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The Feeding of Cod (*Gadus morhua*) on Flemish Cap 1989-90

by

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ABSTRACT

A ramdomly stratified bottom-trawl survey was carried out by C.E.E. on Flemish Cap (NAFO Div. 3M) in July and August 1989 and 1990. Cod stomachs were collected and studied: 1182 in 1989 and 530 in 1990. The cod specimens were classified by age groups.

The feeding intensity was high. The food items, prey occurrence index, the fullness index and diversity index were determined too. The Schoener overlap index was calculated to study the intraspecific diet overlap in cod. The cannibalism and the relation between predator size (cod) and prey size (redfish) was also studied.

INTRODUCTION

Cod stomach were extracted during two summer cruises carried out by B/O "CRYOS" and "IGNAT PAULICHENKOV" (Vazquez,1990 and 1991).

The qualitative and quantitative composition of fish feeding is thought to be important in growth, maturity and fecundity changes. Predation by cod on smaller cod and redfish may also produce variable mortality in juveniles, contributing in this way to variability in year class strength (Akenhead,1978; Lilly, 1985).

Although the stomachs were sampled in summer, these months correspond to the period of highest feeding intensity (Turuk, 1981), and it is known that diet is not very different during the rest of the year (Albikovskaya et al.,1989).

METHODS

Biological samples were collected during both research surveys. In 1990 a few pelagic trawls were carried out and some fry cod caught. The age distributions are shown in tables 1 and 2.

Cod stomachs were preserved in buffered formaldehyde solution (Hunter, 1985). The total length was measured to the nearest cm.. Each individual was weighed, with a precision of ±2 grs.. The otoliths were extracted for age determination.

Stomach contents were examined and the food components were separated and identified as far as possible in the laboratory. Items in each taxon were placed briefly on absorbent paper to remove excess liquid, and then weighed with a precision ±.01 gr.

The prey occurrence index, the Simpson diversity feeding index and the diet overlap index were calculated in the same way in the previous paper. The cannibalism rates were compared with those from earlier paper (Paz et al, 1989). The relative quantity of food in the stomachs and the relative importance of individual prey types was assessed using two indices.

Gravimetric index: total weigth of specific prey in all stomachs as a percentage of total weight of all prey.

Stomach fullness index, calculating the Mean Total Fullness Index (TFI):

$$TFI = \frac{1}{n}\sum_{f=1}^{n} \frac{\text{weight of stomach contents of fish "f"}}{\text{length of fish "f" exp 3}} \; .10 \text{ exp4}$$

where n is the number of stomachs examined

and the Mean Partial Fullness Index of prey "p" (PFI"p"):

$$PFI = \frac{1}{n}\sum_{f=1}^{n} \frac{\text{weight of prey "p" in fish "f"}}{\text{length of fish "f" exp 3}} \; .10 \text{ exp4}$$

The condition factor was studied with Fulton's expression:

$$C.F = \frac{\text{fish weight} * 100}{(\text{total length})^{3}}$$

When calculating the Kruskall-Wallis test, the data distribution was improved by ln transformation :

$$x(i) = \ln (x(i)+1).$$

Whenever digestive condition permitted, redfish total length was measured to the nearest mm. total length. When this was not possible, the jaw bone was measured to calculate the relationship jaw/ length by regression.

RESULTS AND DISCUSSION

The feeding intensity appears in table II: it was similar in both years but a little higher in 1990: F.I.= .978 $\pm$.023.

In tables 3 and 4 the food components are shown distributed into cod age classes. The variety of prey organisms is small. There are no marked differences between the two years. The Polychaeta stand out in the older fish in 1990. The squids (Illex Illecebrosus) were more abundant in the 1990 survey catches and in the stomach contents.

The TFI and the PFI are shown in tables 9 and 10. They confirm the greater importance of polychaetes and cephalopodes in 1990 compared with 1989.

A Kruskal-Wallis Test indicates that redfish ingestion was similar in both years. Other important prey, with high occurrence level, such as Hyperidae, Pandalus and other Crustacea, were dissimilar between the two years also were cod, polychaetes and cephalopods, all with significant diferences at the 99% level.

