International Council for Exploration of the Sea

C.M. 1990 / N: 6
Marine Mammals Committee

HARP SEAL (PHOCA GROENLANDICA) INVASIONS IN NORTH NORWEGIAN COASTAL WATERS: A PRELIMINARY REPORT ON AGE COMPOSITION AND FEEDING HABITS

by*

TORE HAUG[1], ARI B. KRØYER[2], KJELL T. NILSSEN[3] and KARL I. UGLAND[2]

[1] Institute of Marine Research, c/o Norwegian College of Fisheries Science, University of Tromsø, Breivika, N-9000 Tromsø, Norway

[2] Department of Marine Zoology and Marine Chemistry, Biological Institute, University of Oslo, P.O.Box 1064 Blindern, N-0316 Oslo 3, Norway

[3] Norwegian College of Fisheries Science, University of Tromsø, Breivika, N-9000 Tromsø, Norway

ABSTRACT

Since 1978 large numbers of harp seals (Phoca groenlandica) have invaded areas of North Norway in winter and spring. In 1987 and 1988 dramatic increases occurred both in magnitude and geographic extent of these seal invasions, and it is suggested that the collapse of the Barents Sea capelin stock in 1985/1986 may have been a contributory factor to this. Sampling of stomach contents for food analyses and of teeth for age determinations was carried out from harp seals taken as bycatch in Norwegian gill-net fisheries in 1986 and 1988. It appears that the seal herds comprised both immature and mature animals. The stomach analyses Suggested that feeding was opportunistic, with a variety of fish (in particular the gadoid species cod, saithe, haddock and Norway pout, and the pelagic shoaling species herring and capelin) being taken as prey. Prawns and squid were also consumed, but in considerably lower quantities than fish.

* Authorship equal

INTRODUCTION

The harp seal (Phoca groenlandica) is the most abundant seal species in the Barents Sea. Norwegian estimates suggested a total stock size of c. 800 000 animals in 1978, with an annual increase of about 5% (Benjaminsen 1979), which would imply an estimated population size of nearly 1.2 million animals in 1987. Soviet scientists have, however, observed a reduction in recruitment after 1986 (Anon. 1989), i.e., following the collapse of the Barents Sea capelin (Mallotus villosus) stock (Hopkins & Nilssen 1990).

Traditionally, Barents Sea harp seals have been exploited by Soviet and Norwegian sealers in the East Ice (Fig. 1), the pack-ice in the White Sea and the southeastern Barents Sea (Haug 1981). Despite the controversies connected with sealing operations in recent years, Norwegian sealing in the East Ice has been maintained on a small scale both because the harp seal is a valuable renewable resource, and because it may be a significant competitor for other marine resources in the Barents Sea area. Annual invasions of harp seals in coastal waters of North Norway since 1978 (Bjørge et al. 1981, Wiig 1988) have caused particularly large problems for coastal fisheries in this area, and calls have been made not only for a continued hunt but also for an increased exploitation of seals.

Thus, a need has emerged for the study and evaluation of the ecological role of harp seals in the Barents Sea. A long term aim of ongoing research is to include these and other top predators in multi-species models which may form the basis for a more rational management of marine resources in the Barents Sea. A major problem in the evaluation of harp seal predation in the system is, however, the very limited availability of field data, including information about the composition and quantity of prey consumed. Field studies of Barents Sea harp seal feeding have been initiated in order to gather information about the feeding habits and general condition of the animals in the Barents Sea

and in Norwegian coastal waters throughout the year.

In the Northwest Atlantic, harp seals feed intensively during winter and summer, but little or not at all during the breeding and moulting season in the spring and the spring and autumn migrations (Sergeant 1973, Kapel & Angantyr 1989). Reduced food intake during reproduction and early moult, when traditional sealing takes place and makes the seals easily accessible for investigation, has also been reported for the Barents Sea harp seals (Smirnov 1924, Sivertsen 1941, own unpublished data). Very little is known, however, about what and how much these seals eat at other times of the year, and a priority in current Norwegian harp seal studies is to obtain such data.

A sampling design for studies of harp seal feeding habits must be based on existing knowledge about the migratory patterns of harp seals in the Barents Sea (see Smirnov 1924, Sivertsen 1941, Benjaminsen 1979, Wiig 1988). Thus, sampling effort in the study of feeding and condition of harp seals has been concentrated on areas of abundance in the open waters along the pack-ice belt in the Barents Sea in summer, in coastal waters of Norway in winter, and in the breeding and moulting areas in the spring. Pilot summer studies of offshore harp seal feeding in the Barents Sea were carried out in 1981-1983 (unpublished data) and continued in 1987 (Lydersen et al. 1989). In the present paper a preliminary presentation is given of data from studies of harp seals taken as bycatches in gill-net fisheries in some areas along the coast of Northern Norway during the winters of 1986 and 1988.

MATERIAL AND METHODS

Norwegian bycatches of harp seals

Losses imposed on coastal fisheries in Northern Norway by invading harp seals (damage to gill-nets and reduced catches due

to changes in fish behaviour and availability, see Nilssen et al. 1990), have led the Norwegian authorities to introduce payment of compensation (NKR 300-400 per landed seal) to the fishermen. As documentation the fishermen have only to deliver the flippers from the dead seals. Payments were organised by Norges Råfisklag.

It is assumed that the number of seals recorded for compensation purposes may provide a useful relative index of the numbers of seals, even though it is realised that this does not represent the real number of seals captured and fishing effort may well have varied from year to year. The total number of seals recorded during the 1980's, and for the years 1987-1989 also the numbers by areas and months, were compiled by Norges Råfisklag.

Collection of biological material

Samples from harp seals taken as bycatch in gill-net fisheries were collected in coastal areas of North Norway (Fig. 1) during the winters of 1986 and 1988. A total of 354 animals, taken in Troms county, Lofoten in Nordland county and Tana and coastal areas of Finnmark, was examined (Table 1).

Samples were taken as soon as possible after the seals were landed when most animals were still fresh. Due to low winter temperatures, however, some of the animals were frozen and had to be thawed before sampling. Seal stomachs were collected and frozen for laboratory examination of contents. Total lengths of the animals were measured, weights and blubber thickness were recorded, and lower jaws with teeth were collected for age determination. In the samples from Lofoten and Finnmark, collected in 1988, the sexual status of the seals was checked by examination of reproductive organs.

