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Aspects of vertebrate feeding in the marine ecosystem in Hornsund, Svalbard

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SUMMARY

Stomach content from 171 vertebrates from Hornsund collected between September 7th and October 5th 1984 was analysed. Stomachs were collected from 2 species of fish (shorthorn sculpin *Myxocephalus scorpius* and striped seasnail *Liparis liparis*), 8 species of birds (black guillemot *Cepphus grylle*, little auk *Alle alle*, puffin *Fratercula arctica*, Brunnich's guillemot *Uria lomvia*, fulmar *Fulmarus glacialis*, kittiwake *Rissa tridactyla*, glaucous gull *Larus hyperboreus* and eider *Somateria mollissima*), and 2 species of seals (ringed seal *Phoca hispida* and bearded seal *Erignathus barbatus*). Simultanously plankton and benthos were collected from the Hornsund area to get an idea of what was available as food for the vertebrates investegated.

Arctic cod *Boerogadus saida* and the amphipod *Themisto libellula* were the main prey species of black guillemots, little auks, puffins, Brunnich's guillemots, kittiwakes and ringed seals. Fulmars mainly preyed upon the squid *Gonatus fabrici* and the polychaet *Nereis irrorata*, and eiders preyed mainy on bivalves and the amphipod *Gammarellus homari*. *G. homari* and *Gammarus oceanicus* were the most important prey species of striped seasnail, while the shorthorn sculpins mainly preyed upon *G. homari* and *Anonyx sarsi*. Glaucous gulls had many different preys on their menue, none of which seem to dominate. Only one bearded seal stomach with content was available for this study.

It seems like the food base in Hornsund during the study period is inadequate for all the birds living there. They therefore either have to search for food outside Hornsund in the open sea, or find small scale planktonic aggregations caused by hydrological phenomenon within the fiord. Most ringed seals probably leave Hornsund part of the year to feed in other areas.

A food web was constucted based on the knowledge of the preys of the different predators, and finally a clusteranalysis was made to assess the degree different predators utilize the same groups of prey.

INTRODUCTION

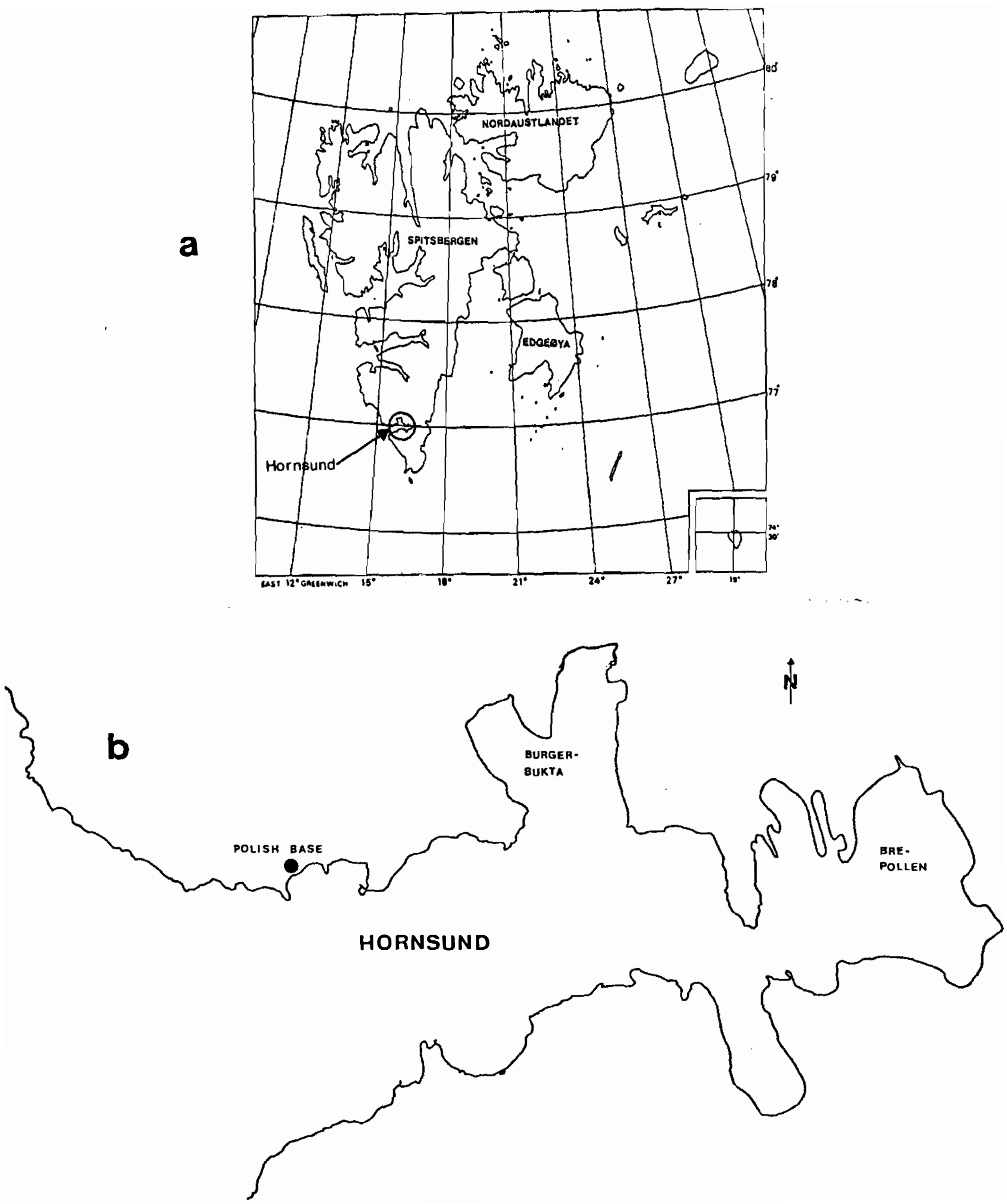


Fig.1.a) Map of Svalbard 1:6900000.
b) Map of Hornsund 1:240000.

The purpose of this study is to investgate the stomach-content of vertebrates in the marine food chain of a Svalbard fiord.Hornsund was chosen because several studies of the marine invertebrate fauna had previously been conducted there (Skoworon 1977,Weslawski 1983,Weslawsi and Kwasniewski 1983,Moskal 1984).Hornsund is also the site of the Polish Polar Station (Fig.1) which with its facilities and equipment offers good working conditions for marine biological studies.

The Hornsund fiord is of special interrest because of its particulary complicated and variable hydrological conditions with occurrence of Atlantic waters,Arctic waters and transformal coastal waters of different origin (Weslawski and Kwasniewski 1983).The main surface currents are shown in fig.2.

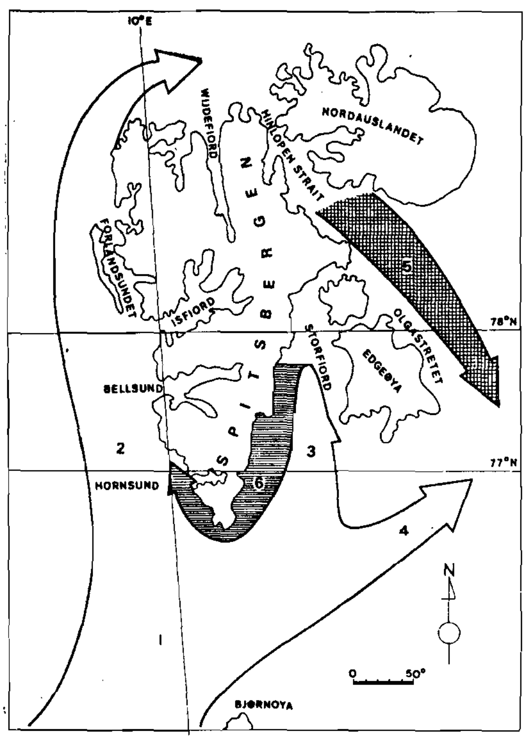


Fig.2.The course of surface currents,revealed by analysis of biological indicators:1 & 2 - West Spitsbergen Current (warm,Atlantic water),3 & 4 - South Cape Current (warm, Atlantic water),5 - Barents Current (cold,Arctic water), 6 - Sørkapp Current (cold,Atlantic water).(From Weslawski and Kwasniewski 1983).

In the Svalbard area previous studies of marine vertebrate and bird diet include Hartley and Fisher 1936,Løvenskiold 1964,DeKorte 1972a,b,c,Norderhaug 1980,Gjertz 1983 and Mehlum and Gjertz 1984.This study will apart from traditional stomach-content analysis,also attempt to describe the food-web interrelations in the marine ecosystem in Hornsund.

Routine benthic and planktonic sampling are performed in Hornsund year around,and results from this sampling relevant to our study are included.

MATERIAL AND METHODS.

Invertebrates.

Polish scientists collect benthic and planktonic samples from a net of stations in Hornsund and adjacent waters througout the year.Fig.3 shows the net of stations,and table 1 gives a closer description of the various stations.

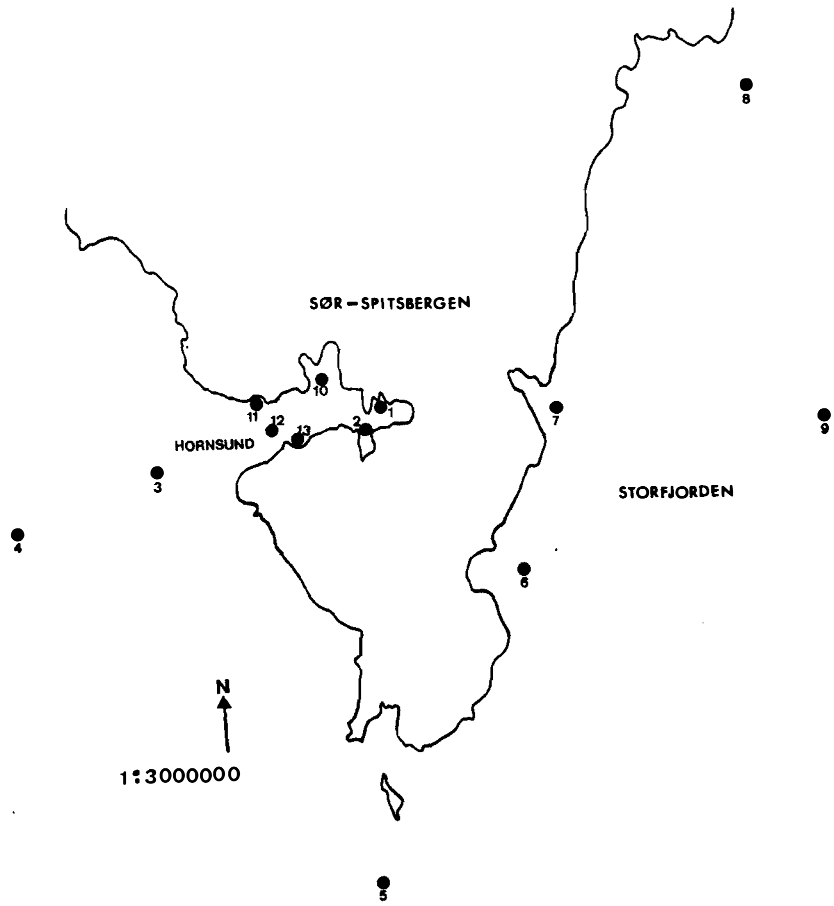


Fig.3.Net of stations used the year around by Polish scientists to collect plankton and benthos.

Data from these stations collected in September 1984,was used in this study to get an idea of what was available as prey for fish,birds and seals at the time they were collected.

Vertical plankton-samples were taken from 0-10m,10-25m, 25-50m and 50-100m using a W-P-2-net with mesh-size of 200 µm. Benthic samples were collected using a Peterson grab with a 0.4m X 0.4m opening.Three samples were taken at each lokality.

Table 1. Specifications of stations used by Polish scientists the year around to collect plankton and benthos.

STATION NO.	LATITUDE	LONGITUDE	DEPTH
1	77.01.04N	16.27.50E	98m
2	76.58.10N	16.19.00E	100m
3	76.50.30N	14.16.00E	66m
4	76.48.50N	13.05.00E	390m
5	76.19.00N	16.41.00E	80m
6	76.49.20N	17.11.00E	18m
7	76.59.80N	17.26.20E	75m
8	77.27.30N	18.24.00E	45m
9	76.57.00N	19.03.00E	110m
10	77.01.00N	15.56.21E	60m
11	77.00.00N	15.36.45E	115m
12	76.59.00N	15.42.43E	180m
13	76.58.00N	15.51.06E	100m

In addition at different localities in Hornsund benthic samples were gathered on a routine basis from various depths beginning with the tidal sone.

All samples were washed on a sieve with mesh-size 1 mm. Wet weights of animals collected were determined to the nearest mg,and a 10% formaldehyd-solution was used as a fixative.All collected material was analysed at the Polish Polar Station.

Vertebrates.

The vertebrates of interrest in this study were 2 species of seals,8 species of birds and those fish species it was possible to catch.The material for stomach-content analysis was collected from September 7th to October 5th 1984.In all it includes 171 stomach samples from 12 species (Table 2).

Fish were attempted caught using nets with different mesh sizes (50mm-200mm) placed at varying depths (1m-100m).An eel-trap with and without bait was also used.One major problem fishing with nets was the loss of equipment due to bad weather and drifting ice.Another significant problem concerned checking the nets.If,due to bad weather,they were left unattended 24 hrs

Table 2. Review of the vertebrate species collected in Hornsund autumn 1984.

	SPECIES		NUMBER
PISCES	*Myxocephalus scorpius*		17
	Liparis Liparis		3
AVES	Black guillemot	*Cepphus grylle*	20
	Brunnich's guillemot	*Uria lomvia*	21
	Little auk	*Alle alle*	11
	Puffin	*Fratercula arctica*	14
	Eider	*Somateria mollissima*	20
	Fulmar	*Fulmarus glacialis*	20
	Kittiwake	*Rissa tridactyla*	20
	Glaucous gull	*Larus hyperboreus*	18
MAMMALIA	Ringed seal	*Phoca hispida*	5
	Bearded seal	*Erignathus barbatus*	2

or more,fish caught would be completely eaten by carnivorous amphipods,leaving only a skeleton which was of little use in this study.Fish were weighed to the nearest g and fork lengths measured to the nearest 0.5 cm.The stomach contents were washed onto a sieve with mesh-size 0.5 mm,and wet weight measured to nearest 0.5 g.The stomach contents were fixed in 40% etanol.The otoliths of each fish were removed and lengths measured to nearest 0.1 mm.Otolith-lengths were used to construct a regression line between otolith- length and fish-length.