Both the Occurrence Index (OCI) (tables 5 and 6) and the gravimetric index (tables 7, 8 and 8 bis) indicate amphipod dominance in the younger age classes. The fishes were incorporated into the diet at age 2 in 1989 and age 3 in 1990, and their presence in both years increases with age (Tables 9 and 10). Redfish was the more important fish prey. It is interesting to note that "0" age group cod also prey on redfish larvae. Although the age group 1 do not prey on redfish and age group 2 had very low predation rates.

The food diversity was very similar in both years increasing with

the age until age group 6 or 7. The larger feeding diversity appears in the age classes 5, 6 and 7 (table 11).

There was cannibalism between age classes 4 and 7 in 1990. The cannibalism index (table 13) was greater in 1990 (4.64%) that in 1989 (0.33%) but similar to 1988 (3.78%). It has a strong year-to year fluctuation. The 1990 result is higher that obtained by LillY (1982, 1983), although her results correspond to winter.

Condition factors by age classes are given in table 12. Their levels were high and similar for the two years.

Three cod age groups were established: A= 1 and 2 years old; B= 3, 4 and 5 years old and C= 6 or more years old. The diet overlap was calculated intraspecifically (Wallace an Ramsey, 1983). The results (Table 14) indicate that cod diet changes between group B and group C . With the Mathur criterion, overlap when the index is higer than 0.6 (1977), there was only diet overlap between groups A and B in 1990. By different depths, this group index was more regular (table 15). At 100-140 fathoms the diet os A and B groups was very similar.

The diet change can be associated with the energetics of sexual maturation and the spawning process.

Predation on redfish. The dominant prey of adult cod on the Flemish Cap in summer is redfish. Their occurrence was high in 1990, but in terms of weight their importance was less

1989 OCI= 0.177, WII= 0.430

1990 OCI= 0.196, WII= 0.39

With the 1990 data the relationship between redfish jaw length and total length was obtain by the regression:

Total L= 6.770 + 6.6392 Ljaw (N= 22, r=0.95, p< 0.001,)

The parameters for the cod length and redfish length were calculated for each year. The results are:

1989: N = 58, r = 0.516, p< 0.001, y = 4.8917 + 0.20162x

1990: N = 136, r= 0.680, p< 0.001, y = 0.76614 + 0.23127x

These values indicates that the length increase of the redfish is closely related to the length of the predator. Redfish abundance in the

survey trawls by length class were compared with redfish abundance in the stomachs contents (fig. 1). The most abundant size classes were those most preyed upon in both years.

CONCLUSIONS.

a) Cod feeding intensity is high in summer.

b) The cannibalism rate has strong year -to-year fluctuations on the Flemish Cap.

c) The amount and length of prey fishes increase with cod lentgh.

d) The variation of some items (Illex illecebrosus) may reflect their availability in the area.

e) There seems to be a change in diet at age 6 in flemish Cap cod.

f) Predation is particulary important on small *redfish* length groups. It begins in "0" group cod. There is a relationship between cod length and redfish length.

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Table.1.- Numbers of cod stomachs at age collected during July 1989 and 1990 on Flemish Cap (NAFO Div.3M).

YEAR 1989

Cod age	1	2	3	4	5	6	7	8	9+
Nº stomachs	7	7	242	467	387	55	9	6	2

YEAR 1990

Cod age	0	1	2	3	4	5	6	7	8	9+
Nº stomachs	14	30	85	44	106	103	86	28	17	17

Table 2.- The Food Intensity Index of cod by age group in Div.3M in July 1989 and 1990.

Cod age	0	1	2	3	4	5	6	7	8	9+
1989		0.857	0.857	0.955	0.938	0.899	0.891	1	1	1
1990	1	0.966	1	1	0.972	0.981	1	1	0.944	0.944

average 1989 (3-6 years): 0.921 + 0.0307

average 1990 (3-6 years): 0.988 + 0.0140

Table 3.- Food items observed in the stomachs of cod, by age groups in Div.3M in July 1989.