Age determination

The ages of the seals were determined by incremental growth

layers in the dentine of the lower canine teeth, examined in transverse sections using transmitted light (Bowen et al. 1983). At present, data are available only for seals collected in Troms and Tana in 1988.

Stomach content analyses

After thawing, the stomachs were cut open. The total weight of the stomach contents was recorded. All fresh specimens of fishes and all crustaceans were identified by gross morphological characteristics and were then sorted from the remainder of the contents. The relative volume of crustaceans was estimated visually. The remaining stomach contents were placed in a tray and washed repeatedly in cold water in order to "pan out" fish otoliths (Treacy & Crawford 1981, Murie & Lavigne 1985). The otoliths were identified to the lowest possible taxon, preferably to species (Breiby 1985, Härkönen 1986). Squid beaks were identified with assistance from J.H. Sundet (Norwegian College of Fisheries Science, Tromsø, Norway, pers. comm.).

The total number of each fish species was determined by adding the number of fresh specimens, the number of intact skulls and half the number of free otoliths. It is known that the small otoliths of species such as herring (Clupea harengus) and capelin are more fragile than gadoid otoliths which resist erosion to a much larger degree (Murie & Lavigne 1985, Jobling & Breiby 1986). Numbers of herring and capelin were therefore estimated from the presence of backbones, which often occurred in larger numbers than otoliths.

In the Troms (1986 and 1988) and the Tana (1988) samples, crude estimates of fresh weight of food consumed were made by summing the calculated weights of all species/taxons identified. For the fish species, all otoliths were measured, and otolith length - fish weight correlations as described by Härkönen (1986) were used to estimate the original fresh weight. No corrections were made for various degrees of otolith degradation (Jobling & Breiby

1986, Kapel & Angantyr 1989). For squids, correlations between URL-measurements on the upper beak (Kashiwada et al. 1979) and weight (E.M. Nilssen, Norwegian College of Fisheries Science, Tromsø, Norway, unpublished data) were used. Crude calculations were made of the original fresh weight of crustaceans by assuming that the observed volumetric ratio between crustaceans and the rest of the stomach contents had remained unchanged from the fresh state. The only crustacean identified in stomach contents was the prawn, Pandalus borealis, and an approximate estimate of the number of individuals occurring in each stomach was obtained by dividing the calculated fresh weight by an assumed average individual prawn weight of 10 g (E.M. Nilssen, pers. comm.).

Feeding indices were used to estimate the dietary contribution of different prey items (Berg 1979, Hyslop 1980, Eliassen & Jobling 1985). Since no feeding index gives a complete or realistic picture of dietary composition, the data were recorded as: 1) Percentages of empty stomachs and stomachs containing one or more specimen of each food item. 2) Relative frequencies of occurrence were calculated for each prey item as a numerical fraction of all prey specimens. 3) Relative frequencies of occurrence were also determined by estimating the relative contribution of each prey species to the total diet expressed in terms of calculated fresh weight.

RESULTS

Bycatches of harp seals in the 1980s

During the first half of the 1980s, the numbers of harp seals recorded as bycatches in Norwegian coastal fisheries varied between 500 and 2000 animals (Fig. 2). The number increased slightly in 1986. In 1987, however, more than 56000 animals were reported caught, and in 1988 the number caught was also high (more than 21000). In 1989 numbers had returned to the level of the early 1980s. In the years 1987 and 1988 most seals were

caught in winter and spring (January-April), with numbers decreasing from May onwards. In 1989 only small numbers of seals were taken in January-April, and the largest numbers were recorded in May and June (Table 2).

In most years harp seal invasions appear to have been confined almost exclusively to the three northernmost counties, although some catches were recorded south of this area (Table 3). In 1987, when significant numbers of seals were caught as far south as the Sagerrak coast (Wiig 1988), large numbers of animals were taken in both Troms and Nordland counties. In 1988 the seal bycatches were largest in Finnmark and decreased southwards along the Norwegian coast, and in 1989 almost all the seal bycatches were recorded in Finnmark county.

Age composition of the captured seals

Age data are available only for the 1988 samples from Troms and Tana (Fig. 3). The age of the harp seals examined in these areas varied between 1 and 28 years, with the majority (45-50%) being subadult animals younger than 5 years.

In the 1986 material from Troms, only one of 60 harp seals was sexually mature, while the rest were young, immature animals. Seals examined in Lofoten in 1988 included 23 sexually mature and 35 immature seals. In the 1988 samples collected along the coast of Finnmark the maturity status was checked for 109 of 119 seals: 68 were mature and 41 were immature.

Stomach contents analyses

Twenty one different species of prey were identified in the stomachs of the harp seals (Table 4). Fish, particularly gadoids and herring, were the prey occurring in most stomachs examined in the Lofoten sample. This was also the case for the samples collected in Troms during 1986, but in 1988 only a few stomachs from seals collected in Troms contained herring. Prawns had been

eaten quite frequently in Troms, and in the Tana and coastal Finnmark samples prawn was the item found in most stomachs. In Tana, herring and capelin were the fish species eaten by most seals. Capelin was found quite frequently in samples collected elsewhere in Finnmark, but gadoids were also frequently recorded.

Analyses of the relative frequencies of occurrence (by numbers) of prey items (Fig. 4) revealed an apparent dominance of gadoids, particularly Norway pout (Trisopterus esmarkii) and saithe (Pollachius virens), in the Lofoten 1988 and Troms 1986 samples. Norway pout occurred quite frequently also in the Troms 1988 material, but the prey item occurring in largest numbers both in this sample and in the Tana and Finnmark 1988 samples was prawn. In Tana 1988, herring was also recorded in considerable numbers, while capelin was the second most frequent item in the Finnmark 1988 sample.

In terms of calculated fresh weight the relative contribution of prawns was small compared to fish in the total diet in Troms 1986 and 1988, and in Tana 1988 (Fig. 5). Gadoids, in particular saithe, and to a lesser extent cod, comprised the main bulk (50-75%) of prey biomass. In the Tana 1988 sample, herring contributed considerably (24%) to the fish prey biomass. In the Troms 1988 sample plaice (Pleuronectes platessa) contributed over 15% of the calculated fresh weight.