Birds were shot with shot-gun from a boat with out-board engine.Hornsund is a national park and it was necessary to get official permission in advance to collect a maximum of 20 birds of each of the 8th species required.Birds were preferably shot when they seemed to be forageing,and collection was spread over the period of field-work in an attempt to get a more representative picture of their diet.The birds were weighed to the nearest 5 g.Oesophagus- and stomach-content were washed onto a sieve with mesh size 0.5 mm,wet weight measured to nearest 0.5 g before fixation in 40% etanol.

Permission to hunt seals in the national park was obtained. Seals were hunted with a rifle (cal.30.06) from a boat with outboard engine.Few seals were observed in Hornsund while the field-work lasted.Dead ringed seals (Phoca hispida) would float because of the buoyancy of their blubber,while bearded seals (Erignathus barbatus) sank at once when shot in the water.Five bearded seals were shot and lost due to this. Seals were weighed to the nearest 0.5 kg (only ringed seals), and the length in a strait line from the tip of the nose to the end of the tail was measured to nearest cm.The maximum girth and the girth under the fore-flippers was measured to the nearest cm.Blubber-thickness over sternum was measured to nearest mm,and the seals reproductive status was determined. Tooth-material to age-determination was also collected.The stomach-contents were treated in the same manner as for birds.

At the Polish Polar Station all vertebrate samples were sorted to the lowest possible taxonomic level using available keys and reference material.Otolith-lengths were measured to the nearest 0.1 mm.Two otoliths from the same species found in one sample and differing less than 0.2 mm in length were considered to be from the same fish.In stomach-samples where polar cod (Boreogadus saida) was a dominating prey-species, the fork length of the polar cod was calculated using the regression: fish length = 2.198x + 1.588,where x= otolithlength (Frost and Lowry,1981).

Lengths of the dominating amphipod species in the bird-stomachs were measured to nearest mm,and used as comparison for lengths of amphipods caught in plankton-nets and in the Peterson grab to determine if birds were selective concerning size of prey.

To assess the degree different predators compete for the same groups of prey,a clusteranalysis was made.The analysis was run on a DEC-10 computer at the University of Oslo. Predators were divided into a dissimilarity matrix according to the frequency of different prey species,using Bray-Curtis dissimilarity index (Bray and Curtis,1957):

$$d_{1,2} = \frac{\sum_{j=1}^{n} |X_{1j} - X_{2j}|}{\sum_{j=1}^{n} (X_{1j} + X_{2j})}$$

where X_{1j} and X_{2j} are the frequencies of the j'th prey species of predator 1 and 2,and $d_{1,2}$ is the difference between the predators.The program for the clusteranalysis is derived from the package CLUSTAN (Wishart 1978).The analysis is presented as a dendrogram,and is constructed using "Group average sorting" (Lance and Williams 1967).

RESULTS.

Plankton.

Plankton biomass collected from the different stations is given in table 3.

Table 3. Zooplankton biomass distribution from vertical profiles taken at the different stations in Hornsund. Biomass is calculated in mg wet weight pr.m^3.

	DEPTH			
STATION NO.	0-10m	10-25m	25-50m	50-100m
1	214	171	257	157
2	428	86	157	0
3	557	14	29	34
4	485	485	485	1000
5	1000	1000	686	186
6	1000	314	0	0
7	649	69	3	3
8	586	171	3	0
9	314	1	3	4
10	143	63	49	0
11	114	43	77	71
12	871	49	34	0
13	614	129	114	71

Plankton biomass range varied from 235-4061 mg w.w.m^{-2} in the upper 50 m of the water column. The highest values were found at station 4 and 5, away from the coast-line. The lowest values were found at the north side of Hornsund fiord.

The plankton biomass in the upper 50 m was unevenly distributed. At most stations the dominating part of the biomass was found in the upper 10 m's of the water column. The northern part of Hornsund differs somewhat from this; here the plankton was evenly distributed in the upper 50 m. The outer shelf part (station 4) had highest biomass values at 50-100 m.

Macroplankton (zooplankton > 5 mm) consisted on average 14% (range 3-27%) of the wet weight of the total zooplankton biomass. The number and occurrence of the species are listed in table 4. Occurrence are defined as no. of hauls with taxon present divided on total no. of hauls.

Table 4. Numbers and occurrence of makroplankton collected in Hornsund September 1984.

SPECIES	TOTAL NO.OF INDIVIDUALS	OCCURRENCE
Cyanea capillata	1	5.3
Aglantha digitale	5	26.3
Parasagitta elegans arctica	257	94.7
Limacina helicina	124	47.4
Clione limacina	16	21.1
Calanus finmarchicus	--	94.7
Themisto libellula	8	21.1
Themisto abyssorum	26	21.1
Hyperia galba	3	10.5
Mysis oculata	3	10.5
Thysanoessa inermis	5	10.5
Thysanoessa longicaudata	2	5.3
Thysanoessa rashii	1	5.3
Euphausiacea larvae	22	15.8
Hyas araneus larvae	1	5.3
Sabinea septemcarcinata	1	5.3
Spirontocaris sp. larvae	3	5.3
Pagurus sp. larvae	55	52.6
Fritillaria borealis	137	52.6

The distribution of the most common makroplankton and their dominance at the different stations is shown in fig.4.

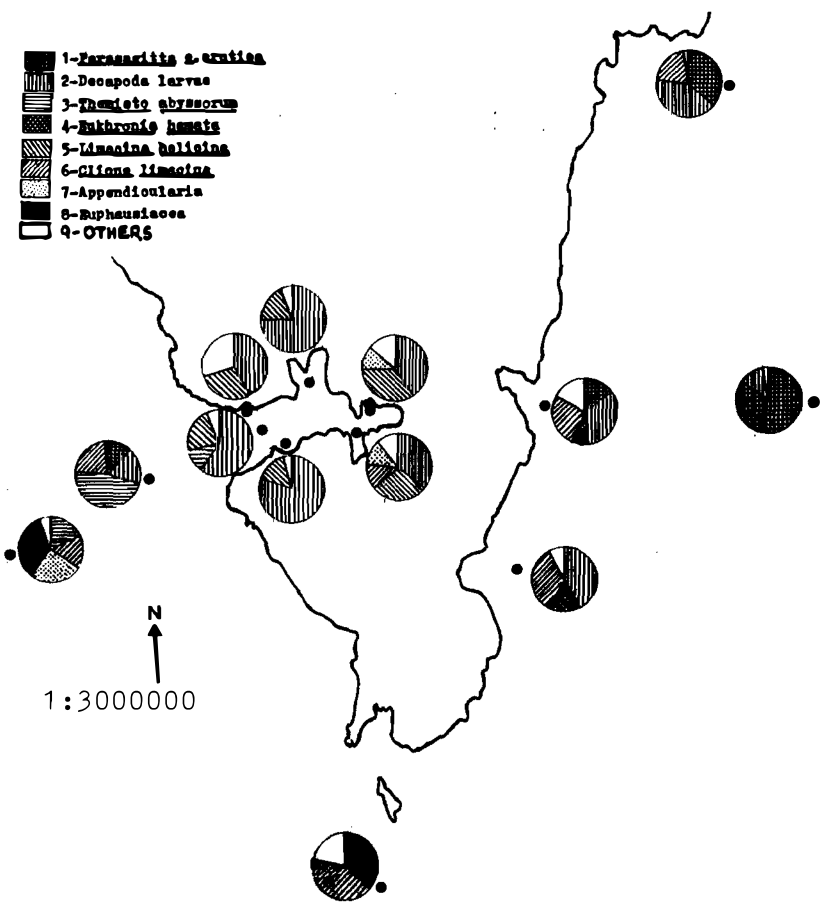


Fig.4. The dominance of the most common macroplanktonic species at different stations expressed as percent of the total number of individuals collected at each station.

Calanus finmarchicus are not included in fig.4 because they were not counted.However C.finmarchicus was found at all localities.This species was especially common at station 3,4 & 5 and not so numerous in the fiord stations.

Benthos.

Only soft bottom living animals are represented in the benthic biomass.It varies from 10-300 gw.w.m^{-2} between stations. Biomass of mobile invertebrates such as most amphipods and decapods are difficult to calculate.Many of them aggregate and may be classified as a mass species.Average values of densities of these are presented in table 5,which lists those soft-bottom species found and their biomass range in gw.w.m^{-2}.

Table 5.Soft-bottom species and ranges of biomass in gm^{-2} found at the different localities in the Hornsund area.

SPECIES	DENSITY (g/m)
Gammarus setosus	400-800
Gammarus oceanicus	400-800
Gammarellus homari	1-2
Anonyx sarsi	0.6
Anonyx nugax	2.0
Onissimus edwardsi	5.0
Onissimus littoralis	50-6000
Ischyrocerus sp.	20-400
Pleustes panoplus	0.5
Orchomene minuta	2.0
Caprella septemtrionalis	0.5
Harpactoida n.det.	50-1000
Paroediceros lynceus	1.0
Arrhis phyllonyx	0.5

Hard bottom animals' abundance are presented in table 6.

Table 6.Relative densities of hard bottom dvelling animals collected in Hornsund September 1984.+-common ++ - abundant +++ - very abundant.

SPECIES	ABUNDANCE
Hyas araneus	+++
Pagurus pubescens	++
Eualis gaimardi	+++
Sabinea septemcarcinata	++
Sclerocragnon boreas	+
Sclerocragnon ferox	++
Synidothea nodulosa	+

The horizontal distribution of benthic species in Hornsund is rather uniform,almost all species are more or less widely distributed over the whole investegated area.Exeptions are the amphipod Arrhis phyllonyx which lives only in the innermost parts of the fiord in partly isolated basins.Gammarus setosus and Gammarus oceanicus also shows a different type of horizontal distribution.G.setosus dominates in the inner parts of Hornsund while G.oceanicus is more common in the outer part of Hornsund and along the west-coast.

Pisces.

Only two species of fish were caught with the equipment used;shorthorn sculpin (Myxocephalus scorpius) and striped seasnail (Liparis liparis)(see table I & II,page 52).

Seventeen shorthorn sculpins were caught,14 of which had identifiable stomach content.All were caught in nets.The results of the stomach content analysis are presented in table 7page15.As table 7 shows Gammarellus homari and Anonyx sarsi are the most important prey of shorthorn sculpins.The mean wet weight of the sculpins' stomach content was $3.1 \pm$S.D.4.2g (empty stomachs excluded).Fifteen of the 17 shorthorn sculpins were females with roe.Otoliths were removed from 16 of the sculpins and a regression analysis on the fish fork length from otolith-length was made.The results are presented in fig.5 page15.As figur 5 shows the relation between the two lengths is as follows:Otolithlength (mm) = $0.1853X + 0.9506$,where X is the fork length in cm.

Table 7. Stomach content analysis of Myxocephalus scorpius caught in Hornsund autumn 1984.

FISH NO.	Hydroida	Lysianassidae n.det.	Ischyrocerus sp	Gammarellus homari	Gammarus setosus	Gammarus oceanicus	Anonyx sarsi	Onisimus littoralis	Onisimus edwardsi	Caprella septentrionalis	Ostracoda n.det.	Mysis oculata	Gastropoda n.det.	Polychaeta n.det.	Harmatoe sp.	Pisces n.det.
1	X	-	-	1	-	-	1	-	-	-	-	1	-	-	-	-
2	-	-	1	1	-	-	1	-	-	-	-	-	1	1	-	-
4	-	-	-	1	10	-	5	1	-	-	1	-	-	-	1	-
5	-	-	9	1	7	5	1	-	-	-	-	-	-	-	-	1
6	-	-	2	3	-	-	5	-	-	-	-	-	1	X	-	-
7	-	-	1	6	-	-	-	-	5	-	-	-	-	1	-	-
8	-	-	-	1	-	-	1	-	-	1	-	-	-	1	-	-
9	-	-	-	1	18	7	3	-	-	-	-	-	-	1	-	-
11	-	1	-	1	-	-	-	2	-	-	-	-	-	1	-	-
12	-	-	1	3	-	-	-	1	-	-	-	-	-	-	1	-
14	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
15	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
16	-	-	-	4	2	-	20	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	8	-	-	-	-	-	-	2	-	-
TOTAL NO. OF ITEMS	-	1	14	23	37	12	48	4	5	1	1	2	2	7	2	1
FREQUENCY (%)	-	0.6	8.6	14.4	23.1	7.5	30.0	2.5	3.1	0.6	0.6	1.3	1.3	4.4	1.3	0.6
NO. OF FISH WITH TAXON PRESENT	1	1	5	11	4	2	10	3	1	1	1	2	2	7	2	1
OCCURRENCE (%)	7.1	7.1	35.7	78.6	28.6	14.3	71.4	21.4	7.1	7.1	7.1	14.3	14.3	50.0	14.3	7.1

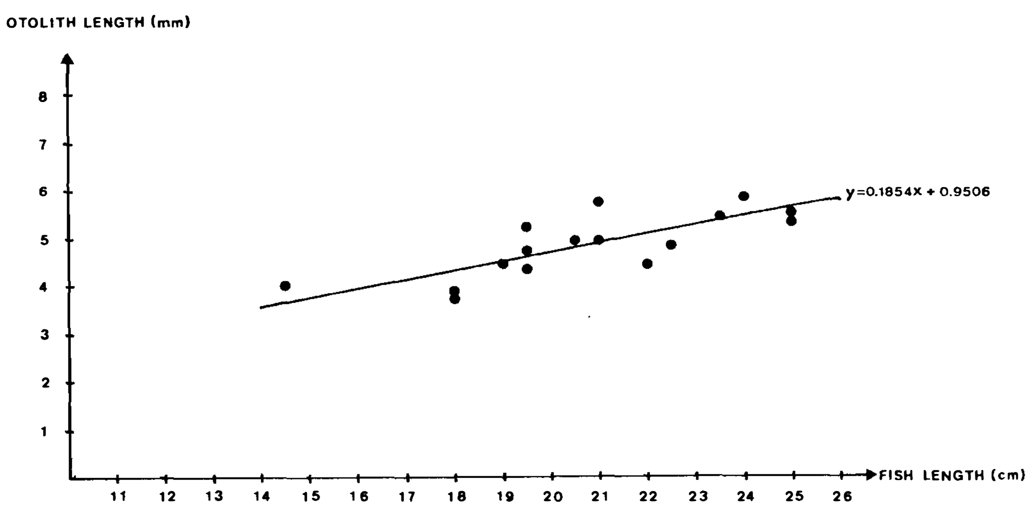


Fig 5. The relation between fork length and otolith-length of M. scorpius caught in Hornsund autumn 1984.

