The ringed seal (*Phoca hispida*) spring diet in northwestern Spitsbergen, Svalbard

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A total of 284 ringed seals (*Phoca hispida*) were sampled to determine their diet in the spring of 1981 and 1982. Few seals contained identifiable stomach contents. No significant age- or sex-related differences in choice of prey were found. It seems that in spring northwestern Spitsbergen ringed seals prey upon arctic cod (*Boreogadus saida*), decapods and larger amphipods. □ *Diet, ringed seal, Svalbard.*

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The ringed seal (*Phoca hispida*) is the most common seal of the Arctic (King 1983). From Svalbard only notes on the feeding habits of ringed seals have been published (Malmgren 1863; Zimmer 1904; Hartley & Fisher 1936).

The recent interest in future offshore oil and gas exploration around Svalbard has made it increasingly important to expand the existing knowledge on ringed seals in this area. The main purpose of the study was to examine the spring diet of ringed seals in northwestern Spitsbergen, Svalbard.

Material and methods

Stomachs from ringed seals were collected in April–July 1981 and April–May 1982 by shooting animals on land-fast ice in three areas: Kongsfjorden (79°N, 12°E), Isfjorden (78°20'N, 16°E), and Wijdefjorden (79°N, 16°E). All stomachs were put in plastic bags and frozen. In the spring of 1982 large intestines (colon) were also collected and preserved in the same way.

In the laboratory, stomach contents were washed onto a 1.0 mm sieve. The contents of the large intestines were suspended in water before being washed onto the sieve. Stomach and intestinal content was used only for determination of species ingested and not for quantitative measurements. All items were sorted to the lowest possible taxonomic level with the aid of suitable literature, available keys and reference specimens. Identification of prey was based primarily on intact specimens, fish otoliths and crustacean exoskeletons. The otoliths were grouped into six categories: arctic cod (*Boreogadus saida*), Zoarcidae, Cyclopteridae, Cottidae, other fish, and unidentifiable remains. The otoliths were counted and the maximum length of 25% of all unbroken and non-degraded arctic cod otoliths were estimated to the nearest 0.1 mm. This was done by reading the otolith length against millimetre graph paper. To determine the accuracy of this method, graph paper estimates of 50 otoliths varying in size from 2.2 mm to 8.2 mm were compared with measurements read with a measuring occular. The estimation of otolith length using graph paper was found to have a mean error of 0.044 mm ± S.D. 0.08.

The sizes of arctic cod ingested were estimated from otolith length using the regression: fork length (cm) = 2.198 otolith length (mm) + 1.588 (Frost & Lowry 1981).

Results and discussion

Of 284 ringed seal stomachs examined, only 39 had identifiable contents. Out of the 105 intestines examined, 85 contained identifiable contents. Results from stomach and intestine analysis are given in Table 1.

The prey species found in the seal stomachs could be grouped into cephalopods, crustaceans, tunicates and fish.

Cephalopods

One lower beak of a Gonatid squid was the only fragment of a cephalopod found in this study, despite the fact that squids are common in the

Table 1. Number of ringed seal stomachs and intestines from northwestern Spitsbergen springs 1981 and 1982 containing specified prey. 39 stomachs and 85 intestines with identifiable contents available for analysis.

Prey	No. of stomachs	No. of intestines
Cephalopoda	—	1
Gonatidae	—	1
Tunicata	—	1
Crustacea	28	57
Crustacea indet	10	48
Amphipoda	12	20
Parathemisto libellula	6	11
Onisimus edwardsi	4	—
Anonyx nugax	2	—
Stegocephalus inflatus	1	—
Rhacotropis aculeata	—	1
Gammarus sp.	2	7
Gammarus locusta	5	2
Gammarus wilkitzkii	—	1
Schizopoda	5	2
Mysis oculata	1	1
Thysanoessa inermis	4	1
Thysanoessa raschii	1	—
Decapoda	15	36
Sabinea septemcarcinatus	5	24
Sclerocragnon boreas	8	3
Pandalus borealis	9	18
Eualus gaimardii	—	1
Spirontocaris phippsi	—	1
Pisces	21	84
Salvelinus alpinus	—	3
Zoarcidae	3	17
Boreogadus saida	13	80
Hippoglossoides platessoides	—	2
Cyclopteridae	3	39
Cottidae	3	49

area (the authors have on several occasions found squid beaks in fulmars (*Fulmarus glacialis*) in the area). Pitcher (1980) states that in harbour seals (*Phoca vitulina*) most cephalopod beaks are regurgitated and do not pass through the intestinal tract. If this is true for ringed seals it might explain why cephalopod remains were scarce. Ringed seals are known to feed on cephalopods in other areas of the Arctic (Johansen 1910; Johnson et al. 1966; Lowry et al. 1978) although this prey seems to be of minor significance.

Crustaceans

Schizopods were found in 5 of 39 stomachs and 2 of 85 intestines. The euphausiid *Thysanoessa inermis* was the most common schizopod found. The small quantity of schizopods recorded indicates that this group of crustaceans is of minor importance as prey for ringed seals in northwestern Spitsbergen in the spring. From other parts of the Arctic, however, schizopods are found to be important ringed seal food (McLaren 1958; Lowry et al. 1978, 1980; Popov 1982).