The numerical relative frequencies of prey items suggest that the older animals took more prawns than the younger seals which seemed to feed on small gadoids such as Norway pout and blue whiting (Micromeistitius poutassou) (in the Troms 1988 material) or the pelagic shoaling fish species herring and capelin (in the Tana 1988 material) (Table 5).

The prey biomass calculations suggest that, in Troms 1988, the cod was eaten by seals of all age groups while saithe was consumed by the older and Norway pout by younger seals (Table 5). Also in the Tana 1988 sample, consumption of saithe was

restricted to the older seals, whilst the stomachs from the younger seals contained more herring (Table 5).

DISCUSSION

The Barents Sea harp seals leave the White Sea area after breeding and moult and follow the pack-ice belt northwards into the Barents Sea (Smirnov 1924, Wiig 1988). Usually, the seals are distributed in open waters along the pack-ice belt in the Barents Sea during summer and autumn, and in October-December they return to coastal waters in the southeastern Barents Sea.

Since 1978 onwards, however, harp seals have appeared in large numbers along the coast of Finnmark, North Norway, in winter and spring (Bjørge et al. 1981). Similar changes in harp seal migrations with resultant invasions of seals to coastal areas of Northern Norway, have also been recorded previously, e.g. at the beginning of the current century (Wiig 1988). According to Bjørge et al. (1981) seals followed migrating capelin into the fjords of eastern Finnmark, and the number of seals drowned in gill-nets was estimated to be more than 10 000 in each of the years from 1978 to 1981. The number of seals drowned probably remained at this level, or even higher, throughout the 1980's (Øritsland 1990). From 1981 onwards, Norwegian authorities have compensated fishermen for destroyed gill-nets, lost catches, and reduced fish availability by making payments for each seal landed. It appears from Fig. 2 that the numbers of seals recorded for compensation purposes are generally much lower than the estimated numbers of drowned animals, and values given in Fig. 2 should be considered as a relative rather than absolute index.

It appears from Fig. 2 that aberrant migratory patterns of harp seals have persisted throughout the 1980's, with dramatic increases in numbers reaching the Norwegian coast in 1987 and 1988. The main invasion was confined to the period January-April (Table 1). The years 1987 and 1988 are noteworthy not only

because of the increased numbers of seals, but also because the invasion was no longer confined mainly to the coast of Finnmark, but included also areas farther south along the the Norwegian coast (Table 3). Wiig (1988) suggested that the number of drowned seals may have been between 60 000 and 100 000 in 1987.

Results of recent tagging experiments (Øien 1989) indicate that some of the harp seals invading the Norwegian coast in 1987 and 1988 originated from areas other than the Barents Sea, i.e., the West Ice which is the pack-ice area in the Greenland Sea (see Fig. 1).

A severe collapse occurred in the Barents Sea stock of capelin in 1985/1986 (see Hopkins & Nilssen 1990), and this may have contributed to the dramatic increase of the harp seal invasion in 1987 and 1988. The capelin stock has been protected from fisheries since 1986, and is now recovering (Anon. 1990). This, combined with a possible reduction in harp seal recruitment in recent years (Anon. 1989) may have contributed to the decreased extent of harp seal invasions indicated by the sharp decrease in harp seal bycatches from 1988 to 1989 (Fig. 2). The background for the more moderate invasions, which have prevailed since 1978, is by no means fully understood. It has been pointed out, however, that these invasions have coincided with a period of low temperatures and salinities, an extensive ice cover and a westerly distribution of both producers, grazers and predators in the Barents Sea (Øritsland 1990).

In the late 1940's a mean age at sexual maturity of 3-4 years was suggested for White Sea harp seals (Chapsky 1963). Age at maturity, which appears to be subjected to density dependent processes (Sergeant 1966), has not been investigated for the harp seals in this area recently. Nevertheless, it seems evident that the seals sampled along the Norwegian coast in 1988 comprised a mixture of immature and mature seals, and the age composition (Fig. 3) was similar to age compositions observed among moulting harp seals in the Barents Sea (Benjaminsen 1979). The presence

of both immature and adult seals was confirmed also during previous invasions (Bjørge et al. 1981, Wiig 1988).

The diet of harp seals occurring along the coast of North Norway during winter is quite varied, comprising a number of fish species as well as prawn and squid (Table 4 and 5). This is in general agreement with observations made on harp seals wintering in coastal waters of Greenland (Kapel & Angantyr 1989). Among fishes, gadoid species (in particular cod, saithe, haddock and Norway pout) dominated the diet of seals in Lofoten and Troms, whereas the pelagic shoaling fishes herring and, to a lesser extent, capelin occurred in the stomachs of seals taken in Finnmark. It should be noted, however, that the rapid erosion of herring and capelin otoliths (Murie & Lavigne 1985, Jobling & Breiby 1986, Jobling 1987) may have led to an underestimation of these two species in the analyses. Other otoliths, e.g., those of gadoids, are known to resist erosion to a much larger degree, but fish size may be underestimated if otoliths are extracted from heavily digested stomach samples. It must also be emphasized that stomach analyses based upon otoliths assumes that the whole fish, or at least the fish head that contains the otoliths, are eaten. In some instances harp seals have been reported to eat the soft parts of large (3-4 kg), dead gadoids entangled in gill-nets (Nilssen et al. 1990). Whether this feeding habit, which implies predation that would be unregistered when employing the present form of stomach analyses, is applicable to free-swimming large fish is, however, not known.

The diet of the harp seals sampled in the current study seems to diverge from observations made in previous years, particularly with respect to the representation of capelin. During the years 1978-1981, the harp seals appearing in Finnmark were suggested to prey almost exclusively upon spawning capelin and demersal capelin eggs (Bjørge et al. 1981). Similar observations were made in these areas during winter of 1984, but some cod were also reported to have been eaten by the seals (Wiig 1988). The collapse of the Barents Sea capelin stock in the mid 1980's

(Hopkins and Nilssen 1990) may have contributed to the apparent reduction in the importance of this species as a prey for the harp seals.

The importance of Crustaceans, particularly prawns, in the diet of harp seals has been emphasized by several authors (e.g., Sergeant 1973, Kapel & Angantyr 1989). A considerable numerical abundance of prawns was confirmed in the current study, and prawns were found to occur frequently in the stomachs of the older seals. The relative importance of prawns is, however, greatly reduced when the data are expressed in terms of biomass instead of numbers.

