

**FEEDING AND FOOD CONSUMPTION  
BY THE BARENTS SEA PREDATORY FISHES  
IN THE 1980-90s**

by A.V.Dolgov

Polar Research Institute of Marine Fisheries and Oceanography  
(PINRO), 6 Knipovich Street., 1983763, Russia

**ABSTRACT**

Data from the Russian-Norwegian database were used to study food composition of the most numerous Barents Sea fishes (cod, haddock, Greenland halibut, long rough dab, thorny and other skates, redfishes, saithe) in the 1980-90s. Length composition of commercial prey species and changes in predator diet depending on their length (age) are analysed. Possible values of total food consumption by these species are estimated and the impact of these predators on the stock status of commercial species is described. Biomass of food consumed by fish is compared to that consumed by other top predators (sea mammals).

**INTRODUCTION**

Of all fishes, only data on feeding of Atlantic cod are presently used in different multispecies models developed for the Barents Sea (Korzhev et al., 1996; Bogstad et al., 1997). Only in the B-species MSVPA the second predator - haddock - is used (Korzhev, Dolgov, in press). Despite the fact that cod is the most abundant predator in the Barents Sea ecosystem and has an impact on many marine species (Dolgov, 1999), including commercial ones, data about feeding of other fishes on commercial species are also of interest as they can be used in multispecies fisheries management.

In this connection the paper describes feeding of the most abundant Barents Sea fishes and attempts at estimating their influence on the commercial species.

**MATERIALS AND METHODS**

The data were taken from the Russian-Norwegian database on fish feeding (cod and haddock) (Mehl, Yaragina, 1992), as well as from PINRO sources (data on feeding of other species). Stomach samples were the most numerous for cod, haddock, Greenland halibut, long rough dab and thorny skate. Therefore, for these species a

more detailed analysis of feeding peculiarities could be made. For other species (sandy ray, blue skate, spinytail skate, redfishes) only the identification of a general food composition and an approximate estimation of consumption were possible.

The following species were regarded as commercial: northern shrimp *Pandalus borealis*, herring *Clupea harengus* (without subdivision into Atlantic and Arctic herring), capelin *Mallotus villosus*, polar cod *Boreogadus saida*, cod *Gadus morhua*, haddock *Melanogrammus aeglefinus*, Greenland halibut *Reinhardtius hippoglossoides* and long rough dab *Hypoglossoides platessoides*. Besides, the importance of planktonic crustaceans of the Hyperridae and Euphausiidae families was considered, because these species play a key role in feeding of many Barents Sea predators,

## RESULTS AND DISCUSSION

### Food composition

Commercial prey species (together with euphausiids and hyperiids) make up a considerable part in food composition of most predators studied (Table 1). For *Sebastes mentella* and Greenland halibut commercial species constitute about 20% of the food bolus weight, for thorny skate, blue skate and haddock - 32-33%, for long rough dab - 42%. Maximum values (up to 70-97%) were registered for cod, spinytail skate, *Sebastes marinus* and saithe.

The portion of macrozooplankton was especially high (up to 10-20% on the average) in the diet of redfishes, saithe, cod and haddock. Northern shrimp was primarily a food object of demersal fishes (thorny and blue skates, long rough dab). Capelin was present in diet of virtually all fishes (except blue skate and those species for which an insufficient amount of stomachs was sampled). Herring occurred mostly in feeding of saithe, cod and haddock. Young cod, haddock, redfishes and long rough dab were consumed mainly by cod, predatory skates, halibut and long rough dab.

In the second half of the 1980s and in the 1990s notable changes were observed, both in food supply of the Barents Sea fishes and in fish feeding. Capelin stock, after a restoration in 1990-1993, declined again in 1994-1995 down to 500 000 t (Anon., 1997b). At the same time a number of strong herring (1992-1 995) and cod (1990-1993) year-classes appeared in the Barents Sea (Anon., 1997a, 1997b). This led to changes in food composition for a number of fishes.

E.g., since 1991 the diet of haddock includes young cod, mean annual value of which amounted up to 0.2-1 .0% of the food bolus (Table 2), while in 1984-199 1 haddock virtually did not feed on cod (Dolgov, Dolgaya, 1995). Mean annual portion of cod juveniles in feeding of cod itself has been increasing sharply since 1993 and in the period from 1993 to 1999 it made up from 4-7 to 20-24%. Before 1993, this value did not exceed 1-3% of the food bolus (Table 2). Capelin started to occur in haddock stomachs in notably smaller quantities. At the same time capelin began to play a more important role in feeding of cod and haddock, making up respectively 5-7 and 3-8 % by mass, as compared to 0.1-3.0 in 1984-1 991 (Dolgov, Dolgaya, 1995; Dolgov, 1999).

Foraging conditions for some species have probably deteriorated over the 1990s that led to an increased consumption of low-value or non-traditional food objects. E.g., in the 1990s long rough dab, thorny skate and Greenland halibut consumed more fisheries waste on the fishing grounds • annual mean up to 35-55% by stomach content weight (Tables 4-6) • whereas in the 1980s the role of fisheries waste was much lower (Berestovsky, 1989, 1996).

### **Food composition of predators from different length groups**

The importance of different prey changes considerably with predator age/length. The general age-related tendency for all predators consists in the declining role of crustaceans and increasing role of fish, as well as in the growing size of prey consumed.

For cod, a decrease in consumption of small zooplanktonic organisms and crustaceans and a parallel increase in consumption of fish are well pronounced. At first prey fish are small or medium-sized (capelin, polar cod, herring), then prey length increases (cod, haddock, long rough dab). For haddock, the portion of fish (mainly capelin, herring and young cod) grows as the predator reaches 20-25 cm length. The portion of fish is the greatest in large specimens (Fig. 1). At the same time, the percentage of benthic organisms (Polychaeta, molluscs, echinoderms) remains virtually stable and makes up about 30-35% of the food bolus.

It is typical of small Greenland halibut below 45-49 cm length to feed on northern shrimp. On reaching this length the importance of fisheries waste in their feeding increases. In large specimens above 70-75 cm length a sharp increase in the consumption of cod and haddock was observed (Fig.2). For long rough dab, northern shrimp was consumed by specimens 20-35 cm long. From 20 cm length and above the role of fisheries waste and fish grew and young cod was the most important prey. The consumption of northern shrimp was even in all length groups of thorny skate from 15-20 cm length. In feeding of skate 30-35 cm long, capelin and cod appeared. Cod was chiefly consumed by fish 40-60 cm long (Fig.2). Long rough dab occurred in feeding of the longest groups of thorny skate (45-60 cm).

### **Length composition of commercial prey in predators' stomachs**

All length groups of northern shrimp • from 2-3 to 13 cm • were subjected to predation (Fig.3). Length of shrimp consumed by haddock was somewhat smaller • up to 10 cm. For all predators length of consumed shrimp grew with an increase of predator length.

