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ON THE FEEDING OF PLAICE (Pleuronectes platessa L.) IN THE SOUTHERN NORTH SEA

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SUMMARY

This paper presents the results of the investigation on the feeding habits of plaice (Pleuronectes platessa L.) in the Southern North Sea during two groundfish surveys carried out in 1988. About 50 different prey species were detected during both surveys.

The feeding pattern in the offshore areas of the western part of IVc was characterized by the predominance of Polychaeta. In the latter taxonomic group Pectinaria koreni was by far the most important prey species. Also Crustacea, Mollusca and Echinodermata constituted a substantial part of the food intake of plaice. The food preference seemed to be related with body length ,viz. only large plaice fed to some extent on fish. Generally no clear relationship became apparent between the depth and the frequency of occurrence of the several preys. The proportion of empty stomachs was highest at dawn and decreased during the course of the day. Large plaice tended to feed less frequently than smaller plaice.

The feeding of plaice in the coastal area showed a somewhat different pattern. Mollusca became the dominant prey group followed by Polychaeta. The main food item in this area was Abra alba .

RESUME

Ce rapport décrit les investigations en 1988 sur les habitudes alimentaires de la plie (Pleuronectes platessa) lors de deux prélèvements de poissons démersaux dans la partie méridionale de la mer du Nord. Une grande variété de proies (plus de 50) a été identifiée.

La nutrition dans les régions au large de la partie occidentale de IVc était caractérisée par la prédominance de Poly-

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chaeta. Dans ce groupe taxonomique Pectinaria koreni était de loin la proie la plus importante. Crustacea, Mollusca et Echinodermata constituaient également une partie substantielle de la nutrition de la plie. La préférance alimentaire semblait être en rapport avec la longueur du corps, viz. seulement les grandes plies se nourrissaient à un certain degré de poisson. Généralement aucune relation évidente ne se manifestait entre la profondeur et la fréquence de la présence des différentes proies.
La proportion d'estomacs vides était la plus élevée à l'aube et diminuait au cours de la journée. Les grandes plies semblaient se nourrir moins fréquemment que les petites.
La nutrition de la plie dans les eaux côtières était quelque peu differente. Mollusca devenait la proie prédominante suivi par Polychaeta. La nourriture principale dans cette région était Abra alba.

INTRODUCTION

Regular recording of the density of the plaice population in the North Sea was carried out by means of a joint Dutch, UK and Belgian beamtrawl survey during August-September.
The biomass is now estimated at a value of about 550 thousand tons (ANON,1989) being one of the most important flatfish stocks in that area.

The aim of this study was to contribute to the rôle of the plaice as a predator or competitor in coastal and offshore areas of the North Sea. To this end the species composition of the stomach content was analysed. Furthermore the influence of depth, predator size and time on the diet was studied.

MATERIAL AND METHODS

Stomach samples were collected as part of two groundfish surveys in 1988,viz. the August beamtrawl survey offshore and the September pre-recruit survey along the Belgian coast.

The area sampled is shown on figure 1. The August survey covered the western part of IVc and consisted of 40 stations during which a total of 470 plaice stomachs were analysed. During the September survey carried out along the Belgian coast 27 stations were sampled resulting in a total of 283 plaice stomachs. Due to the nature of these surveys fishing was limited to the daytime.

On each haul the guts of a number of plaice were dissected by cutting off at the pharynx and pylorus.Individual guts were preserved in 10 % buffered formaldehyde. Each stomach content was analysed to the species level wherever possible, digestion sometimes made prey identification difficult or even impossible.

The final results were expressed in numerical percentages for each prey species or prey group and by frequence of occurrence.

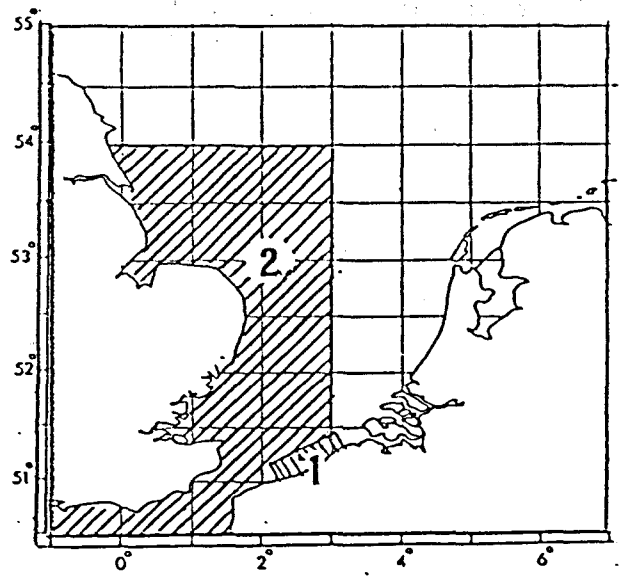

Figure 1.- Sampled are

RESULTS AND DISCUSSION

AUGUST SURVEY - IVc offshore

1.General species preference

The analysis of the stomach content indicated that about 45 different species contributed to the diet of North Sea plaice. The feeding pattern was characterized by the predominance of Polychaeta as shown in table 1. Also Crustacea, Mollusca and Echinodermata constituted a large part of the total food intake.

