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FEEDING HABITS OF NORTHEAST ATLANTIC HARP SEALS PHOCA GROENLANDICA ALONG THE SUMMER ICE EDGE OF THE BARENTS SEA

BY

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ABSTRACT

Stomachs from 58 harp seals Phoca groenlandica from the northern parts of the Barents Sea were collected between August 20 and September 5 1987. Fiftysix of the stomachs contained identifiable contents. The amphipod Parathemisto libellula was the most common food items, found in 98% of the seal stomachs and constituted 57.9% of total volume. Fishes were found to be the second most important prey group, with arctic cod Boreogadus saida as the dominant species followed by Nybelin's sculpin Triglops nybelini and Greenland halibut Reinhardtius hippoglossoides. Decapods, mainly Pandalus borealis, were also common as prey of harp seals. No sex or age related differences in choice of food were found. From knowledge of depths at locations seals were collected and precence of fresh bentic fish in the seal stomachs, harp seals were assumed to be able to collect food at depths below 300 m.

Introduction.

The harp seal *Phoca groenlandica* is an important species of the marine ecosystem in the Barents Sea. Its impact on the system is dependent on the size of the population and its food habits. No recent estimate of the population size exist. In 1978 the population was estimated to number 800.000 seals with an annual increase of about 5% (Benjaminsen 1979). During the early 1980's the population size was believed to exceed 1 mill, while the population size the last years probably has decreased (Ulltang and Øien 1988).

Markussen and Øritsland (1985) estimated a population of 1 mill. harp seals in the Barents Sea needing 1.4 to 4.2 mill. tons of food every year depending on prey organism. Knowledge of the feeding habits of harp seals is, however. scarce. Most of the available information is based on material collected during the breeding season (Sivertsen 1941, Myers 1959, Sergeant 1973, Bowen 1985), and most of the quantitative information originates from the northwest Atlantic stock. The present paper reports on feeding habits of harp seal collected along the summer ice edge of the Barents Sea.

Material and methods.

Stomachs of 58 harp seals were collected at the ice edge in the northern parts of the Barents Sea (79°15'-79°55' N, 27°35'-44°50'E) in the period from August 20 to September 5 1987. The seals were shot in the water and immediately dissected on the deck. The stomach contents were rinsed through a sieve with mesh size 1 mm and then frozen. Teeth and sex organs were sampled for age determination and evaluation of stage of sexual

maturity. Water depth at most of the hunting sites was recorded using the echo-sounder onboard the research vessel.

In the lab the stomach contents were sorted to the lowest possible taxionomic level. Total wet weight of the contents and volume percentages (V) of the major prey groups were registered. A non-trace frequency of occurrence (O) was calculated for the main prey groups, according to Bigg and Perez (1985). Prey represented by trace elements only, like beaks of squid and otoliths of fish, were excluded from these calculations and were only examined for qualitative purposes. In order to evaluate the relative importance of different preys, an abundance factor (A) was calculated as: $A = V \times O$.

Sizes of testis or presence of corpora lutea or albicantia in ovaries were used to evaluate the stage of sexual maturity. The age determination was performed reading growth lairs in the dentine of cross sections of the canine teeth.

Results.

Two of the collected stomachs were empty. The mean drained wet weight of the rest of the stomachs was 273 ± 253g (SD) with a range from 0.1-1326g. The main prey groups and their relative contribution to the diet of the harp seals are shown in Table 1.

It appears that amphipods is the most important prey group. The amphipod group consists almost entirely of *Parathemisto libellula* (Tab.2). Fish constitute the second most important prey group, and is dominated by polar cod (*Boreogadus saida*). More benthic fish like Greenland halibut (*Reinhardtius hippoglossoides*) and Nybelin's sculpin (*Triglops nybelini*) were also common. The largest fraction of the fish group consisted of

partly digested fish which was not identified to species level. This fraction is not included in Table 2 and contstitutes 63.7% of the fish volume in Table 1. Some species were only found as traces in single seal stomachs and were excluded in Table 2. They include the copepode *Pareuchaeta glacialis*, the isopode *Idotea granulosa*, and the bivalves *Astarte elliptica* and *Leda pernula*.

The harp seal sample consists of 23 females and 35 males. The mean age of females was 7.2± 4.7yrs (range 1-16 yrs) and of males 8.1± 4.5yrs (range 1-15 yrs). In order to test for age and/or sex related differences in diet, we grouped the stomach contents of adult males (N=23,+2 empty stomachs), subadult males (N=12), adult females (N=11), and subadult females (N=12) respectively (Fig.1). No significant differences in diet were found between males and females (χ^2=0.190, p=0.66), or between adults and subadults (χ^2=0.365, p=0.55). Within the 4 groups in Fig.1, subadult females and adult females were differing the most in choice of food. This difference was, however, not significant (χ^2=2.318, p=0.13).