Length of capelin in stomachs of predatory fishes ranged from 4-5 to 7-9 cm, but mainly individuals 10-16 cm long were consumed (Fig.4).

Minimum length of consumed young cod was 7-9 cm. Maximum length depended on predator length (Fig.5). E.g., in haddock which has a small mouth opening maximum length of cod was 17-18 cm. Long rough dab and thorny skate which have a larger mouth consumed cod up to 20-21 and 29 cm long, respectively. A larger fish • Greenland halibut • could feed on cod up to 43-44 cm long. The longest cod (up to 55-60 cm) was consumed by large specimens of cod itself; It should be mentioned that

cod above 30-35 cm length started to occur in stomachs only in 1992-1993. For all predators, length of consumed cod grew with an increase of predator length.

Length of haddock in stomachs of cod and Greenland halibut made up from 20 to 44 cm, in stomachs of long rough dab and thorny skate it did not exceed 18-20 cm.

Young **redfish**, despite sharp spines on gill covers and fins, were consumed by long rough dab and Greenland halibut. Length of **redfish** from stomachs of these predators was 6-10 and 5-28 cm, respectively. Cod fed on **redfish** 5-30 cm long.

Length of long rough dab from stomachs ranged from 2-3 to 10 cm in haddock, from 2 to 18 cm in thorny skate, from 20-21 to 29 cm in Greenland halibut and up to 30-35 cm in cod.

### **Stock size**

Stock size estimates are not available for all Barents Sea fishes. ICES Arctic fisheries Working Group (Anon., 1997a) estimates the stocks of haddock, saithe, *Sebastes mentella* and Greenland halibut using the VPA method. As the saithe stock was estimated for ICES subareas I and IIa taken together, for the Barents Sea it was assumed as 50 000t. Average stock size of *Sebastes marinus* was estimated by the Norwegian survey data. Size of the long rough dab and thorny skate stocks was estimated by the Russian trawl survey data (Dolgova, Dolgov, 1997; Dolgov, 1997). However, considering that these species, have a wide distribution and that the survey area did not cover the entire Barents Sea, a larger stock size can be suggested.

For other species, in particular for other skates, even a rough estimation of stock size appears impossible. Therefore a more detailed analysis of both Russian and Norwegian trawl survey data is probably required. An attempt can be made to calculate stock size for other species which are usually not paid attention to, but which can be of interest for **modelling**.

Table 7 presents mean stock size of different species for 1984-1999. The highest stock size (200 000 -300 000t) was observed for haddock and *S.mentella*. For other species it did not exceed 100 000 t.

### **Estimations of food consumption**

Mean annual consumption of commercial prey by cod, haddock, long rough dab and thorny skate by quarters, separately for different age or length groups, was estimated by us before (Dolgov, 1999; Dolgov, Dolgaya, 1995; Dolgova, Dolgov, 1997; Dolgov, 1997). For other species the data on whose feeding was insufficient, a possible consumption was calculated on the basis of their stock size, possible daily ration and general food composition. At daily rations of 1% of body weight, the total consumption of shrimp by all these predators can make up 174 000t, of capelin - 309 000 t, of herring - 45 000 t, of cod - 148 000 t, of haddock - 13 000 t and of redfish - 27 000 t (Table 6). Comparison of these values with estimates of consumption of these species by cod (Dolgov, 1999), harp seal (Nilssen et al., 1997) and minke whale (Folkow et al., 1997) for 1991-1996 shows that the consumption of most prey by cod is equal to or exceeds the consumption of these prey by all the other predators taken

together (Fig.6). The exception is herring major part of which (up to 66% of the total consumption) is consumed by minke whale.

Of other fishes, haddock and thorny skate have the greatest impact on' shrimp; haddock, saithe, Greenland halibut and long rough dab - on capelin; haddock - on herring; long rough dab, thorny skate and Greenland halibut - on young cod; Greenland halibut, long rough dab and thorny skate - on young haddock and redfishes.

## CONCLUSION

Thus, the greatest impact on the Barents Sea **commercial** species is made by cod, owing to both food composition and high abundance of this'predator, Of other fishes, the predation of which can affect the dynamics of commercial marine species, the most important are Greenland halibut, long rough dab and thorny skate. Haddock **predation** is less important due to a rather small role of commercial species in its feeding. Data on feeding of redfishes and saithe are, unfortunately, scarce but nonetheless suggest the importance of their feeding on some prey species.

Studies of feeding of these species should be continued. More stomachs should be sampled and this sampling should be more **evenly** conducted over seasons and areas in order to potentially use these data in multispecies modelling.

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Table 1

## Importance of commercial prey species in feeding of some predators in the Barents Sea

Prey species	Raja radiata	Raja batis	Raja fyllae	Raja spinicauda	Raja hyperborea	Cod	Haddock	Saithe	Sebastes marinus	Sebastes mentella	Greenland halibut	Long rough dab
Hyperiidæ	0,04					7,56	3,42	1,08	1,63	0,41	0,34	0,02
Euphausiidæ	1,59	0,08	1,38			2,43	12,66	15,56	81,01	2,67	0,02	0,34
Shrimp	5,43	2,56	30,2	0,24	1,44	7,99	2,03	0,17	0,06	17,76	2,87	2,06
Herring	0,18					3,54	1,41	13,45			1,07	0,57
Capelin	3,94					29,43	10,52	55,44	14,65		5,29	8,09
Polar cod	0,8					3,19					0,67	3,9
Cod	15,12	14,07	2,08			7,34	0,55	4,53			4,68	26,66
Haddock	0,64	15,6		45,05		2,42	0,55	0,8			1,7	0,49
Redfish	1,48	34,6		46,78		5,6	1,87		0,25		2,1	0,52
Greenland halibut						0,05					1,58	
Long rough dab	2,78					1,81	0,42				0,55	0,05
Total number of stomachs	1364	33	66	3	6	118787	22267	313	154	79	3846	3902
Percentage of empty stomachs	23,2	9,1	9,1	0,0	0,0	24,3	27,5	30,7	14,3	55,7	57,3	60,8
Average filling degree	1,6	1,8	2,0	3,0	1,6	1,5	1,3	1,1	3,0	0,9	0,7	0,6
Mean index of stomach fullness, ‰	268,0	251,5	145,4	264,8	113,6	222,1	105,36	177,2	226,0	121,6	334,0	277,4



