

**VARIABILITIES IN STOMACH CONTENTS OF COD, COLLECTED BY
DEMERSAL AND PELAGIC TRAWL IN THE SOUTHERN PART OF
THE BARENTS SEA**

by

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ABSTRACT

Samples of Northeast Arctic cod stomachs were collected separately on demersal and pelagic stations at the same date in February 1986 and were analysed for length group 30-40cm. The results indicate that the mean value of the stomach contents weight as well as the food composition are substantially different for the two type of gear. The Spearman rank correlation coefficient ($r_s = 0.109$; $t = 0.363$; $P > 0.1$) is not significant based on frequency data calculated from the diet of cod gathered by demersal and pelagic stations. These results question the accuracy of the consumption estimates which is based on a combination of field stomach contents weight and laboratory gastric evacuation rate studies. Therefore the mean value of the stomach contents weight should be distributed on the fishing gears, in addition to seasons, subareas, fish size and time of the day.

INTRODUCTION

Northeast Arctic cod has had a large predation impact on a different prey population in the Barents Sea (Ponomarenko and Yaragina, 1978 ; Mehl, 1989), and recent evidence points to predation as the predominant factor in relation to recruitment (Daan, 1987). The estimation of the consumption of different prey by cod in MULTSPEC "Multispecies model for the Barents Sea" is based on field data on stomach contents. However, the food consumption is very sensitive to an accurate estimate of the mean value of the stomach contents weight, and if that mean is overestimated, food consumption will be overestimated or vice versa. During 1986 a total of 1114 cod stomachs have been collected during the first quarter, 725 stomach have been gathered by demersal and 389 stomachs by pelagic trawl. The aim of the current paper is to study the feeding habits of cod in the Southern part of the Barents Sea based on cod stomachs collected from different habitats, mainly demersal and pelagic. Information on that kind is, however, limited from the Barents Sea.

MATERIALS AND METHODS

Only one length group (30-40cm) was analyzed from stomach data of Northeast Arctic cod collected by demersal and pelagic trawl from winter surveys (february 1986) in the Southern part of the Barents Sea (Table 1). Details of the sampling procedure and methods of stomach contents analysis are given in Mehl (1986). Spearman rank correlation coefficients have been applied to frequency data calculated from the diet of cod gathered by demersal and pelagic stations. Food items were then ranked serially according to their % frequencies, in descending order. That is, the highest percentage value was assigned rank number n , a number equal to the total number of food items being compared (Fritz, 1974).

RESULTS AND DISCUSSION

The stomach contents weight showed a large variation between samples collected by demersal and pelagic stations. The distribution of the individual stomach contents weight (Fig. 1) is skewed to the right in both samples (gl demersal = 1.06 ;gl pelagic = 1.11). The median weight of the stomach was much lower than the mean in both cases (demersal: mean=3.22, median = 2.05; pelagic: mean=13.74, median=8.13). These results indicate that the stomach contents weight are not normally distributed. The same phenomena have been reported in several studies for different species (Clarke, 1978; Cochran and Adelman, 1981; Durbin et al., 1983). The elongated body with a big mouth opening which is typical for piscivorous predators, enable cod to swallow a very large prey item. This may contribute, with other factors, to the skewed distribution of the stomach contents weight.

The proportions (weight %) of the major taxa in the diet of cod were markedly different among the two types of stations (table 2). Northeast Arctic cod, collected at pelagic stations consumed mainly fish preys (95.77 % of the stomach weight) namely; Clupea harengus, Mallotus villosus and Sebastes sp. In contrast, cod collected at demersal stations consumed two major preys; crustaceans (17.9 %) and fish preys (80.37 % of the stomach weight). The relatively greater importance of Clupea and Mallotus in a pelagic collection and crus-

taceans, Sebastes and Mallotus in a demersal collection of stomach, may be attributed to their availability at a particular channel of the water column.

In order to illustrate the difference of the food habit of cod distributed pelagically and demersally in the same area, table 3 was constructed. A "t" test on the Spearman rank correlation coefficient $r_s = 0.109$ (table 3) indicates that the correlation is not significant ($p > 0.1$). And the pelagic and the demersal diets are different both in quantities consumed and the relative importance of the various prey items (table 2). Nevertheless the diet of cod in both habitats contain the same 5 items out of 13 different food items.

The large differences in the mean value of the stomach contents weight between demersal and pelagic diet found in the current paper has undoubtedly an effect on the accuracy of the estimation of the consumption which is based on the mean of whole samples regardless of the type of station. Bajkov's method, modified by Eggers (1979), was used for comparison between demersal and pelagic diet.

$$C = 24 * S * R$$

where C is the daily consumption, S is the mean value of the stomach contents during 24 hours and R is the exponential gastric evacuation rate which is set equal to 0.03 (the average of the data from all the prey species used in the experiment on gastric evacuation rates for cod in Northern Norway (J.Santos, unpublished data). For example, we applied the data shown in the text table below for cod at 5 years old collected during february 1986,

	n	mean weight of stomach contents (grams) during 24 hours
pelagic	58	32.86
demersal	109	25.48
total	167	28.04

to the above equation, and obtained the following:

$$\begin{aligned} C \text{ pelagic} &= 23.18 \\ C \text{ demersal} &= 18.34 \\ C \text{ total} &= 20.18 \end{aligned}$$

It's clear that the daily consumption of the pelagic diet is higher than the demersal diet consumption and the daily ration estimates of 1.87% Body Weight/Day for pelagic and 1.45%, 1.59% BW/D for demersal and a total sample, respectively (mean weight of 5 years old during february 1986 equaled 1760.81 gr.). However, Antipova and Yaragina (1984) reported that the daily ration for cod (46-55cm) collected by bottom trawl during August 1980 in the Barents Sea, was 0.58% Body Weight/Day.