Food items	Cod age							
	1	2	3	4	5	6	7	8+
Class Ctenophora				+	+			
Class Anthozoa								
O.Actinida			+	+	+			
Class Polychaeta								
O.Errantia			+		+	+		
Class Crustacea								
O.Isopoda				+				
O.Copepoda			+	+	+			
O.Amphipoda	+	+	+	+	+	+	+	
O.Decapoda								
Pandalus borealis		+	+	+	+	+	+	
Other decapoda			+	+				
Class Bivalva				+				
Class Cephalopoda								
Illex illecebrosus			+	+	+			
Class Ophiuroidea				+				
Class Echinoidea				+	+			
Class Asteroidea				+				
Class Pisces								
Fam.Scorpaenidae								
Sebastes spp.			+	+	+	+	+	+
Fam.Gadidae								
Gadus morhua				+	+	+		
Fam.Serrivomeridae			+	+	+	+		
Fam.Anarhichadidae								
Anarhichias sp.			+	+	+	+	+	
Anarhichias lupus			+	+	+			
Anarhichias denticulatus					+			
Fam.Myctophidae				+	+			
Other pisces			+	+	+			
Eggs of pisces				+				

Table 4.- Food items observed in the stomachs of cod, by age groups in Div.3M in July 1990.

Food items	Cod age									
	0	1	2	3	4	5	6	7	8	9+
Class Polychaeta										
O.Errantia		+	+	+	+	+	+			
Fam.Aphroditidae			+	+	+	+				
Class Crustacea										
O.Copepoda	+	+	+	+	+					
O.Amphipoda	+	+	+	+	+	+	+	+	+	
Fam.Gammaridae		+	+		+	+	+			
O.Decapoda										
Pandalus borealis		+	+	+	+	+	+	+	+	+
Pagurus sp.					+		+			
Fam.Maiidae					+	+				+
Class Gasteropoda						+				+
Class Bivalva										+
Class Cephalopoda			+		+	+	+	+	+	
Class Ophiuroidea			+			+	+			+
Class Holoturoidea							+			
Class Ascidiacea							+			
Class Pisces										
Fam.Scorpaenidae										
Sebastes spp.	+		+	+		+	+	+	+	+
Fam.Gadidae										
Gadus morhua					+	+	+	+		
Fam.Stichaeidae										
Lumpenus sp.			+			+	+			
Fam.Cottidae										
Triglops murrayi			+							
Fam.Macrouridae										
Nezumia bairdi							+			
Fam.Anarhichadidae					+	+				+
Fam.Myctophidae			+		+	+				
Other pisces						+		+		

Table 5.- The Occurrence Index of food items of cod, by age groups in Div.3M in july 1989.

Food items	Cod age								
	1	2	3	4	5	6	7	8	9+
Class Anthozoa									
O.Actinida	-	-	0.004	0.002	0.003	-	-	-	-
Class Ctenofora	-	-	-	0.002	0.003	-	-	-	-
Class Polychaeta	-	-	0.016	-	0.005	0.018	-	-	-
Phylum Echinodermata	-	-	-	0.009	0.003	-	0.111	-	-
Phylum Mollusca									
Class Cephalopoda	-	-	0.025	0.013	0.013	-	-	-	-
Other Mollusca	-	-	-	0.004	0.003	-	-	-	-
Mollusca Total	-	-	0.025	0.017	0.016	-	-	-	-
Class Crustacea									
O.Copepoda	-	-	0.45	0.011	0.008	-	-	-	-
Fam.Hyperidae	0.14	0.57	0.839	0.694	0.486	0.163	0.222	-	-
O.Decapoda									
Pandalus borealis	-	0.143	0.07	0.107	0.145	0.127	0.222	-	-
Other crustacea	-	0.286	0.012	0.017	0.005	-	-	-	-
Crustacea Total	0.14	0.999	1.371	0.829	0.644	0.290	0.444	-	-
Class Pisces									
Sebastes spp.	-	-	0.012	0.122	0.284	0.491	0.444	1	1
Gadus morhua	-	-	-	0.002	0.003	0.018	-	-	-
Anarhichias sp.	-	-	0.008	0.009	0.023	0.018	0.111	-	-
Fam.Myctophidae	-	-	-	0.009	0.008	-	-	-	-
Fam.Cottidae	-	-	0.004	-	-	-	-	-	-
Fam.Macrouridae	-	-	-	-	0.005	-	-	-	-
Other pisces	-	-	0.004	0.013	0.008	0.018	-	-	-
Unidentified	-	-	0.045	0.124	0.196	0.218	0.444	-	-
Pisces Total	-	-	0.073	0.279	0.527	0.763	0.999	1	1
Other prey*	0.714	-	0.074	0.058	0.044	0.018	-	-	-
Total	0.854	0.999	1.563	1.196	1.245	1.089	1.554	1	1
Nº stomachs	7	7	242	467	387	55	9	8	2
% empty stomachs	14.3	14.3	4.5	6.2	10.1	10.9	0	0	0

* Mainly unidentified

Table 6.- The Occurrence Index of food items of cod, by age groups in Div.3M in july 1990.