Table 2

Yearly dynamics in cod feeding in 1984-1999, % by stomach content weight

Prey species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hyperliids	0.85	7.76	16.82	20.39	23.69	18.69	1.59	0.41	0.17	1.10	3.31	5.28	12.79	2.19	5.13	0.76
Euphausiids	0.49	0.07	0.75	1.27	8.74	5.27	0.38	0.15	5.27	0.20	2.44	2.74	6.72	3.84	2.83	2.78
Shrimp	23.30	6.23	11.30	10.61	5.67	8.92	6.25	2.12	9.24	3.51	7.82	6.02	5.02	6.24	11.45	6.18
Herring	3.00	1.99	2.63	0.30	0.95	0.18	0.94	1.16	7.44	7.48	5.25	8.13	4.52	4.02	3.33	5.29
Capelin	19.21	55.25	20.21	7.32	7.00	23.89	43.94	68.12	42.01	47.40	30.40	7.25	11.13	17.54	13.71	56.56
Polar cod	0.36	0.00	6.48	7.04	0.02	1.54	0.25	0.68	3.88	3.58	6.40	4.24	3.61	4.01	8.20	0.77
Cod	2.05	2.50	5.12	2.73	0.61	0.38	0.80	0.89	1.52	4.68	11.69	18.12	19.32	24.40	15.26	7.35
Haddock	1.69	1.01	3.66	1.39	2.91	0.33	0.56	0.72	2.29	3.55	4.22	5.72	4.63	3.14	2.33	0.44
Redfish	15.07	3.58	6.64	19.82	5.20	7.93	4.62	2.33	4.72	1.36	2.35	4.96	2.85	2.69	1.51	1.93
Wolffish	0.01	0.02	0.03	0.01	0.03	0.38	0.16	0.01	1.16	0.08	0.11	0.01	0.92	0.19	0.08	0.01
Long rough dab	3.77	1.29	1.27	1.15	0.46	3.01	2.83	0.60	1.21	2.86	1.56	1.85	2.65	2.10	1.72	0.91
Greenland halibut	0.00	0.00	0.11	0.01	0.00	0.00	0.00	0.01	0.01	0.08	0.01	0.06	0.11	0.35	0.00	0.00
Other fish	21.18	16.47	18.42	17.12	44.00	19.01	30.22	21.29	13.68	7.71	9.25	8.64	12.44	15.78	15.70	10.78
Other food	8.80	3.83	4.58	10.84	0.72	12.47	7.66	1.51	12.40	16.42	15.19	26.98	13.29	13.51	18.75	6.28
Total number of stomachs	3731	3879	6064	5944	5696	7828	8443	6671	5217	7660	7554	10601	11772	12037	15433	3988
Percentage of empty stomachs	20.0	28.9	19.6	23.9	17.5	17.5	14.3	16.9	36.7	32.2	29.2	23.0	24.2	29.6		
Average filling degree	2.7	2.6	2.3	1.8	2.7	2.6	2.7	3.2	2.4	2.8	2.3	2.9	2.6	2.5		1.2
Mean index of stomach fullness, ‰	166.8	329.8	191.0	185.2	180.3	170.4	242.1	285.9	240.6	245.8	214.0	175.8	158.5	196.5	206.9	308.8

Table 3

Yearly dynamics of haddock feeding in 1984-1999, % by stomach content weight

Prey species	Year															
	1984	1985	1986	1987	1988	1989	1990	1991	1993	1994	1995	1996	1997	1998	1999	
Polychaeta	5.49	1.94	2.88	0.75	2.90	4.37	5.72	1.92	10.26	3.86	11.47	5.85	5.79	8.52	7.25	
Mollusca	1.51	3.01	10.05	11.13	2.18	1.24	11.31	0.45	47.83	11.91	11.03	9.31	22.96	6.97	4.39	
Echinodermata	34.85	36.98	19.70	35.20	11.35	18.47	10.72	13.04	26.42	19.00	19.49	4.29	11.62	10.49	25.73	
Hyperiididae	5.81	6.67	9.26	1.15	7.08	1.56	0.08	6.27	0.11	1.60	0.06	6.39	3.46	0.67	4.41	
Euphausiidae	4.88	1.88	4.30	6.67	50.19	44.37	11.76	2.94	0.03	4.99	2.08	36.84	12.93	11.44	3.03	
Shrimp	8.34	2.60	1.54	2.42	2.05	1.58	4.29	0.07	0.19	0.62	0.63	0.52	4.77	1.30	0.87	
Herring	0.90		1.03		0.17	0.03	0.60		3.72	1.15	7.86	0.04	0.25	0.36		
Capelin	3.19	10.57	13.52		1.47	5.36	6.44	36.15	0.49	28.00	0.52	1.41	2.21	16.01	26.33	
Gadidae		0.03						0.88	1.44		0.06			0.16		
Cod								0.26	0.16	0.28	0.80	0.39	0.66	1.35		
Haddock			0.80				0.79				0.66	0.50		0.08		
Redfish	1.69	0.23	4.15	4.81	4.24	2.05	1.81			0.05	0.05	0.33	0.10			
Long rough dab			2.70		0.01	0.96	0.19			0.06	0.02	0.08	0.01	0.47	0.30	
Other fish	7.60	10.02	10.39	4.68	3.12	5.22	18.44	20.23	1.32	4.96	4.59	1.28	3.69	3.50	3.27	
Other food	7.90	18.32	11.81	13.66	10.29	8.88	11.65	14.37	5.50	10.92	10.48	20.16	11.91	30.84	15.67	
Fishery waste												1.33	0.52	1.46	4.33	
Indeterminatus	18.04	7.75	7.87	19.53	4.95	5.91	14.20	4.37	2.53	12.65	30.10	11.28	19.10	6.36	4.42	
Total number of stomachs	593	1226	1242	1025	2510	2472	2374	1159	484	731	912	1100	1998	2873	1568	
Percentage of empty stomachs	21.7	26.8	34.1	25.1	18.1	22.0	19.0	28.7	39.7	37.3	12.4	24.9	32.8	33.8	46.7	
Average filling degree	1.4	1.5	1.2	1.1	1.5	1.5	1.7	1.7	1.1	1.0	1.6	1.3	1.1	1.1	0.8	
Mean index of stomach fullness, ‰	91.5	90.9	64.1	59.3	188.2	84.8	130.4	137.0	85.2	114.6	103.3	133.4	86.6	108.8	102.4	

Table 4

Year dynamic in greenland halibut feeding in 1990-1999, % by stomach content weight

Prey species	Year							99
	1990	1991	1994	1995 <sup>g</sup>	1996	1997	1998	
Cephalopoda	77.25			0.69		12.8	29.74	3.42
Hyperiididae	0.03			1.24		0.38	0.01	
Euphausiidae						0.06	0.01	
Shrimp	11.01	0.26		0.24	0.05	1.3	10.28	2.01
Herring						2.09	1.88	
Capelin		73.74	2.7	0.94		1.51	1.38	75.77
Gadidae		1.71		1.64	0.13	1.46	1.44	0.65
Polar cod				2.73			0.68	1.63
Cod		6.62	15.26	1.78	3.26	4.8	7.9	
Haddock		9.26		0.91	0.84	3.34		
Redfish		2.57		1.54	3.34	1.71	2.34	
Greenland halibut				0.67		1.36		
Long rough dab			3.04		3.17	2.29	0.7	
Other fish	4.85	0.09	5.06	8.39	0.46	8.29	16.19	10.04
Other food	3.05	5.26		1.34	0	2.59	3.35	1.04
Fishery waste			70.71	74.28	86.53	51.87	19.18	
Indeterminatus	3.81	0.49		3.61	2.22	4.15	4.92	5.44
Total number of stomachs	39	145	25	368	223	1292	1664	90
Percentage of empty stomachs	5.1	30.3	44.0	52.2	35.9	57.7	65.3	45.16
Average filling degree	1.6	0.8	0.8	0.8	0.9	0.7	0.6	0.7
Mean index of stomach fullness, ‰	251.7	166.2	254.0	574.0	625.1	312.7	230.0	413.7

