Fol. 41 G

FISKERIDIREKTORATETS
HAVFORSKNINGSINSTITUTT
P.b. 1870 - Nordnes
5024 Bergen

International Council for the
Exploration of the Sea

C.M. 1986/G:71
Demersal Fish Committee

PRELIMINARY REPORT FROM A COMPARATIVE STUDY OF THE DIET OF FOUR GADOID FISHES IN A FJORD OF WESTERN NORWAY

by

A.G. Vea Salvanes
Institute of Marine Research, Bergen, Norway

ABSTRACT

As a contribution to a research program on sea ranching of cod in a fjord in western Norway, a dietary analysis of the main gadoid species has been conducted. The main aim of the analysis has been to identify potential predators and competitors to the young cod which will be released.

Stomachs of the gadoid species cod (G. morhua), pollack (P. pollachius), saithe (P.virens), and poor-cod (T. minutus) were collected during monthly experimental fishing, June-85 - July-86.

The gobies Pomatochistus minutus and Gobisculus flavesenc are found to be important food items of all the Gadidae examined. The smallest length groups of all four species tend to overlap in diet, and one conclusion reached is that an extended analysis should include investigations of the four Gadidae caught at the same place and time together with an examination of the prey species, among which gobies should be given special attention.

Cod is found to feed canibalistically, and pollack is found to be an important predator to cod. A second conclusion is therefore that a more detailed study of the abundance and distribution of pollack is needed.

1. INTRODUCTION

As a contribution to a research program on sea ranching of cod in Masfjorden, a fjord in western Norway, a comparative study of the diet of the major gadoid species is being conducted. The main aim of the research program is to investigate whether it is possible to build up the local cod population in the fjord by releasing artificially reared young cod. An important part of this program is to examine and analyse the ecosystem in the fjord before codlings are released into the population in large quantities. The present paper is a preliminary report from the part of the investigations dealing with dietary analysis of the gadoid species with the aim of identifying potential predators and potential competitors to the young cod which will be released. After 2-3 years investigation, artificially reared young cod will be released in Masfjorden, and the dietary studies will then be focused on possible changes in the feeding strategy.

2. MATERIAL AND METHODS

Stomachs of the four gadoid species cod (Gadus morhua), pollack (Pollachius pollachius), saithe (Pollachius virens), and poor cod (Trisopterus minutus) have been collected during a program of monthly experimental fishing since June 1985. The stomachs of small fishes are preserved in 6% formaldehyde, and stomachs of large fishes are preserved by freezing. More detailed description of the experimental fishery is found in SALVANES (1986).

As of July 1986, a total of 2828 stomachs of the four Gadidae have been preserved. So far only 537 have been examined. Table 1 gives the number of examined stomachs by 5 cm length groups.

The preserved stomachs were examined after a period of storage. Individual food items were separated and identified to as low taxa as possible, and coded according to the NODC System (Third edition, July

1981). Excess moisture was removed with absorbant tissue. The items were separated into size groups, and each group was weighed to the nearest milligram, and the individuals counted. Also any remaining unidentifiable material was weighed.

The data are further registered in a database, and tables of the mean diets of the four gadidae are produced using the methods described in Westgård (1982).

The limited number of stomachs examined has only allowed us to describe the principal diet during the whole year and the summer and winter diet.

3. FOOD CONSUMED

3.1 Stomach contents

The number of empty stomachs varied according to species. Percent empty stomachs of cod, pollack and saithe did not show any difference between the two periods April-September and October-March. On the other hand the percent of empty stomachs of poor cod varied between the two periods. 27% of cod stomachs were found to be empty, 18% of pollack and 40% of saithe, while 38% of poor cod was found empty in the period April-September and 23% in October-March. At first sight the diet of cod, pollack and poor cod seems to be very diverse, with respectively 48, 42 and 42 different prey species occuring in the stomachs examined. In the stomachs of saithe only 14 different prey species occur. Table 3 lists all the prey species which occur in the stomach contents of all the four predator species. The proportion (%) by weight and number is given for each species. The prey items include a variety of crustaceans, ranging from large crabs to the smaller prawns and shrimps, several fish species and polychaet worms.

Fish seems to be the most important prey item of cod, pollack and poor cod, while small copepods dominate the diet of saithe.

3.1.1 Changes in diet with size

To examine changes in diet associated with growth, the fishes are divided into length groups, and the various food items are grouped

into several broad categories as in Table 2. Fig. 1 shows the composition of the principal food found in the stomachs of cod, pollack, poor cod and saithe; (a) shows the proportion of prey items by weight, and (b) the proportion by number.

Cod (G. morhua)

Gobies (VI) are the most important food item by proportion of weight for cod less than 25 cm. The proportion by weight decreases with increasing fish size, while the proportion by number increases with fish length. The proportion by weight of large epibenthic crustaceans increases with fish length if one excludes the peak of size group 21-25 cm which is based on two stomachs containing large quantities of crabs. Other fishes (VII) show a tendency to increase in weight with size of the predator. Polychaets (VI) are found in stomachs of cod > 20 cm. Small crustaceans (II) are found in large number in all length groups but never important by weight. Gastropods (III) and bivalve molluscs (VI) are less important in the food of cod in Masfjorden, but to a certain degree, cod eats algae.