Food items	Cod age									
	0	1	2	3	4	5	6	7	8	9+
Class Polychaeta	-	0.03	0.15	0.09	0.12	0.07	0.05	-	-	-
Phylum Echinodermata	-	-	0.01	-	-	0.01	0.01	-	-	-
Phylum Mollusca										
Class Cephalopoda	-	-	0.02	-	0.02	0.13	0.08	0.04	0.06	-
Other Mollusca	-	-	-	-	-	0.02	-	-	-	-
Mollusca Total	-	-	0.02	-	0.02	0.15	0.08	0.04	0.06	-
Class Crustacea										
O.Copepoda	0.21	0.20	0.05	0.04	0.01	-	-	-	-	-
Fam.Hyperidae	0.43	0.83	0.87	0.93	0.93	0.91	0.48	0.18	0.18	-
O.Decapoda										
Pandalus borealis	-	0.23	0.27	0.34	0.28	0.23	0.33	0.14	0.18	0.12
Other crustacea	0.21	0.03	0.05	0.02	0.05	0.05	0.05	-	-	0.06
Crustacea Total	0.85	1.29	1.24	1.33	1.27	1.19	0.86	0.32	0.36	0.18
Class Pisces										
Sebastes spp.	0.36	-	0.01	0.02	-	0.07	0.46	0.82	0.82	0.76
Gadus morhua	-	-	-	-	0.01	0.07	0.06	0.07	-	-
Anarhichias sp.	-	-	-	-	0.01	0.02	-	-	-	0.06
Fam.Myctophidae	-	-	0.01	-	0.01	0.02	-	-	-	-
Fam.Cottidae	-	-	0.01	-	-	-	-	-	-	-
Fam.Macrouridae	-	-	-	-	-	-	0.01	-	-	-
Other pisces	-	-	0.01	-	-	0.02	0.01	0.04	-	-
Unidentified	-	-	0.02	0.02	0.07	0.16	-	0.06	-	0.18
Pisces Total	0.36	-	0.06	0.04	0.10	0.36	0.54	0.99	0.82	1.00
Other prey*	0.07	0.03	0.03	0.02	0.02	0.04	0.03	-	-	-
Total	1.28	1.35	1.51	1.48	1.53	1.82	1.57	1.35	1.24	1.18
Nº stomachs	14	30	85	44	106	103	86	28	17	17
% empty stomachs	-	3.3	-	-	2.8	1.9	-	-	5.9	5.9

* Mainly Unidentified

Table 6 (bis).- The Ocurrence Index of food items of cod, in Div.3M in July 1989 and 1990.

Food items	year	
	1989	1990
Class Anthozoa		
O.Actinida	0.002	-
Class Ctenophora	0.002	-
Class Polychaeta	0.006	0.079
Phy. Echinodermata	0.005	0.006
Phylum Mollusca		
Class Cephalopoda	0.014	0.049
Other mollusca	0.002	0.007
Mollusca Total	0.016	0.056
Class Crustacea		
O.Copepoda	0.016	0.030
Fam.Hyperidae	0.618	0.732
O.Decapoda		
Pandalus borealis	0.112	0.257
Other crustacea	0.012	0.045
Crustacea Total	0.758	1.064
Class Pisces		
Sebastes spp	0.177	0.196
Gadus morhua	0.002	0.028
Anarhichias sp.	0.014	0.007
Fam.Myctophidae	0.006	0.007
Fam.Cottidae	0.001	0.002
Fam.Macrouridae	0.002	0.002
Other pisces	0.005	0.004
Unidentified	0.136	0.075
Pisces Total	0.343	0.321
Other prey**	0.057	0.028
Total	1.189	1.552
Nº stomachs	1182	516
% empty stomachs	7.36	1.35

** Mainly Unidentified

Table 7.- The Gravimetric Index (%) of food items of cod, by age groups in Div.3M in July 1989.