The results of the numerical percentages illustrated clearly that Polychaeta was the most important food component and accounted for almost 50 %. The main species consumed in this group was Pectinaria koreni.

The second most important taxonomic group was Crustacea (Amphipoda,Decapoda and Mysidacea) with approximately 23 %. Bathyporeia ssp. and Mysis ssp.

Also large amounts of Echinodermata occurred in the stomachs of plaice: 16.7 % in total. The majority of the Echinodermata component in the diet was Echinocyamus ssp. and Ophiura ssp..

The sequence in descending order of importance was :
Pectinaria koreni (35.4 %)
Bathyporeia ssp (11.8 %)
Echinocyamus ssp (9.4%)
Ophiura ssp (6.5 %)
and Mysis ssp. (6.0%)

The frequency of occurrence was calculated and excluded were the samples with empty stomachs (Kennedy et al., 1972).

The results of this analysis are presented in table 1 and confirmed also the dominance of the Polychaeta (60.3%). Echinodermata became second in importance (32.5 %),followed by Crustacea (29.0%) and Mollusca (23.3%).

The examination on species level indicated a slightly modified sequence of importance:
Pectinaria koreni (32.8%)
Ophiura ssp. (18.0%)
Echinocyamus ssp (17.4%)
Owenia fusiformis (14.5%)
Bathyporeia ssp (12.0%)
Nephtys ssp (13.6%)
and Mya ssp (10.1%)
These seven species occurred in more than 10% of all the stomachs sampled.

2. Changes in diet with increasing size

To examine the diet associated with body length the data were divided into four predator length groups, viz <25cm, 25-29cm, 30-34cm and >35 cm as shown in Figure 1.

The stomach content was expressed in percentages of frequence of occurrence for each length group.

A clear differentiation in the diet in relation with the body length was observed.

The Polychaeta group showed an increasing trend in frequence of occurrence with increasing body length of plaice. This trend was mainly due to the more frequent presence of Pectinaria koreni and Owenia fusiformis. Nephtys ssp however had a highest abundancy in the length class 13-29 cm and decreased in plaice at greater lengths.

Crustacea as food supply tended to decrease in larger plaice. This decrease was most obvious in the Amphipoda viz. Bathyporeia ssp.

The importance of Lamellibranchiata in the diet especially Mya ssp increased considerably in older plaice.

The predation on Pisces occurred at large plaice : 33 % in the plaice samples over 40 cm length.

Finally the consumption of Echinodermata did not seem to be influenced by the length of the predator.
When a specific prey occurred in the stomach its mean number per stomach could be used as a semi-quantitative analysis (figure 3).

Preys having an occurrence between 5 and 10 per stomach were Bathyporeia, Echinocyamus and Pectinaria.

Gammarus, Mya, Ophiura and Owenia had a mean number of 2 to 5 individuals.

Other preys were only consumed per 1 or 2 individuals at the time as Crangon, Eupagurus, Nephtys, Nereis and Pisces.

These differences may be related to the volume of each prey type.

The relation between length of the predator and length of the prey is not very clear from figure 3 except for Echinocyamus where the number consumed decreased substantially at increasing plaice lengths.

3. Changes in diet with increasing depth

The food composition tended to vary considerably depending on the area. However these differences could have been mainly caused by the depth.

The data of this study were classified into four depth categories, viz. less than 25 meter, 25 to 34 meter, 35 to 44 meter and more than 45 meter. The main results are presented in figure 2 .

Polychaeta remained the most important food component over all the depth categories. However the feeding pattern changed from Errantia (Nephtys ssp) to Sedentaria especially Owenia fusiformis and Pectinaria koreni.

Echinodermata (mainly Ophiuroidea) became the second most important food component in the deepest areas over 45 meter.

Anthozoa viz. sea-anemones indet. as food became almost unimportant at greater depths.

The frequency of Decapoda decreased substantially with increasing depth. The pattern of Amphipoda and Mysidacea did not seem to be very clear.

The predation of Pisces was considerably higher in the deepest grounds. This trend was also linked to the increased plaice body length. Ammodytes ssp was the most common food item.

The other foor sources as Mollusca did not show any apparent relationship with the depth.

4. Changes in diet with time

Differences in stomach fullness with time were also studied. The highest number of empty stomachs was observed in the early morning samples and decreased thereafter as follows :

6 - 8 a.m. : 65.4 % empty
8 -12 a.m. : 29.9 % empty
12-16 p.m. : 26.8 % empty
16-20 p.m. : 18.7 % empty
20-24 p.m. : 20.8 % empty

These results showing a maximal stomach fullness during the course of the day thus indicated that plaice is a typical daytime feeder.

5. Changes in diet with time, body length and depth.

Table 2 presents the results of the changes in diet related with a combination of the time of the day, the body length and the depth.

Although through this exercise a number of samples of a certain type of combination became sometimes rather limited some conclusions could nevertheless be formulated:

- There seemed to be an overall trend that higher numbers of empty stomachs were associated with higher lengths of plaice.
- For a fixed time period and length class the number in percentage of empty stomachs declined at greater depths.

