

Northwest Atlantic



Fisheries Organization

Serial No. N562

NAFO SCR Doc. 82/VI/69

SCIENTIFIC COUNCIL MEETING - JUNE 1982

CHARACTERISTICS OF FEEDING OF THREE SPECIES OF WOLFFISHES
IN THE NORTHWEST ATLANTIC

by

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Abstract

Qualitative and quantitative-mass analysis of stomachs content in 3 species of wolffishes exposed similarity in rations of Atlantic and spotted wolffishes. A degree of similarity between northern wolffish and two other species lessens because A. latifrons feed on bathypelagic organisms.

Wolffishes fed most actively on the Flemish Cap Bank. Northern wolffish have worse indices than Atlantic and spotted wolffishes have.

Introduction

Feeding of traditional objects of fishery in the Northwest Atlantic, such as cod, beaked redfish, grenadier, halibut is in the focus of investigations during a long time (Zheltenkova, 1961, 1972; Yanulov, 1963; Konstantinov, 1968, 1972; Konstantinov, Turuk, 1968; Podrazhanskaya, 1969; Turuk, 1973). The present paper presents characteristics of feeding of 3 species of wolffishes: Atlantic, spotted and northern in divisions of the South Labrador, Grand Newfoundland Bank (3K, 3L) and the Flemish Cap Bank. There were no such investigations in the previous years, though in some papers concerning feeding and food competition of the Barents Sea and Northwest Atlantic fishes some brief characteristics of food spectra of wolffishes are given and the coefficient of similarity in feeding (with other fishes) is calculated (Baranenkova et al., 1960; Turuk, 1980). Many authors indicate similarity in feeding of Atlantic and spotted wolffishes, particularly, the fact that Echinodermata, molluscs, Crustacea are dominant in it. It is indicated that feeding on bathypelagic Invertebrata is specific for northern wolffish, rather often their stomachs are full with Ctenophora and medusas which distinguish A. Latifrons from other species (Barsukov, 1959, 1961; Barsukov, Nizovtsev, 1960; Baranenkova, 1960; Turuk, 1980).

The present paper is aimed to generalize the materials on wolffishes feeding in Divisions of South Labrador (2J), Grand Newfound-

land Bank (3K, 3L), Flemish Cap Bank (3M) for 1977-1981, to give qualitative and quantitative-mass analysis of the data available.
Material and methods

Field analyses of wolffishes feeding made during 4 spring-summer and 3 autumn-winter cruises of R/Vs "Persey III", "Suloy" and "N.Kononov" in 1977-1980 served as the basic material for the present paper (Table 1).

Besides, in the R/V "N.Kononov" cruise in May-August 1981 several samples of stomachs were fixed in 4% formalin for their consequent treatment. All the stomach content was processed by the method of quantitative-mass analysis. Some dozens of wolffishes were frozen for their further treatment in laboratory conditions. All the fishes were weighed, measured, their stomachs were treated.

Analyzing the primary data we made such calculations:

1. Frequency of occurrence of food components in fish stomachs calculated by the total number of stomachs (including empty);
2. Degree of stomach fullness: 0-empty, 2-slight filling of the stomach, 1-some organisms are found, 3-full stomach, 4-walls of the stomach are stretched;
3. Average index of stomach fullness calculated as mean arithmetical from index of fullness of every stomach examined;
4. Average general index of stomach fullness (in %/ooo);
5. Index of stomach fullness by frequency of occurrence of food components (in %/ooo);
6. Coefficient of food similarity (CFS) by Yanulov's formula (1963).

CFS = $\frac{n}{N} \cdot 100\%$ where N - sum of maximum, n - sum of minimum values of frequency of food components occurrence in fishes compared.

At complete difference of food the CFS equals to zero and at complete similarity -100%.

Feeding of the Northwest Atlantic wolffishes

First of all it is worth mentioning about one most characteristic biologic peculiarity of wolffishes - a specific construction of dental system. All the species have much in common: strongly developed teeth are located on intermaxillae, mandibles, palate bones and vomer. With the help of hook-shaped teeth located on the frontal parts of maxillae and mandibles wolffishes tear the food off the substrate. Conic and round teeth on sides of jaws, on vomer and palate bones of Atlantic and spotted wolffishes which serve for crushing of solid external skeletons of bottom animals rub off rather quickly and they are replaced by new ones annually. Fangs of northern wolffish are smaller and sharper than those in other species, they are not rubbing off. Apparently, they are not accustomed fro tearing off the organisms from the substrate and serve mainly for retaining the floating food; many morphologic features of northern wolffish testify to the fact that they are to a lesser degree connected with the bot-

tom than other species of wolffish (Barsukov, 1959, 1961; Barsukov, Nizovtsev, 1960).