The apparent temporal change in the relative composition of the diet (in particular the reduced importance of capelin) and the observed variation in stomach contents between areas (Finnmark versus Troms/Lofoten) support the suggestions made by previous authors (Bowen 1985, Kapel & Angantyr 1989) that harp seals feed opportunistically. According to Bowen (1985), it is unlikely that the harp seal, being a long-lived predator, could specialize on one particular prey item such as capelin, especially given the considerable natural fluctuations which may occur in capelin biomass.

ACKNOWLEDGEMENTS

The following are thanked for collecting biological samples from harp seals: P.E. Aspholm, K.A. Fagerheim, C. Lydersen, J.R. Martinsen and J. dos Santos. Unpublished data were made available by the Sea Mammal Section, Institute of Marine Research, Bergen. M. Jobling, Tromsø, and T. Øritsland, Bergen, are thanked for commenting on the manuscript. The ecological studies of harp seals are supported by funding from the Norwegian Council of Fisheries Research (NFFR), project no. I 701.260.

REFERENCES

Anon. 1989. Ressursrapport for 1989 og miljørapport for 1988. Fisken Hav. 1989 (Særnummer 1): 1-99.

Anon. 1990. Ressursoversikt for 1990. Fisken Hav. 1990 (Særnummer 1): 1-80.

Benjaminsen, T. 1979. Pup production and sustainable yield of White Sea harp seals. FiskDir. Skr. Ser. HavUnders. 16: 551-559.

Berg, J. 1979. Discussion of methods of investigating the food of fishes, with reference to a preliminary study of the prey of Gobiusculus flavescens (Gobiidae). Mar. Biol. 50: 263-273.

Bjørge, A., Christensen, I. & Øritsland, T. 1981. Current problems and research related to interactions betweem marine mammals and fisheries in Norwegian coastal and adjacent waters. Coun. Meet. int. Coun. Explor. Sea 1981/N:18: 10 pp (Mimeo).

Bowen, W.D. 1985. Harp seal feeding and interactions with commercial fisheries in the north-west Atlantic. Pp. 135-152 in: Beddington, J.R., Beverton, R.J.H. & Lavigne, D.M. (eds). Marine Mammals and Fisheries. George Allen & Unwin, London. 354 pp.

Bowen, W.D., Sergeant, D.E. & Øritsland, T. 1983. Validation of age estimation in harp seal, Phoca groenlandica, using dentinal annuli. Can. J. Fish. Aquat. Sci. 40: 1430-1441.

Breiby, A. 1985. Otolitter fra saltvannsfisker i Nord-Norge. Tromura Naturvitensk. 53: 30 pp.

Chapsky, K.K. 1963. Studies of the reproductive system of the

harp seal and the breeding intensities of its White Sea population. (In Russian). Trudy PINRO 15: 215-234.

Eliassen, J.-E. & Jobling, M. 1985. Food of the roughhead grenadier, Macrourus berglax Lacepede, in North Norwegian waters. J. Fish Biol. 26: 367-376.

Härkönen, T. 1986. Guide to the otoliths of the bony fishes of the northeast Atlantic. Danbiu ApS, Hellerup, Denmark. 256 pp.

Haug, T. 1981. Grønlandssel, klappmyss og selfangst på Ishavet. Ottar 132: 16-30.

Hopkins, C.C.E. & Nilssen, E.M. 1990. The rise and fall of the Barents Sea capelin (Mallotus villosus): a multivariate scenario. PRO MARE SYMPOSIUM Trondheim, Norway, 12-16 May 1990: In subm.

Hyslop, E.J. 1980. Stomach content analysis - a review of methods and their application. J. Fish Biol. 17: 411-429.

Jobling, M. 1987. Marine mammal faeces samples as indicators of prey importance - a source of error in bioenergetics studies. Sarsia 72: 255-260.

Jobling, M. & Breiby, A. 1986. The use and abuse of fish otoliths in studies of feeding habits of marine piscivores. Sarsia 71: 265-274.

Kapel, F. & Angantyr, L.A. 1989. Feeding patterns of harp seals (Phoca groenlandica) in coastal waters of West Greenland, with a note on offshore feeding. Coun. Meet. int. Coun. Explor. Sea 1989/N:6: 28 pp (Mimeo).

Kashiwada, J., Recksiek, C.W. & Karpov, K.A. 1979. Beaks of the

market squid, Loligo opalescens, as tools for predator studies. Cal. Coop. Ocean. Fish. Inv. Rep. 20: 65-69.

Lydersen, C., Angantyr, L.A., Wiig, Ø. & Øritsland, T. 1989. Feeding habits of northeast Atlantic harp seals Phoca groenlandica along the summer ice edge of the Barents Sea. Coun. Meet. int. Coun. Explor. Sea 1989/N:11: 13 pp (Mimeo).

Murie, D.J. & Lavigne, D.M. 1985. Digestion and retention of Atlantic herring otoliths in the stomachs of grey seals. Pp. 292-299 in: Beddington, J.R., Beverton, R.J.H. & Lavigne, D.M. (eds). Marine Mammals and Fisheries. George Allen & Unwin, London. 354 pp.

Nilssen, K.T., Grotnes, P. & Haug, T. 1990. The effect of invading harp seals (Phoca groenlandica) on local fish stocks in North Norway. ICES CM 1990: In prep.

Øien, N. 1989. Mark-recapture experiments on harp seals breeding in the West Ice. ICES Working Gr. Harp and Hooded Seals, Bergen 16-18 October 1989, working paper, 8pp.

Øritsland, T. 1990. Seals in the northeast Atlantic and interactions with fisheries. Comité Arctique International, Commentary 1990 (2): 10-13.

Sergeant, D.E. 1966. Reproduction rates of harp seals, Pagophilus groenlandicus (Erxleben). J. Fish. Res. Board Can. 23: 757-766.

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

Sivertsen, E. 1941. On the biology of the harp seal Phoca groenlandica Erxl. Investigations carried out in the White Sea 1925-1937. Hvalrådets Skr. 26: 1-166.

Smirnov, N. 1924. On the eastern harp seal Phoca (Pagophoca) groenlandica var. oceanica Lepechin. Tromsø Mus. Årsh. 47(2): 1-11.

Treacy, S.D. & Crawford, T.W. 1981. Retrieval of otoliths and statoliths from gastrointestinal contents and scats of marine mammals. J. Wildl. Manage. 45: 990-993.