Pollack (P. pollachius)

Gobiidae (VI) and small crustaceans (II) are important food items for pollack. Fig.1 shows a decreasing weight percent with increasing fish length. The second group is also important by number for pollack over a wide length range. The proportion by weight of other fishes (VII) in the diet increases with length. Polychaets (V) are to a certain degree important in the food of pollack of all sizes. Large crustaceans (I) are not important by weight, but to a certain degree in numbers for pollack having a length 25-45 cm.

Poor Cod (T. minutus)

Important food items of poor cod are large epibentic crustaceans (I), small crustaceans (II), polychaeta (V) and gobies (VI). Gastropods (III) and bivalves (IV) are also present as a small proportion in the diet of poor cod, but are not important in proportion by weight.

Saithe (P. virens)

Small crustaceans (II) totally dominate the diet of saithe, both in

proportion by weight and number (excluding the single stomach examined in length group 25-30 cm). But gobies also occur in large proportion for fish less than 25 cm. Polychaets are important by weight over the whole size range of saithe. The previously mentioned single fish in group 25-30 cm was excluded when calculating proportions by number

3.1.2. Seasonal diet changes

To examine diet changes associated with growth and season, the data are divided into two time periods: April-September (summer) and October-March (winter). Fig.2 shows the food composition of the diet found in stomachs of cod, pollack and poor cod in proportion by weight for the two seasons. Fig.3 shows the same in proportion by number. Saithe is excluded in Fig.2 and Fig.3 because too few stomachs were examined from each group (Table 1).

Cod (G. morhua)

Gobiidae (VI) dominate the diet of small cod in October-March, while they seem to be more important for larger cod in the period April-September. Large crustaceans (I) are also more important in the winter than in the summer period for cod > 25 cm. The same is also noticed for other fish (VII). Bivalves (IV) and algae (VIII) occur in the diet only in October-March. Polychaet worms (V) show no difference in occurrence in the two periods.

Pollack (P. pollachius)

Polychaet worms (V) seem to be more important in October-March than in the other period both by weight and number. Gobiidae (VI) are also more important in October-March. Other fish (VII) showed higher proportions in the summer period than in the winter for pollack 25-45 cm. Small crustaceans (II) occur in larger proportion in April-September both in weight and number.

Poor cod (T. minutus)

Gobiidae (VI) and polychaeta (V) are more important in winter than in the summer period. Large crustaceans (I) occur in higher proportion by weight in the summer than in the winter period. The same does the number of small crustaceans (II). (In Fig.2, the proportion of

polychaeta (V) for fish length 11-15 cm is biased as only one stomach was examined).

4. DISCUSSION

The proportion of empty stomachs in the periods April-September (38%) and October-March (23%) was different only for poor cod. We did notice that poor cod having ripe and "running" gonads tended to have empty stomachs. Immature and spent individuals of poor cod tended to have half-full or even full stomachs, in contrast to what we observed for cod, pollack and saithe. This agrees with Armstrong's (1982) findings for gadoid fishes on the west coast of Isle of Man.

The gobies Gobisculus flavesence and Pomatochistus minutus are found in large proportions in the stomachs of cod and pollack caught in Masfjorden, and the largest proportions occur in the period September-March. This is also what Denstadlid (1972) found for cod in Borgenfjorden, a fjord half way up the Norwegian coast, and is what we should expect according to the peak abundance of gobies in October-December (Pethon, 1985) and according to the consideration of cod as an opportunistic feeder (Eliassen and Grotnes, 1985).

Large epibenthic crustaceans occure in the stomachs of cod and poor cod, and the proportion by weight tends to increase with fish length. They are uncommon in stomachs of pollack and saithe. Hawkins, Soofiani and Smith (1985) also noticed high weight proportions of large crustaceans in a fjordic sea loch in Scotland and did notice increasing incidence of occurrence with increasing cod length, but not increasing weight proportions with length. Svåsand and Kristiansen (1985) also noticed high proportions of large crustaceans in stomach content of cod caught at Austevoll, and Armstrong (1982) in stomachs of cod and poor cod at the Isle of Man. The reptant decapods Macropipus acuatus and the Norway lobster Galathea sp. were among the most important of the large crustaceans in stomachs of cod and poor cod in Masfjorden.

In a pilot examination of the littoral zone in Masfjorden, in July this year, not a single M. acuatus was found, but large numbers of Carcinus maenas. Small individuals of those species may have been misclassified if some of the legs are missing. M. acuatus is also

found as the most important among the large crustaceans in Austevoll (Svåsand and Kristiansen, 1985). Some misclassifications might have occured, but the difference is probably partly caused by difficulties in sampling the crabs. In Scotland (Hawkins, Soofiani and Smith 1985), and at the Isle of Man (Armstrong, 1982), the heremit crab Pagurus bernhardus, was found to be the most important reptant decapod in the diet. This taxa is of some pmportance, also at Austevoll (Svåsand and Kristiansen 1985), but not in our examination of fish stomachs from Masfjorden.