SEPTEMBER SURVEY - Belgian coast

1. General species preference

The pre-recruit survey along the Belgian coast provided plaice samples in a depth zone less than 25 meter. Due to the fact that the area is rather limited in surface populated by typical coastal benthic communities, the data on the stomach content were treated separately from the ones of the August survey.

The results of the composition by number in percentages as well as the frequency of occurrence are shown in table 3.

A total of 22 different species were identified.

Coastal plaice mainly fed on Mollusca (67 % in numbers, 74 % in frequency of occurrence) from which diet Abra abra accounted for about 90 % and Ensis ssp for about 7 %.

Polychaeta were the second most important taxonomic group with 31.6 % in number and 50.9 % in frequency of occurrence. The majority of the Polychaeta in the diet consisted of Owenia fusisformis and to a lesser extent of, Pectinaria koreni, Nepthys ssp and Nereis ssp.

The other taxonomic groups as Anthozoa, Nematoda and Crustacea were almost unimportant as food items for coastal plaice.

2. Changes in diet with increasing size.

The larger the plaice the higher the frequency of occurrence for Polychaeta : from 25 % in plaice < 25 cm up to 62 % and 55 % in the categories repectively of 25-29 cm and 30-34 cm. The frequency went further up even till 100 % in the samples of plaice larger than 35 cm. However the latter group was only composed by 4 samples. The increase was mainly due to the higher consumption of Owenia.

Also Mollusca (mainly Abra alba) became more important as food for larger plaice.

3. Changes in diet with time

As in the IVc offshore area the number in percentage of the empty stomachs was highest in the early morning samples and decreased afterwards as follows:

8 - 10 a.m. : 25 % empty
10- 12 a.m. : 22 % empty
12- 14 p.m. : 10 % empty
14- 16 p.m. : 10 % empty

DISCUSSION

About 9 detailled decriptions of the food of plaice in different areas and sub-populations are available in the literature:

- Smith (1892) : North Sea (Firth of Forth and St- Andrew Bay)
- Ritchie (1928) : North Sea (St-Andrews Bay)- frequence of occurrence
- Blegvad (1916) : Nyborg Fjord, Denmark - weights in percentages
- Todd (1905) : North Sea -numbers in percentages
- Blegvad (1930) : Baltic Sea - frequence of occurrence
- Smidt (1951) : North Sea especially the Danish Waddensea
- Braber and De Groot (1973) : North Sea, especially the German Bight -numbers in percentages

- Lande (1973) : Borgenfjorden, North- Tröndelag - frequence of occurrence
- De vlas (1979) : percentages of preys per square meter

The results of these studies were compared with the present findings and tabulated on table 4.

Todd (1905) and Braber et al(1973) already pointed out that plaice could be described as a selective feeder. This statement is also in line with the results of this study.

Secondly the relative importance of each taxonomic group for each study has been compared. The main results are as follows:

- Cnidaria

This taxonomic group appeared to be of little importance during this research (3.8 %) and was limited to the depth zones of less than 25 meter. Only Todd (1905) reported this group as food item, viz. Ceranthius lloydii and Obelia longissima.

Cnidaria was not mentionned by the other authors, but this may be due to the depth limits of sampling.

-Nemertini

Small amounts of Nemertini were described in the results of Todd (1903), Blegvad (1916 and 1930), Smidt (1951) and De vlas (1973).
In general this food source does not appear to be of significant importance.

- Polychaeta

The taxonomic group Polychaeta is undoubtly one of the most important food components of plaice. In the results of most of the authors as well as in this report the Polychaeta group constitutes even the major prey group.

Especially Pectinaria koreni appeared to be the main species in almost all the available studies. Owenia was only observed by Todd (1905). To a lesser extent Nephtys was also found to be a common prey.

- Crustacea

Most of the authors listed above indicated this taxonomic group as a rather important food source. This was confirmed by the stomach analysis of this research (29%). The different distribution pattern and the limited mobility of these prey species may be responsible for the different importance and great variety as suggested by several authors.

-Mollusca

Mollusca is undoubtedly very important as food for plaice. All studies demonstrate the frequent occurrence of Abra ssp, Mya ssp and Venus ssp.

- Echinodermata

This group may be cited as an important food component, but its selection seemed to be related with the depth (mainly Ophiura ssp and Echinocyanus ssp). Samples however from shallow waters as the Danish coast (Blegvad,1916) or the Waddensea (Smidt,1951) did not show the presence of this group. Ophiura ssp and Echinocyanus ssp were the most frequent species of that group.

- Pisces

Several authors indicated Ammodytes ssp as a common food component.This report also revealed the rôle of this fish for larger plaice.

CONCLUSIONS

This contribution tended to illustrate some aspects of the feeding pattern of plaice and its rôle as a Polychaeta or Mollusca feeder. In general the conclusions were in line with former studies in this field. However new information became available on the parameters which could influence the diet of plaice, viz. the length of the predator, the depth and the time. Further research is planned and will be more directed towards a quantitative approach.