Food items	Cod age								
	1	2	3	4	5	6	7	8	9+
Class Anthozoa									
O.Actinida	-	-	0.2	*	*	-	-	-	-
Class Ctenophora	-	-	-	0.2	*	-	-	-	-
Class Polychaeta	-	-	0.44	-	0.06	0.05	-	-	-
Phy. Echinodermata	-	-	-	0.09	*	-	0.15	-	-
Phylum Mollusca									
Class Cephalopoda	-	-	0.8	1.3	0.2	-	-	-	-
Other mollusca	-	-	-	*	0.04	-	-	-	-
Mollusca Total	-	-	0.8	1.3	0.24	-	-	-	-
Class Crustacea									
O.Copepoda	-	-	0.2	*	*	-	-	-	-
Fam.Hyperidae	42.2	83.4	86.5	52.43	27.07	2.1	1.2	-	-
O.Decapoda									
Pandalus borealis	-	7.9	1.8	1.65	1.62	0.3	0.2	-	-
Other crustacea	-	8.7	0.2	0.8	0.03	-	-	-	-
Crustacea Total	42.2	100	88.7	54.88	28.72	2.4	1.4	-	-
Class Pisces									
Sebastes spp	-	-	3.4	32.85	55.43	79.94	48.1	100	100
Gadus morhua	-	-	-	0.22	0.2	0.9	-	-	-
Anarhichias sp.	-	-	0.7	0.69	2.24	6.5	17.6	-	-
Fam.Myctophidae	-	-	-	0.09	0.1	-	-	-	-
Fam.Cottidae	-	-	0.23	-	-	-	-	-	-
Fam.Macrouridae	-	-	-	-	0.88	-	-	-	-
Other pisces	-	-	1.9	1.39	0.79	1.4	-	-	-
Unidentified	-	-	1.83	8.49	10.68	9.1	33.8	-	-
Pisces Total	-	-	8.06	43.73	70.32	97.84	99.5	1	1
Other prey**	58.24	-	2.13	1.07	0.84	0.12	-	-	-
Nº stomachs	7	7	242	467	387	55	9	6	2
% empty stomachs	14.3	14.3	4.5	6.2	10.1	10.9	0	0	0

* Trace
** Mainly Unidentified

Table 8.- The Gravimetric Index (%) of food items of cod, by age groups in Div.3M in July 1990.

Food items	Cod age								
	1	2	3	4	5	6	7	8	9+
Class Polychaeta	0.22	2.30	0.49	0.69	0.19	0.02	-	-	-
Phy. Echinodermata	-	*	-	-	*	0.002	-	-	-
Phylum Mollusca									
Class Cephalopoda	-	0.45	-	0.078	5.94	11.57	0.001	0.005	-
Other mollusca	-	-	-	-	0.25	-	-	-	0.34
Mollusca Total	-	0.45	-	0.078	6.19	11.57	0.001	0.005	0.34
Class Crustacea									
O.Copepoda	3.58	0.20	0.05	0.006	-	-	-	-	-
Fam.Hyperidae	63.31	82.97	60.13	89.70	78.42	15.44	0.73	0.16	-
O.Decapoda									
P. borealis	24.8	6.56	2.90	1.28	0.45	1.05	0.23	0.57	0.32
Other crustacea	4.7	0.31	0.05	0.19	0.29	2.31	-	-	3.96
Crustacea Total	96.39	90.04	63.13	91.17	79.16	18.80	0.96	0.73	4.28
Class Pisces									
Sebastes spp	-	1.65	36.15	-	6.87	54.41	96.39	99.24	82.57
Gadus morhua	-	-	-	0.34	4.49	12.57	2.49	-	-
Anarhichias sp.	-	-	-	0.19	0.60	-	-	-	8.45
Fam.Myctophidae	-	2.74	-	0.32	0.13	-	-	-	-
Fam.Cottidae	-	2.54	-	-	-	-	-	-	-
Fam.Macrouridae	-	-	-	-	-	0.26	-	-	-
Other pisces	-	1.10	-	-	0.88	0.07	0.16	-	-
Unidentified	-	1.41	0.18	4.90	1.33	1.56	-	0.03	4.24
Pisces Total	-	9.44	36.33	5.75	14.30	68.87	99.04	99.27	95.26
Other prey**	3.35	0.24	0.03	0.08	0.13	0.11	-	-	-
Nº stomachs	30	85	44	106	103	86	28	17	17
% empty stomachs	3.3	-	-	2.8	1.9	-	-	5.9	5.9

* Trace
** Mainly Unidentified

Table 8 (bis).- The Gravimetric Index (%) of food items of cod in Div.3M in July 1989,1990.

