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**STOMACH ANALYSES OF
NORTHEAST ARCTIC SAITHE
SAMLED DURING THE SAITHE SURVEY
VARANGER-MØRE
1998-2003**

PRELIMINARY RESULTS

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INTRODUCTION

Autumn 1998 a three-year stomach sampling program for Northeast Arctic saithe was initiated as a part of a master grad thesis at the University of Bergen, Norway. The aim of the program was to get a general picture of the diet of saithe along the Norwegian coast north of 62° N in late autumn, and to collect a large enough material to perform some statistical analysis. Unfortunately, the thesis was not completed.

After a long period of low stock abundance, mainly due to high exploitation, the saithe stock recovered during the 1990s with the recruitment of several above-average year classes. Both total stock biomass and spawning stock biomass increased rapidly, and from 1990 to 2000 the fishing mortality was reduced by about 2/3. Fishing mortality is stable and has since 1996 been below F_{pa} . The SSB has since 1994 been well above B_{pa} .

The increasing stock size of saithe has raised some questions, both from industry, management and researchers. What are the costs having a large saithe stock? Will the yield from commercially exploited prey stocks, e.g. Norwegian spring spawning herring, be reduced? Will the growth rate of saithe be reduced, and will the immigration of saithe to Iceland and the Faeroe Islands increase? To shed some more light on these topics, it was decided to carry on the stomach sampling program.

MATERIAL AND METHODS

Since 1985 a Norwegian acoustic survey specially designed for saithe has been conducted annually in October-November (Nedreaas 1997). The survey covers the near coastal banks from the Varangerfjord close to the Russian border and southwards to 62° N. The whole area has been covered since 1992, and the major parts since 1988. Until 2003 the survey mainly covered the grounds where the trawl fishery takes place, normally dominated by 3 - 5(6) year old fish. 2-year-old saithe, mainly inhabiting the fjords and more coastal areas, are also represented in the survey, although highly variable from year to year. Autumn 2003 the saithe- and coastal cod surveys were combined, and this should in theory improve the sampling of young saithe.

Trawl hauls, both with bottom and pelagic trawl, are normally based on acoustic information. Since 2003 also some bottom trawl hauls at fixed positions are taken. The purpose of the trawl hauls is to provide information about the species composition in the acoustic registrations and to do biological sampling of the target species. On every station with catch of saithe, 5 fish in each 5 cm length group is sampled for length, weight, age (otoliths), sex, maturity and stomach content. The whole stomachs are frozen individually, and later analysed in the laboratory at IMR. The methods applied are the same as in the North Sea stomach sampling programs (Anon. 1981, ICES 1991) and the joint Norwegian-Russian program in the Barents Sea (Mehl and Yaragina 1991).

The survey area is divided into four sub-areas, and Table 1 presents the number of stomachs sampled in each sub-area and year.

Table 1. Number of stomachs sampled by year and sub-area.

	1998	1999	2000	2001	2002	2003	Total
A. North of 69°30'N	538	667	366	410	352	455	2788
B. 67°00' - 69°30'N	221	332	259	119	270	256	1457
C. 63°30' - 67°00'N	153	135	113	143	118	42	704
D. 62°00' - 63°30'N	163	94	89	224	190	156	916
Total	1075	1228	827	896	930	909	5865

RESULTS

Percentage of empty stomachs

Table 2 and Figure 1 presents the percentage of empty stomachs in each sub-area and year. All over the percentage of empty stomachs has been between about 20 and 50 %, lowest in sub-area C and highest in sub-area B. In the to northernmost areas there is a trend towards a higher percentage of empty stomachs in the last part of the time series.

Table 2. Percentage of empty stomachs by year and sub-area.

	1998	1999	2000	2001	2002	2003	Mean
A. North of 69°30'N	36.8	43.8	18.9	33.9	43.5	48.8	37.6
B. 67°00' - 69°30'N	26.2	34.0	44.8	33.6	52.2	48.4	39.9
C. 63°30' - 67°00'N	28.8	43.7	8.8	38.5	28.0	4.8	25.4
D. 62°00' - 63°30'N	42.9	54.3	21.3	40.6	27.4	35.9	37.1
Total	34.4	42.0	26.0	36.3	40.8	44.4	37.3