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Table 1 :
Composition by number (N) and frequency of occurrence (F) in percentages of the preys in the offshore area

Taxonomic group	N (%)	F (%)
ANTOZOA	1.27	3.79
Actinia spp.	0.05	0.32
Anemone, indet	1.22	3.47
NEMERTINI	0.55	0.32
Protonemertes spp.	0.55	0.32
NEMATODA	0.20	0.32
Nematoda, indet.	0.20	0.32
POLYCHAETA	48.75	60.25
Errantia	7.04	23.03
Eulalia spp.	0.10	0.63
Eunice spp.	0.30	1.89
Glycera lapidum	0.71	3.79
Nephtys spp.	2.64	13.56
Nereis spp.	1.57	5.99
Phyllodoce spp.	0.20	1.26
Syllis spp.	0.15	0.63
Sedentaria	41.71	48.26
Amphitrite spp.	0.10	0.32
Arenicola marina	0.15	0.95
Lanice spp.	0.71	3.15
Ophelia spp.	0.10	0.63
Owenia fusiformis	5.27	14.51
Pectinaria koreni	35.38	32.81
Polychaeta, indet.	1.37	3.15
CRUSTACEAE	22.90	29.02
Amphipoda	13.63	16.04
Bathyporeia spp.	11.81	11.99
Gammarus spp.	1.77	5.66
Amphipoda, indet.	0.05	0.32
Decapoda	3.24	14.25
Cragnon cragnon	1.52	5.36
Eupagurus bernhardus	0.61	3.47
Galathea spp.	0.05	0.32
Macropipus holsatus	1.01	5.68
Xantho spp.	0.05	0.32
Mysidaceae	6.03	0.95
Mysis spp.	6.03	0.95
MOLLUSCA	7.69	23.34
Gastropoda	0.25	1.58
Littorina spp.	0.10	0.63
Natica spp.	0.15	0.95
Lamellibranchiata	6.48	22.81
Ensis spp.	0.10	0.63
Mactra spp.	0.30	1.89
Mya spp.	3.85	10.09
Mytilus edulis	0.15	0.32

Scrobicularia spp.	0.10	0.63
Spisula spp.	0.66	2.84
Tellina spp.	0.91	2.52
Venus spp.	0.41	1.89
Lamaellibranchiata, indet.	0.61	1.58
Sipho	0.35	1.26
ECHINODERMATA	16.68	32.49
Echinoidea	10.09	19.24
Echinocardium spp.	0.41	1.58
Echinocyamus spp.	9.38	17.35
Echinus spp.	0.10	0.63
Psammechinus spp.	0.15	0.32
Sphaerechinus spp.	0.05	0.32
Ophiuroidea	6.59	18.30
Ophiottrix	0.05	0.32
Ophiura spp.	6.54	17.98
CHORDATA	1.27	4.10
Pisces, indet.	1.27	4.10

Table 2 : Percentage of empty stomachs in relation to the size of the plaice, time and depth of capture

depth (m)	time	size (cm) <25	25-29	30-34	35-39	>40
		empty stomachs (%)				
<25	6-8	-	-	-	-	-
	8-12	100.0*	50.0*	0.0*	0.0*	-
	12-16	-	-	-	-	-
	16-20	2.9	6.7	20.0	0.0*	0.0*
	20-24	-	-	-	-	-
25-34	6-8	100.0*	100.0*	100.0*	100.0*	-
	8-12	21.1	41.2	57.1	-	0.0*
	12-16	40.0*	10.0	26.7	0.0*	0.0*
	16-20	-	46.2	20.0*	25.0*	-
	20-24	-	0.0*	50.0*	-	-
35-44	6-8	-	-	-	-	-
	8-12	0.0*	19.0	33.9	41.2	100.0*
	12-16	85.7	45.5	6.7	0.0*	-
	16-20	0.0*	0.0	12.1	33.3	0.0*
	20-24	-	-	-	-	-
>45	6-8	16.7	31.3	79.1	75.0	0.0*
	8-12	31.3	0.0	17.6	20.0	-
	12-16	-	-	-	-	-
	16-20	-	-	-	-	-
	20-24	-	0.0*	33.3	14.5	0.0

* : less than 5 samples.

Table 3:

Composition by number (N) and frequency of occurrence (F) in percentages for the preys in the coastal area

prey species	N (%)	F(%)
ANTHOZOA	0.6	4.8
Anemone, indet.	0.6	4.8
NEMERTINI	0.1	0.5
Cephalothrix rufifrons	0.1	0.5
NEMATODA	0.1	0.5
Nematoda, indet.	0.1	0.5
POLYCHAETA	31.6	50.9
Errantia	4.6	27.0
Glycera spp.	0.7	2.6
Nephtys spp.	2.1	14.3
Nereis spp.	1.7	11.7
Phyllodoce spp.	0.1	0.9
Sedentaria	27.0	42.2
Arenicola marina	0.1	0.5
Lanice spp.	0.9	2.6
Owenia fusiformis	21.1	36.4
Pectinaria koreni	2.3	13.9
Sabella pavonia	1.0	3.9
Polychaeta, indet.	1.6	5.6
CRUSTACEAE	0.7	2.2
Amphipoda	0.1	0.5
Gammarus spp.	0.1	0.5
Decapoda	0.3	1.7
Cragnon cragnon	0.2	1.7
Macropipus holsatus	0.1	0.5
MOLLUSCA	67.0	74.3
Lamellibranchiata	67.0	74.3
Abra alba	60.2	69.3
Ensis spp.	4.7	17.7
Mytilus edulis	0.1	0.9
Spisula spp.	0.1	0.5
Tellina spp.	0.1	0.5
Thracia spp.	1.3	4.3
sipho	0.5	2.2

Table 4 :Food preference findings as reported by different authors.