Three striped seasnails were caught. Two were caught in an eel-trap and one was taken by hand at low tide. All 3 fish had identifiable stomach-content, with a mean wet weight of 0.67 ± S.D.0.3 g. Results of the stomach content analysis is presented in table 8.

Table 8. Stomach content analysis of Liparis liparis caught in Hornsund autumn 1984.

FISH NO.	Ischyroserus sp.	Gammarus sp.	Gammarellus homari	Gammarus oceanicus	Onisimus edwardsi	Orchomene minuta	Harpactoida n.det.	Polychaeta n.det.
1	1	-	3	-	-	-	-	-
2	-	3	1	1	-	-	1	1
3	-	-	1	3	2	3	-	1
TOTAL NO. OF ITEMS	1	3	5	4	2	3	1	2
FREQUENCY (%)	4.8	14.3	23.8	19.0	9.5	14.3	4.8	9.5
NO.OF FISH WITH TAXON PRESENT	1	1	3	2	1	1	1	2
OCCURRENCE (%)	33.3	33.3	100.0	66.6	33.3	33.3	33.3	66.6

G.homari and G.oceanicus along with polychaets seemed to be the significant prey of striped seasnail.

The two longest striped seasnailes were 16.5 cm and 16.0 cm. Christiansen (1976) states that this species can obtain a length of 15 cm. The specimens caught in Hornsund show that the maximum length of this species obviously is longer than quoted in the litterature.

Aves.

For data on the 8 species of bird collected in Hornsund; see table III-X, page 53-56. Besides these 8 species, arctic terns (Sterna paradisaea) and longtailed ducks (Clangula hyemalis) were observed in large numbers and should have been included in this study,however hunting permission had not been applied for these two species.

Of the 20 fulmars (Fulmarus glacialis) collected 3 had empty stomachs.The mean wet weight of the stomach content of the other 17 was 1.3 $\pm$ S.D.1.7 g.The results of the stomach content analysis is presented in table 9.

Table 9.Stomach content analysis of Fulmarus glacialis from Hornsund autumn 1984.

BIRD NO.	Pteropoda sp.	Hyperiidae n.det.	Hyperia galba	Themisto libellula	Themisto abyssorum	Gammarus oceanicus	Onisimus littoralis	Mysis oculata	Nereis irrorata (jaws)	Gonatus fabricii (beaks)	Pisces rests n.det.	Boreogadhus saida	Pollachius virens	Salvelinus alpinus
24	-	-	-	-	-	-	-	-	3	16	-	-	-	-
25	-	-	-	-	-	-	-	-	1	2	-	-	-	-
33	-	-	-	-	-	-	-	-	46	-	29	-	-	-
46	-	-	1	5	29	2	1	18	-	-	-	-	-	-
48	-	-	-	-	-	-	-	-	2	-	-	-	-	-
55	X	-	-	-	-	-	-	-	-	-	2	-	-	-
56	X	-	-	-	-	-	-	-	-	-	-	-	-	-
96	-	-	-	-	-	-	-	-	18	1	1	-	-	-
100	-	-	-	-	-	-	-	-	28	-	-	-	-	-
101	-	1	-	-	-	-	-	-	1	-	1	-	-	-
102	-	-	-	-	-	-	-	-	10	-	-	-	1	-
103	-	-	-	-	-	-	-	-	4	2	-	-	-	-
104	-	-	-	-	-	-	-	-	14	1	-	-	-	-
105	-	-	-	-	-	-	-	-	78	-	2	-	-	-
114	-	-	-	-	-	-	-	-	3	2	-	1	-	1
115	-	-	-	-	-	-	-	-	6	1	3	1	-	-
116	-	-	-	-	-	-	-	-	145	-	-	-	-	-
TOTAL NO. OF ITEMS	-	1	1	5	29	2	1	18	228	25	-	2	1	1
FREQUENCY (%)	-	0.3	0.3	1.6	9.2	0.6	0.3	5.7	72.6	8.0	-	0.6	0.3	0.3
NO.OF BIRDS WITH TAXON PRESENT	2	1	1	1	1	1	1	1	14	7	9	2	1	1
OCCURRENCE (%)	11.8	5.9	5.9	5.9	5.9	5.9	5.9	5.9	82.4	41.1	52.9	11.8	5.9	5.9

Most fulmar stomachs only contained undigestable remains of prey.The dominating remains were squid beaks from Gonatus fabrici and polychaet jaws from Nereis irrorata. In 6 cases hard "plastic-like" items were found in stomachs. It was not possible to determine the origin of these items. In this report they will hereafter be called "plastic barrels" because of their barrel like shape. Fig.6 shows some of these forms.

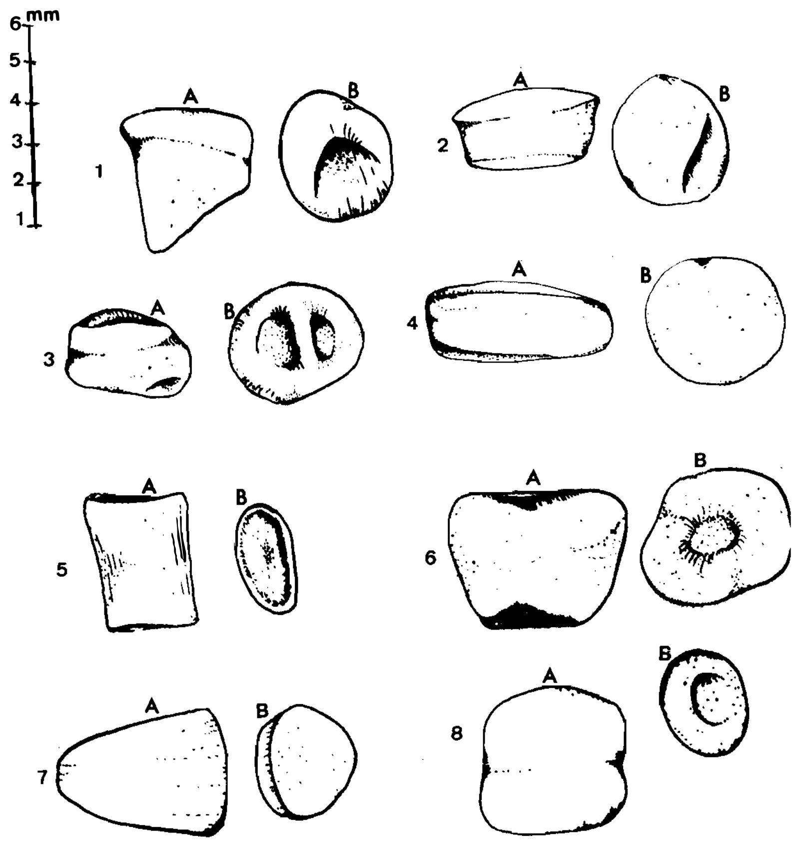


Fig.6. Drawings of 8 different "plastic barrels" found in fulmar stomachs from Hornsund autumn 1984. A-side view, B-top view.

A total of 15 "plastic barrels" were found in the 6 fulmar stomachs. The shape of barrel 2 and 5 in fig.6 was most common.

Three of the 20 eiders (Somatera mollissima) collected had empty stomachs. The mean wet weight of the other 17 eiders was 19.2 ± S.D. 9.3 g. Results of the stomach content analysis is presented in table 10.

Table 10. Stomach content analysis of Somateria mollissima caught in Hornsund autumn 1984.

BIRD NO.	Bryozoa	Crustacea n.det.	Gammarus sp.	Themisto sp.	Gammarellus homari	Gammarus setosus	Gammarus oceanicus	Anonyx sarsi	Onissimus littoralis	Paroedicerus lynceus	Brachyura sp.	Hyas sp.	Hyas araneus	Mysis oculata	Gastropoda sp.	Buccinum sp.	Margarites groenlandicus	Bivalvia sp.	Polychaeta sp.	Boreogadus saida
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
18	X	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-
28	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
29	1	-	-	1	1	1	1	46	-	1	-	-	-	-	-	-	-	-	X	-
40	-	-	-	-	5	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
41	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
42	-	-	-	-	2	-	-	-	-	-	X	-	-	-	-	15	-	-	-	-
70	-	X	-	-	29	1	-	-	-	-	-	-	-	-	-	-	2	X	X	-
71	-	-	-	-	-	-	-	2	-	-	-	-	-	-	3	-	-	-	X	-
72	-	-	1	-	-	-	-	1	4	-	-	-	-	500	-	-	-	-	-	-
73	X	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
74	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	X	-	-
92	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
93	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
94	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
95	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1
121	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	X	-
TOTAL NO. OF ITEMS	1	-	1	1	74	2	1	49	4	1	-	1	1	500	3	20	4	-	-	1
FREQUENCY (%)	0.2	-	0.2	0.2	11.2	0.3	0.2	7.4	0.6	0.2	-	0.2	0.2	75.3	0.5	3.0	0.6	-	-	0.2
NO.OF BIRDS WITH TAXON PRESENT	3	2	1	1	8	2	1	4	1	1	3	1	1	1	2	2	2	6	4	1
OCCURRENCE (%)	17.6	11.8	5.9	5.9	47.1	11.8	5.9	23.5	5.9	5.9	17.6	5.9	5.9	5.9	11.8	11.8	11.8	35.3	23.5	5.9

The amphipod G.homari and remains of bivalves were the commonmost prey.Bryozoa in table 10 were found in connection with algae remains in 9 stomachs.

Four of the 18 glaucous gulls (Larus hyperboreus) had empty stomachs.The mean wet weight of the glaucous gulls with stomach content was 12.9 $\pm$ S.D.17.2 g.The results of the stomach content analysis is presented in table 11 on page 20. The table shows that glaucous gulls have a varied menue,ranking from algae and tundra plants to several phyla of the marine ecosystem and birds.Remains of birds;feathers and bones were found in half of the stomachs investegated.One glaucous gull vomited a complete fulmar head when it was shot.The reason

Table 11. Stomach content analysis of glaucous gulls caught in Hornsund autumn 1984.

BIRD NO.	Algae fragm.n.det.	Tundra plant fragm.n.det.	Bryozoa n.det.	Gastropoda eggs n.det.	Buccinum sp.eggs	Margarites groenlandicus	Pteropoda n.det.	Amphipoda fragm.n.det.	Oedicerotidae n.det.	Onisimus littoralis	Monoculodes borealis	Brachiura fragm.n.det.	Mysis oculata	Polychaeta fragm.n.det.	Bivalvia fragm.n.det.	Echinodermata fragm.n.det.	Tunicata fragm.n.det.	Boreogadhus saida	Liparis liparis	Aves rests
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
45	X	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
69	-	-	-	-	-	-	X	-	-	-	-	1	-	-	-	-	-	-	-	-
119	-	X	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
120	-	-	-	-	-	-	-	-	1	90	1	-	-	1	-	-	-	2	-	X
123	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
128	-	X	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	1	X
129	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
130	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
141	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	X
143	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
144	X	-	-	-	-	3	-	-	-	-	-	X	-	-	X	-	-	1	-	X
TOTAL NO. OF ITEMS	-	-	-	-	-	3	-	-	1	90	1	2	1	1	-	-	3	3	1	-
FREQUENCY (%)	-	-	-	-	-	2.8	-	-	0.9	84.9	0.9	1.9	0.9	0.9	-	-	2.8	2.8	0.9	-
NO.OF BIRDS WITH TAXON PRESENT	5	4	2	1	1	1	1	1	1	1	1	3	1	1	1	2	2	2	1	7
OCCURRENCE (%)	35.7	28.6	14.3	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	21.4	7.1	7.1	7.1	14.3	14.3	14.3	7.1	50.0

that the quota of glaucous gulls was not filled,was not due to lack of gulls in the area.Birds were to be shot throughout the fieldperiod.At the end of the fieldperiod seal carcasses lay several places in the fiord and glaucous gulls consentrated around these.Fortyfive glaucous gulls were observed next to one seal carcass.It was therefor decided not to collect gulls in vacinity of sealcarcasses because they might bias the representativity of the stomach content analysis.

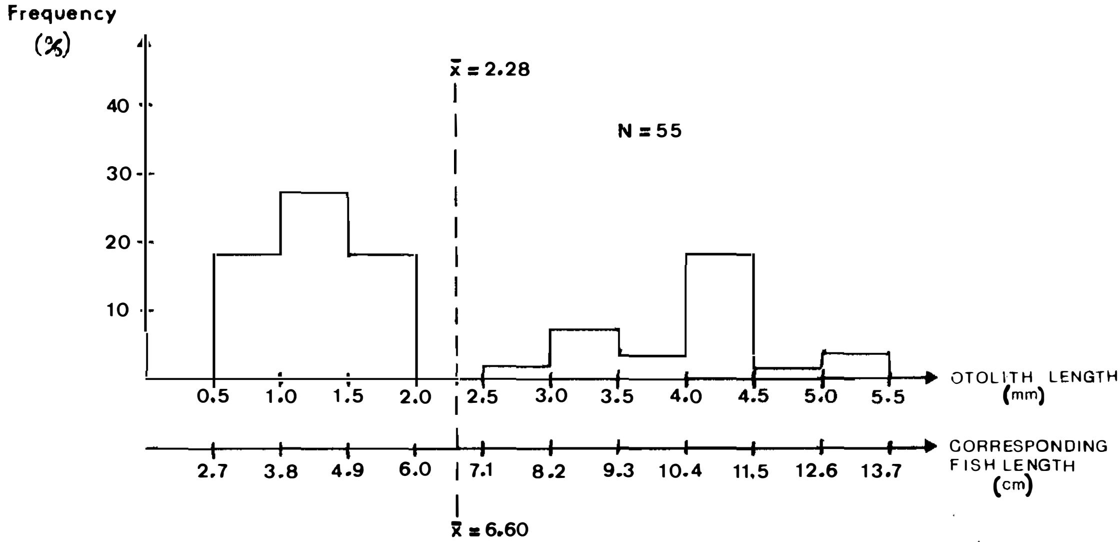
Two of the 20 kittiwakes (Rissa tridactyla) collected had empty stomachs. One of the birds with identifiable stomach content had its stomach shot to pieces which prevented the wet weight of the stomach content being measured. The mean wet weight of the remaining 17 birds was 2.4 ± S.D.2.6 g. The results of the stomach content analysis is presented in table 12.

Table 12. Stomach content analysis of kittiwakes collected in Hornsund autumn 1984.