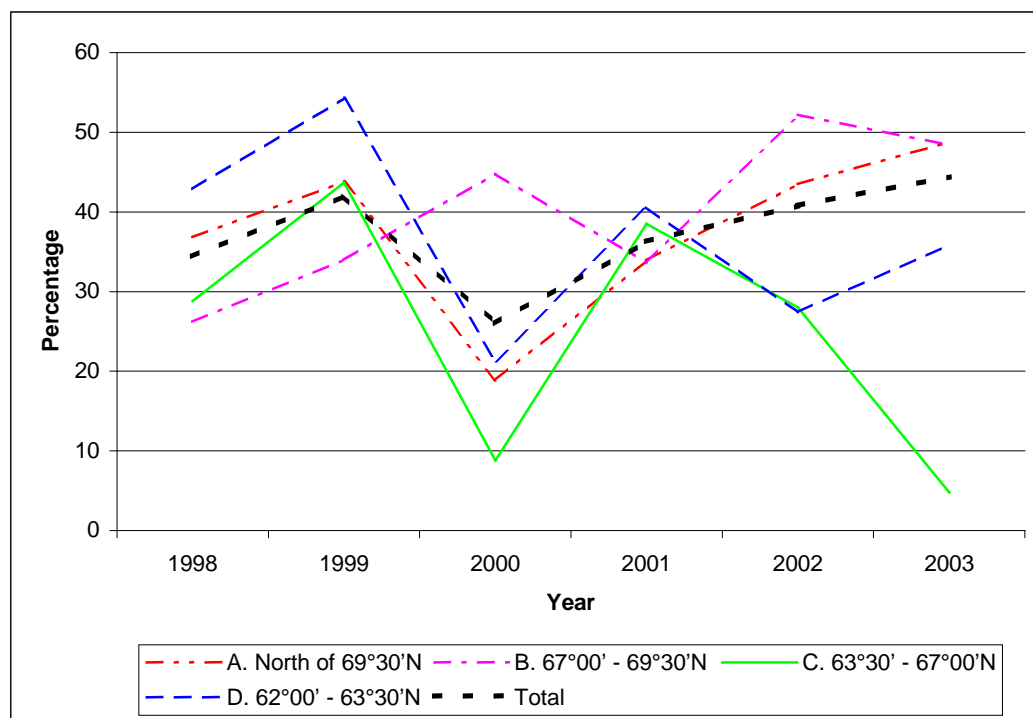


Figure 1. Percentage of empty stomachs sampled by year and sub-area.

Main prey phylum by year

Table 3 gives an unweighted mean of the percent wet weight of main prey phylum found in saithe stomachs of all size groups in the whole area by year. Fish was the dominant prey category (70-95 %), followed by crustaceans (5-29 %). Cephalopods and gastropods occurred less frequently, and practically all prey items were identified (no undetermined). It should, however, be noted that the figures are unweighted means of all samples, where large fish contribute more than smaller ones, but the latter are more abundant. Details by sub-area and predator size are given below.

Table 3. Percentage wet weight of main prey phylum found in saithe stomachs of all size groups in the total area by year.

	1998	1999	2000	2001	2002	2003	2004
Gastropods	1.5	+	0.5	1.8	0.4	-	
Cephalopods	7.0	0.1	0.1	-	0.8	+	
Crustaceans	15.8	4.5	5.3	19.9	28.9	14.0	
Fish	75.7	95.3	94.1	78.2	69.9	85.9	
Undetermined	-	-	-	0.1	-	-	

Main prey phylum by sub-area

Table 4 gives an unweighted mean of the percent wet weight of main prey phylum found in all size groups in each sub-area in the period 1998-2003. Fish was the dominant prey category in all areas, and most important in the two northern sub-areas, where fish made up about 90 % of the stomach content. In the two southern sub-areas fish made up about 65 %, while crustaceans contributed around 35 %. More details by year and predator size are given below.

Table 4. Percentage wet weight of main prey phylum found in saithe stomachs of all size groups by sub-area in 1998-2003.

	A. North of 69°30'N	B. 67°00' - 69°30'N	C. 63°30' - 67°00'N	D. 62°00' - 63°30'N
Gastropods	0.4	0.5	2.8	0.1
Cephalopods	2.1	+	0.1	0.6
Crustaceans	9.9	4.6	28.4	36.7
Fish	87.5	94.9	68.7	62.6
Undetermined	+	+	+	-

Stomach content by sub-area, year and predator size group

A. North of 69°30'N

Table 5 presents the percentage wet weight of main prey categories/species, total average stomach weight (g), number sampled and percentage empty by saithe size group in area A (North of 69°30'N). In the smallest size group, 20.0 – 39.9 cm, crustaceans were the dominating prey category. Krill (*Meganyctiphanes norvegica*) was most important in all years, followed by amphipods and copepods. Gastropods (*Clione limacina*) were also found frequently in some years. Of fish prey, small herring (5-9 cm) was common in 1999 and 2003. The total weight of the stomach content was between 0.3 and 3.1 g, highest in 2001 and lowest in 1999. The percentage empty varied between 18 and 58, lowest in 2001 and highest in 1999.

Table 5. Area A. Percentage wet weight of main prey categories/species, total average stomach weight (g), No. sampled and percentage empty by saithe size group

Size group 20.0 – 39.9 cm							
	1998	1999	2000	2001	2002	2003	2004
Gastropods	21.5	1.3	39.4	8.0	3.9	-	
Copepods		18.4	0.3	-	-	-	
Amphipods	20.7	4.8	-	-	0.2	-	
Krill	57.8	43.1	60.0	85.7	86.4	20.3	
Shrimp			0.3			2.7	
Herring 5-9 cm		32.4			9.5	58.6	
Norway pout 5-9 cm						11.4	
Undetermined fish				6.2		3.9	
Various						3.1	
Total average weight	0.96	0.33	1.10	3.09	0.85	0.95	
No. of stomachs	26	70	59	130	85	16	
Percentage empty	30.8	58.6	18.6	18.5	43.5	56.0	

In the 40.0 – 59.9 cm size group, fish was the dominating prey category. Herring of 5-19 cm was most abundant, and 20-29 cm herring also occurred. Other common fish prey was haddock (10-24 cm), Norway pout (5-19 cm) and blue whiting (10-19 cm). Small cod (5-14 cm) was only found sporadically in two years. The second most important prey category was crustaceans, dominated by krill. Cephalopods and gastropods were more scarce. The total weight of the stomach content was between 2.3 and 11.2 g, highest in 2000 and lowest in 2002. The percentage empty varied between 19 and 48, lowest in 2000 and highest in 2003.