Food items	year 1989	1990
Class Anthozoa		
O.Actinida	0.02	-
Class Ctenophora	0.05	-
Class Polychaeta	0.05	1.4
Phy. Echinodermata	0.03	*
Phylum Mollusca		
Class Cephalopoda	0.34	4.37
Other mollusca	0.02	0.07
Mollusca Total	0.36	4.44
Class Crustacea		
O.Copepoda	0.12	*
Fam.Hyperidae	31.84	28.47
O.Decapoda		
Pandalus borealis	1.27	0.8
Other crustacea	1.59	1.08
Crustacea Total	34.82	30.35
Class Pisces		
Sebastes spp	51.96	56.96
Gadus morhua	0.28	5.1
Anarhichias sp.	2.71	0.86
Fam.Myctophidae	0.07	0.05
Fam.Cottidae	0.01	0.03
Fam.Macrouridae	0.3	0.07
Other pisces	1.03	0.22
Unidentified	9.27	1.45
Pisces Total	65.63	64.74
Other prey**	3.92	0.04
Nº stomachs	1182	516
% empty stomachs	7.36	1.35

* Trace
** Mainly Unidentified

Table 9.-Total and Partial Fullness Index for Atlantic Cod by age groups in Flemish Cap.(July 1989).

Food items	Cod age								
	1	2	3	4	5	6	7	8	9+
Class Anthozoa									
O.Actinida	-	-	0.001	*	*	-	-	-	-
Class Ctenofora	-	-	-	0.001	*	-	-	-	-
Class Polychaeta	-	-	0.007	-	0.001	0.001	-	-	-
Ph.Echinodermata	-	-	-	0.001	*	-	0.004	-	-
Phylum Mollusca									
Class Cephalopoda	-	-	0.006	0.010	0.003	-	-	-	-
Other Mollusca	-	-	-	*	0.001	-	-	-	-
Mollusca Total	-	-	0.006	0.010	0.004	-	-	-	-
Class Crustacea									
O.Copepoda	-	-	0.004	*	*	-	-	-	-
Fam.Hyperidae	0.233	0.341	0.826	0.755	0.382	0.056	0.026	-	-
O.Decapoda									
P. borealis	-	0.113	0.024	0.021	0.020	0.011	0.005	-	-
Other crustacea	-	0.097	0.002	0.006	*	-	-	-	-
Crustacea Total	0.233	0.551	0.856	0.782	0.402	0.067	0.031	-	-
Class Pisces									
Sebastes spp.	-	-	0.021	0.348	0.592	1.568	0.826	2.527	1.250
Gadus morhua	-	-	-	0.002	0.003	0.015	-	-	-
Anarhichias sp.	-	-	0.004	0.007	0.023	0.074	0.323	-	-
Fam.Myctophidae	-	-	-	0.001	0.001	-	-	-	-
Fam.Cottidae	-	-	0.002	-	-	-	-	-	-
Fam.Macrouridae	-	-	-	-	0.009	-	-	-	-
Other pisces	-	-	0.010	0.019	0.009	0.039	-	-	-
Unidentified	-	-	0.018	0.105	0.133	0.173	0.848	-	-
Pisces Total	-	-	0.055	0.482	0.770	1.869	1.997	2.527	1.250
Other prey**	0.294	-	0.024	0.017	0.011	0.003	-	-	-
TOTAL.FULLNESS. INDEX	0.527	0.551	0.941	1.292	1.183	1.940	2.016	2.527	1.250
Nº stomachs	7	7	242	467	387	55	9	8	2
% empty stomachs	14.3	14.3	4.5	6.2	10.1	10.9	0	0	0

* Trace
** Mainly unidentified

Table 10.-Total and Partial Fullness Index for Atlantic Cod by age groups in Flemish Cap (July1990).