BIRD NO.	Pteropoda n.det.	Amphipoda rests n.det.	Gammarus sp.	Themisto libellula	Gammarellus homari	Nereis irrorata (jaws)	Pisces rests n.det.	Boreogadhus saida	Liparis liparis	Pollachius virens
21	-	-	-	-	-	-	X	1	-	-
37	-	-	-	19	-	12	-	-	-	-
39	-	-	-	-	-	10	-	-	-	-
57	X	-	-	-	-	-	-	-	-	-
58	X	-	-	-	-	-	-	-	-	-
64	-	-	-	X	-	-	-	-	-	-
67	X	-	-	-	-	-	-	-	-	-
68	X	-	-	-	-	-	-	-	-	-
98	-	-	1	-	-	1	-	3	1	-
99	-	-	-	-	-	1	-	1	-	-
106	-	-	-	3	-	-	-	5	-	-
107	-	X	-	4	1	-	-	2	-	-
108	-	-	-	5	-	-	-	13	-	1
109	-	-	-	-	-	-	-	4	-	-
110	-	X	-	-	-	-	-	2	-	-
111	-	-	-	-	-	-	X	-	-	-
112	-	-	-	-	-	-	X	1	-	-
113	-	-	-	-	-	2	X	-	-	-
TOTAL NO. OF ITEMS	-	-	1	31	1	26	-	32	1	1
FREQUENCY (%)	-	-	1.1	33.3	1.1	28.0	-	34.4	1.1	1.1
NO. OF BIRDS WITH TAXON PRESENT	4	2	1	5	1	5	4	9	1	1
OCCURRENCE (%)	22.2	11.1	5.6	27.8	5.6	27.8	22.2	50.0	5.6	5.6

The table shows that arctic cod and Themisto libellula were the two dominating prey species, closely followed by N. irrorata and pteropods. In one kittiwake stomach pieces of plastic were found. Figure 7 shows the frequency distribution of polar cod otoliths and corresponding fork length found in kittiwakes.

Fig.7.Frequency distibution of lengths of arctic cod otoliths and corresponding fork lengths of arctic cod found in kittiwakes collected in Hornsund autunm 1984.



The figure shows that kittiwakes predate arctic cod with otoliths of mean length 2.28 ± S.D.1.48 mm.This correspond to a mean fish length of 6.60 cm.

All black guillemots (Cepphus grylle) collected contained identifiable stomach content.The mean wet weight of the stomach content was 5.0 ± S.D.4.0 g.The results of the stomach content analysis is presented in table 13 (page 23).The table shows that black guillemots have a varied diet consisting of benthic and planktonic prey species.Arctic cod and T.libellula were were the most commom food items found in 60% and 55% respectively of the black guillemots.Mysis oculata was also a significant prey.Figure 8 (page23) shows the frequency distribution of arctic cod otoliths and corresponding fork length found in black guillemots.The figure shows that black guillemots predate arctic cod with otoliths of mean length 1.42 ± S.D.1.50 mm.This correspond to a mean fish length of 4.70 cm.

Table 13.Stomach content analysis of black guillemots caught in Hornsund autumn 1984.

BIRD NO.	Brachyura frag. n.det	Calanus sp.	Amphipoda rests n.det.	Ampeliscidae n.det	Themisto libellula	Gammarus wilkitzki	Gammarus oceanicus	Gammarellus homari	Melita formosa	Hyperia galba	Paroediceros lynceus	Harpactoides sp.	Thyssanoessa inermis	Mysis oculata	Decapoda n.det.	Gastropoda rests n.det.	Polychaeta rests n.det.	Bivalvia rests n.det	Nereis irrorata	Gonatus fabrici	Margarites groenlandicus	Pisces rests n.det.	Boreogadus saida	Liparis liparis	Lumpenus lampretiformis	Pollachius virens	Myxocephalus scorpius
1	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	8	-	-	-	-
3	-	-	-	-	21	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-
12	-	-	-	-	3	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
13	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	1	-	-	-	-
20	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	X	X	-	-	1	2	X	-	-	-	-	-
23	-	-	-	-	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
26	-	-	-	-	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
30	-	-	-	1	-	-	-	1	-	-	-	-	-	18	-	-	-	-	-	-	-	-	1	-	-	-	-
35	-	-	-	-	-	-	-	1	-	-	-	-	-	8	-	-	-	-	-	-	2	-	-	-	-	-	-
43	1	-	-	-	1	-	-	1	-	-	-	-	-	32	-	-	-	-	-	-	1	X	-	-	-	-	-
61	-	1	X	-	-	-	-	-	-	-	-	1	-	1	-	X	-	-	-	-	-	-	5	-	-	-	-
66	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-	-	-
97	-	-	-	-	9	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	-	-
117	-	-	-	-	4	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	1	-
122	-	-	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	9	1	-
124	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-
125	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	X	-	-	-	X	2	-	-	-	-
126	-	-	-	-	-	-	1	-	-	-	-	-	-	1	X	-	-	-	-	-	1	X	-	-	X	-	-
127	-	-	-	-	X	X	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-	X	-	-	-		1
TOTAL NO. OF ITEMS	1	1	-	1	96	3	1	6	1	1	-	1	1	61	1	-	-	-	1	1	7	-	36	1	9	2	1
FREQUENCY (%)	0.4	0.4	-	0.4	41.2	1.3	0.4	2.6	0.4	0.4	-	0.4	0.4	26.8	0.4	-	-	-	0.4	0.4	3.0	-	15.5	0.4	3.9	0.9	0.9
NO.OF BIRDS WITH TAXON PRESENT	1	1	1	1	11	3	1	7	1	1	1	1	1	7	2	2	1	3	1	1	5	8	12	1	2	2	1
OCCURRENCE (%)	5.0	5.0	5.0	5.0	55.0	15.0	5.0	35.0	5.0	5.0	5.0	5.0	5.0	35.0	10.0	10.0	5.0	15.0	5.0	5.0	25.0	40.0	60.0	5.0	10.0	10.0	5.0

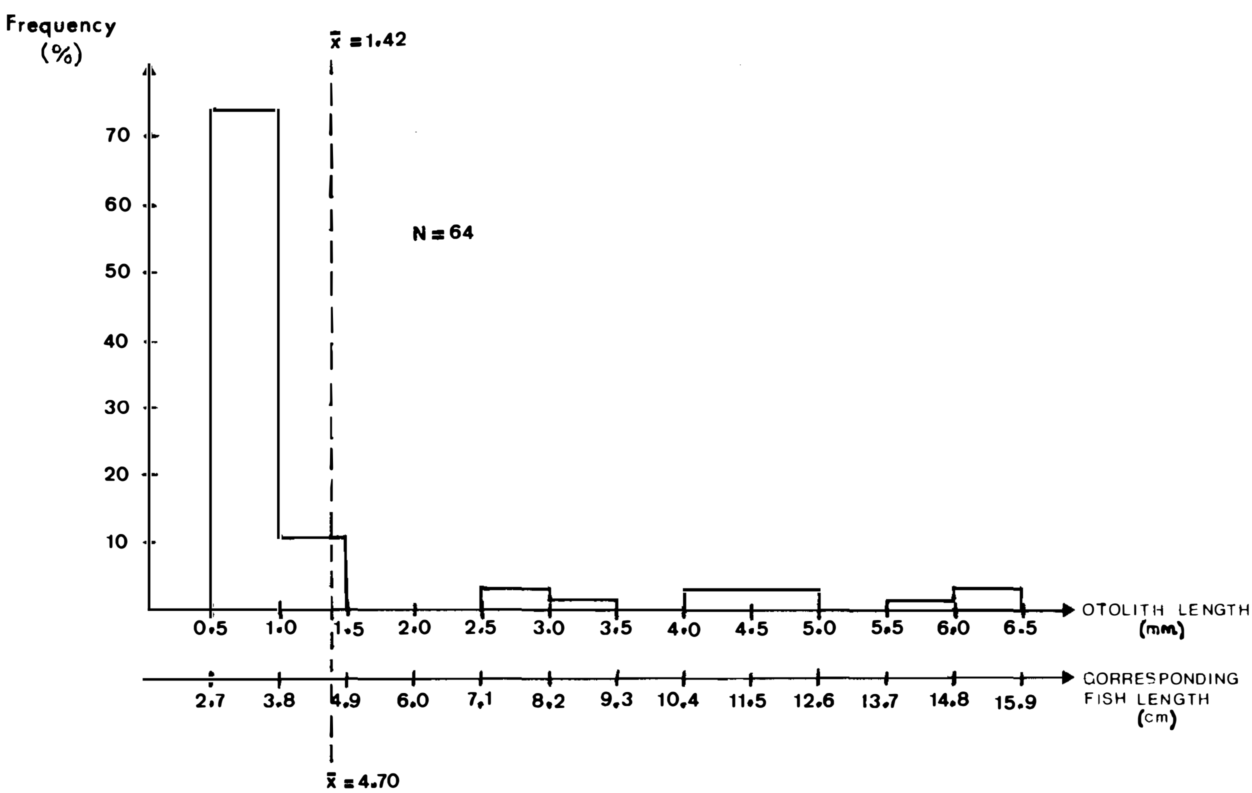


Fig.8.Frequency distribution of lengths of arctic cod otoliths and corresponding fork lengths of arctic cod found in black guillemots from Hornsund autumn 1984.

Two of the 21 Brunnich's guillemots (Uria lomvia) caught had empty stomachs. The mean wet weight of the stomach content of the 19 other birds was 3.3 ± S.D.3.7 g. In 5 cases plastic items were found in Brunnich's guillemot stomachs. Five of the stomachs contained "plastic barrels" (See fulmars page18). The results of the stomach content analysis are presented in table 14.

Table 14. Stomach content analysis of Brunnich's guillemots collected in Hornsund autumn 1984.

BIRD NO.	Nereis irrorata	Amphipoda rests n.det.	Themisto sp.	Themisto libellula	Gammarus sp.	Gammarellus homari	Anonyx sp.	Thyssanoessa inermis	Decapoda rests n.det	Margarites groenlandicus	Gonatus fabricii	Pisces rests n.det.	Lycotidae	Boreogadus saida	Pollachius wirense	Liparis liparis	Lumpenus sp.
4	-	-	-	2	-	-	-	14	-	-	-	-	-	5	2	-	-
36	-	-	-	2	-	-	-	-	-	-	-	-	-	9	2	-	-
52	-	-	-	-	-	-	-	-	X	X	-	-	4	-	-	-	-
53	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
75	-	X	-	-	-	1	-	-	-	-	-	-	-	-	2	-	1
76	-	-	-	-	-	-	-	-	-	1	-	X	-	-	-	-	-
77	-	-	-	28	-	-	-	-	-	-	-	X	-	-	-	-	-
78	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-
80	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
82	-	-	-	-	-	-	-	-	-	-	-	X	-	1	-	-	-
83	-	-	3	-	1	-	-	-	-	-	-	-	-	2	-	-	-
84	-	-	-	1	-	-	-	-	-	-	-	-	-	5	-	-	-
85	1	-	-	-	-	1	-	-	-	-	-	-	-	14	-	-	-
86	-	-	-	-	-	-	-	-	-	-	-	-	1	4	-	-	-
87	-	-	1	-	-	-	-	-	-	-	-	-	-	10	-	7	-
88	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-
89	-	-	-	-	1	-	-	-	-	-	1	-	-	2	-	-	-
90	-	-	-	-	-	-	-	-	-	-	-	-	-	27	-	4	-
91	-	-	1	-	-	-	1	-	-	-	-	-	-	2	1	-	-
TOTAL NO. OF ITEMS	1	-	5	33	2	2	1	14	-	1	1	-	5	87	9	11	1
FREQUENCY (%)	0.6	-	2.9	19.1	1.2	1.2	0.6	8.1	-	0.6	0.6	-	2.9	50.3	5.2	6.4	0.6
NO.OF BIRDS WITH TAXON PRESENT	1	1	5	5	2	2	1	1	1	2	1	3	2	14	5	2	1
OCCURRENCE (%)	5.3	5.3	26.3	26.3	10.5	10.5	5.3	5.3	5.3	10.5	5.3	15.8	10.5	73.7	26.3	10.5	5.3

The table shows that arctic cod are the most common prey, followed by T.libellula and coalfish (Polachius virens).

Figure 9 shows the frequency distribution of arctic cod otoliths and corresponding fork length found in Brunnich's guillemots.

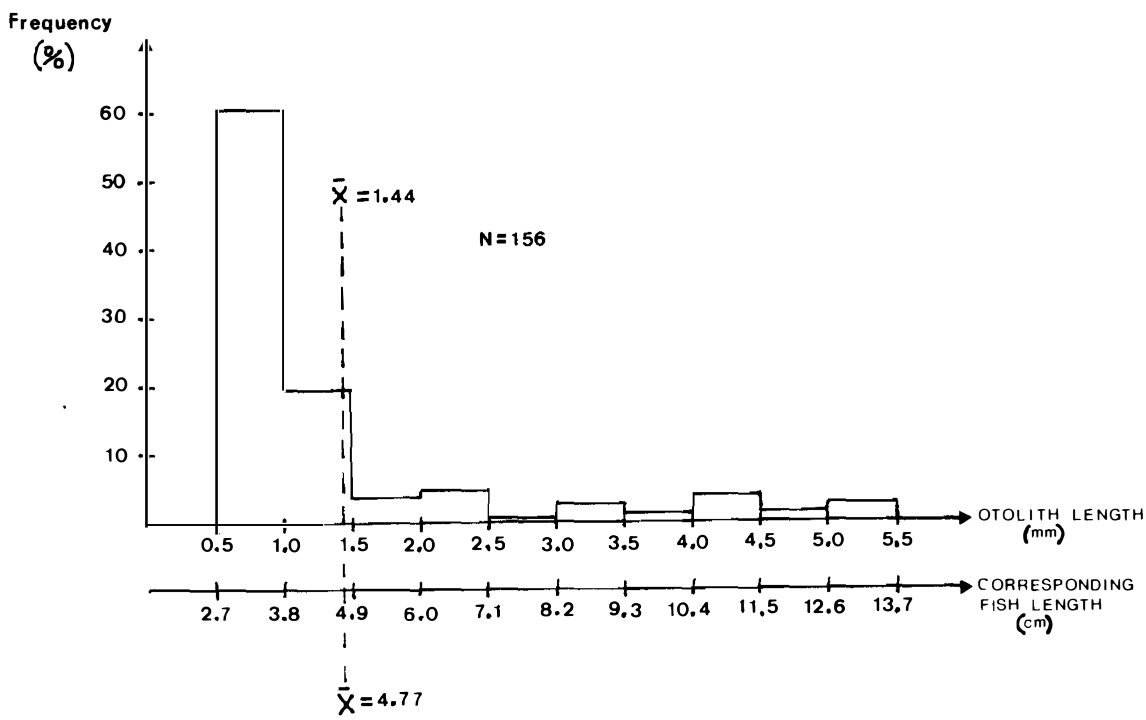


Fig.9.Frequency distribution of lengths of arctic cod otoliths and corresponding fork lengths of arctic cod found in Brunnich's guillemots caught in Hornsund autumn 1984.