Table 5 cont.

Size group 40.0 – 59.9 cm							
	1998	1999	2000	2001	2002	2003	2004
Gastropods	2.2	+	0.9	0.5	3.1		
Cephalopods	6.2	+	0.7			0.1	
Copepods	+	1.2	1.2				
Amphipods	10.3	0.3	0.1				
Krill	26.2	5.5	3.7	34.5	38.2	16.8	
Shrimp	0.2	-	0.1			0.7	
Herring 5-9 cm	3.2	15.2	0.5			28.0	
10-14 cm	7.6	38.3	0.4			11.1	
15-19 cm	13.3	18.5	3.7	1.9	1.6		
20-24 cm		3.5	3.9	5.6			
25-29 cm				7.8			
Cod 5-9 cm		0.4					
10-14 cm		0.9			2.7		
Haddock 10-14 cm	13.4	2.1	3.5		51.1	12.4	
15-19 cm	8.1	7.0		2.0			
20-24 cm			1.8				
Norway pout 5-9 cm	0.2	-	0.7			14.0	
10-14 cm	2.0	0.6	2.2			15.5	
15-19 cm		4.1	1.5	4.1			
Blue whiting indet.	0.1	0.2					
10-14 cm			35.0				
15-19 cm			38.3	18.3			
Undetermined fish	5.4	0.9	2.0	25.1	2.5	1.1	
Various	1.6	1.3	0.8	0.2	0.8	0.5	
Total average weight	6.97	8.06	11.19	6.91	2.25	7.02	
No. of stomachs	335	411	224	233	195	227	
Percentage empty	40.0	46.7	18.8	38.2	44.1	48.0	

In the 60.0 – 79.9 cm size group, fish was even more dominating, with the same prey species contribution as in the 40-59 cm size group, but with increased importance of larger prey size groups. Crustaceans and other prey were less common. The total weight of the stomach content was between 7.1 and 39.5 g, and as in the former size group it was highest in 2000 and lowest in 2002. The percentage empty varied between 19 and 59, lowest in 2000 and highest in 2001.

Only a few saithe of 80 cm and larger were sampled. In those with any stomach content, herring was the dominating prey species. All size groups from 5 to 34 cm were represented. The highest average stomach weight observed was 308 g. (2001).

Table 5 cont.

Size group 60.0 – 79.9 cm							
	1998	1999	2000	2001	2002	2003	2004
Gastropods	+	+					
Cephalopods	8.9	0.1	+				
Copepods	0.1	0.1	+				
Amphipods	0.2	+	0.1				
Krill	2.4	1.9	0.7	0.5	3.9	2.2	
Shrimp	0.1					0.6	
Herring 5-9 cm	13.2	31.8				9.8	
10-14 cm	22.1	44.6	1.0			3.4	
15-19 cm	18.3	6.2	2.7	24.3	14.8		
20-24 cm	1.9	7.8	17.8	37.9			
25-29 cm	1.7						
30-34 cm			11.2				
Cod indet.					2.3		
5-9 cm	0.1	+					
10-14 cm			0.3				
15-19 cm	0.4						
Haddock 5-9 cm						1.4	
10-14 cm	22.3	2.2	1.2		71.1	11.3	
15-19 cm	2.0		3.8			15.8	
Norway pout 5-9 cm				2.9		7.2	
10-14 cm	0.7	0.2	0.3			22.3	
15-19 cm			1.6			24.6	
Blue whiting indet.	2.6	1.4		2.2			
10-14 cm			55.7				
15-19 cm			3.5				
Undetermined fish	1.7	3.7	0.1	32.2	7.9	-	
Various	1.2	+	-	-	-	1.4	
Total average weight	36.90	29.6	39.49	38.93	7.10	17.86	
No. of stomachs	177	167	82	44	70	60	
Percentage empty	31.6	32.3	19.5	59.1	41.4	33.3	

Table 5 cont.

Size group > 80.0 cm							
	1998	1999	2000	2001	2002	2003	2004
Krill						1.8	
Shrimp			100				
Herring 5-9 cm						44.6	
10-14 cm		6.8					
15-19 cm				14.1			
20-24 cm		35.3		49.5			
25-29 cm		7.7		19.6			
30-34 cm		45.9					
Norway pout 5-9 cm						10.9	
10-14 cm						42.7	
15-19 cm		1.0					
Blue whiting indet.		2.2		7.6			

Undetermined fish		-		9.2		-	
Various		1.1		-	100	-	
Total average weight		208.4	15.0	308.4	0.81	45.4	
No. of stomachs	0	19	1	3	2	2	
Percentage empty		26.3	0	0	50.0	0	

B. 67°00' - 69°30'N

Table 6 presents the percentage wet weight of main prey categories/species, total average stomach weight (g), number sampled and percentage empty by saithe size group in area B (67°00' - 69°30'N). Like in area A, crustaceans were the dominating prey category in the 20.0 – 39.9 cm size group. Also here krill was most important in most years, followed by copepods and amphipods. Gastropods were more common than in area A. Of fish prey, small herring and Norway pout was most common. The total weight of the stomach content was between 0.3 and 2.4 g, highest in 1998 and lowest in 1999. The percentage empty varied between 10 and 49, lowest in 1998 and highest in 2002.