Fishes other than gobies occur in large proportion in the stomach contents of cod and pollack, and the proportion tends to increase with fish length. Detailed examination of other fishes eaten reveals that cod mainly feeds on bottom-feeding species as Pholis gunnellus, Taurulus bubalis, Myxocephalus scorpius, Callionymidae, Centrolabrus exoletus and Crenilabrus melops, while pollack also feed on zooplankton-feeding species as Maurolicus muelleri, Gasterosterus aculeatus and Micromestitous poutassou. Cod feeds cannibalistically in Masfjorden. This is also found for cod in Balsfjorden (Klemetsen, 1982; Eliassen and Grotnes, 1985) and for cod in the North Sea (Ursin 1974, Pallson 1983). The stomach content analysis from Masfjorden shows that pollack feeds cannibalistically, and that it, in agreement with the findings of Nedreaas (1984) for pollack caught at Brandesund in western Norway, is an important predator of other gadidae. Also according to the more pelagic behaviour of pollack, the stomachs contain larger proportions of the smaller crustaceans Calanus finmarchicus, Praunus sp. and Meganyctiphanes norwegia than the stomachs of cod. Small crustaceans occur in highest proportions in the diet of pollack in the period April-September, especially for the smallest length groups.

The polychaet worms, including the swimming species of Nereidae and Glyceridae, occur in the stomachs of all the four gadidae examined, but the highest proportions are found in stomachs of poor cod and saithe. Polychaets are also found in stomachs of cod from other places (Svåsand and Kristiansen, 1985; Hawkins, Soofiani and Smith 1985 and Armstrong, 1982), in coalfish in Norwegian waters (Lie, 1962), and in stomach contents of poor cod at the Isle of Man (Armstrong, 1982).

5. CONCLUSION

As the gobies are found in large proportions in the mean diet of the gadoid fishes cod, pollack, saithe and poor cod of sizes less than 30 cm, there is a need for a more extensive analysis of the feeding strategy of those species, to examine if one or more of the species could be potential competitors to the young cod which will be released. Jones (1978) concluded (with references to some Gadoid species in the North Sea) that if gadoid species appear to be eating the same kind of food, direct competition appears to be avoided in that the different species are feeding on similar prey species and sizes but at different times or places, or that different species are feeding on the same prey species but on different prey sizes. The analysis should therefore include investigations of the diet of all the four gadidae caught at the same place and time together with observations of the composition and abundance of the prey species at that time and place. Pihl (1982) made a similar examination of shallow nursery areas on the west coast of Sweden. A small shallow bay was enclosed once a month, and the number of visiting fish and their food intake were estimated.

Since gobies are an important food item for gadidae in Masfjorden, a special study of the abundance and distribution of these species should be conducted focusing especially on seasonal and year to year variations. It is possible that the high proportions in our examination of stomachs during 1985-86 only reflects a year of seldomly occurring high abundance.

As pollack has been shown to be an important predator to gadidae in Masfjorden and seems to be quite abundant in the fjord (Salvanes, 1986), it is also important to examine the abundance and distribution of this Gadidae, for example by using tag-recapture experiments. Schoener (1982) suggests that coexistence of species having a high degree of overlap in their use of resources is made possible in that their abundance is held down by predators. Pollack may be among the most important regulating predators of the abundance of small Gadidae in Masfjorden, and therefore release of young cod may result in a large food supply for pollack.

6. ACKNOWLEDGEMENTS

I should like to thank Mr. Ø. Ulltang for helpful comments to the paper. I also acknowledge the assistance of the technical staff.

7. REFERENCES

Armstrong, M.J. 1982. The predator-prey relationships of Irish Sea poor cod (Trisopterus minutus L.) , pouting (Trisopterus luscus L.), and cod (Gadus morhua). J. cons. int. Explor. Mer, 40:135-152.

Denstadli, S.O. 1972. Forplantning, vekst og ernæring hos torsk (reproduction, growth and feeding of cod)(Gadus morhua L.) i Borgenfjorden, Nord-Trøndelag. Thesis in marine zoology at the University of Trondheim.

Eliassen, J.E. and P. Grotnes 1985. Feeding habits of cod (Gadus morhua) in Balsfjorden, northern Norway in relation to the distribution and availability of potential food species. Coun. Meet.int. Coun. Explor. Sea, 1985 (G:58) (Mimeo).

Hawkins, A.D., N.M. Soofiani and G.W. Smith 1985. Growth and feeding of juvenile Cod (Gadus morhua L.) J. Coun. int. Explor. Mer, 42:11-32.

Jones, R. 1978. Some observations on competition between some gadoid fish species. ICES-symposium on the changes in the North Sea Fish stocks and their causes. Rapp. p.-v. Reun.Coun.int. Explor.Mer. 172:292-300.

