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Studies on the food of herring (*Clupea harengus*) in ICNAF Divisions 3P, 4R, 4T and 4V

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Introduction.

Herring samples were taken from the catches made by the R/V CRYOS during the 1972 cruises, and used to study the food of this fish. In all, the stomach contents of 195 individuals were analysed for both quality and quantity.

The positions of the stations in the prospected sectors, ICNAF subareas 4 V, 4 R, 4 T and 3 Pn, are illustrated in figure 1. General information about these stations is given in table 1.

Method.

The only method we were able to use was a rather simple one. First, we took volumetric measurements. The volume of stomach and caecum together is measured as it is when removed from the animal (Vt). Then, the stomach alone is emptied of its food content and the stomach-caecum now empty, is again measured for volume (Vn). An evaluation of the difference between these two measurements gives the volume of the stomach contents or alimentary bolus. The Vn/Vt relationship, that is food or content ratio, provides us with an interesting estimation of the amount of food ingested by the fish at the time of its catch. Conveyed in percentage, the ideas of repletion and emptiness, once in figures, make the data more precise (fig. 2). In extreme cases, where the values of Vt and Vn are equivalent, that is when there is a total absence of food, the relationship is null. On the other hand, the more food there is, the greater the tendance towards 1. The greatest value found, for a stomach distended with foods, was 0.87. We have purposefully neglected to analyse the caecum contents, whose components, when examined, were difficult to identify due to the more advanced stage of digestion. TRAUBERG (1969) calculated a different index for stomach contents, by introducing ponderal differences : weight of the fish and weight of food.

Secondly, we sorted the organisms in the alimentary bolus by quality, later enumerating them in a box with a grilled bottom. In cases where the volume of the stomach contents was too great, the latter were divided into equal parts and we worked on the resulting aliquot parts.

Results.

1) Volumetric data.

Because the samples were chosen according to the size of the alimentary bolus, no definitive conclusion may be drawn from these first measurements. At the very most we can show that there is a difference in the values of the Vn/Vt ratio for mature individuals as compared to the immatures of the herring populations fished in November-December, at the stations between Cape Dauphin and Cape St Lawrence. For the immatures (smaller than 22.7 cm, ICNAF spec. meet. herring, 1972) the food ratio is between 25 and 50 %, average ratio : 0.235 and for the matures between 50 and 75 %, average ratio : 0.447.

This type of sampling does not allow, either, a simple alimentary differenciation between the herring caught in free waters and those caught on the bottom. It may be added however that 50 to 100 % of the stomachs of herring caught in the pelagic trawl in various regions contained food, while the percentage is only 4 to 30 % for those caught on the bottom.

2) Qualitative composition of stomach contents.

The list of species found in the analysed stomachs is given in table 2. Of the total stomach contents, the copepods represent 53.77 %, the euphausiids 28.65 % and the amphipods 12.56 %

Nutrition and prematuration concentrations take place in the month of April in the Newfoundland, St Paul Island and Banquereau regions. Almost all the individuals have full stomachs, and composition by species is weak, sometimes limited to only two species. But in all cases, Calanus finmarchicus represents the greater fraction, 87 to 99 % and more, and a percentage frequency of 100 % (table 2).

The predominance of plankton species in the stomach contents of the herring on the bottom is less constant. The diversity seems to be greater (up to seven species per stomach). Is this an indication of limited stocks of one species, compelling the herring to wander in search of food ?

The euphausiids Meganyctiphanes norvegica are largely dominant in the stomach contents of the Banquereau herring caught on the bottom in May. This same species is found together with Pareuchaeta norvegica in the Gulf of St Lawrence in July (Table Point). In November and December, in the Cape Dauphin and Cape St Lawrence sectors (4 Vn, 4 T) the alimentary bolus

is composed mainly of Temora longicornis, Meganyctiphanes norvegica, and not as regularly of Parathemisto gaudichaudi and Sagitta elegans. The stomachs of immatures originating in the same depths are less filled, and the species less numerous with no particular predominance of one over the others.

Conclusion.

1) A method was originated for the quantitative evaluation of food ingested by herring under various conditions. It will be useful to compare the results to data on the index of content $\frac{\text{weight of food}}{\text{weight of fish}}$. 10,000, in a later work.

2) Although it could not be tested using representative samplings, we were able to establish that the immature herring had a smaller stomach filling than that of the adults originating in the same depths at the same time of year.

3) Calanus finmarchicus constitutes the principal food of the herring in nutrition and prematuration concentrations. In other circumstances Meganyctiphanes norvegica and Temora longicornis form the bases of the stomach contents.