Table 5

Year dynamic in thorny skate feeding in 1994-1999, % by stomach content weight

Prey species	Year					
	1994	1995	1996	1997	1998	1999*
Polychaeta	6.31	0.98	5.39	2.07	10.61	8.08
Gammaridea	6.56		1.4	0.26	6.29	5.49
Hyperiididae			0.01	0.1		
Euphausiidae	0.02	14.02	1.72	2.24	0.2	1.06
Shrimp	8.48		7.43	7.98	15.08	10.42
Other Decapoda	16.94		2.78	1.67	10.14	14.98
Clupea harengus		7.2	0.15		0.81	0.3
Capelin	2.22	12.5	0.99	0.04	4.46	23.39
Gadidae	0.68					
Polar cod	0.5		1.18		3.29	1.33
Cod	7.68		11.29	20.11	10.66	11.8
Haddock			1.97		1.43	
Redfish			1.8	1.9	1.03	
Long rough dab	5.26		1.02	3.05	2.72	3.11
Other fish	8.73		6.52	5.04	11.36	13.95
Other food	5.48		0.85	5.67	4.91	5.62
Fishery waste			54.8	47.95	16.98	
Indeterminatus	31.14	65.3	0.7	1.92	0.03	0.47
Total number of stomachs	131	2	331	448	383	69
Percentage of empty stomachs	9.9	0.0	29.0	27.0	19.8	14.5
Average filling degree	2.0	2.0	1.4	1.4	1.8	1.9
Mean index of stomach fullness, ‰	299.3	133.5	250.3	365.6	179.1	160.6

\* - preliminary data

Table 6

Year dynamic in long rough dab feeding in 1989-1998, % by stomach content weight

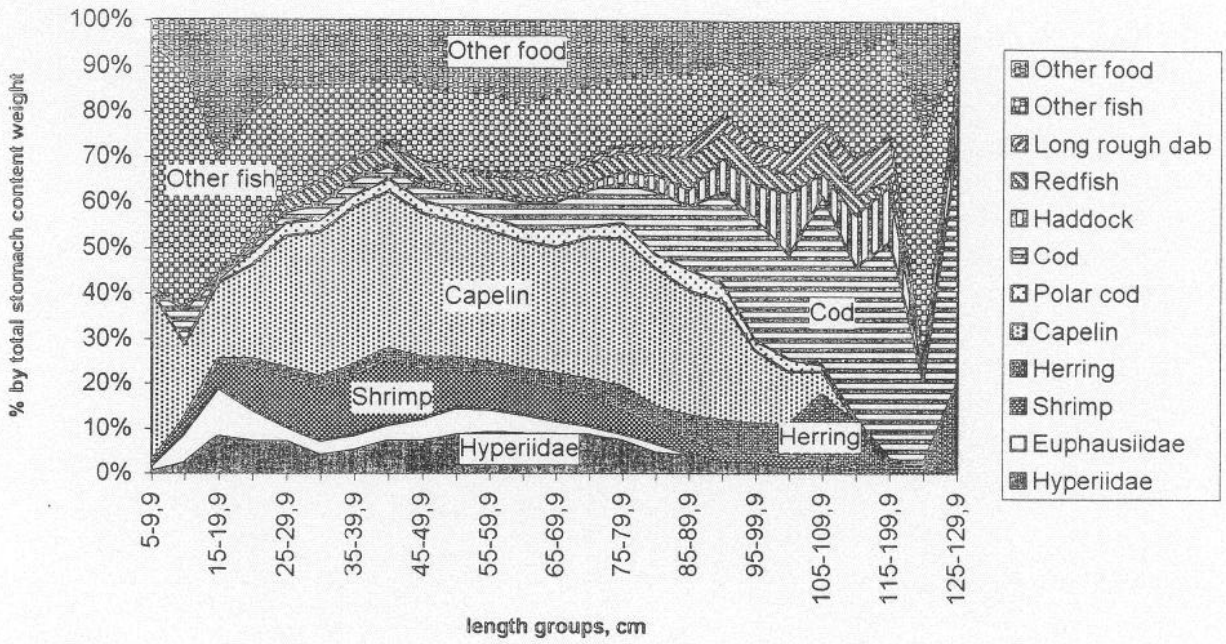
Prey species	Year									
	1989	1990	1991	1992	1994	1995	1996	1997	1998	1999
Polychaeta	3,03	54,6	0,16		2,58	22,46	1,31	0,21	3,15	3,93
Mollusca	3,25		0,01	1,66		4,45	1,28	0,24	3,96	1,4
Echinodermata	74,92	0,01	21,04	7,02	3,92	1,68	2,37	2,85	12,74	11,78
Hyperiididae								0,02	0,07	0,07
Euphausiidae			0,1		0,12	0,06	0,32	0,54		0,49
Shrimp				20,11	1,57		1,54	1,03	2,6	4
Herring					0,23			0,77		2,58
Capelin			67,18		1,51		1,1	1,69	2,7	24,05
Gadidae			2,1	0,01	0,81					
Polar cod					1,74		0,86		2,21	3,7
Cod			0,86	22,93	49,79	19,34	35,84	36,3	14,47	2,56
Haddock			0,68			17,06	0,65		0,72	
Redfish			2,94	16,97			0,32			
Long rough dab							0,05		0,25	
Other fish	10,59	39,3	4,29	26,49	0,72		3,94	3,94	6,18	1,46
Other food	2,07	0,09	0,46	2	1,42	16,9	10,35	2,59	3,15	0,68
Fishery waste							39,95	46,3	4,5	42,85
Indeterminatus	6,14	6	0,18	2,81	35,59	18,05	0,12	3,52	2,8	0,45
Total number of stomachs	30	10	85	49	182	75	736	690	1392	626
Percentage of empty stomachs	3,3	0	11,8	0	61	25,3	47,4	56,4	77,7	63,4
Average filling degree	2,1	2,1	1,3	2,3	0,5	1,1	0,9	0,7	0,4	0,6
Mean index of stomach fullness, ‰	88,1	191,9	244,9	128,3	292,3	86,7	319,6	357,6	205,8	308,2

Table 7

Predators stock levels and possible yearly consumption of commercial prey species