The figure shows that Brunnich's guillemots predate arctic cod with otoliths of mean length 1.44 ± S.D.1.13 mm.This correspond to a mean fish length of 4.77 cm.

Fourteen puffins (Fratercula arctica) were collected.One had empty stomach.The mean wet weight of the stomach content of the 13 other puffins was 1.2 ± S.D.0.9 g.The results of the stomach content analysis is presented in table 15 (page26). The table shows that puffins mainly predate on fish,especially arctic cod which was found in all 13 puffins.T.libellula and Calanus sp. were the only invertebrates occurring in more than

Table 15.Stomach content analysis of puffins collected in Hornsund autumn 1984.

BIRD NO.	Gammarus sp.	Gammarus wilkitzkii	Themisto libellula	Onisimus littoralis	Calanus sp.	Gonatus fabricii	Pisces n.det.	Boreogadhus saida	Liparis liparis	Pollachius virens	Clupea harengus
7	-	-	2	-	6	-	X	8	-	-	-
8	-	-	-	-	-	-	X	11	-	-	-
10	-	-	-	-	-	-	-	14	4	-	-
11	-	-	-	-	3	-	-	19	-	-	-
14	1	-	-	-	-	-	X	9	-	-	-
38	-	-	-	-	-	-	-	X	-	-	-
47	-	-	-	-	-	-	X	6	-	-	-
49	-	-	-	-	-	-	X	1	-	-	-
50	-	-	-	-	-	1	X	2	-	1	-
51	-	-	-	-	-	-	X	X	-	-	-
54	-	1	4	1	-	-	-	1	-	-	-
60	-	-	-	-	-	-	-	1	-	-	6
62	-	-	-	-	-	-	-	31	-	-	-
TOTAL NO. OF ITEMS	1	1	6	1	9	1	-	103	4	1	6
FREQUENCY (%)	0.8	0.8	4.5	0.8	8.8	0.8	-	77.4	3.0	0.8	4.5
NO.OF BIRDS WITH TAXON PRESENT	1	1	2	1	2	1	7	13	1	1	1
OCCURRENCE (%)	7.7	7.7	15.4	7.7	15.4	7.7	53.8	100.0	7.7	7.7	7.7

one stomach.Puffin no.60 is noted as having 6 herrings (Clupea harengus) in its stomach.The bird had 5 of these in its bill when it was shot.Figure 10 shows the frequency distribution of arctic cod otoliths and corresponding fork length from puffins.

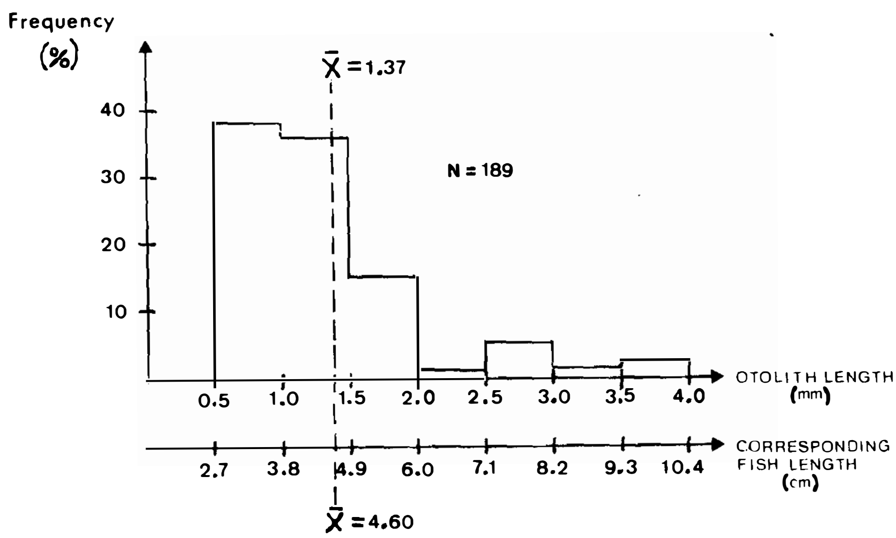


Fig.10.Frequency distribution of length of arctic cod otoliths and corresponding fork lengths of arctic cod found in puffins caught in Hornsund autumn 1984.

The figure shows that puffins predate on arctic cod with otoliths of mean length 1.37 $\pm$ S.D.1.09 mm.This correspond to a mean fish length of 4.60 cm.Only 14 puffins out of a quota of 20 were collected.This is,as menthioned in material and methods,due to a wish to collect birds throughout the field period,but the puffins left Hornsund earlier than expected.

All 11 little auks (Alle alle) collected had identifiable stomach content.The mean wet weight of the stomach contents was 1.2 $\pm$ S.D.0.9 g.The results of the stomach content analysis is presented in table 16.

Table 16.Stomach content analysis of little auks collected in Hornsund autumn 1984.

BIRD NO.	Gammarus sp.	Hyperidae n.det.	Gammarus wilkitzkii	Themisto libellula	Helicina sp.	Pisces rests n.det	Boreogadhus saida	Liparis liparis
131	-	-	-	1	1	-	15	1
132	-	-	-	4	-	-	-	-
133	-	-	-	2	-	-	1	-
134	1	-	-	4	1	-	-	-
135	1	-	-	3	-	-	1	-
136	-	-	1	-	-	1	10	-
137	2	-	-	-	-	1	8	2
138	-	X	-	-	-	1	4	1
139	-	-	-	1	1	-	8	1
140	-	-	-	3	-	-	1	-
142	1	-	1	-	-	X	3	1
TOTAL NO. OF ITEMS	5	-	2	18	3	3	51	6
FREQUENCY (%)	5.7	-	2.3	20.4	3.4	3.4	58.0	6.8
NO.OF BIRDS WITH TAXON PRESENT	4	1	2	7	3	4	9	5
OCCURRENCE (%)	36.4	9.1	18.2	63.6	27.3	36.8	81.8	45.5

The table shows that arctic cod and T.libellula are the most important prey species,but also typical benthic fish like striped seasnail are common prey of little auks.In 5 cases plastic debris were found in the stomachs.Littles auks were not present in Hornsund when the field work commenced.On September 29th and 30th they suddenly appeared in the fiord and 11 were collected.Figure 11 shows the frequency distibution of arctic cod otoliths and corresponding fork length found in little auks.

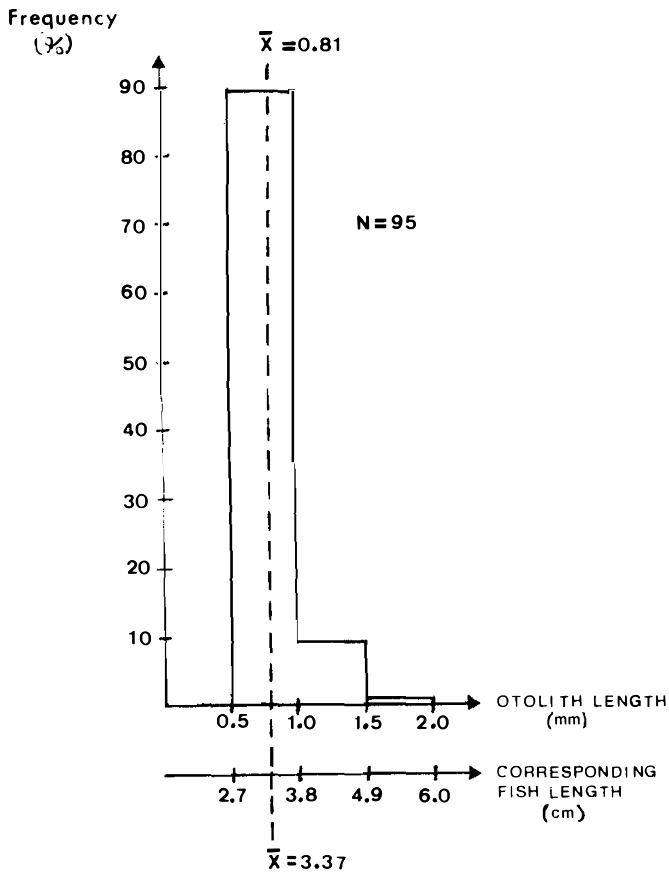


Fig.11.Frequency distibution of length of arctic cod otoliths and corresponding fork lengths of arctic cod found in little auks caught in Hornsund autumn 1984.

The figure shows that little auks predate arctic cod with otoliths of mean length o.81 ± S.D.0.20 mm.This correspond to a mean fish length of 3.37 cm.

Mammalia.

For datas on the two seal species collected in Hornsund; see table XI and XII page 57. Other marine mammals observed during the field work were harp seals (Phoca groenlandica), killer whales (Orcinus orca) and belugas (Delphinapterus leucas).

A total of 5 ringed seals (Phoca hispida) were collected, all with identifiable stomach content. The mean wet weight of the stomach contents was 117.8 ± S.D. 60.0 g. Table 17 presents the results from the stomach content analysis.

Table 17. Stomach content analysis of ringed seals collected in Hornsund autumn 1984.

SEAL NO.	Themisto libellula	Gammarellus homari	Gammarus wilkitzkii	Mysis oculata	Euphausiacea fragm.	Decapoda n.det.	Decapoda larvae	Sclerocragnon sp.	Sabinea septemcarcinata	Eualis gaimairdi	Polychaeta n.det.	Bivalvia juv.	Pollachius wirense	Lumpenus lampretiformis	Boreogadhus saida	Liparis liparis	Gonatus fabricii
1	5	-	-	3	1	5	-	-	-	-	-	-	-	3	9	-	-
2	-	5	-	-	-	-	-	-	-	-	-	-	7	-	3	-	-
3	54	3	4	52	-	-	1	-	3	19	X	4	-	1	240	10	7
4	2	-	-	2	-	-	1	2	-	4	-	-	4	-	5	-	-
5	2	-	-	2	-	-	-	-	-	-	-	-	-	-	31	-	-
TOTAL NO. OF ITEMS	63	8	4	59	1	5	2	3	3	23	-	4	11	4	288	10	7
FREQUENCY (%)	12.7	1.6	0.8	11.9	0.2	1.0	0.4	0.6	0.6	4.6	-	0.8	2.2	0.8	58.2	2.0	1.4
NO. OF SEALS WITH TAXON PRESENT	4	2	1	4	1	1	2	2	1	2	1	1	2	2	5	1	1
OCCURRENCE (%)	80	40	20	80	20	20	40	40	20	40	20	20	40	40	100	20	20

The table shows that arctic cod is the most common prey of ringed seals, followed by T. libellula and M. oculata.

Figure 12 shows the frequency distribution of arctic cod otoliths and corresponding fish length found in ringed seals.

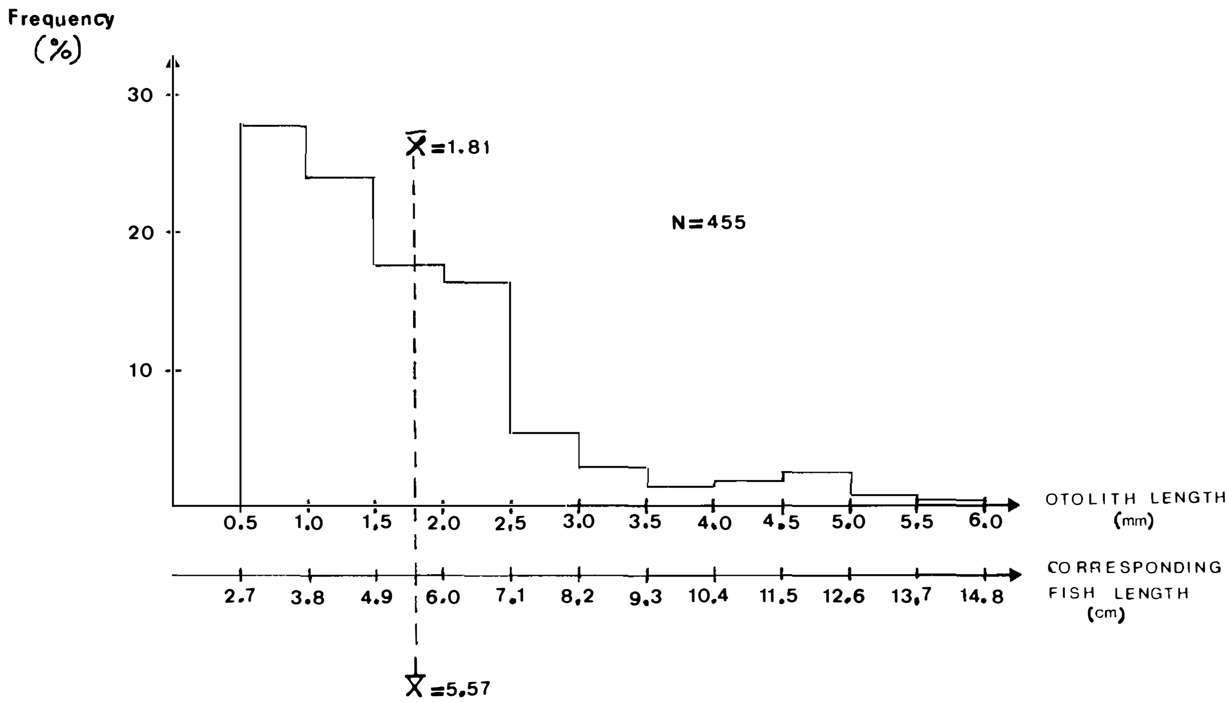


Fig.12.Frequency distibution of length of arctic cod otoliths and corresponding fork lengths of arctic cod found in ringed seals caught in Hornsund autumn 1984.

The figure shows that ringed seals predate arctic cod with otoliths of mean length 1.81 ± S.D.1.41 mm,which correspond to a mean fork length of 5.57 cm.