Classification:
1 : >20%
2 : 5- 20%
3 : 1-5%
4 : <1%
5 : relative importance not mentionned
Authors:

Smith (1892) S92 : North Sea(Firth of Forth and St- andrews Bay, East-Scotland

Ritchie (1928) R28 : North Sea(St-Andrews Bay,East-Scotland) frequence of occur rence

Blegvad (1916) B16 : Nyborg Fjord, Denmark composition by number in %

Todd (1905) T03 : North Sea composition by number in %

Blegvad(1930) B30 : Baltic Sea frequency of occurrence

Smidt (1951) S51 : North Sea (Danish Waddensea)

Braber en De Groot (1973) B73 : North Sea (German Bight) composition by number in %

Lande (1973) L73 Borgenfjorden, North- Trönde lag, Norway frequency of occurrence

De vlas d79 % of number of preys preda ted per square meter

De Clerck and Buseyne D89

	D89	S92	R28	B16	T05	B30	S51	B73	L73	d79
Cnidaria	3				4					
Anthozoa	3				4					
Actinia spp.	4									
Ceranthius lloydii					4					
Anemoon, indet.	3									
Hydroidea					4					
Obelia longissima					4					
Priapulida										
Halicryptus spinolosus							5			
Priapulus spp.							5			
Nemertini	4			4	4	3	5			4
Protonemertes sp.	4						5			
Annelida	1	2	1	1	1	1	5	1	1	1
Polychaeta	1	2	1	1	1	1	5	1	1	1
Errantia	1	3	1	1	2	1	5	2	1	4
Aphrodite aculeata			4	4						
Eulalia spp.	4									
Eunice spp.	3									

	D89	S92	R28	B16	T05	B30	S51	B73	L73	d79
Eunice spp.	3									
Gonodia maculata			3			4				
Glycera lapidum	3		2		4					
Lagis koreni			2							
Lumbrenereis fragilis				4						
Melinna elizabethae			3							
Nephtys caecca					3					
Nephtys ciliata									1	
Nephtys spp.	2		1	2	3	1	5			4
Nereis spp.	3		4	4	4		5	2		4
Phyllodoce groenlandica					4					
Phyllodoce spp.	4		3		4	2	5			4
Stenehalis limicola					4					
Sedentaria	1	3	3	1	1	1	5	1	1	1
Ammotrypane auglogaster				4		4				
Amphitrite spp.	4		4							
Arenicola marina	4		3	2	4	1	5	3		4
Aricia armiger				4						
Capitella spp.							5			
Lanice spp.	3		4	4				3		4
Ophelia limacina	4			4	3	2				
Owenia fusiformis	2				2					
Pectinaria koreni	1			3	1				1	
Pectinaria spp.		3		3		2	5	1		
Polydora spp.										3
Pygospio spp.							5			1
Travisia Forbesi				4		3				
Scoloplos spp.							5			
Tharyx marioni										2
Crustacea	1	2		2	2	2	5	2	3	3
Ostracoda							5	3		
Copepoda						2		2		3
Harpacticoidea								3		
Malacostraca										
Peracarida							5			
Mysidacea	4				3		5	3		
Mysis relicta										
Mysis spp.	4				3		5			
Gastrosacus spinifer					4					
Cumacea		2		4	4	4	5			
Cuma rathkii		2								
Diastylis spp.				4						
Isopoda				4		4				
Idothea spp.				4		4				
Amphipoda	2	2			3	2	5			3
Ampelisca spp.		2				2				
Gammarus spp.	3						5			4
Bathyporeia spp	2									
Corophium spp.							5			3
Amphipoda, indet.	4					3				
Eucarida				2						4
Decapoda	2			2	3		5	3		4
Brachyura	2			2	4		5			4
Macropipus holsatus	2									
Portunus holsatus										