From the same research view-point, relationships may be sought between the proportion of food and the size of the herring on one hand, and between the hydrography and the plankton composition on the other.

Bibliography.

ICNAF, 1972.- Proceedings of the 22nd annual meeting. Spec. meeting herring, Proceed n° 4, appendice IV, p. 206.

TRAUBERG, (H.F.), 1969.- Feeding of the young herring in the Riga Gulf, 1968 and 1969. C.I.E.M., Ann. biol. n° 26 : 239-240.

Table 1 - General information concerning trawling stations.

Stations	Positions	Location	Dates	Fishing Gear used	Observations
Y 85	43°57'8 N 58°39'0 W	Banquereau	March	Bottom trawl	
Y 112	48°24'0 N 59°31'5 W	Cape St George	April	Bottom trawl	
Y 129	48°22'2 N 59°26'8 W	Cape St George	April	Pelagic trawl	Large herring concentration
Y 131	47°32'4 N 58°59'7 W	Southern coast of Newfoundland Isle aux Morts	April	Pelagic trawl	" " "
Y 136	47°10'0 N 60°27'2 W	St Paul Island district area	April	Pelagic trawl	Middle herring concentration
Y 138	47°09'8 N 60°14'0 W	St Paul Island district area	April	Pelagic trawl	Large concentration
Y 142	43°58'8 N 58°45'6 W	Banquereau	April	Pelagic trawl	Middle concentration
Y 150	44°02'3 N 58°37'5 W	Banquereau	April	Semi-pelagic trawl	
Y 294	44°07'0 N 58°57'2 W	Banquereau	May	Semi-pelagic trawl	
Y 437	50°23'5 N 57°38'2 W	Gulf of St Lawrence - Table point	July	Bottom trawl	
Y 489	46°35'2 N 60°18'4 W	Cape Smoky	November	" "	
Y 491	46°36'2 N 60°18'7 W	Cape Smoky	November	" "	
Y 494	46°26'0 N 60°19'5 W	Cape Dauphin	November	" "	
Y 515	46°28'7 N 60°23'5 W	Cape Dauphin	December	" "	
Y 518	46°31'1 N 60°23'4 W	Cape Dauphin	December	" "	
Y 521	47°18'0 N 60°32'0 W	Cape St Lawrence	December	" "	

Table 2. Inventory by species of stomach contents. Dominance (D) and frequency (F) of species in percentage.

Month	MARCH		APRIL												MAY	
Stations	Y 85		Y 112		Y 129		Y 131		Y 136		Y 138		Y 142		Y 150		Y 294	
Species	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F
Aglantha digitale													p	5				
Sagitta elegans													0.10	5				
Limacina retroversa													0.10	5				
Philomedes globosa													p	5				
Calanus finmarchicus			47.16	100	98.89	100	99.69	100	76.70	100	98.55	100	87.07	100	39.00	40	5.60	40
" hyperboreus									1.60	45								
" helgolandicus																		
Mannocalanus minor													1.60	55				
Pseudocalanus elongatus									1.10	25			2.05	25				
Pareuchaeta norvegica													0.18	10				
Temora longicornis																		
Metridia longa													0.10	5				
Metridia lucens			0.20	25					0.10	5	0.04	4	6.24	80				
Eudorallopsis deformis																		
Parathemisto sp.	26.0	66	0.05	25							0.04	8						
" abyssorum			2.13	100	0.10	10							2.31	60	47.20	50		
" gaudichaudi			4.07	100	0.10	20			0.40	5	0.01	4	0.25	10	13.80	30		
Euthemisto bispinosa													p	5				
Euphausiacea (furcilia)	74.0	100	8.68	75	0.91	60	0.31	20			1.36	60	p	5				
Meganyctiphanes norvegica									20.10	70							94.40	100
Thysanoessa inermis			37.71	25														
Decapoda (larvae)													0.10	5				
Teleostei (larvae)													0.10	5				
Phytoplankton																		