Material was collected from 2 bearded seals (Erignathus barbatus).One contained nematodes and cestodes,but no identfiable prey species in its stomach.The stomach content of the other bearded seal had a wet weight of 585 g.The following species were found:G.homari,Sclerocragnon boreas,S.ferox and Hyas sp. & Pagurus sp..208 g. of the wet weight were composed by Decapoda n.det..A total of 251 operculi from Buccinum sp. were found in the seal stomach,together with 8 otoliths from coalfish.

Predation in relation to abundance of food,with special reference to birds as predators.

Special reference to birds was chosen because this was the group with the best data-set.It seems evident that only little of the planktonbiomass can bee considered as food for birds. The most abundant makroplanktonic species as Parasagitta elegans arctica,Frittilaria borealis and Aglantha digitale were not found in any of the bird stomachs investegated.C. finmarchicus was found in all stations but was rarely found in bird stomachs.

Hyperidae amphipods were important as prey.T.libellula was the most common.T.abyssorum was found in relatively large numbers in plankton samples from outer Hornsund,but were rarely found in bird/seal-stomachs.Figure 13 shows the frequency distribution of lengths of T.libellula caught in plankton net compared with T.libellula found in bird stomachs.

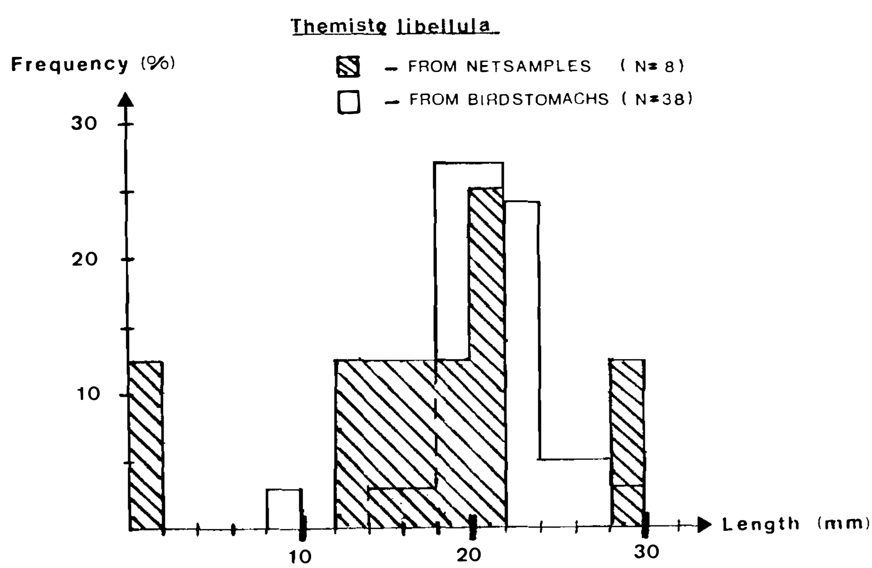


Fig.13.Length frequency distribution of T.libellula caught in plankton net compared with T.libellula found in bird stomachs in Hornsund autumn 1984.

T.libellula found in bird stomachs had a mean length of 20.4 mm while the mean length of those caught in plankton nets was 17.6 mm. Birds obviously prey on large specimens which according to fig.13 are somewhat larger than the average size of those caught in plankton nets.

Distribution and abundance in the Hornsund area of fish, squid and polychaets which were common in bird stomachs, are not known. However, arctic cod is obviously common in the area since 50% of all birdstomachs with identifiable content contained remains of this species. Craig et.al.(1982) claim that arctic cod of agegroup 1 have a mean length of 84 ± 13 mm (range 54-110 mm). According to recalculated mean lengths of arctic cod found predated in this study, it would seem that they mostly belong to agegroup 1.

The most commom benthic species found in stomach of birds (and also seals and fish), were A.sarsi and G.homari. They were presented in 27% of all investegated stomachs with content. A comparison between individuals of these two species found in bird stomachs and caught in grab samples is shown in figures 14 and 15.

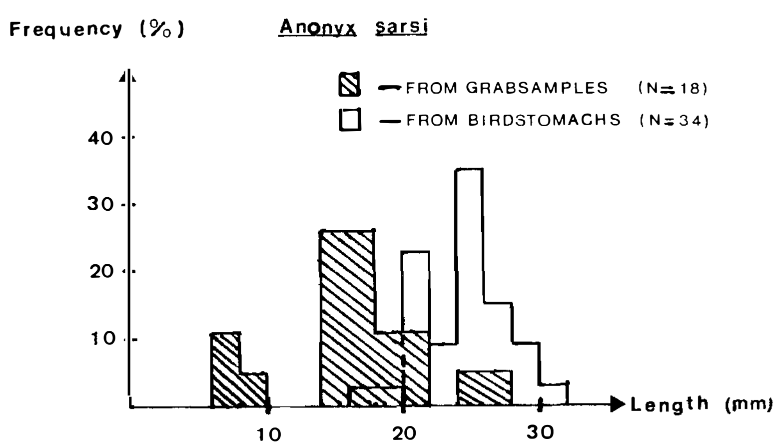


Fig.14. Length frequency distribution of A.sarsi caught in Peterson grab compared with A.sarsi found in bird stomachs in Hornsund autumn 1984.

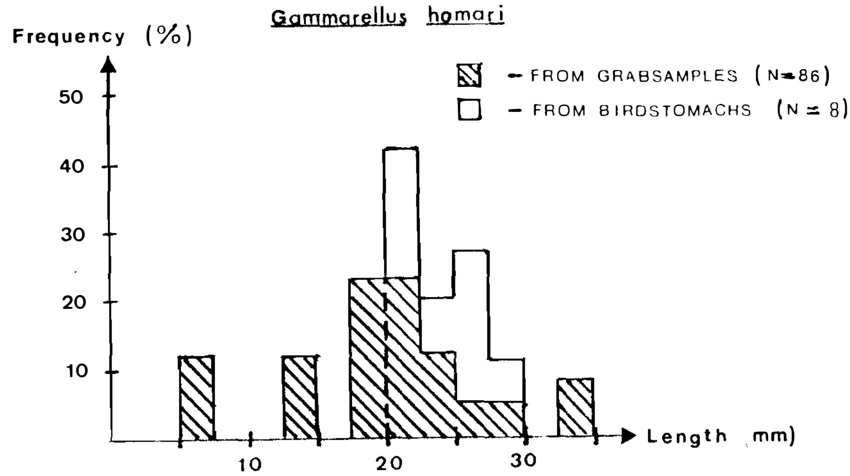


Fig.15.Length frequency distribution of G.homari caught in Peterson grab compared with G.homari found in bird stomachs in Hornsund autumn 1984.

Figures 14 and 15 both shows that the birds choose the largest specimens of the preypopulations.

Most benthic prey species occur in the phytal sone ;down to 20 m.37% of the benthic preyspecies live in the laminarian belt on hard bottom substratum.These include G.homari,A.sarsi, Ischyrocerus sp.,Margarites groelandicus,most harpacticoidea and many decapods.All benthic species found as prey species were also found in trawl or sampler material in Hornsund.The most important benthic prey species were those found to be the most common inhabitants of the fiord.Most belong to the widely dispersed boreo-arctic fauna with high tolerance to changes in salinity and low temperatures.

Links between predators and prey.

A food-web was constructed to visualize the connections between predators and their most common prey species.This web is shown in figure 16 on page 34.Arrows lead from one predator to all its registered prey species.Such a figure becomes

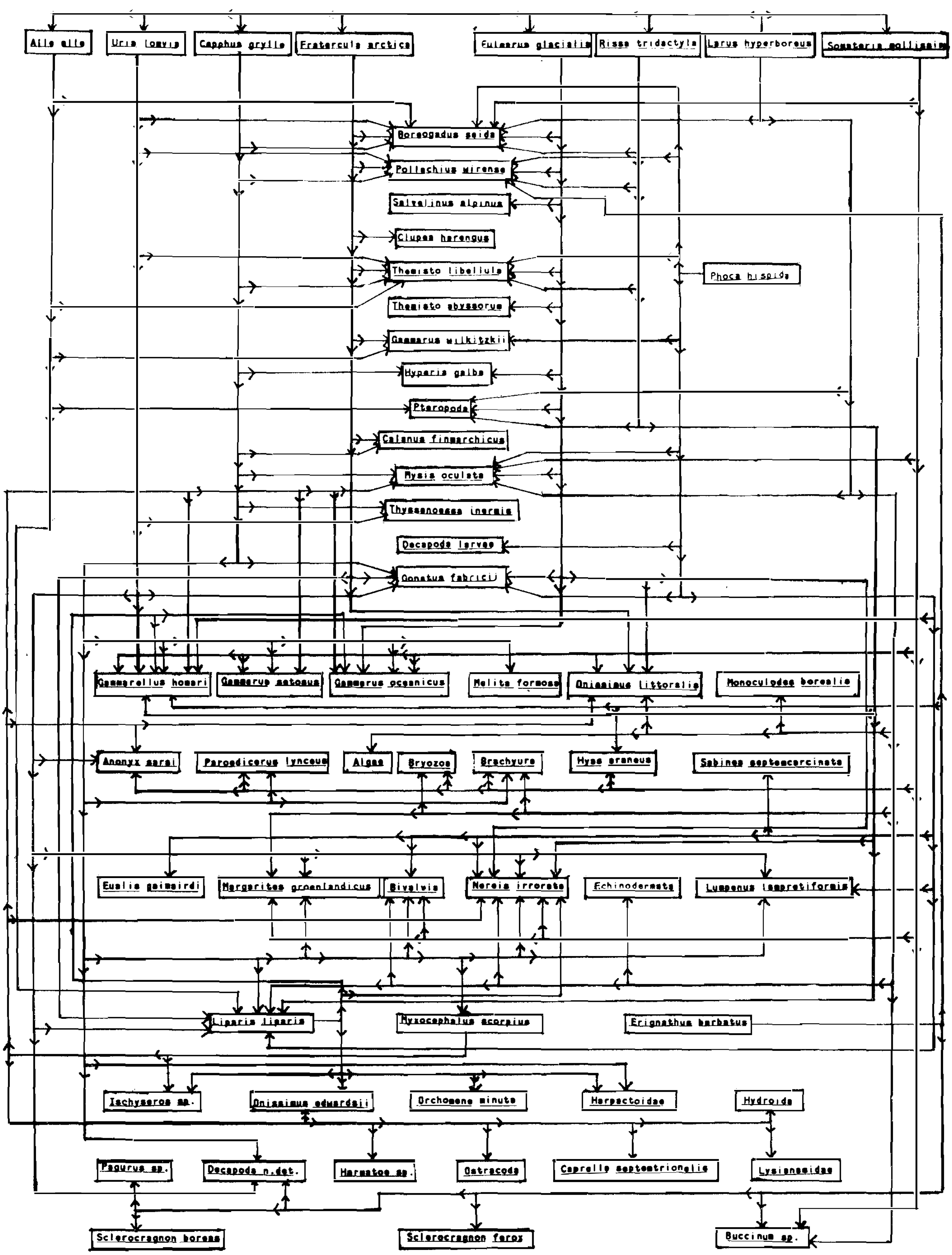


Fig.16.Food web created on basis of stomach analysis of predators collected in Hornsund autumn 1984.

rather unclear when the web is not created according to the different prey species' significance.Figure 17 shows the same food web including only the two most dominating prey species for each predator.

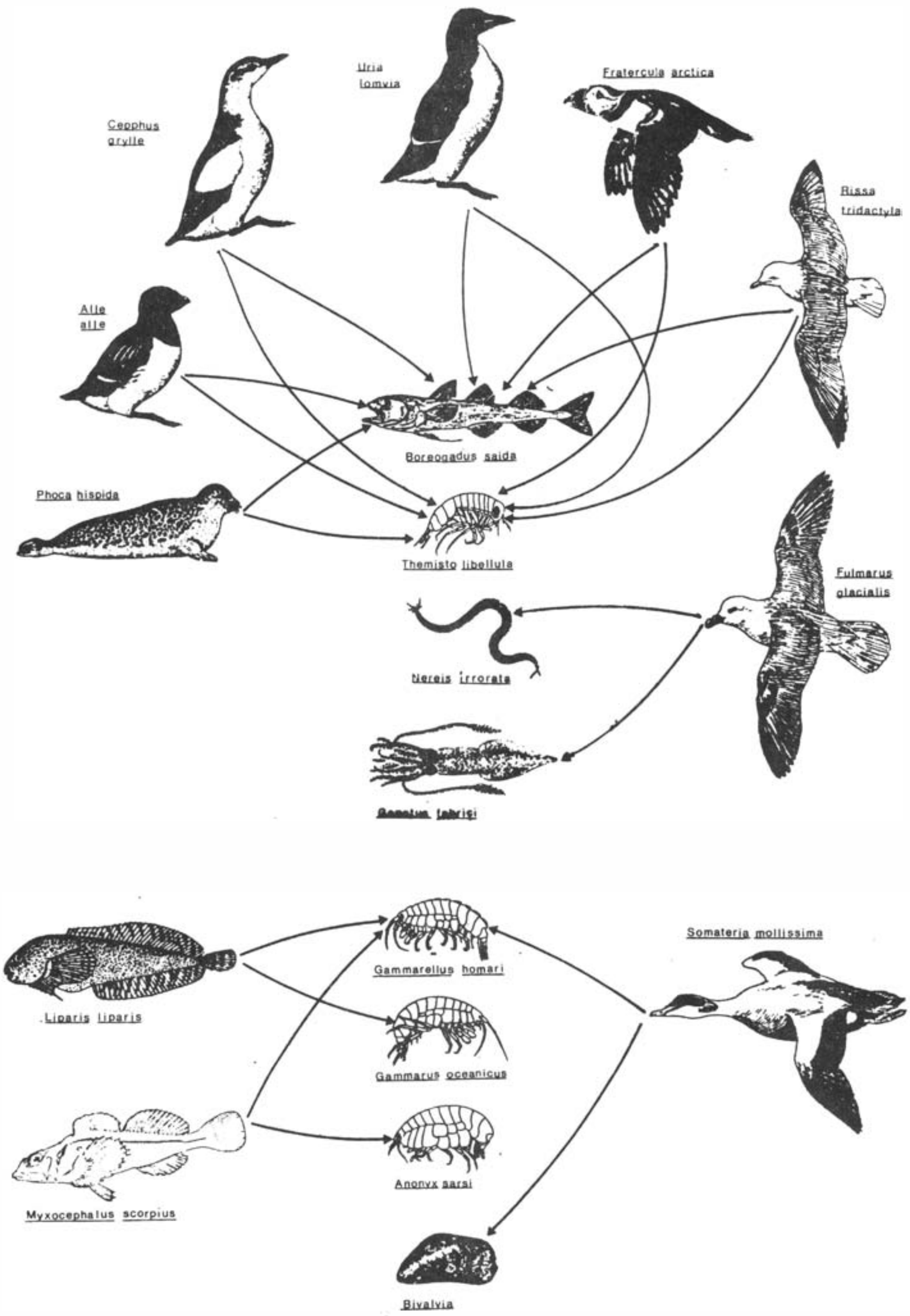


Fig.17.Food web created on the basis of stomach content analysis of predators collected in Hornsund autumn 1984.Only the two most important prey species of each predator are included.