Wiig, Ø. 1988. Grønlandssel og selinvasjon Hva vet vi - hva tror vi? Naturen 1988(2): 35-41.

Table 1. Number of harp seal stomachs examined in North Norway in 1986 and 1988.

YEAR	MONTHS	AREAS			
		LOFOTEN	TROMS	TANA	FINNMARK COAST
1986	Jan-Feb		60		
1988	Feb		50	47	
	Mar-May	78			119
TOTAL		78	110	47	119

Table 2. Monthly records of harp seals taken as bycatch in Norwegian coastal fisheries during the years 1987-1989. (Data compiled by Norges Råfisklag, Tromsø, Norway. Catches recorded in southern Norway are not included.)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTAL
1987	10742	18718	10850	9181	4316	2155	685		56647
1988	890	5982	4383	3808	3563	2288	457	103	21474
1989	1	3	10	97	851	233	56	63	1314

Table 3. Number of harp seals taken as bycatch in gill-net fisheries in Norwegian counties from Møre to Finnmark inclusive in 1987-1989. Data compiled and kindly provided by Norges Råfisklag, Tromsø, Norway.

COUNTY	NO. OF HARP SEALS IN		
	1987	1988	1989
Finnmark	13353	11399	1277
Troms	16786	6620	8
Nordland	21404	3005	27
North Trøndelag	1612	157	
South Trøndelag	2290	174	2
Møre and Romsdal	1202	119	

Table 4. Frequencies of empty stomachs and identified species of prey in stomachs of immature and mature harp seals captured in gill nets in various coastal areas of North Norway in 1986 and 1988. N = number of stomachs examined.

PREY ITEM	PERCENTAGE OCCURRENCE				
	LOFOTEN 1988 (N=78)	TROMS 1986 (N=60)	TROMS 1988 (N=50)	TANA 1988 (N=47)	FINNMARK 1988 (N=119)
Empty stomachs	11.5	11.7	8.0	8.5	8.4
Mollusca:					
Cephalopoda:					
Gonathus fabricii		1.7			
Todarodes sagittatus		3.3			
Unident. cephalopod remains	5.1				10.1
Crustacea:					
Decapoda:					
Pandalus borealis	1.3	20.0	46.0	72.3	47.1
Pisces:					
Clupeidae					
Clupea harengus	39.7	35.0	4.0	55.3	9.2
Osmeridae					
Mallotus villosus		1.7		31.9	17.6
Gadidae					
Gadus morhua	9.0	33.3	60.0	19.1	33.6
Gadiculus argenteus thori	15.4				2.5
Melanogrammus aeglefinus	10.3	40.0	58.0	8.5	18.5
Merlangius merlangus		10.0	2.0	2.1	
Micromesistius poutassou	23.1	33.3	30.0	12.8	3.4
Pollachius virens	38.5	45.0	30.0	12.8	5.9
Trisopterus ismarckii	25.7	43.3	68.0	8.5	4.2
Molva molva		3.3		2.1	
Rhinonemus cimbrius	2.6			2.1	0.8
Uident. gadoid remains	11.6	6.7	14.0	2.1	9.2
Anarhichadidae					
Anarhichas sp.					5.9
Zoarcidae					
Lycodes vahlii					4.2
Scorpenidae					
Sebastes sp.	2.6	10.0	20.0	10.6	18.5
Cottidae					
Myoxocephalus scorpius					5.9
Pleuronectidae					
Pleuronectes platessa		15.0	16.0	2.1	1.7
Glyptocephalus cynglossus		1.7	34.0	4.2	3.4
Hippoglossoides platessoides		23.3	22.0	8.5	10.1
Unident. pleuronectoid remains		6.7	10.0	6.4	6.0

Table 5. The relative composition of stomach contents in harp seals sampled in Troms and Tana in 1988, by age groups of seals; based on numerical frequencies of occurrence (num) and calculated fresh weight (biom). N = number of stomachs examined.

PREY	COMPOSITION (%)											
	TROMS 1988						TANA 1988					
	1 year N=5		2-4 years N=15		5+ years N=26		1 year N=1		2-4 years N=22		5+ years N=20	
	num	biom	num	biom	num	biom	num	biom	num	biom	num	biom
Prawns	52.7	6.9	22.2	4.2	67.0	10.4	50.0	33.3	26.5	12.7	58.2	17.7
Herring					0.2	0.7	50.0	66.7	58.8	56.4	23.7	8.8
Capelin									8.0	4.7	7.2	2.0
Cod	6.8	65.7	2.4	11.2	5.3	20.0			2.3	15.5	3.3	26.9
Haddock	2.7	1.6	5.0	6.4	4.7	13.9			0.8	2.4	0.4	1.6
Blue whiting	8.1	0.1	6.7	0.3	2.9	0.2			1.3	0.4	1.0	0.2
Norway pout	23.0	20.1	52.0	49.2	9.4	6.6			0.6	0.2	0.7	0.2
Saithe	1.4	3.0	1.6	8.6	1.8	33.9			0.2	1.1	2.0	34.1
Plaice			1.8	7.4	0.4	1.4					0.3	3.1
Redfish			4.5	5.7	4.4	3.3			1.0	3.1	0.7	1.7
Various	5.3	2.6	3.8	7.0	3.9	9.6			0.5	3.5	2.5	3.7