contin

Table 2. Continued

Month	JULY		NOVEMBER										DECEMBER					
Stations	Y 457		Y 489		Y 491				Y 494				Y 515		Y 518		Y 521	
					matures		Immatures		matures		Immatures		Immatures		Immatures		Immatures	
Species	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F
Aglantha digitale																		
Sagitta elegans									33.59	60			+	7				
Limacina retroversa																		
Philomedes globosa																		
Calanus finmarchicus	16.90	20			2.52	13			0.54	40	5.65	40			5.07	20	9.98	25
" hyperboreus																	6.60	12
" helgolandicus									1.73	20								
Nannocalanus minor																		
Pseudocalanus elongatus			1.76	16														
Pareuchaeta norvegica	34.28	50			1.44	6			6.92	20	0.22	20						
Temora longicornis			65.38	83	50.82	73	65.21	72	35.07	40			+	7	27.24	40		
Metridia longa																		
Metridia lucens																	11.00	12
Eudorallopsis deformis					0.38	6					5.54	20						
Porathemisto sp.																		
" abyssorum	3.96	10			2.16	13			13.51	40	38.69	80						
" gaudichaudi			p	16	8.22	40	10.92	45	6.05	20					32.26	50		
Euthemisto bispinosa					1.44	6			p	20								
Euphausiacea (furcilia)									1.73	20	5.54	20						
Meganyctiphanes norvegica	44.86	50	32.86	100	33.02	86	23.87	47									68.15	100
Thysanoessa inermis															35.43	20	4.27	12
Decapoda (larvae)											44.36	20						
Teleostei (larvae)									0.86	20								
Phytoplankton													+	46	+	60		

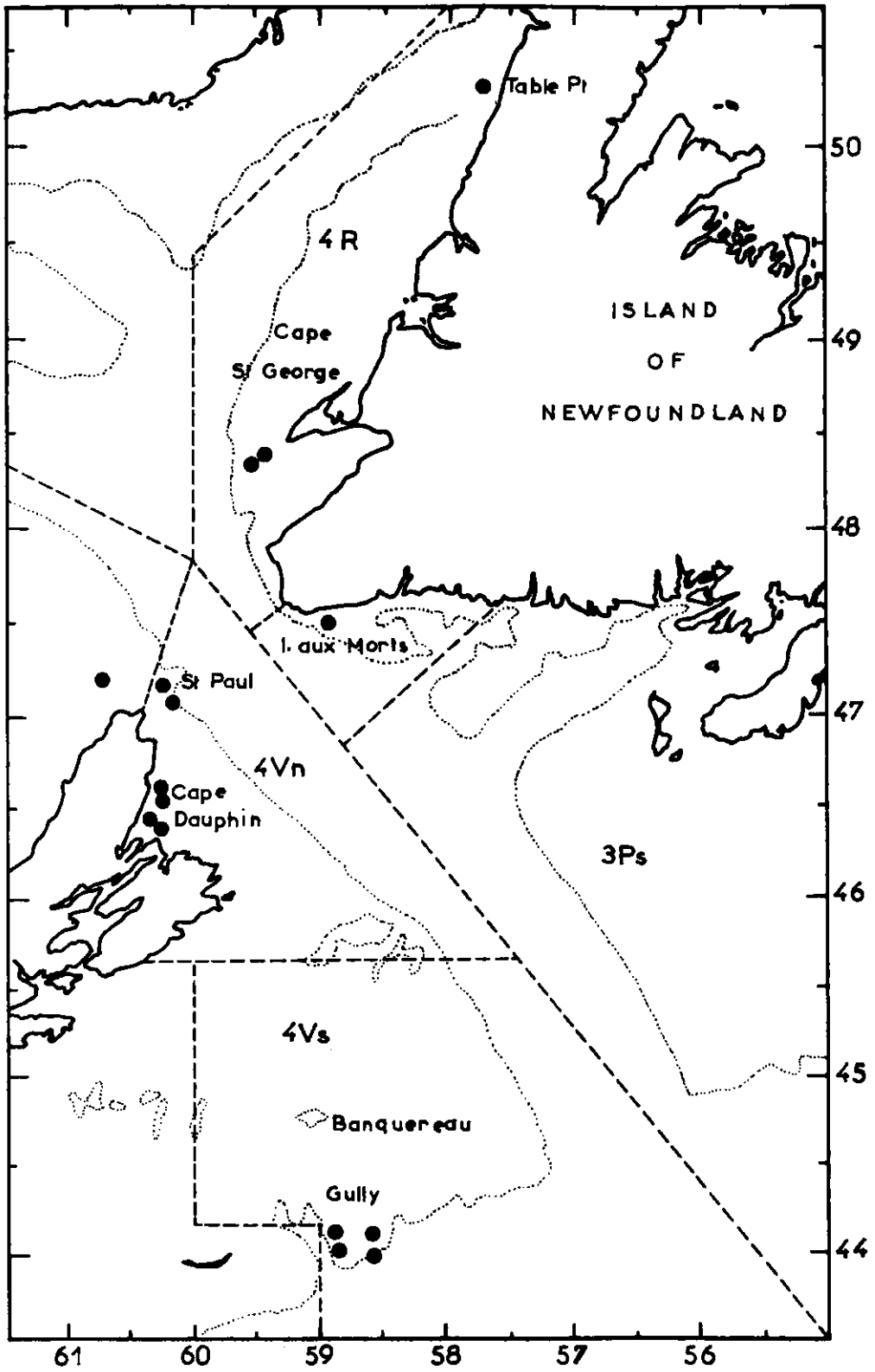

Fig. 1. Geographical situation of trawling stations.