	D89	S92	R28	B16	T05	B30	S51	B73	L73	d79
Portunus pusillus					4					
Portunus spp.				2	4					
Corystes cassivelanus					4					
Carcinus spp., juv.				4			5			4
Xantho spp.	4									
Anomura	2				4			3		
Eupagurus bernhardus	2				4			3		
Galathea spp.	4									
Macrura	2			4	4		5	3		4
Cragnon cragnon	2							3		4
Cragnon spp.				4	4		5			
Mollusca	1	1	1	1	1	1	5	1	1	1
Gastropoda	4		4	3	3	2	5		3	4
Acera bullata				3		3				
Buccinum undatum									3	
Hydrobia spp.				3		2	5			4
Natica spp.	4				3					
Retusa spp.							5			
Cylichna cylindriacea					4					
Litorina spp.	4									
Philine aperta				4		2				
Philine scabra					4					
Philine spp			4	4						
Rissoa spp.				4						
Lamellibranchia	1	1	1	1	1	1	5	3	1	3
Taxodonta			1		4	3				
Nucula nitida			1	4						
Nucula spp.		1	4	4	4					
Anisomyria	4				3		5			
Mytilus edulis	4							3		
Mytilus spp.							5			
Pecten spp., juv.					3					
Eulamellibranchia	1	1	1	1	1	1	5	1	1	3
Cardium aculeatum					4					
Cardium edule, juv.		3	3	4	4		5			
Cardium fasciatum				4						
Venus exolata				4	4					
Venus gallina			1		3	2		4		
Venus spp.	3									
Venerupsis spp., juv.					4					
Spisula spp.	3						5	3		
Mactra solida				4	2					
Mactra subtruncata				3	1					
Mactra stultorum				4	3					
Mactra spp.	3		4	4	2					
Musculus niger									1	
Donnax vittatus								4		
Nuculana spp.									2	
Scrobicularia alba					1					
Scrobicularia nitida					4					
Scrobicularia plana		1								
Scrobicularia prismatica					3					
Scrobicularia spp.	4				2					
Abra alba	1		2	1						

	D89	S92	R28	B16	T05	B30	S51	B73	L73	d79
Abra spp.		1							1	
Abra nitida				3						
Macoma balthica				3		3		1		4
Macoma calcarea				3		3				
Macoma solidula		1								
Macoma spp.							5	1		
Tellina donacina					4					
Tellina fabula			4	4	1	2				
Tellina tenuis				3	4	3		2		
Tellina spp.	3									
Ensis ensis			1							
Ensis spp.	4		3					3		
Solen spp.		3		2						
Corbula gibba		1		3						
Mya arenaria, juv.		3		4		3			2	3
Mya truncata, juv.				3	4				2	
Mya spp., juv.	2						5		2	
Thracia spp.				1						
Cyprina islandica				4						
Leda pernula				4						
Leda minuta				4						
Angulus tennis								3		
Cerastoderma edule										4
Syndosmya nitida						3				
Cultellus pelluucidus						2				
Tunicata					4					
Pelonaia spp.					4					
Echinodermata	1		1		2	3		2	2	
Echinoidea	1				2	3				
Echinocyamus pusillus					2					
Echinocardium spp.	3				3	4				
Echinus miliaris					3					
Echinus spp.	4									
Psammechinus spp.	4									
Sphaerechinus spp.	4									
Echinocyamus spp.	2									
Ophuiroidea	2		1		3					
Ophiura ciliaris					4					
Ophiura albida			1		3					
Ophiura texturata			1							
Ophiura spp.	2				3					
Amphiura filiformis					3					
Ophiotthrix spp.	4									
Asteroidea		3						2		
Asterias rubens		3						2		
Ascidiacea									2	
Ciona intestinalis									2	
Bryoza					4					
Alcyonidium spp.					4					
Chordata	3	2	3		3	4	5	3		4
Vertebrata	3	2	3		3	4	5	3		4

	D89	S92	R28	B16	T05	B30	S51	B73	L73	d79
Pisces	3	2	3		3	4	5	3		4
Gasterosteus spp.		2								
Ammodytes spp.	3		3		3	4		3		
Clupea spp., juv.							5	4		
Gobius spp.										
Solea solea								4		
Fish eggs								4		
Elvers						4				