Nedreaas, K. 1984. Ernæring og beiteadferd hos sei (Pollachius virens (L) på kysten av Hordaland. (Nourishment and feeding behaviour of saithe on the coast of Hordaland). Thesis in Fisheries biology, the University of Bergen.

Pallson, Q.K. 1983. The feeding habits of demersal fish species in Icelandic waters. Rit. Fiskideildar. Marine Institute, Reykjavik.

Pethon,P. 1985. Aschehougs store fiskebok. Alle norske fisker i farger. (Aschehougs big book of fish; all Norwegian fish in colour) Oslo, Aschehoug.

Pihl, L. 1982. Food intake of young cod and flouender in a shallow bay on the Swedish west coast. Netherlands Journal of Sea Research 15 (3/4):419-432.

Salvanes,A.G.V. 1986 . Preliminary report from a study of species composition, size composition and distribution of the fish in a fjord of western norway based on regularly conducted experimental fishing and catch statistics during one year. Coun.Meet. int. Coun. Explor. Sea 1986 (G:/70) (Mimeo).

Schoener, T.W. 1982. The controversy over interspecific competition. American Scientist, Vol. 70, 586-598.

Strong, D.R. 1980. Null hypothesis in exologi. Synthese 43:271-285.

Svåsand,T. and T. Kristiansen 1985. Release of artificially reared 0-group coastal cod (Gadus morhua) in a landlocked fjord in western Norway. Coun. Meet. int. Coun. Explor. Sea 1985 (F:10) (Mimeo).

Ursin,E. 1976. Samspillet mellom fiskeartene. (Introduction of fish species). Fisk og Havet, Skr.Danm.Fiske Havunders. 37:3-9.

Westgård, T. 1982. Programs for handling and analysis of stomach contents data. Coun. Meet. int. Coun.Explor. Sea, 1982 (H:21) (Mimeo).

Table 1. Number of stomachs examined from cod, pollack, saithe and poor cod. The numbers of stomachs examined from fish caught in the summer and winter period are given in brackets.

Size Class	Cod	Pollack	Saithe	Poor cod
	N (s w)	N (s w)	N (s w)	s w
< 10	13 (0 13)	-	-	-
11-15	11 (1 10)	-	-	2 (1 1)
16-20	15 (1 14)	19 (6 13)	7 (7 -)	46 (25 21)
21-25	2 (1 1)	26 (25 1)	15 (1 14)	44 (22 22)
26-30	31 (19 12)	50 (48 2)	1 (1 -)	1 (- 1)
31-35	24 (9 15)	36 (25 11)	27 (8 19)	
36-40	15 (4 11)	36 (32 4)	10 (- 10)	
41-45	7 (- 7)	35 (27 8)	5 (1 4)	
46-50	1 (- 1)	16 (12 4)	9 (- 9)	
> 51	24 (4 20)	9 (7 2)	-	

Table 2. The main categories of prey item found in the stomachs of Gadus morhua, Pollachius pollachius, Pollachius virens and Trisopterus minutus caught in Masfjorden from June 1985 to July 1986.

Category	Description
I	Large epibenthic decapod crustaceans, including Paguridae, Portunidae, Majidae, Munida, Galathea
II	Small crustaceans, including Caridea, Amphipoda, Copepoda, Mysida, Isopoda and Urochordata including Appendicenlaria (Larvacea)
III	Gastropoda, including Rissodia, Opisthobranchia, Nudibranchia
IV	Bivalvia, including Mythilus, Chlamys and Cardiidae and Echinodermata, including Ophiotrix
V	Polychaet worms including Nereidae, Glyceridae, Flabelligeridae, Capitellidae, Arenicolidae
VI	Gobiidae, including Gobisculus flavescens and Pomatochistus minutus
VII	Other fishes, including Gadidae, Pleuronectidae, Labridae, Cottidae, Blennidae, Pholidae, Callionymidae, Gasterosteridae and Stomiatoidei
VIII	Algae, including Chlorophyceae, Phaeophyta, Rhodophyceae, corals including Anthozoa, Ectoprocta and Ascidiacea including ciona intestinalis
IX	Unidentified material

Table 3. Stomach content of G. morhua, P. pollachius, I. minutus and P.virens caught in Masfjorden during the period 85/86 (June-June). N% is percent by number and W% is percent by weight. Values in "()" are parts of the nearest value above having no brackets. Values in "<>" are parts of the nearest value above in "()". Values less than 0.01 are marked with a +.