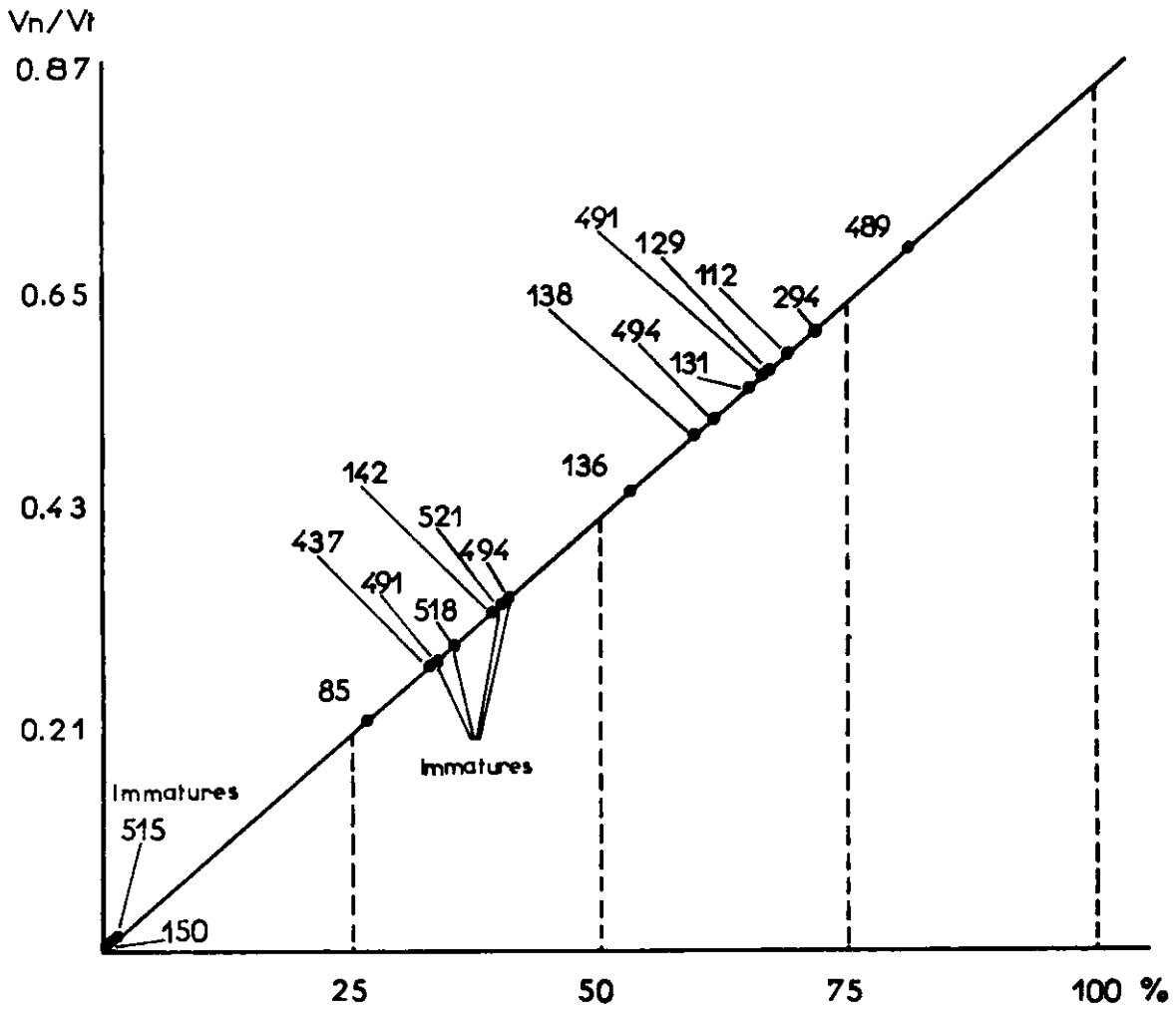

Fig. 2. Conversion of nutrition report (Vn/Vt) into percentage and average values for each sample.