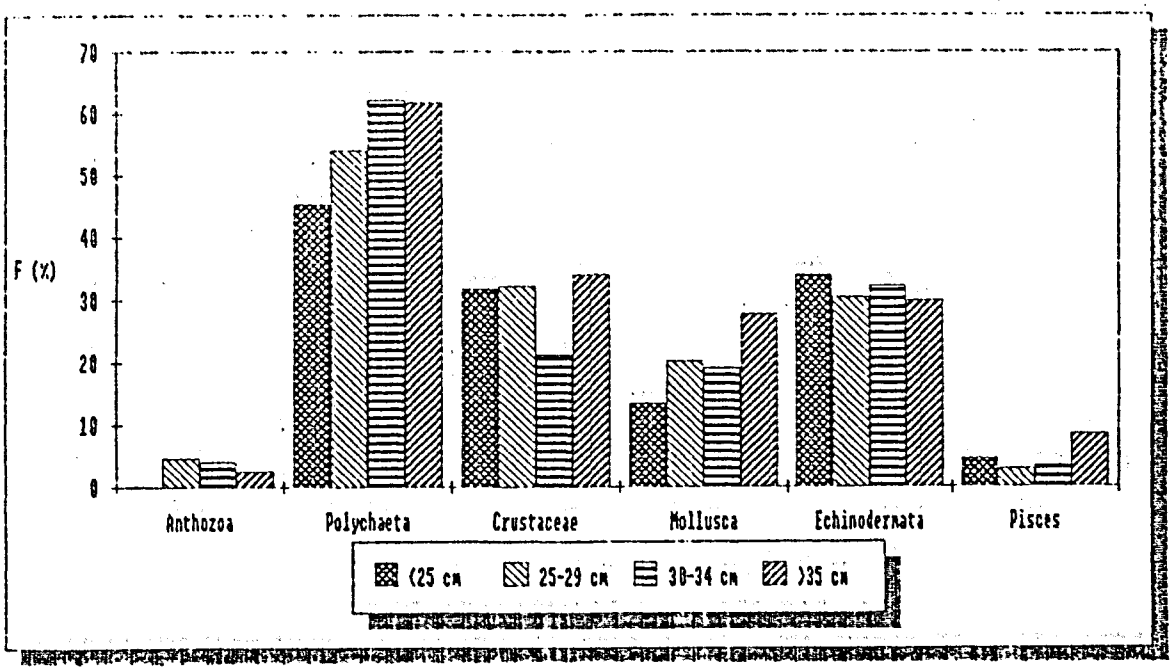

Figure 2.- Food selection by length group

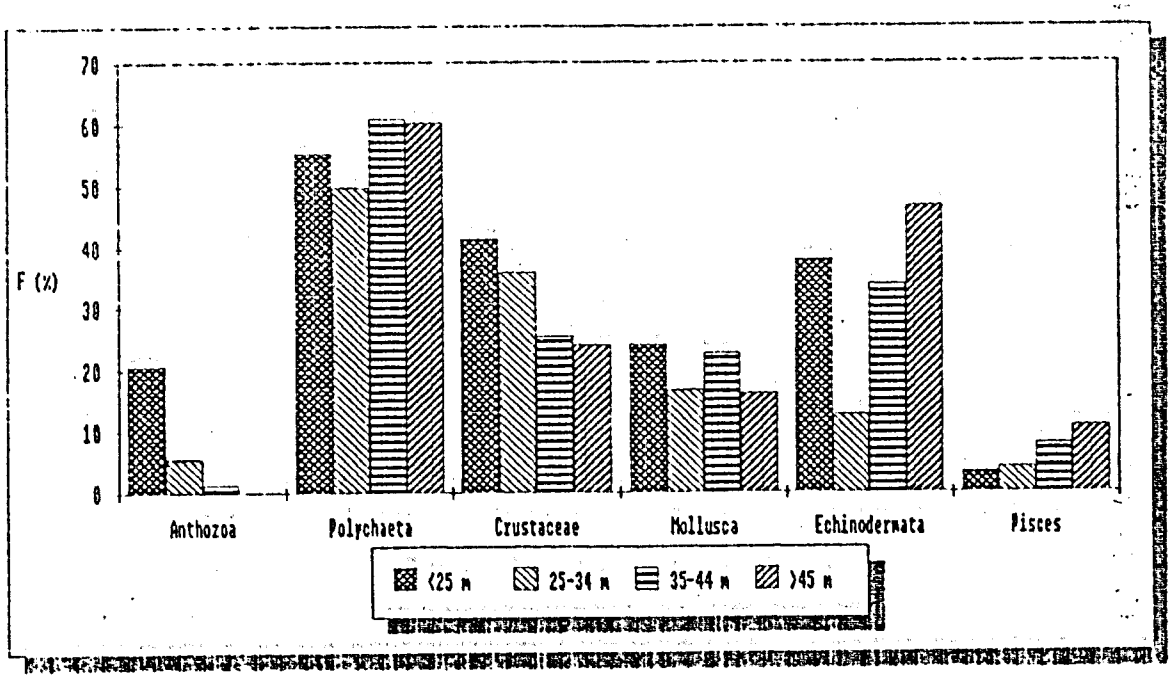

Figure 3.- Food selection by depth zones

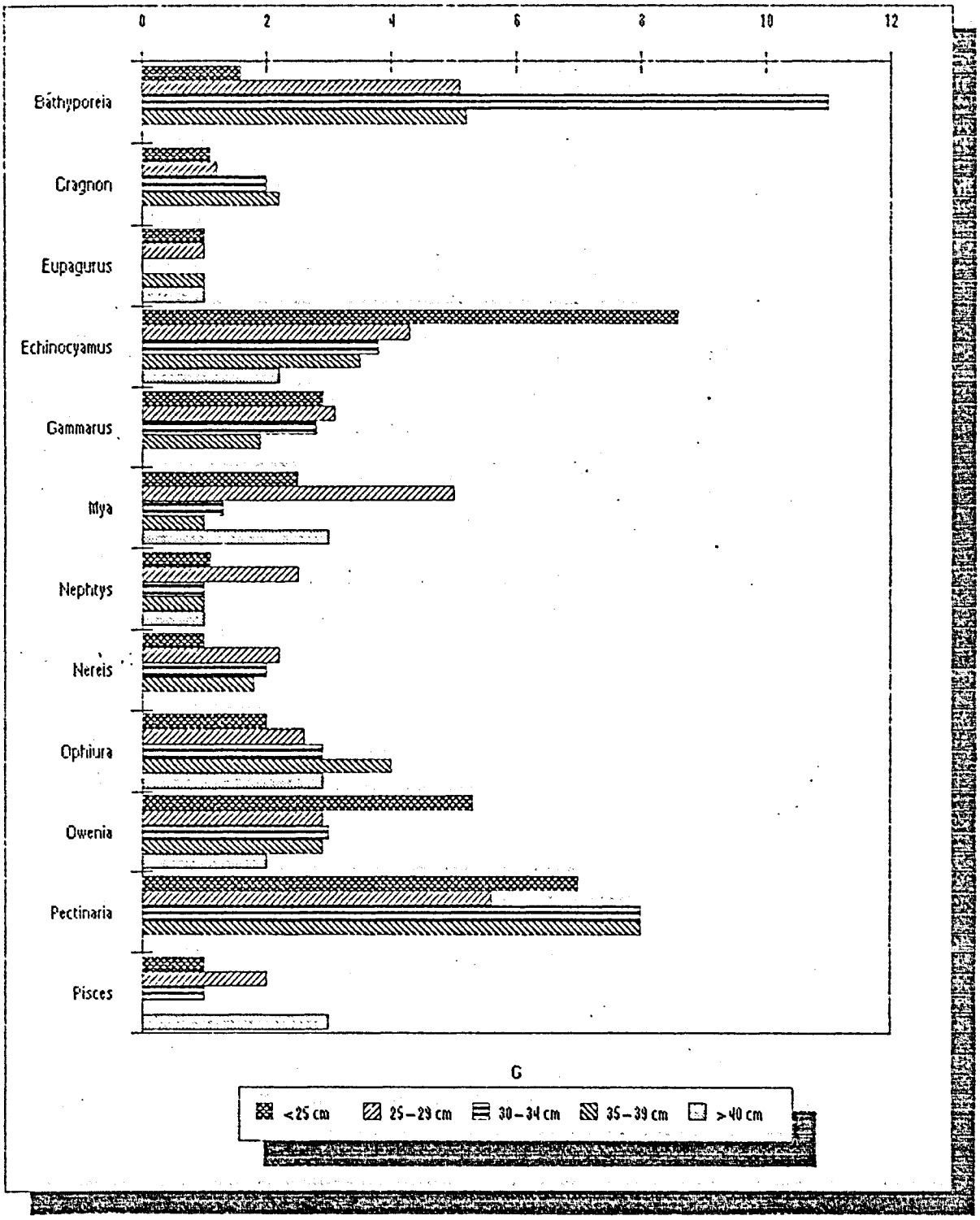