Species	Biomass thous tons	Daily intake, % BW	% in feeding						Consumption, thous tons					
			Shrimp	Capelin	Herring	Cod	Haddock	Redfish	Shrimp	Capelin	Herring	Cod	Haddock	Redfish
Haddock	300,00	1	1,4	0,5	0,5	1,8	21,3	111,8	21,9	115,0	15,3	5,5	5,5	19,7
Saithe	50,00	1	13,4	4,5	0,8	0,0	0,4	101,1	0,4	101,1	24,5	8,2	1,5	0,0
Sebastes mentetia	200,00	1	0,1	1,0	0,0	0,0	122,5	7,0	128,5	7,3	0,7	7,3	0,0	0,0
Sebastes marinus	80,00	1	0,1	1,0	0,0	0,2	0,3	44,9	0,3	42,6	0,3	2,9	0,0	0,6
Greenland halibut	50,00	1	1,1	4,7	1,7	2,1	9,0	16,5	5,3	9,7	2,0	8,6	3,1	3,8
Long rough dab	85,00	1	0,6	26,7	0,5	0,8	6,4	24,9	6,5	25,1	1,9	82,8	1,6	2,5
Thorny skate	60,00	1	0,1	15,1	0,5	0,5	10,4	7,5	11,8	8,5	0,2	33,1	1,1	1,1
Sum									174,7	309,4	44,9	148,4	12,7	27,7

Cod



Haddock

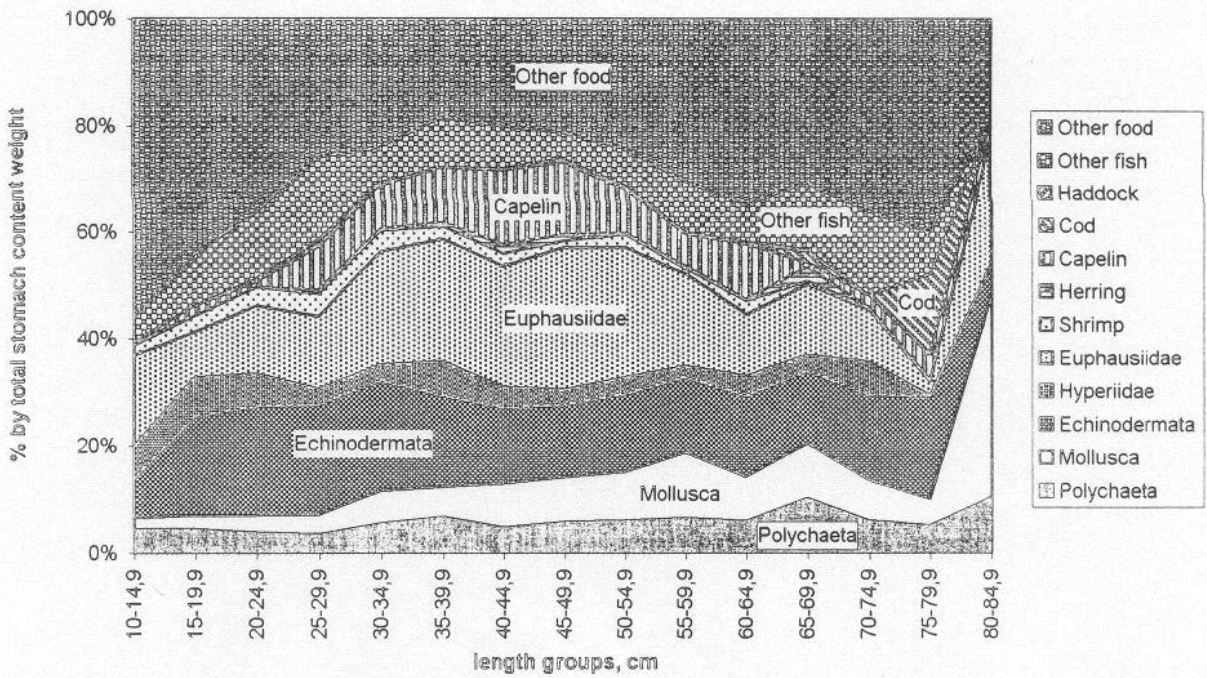
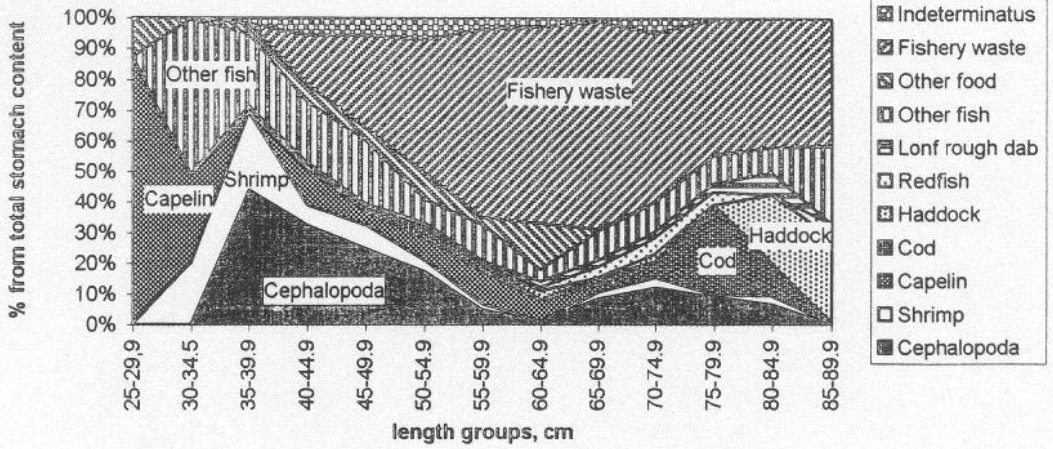
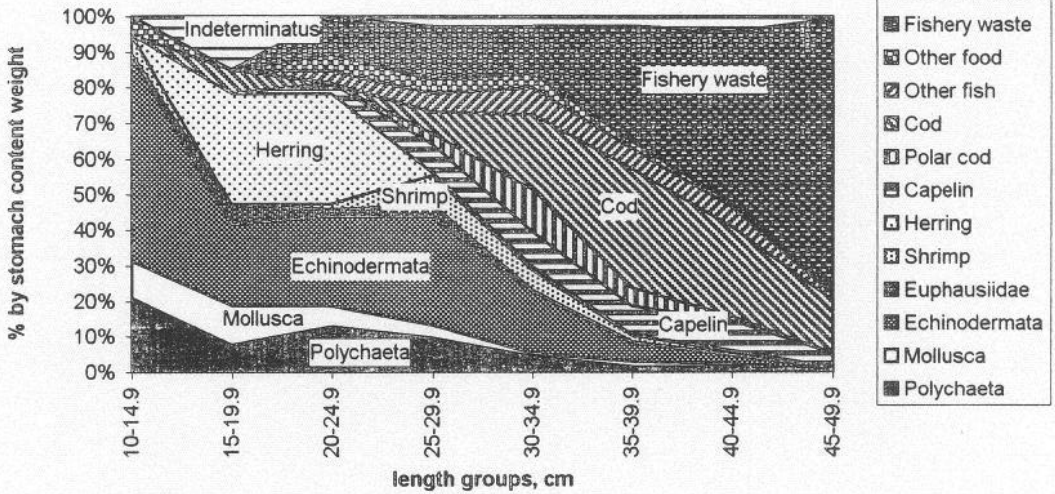