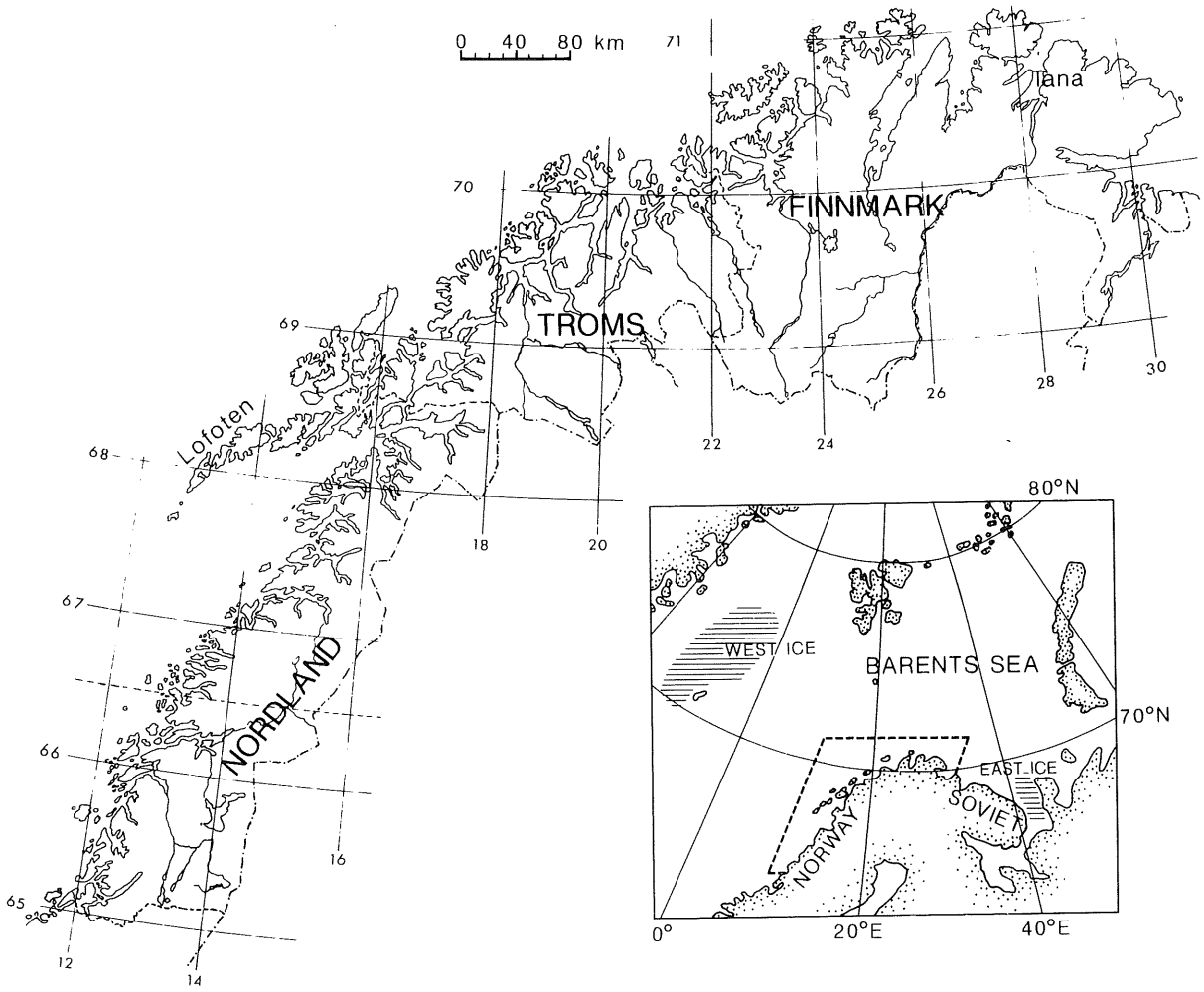

Fig. 1. Map showing the three northernmost counties of Norway. The West Ice and the East Ice sealing areas are indicated by hatching on the overview map.

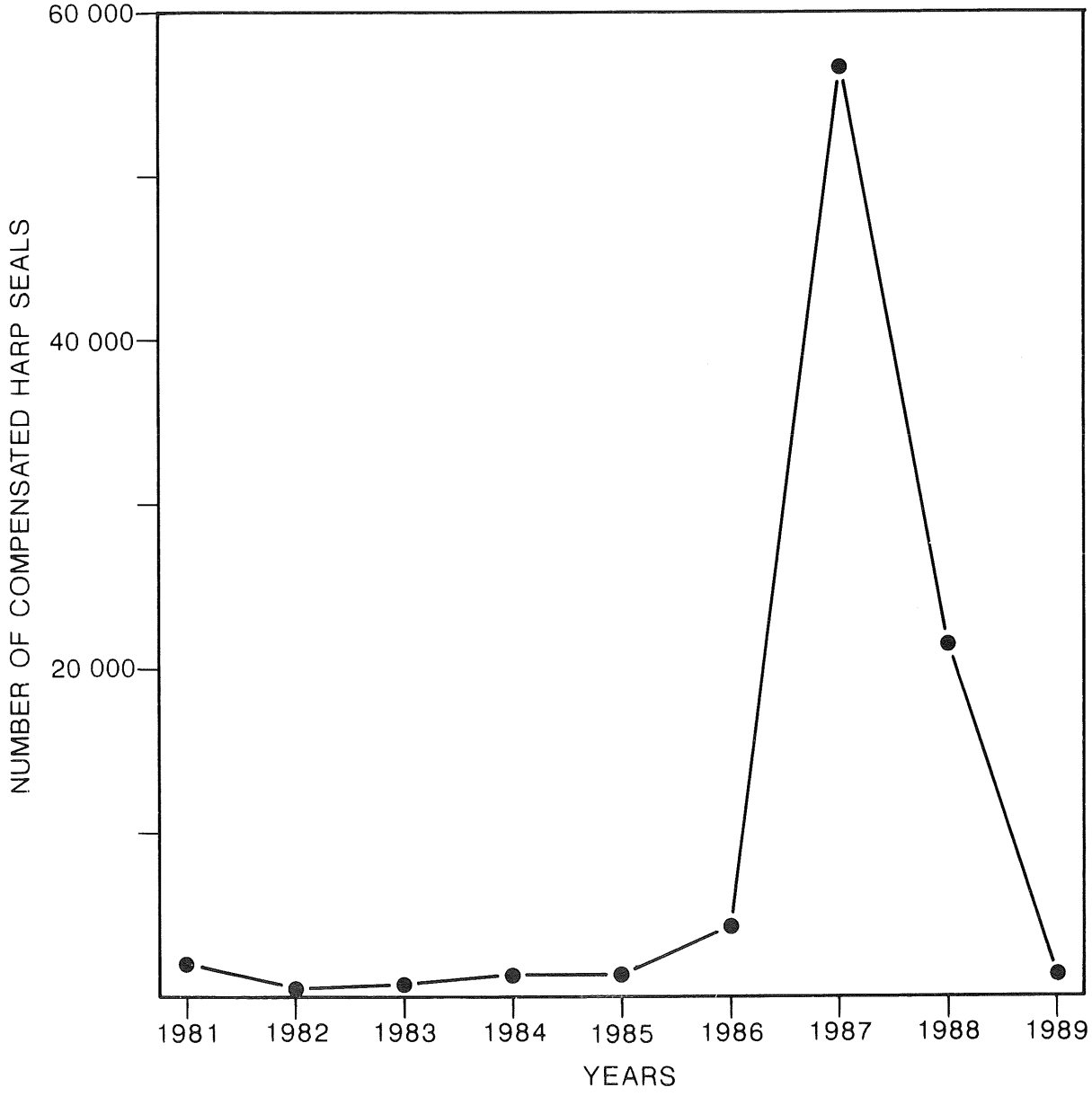

Fig. 2. Number of seals taken as bycatch in Norwegian gill-net fisheries and reported for financial compensation by Norges Råfisklag throughout the 1980's.