The general picture arising from this analysis supports the idea that the sampling effort for the estimation of the mean value of the stomach contents weight should be distributed on station type, in addition to seasons, subareas, fish size and time of the day.

Cod stock's consumption was estimated by Mehl (1989). There is a short comments on this approach. Firstly, the mean value of the stomach content which was applied in that model, was from the "whole" sample mean (i.e demersal + pelagic). Secondly, this mean value have been multiplied by prey species proportion of the weight of the stomach contents, calculated from the total sample. The mean value of the stomach content and the proportion of prey species in demersal and pelagic diets, according to our finding in this paper, are significantly different . Therefore his combination of the stomach data and insufficient information about the proportion of cod in each age group which is distributed pelagically or demersally, constitute a source of uncertainty in the cod stock's consumption. The accurate estimation of the food consumption is critically dependent upon application of an appropriate model (Sainsbury, 1986). However, the accuracy is also affected by the sampling variability as in the case dealing with pelagic and demersal diets.

In summary, this paper advocates the need to examine thoroughly the reliability of the consumption estimates based on those models which deal with pelagic and demersal diets indifferently. Additionally, it shows the need of a sampling strategy to precisely detect possible differences in the diets as far as cod distribution in the water column is concerned.

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Table.1 Stations, date, position and gear used from which cod stomach were sampled.

STATION	DATE	POSITION	GEAR
1	1/2-1986	70.22" 32.07"	demersal trawl
2	2/2-1986	70.20" 34.44"	=
3	2/2-1986	70.30" 37.06"	=
4	2/2-1986	70.34" 34.08"	=
5	1/2-1986	70.21" 33.40"	pelagic trawl
6	2/2-1986	70.52" 35.10"	=

Table.2 Comparison of the diet of Northeast Arctic cod collected by demersal and pelagic trawl from February 1986 (% occ = percentage frequency, % N = percentage of number and % W = percentage of stomach contents weight

Food Items	<u>demersal</u>			<u>Pelagic</u>		
	% occ	% N	% W	% occ	% N	% W
Polychaeta	0	0	0	8.6	2.44	.40
Crustacea	4.8	3.23	.19	0	0	0
Malacostraca	19.8	12.90	3.46	0	0	0
Isopoda	4.8	3.23	7.47	0	0	0
Hyperiididae	0	0	0	25.9	41.47	.40
Amphipoda	4.8	3.23	.22	0	0	0
Euphausiidae	4.8	9.68	.49	21.6	18.29	.66
Pandalus borealis	13.3	5.40	6.07	13.0	3.66	2.78
Teleostei	38.1	25.81	41.08	56.5	24.39	44.65
Clupea harengus	4.8	3.23	15.34	26.6	7.32	47.94
Mallotus villosus	0	0	0	4.3	1.22	2.51
Sebastes sp.	23.8	29.03	23.95	4.3	1.22	.67
Indeterminatus	4.8	.00	1.73	0	0	0

demersal: number of stomach with food = 21; number of empty = 18; Mean stomach weight (Gr.) = 3.22

Pelagic: number of stomach with food = 23; number of empty = 1; Mean stomach weight (gr.) = 13.74

Table.3 Comparison of the diet of Northeast Arctic cod collected by demersal and pelagic trawls from February 1986 (% occ = percentage frequency, Nr = number of ranks

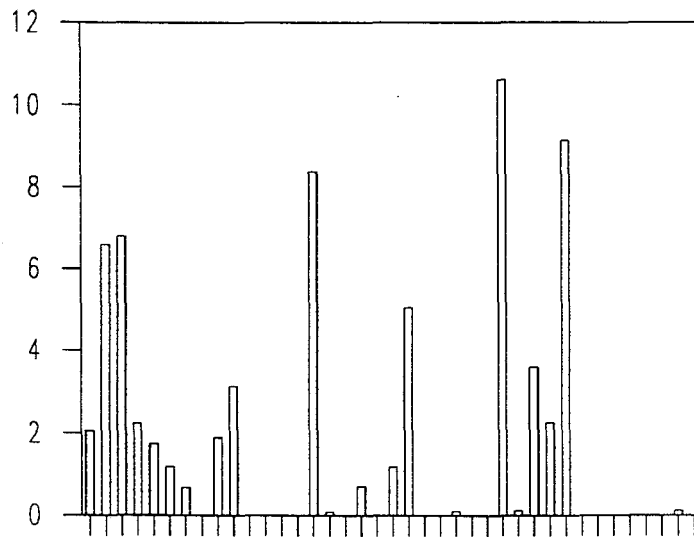
Food Items	<u>demersal</u>		<u>Pelagic</u>	
	% occ	rank	% occ	rank
Polychaeta	0	2	8.6	8
Crustacea	4.8	6.5	0	3
Malacostraca	19.8	11	0	3
Isopoda	4.8	6.5	0	3
Hyperiidæ	0	2	25.9	11
Amphipoda	4.8	6.5	0	3
Euphausiidae	4.8	6.5	21.6	10
Pandalus borealis	13.3	10	13.0	9
Teleostei	38.1	13	56.5	13
Clupea harengus	4.8	6.5	26.6	12
Mallotus villosus	0	2	4.3	6.5
Sebastes sp.	23.8	12	4.3	6.5
Indeterminatus	4.8	6.5	0	3

Bottom n = 21

Pelagic n = 23;Nr = 13;rs = 0.109;t = 0.363;p > 0.1;df = 11

Figure 1.

Demersal



Pelagic