Fig. 1 Diet changes in different length groups of cod and haddock in 1984-1999

Greenland halibut



Long rough dab



Thorny skate

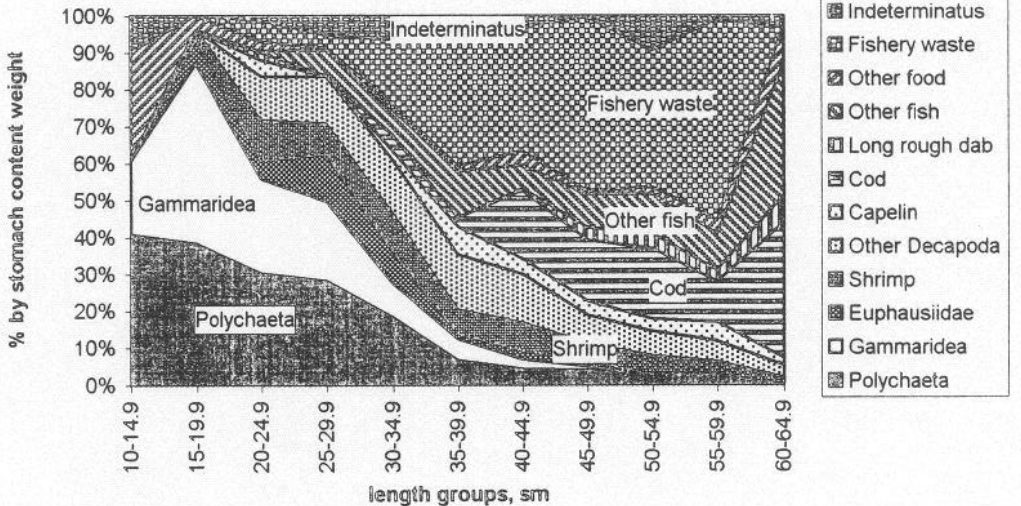


Fig.2 Diet changes in different length groups of Greenland halibut, long rough dab and thorny skate in 1990-1999



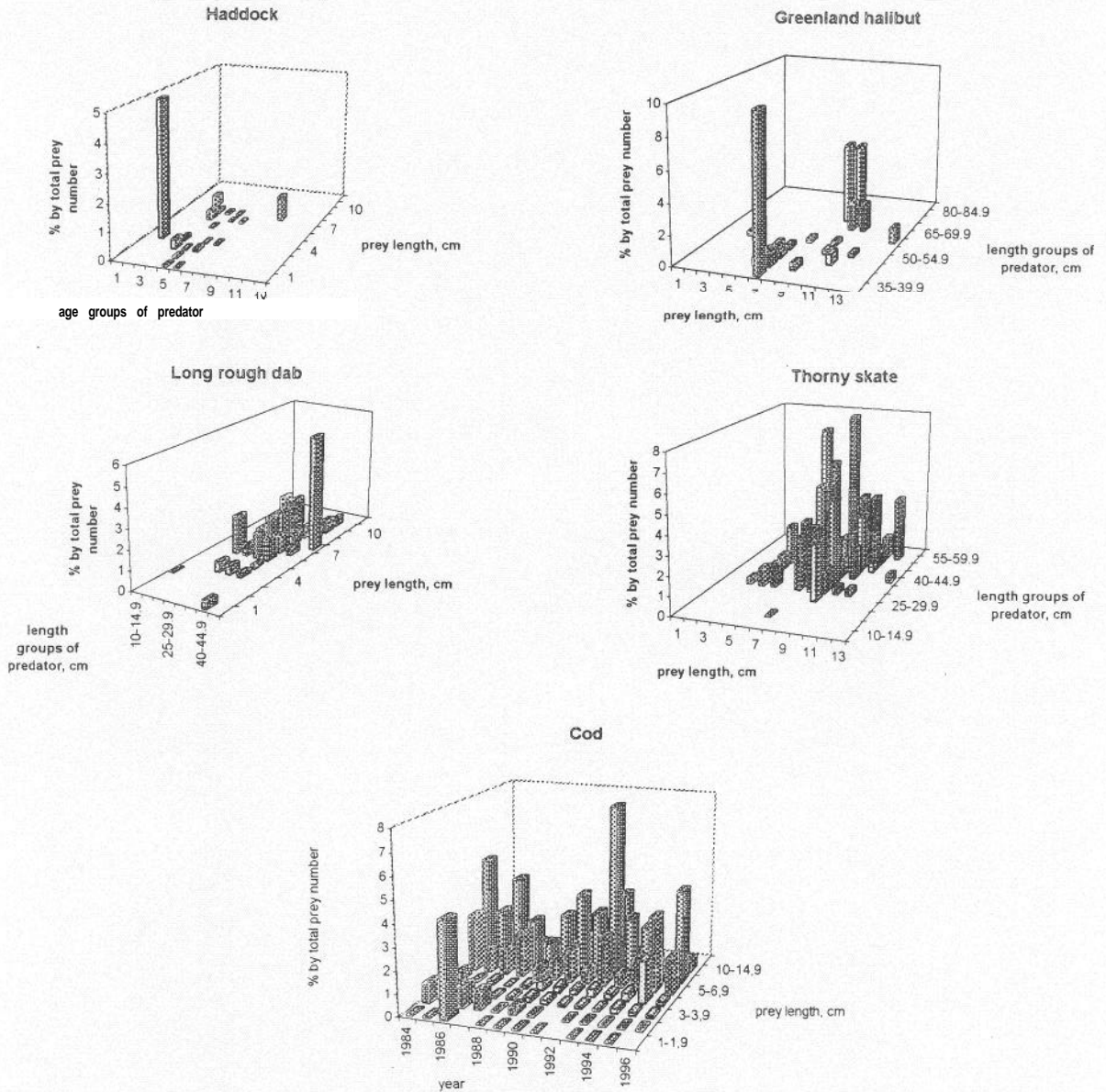


Figure 3 Length distribution of *Pandalus borealis* from different predators stomachs