The mean depth recorded where stomachs contained freshly eaten benthic fish (N=12) was 256m ± 61m, with a maximum recorded depth of 340m.

Discussion.

During summer periods large herds of harp seals are normally observed in the open waters between the coast of Finmark (northern Norway) and the Svalbard - Franz Josef Land archipelagoes. During our field work, a lot of effort was used trying to detect some of these herds in order to increase the possibility of getting a large sample size. All attempts in detecting herds of harp seals failed to succeed. Along the ice edge,

however, in the northern parts of the Barents Sea, single individuals and scattered groups of harp seals were observed, and finally the sampling was concentrated in this area.

Bigg and Perez (1985) proposed a modified volume method which incorporates measure of volume and frequency of occurrence of different food items in order to assess marine mammal food habits. The abundance factor calculated in the present work is a modification of that method. The non-trace frequency of occurrence is incorporated in order to moderate the effect on the volume precentage of one large prey organism in a single stomach.

The information on diets of harp seals is scarce. Myers (1959) found fish remains with herrings (*Clupea harengus*) as the dominant species in a sample of 185 harp seals from Canadian waters. Sergeant (1973) states that pelagic fish, especially capelin (*Mallotus villosus*), plus pelagic and benthic crustaceans were the most important preys. He collected some harp seals summering in the cold waters between northwest Greenland and the Canadian arctic archipelago. Although small sample size, these seals were mainly eating arctic cod and various crustaceans including *P. libellula*. Bowen (1985) has analysed available data on feeding of the northwest Atlantic harp seal population and concludes that they mainly feed on pelagic fishes dominated by capelin and arctic cod, and on a variety of invertebrates where euphausids and shrimps are the most dominant.

Of the information on diets of the northeast Atlantic population, Smirnov (1924) states without any further information on number of seals, age, sex etc., that pelagic crustaceans and polar cod followed by capelin, herring and pelagic molluscs are the most important preys.

Sivertsen (1941) found that young of the year harp seals after weaning starts feeding on pelagic crustaceans, especially the euphausids *Thysanoessa inermis* and *Thysanoessa raschii* and the amphipod *Anonyx nugax*. Yearlings had a different diet including capelin and shrimp species like *Spirontocaris turgida* and *Crangon crangon* Information on adult diets were based on 2 animals with contens in their stomach containing *T. raschii* and *C. crangon*.

The results of the present paper seem to correspond to the results of the analyses of harp seals from the cold waters between Greenland and Canada reported by Sergeant (1973).

One single harp seal was shot in the southern Barents Sea, but was excluded from our sample since collected distantly from the rest of the sample. This seal, however, had eaten capelin, indicating this species as a potential prey for harp seals in the Barents Sea.

It seems when comparing results from investegations of stomachs from different seal species forageing, at least partly, pelagically in association with the ice edge both in European and Canadian Arctic, that pelagic crustaceans including *P. libellula* and arctic cod are the most significant preys (Lowry et al.1980, Bradstreet and Cross 1982, Gjertz and Lydersen 1986, Smith 1987, Lydersen et al.1989).

Sergeant (1973) suggests diving abilities of harp seals down to 250 m based on registrations of fresh bethic fish in stomachs of seals collected in areas of known depths. We collected harp seals containing fresh benthic fish on depths deeper than 300m. *R. hippoglossoides* was one of the species we considered benthic. This species is, however, found to have a bathypelagic mode of life (Chumakov 1969) feeding in the water column

(Haug and Gulliksen 1982)., and might therefore seem unsuited as indicator of foraging depths of harp seals. Most of the *R. hippoglossoides* in the Svalbard area are however, caught on depths below 200m (Godø and Haug 1987) and Chumakov (1969) states that *R. hippoglossoides* sink to the bottom during day time which is when most seals were collected. Thus the present study indicates that the harp seal might feed on depths down to at least 300m.

As a conclusion, amphipods,mainly *P. libellula* were found to be the most significant food item of harp seals feeding along the ice edge in the northern parts of the Barents Sea. Fishes were found to be the second most important prey group, with arctic cod as the dominant species followed by *T. nybelini* and *R. hippoglossoides*. No significant sex or age related differences in choise of prey were found. The seals might be able to search for food at depths down to 300m.

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References.

BENJAMINSEN, T. 1979. Pup production and sustainable yield of White Sea harp seals. Fisk. Dir. Skr. Ser. HavUnders. **16**: 551-559.