Amphipods occurred in 12 of 39 stomachs and 20 of 85 intestines and were the numerically most common invertebrate found. Eight species of amphipods were recorded. Of these *Gammarus* sp. and *Parathemisto libellula* were the most frequent. *P. libellula* is found to be one of the most important prey species in ringed seal diets in other parts of the Arctic also (McLaren 1958; Lowry et al. 1980; Finley et al. 1983).

Decapods were the crustaceans most frequently found, occurring in 15 of 39 stomachs and 36 of 85 intestines. Five species of decapods were ingested by ringed seals in northwestern Spitsbergen. *Sabinea septemcarcinatus* was found in the greatest number of stomachs and intestines combined, but *Pandalus borealis* occurred in larger quantities and was considered the decapod of greatest importance. Great quantities of *P. borealis* are found off Spitsbergen, indicated by large shrimp fisheries in these waters. In Alaska, *Pandalus* sp. was found to be of importance as food for ringed seals (Kenyon 1962; Johnsen et al. 1966; Lowry et al. 1980).

Tunicates

Ascidiacea: sea squirt gill fragments were found in one ringed seal intestine from northwestern Spitsbergen. Johnson et al. (1966) found tunicates in ringed seal stomachs in Alaska, but that they did not constitute an important prey, which also appears to be the case in this study.

Fish

Fish remains occurred in 21 of 39 stomachs and in 84 of 85 intestines. The remains were mainly otoliths but some bones and flesh were also recorded. A total of 18,233 otoliths were found, 77.1% of which were arctic cod, 10.1% Cottidae, 7.8% Cyclopteridae, 1.0% Zoarcidae, 0.1% other fish (arctic char *Salvelinus alpinus* and *Hippoglossoides platessoides*), and 3.8% unidentifiable. The size distribution of arctic cod otoliths and corresponding fish lengths is shown in Fig. 1. The average otolith length (3.4 mm ± S.D. 1.4)

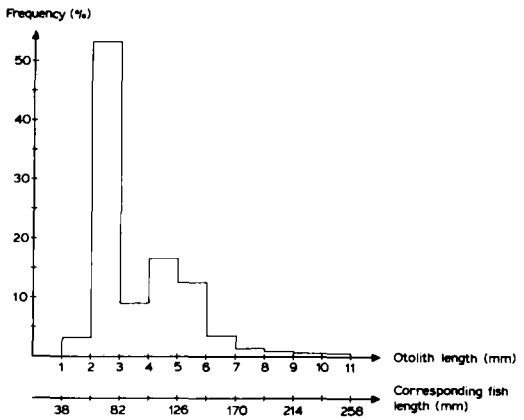

Fig. 1. Frequency distribution of lengths of arctic cod otoliths and corresponding fork lengths of arctic cod. Found in ringed seals caught in northwestern Spitsbergen 1981 and 1982.

of arctic cod ingested by ringed seals corresponded to a fish length of 9.1 cm.

Arctic cod were found to be by far the most important fish prey for northwestern Spitsbergen ringed seals. This corresponds to findings in most other areas where arctic cod or other schooling fish are significant ringed seal food (McLaren 1958; Lowry et al. 1980; Popov 1982). The relatively small size of the fish ingested suggests that young arctic cod may be more abundant in the area than older ones, or that they are easier to catch. According to Hognestad (1968) it seems that a higher percentage of young fish is found at the coasts of Spitsbergen and in the central parts of the Barents Sea than in its eastern areas, at least outside the spawning season. This may explain the relatively small size of arctic cod ingested by ringed seals in this study.

Cottidae were found to be the second most common fish prey in northwestern Spitsbergen. This corresponds to McLaren's (1958) and deGraaf et al.'s (1981) findings from eastern Canada. Vibe (1950) claims that Cottidae is taken only exceptionally.

Shustov (1970) states that ringed seals digest their food very quickly and that it is difficult to identify food items one hour after ingestion. Most ringed seals collected in this study had dry pelts when shot, indicating that they had been hauled out on the ice for some time. According to Pikharev (1946) and Vibe (1950), as a rule stomachs of all rested and dry ringed seals are empty. Quick digestion may be one reason for the low number of stomachs with identifiable remains. It has also been stated that the food intake is reduced during breeding and moult in spring and early summer (Lowry et al. 1980). This may also account for the high number of empty stomachs found in our study.

Food remains present in stomachs and intestines consisted mostly of slowly digestible hard parts of prey, and therefore the importance of soft bodied prey in the samples cannot be evaluated. Individual stomach content wet weights are therefore not given.

All seals investigated were aged by Lydersen (1983) by reading tooth growth annuli. No significant age- or sex-related differences in choice of prey were found in this study. This is in agreement with McLaren (1958) and Lowry et al. (1978), but in contrast to Lowry et al. (1980), who found a clear age-related difference in choice of prey.

The relative abundance of prey species in the localities where seals were collected is not known. It was therefore not possible to determine whether the ringed seals were selective in their choice of prey.

In summary, it seems that in the spring, northwestern Spitsbergen ringed seals preferably prey upon arctic cod, decapods and larger amphipods.

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