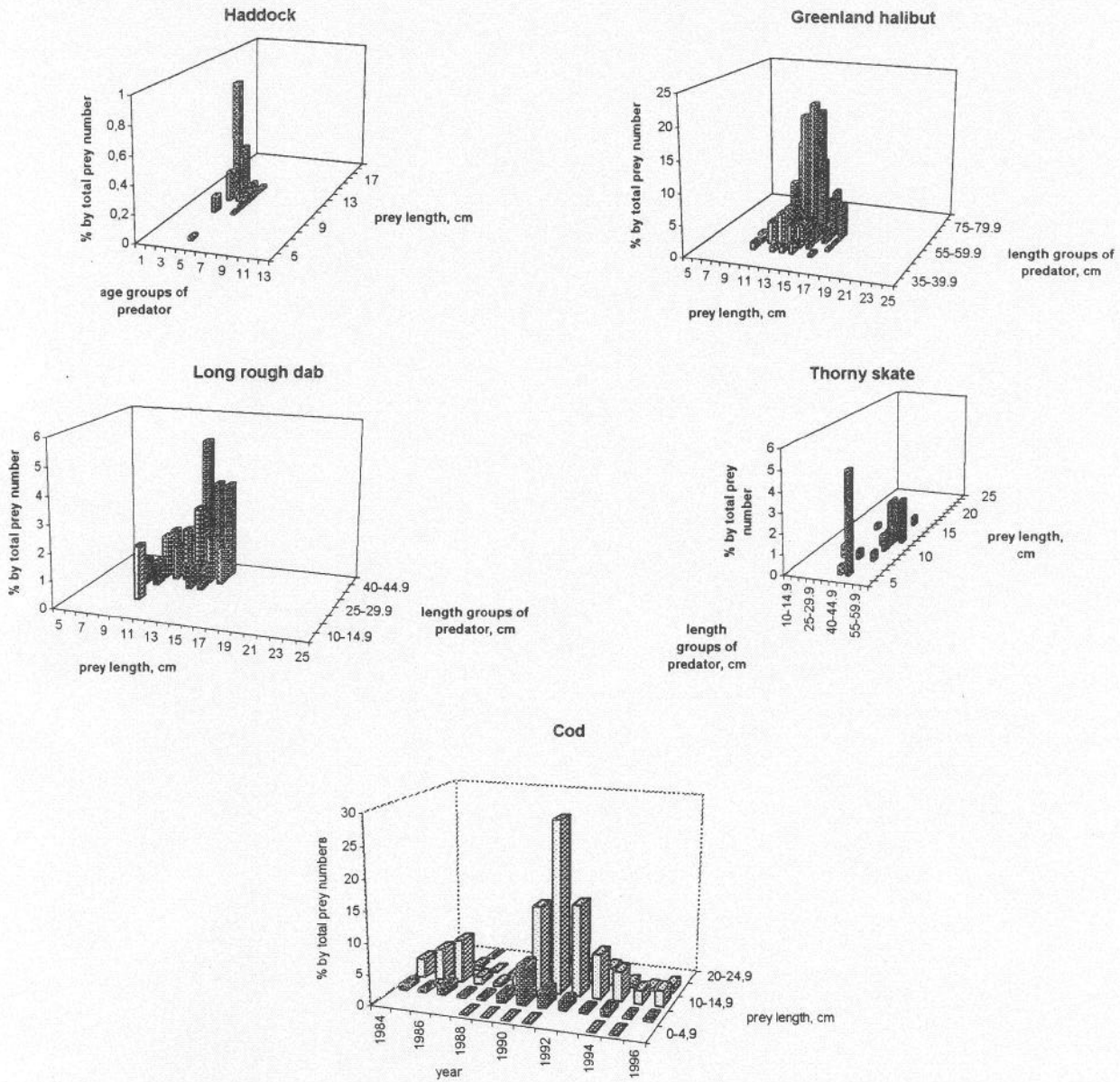


Figure 4 Length distribution of capelin from different predators stomachs

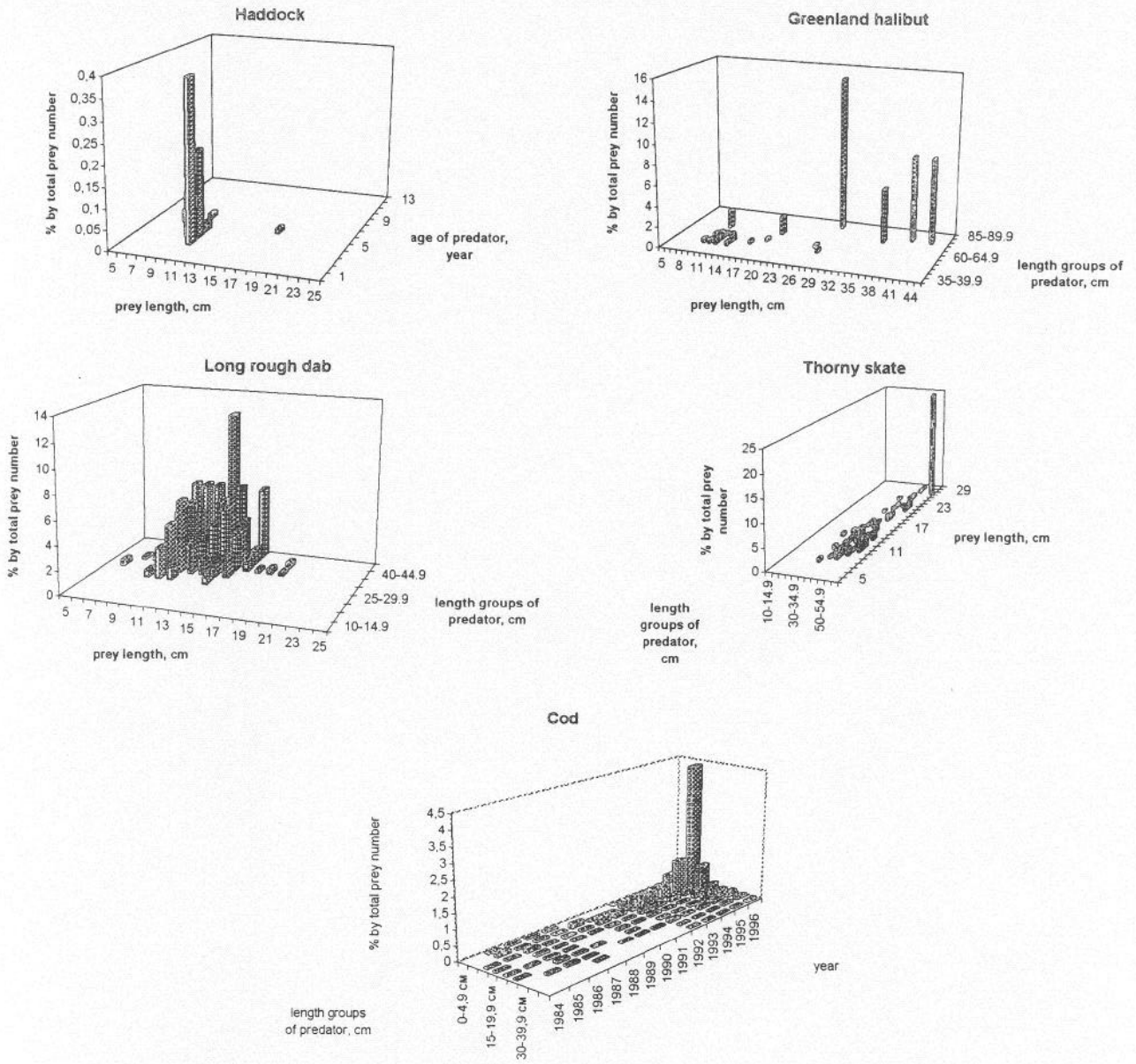
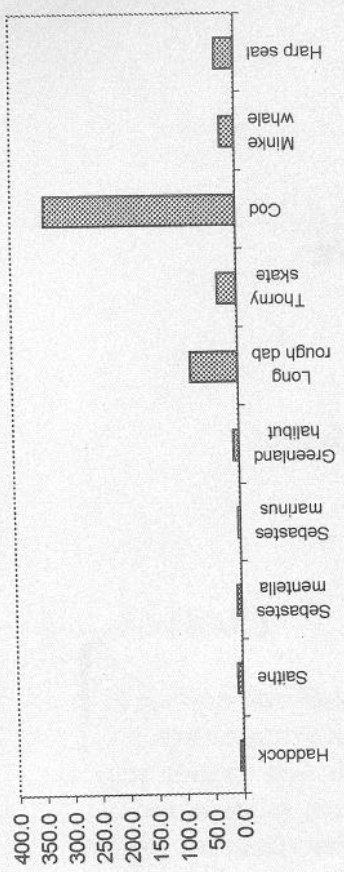