BIGG, M. A., and PEREZ, M. A. 1985. Modified volume: a frequency - volume method to assess marine mammal food habits. *In* Marine mammals and fisheries. *Edited by* J. R. Beddington, R. J. H. Beverton and D. M. Lavigne. George Allen & Union. London. pp 277-283.

BOWEN, W. D. 1985. Harp seal feeding and interactions with commercial fisheries in the north-west Atlantic. *In* Marine mammals and fisheries. *Edited by* J. R. Beddington, R. J. H. Beverton, and D. M. Lavigne. George Allen & Unwin. London. pp. 135-152.

BRADSTREET, M. S. W., and CROSS, W. E. 1982. Trophic relations at high arctic ice edges. Arctic. **35**: 1-12.

CHUMAKOV, A. K. 1969. The Greenland halibut (*Reinhardtius hippoglossoides*(Walbaum)) in the Iceland area - the halibut fisheries and tagging. J. Ichthyol. (Vopr. Ikht.) **9**: 909-912.

GJERTZ, I, and LYDERSEN, C. 1986. The ringed seal (*Phoca hispida*) spring diet in northwestern Spitsbergen, Svalbard. Polar Research **4**: 53-56.

GODØ, O. R., and HAUG, T. 1987. Migration and recruitment to the commercial stock of Greenland halibut, *Reinhardtius hippoglossoides*(Walbaum), in the Svalbard area. FiskDir. Skr. Ser. HavUnders., **18**: 311-328.

HAUG, T., and GULLIKSEN, B. 1982. Size, occurrence, growth, and food of Greenland halibut, *Reinhardtius hippoglossoides*(Walbaum) in coastal waters of western Spitzbergen. Sarsia **68**: 293-297.

LOWRY, L.F., FROST, K., and BURNS, J. J. 1980. Variability in the diet of ringed seals, *Phoca hispida*, in Alaska. Can. J. Fish. Aquat. Sci. **37**: 2254-2261.

LYDERSEN,C., GJERTZ, I, and WESLAWSKI, J. M. 1989. Stomach contents of autumn-feeding marine vertebrates from Hornsund, Svalbard. Polar Record. **25**: 107-114.

MARKUSSEN, N. H., and ØRITSLAND, N. A. 1985. Grønlandselens matbehov III. Videreutvikling og anvendelse av simuleringsmodellen SEAERG. Biologisk Institutt. Avd. fro generell fysiologi. Universitetet i Oslo. 61 pp.

MYERS, B. J. 1959. The stomach contents of harp seals (Phoca groenlandica Erxleben) from the Magdalen Islands, Quebec. Can. J. Zool. **37**: 378.

SERGEANT, D. E. 1973. Feeding, growth, and productivity of northwest Atlantic harp seals (*Pagophilus groenlandicus*). J. Fish. Res. Board Can. **30**: 17-29.

SIVERTSEN, E. 1941. On the biology of the harp seal *Phoca groenlandica* Erxl. Hvalrådets Skr. No. 26.

SMIRNOV, N. 1924. On the eastern harp-seal Phoca (Pagophoca) groenlandica var. oceanica Lepechin.. Tromsø Museums Årshefter **47** No. 2.

SMITH, T. G. 1987. The ringed seal, *Phoca hispida*, of the Canadian western arctic. Bull. Fish Res. Board Can. No. 216.

ULLTANG, Ø., and N. ØIEN. 1988. Bestandsutvikling og status for grønlandssel og klappmyss. Fiskets Gang **6/7**: 8-10.

Table 1. Distribution of major groups of preys from stomachs of harp seals collected in northern parts of the Barents Sea autumn 1987. Volume percent (V) referres to volume of prey group compared to total volume of all preys. Occurrence (O) is the number of seals with prey group in stomach compared to the total number of seals. The abundance factor (A) is V x O.

Prey group	Volume percent (V)	Occurrence (O)	Abundance factor (A)
Fish	28.0	0.70	19.6
Amphipods	57.9	0.98	56.7
Decapods	13.1	0.66	8.6
Cephalopods	1.0	0.29	0.29

Table 2. Distribution of prey species within each main prey group from stomachs of harp seals collected in northern parts of the Barents Sea autumn 1987. Volume percent (V) referres to volume of one prey species compared to total volume of all preys.in that group Occurrence (O) is the number of seals with prey species in stomach compared to the total number of seals. Abundance factor (A) is V x O.

