoundland areas.

Division	Species	Beaked	American plaice	Greenland   halibut	Northern wolffish	: Spotted wolffish	:Roughhead :grenadier	
	Cod	<u>- 19011511</u> 54.8	19.2	64.0	9.2	8.4	33.9	
2j July	Beaked redfish		6.3	31.5	4.4	3.4	21.1	
	American plaice			I4.0	33.3	36.4	40.5	
	Greenland halibut			,-	II.5	12.6	37.I	
	Atlantic wolffish	алан тараан т Тараан тараан т				64.0	14.6	
	Spotted wolffish	• • • •					I5.0	
	:	Beaked	:American	:Greenland :	Witch flounde	rNorthern	Spotted	
		: redfish	: plaice	:halibut :		:wolffish	wolffish	
	Cod	64.0	II.I	49.7	5.9	22.2	I4 <b>.</b> 3	
	Beaked redfish		3.I	46.9	2.5	22.7	16.2	
3 к	American plaice			3.I	41.2	51.7	38.7	
July	Greenland halibut	<b>;</b>			3.4	19.4	15.3	
	Witch flounder					5.8	4.I	
	Northern wolffi	sh				· · · · ·	75.9	
		:Beaked red- : fish	:American : plaice			<u> </u>		
3L May	Cod		53.6					
	<u></u>	: Beaked : redfish	: American : plaice	:Greenland : halibut	: Atlantic : wolffis	h : Dab	:	
	Cod	38.9	I8.3	20.0	7.9	I8.6		
	Beaked redfish		9.3	18.9	5.I	Ι.6		
3 L .	American plaice			5.0	67.8	I9.I		
June	Greenland halibu	ut sh			2.6	I.2 21 9		
	:	Beaked redf	ish: American : plaice	:Greenland	: Witch : flounde	Dab	:Longhorn :sculpin	
	Cod	40.3	37.0	62.0	IO.I	 I3.0	23.I	
	Beaked redfish		19.0	33.6	8.7	9.I	14.2	
З <sup>№</sup>	American plaice			22.0	I6.3	60.I	49.I	
June	Greenland halibu	it.		5 A.	I.4	3.6	5.8	
	Witch flounder					47.2	II.4	
	Dab						I2.7	
	:	Beaked redfish	American plaice	:Greenland : libut	ha:Roughhead : grenadie	r : skate	:	
	Cod	7.I	20.7	84.6	37.2	67.4		
	Beaked redfish		2.5	I.7	2.3	I.I		
3 N	American plaice			33.5	38.7	4I <b>.</b> 4		
Augus	t Greenland halibu	it			37.8	67.4		
	Roughhead grenad	lier				62.3		
		Beaked redfish	American plaice	:Witch flounder	: Dab	: White ha	ke :	
	Cod	31.1	28.6	I4.I	I5.2	37.9		
	Beaked redfish		I2.2	3.7	4.I	37.5		
30,	American plaice			24.7	43.3	20.7		
June	witch flounder				57.6	4.8		
	Dab	·		- -		8.4		
		Beaked redfish	: Redfish	:American : plaice	:Green- :No :land h.:wo	orthern:Spotte olffish: wolf	ed :Blue fish:whiting	
	Cod	24.8	10.1	6.8	I2.8	22.8 I5.2	2 3I.I	
	Beaked redfish		67.5	I.2	4.9	10.9 4.5	5 59.7	
з <sup>м</sup> ,	Redfish			I.0	0.6	0.6 0.6	5 <b>29.</b> 8	
July	American plaice					66.3 69.3	2 0.9	
v	Greenland halibut					7.7 4.7	7 15.4	
	Northern wolffish					66	[ 7.7	
	Spotted wolffish						4.7	



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Fig. 1. Frequency of occurrence of food organisms in cod (1) and American plaice (2) in Div. 3L in May (A); in cod (1) and beaked redfish (2) in Div. 3K in July (B); in cod (1) and Greenland halibut (2) and in cod (1) and beaked redfish (2) in Div. 2J in July (C,D). Food organisms: 1 - copepodes; 2 - Sagitta; 3 - euphausiids; 4 - Themisto; 5 - Amphipoda; 6 - shrimp; 7 - worms; 8 - polychaete worms; 9 - Isopoda; 10 - crabs; 11 - gastropods; 12 - bivalve molluscs; 13 - squids; 14 - starfish 15 - Ophiura; 16 - Diadematoidea; 17 - Glypeastroidea; 18 - capelin; 19 - sand eel; 20 - lanternfishes.



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Fig. 2. Frequency of occurrence of food organisms in cod (1) and beaked redfish (2); and in cod (1) and white hake (2) in Div. 30 in June (A,B); in cod (1) and beaked redfish (2), in cod (1) and blue whiting (2), in beaked redfish (1) and redfish (2) in Div. 3M in July (C,D,E). The legend for food organisms is the same as in Fig. 1.

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