Prey item	G.morhua N= 145 W%	N%	P.pollachius N=241 W%	N%	T.Minutus N=93 W%	N%	P. virens N=74 W%	N%
ALGAE	6.5		0.2				0.1	
ANTHOZOA	+							
POLYCHAETA	0.8	16.0	5.3	5.0	16.1	7.8	15.8	0.4
Nereidae			(2.0)	(0.5)				
Nereis	(0.1)	(4.0)	<1.3>	<0.4>	(9.0)	(3.9)	(7.0)	(0.3)
Glyceridae			(1.0)	(1.1)	(5.7)			(0.1)
Glycera			<0.1>	< + >				
Flabelligeridae					(0.5)	(0.2)		
Arenicola marina	(0.3)	(0.1)			(2.3)	(0.1)		
MOLLUSCA								
Gastropoda	0.1	1.4	+	+	0.2	0.9	+	0.1
Mesogastropoda			(+)	(+)	(+)	(0.1)		
Rissoa sp.	(+)	(0.4)						
Bivalvia	+	0.3			0.1	0.1		
Mytilus edulis	(+)	(0.1)	+	+				
Pectenidae								
Chlamus opercularis	(+)	(0.1)						
Cariidae					(0.1)	(0.1)		
CRUSTACEA	12.4	50.6	8.4	84.9	32.9	79.7	34.4	98.8
Copepoda							(0.7)	(93.9)
Calanoida	(+)	(0.7)				(10.3)	(2.6)	<9.5>
Calanus				(0.1)			(0.2)	
C. finmarchicus			(1.1)	(44.7)	(+)	(0.2)	(18.8)	<81.5>
Malacostraca			(+)	(0.2)	(0.4)	(4.4)		
Nebalidae			(+)					
Nebalia bipes			(+)	<0.2>	<+>	<0.4>		
Mysida	(0.1)	(15.4)	(1.0)	(12.2)	(3.0)	(27.8)		
Praunus		<0.4>	<0.1>	<1.7>		<0.4>		
P.flexuosus	<0.1>	<1.3>	<0.1>	<0.3>	<1.0>	<6.8>		
P.neglectus	<+>	<5.8>	<0.1>	<0.1>	<0.1>	<0.5>		
P.inermis	<+>	<5.8>	<0.5>	<4.2>	<2.8>	<19.4>	(+)	(+)
Isopoda	(0.5)	(2.3)						
Idoteidae			(0.4)	(2.5)				
Idotea	<+>	<0.1>	<+>		(2.2)	(2.6)		
I.baltica	<+>	<0.4>	<+>		<0.1>	<0.1>	(0.5)	(+)
I.neglecta	<0.5>	<1.7>	(+)	<+>	<1.9>	<1.2>		
I.granulosa			<+>	<+>	<0.1>	<0.5>		
Asellota,								
Jaera							(+)	

Table 3, continued

Prey item	G.morhua N= 145 W%	G.morhua N= 145 N%	P.pollachius N=241 W%	P.pollachius N=241 N%	T.Minutus N=93 W%	T.Minutus N=93 N%	P. virens N=74 W%	P. virens N=74 N%
Amphipoda	(+)	(5.6)	(+)	(1.0)	(7.8)		(0.2)	
Parathemisto abyssorum			(+)	(+)				
Gammaridea	<+>	<1.0>	(0.9)	(5.0)	<0.6>	<1.6>		
Amphithoe-rubricata	<+>	<0.4>	(+)		(+)	<0.3>		
Calliopius-laeviusculus			<+>	<0.1>	<+>	<0.7>	<0.1)	(+)
Dexamine spinosa	<+>	<0.7>	(0.7)	<3.4>	<0.2>	<1.2>	<+>	
Gammaridae	<+>	<0.5>	<0.1>	<0.4>	<0.1>	<0.7>	<+>	(+)
Gammarellus homari	<+>	<0.1>						
Gammarus	(+)	<2.2>	<+>	(+)	<0.1>	<0.7>		
G.locusta					<+>	<0.1>		
Hyperia galba						(+)	(+)	
Euphausiacea	(+)	(2.5)				(0.7)	(0.4)	.8)
Euphausiidae			(0.2)	(0.1)			(8.4)	
Meganyctiphanes sp.					(0.4)		<2.0>	<1.0>
M.norvegica	<+>	<2.5>	(3.4)	(3.3)		<0.6>	<6.4>	<1.7>
Caridea	(0.2)	(8.5)	(0.3)	(0.3)	(3.9)	(14.2)		(2.8)
Athanas nitescens	<+>	<0.1>	<+>					
Hippolyte varians	<0.1>	<3.7>	<+>	<0.2>	<1.7>	<8.8>		
Spirontocaris	<+>	<0.4>						
S. chranchi					<0.1>	<0.1>		
Eaulus sp.	<+>	<0.1>						
E.gaimardi			<+>	<0.1>				
E.occultus	<+>	<0.5>	<+>		<0.2>	<0.7>		
Caridion gordoni			<+>					
Pandalus borealis			<0.1>					
P.montagui	<0.1>	<0.2>	<+>		<0.2>	<0.1>		
P. breviostris					<0.1>	<0.8>		
Pandalina brevirostris	<+>	<0.1>			<0.4>	<0.2>		
Dichelopandalus bonnieri			<+>					
Crangonidae		<0.1>			<0.2>	<0.1>		
Crangon crangon	<+>	<0.1>						
Anomura								
Paguridae	(0.1)	(0.2)	<+>		<+>	(0.3)		
Eupagurus bernhardus	(+)	<0.1>						
Galatheidae								
Munida	(0.5)	(0.1)			(+)	(3.3)		
M.sarsi								
Galathea	(5.4)	(2.0)	(0.1)	(+)	<1.4>	<2.3>	(+)	
G.intermedia	<3.5>	<0.7>			<0.8>	<0.4>		
G.squamifera	<0.4>	<0.4>			<0.3>	<0.5>		
G.nexa	<+>	<0.1>	<0.1>	<+>				
G.strigosa	<0.3>	<0.1>						