Table 6. Percentage wet weight of main prey categories/ species, total average stomach weight (g), No. sampled and percentage empty by saithe size group

Size group 20.0 – 39.9 cm							
	1998	1999	2000	2001	2002	2003	2004
Gastropods	0.3	1.8	28.7	75.1	8.5		
Copepods		64.7	5.3				
Amphipods	5.1	4.1					
Krill	87.4	24.7	36.2	24.9	86.0	100	
Herring indet.			27.1		0.6		
Norway pout 5-9 cm	7.2						
Undetermined fish		4.0	2.7				
Various		0.7					
Total average weight	2.36	0.28	0.95	1.03	0.47	0.88	
No. of stomachs	31	100	70	81	83	51	
Percentage empty	9.7	25.0	30.0	28.4	49.4	62.7	

In the 40.0 – 59.9 cm size group, fish was again the dominating prey category. Norway pout (5-19 cm) was most abundant, followed by herring (10-14 cm), blue whiting (10-19 cm) and haddock (15-19 cm). No cod prey was found in this area. The second most important prey category was crustaceans, dominated by krill. Cephalopods were not found and gastropods were scarce. The total weight of the stomach content was between 0.5 and 11.1 g, highest in 2000 and lowest in 1999. The percentage empty varied between 19 and 54, lowest in 1998 and highest in 2000.

Table 6 cont.

Size group 40.0 – 59.9 cm							
	1998	1999	2000	2001	2002	2003	2004
Gastropods	1.3		0.2	10.2			
Copepods	5.9	11.1	0.1				
Amphipods	31.6	5.3	0.2				
Krill	24.6	15.9	13.1	29.6	14.0	22.0	
Shrimp	1.9	12.7	0.5			1.8	
Herring indet.	28.3		23.4			7.3	
10-14 cm					7.4		
Haddock 15 -19 cm					22.6		
Norway pout 5-9 cm		35.2	1.1	9.4	14.1		
10-14 cm					16.3	34.5	
15-19 cm			2.4		10.2	29.3	
Blue whiting 10-14cm			39.9				
15-19 cm			10.2				
Undetermined fish	6.2	14.3	8.4	50.8	9.5	4.6	
Various	0.2	5.5	0.5		5.9	0.5	
Total average weight	1.94	0.52	11.01	2.19	2.35	3.33	
No. of stomachs	154	171	113	35	137	119	
Percentage empty	18.8	33.9	54.0	42.9	52.6	50.4	

Table 6 cont.

Size group 60.0 – 79.9 cm							
	1998	1999	2000	2001	2002	2003	2004
Gastropods	0.1		0.1				
Cephalopods		0.7	0.2				
Amphipods		+					
Krill	39.2	+	0.2		0.3	0.2	
Shrimp		0.4	+			0.1	
Herring indet.					42.4	76.6	
20-24 cm		12.3					
25-29 cm		61.7	45.6				
30-34 cm			48.9				
Haddock indet.					9.9		
20-24 cm						4.1	
Norway pout 5-9 cm			0.5		1.4	0.3	
10-14 cm	49.0	2.3	0.5		4.6	3.7	
15-19 cm		12.0	2.4		18.8	3.6	
Blue whiting indet.		3.5	1.6				
15-19 cm						4.3	
20-24 cm						6.6	
Undetermined fish		2.8		100	11.1	0.1	
Various	11.7	4.3	-		11.5	0.4	
Total average weight	2.69	19.8	25.8	19.3	16.9	35.8	
No. of stomachs	31	59	50	3	44	67	
Percentage empty	71.0	49.2	58.0	66.7	63.6	43.3	

Like in area A, fish was even more dominating in the 60.0 – 79.9 cm size group. The prey species contribution was as in the 40-59 cm size group, but with increased importance of herring and of larger prey size groups. Crustaceans and other prey were less common. The total weight of the stomach content was between 2.7 and 35.8 g, highest in 2003 and lowest in 1998. The percentage empty varied between 43 and 71, lowest in 2003 and highest in 1998.

Some more saithe of 80 cm and larger were sampled than in area A. Herring was the dominating prey species, with size groups from 20 to 34 cm were represented. The highest average stomach weight observed was 343 g. (2003).

Table 6 cont.

Size group > 80 cm							
	1998	1999	2000	2001	2002	2003	2004
Gastropods							
Cephalopods			+				
Amphipods							
Krill							
Shrimp						+	
Herring indet.		100			95.5		
20-24 cm			6.1				
25-29 cm			48.3			69.3	
30-34 cm			42.3			27.2	
Haddock indet.							
Norway pout 5-9 cm			0.3				
10-14 cm			0.5				
15-19 cm			1.9		3.9	1.0	
Blue whiting indet.					0.6		
15-19 cm			0.6				
20-24 cm						0.9	
25-29 cm						1.5	
Undetermined fish			+				
Various	100						
Total average weight	0.01	24.9	149.3		175.7	343.2	
No. of stomachs	5	2	26	0	6	19	
Percentage empty	80.0	50.0	19.2		0	15.8	

C. 63°30' - 67°00'N

Table 7 presents the percentage wet weight of main prey categories/species, total average stomach weight (g), number sampled and percentage empty by saithe size group in area C (63°30' - 67°00'N). Like in area A and B, crustaceans were the dominating prey category in the 20.0 – 39.9 cm size group. Also here krill was most important, but also copepods made a large contribution, while amphipods only were found in one year (1998). Gastropods also were only found in 1998. Of fish prey, a few small Norway pout occurred in 2002. The total weight of the stomach content

was between 0.1 and 7.1 g, highest in 2003 and lowest in 1999. The percentage empty varied between 0 and 46, lowest in 2003 and highest in 2001.