Food items	Cod age									
	0	1	2	3	4	5	6	7	8	9+
Cl. Polychaeta	-	0.002	0.036	0.015	0.013	0.004	0.001	-	-	-
Phylum. Echinodermata	-	-	*	-	-	*	*	-	-	-
Ph. Mollusca										
Cl. Cephalopoda	-	-	0.008	-	0.002	0.111	0.130	*	*	-
Other mollusca	-	-	-	-	-	0.003	-	-	-	0.003
Mollusca Total	-	-	0.008	-	0.002	0.114	0.130	*	*	0.003
Cl.Crustacea										
O.Copepoda	0.676	0.055	0.004	0.001	*	-	-	-	-	-
Fam.Hyperidae	0.864	0.787	1.207	1.566	1.524	1.523	0.370	0.034	0.006	-
O.Decapoda										
P.borealis	-	0.242	0.115	0.072	0.027	0.009	0.022	0.009	0.013	0.003
Other crustacea	0.410	0.037	0.004	0.002	0.005	0.007	0.064	-	-	0.045
Crustacea Total	1.950	1.121	1.330	1.641	1.556	1.539	0.456	0.043	0.019	0.048
Cl.Pisces										
Sebastes spp	1.885	-	0.016	-	-	0.115	0.968	2.382	1.712	0.891
Gadus morhua	-	-	-	-	0.038	0.085	0.147	0.111	-	-
Anarhichias sp.	-	-	-	-	0.003	0.009	-	-	-	0.331
Fam.Myctophidae	-	-	0.004	-	0.007	0.003	-	-	-	-
Fam.Cottidae	-	-	0.034	-	-	-	-	-	-	-
Fam.Macrouridae	-	-	-	-	-	-	0.005	-	-	-
Other pisces	-	-	0.014	-	-	0.010	0.002	0.006	-	-
Unidentified	-	-	0.025	0.004	0.091	0.019	0.031	-	0.001	0.039
Pisces Total	1.885	-	0.093	0.004	0.139	0.241	1.153	2.499	1.713	1.261
Other prey**	0.106	0.045	0.005	0.001	0.001	0.002	*	-	-	-
TOTAL.FULLNESS. INDEX.	4.600	1.168	1.472	1.661	1.710	1.900	1.758	2.453	1.731	1.063
Nº stomachs	14	30	85	44	106	103	86	28	17	17
% empty stomachs	0	3.3	0	0	2.8	1.9	0	0	5.9	5.9

* Trace
** Mainly unidentified

Table 11.- The Food Diversity Index of cod by age groups in Div.3M in July 1989-1990.

AGE	0	1	2	3	4	5	6	7	8	9+
July 1989	-	0.33	0.667	0.464	0.634	0.756	0.732	0.846	0	0
July 1990	0.797	0.590	0.631	0.552	0.586	0.704	0.739	0.571	0.580	0.641

Average Index for cod age 3,4,5,6.

	mean	S.D
1989	0.707	+ 0.064
1990	0.676	+ 0.080

Average Index for cod age 3,4,5,6,7.

	mean	S.D
1989	0.686	+ 0.145
1990	0.630	+ 0.0849

Total Average Index

	mean	S.D
1989	0.633	+ 0.179
1990	0.639	+ 0.082

Table 12.- The Condition Factor of cod by age groups in Flemish Cap in July in the years 1989-1990.

Age	1989		1990	
	F.C	Nº of cod	F.C	Nº of cod
0	-	-	0.788	14
1	0.989	7	0.812	30
2	1.153	7	0.979	85
3	0.921	242	0.918	44
4	0.918	467	0.960	106
5	0.910	387	0.936	103
6	0.911	55	0.935	86
7	0.906	9	0.938	28
8	0.907	2	0.916	17
9+	0.944	2	0.957	17

Table 13.-The cannibalism of cod,by age groups, in the total stomachs in Div.3M in July of the years 1988-1990.