Table 3, continued

Prey item	G.morhua N= 145 W%	N%	P.pollachius N=241 W%	N%	T.Minutus N=93 W%	N%	P. virens N=74 W%	N%
Brachyura	(5.3)	(7.2)	(0.6)	(8.5)	(15.9)	(4.3)		
Hyas araneus	(0.3)	<0.1>	<+>	<0.4>				
Inachus dorsettensis					<0.4>	<0.1>		
Macropodia rostrata	<+>	<0.1>						
Carcinus maenas	<0.2>	<0.2>	<+>	<0.1>	<0.1>	<0.1>		
Macropipus sp.	<0.4>	<0.7>			<1.0>	<0.4>		
M.acuatus	<2.9>	<4.3>	<0.1>	<+>	<10.8>	<2.5>		
M.depurator	<+>	<0.1>						
M.pusillus	<0.1>	<0.1>			<1.4>	<0.1>		
M. holosatus					<0.2>	<0.1>		
Decapoda unid.			(0.5)		(3.7)	(1.3)	(1.7)	
ECTOPROCTA	0.3	0.2			0.1	0.1		
ECHINODERMATA								
Ophiothrix fragilis	+	0.1			0.5	0.7		
UROCHORDATA								
Ciona intestinalis	1.2	0.2						
Appendicularia (larvacea)			+	1.1				
TELEOSTEI unid.	32.2	4.9	3.9	0.8	1.3	2.0	2.5	0.3
Maurolicus muelleri			7.4	0.4			0.1	+
Gasterosterus aculeatus			1.0	0.3				
Myxocephalus scorpius	+	0.1						
Taurulus bubalis	+	0.1						
Pholis gunnellus	2.7	0.1						
Hippoglossus hippoglossus							+	+
Callionymidae	1.3	0.1						
Gadidae	0.4	0.1	30.4	+				
Gadus morhua			(2.4)					
Pollachius sp.			(8.6)					
Micromes,stius poutassou			(2.7)					
Labridae	23.5	1.4	12.2	(+)				
Crenilabrus melops	(0.1)	(0.1)						
Centrolabrus exoletus	(7.7)	(0.1)	(2.1)	<+>				
Ctenolabrus rupestris			(4.4)	<+>				
Gobiidae	10.5	23.6	21.1	6.6	34.6	8.5	11.1	0.1
Gobiusculus flavescens	(2.0)	(2.0)	(7.2)	(1.4)	(17.1)	(2.8)		(+)
Pomatoschistus minutus	(4.9)	(4.9)	(0.2)	(+)	(2.2)	(0.1)		
Unidentified material	8.1	0.8	10.1	0.9	14.2	0.2	36.0	0.7