Glaucous gulls are not included in figure 17,because this species didn't show any preferance in choice of prey.Bearded seals are also excluded because of the small sample size of stomachs from this species.

It would seem from figure 17 as if there are two basic food chains;one pelagic and one benthic.In the pelagic food chain arctic cod and T.libellula comprize a large part of the food of ringed seals,little auks,black guillemots,Brunnich's guillemots,puffins and kittiwakes.Fulmars differ from other birds feeding pelagically in that their main prey consist of N.irrorata and G.fabrici.In the benthic chain benthic fish and eiders seem to be the main predators.They predate benthic amphipods and bivalves.

Attempting to determine to which degree the predators compete for prey a clusteranalysis was made.Here all 8 bird species and ringed seals are matched against 38 of the most common prey species.Results are shown in figure 18,page 37,and are based on frequencies of the different preys found in each of the 9 predator species.Figure 18 shows (as also indicated in fig. 17) that little auks,Brunnich's guillemots,ringed seals,black guillemots,puffins and kittiwakes feed on a relatively similar food base.Especially little auks,Brunnich's guillemots and ringed seals have a similar menue.Fulmars,eiders and glaucous gulls differ from these 6 other predator species and from each other concerning choice of food.

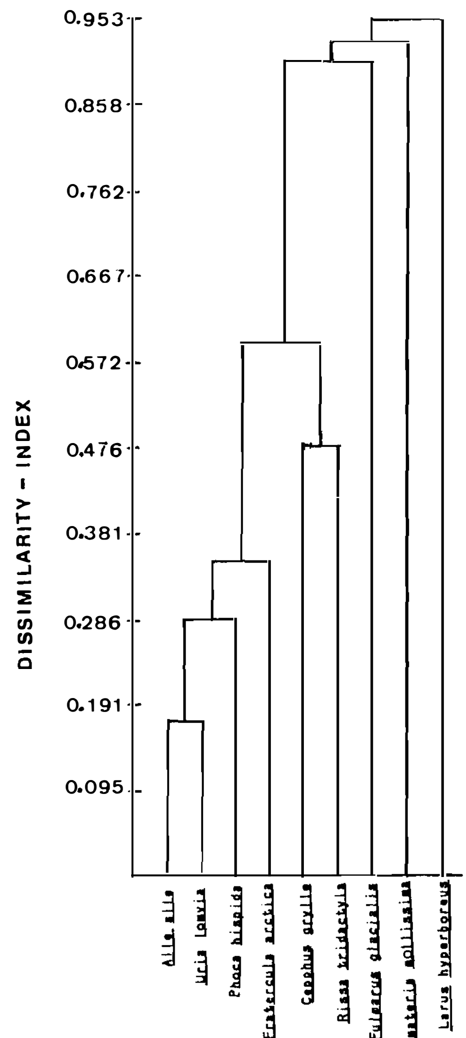


Fig.18.Clusteranalysis based on frequencies of preys from 9 different predator species caught in Hornsund autum 1984.

DISCUSSION

In this study only two species of fish were caught,shorthorn sculpins and striped snailfish.Little information is available on the feeding habits of these species from Svalbard. This study shows that the most important prey of these benthic fish were the benthic amphipods that dominated in the study area.Shorthorn sculpins and striped snailfish do not seem to be of significance as prey for higher vertebrates,even though remains of striped snailfish were found in stomachs of 6 of the 8 bird species in this study,and also in ringed seals. Remains of shorthorn sculpins were only found in black guillemots.

Fish species preyed upon by birds and seals,but not caught in this study were arctic cod,coalfish,arctic char (*Salvelinus alpinus*) , *Lumpenus lampretiformis* and herrings.Arctic cod were an especially dominating prey in this study and were predated by all higher vertebrates except bearded seals.If arctic cod are to be sampled for stomach content analysis equipment like pelagic trawls are needed.Such equipment was however not available for this study.

Before discussing the results of the bird and seal stomach analysis,light should be cast on some aspects in general. Sampling methods can often be questionable.Sampling was attempted spread throughout the field period.If a full quota of birds had been shot while they were foraging in the same planktonic aggregation,the results from the stomach content analysis would have been quite different from that presented in this report.Large flocks of fulmars,kittiwakes and glaucous gulls were observed foraging on pteropods.If a full quota had been collected on such an ocassion pteropods would have been the dominating prey for these three bird predators.In view of this,a sample of 20 birds of each species is inadequate for statistical evaluation on the importance of the different prey species,and therefore age and sex differences in the diets of the different predators were also disregarded.

The total wet weight of the stomach contents from the different predators were registered,while the fractions of the contents were only counted and not weighed.This is a weakness because in principle a C.finmarchicus will be given the same importance as for instance an arctic cod.In future the different fractions of the stomach contents should also be weighed.

Lengths of dominaing crustaceans found in bird stomachs were measured to find a length/frequency distibution.Crustaceans of one species from all bird stomachs were mixed before measurements.Therefore nothing is known of different bird species' selectivity in prey size.

Another difficulty is that the hard,indigestible parts of prey only slowly pass through the digestive tract and accumulate in stomachs with time.This is documented for otoliths found in ringed seal stomachs (Nazarenko 1967).It is likely that this also is true for otoliths,squid beaks and polychaet jaws found in bird stomachs.If this is correct it may lead to an overrepresentation of arctic cod,G.fabrici and N.irrorata in the bird stomach analysis.

Findings in fulmar stomachs from Hornsund correspond with those from previous studies from Svalbard (DeKorte 1972a, Mehlum & Gjertz 1984).Harley and Fisher (1936) also found many of the same species as those found in this study,but Thyssanoessa inermis totally dominated the content of the fulmar stomachs they investegated.Species such as P.elegans arctica and F.borealis have previously been found in fulmar stomachs (Hartley & Fisher 1936,Løvenskiold 1964),but were not found in this study eventhough they were among the most common species in the zooplankton in Hornsund.Species such as G.fabrici and N.irrorata however often occurred in fulmar (and other bird) stomachs from Hornsund.These two species were never caught in plankton nets or other sampling devices in the study area prior to or during this study (Zmijewska 1976,Skowron 1977,Weslawski & Kwasniewski 1983,Kwasniewski 1985).The origin of the unidenti-ed structures found in fulmar stomachs from Hornsund previously referred to as "plastic barells"(fig.6) is unknown;they may possibly be remains of squid.This guess is derived from the fact that those objects most often are found along with squid beaks.

Little work has previously been done on feeding of eiders in Svalbard.Just as Hartley and Fisher (1936) this study found that eiders mainly eat crustaceans and mollusks.Løvenskiold (1964) found that most of the moulting drakes mainly lived on holothurians in the area south of Hornsund.

Glaucous gulls have a varied diet.This because they act both as scavengers and common avian predators.This species also seem to forage on land plants.Fragments of land plants were found in glaucous gulls also by DeKorte (1972b) .

In this study kittiwakes were found mainly to eat arctic cod and T.libellula.This was also the case in the study done by Mehlum & Gjertz (1984).Hartley and Fisher (1936) found that T.inermis and T.libellula were the most common prey of kitti-wakes.N.irrorata were found in some kittiwake stomachs in this present study.The biology of this polychaet is not well known, but since this species often is found in stomachs of surface feeding bird,like kittiwakes and fulmars,at least parts of N.irrorata's life cyclus must be pelagic.Recalculating arctic cod fork lengths from otolithlengths shows that kittiwakes caught fish of mean length 6.6 cm (range 2.7-13.7 cm).Craig et. al.(1982) have in their study of arctic cod lengths vs. ages from the Beaufort Sea shown that agegroup 1 fish have a mean length of 84 mm (range 54-110 mm) and agegroup 2 a mean length of 128 mm (range 88-177 mm).If their data is used on arctic cod from Hornsund,kittiwakes mainly prey on arctic cod of agegroup 1,with some fish from agegroup 2.

Black guillemots were found to prey dominantly on T.libellula and arctic cod.Black guillemots were the predator in this study which preyed on the greatest number of different species. Hartley and Fisher (1936) found that the most common species preyed upon by black guillemots were T.inermis,M.oculata and T. libellula.DeKorte (1972c) found that 2 stomachs with content (out of 19) contained only Gammaridae.Mehlum and Gjertz (1984) found that arctic cod and Gammarus wilkitzki were the dominating prey of black guillemots.Recalculating arctic cod fork lengths from otolithlengths show that this bird mainly predates arctic cod of agegroup 1,but also some agegroup 2 fish.

Arctic cod and T.libellula were also the dominating prey species of Brunnich's guillemots.Hartley and Fisher (1936) found T.inermis to be the dominating prey also for this species. Besides Hartley and Fisher (1936) and this report,little has yet been published on feeding habits of Brunnich's guillemots from Svalbard.The so called "plastic barells" were found Brunnich's guillemots and so were beaks from G.fabrici,which again suggests that the "plastic barells" may come from this squid.Recalculating arctic cod fork lengths from otolithlengths from Brunnich's guillemots show that this bird mainly predates arctic cod of agegroup 1 but also some from agegroup 2.

All puffins with stomach content had preyed upon arctic cod. T.libellula and Calanus sp. were found to be the prey of second most significance.Hartley and Fisher (1936) found that puffins preyed upon T.inermis and fish (including arctic cod).Little other information on puffin feeding in Svalbard is published. Puffins were found to prey on arctic cod of agegroup 1.

T.libellula and arctic cod were also the dominating prey of little auks.L.liparis,a typical benthic fish,were found in 45.5% of the little auk stomachs.Fish have not been recorded as little auk prey in previous studies by Løvenskiold (1964), DeKorte (1972b),Norderhaug (1980) or Mehlum and Gjertz (1984), with the exception of Norderhaug who found 1 fish larvae. Løvenskiold (1964) and Norderhaug (1980) claim that Hartley and Fisher (1936) had registered arctic cod and Leptoclinus machulatus in little auk stomachs.The authors of this present report have read Hartley and Fisher's work and it is clearly stated concerning little auks that "no fish were found". Prey of importance for little auks found by the above mentioned authors are crustaceans notably C.finmarchicus but also T. libellula,M.oculata and T.inermis.The reason for the difference in results may be that this study was conducted at a time of the year when C.finmarchicus did not dominate in the plancton. Norderhaug (1980) studying little auks in the Hornsund area found that C.finmarchicus was the dominating prey.His study was conducted during the breeding period and it may be that C. finmarchicus was more common in the plankton at that time and/or that this prey is prefered as food for the chicks. Little auks were according to length of arctic cod otoliths found to predate arctic cod of agegroup 1

Pebbles were found in 41 of the bird stomachs.Some of these may have been swallowed accidentaly,however it is known that many bird species swallow stones to help them with their digestion.Remains of man made debris,such as nylon and plastic were found in 14 bird stomachs from Hornsund.This has been reported by Franeker (1983) as being common in marine birds, and Mehlum and Gjertz (1984) found such remains in 5 of 14 fulmar stomachs.In the present study such debris was found in stomachs from fulmars,kittiwakes,Brunnich's guillemots and little auks.The effect such debris has on the birds is not known.

Few ringed seals were observed during the field work.Most of those observed seemed small of size and were probably sub-adults.Of the 5 ringed seals shot,4 were in the agegroup 1-3 years.Hundreds of ringed seals are observed in Hornsund each spring.This suggests that Hornsund is a good area for ringed seal breeding.Most ringed seals leave the area in late summer. The reason for this is not known,but scarcity of food in Hornsund may be one of the reasons.Arctic cod were found in all 5 ringed seal stomachs.*T.libellula* and *M.oculata* were also common prey.This is in coordinance with ringed seal stomach content analysis performed in other parts of Spitsbergen (Gjertz 1983).According to lengths of arctic cod otoliths ringed seals prey mainly on agegroup 1,but also on fish from agegroup 2.

Bearded seals were observed regularly throughout the study period.It seems as though Hornsund has a fairly stable number of bearded seals year around.This may be because this seal mainly feed on benthic organisms which are present all year around.This is not the case with the important pelagic preys which for instans ringed seals prey on.The stomach content analysis which consists of only one bearded seal stomach is inadequate to form the basis of a comment on the feeding of this species in general.With exception of coalfish the bearded seal studied had only been feeding on benthic organisms.

It is difficult to determine the food base of birds and seals from the results of the plankton and benthos sampling. Observed biomass at each station should be reduced to biomass of the species preyed on by predators in this study.Biomass of plankton preyed on by birds should only include the upper 10 m of the water column,because this seems to be the watermass used by pelagic feeding birds (Stempniewicz and Weslawski 1984). If this is done most macroplanktonic food objects in the Hornsund area occur in densities of only a few specimens pr. 100 m^3.In areas with great abundance of birds like Hornsund this will lead to special feeding habits.Patchiness and aggregative behavior of plankton seem to be of significance in this respect.Some of these phenomenon have been described in the litterature:The effect of local uppwelling close to glacier fronts which creates aggregations of macroplankton used by kittiwakes and fulmars are described by Hartley and Fisher (1936),Stott (1936) and Dunbar (1951).This phenomenon was also observed in Hornsund.Birds in Hornsund were often observed feeding along narrow lines of turbulent water during gentle breeze.These lines probably originated as Langmuir cells.This hydrological phenomenon was describes by Ledbetter

(1979) as one factor causing planktonic consentrations. Other mechanisms which may lead to plankton aggregations are "the ice edge effect" described by Cross (1982),and the zone of contact between different water masses (here:the Polar front) which was described by Løvenskiold (1964) as the most important area of bird feeding.Macroplankton in connection with pack-ice was not observed in Hornsund in 1984,while in 1975,1979 and 1982 large amounts of pack-ice with associated plankton communities drifted into Hornsund (Weslawski & Kwasniewski 1983). Summing up:The pelagic food base in Hornsund during the study period is inadequate for all the birds living there.They therefore either have to search for food in the open sea,or find small scale planktonic aggregations caused by hydrological phenomenons within the fiord.Most ringed seals probably leave Hornsund part of the year to feed in other areas.