Table 7. Percentage wet weight of main prey categories/ species, total average stomach weight (g), No. sampled and percentage empty by saithe size group

Size group 20.0 – 39.9 cm							
	1998	1999	2000	2001	2002	2003	2004
Gastropods	48.5						
Copepods	36.4	76.3	71.3				
Amphipods	7.2						
Krill	7.9	23.7	28.7	100	94.6	100	
Norw. pout 10-14cm					5.4		
Total average weight	1.88	0.14	0.56	1.09	6.7	7.13	
No. of stomachs	16	21	18	24	25	24	
Percentage empty	31.3	33.3	5.6	45.8	8.0	0	

In the 40.0 – 59.9 cm size group, fish was the dominating prey category in 1998-2000, while krill was more important in 2001-2003. Norway pout (5-19 cm) was the most abundant fish prey, while blue whiting (10-14 cm), haddock (10-14 cm) and herring were scarce. No cod prey was found in this area either. Cephalopods were not found, while gastropods were common in 1998. The total weight of the stomach content was between 1.2 and 7.7 g, highest in 2000 and lowest in 1999. The percentage empty varied between 8 and 37, lowest in 2000 and highest in 1999.

Table 7 cont.

Size group 40.0 – 59.9 cm							
	1998	1999	2000	2001	2002	2003	2004
Gastropods	39.3		+				
Copepods	2.2	2.2	1.2				
Amphipods	1.4	1.0	1.6				
Krill	0.8	12.1	13.4	71.9	77.6	100	
Shrimp		0.8					
Herring indet.		1.3					
Haddock 10-14 cm	5.0						
Norw. pout 5-9 cm				4.1	10.5		
10-14cm	35.2	50.3	40.7	24.0	9.3		
15-19 cm	15.3	27.4	26.9				
Blue whiting 10-14cm			16.2				
Various	0.8	4.9			2.6		
Total average weight	2.55	1.20	7.68	2.08	3.27	5.28	
No. of stomachs	101	74	66	77	73	18	
Percentage empty	25.7	36.5	7.6	29.9	27.4	11.1	

Like in area A and B, fish was even more dominating in the 60.0 – 79.9 cm size group in all years. The prey species contribution was as in the 40-59 cm size group, but with increased importance of larger prey size groups. Crustaceans and other prey were of relatively little importance. The total weight of the stomach content was between 2.6 and 37.5 g, highest in 2000 and lowest in 2002. The percentage empty varied between 14 and 63, lowest in 2000 and highest in 1999. No saithe of 60.0 – 79.9 cm was sampled in this area in 2003.

Table 7 cont.

Size group 60.0 – 79.9 cm							
	1998	1999	2000	2001	2002	2003	2004
Gastropods	0.5						
Cephalopods		1.9	+				
Copepods	0.9		0.2		0.8		
Amphipods	0.3		0.2				
Krill	3.4	1.5	0.3	4.2	17.4		
Shrimp	0.9	0.1					
Herring indet.							
Haddock 5-9 cm	12.0						
10-14 cm	51.0		1.3		21.3		
Norw. pout 5-9 cm	12.4		0.6		12.7		
10-14cm	13.8	73.5	51.1	31.9	47.8		
15-19 cm	4.8	22.8	37.2	15.1			
Blue whiting 15-19 cm			2.0	28.7			
Undetermined fish		0.2		17.8			
Various			7.1	2.3			
Total average weight	4.83	3.19	37.5	8.67	2.58		
No. of stomachs	36	40	29	40	20	0	
Percentage empty	36.1	62.5	13.8	47.5	55.0		

In area C there was not sampled any fish of 80 cm and larger in 1998-2003.

D. 62°00' - 63°30'N

Table 8 presents the percentage wet weight of main prey categories/species, total average stomach weight (g), number sampled and percentage empty by saithe size group in area D (62°00' - 63°30'N). Like in the three other areas, crustaceans were the dominating prey category in the 20.0 – 39.9 cm size group. Also here krill was most important. Copepods made a large contribution in 1998, while no amphipods were found. Gastropods occurred in half of the years. Of fish prey, Norway pout was found in a couple of years. No cod prey was found in this area either. The total weight of the stomach content was between 0.2 and 5.6 g, highest in 2002 and lowest in 1999. The percentage empty varied between 5 and 67, lowest in 2000 and highest in 1998.

Table 8. Percentage wet weight of main prey categories/ species, total average stomach weight (g), No. sampled and percentage empty by saithe size group

Size group 20.0 – 39.9 cm							
	1998	1999	2000	2001	2002	2003	2004
Gastropods	16.6		1.1	9.7			
Copepods	55.9		0.3				
Amphipods							
Krill	26.4	100	98.6	67.3	99.1	90.9	
Undetermined fish	1.1				0.9		
Norw. pout 5-9 cm				23.0		3.8	
10-14 cm						5.3	
Total average weight	0.27	0.21	2.83	0.49	5.56	3.16	
No. of stomachs	33	26	19	87	52	46	
Percentage empty	66.7	65.4	5.3	44.8	42.3	45.7	

In the 40.0 – 59.9 cm size group, fish was the dominating prey category in 1998-1999 and 2001, while krill was more important in 2000 and 2002-2003. Norway pout (5-19 cm) was the most abundant fish prey, while blue whiting (15-19 cm) and haddock (10-19 cm) were less common, and herring was not found at all. Cephalopods and gastropods were both scarce. The total weight of the stomach content was between 1.6 and 9.8 g, highest in 2002 and lowest in 1999. The percentage empty varied between 22 and 52, lowest in 2002 and highest in 1999.