Species composition of food objects in wolffishes is given in Tables 2, 3. The field analysis showed that a great variety of organisms were found in wolffishes stomachs, though only some of them were the main food objects. The most widely-distributed objects of wolffishes feeding are Echinodermata, mainly Ophiurae (Table 4).

A considerable place in A.lupus feeding take also bivalve molluscs, Gastropoda, crabs. Stomachs of A.minor often contain crabs and worms. Echinodermata and crabs are frequent in northern wolffish feeding but compared with other species of wolffishes organisms with solid carapace are of less importance, these species more often feed on floating Mollusca: Ctenophora, medusas which testifies to a lesser connection of A.latifrons with the ground.

In stomachs examines all external skeletons of bottom organisms were almost always crushed. Sand, silt and stones are frequent in wolffishes stomachs.

Thus, our investigations completely conform to the opinion that Atlantic and spotted wolffishes are typical benthophages which have a considerable coincidence of feeding spectra. Coefficient of food similarity for these species is rather high: 69.9%. The greatest difference in feeding is between Atlantic and northern wolffishes: CFS = 32.9%. The degree of food similarity in these species is lower due to feeding on different organisms. Coefficient of food similarity of spotted and northern wolffishes equals to 42.5%. Food composition of wolffishes in different areas differs slightly.

Indices of stomach fullness for Atlantic and spotted wolffishes vary in different areas but they are always higher than those of Northern wolffish. The results of analyses of the fixed and frozen samples are given in Table 5. High values of stomach fullness indices in fish analysed and also higher average indices of stomach fullness in spring-summer compared with those in autumn-winter (Table 6) allow us to consider that spring-summer is the period of an intensive feeding of wolffishes.

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Table 1 Number of wolffishes stomachs treated by the method of field analysis in Div. 2J, 3K, 3L, 3M in April-August 1977-1980

Table 2 Food composition and partial indices of stomachs fullness
(in ‰) (fixed material)

Objects of feeding	2J		3K		3 L		3 M	
	north		Atl.	spot.	north	Atl.	north	Atl.
	atl.	spot.	atl.	spot.	atl.	spot.	atl.	spot.
Hydroidea	0,7	0,5	3,2		I,4			
Themisto libellula					0,2			
Gammaridea			2,7					
Calathura brachiata			3,I					
Brachyura sp.	0,I	0,4	I,7	4,4				
Ilyas sp.					7,3			
Pagurus pubescens	0,I	5,2		II,I			9I,6	
Pandalus borealis		I2,6	5,3	3,0				7,4
Solariella obscura		I,5						
Trichotropis borealis			0,I					
Buccinum sp.		I09,I	9,I		36,I			
Gastropoda spp.		7,2			I5,I		4,5	27,2
Bivalvia		27,I			5,5 I,9		2083,4	2,3
Strongylocentrotus	I,5		5,3	I8,8 I0,3			7,0	
Clypeastroidea			I,I				I05,4	395,7
Ctenodiscus crispatus		7,5	I24,7	I2,4				
Ophiocten aculeata	II,3		3,7					
Ophiura sarsi	0,I	3,I	26,4	0,3			0,6	
Ophiura sp.	37,I	I,8	3,2	7,9 I2I,4				338,9
Ophiocantha bidentata					I2,3			
Gorgonocephalus						4,4		
Tubes Polychaeta	0,I	I,2		0,8	I,8			0,I
Sebastes mentella							422,5	
Gadus morhua m.							5II,2	
Raja					I6,I			
Digested fish							2,9	49,2
Digested food				4,2				
Stone, silt, sand	I,7	85,8	I2I,0	20,7	II7,9	I3,0	229,3	I6,5 I39,I
	I,0	0,9	2,8		I4,9			4,2

Table 3 Food composition and partial indices of stomach fullness (in %/ooo)
(frozen material)