The list of benthic species preyed upon by birds and seals in Isfjorden (Hartley & Fisher 1936) differs from our material mainly in that bivalvia was more common in the Isfjord material than in this.All benthic crustaceans found in stomachs in Isfjorden were also found in this present study.The main differnce is that G.homari which were observed in Isfjorden but not found in any stomachs,was the most common preyed upon food object among malacostraca crustaceans in Hornsund.Hornsund might be divided into zones of animal feeding:

1. Shallow water intertidal zone (Onissimus littoralis, Gammarus spp.)
2. Phytal zone (most decapods and amphipods)
3. Soft bottom sediment (polychaets,bivalves)

The phytal zone is probably that with the richess biomass and number of species.(Weslawski 1983,Stempniewicz and Weslawski 1984).This is the zone of feeding for most of the vertebrate species in Hornsund. The tidal zone which is of importance regarding biomass is mainly feeding ground of the relatively few wading birds in the area (Stempniewicz and Weslawski 1984). Plankton species composition may vary considerably from year to year in Hornsund due to among other things the influx of pack-ice with associated plankton communities. This does not apply for the benthos, which has had a rather stable composition through the last decades (Gromisz 1983, Weslawski and Kwasniewski 1983). The general tendancy of climatic changes in the Arctic concerning warming of the water masses is mentioned by several authors as being responsible for the long term changes in benthic composition (Blacker 1957, Demel and Rutkowisz 1958, Vibe 1967). Some changes have been observed in Hornsund concerning the amphipod fauna (Weslawski 1984), concerning less common and not abundant species. No crustaceans of abundance have appeared in Hornsund during the last 50 years (Weslawski 1984).

Visualizing a food web as in figure 16 gives a rather confusing picture, but is done to show the connections between predators and prey in this study. Weighted connections should have been used to show each preys significance for the different predators. By using weighted connections, available informations on number of birds of different species in Hornsund and information on caloric requirements of birds and the caloric values of prey species, it is possible to calculate the amount of biomass which is removed from the ocean by avian predators. Whereas seals are concerned this is more difficult because little is known about the number of seals staying in the area at a given time.

In figure 17 bearded seals would probably (given a larger stomach content analysis sample size) prove to be an important part of the benthic food chain.

The dendrogram in figure 18 is a twodimentional picture and this may lead to loss of information.Several authors therefore suggest to use other methods of analysis besides the cluster-analysis (Green 1979,Field et.al.1982).The analysis emphasis numerically dominating species (Field and McFarlane 1968).This could be moderated by transforming the data set for instance by using arcsin$\sqrt{f}$,log(f+1) or ln(f+1),where f is the frequencies.This has not been done in this study,and since the clusters seem to be in agreement with the results from Hornsund,this analysis is presented in spite of teorethically drawbacks of the method.

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APPENDIX.

TABLE I, DATAS ON *Myxocephalus scorpius* FROM HORNSUND AUTUMN 1984.

FISH NO.	CATCHING DATE	FORK LENGTH (cm)	WEIGHT (g)	WEIGHT OF STOMACH-CONTENT (g)	OTOLITH LENGTH (mm)	REMARKS
1	080984	25.0	270	1.0	5.35	Oviparous
2	080984	20.5	105	0.5	4.95	
3	080984	22.0	150	0.0	4.45	Oviparous
4	080984	18.0	110	6.0	3.70	Oviparous
5	090984	22.5	165	6.0	4.80	Oviparous
6	090984	18.0	100	2.0	3.85	Oviparous
7	090984	19.5	110	2.0	5.15	Oviparous
8	120984	14.5	40	0.5	4.00	
9	120984	25.0	290	15.0	5.50	Oviparous
10	120984	24.0	260	0.0	5.80	Oviparous
11	120984	19.5	110	0.5	4.30	Oviparous
12	120984	19.0	100	0.5	4.35	Oviparous
13	021084	21.0	75	0.0	4.95	Oviparous
14	021084	22.0	90	0.5	----	Oviparous
15	021084	22.0	85	1.0	5.70	Oviparous
16	021084	19.5	70	0.5	4.75	Oviparous
17	021084	23.5	125	8.0	5.45	Oviparous

TABLE II. DATAS ON *Liparis Liparis* CAUGHT IN HORNSUND AUTUMN 1984.

FISH NO.	CATCHING DATE	FORK LENGTH (cm)	WEIGHT (g)	WEIGHT OF STOMACH-CONTENT (g)	OTOLITH LENGTH (mm)
1	120984	16.0	48	0.5	1.60
2	140984	13.5	38	1.0	1.50
3	150984	16.5	60	0.5	1.45

TABLE III. Catching date, weight of bird and stomach-content of fulmars caught in Hornsund autumn 1984.

BIRD NO.	CATCHING DATE	WEIGHT OF BIRD (g)	WET-WEIGHT OF STOMACH-CONTENT (g)	REMARKS
2	070984	895	0.0	
9	070984	1105	0.0	
24	120984	610	0.5	
25	120984	670	0.5	Stones and 7 "plasic barrells" in stomach.
32	130984	810	0.0	
33	130984	730	0.5	
46	150984	790	4.0	
48	150984	1020	0.5	
55	160984	840	0.5	8 nematodes in stomach.
56	160984	740	7.0	
96	250984	890	0.5	Stones and algae-fragm.in stomach.
100	260984	920	0.5	Stones in stomach.
101	260984	750	0.5	4 "plastic barrells" in stomach.
102	260984	830	0.5	1 "plastic barrell",stones,plastic wire and
103	260984	920	1.0	
104	260984	750	0.5	1 "plastic barrell",plastic rests and stones
105	260984	790	1.0	1 "plastic barrell",plastic rests and stones
114	260984	830	2.0	
115	260984	800	0.5	1 "plastic barrell" in stomach.
116	260984	890	0.5	stones in stomach.

TABLE IV. CATCHING DATE, WEIGHT OF BIRD AND STOMACH-CONTENT OF EIDERS FROM HORNSUND AUTUMN 1984.

BIRD NO.	CATCHING DATE	WEIGHT (g)	WEIGHT OF STOMACH-CONTENT. (g)	REMARKS
15	080984	2100	17.0	Stones in stomach.
18	080984	2415	28.0	
28	130984	1530	38.0	Stones in stomach.
29	130984	1530	31.0	Stones and algae-fragm.in stomach.
34	130984	1060	0.0	
40	150984	1990	13.0	Stones in stomach.
41	150984	2150	12.0	Stones and green-algae fragm.in stomach.
42	150984	2220	19.0	Stones and algae-rests in stomach.
63	212084	2120	0.0	
70	180984	2240	19.0	Stones in stomach.
71	180984	1960	19.0	Stones and algae in stomach.
72	180984	2000	37.0	
73	180984	2050	20.0	
74	220984	2200	21.0	
92	250984	1880	10.0	Stones and algae in stomach.
93	250984	1590	14.0	Stones and algae in stomach.
94	250984	1900	7.0	Stones,algae and hydrozoas in stomach.
95	250984	1920	11.0	
118	260984	2190	0.0	Stones and algae in stomach.
121	2609084	2330	10.0	Stones and algae in stomach.

TABLE V. CATCHING DATE, WEIGHT OF BIRD AND STOMACH-CONTENT OF BLACK GUILLEMOTS FROM HORNSUND AUTUMN 1984.

BIRD NO.	CATCHING DATE	WEIGHT (g)	WEIGHT OF STOMACH-CONTENT (g)	REMARKS
1	070984	490	2.0	Stones in stomach.
3	070984	445	5.0	Stones in stomach.
12	080984	450	4.0	
13	080984	410	6.0	Stones in stomach.
19	120984	410	6.0	
20	120984	410	1.0	Stones in stomach.
23	120984	470	4.0	Stones in stomach.
26	130984	440	7.0	Stones in stomach.
30	130984	390	3.0	Stones in stomach.
35	140984	420	1.0	
43	150984	420	6.0	Stones in stomach.
61	160984	420	2.0	
66	160984	430	12.0	
97	250984	410	5.0	Stones in stomach.
117	260984	480	16.0	Stones in stomach.
122	260984	430	11.0	Stones in stomach.
124	260984	400	5.0	
125	260984	430	1.0	Stones in stomach
126	260984	410	2.0	Stones in sromach.
127	280984	400	1.0	

TABLE VI. CATCHING DATE, WEIGHT OF BIRD AND STOMACH-CONTENT OF KITTIWAKES FROM HORNSUND AUTUMN 1984.

BIRD NO.	CATCHING DATE	WEIGHT (g)	WEIGHT OF STOMACH-CONTENT (g)	REMARKS
6	070984	425	0.0	
21	120984	410	0.5	
22	120984	350	0.0	
37	150984	350	5.0	Juvenile
39	150984	380	0.5	
57	160984	430	6.0	
58	160984	440	2.0	
64	160984	350	0.5	
67	180984	340	9.0	Juvenile
68	180984	370	---	Stomach shot into pieces.
98	250984	420	2.0	
99	250984	390	1.0	
106	260984	350	0.5	Juvenile
107	260984	340	2.0	Juvenile
108	260984	380	3.0	Juvenile
109	260984	510	6.0	
110	260984	510	0.5	
111	260984	470	0.5	
112	260984	430	1.0	
113	260984	470	0.5	Plastic rests in stomach.

TABLE VII. CATCHING DATE, WEIGHT OF BIRD AND STOMACH-CONTENT OF BRUNNICH'S GUILLEMOTS FROM HORNSUND AUTUMN 1984.

BIRD NO.	CATCHING DATE	WEIGHT (g)	WEIGHT OF STOMACH-CONTENT (g)	REMARKS
4	070984	1060	10.0	
36	150984	1020	3.0	
52	150984	1050	2.0	Stones in stomach.
53	160984	1010	10.0	
75	230984	1060	1.0	Stones in stomach.
76	230984	1120	0.5	1 "plastic barrell" and plastic wire in stomach.
77	230984	1000	10.0	
78	230984	1040	0.0	
79	230984	960	0.5	32 mm long plastic tread in stomach.
80	230984	830	0.5	Algae fragm.in stomach.
81	230984	1000	0.0	
82	230984	1060	0.5	plastic rests in stomach.
83	230984	960	1.o	
84	230984	1010	9.0	
85	230984	1030	4.0	1 "plastic barrell" in stomach.
86	230984	1030	0.5	
87	230984	1040	2.0	1 "plastic barrell" and plastic rests in stomach.
88	230984	1130	2.0	
89	230984	1140	2.0	1 "plastic barrell" and plastic rests in stomach.
90	230984	1070	1.0	1 "plastic barrell" in stomach.
91	230984	1030	0.0	

TABLE VIII. CATCHING DATE, WEIGHT OF BIRD AND STOMACH-CONTENT OF GLAUCOUS GULLS FROM HORNSUND AUTUMN 1984.

BIRD NO.	CATCHING DATE	WEIGHT (g)	WEIGHT OF STOMACH-CONTENT. (g)	REMARKS
16	080984	1990	0.0	
17	080984	2050	0.0	
27	130984	1680	10.0	
31	130984	1330	0.5	Complete fulmar-head regurgitated when shot.
44	140984	1350	0.0	
45	150984	1530	0.5	Stones in stomach.
59	160984	1790	8.0	
65	160984	2100	0.0	
69	180984	1170	0.5	
119	260984	1560	0.5	
120	260984	1370	46.0	Stones in stomach.
123	260984	1600	30.0	Stones in stomach.
128	280984	1320	5.0	Stones in stomach.
129	280984	2070	50.0	Stones in stomach.
130	280984	1590	21.0	
141	300984	1350	3.0	
143	300984	2360	2.0	
144	300984	1500	3.0	Stones in stomach.

TABLE IX.CATCHING DATE,WEIGHT OF BIRD AND STOMACH-CONTENT OF LITTLE AUKS CAUGHT IN HORNSUND AUTUMN 1984.

BIRD NO.	CATCHING DATE	WEIGHT (g)	WEIGHT OF STOMACH-CONTENT. (g)	REMARKS
131	290984	180	0.5	
132	290984	170	3.0	Plastic rests in stomach.
133	290984	185	1.0	Plastic rests in stomach.
134	290984	195	2.0	
135	290984	185	2.0	
136	290984	180	0.5	Plastic rests in stomach.
137	290984	170	1.0	
138	290984	200	2.0	
139	290984	180	1.0	Plastic rests in stomach.
140	290984	180	1.0	
142	300984	150	2.0	

TABLE X.CATCHING DATE,WEIGHT OF BIRD AND STOMACH-CONTENT OF PUFFINS FROM HORNSUND AUTUMN 1984.

BIRD NO.	CATCHING DATE	WEIGHT (g)	WEIGHT OF STOMACH-CONTENT. (g)	REMARKS
5	070984	545	0.0	
7	070984	625	0.5	
8	070984	605	1.0	
10	070984	725	0.5	
11	070984	625	2.0	
14	080984	560	0.5	
38	150984	620	0.5	
47	150984	540	2.0	
49	150984	580	0.5	
50	150984	570	0.5	
51	150984	670	0.5	
54	160984	400	2.0	Algae rests in stomach.
60	160984	580	3.0	Shot with 5 herrings in bill.
62	160984	580	2.0	

TABLE XI DATAS ON RINGED SEALS CAUGHT IN HORNSUND AUTUMN 1984.

SEAL NO.	CATCHING DATE	WEIGHT (kg)	LENGTH (cm)	AXILLARY GIRTH(cm)	MAXIMUM GIRTH(cm)	BLUBBER-THICKNESS (mm)	SEX	AGE (years)	WEIGHT OF STOMACH-CONTENT (g)	REMARKS
1	130984	---	92	64	71	28	Female	1+	118	Stones in stomach.
2	210984	22	97	67	74	20	Male	1+	68	Nematodes in stomach.
3	280984	35	110	80	84	32	Female	3	84	
4	021084	85	140	107	114	57	Female	10	220	Embryo in left uterine horn.
5	031084	25	94	72	74	31	Female	1+	99	

TABLE XII.DATAS ON BEARDED SEALS CAUGHT IN HORNSUND AUTUMN 1984.

SEAL NO.	CATCHING DATE	LENGTH (cm)	AXILLARY GIRTH(cm)	MAXIMUM GIRTH(cm)	BLUBBER-THICKNESS (mm)	SEX	WEIGHT OF STOMACH-CONTENT (g).	REMARKS
1	210984	245	130	160	30	Male	585	Found dead.
2	011084	230	155	175	50	Male	---	Stmach and intestines full of nematodes and cestodes.