Table 8 cont.

Size group 40.0 – 59.9 cm							
	1998	1999	2000	2001	2002	2003	2004
Gastropods	0.2		1.3				
Cephalopods		2.7					
Copepods	2.7	0.2	0.5				
Amphipods	0.3		0.7				
Krill	1.7	14.5	54.9	29.9	49.5	92.3	
Shrimp	0.2				0.3	1.5	
Haddock 10-14 cm	4.4			6.0	1.5		
15-19 cm	9.8						
Norway pout indet.	6.3						
5-9 cm		82.6	42.6	9.7	11.1	4.1	
10-14cm	40.2			28.4	31.7	1.2	
15-19 cm	24.2			18.6	4.0		
Blue whiting 15-19cm	7.9						
Undetermined fish	0.2			7.4	1.3	0.9	
Various	1.9				0.6		
Total average weight	3.37	1.56	4.32	3.12	9.84	8.27	
No. of stomachs	109	48	49	106	107	81	
Percentage empty	41.3	52.1	26.5	38.7	21.5	38.3	

In the 60.0 – 79.9 cm size group fish was the dominating prey category in all years except in 2003, when krill was most important. The prey species contribution was as in the 40-59 cm size group, but with increased importance of larger prey size groups. Other prey was of relatively little importance. The total weight of the stomach content was between 11.3 and 40.0 g, highest in 2000 and lowest in 1999. The percentage empty varied between 15 and 44, lowest in 1998 and highest in 1999.

Table 8 cont.

Size group 60.0 – 79.9 cm							
	1998	1999	2000	2001	2002	2003	2004
Cephalopods	0.1				8.3		
Amphipods			+				
Krill	0.4		0.6	1.0	13.7	80.9	
Shrimp						2.9	
Haddock 10-14 cm	11.6				13.4		
Norway pout indet.							
5-9 cm	5.6		1.0	28.0	16.4	9.5	
10-14cm	41.9	100	62.7	33.3	27.2	6.4	
15-19 cm	37.4		21.3	16.5	5.8		
Blue whiting indet.					5.0		
10-14 cm			2.8				
15-19 cm			10.2	6.7			
Undetermined fish			1.4	14.5	8.7	0.3	
Various	3.0				1.5		
Total average weight	28.0	11.33	40.01	18.32	17.61	22.33	
No. of stomachs	20	5	19	25	29	25	
Percentage empty	15.0	43.8	26.3	24.0	20.7	16.0	

Table 8 cont.

Size group > 80 cm							
	1998	1999	2000	2001	2002	2003	2004
Amphipods							
Krill	100				100		
Shrimp						1.9	
Herring indet.						2.1	
Haddock 10-14 cm						9.1	
15-19 cm						13.5	
Norway pout 5-9 cm				13.3			
10-14cm		100	22.4	86.7		34.6	
15-19 cm			37.8			8.5	
Blue whiting 10-14 cm			39.8				
Various						30.3	
Total average weight	1.07	22.53	43.65	7.13	6.49	103.4	
No. of stomachs	1	4	2	6	2	4	
Percentage empty	0	50.0	0	83.3	50.0	0	

Also in area D relatively few saithe of 80 cm and larger were sampled. Krill was the only prey species found in just a couple of samples in 1998 and 2002, while Norway pout was (5-19 cm) was most important in the other years. Haddock (10-19 cm), blue whiting (10-14 cm) and herring also occurred sporadically. The highest average stomach weight observed was 103 g. (2003).

Table 9 presents an unweighted average of the total stomach weights over the whole period for each sub-area. There are no clear trends, but for the smallest size groups the average stomach weight tends to be highest in the two southern sub-areas and the opposite for the largest size groups.

Table 9. Total average wet weight of stomach content (g by size group and area

Area	Predator size group			
	20.0 – 39.9	40.0 – 59.9	60.0 – 79.9	> 80
A. North of 69°30'N	1.2	7.1	28.3	115.6
B. 67°00' - 69°30'N	1.0	3.6	20.0	138.6
C. 63°30' - 67°00'N	2.9	3.7	11.4	
D. 62°00' - 63°30'N	2.1	5.1	22.9	30.7

PRELIMINARY CONSUMPTION ESTIMATES

Based on the average stomach content by predator age group and sub-area, the acoustic abundance estimate of saithe and average weight at age by sub-area and average temperature in 100 m depth by sub-area (Tables 10-12, from Berg, Korsbrekke and Mehl 2003), estimates of the consumption in quarter 4. are calculated. The gastric evacuation model applied for cod in the Barents Sea is also used for saithe, with the same prey specific constants (Bogstad and Mehl 1997, Bogstad, Haug and Mehl 2000).

Table 10. Northeast Arctic saithe acoustic abundance indices by age Oktober-November 1998 – 2003 (numbers in millions).

Year	Age					Total
	2	3	4	5	6+	
1998	43.6	96.5	200.6	70.0	96.7	507.5
1999	61.1	233.8	72.9	62.2	47.8	478.3
2000	164.8	142.5	176.3	11.6	26.5	521.8
2001	104.7	275.9	45.9	53.8	20.1	500.4
2002	25.5	230.2	92.6	18.9	15.7	382.8
2003	31.0	87.5	151.7	26.1	15.8	312.1

Table 11. Mean weight (kg) at age in the Northeast Arctic saithe stock 1998-2003.