Figure 4.- Offshore area: mean number of preys per stomach for different length categories of plaice.

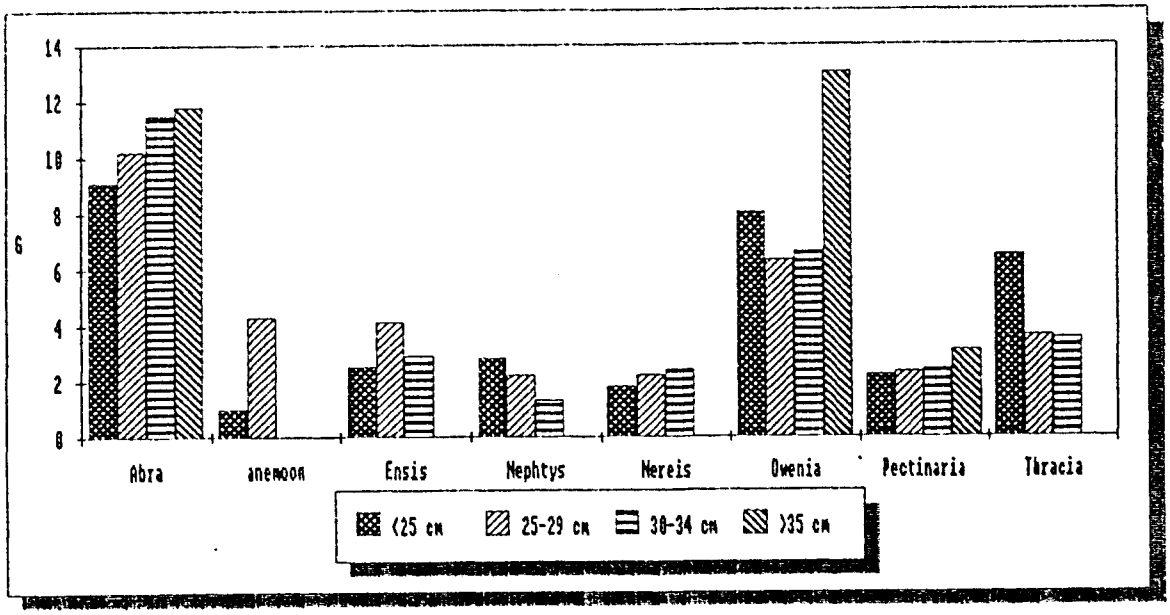

Figure 5.- Coastal area: mean number of preys per stomach for different length categories of plaice.