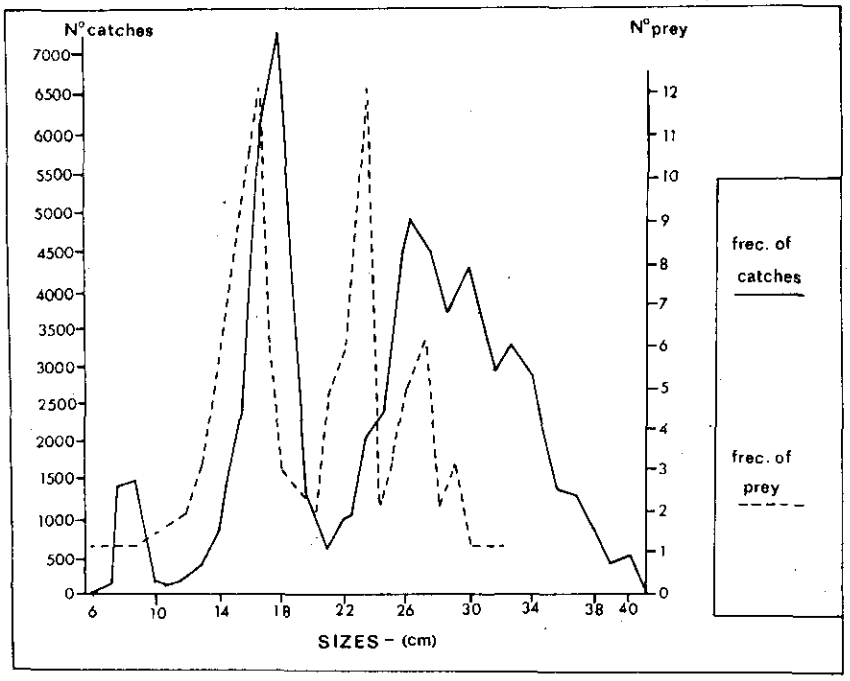
AGE	3	4	5	6	7	Average
July 1988	0.6%	4.2%	9.4%	15.4%	4.5%	3.78%
July 1989	-	0.21%	0.25%	1.8%	-	0.33%
July 1990	-	0.94	6.8%	5.8%	7.1%	4.64%

Table 14.- The Overlap index of Shoener in Div.3M.July 1989 and 1990, for three groups of cod: group A (age 1-2), group B (age 3-5), group C (age 6-10).

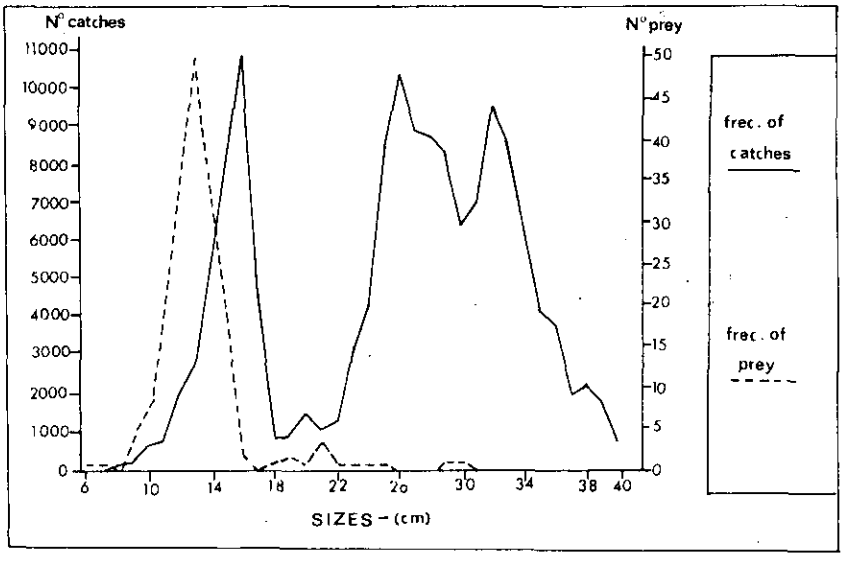
	1989	1990
Rª(A-B)	0.518	0.891
Rª(B-C)	0.507	0.569
Rª(A-C)	0.223	0.467

Table 15.- The Overlap Index of Shoener of the cod groups A,B yC for 1989 and 1990 in diferent waters depths. Group A (age 1-2), group B (age 3-5), group C (age 6-10).

depth	80f	100f	140f	200f	300f	TOTAL
Rª(A-B)	0.593	0.856	0.804	0.537	0	0.785
Rª(B-C)	0.658	0.614	0.650	0.725	0.473	0.593
Rª(A-C)	0.556	0.623	0.468	0.279	0	0.424



a



b

Fig. 1.- Redfish abundance compared with redfish in the stomachs contents. A year 1989. B year 1990.