Figure 5

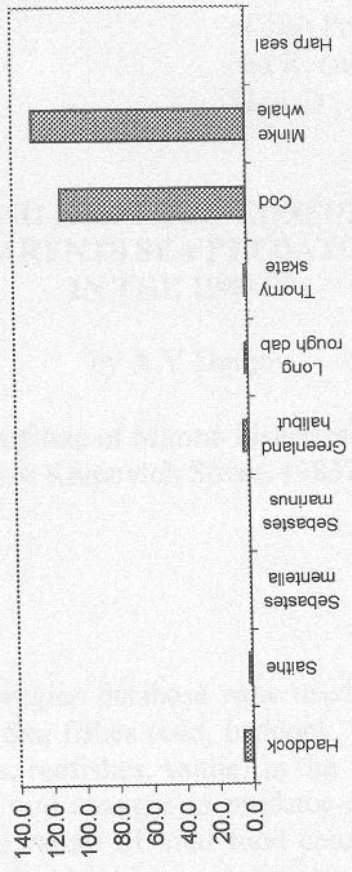
Length distribution of cod from different predators stomachs



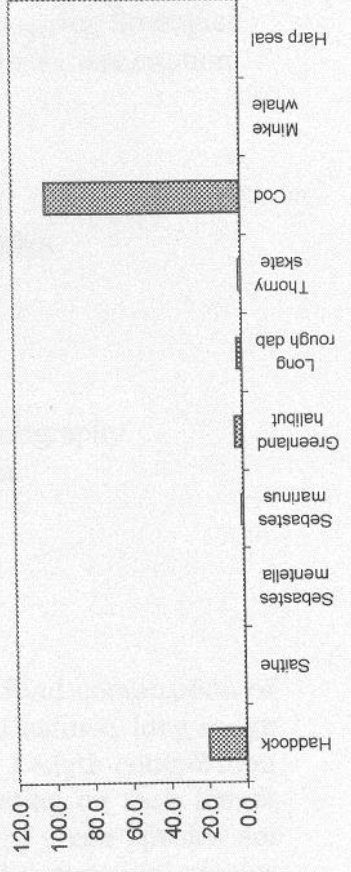
Cod



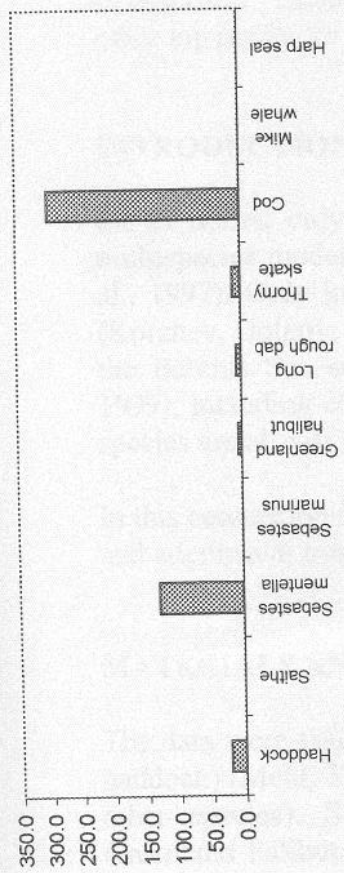
Haddock



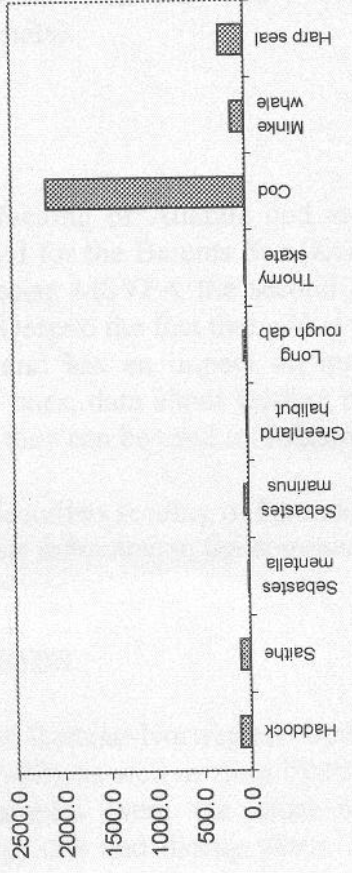
Redfish



Shrimp



Capelin



Herring

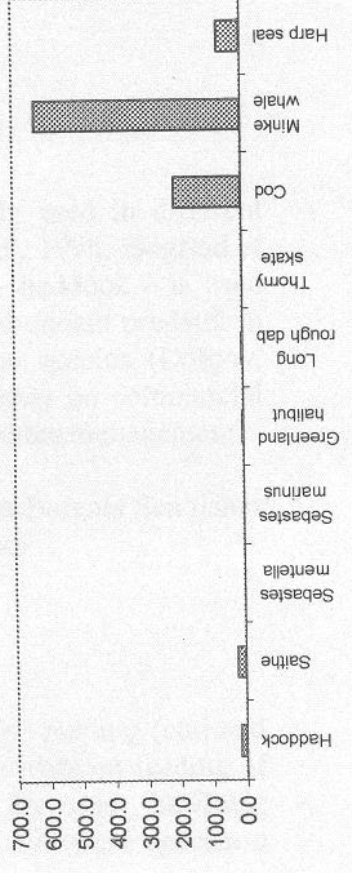


Figure 6 Comparison of consumption of some prey species by various predators, thous tons