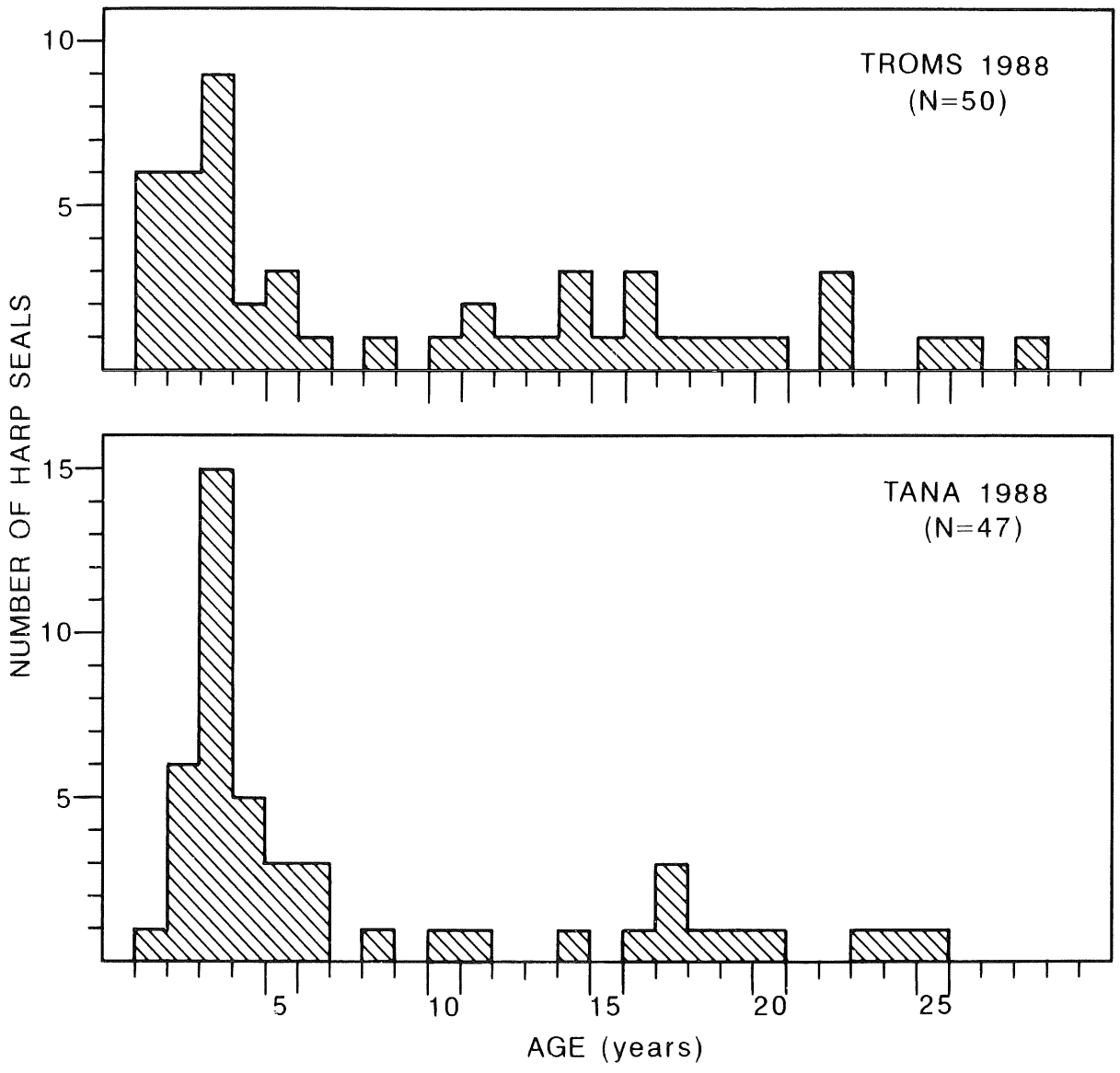

Fig. 3. Age composition of harp seals sampled in Troms and Tana in 1988. N = number of seals examined.