Year	Age					
	2	3	4	5	6	7
1998	0.43	0.75	1.00	1.60	1.91	2.49
1999	0.41	0.62	1.19	1.42	1.88	2.56
2000	0.36	0.67	0.99	1.63	2.25	2.66
2001	0.31	0.49	0.97	1.42	1.99	2.83
2002	0.37	0.57	0.81	1.49	2.15	2.33
2003	0.40	0.59	0.82	1.13	1.97	2.45

Table 12. Mean temperatures in 100 m depth in 1998 - 2003

Area	Mean temperature					
	1998	1999	2000	2001	2002	2003
Nort of 69°30'N	7.23	8.07	8.08	7.48	8.35	7.71
67°N - 69°30'N	8.67	8.10	8.77	8.23	8.17	8.12
63°30'N - 65°30'N	8.39	8.33	9.22	8.51	8.73	8.07
62°N - 63°30'N	8.96	9.08	10.23	9.31	9.01	8.81

The calculations are done by sub-area. Tables 13-14 present the consumption of the main or commercially most important prey species for sub-area A+B (north of 67°N) and C+D (south of 67°N). The average consumption pr. predator and daily consumption in percent of the predator weight is also given. Figures 2-3 summarize the main results. In north krill (*M. norvegica*) was the most important prey species in most years, followed by herring, haddock, Norway pout and blue whiting. In 1999 herring dominated in the consumption estimates, and in 2000 blue whiting. Also in south *M. norvegica* dominated in most years, followed by Norway pout, which was the most important prey species in 1999 and 1998. Haddock and blue whiting were of less importance, and herring was almost not found in the stomach samples.

Table 13. The Northeast Arctic saithe stocks' consumption in tonnes of main prey and commercially important preys species north of 67°N in quarter 4 1998-2003.

	1998	1999	2000	2001	2002	2003
Other	26208	13905	31791	37489	5660	690
Amphipods	22360	2718	341	0	38	0
Krill	110194	26605	70376	92499	53548	39997
Shrimp	250	313	157	0	0	850
Herring	79081	81068	35402	17665	6148	18826
N. pout	6058	5785	10028	6109	13531	35165
Cod	708	1805	51	0	664	0
Haddock	41333	8277	4367	1694	22576	3986
Redfish	0	369	0	0	0	0
B. whiting	4002	628	158025	21948	0	1984
TOTAL	290193	141473	310537	177404	102164	101498
Per predator (g)	832	676	1092	845	624	783
% of BW pr day	0.75	0.51	0.89	0.83	0.57	0.72

Table 14. The Northeast Arctic saithe stocks' consumption in tonnes of main prey and commercially important preys species south of 67°N in quarter 4 1998-2003.

	1998	1999	2000	2001	2002	2003
Other	13131	1355	1868	889	123	0
Amphipods	990	124	852	0	0	0
Krill	10869	22345	50605	37938	90322	129435
Shrimp	0	60	0	0	17	156
Herring	0	79	0	0	0	6
Norway pout	58982	47362	29719	36865	15740	5562
Haddock	11732	0	75	803	586	0
Blue whiting	295	0	3180	1385	129	0
TOTAL	95999	71325	86298	77880	106918	135159
Per predator (g)	791	551	1615	856	1121	1375
% of BW pr day	0.63	0.43	1.29	0.77	1.47	1.67

The average stomach content weight per predator (unweighted mean of all age groups) was highest in north in 2000-2001 and in south in 2000 and 2002-2003. In 2002 and 2003 the weight in south was almost 80 % higher than in north. The daily consumption in percent of the body weight (BW) reflects the same differences. It has varied from 0.43 to 1.67 %, lowest in both areas in 1999 and highest in north in 2000 and in south in 2003. The variations were largest in south.