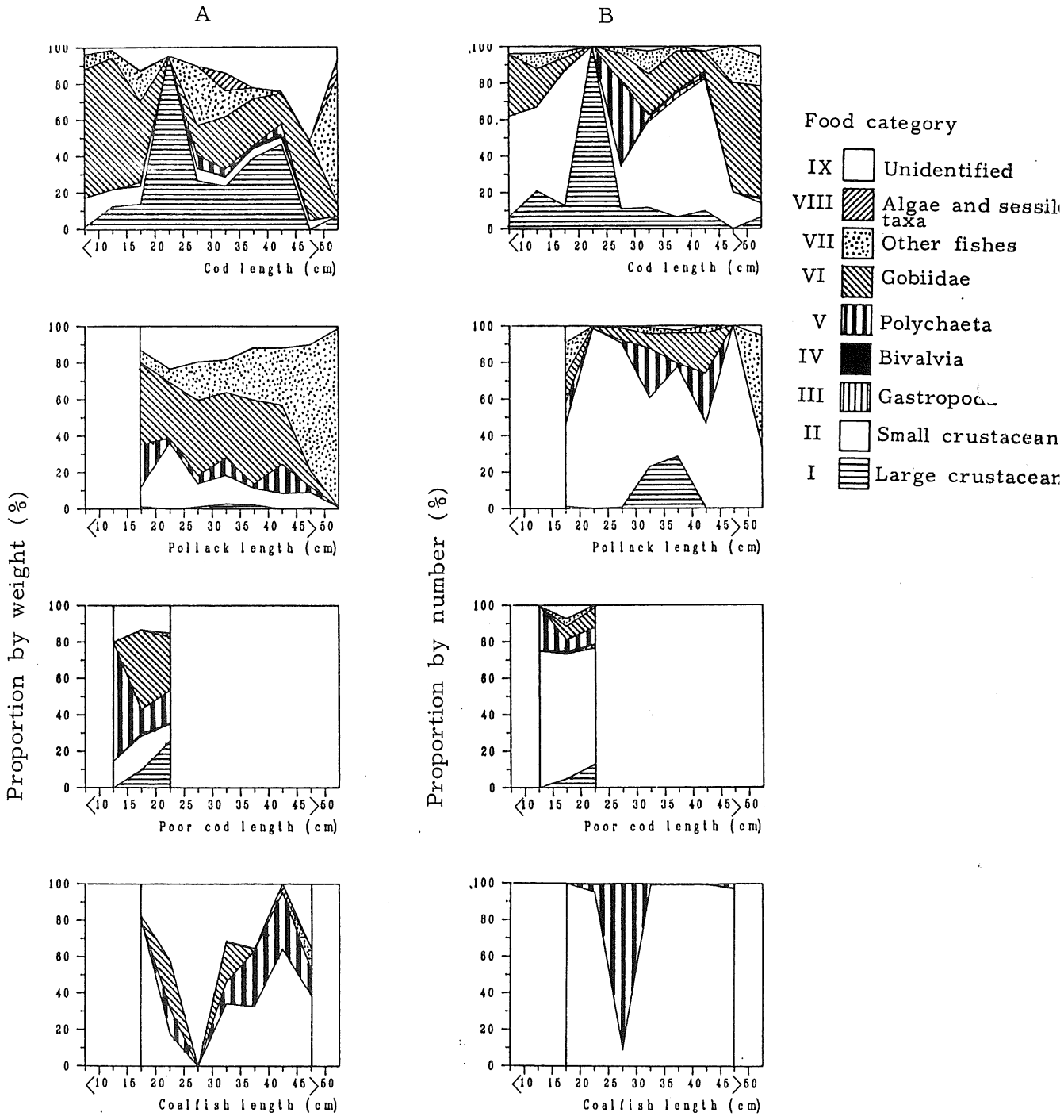

Fig. 1. Composition of the food found in stomachs of cod, pollach, saithe and poor cod of different length, caught in Masfjorden. (A) Proportion of prey item by weight. (B) Proportion of prey item by number. The different categories of food are defined in Table 2.