Prey species	Volume percent (V)	Occurrence (O)	Abundance factor (A)
Fish:			
Boreogadus saida	56.1	0.36	20.2
Triglops nybelini	23.2	0.27	6.3
Reinhardtius hippoglossoides	16.9	0.18	3.0
Other fish	3.8	0.12	0.5
including:			
Sebastes marinus			
Hippoglossoides platessoides			
Leptoclinus maculatus			
Benthosema glaciale			
Liparis sp.			
Amphipods:			
Parathemisto libellula	99.6	0.98	97.6
Gammarus spp.	0.2	0.07	0.01
Other amphipods	0.2	0.02	0.003
Decapods			
Pandalus borealis	95.0	0.66	62.7
Sabinea septemcarcinatus	2.0	0.13	0.26
Other decapods	3.0	0.09	0.27
including:			
Lebbeus polaris			
Pasiphaea tarda			
Cephalopods			
Gonatus fabricii	83.3	0.27	22.5
Octopods	16.7	0.04	0.7
including:			
Bathypolipus arcticus			
Elodone cirrhosa			

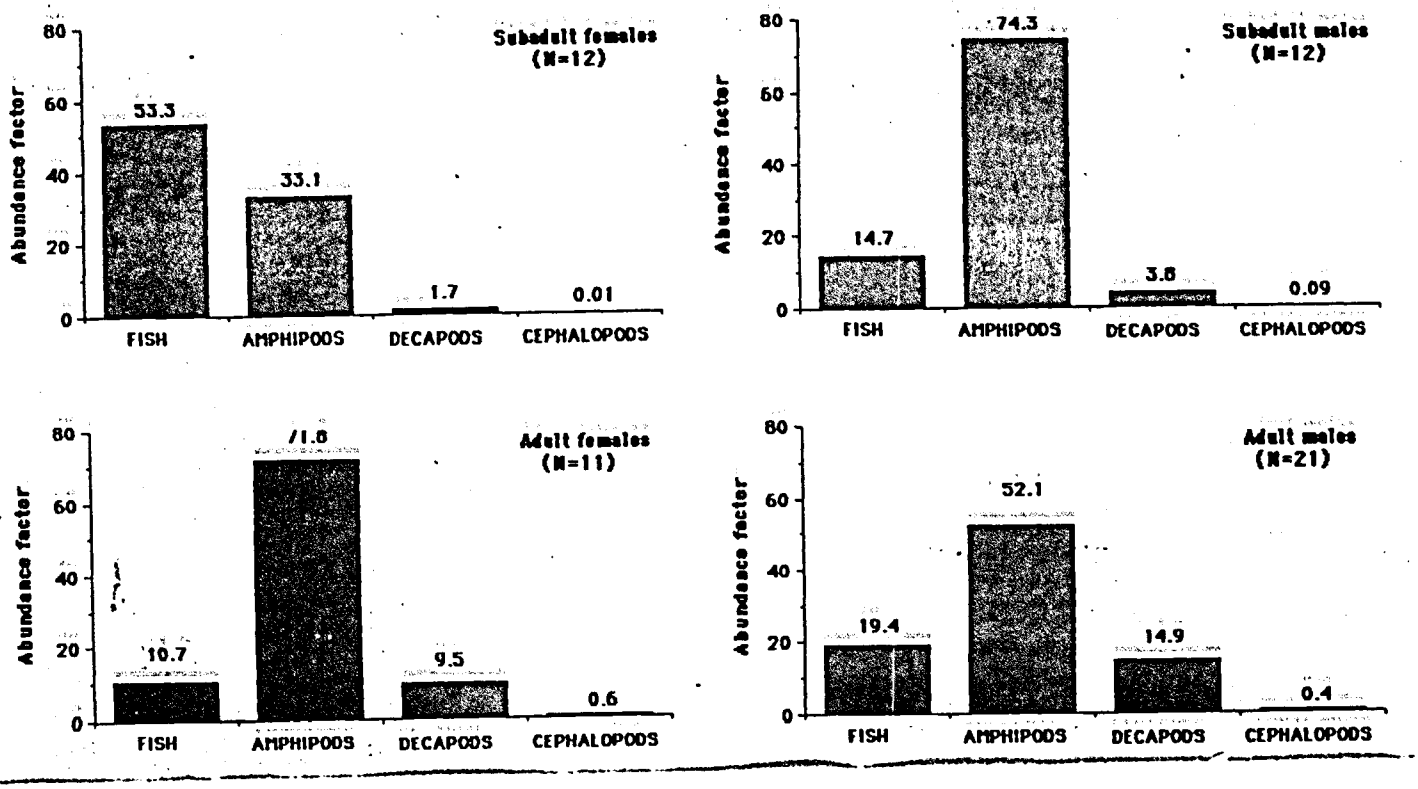

Fig.1. Results from analysis of stomach contents of harp seals of different age and sex groups collected in the Barents Sea summer 1987.