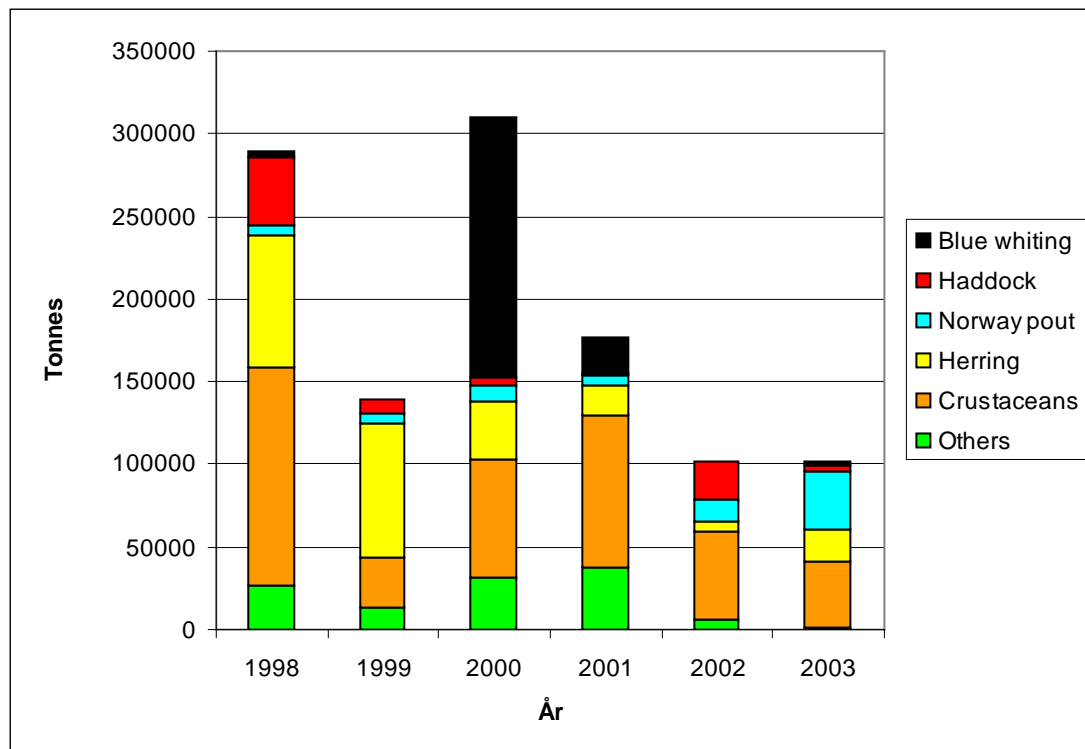


Figure 2. The Northeast Arctic saithe stocks' consumption in tonnes of main prey and commercially important preys species north of 67°N in quarter 4 1998-2003.

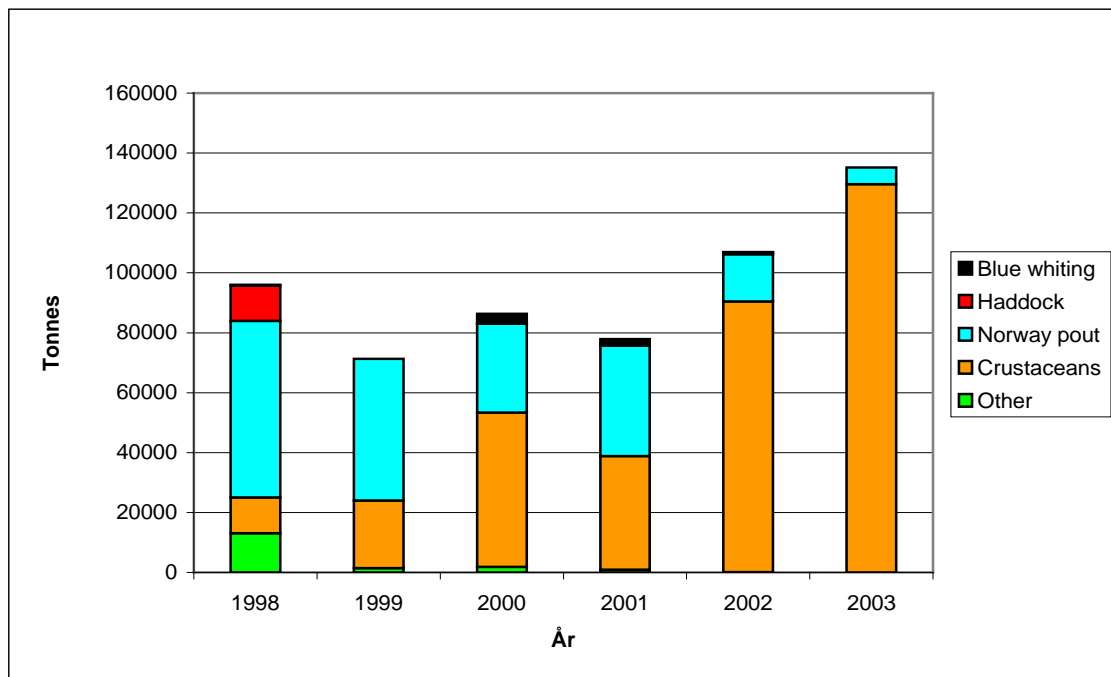


Figure 3. The Northeast Arctic saithe stocks' consumption in tonnes of main prey and commercially important preys species south of 67°N in quarter 4 1998-2003.

CONCLUDING COMMENTS

In the period 1998-2003 almost 6 000 stomachs were sampled of Northeast Arctic saithe along the Norwegian coast north of 62° N. The sampling took place during the annual saithe/coastal survey in October - November.

On average 35 - 40 % of the stomachs were empty. Measured in percent wet weight of the total stomach content over all predator size groups, fish was the dominating prey group in all sub-areas and years, followed by crustaceans. The importance of fish was highest in north, while in south the importance of crustaceans increased. In most sub-areas the stomach content weights were lowest in 1999.

In the smallest size group (20-39 cm), krill was the dominating prey item in all sub-areas, while in the larger size groups fish dominated, and most in north. In the northernmost sub-area (A), herring was the most important fish prey, followed by haddock, Norway pout and blue whiting. Cod only occurred sporadically. In sub-area B, Norway pout and herring was the dominant fish prey, and haddock and blue whiting came next. No cod was found in the stomachs. In area C and D, Norway pout was the dominating fish prey, followed by blue whiting and haddock. Herring was scarce and no cod was found. The size of the fish prey increased with increasing predator size.

Preliminary consumption estimates for quarter four show that when the number of fish in each predator age group is taken into account, krill was the single most important prey species, followed by Norway pout, herring, blue whiting and haddock.

The consumption estimates are quite variable from sub-area to sub-area and year to year, and may only partly reflect the consumption and predation pressure of the Northeast Arctic saithe stock.

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