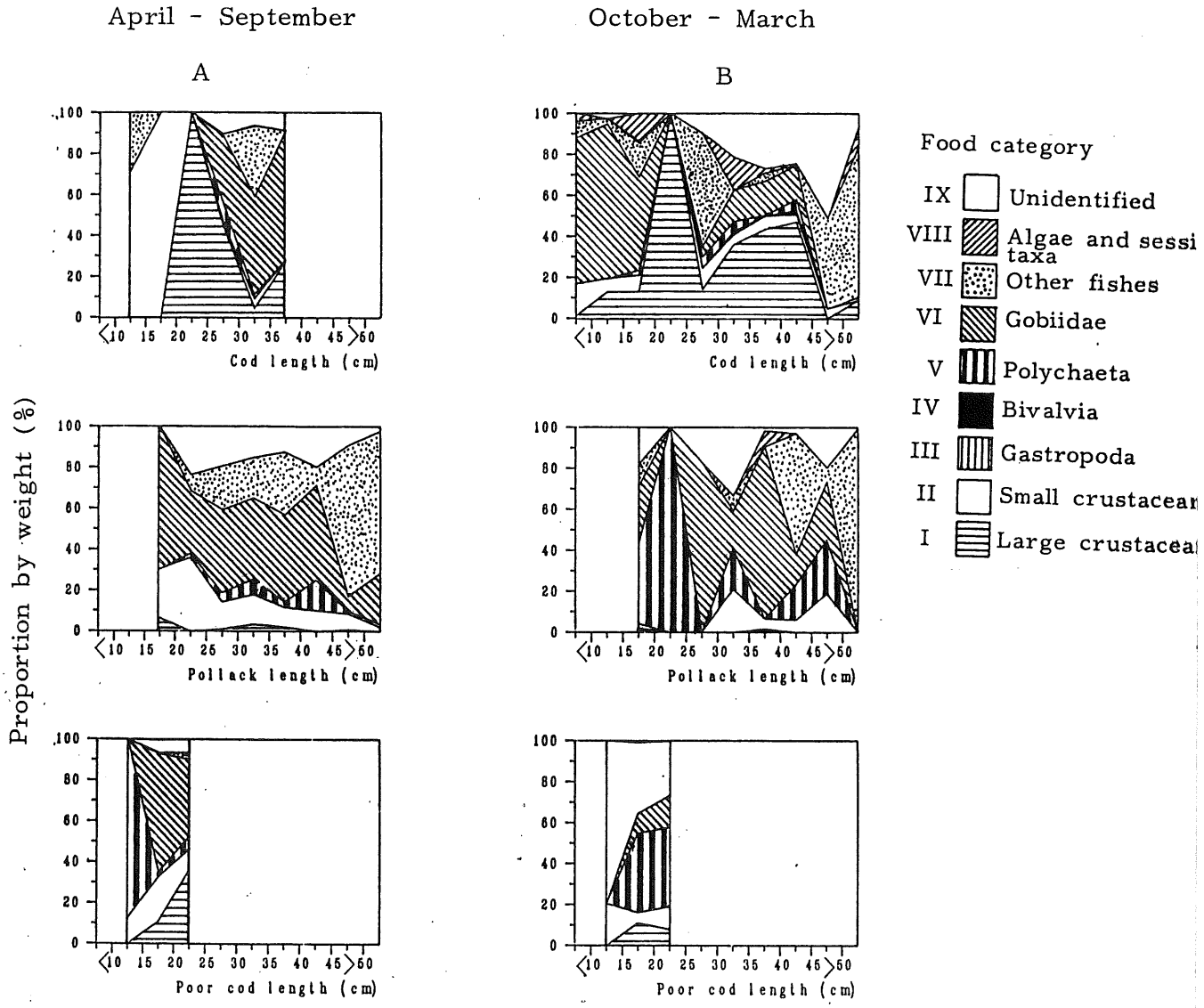

Fig.2. Composition of the food in stomachs of cod, pollach and poor cod of different length, caught in Masfjorden. Proportion of prey item by weight.

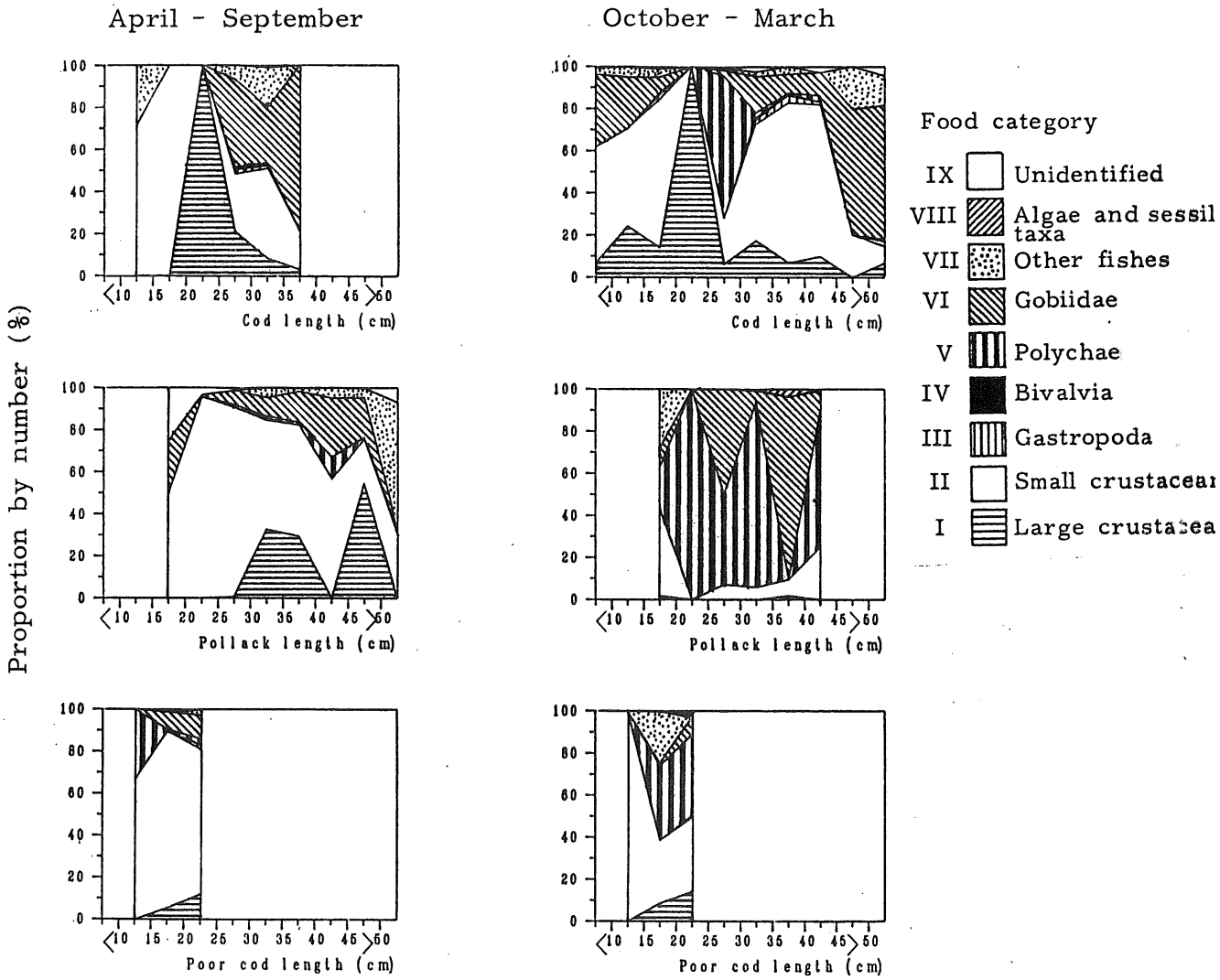

Fig. 3. Composition of the food in stomachs of cod, pollach and poor cod of different length, caught in Masfjorden. Proportion of prey item by number.