Objects of feeding	2 J		3 K		3 L	
	Atlan.	spot.	Atlan.	Atlan.	spot.	north
Hydroidea sp.	23,4			3,0	I,7	
Calathura brachiata				2,3		
Hyas sp.		280,3				
Brachyura sp.	15,6	376,9	0,4	20,32		
Pandalus borealis	44,4					
Solariella obscura				3,I	I,3	
Buccinum sp.					66,5	
Gastropoda spp.	I4,5	5,I	6,7	I5,7	0,9	
Bivalvia sp.	0,4			2,2		
Cephalopoda sp.				220,2		
Strongylocentrotus sp.	33,9		433,8			
Clypeastroidea sp.				II4,2	444,7	
Ctenodiscus crispatus	54,6		47,I			
Ophiopholis aculeata	48,8			2I9,0		
Ophiura sarsi	0,6				I4,9	0,6
Ophiura spp.		56,0		3I,9		9,9
Gorgonocephalus sp.						26,5
Tubes Polychaeta	7,I	8,5	0,4	I,2	I,8	I,I
Sebastes mentella				367,I		
Digested fish				53,9		
Digested food	2I2,6	94,6	26,2	72,3		I2,0
Stone, silt, sand	47,5			4,6	I,8	

Table 4. Frequency of occurrence (%) of different food components in wolffishes stomachs, 1977-1980

	Objects of feeding	2 J	3 K	3 L	3 M								
		Atl.	spot.	north									
Ctenophora	-	I,3	7,2	-	-	28,I	-	I3,6	0,2	3,9	8,I	-	-
Medusas	-	-	-	-	-	3,0	-	-	0,9	-	I,3	5,4	-
Copepods	0,6	-	-	-	I,7	-	-	-	-	-	-	-	-
Isopoda	0,1	I,3	-	I,4	-	I,7	0,6	0,9	-	0,3	I,3	-	-
Amphipoda	I6,8	3I,6	II,6	I3,6	9,8	9,I	II,I	7,2	4,5	8,6	-	8,I	-
Crabs	20,9	24,8	6,4	34,0	49,0	I4,7	0,8	2,7	I,8	-	-	-	-
Asteroidea	-	-	-	-	-	-	-	-	-	-	-	-	-
Ophiura	47,3	33,9	30,2	45,6	33,3	26,8	5I,2	67,6	33,6	-	-	-	-
Echinoidea	3I,9	I7,0	I2,0	20,I	7,8	2,2	37,5	37,8	5,4	-	-	-	-
Bivalve molluscs	I5,I	-	0,8	27,8	5,9	-	I3,2	9,9	2,7	I5,2	5,3	I,3	-
Gastropoda	29,2	6,6	0,6	44,9	7,8	I,3	38,I	I3,5	-	I0,I	3,9	2,7	-
Cephalopoda	0,8	-	0,8	I,8	2,0	I,7	0,4	-	-	I,8	I,3	-	-
Worms	6,2	II,8	I,6	10,0	5,9	0,4	2,9	2,7	0,9	6,4	5,3	I,3	-
Fish	0,7	-	I,6	0,8	2,0	-	I,0	II,7	-	I,6	-	2,7	-
Digested fish	-	I,3	-	0,2	-	-	0,9	-	0,9	2,2	I,3	I7,6	-
Other organisms	4,0	7,9	I,6	2,6	-	9,I	4,4	5,4	I,8	6,3	-	I,3	-
Digested food	0,2	-	I,0	0,I	-	3,9	0,6	-	3,6	0,5	-	2,7	-
Empty stomachs	30, 4	II,8	39,0	II,2	2,0	38,5	22,2	5,4	42,7	8,4	I4,5	25,4	-

Table 5. Average index of stomach fullness (in %/ooo) of wolffishes
in June-July 1981

Species	2 J	3 K	3 L	3 M
Fixed material				
Atlantic	-	II4,7	I85,I	867,3
Spotted	-	34I,I	-	728,2
Northern	3I,3	37,2	I7,4	I39,2
Frozen material				
Atlantic	26I,4	329,4	I82,4	-
Spotted	37I,8	-	45I,0	-
Northern	-	-	II,8	-

Table 6. Average index of stomach fullness in spring-summer and
autumn-winter cruises, 1977-1980

Season	2 J			3 K			3 L			3 N		
	Atl.	spot.	nor.									
spr.-sum	2,0	2,6	I,3	2,2	2,7	I,4	2,3	2,6	I,5	2,2	2,I	I,0
aut.-win.	I,I	I,I	I,2	0,4	-	0,5	-	-	-	0,5	0,6	I,8