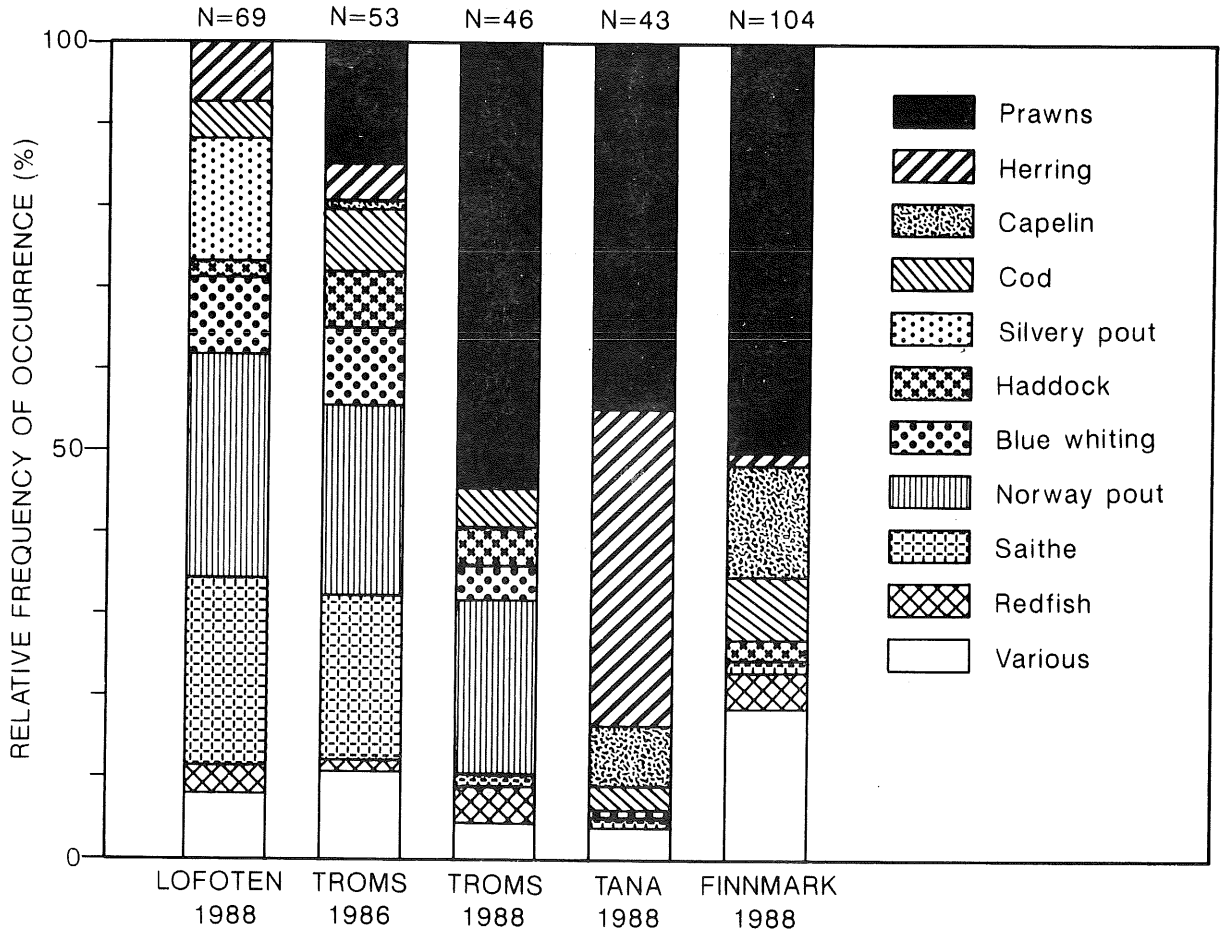

Fig. 4. Food composition, expressed as relative frequency of occurrence (by numbers) of prey organisms, in harp seals sampled in Troms and Finnmark counties in 1986 and 1988. N = number of stomachs examined.

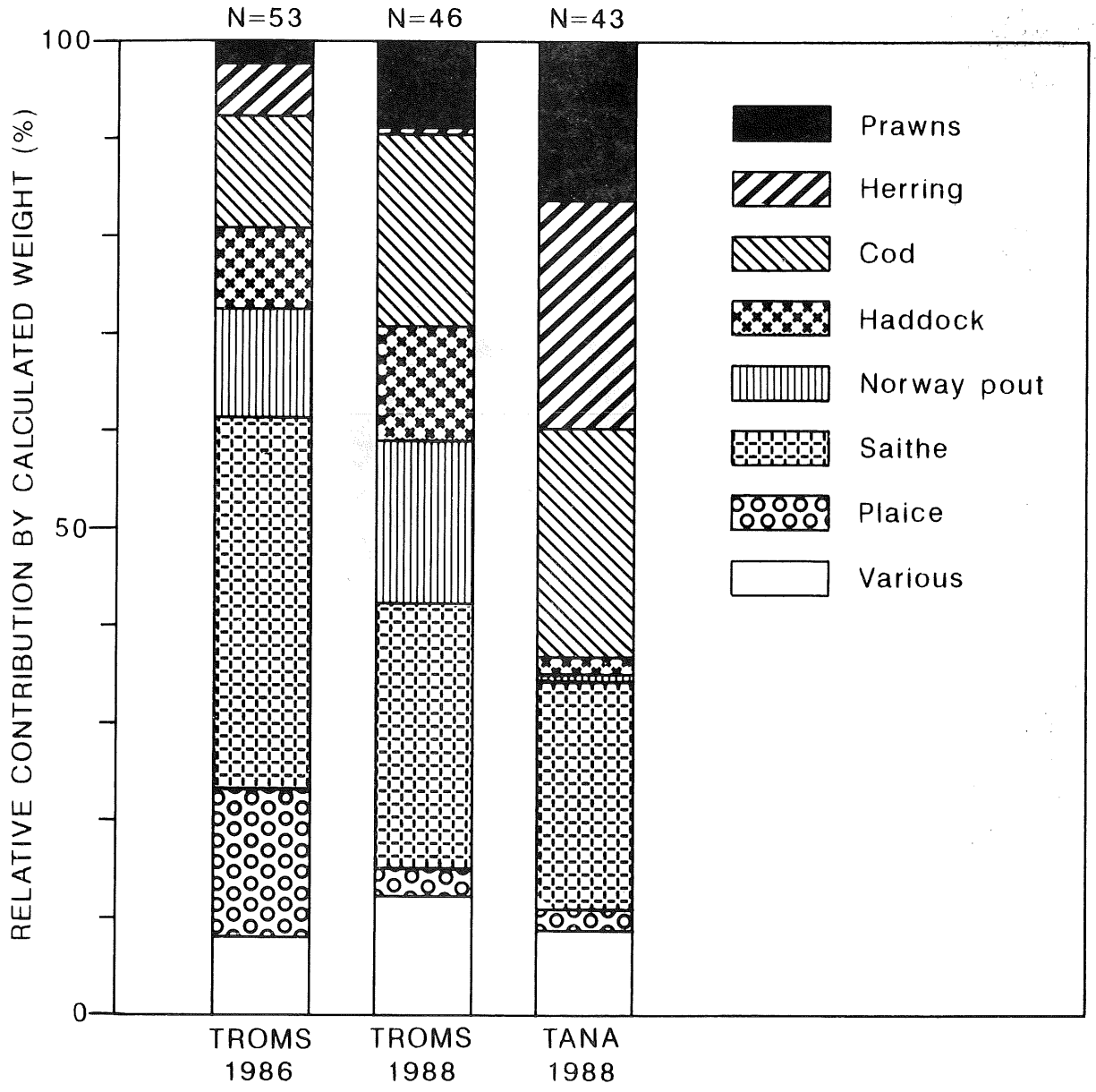

Fig. 5. Food composition, expressed as relative biomass (by calculated fresh weight) of prey organisms, in harp seals sampled in Troms and Finnmark counties in 1986 and 1988. N = number of stomachs examined.