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Change in the degree of infestation of parasitic nematodes in Grey Seals *Halichoerus grypus* from Froan, Norway

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Change in nematode infestation in stomachs of Grey Seals caught at the breeding ground at Froan on the coast of Sør-Trøndelag county, Norway, is recorded. The abundance of nematodes decreased from 1977/78 to 1982/84. In the first period more than 50% of the seals had more that 1000 nematodes whereas in 1982/84 most of the seals had fewer than 500 nematodes in their stomachs. In the same period the breeding stock of seals in the area has increased. The decreased infestation of nematodes in the seals might be an effect of change in food habits from demersal to pelagic fish.

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INTRODUCTION

Three species of parasitic nematodes have been recorded from the stomachs of Grey Seals *Halichoerus grypus* at the Norwegian coast: *Phocanema decipience, Anisakis simplex* and *Contracoecum osculatum* (Bjørge 1984).

The Grey Seal appears to be the most important definitive host of *P. decipience* in the North Atlantic (e.g. McClelland *et al.* 1983) A coincidence of Grey Seal population growth and increased abundance of *P. decipience* in the nearby groundfish populations has clearly been documented (Young 1972, Mansfield and Beck 1977, McClelland *et al.* 1983, Hauksson 1985).

The abundance of coastal seals in Norway increased after 1973 when all seals were protected throughout the year in southern Norway and from 1 May to 30 September north of 61°N (Bjørge *et al.* 1981). In Sør-Trøndelag county which has the highest abundance of Grey Seals in Norway (Wiig 1986), local protection has been in force since 1953 (Wiig 1987a).

The increase in numbers of coastal seals caused considerable difficulties for inshore fisheries. The most serious and widely distributed problem is the spreading of parasitic nematodes in fish, particularly in cod *Gadus morhua* (Bjørge et al. 1981).

Bjørge (1984) published data on the nematode infestation in coastal seals on the Norwegian coast in 1977 and 1978. In the present paper some of these data are reevaluated and compared to data on the infestation of Grey Seals from Froan in Sør-Trøndelag in 1982 and 1984.

MATERIAL AND METHODS

The present work is based partly on data from 25 Grey Seals caught in the breeding season at Froan in Sør-Trøndelag in 1977 and 1978 (Bjørge 1984) which are compared to data from 21 seals caught at Froan in the breeding seasons of 1982 and 1984.

In 1977 and 1978 the nematodes in the seal stomachs were counted in the field and subsamples of about 30 nematodes from each seal were collected for further identification (Bjørge 1984). The rest of the material has been taken from stomachs fixed in formaline by the hunters. Only stomachs from seals older than four years were used in the present study.

It is often difficult to count the number of nematodes exactly, particularly in stomachs

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Table 1. Degree of infestation of parasitic nematodes in the stomachs of Grey Seals *Halichoerus grypus* from Froan, Norway, caught in the breeding season. The seals are grouped in relation to estimated numbers of nematodes.

Year	Number of nematodes				
	0-500	501-1000	>1000	Range	Mean
1977	2	4	7	50-2870	1272
1978	3	2	6	160-3780	1613
1982	10	2	0	80-900	332
1984	10	2	2	40-1500	504

which are heavily infested. This is because small and large nematodes often are intertwined into balls which are difficult to disentangle without tearing the nematodes into several pieces. The numbers of nematodes counted in individual stomachs therefore are estimates rather than exact numbers. In addition, the resulting numbers of nematodes do not seem to follow a normal distribution. It therefore seems reasonable to group the seals according to degree of estimated infestation when testing for differences between years. The yearly means are, however, also given.

RESULTS

The distribution of Grey Seals in relation to the degree of infestation of parasitic nematodes in their stomach is given in Table 1.

The distributions in 1977 and 1978 are not significantly different ($\chi^2 = 0.78$, $P > 0.05$), neither are the distributions in samples from 1982 and 1984 ($\chi^2 = 1.86$, $P > 0.05$). However, a comparison of the pooled distributions from 1977 and 1978 to those from 1982 and 1984 gives a highly significant result ($\chi^2 = 17.4$, $P < 0.001$).

Accordingly it appears that the degree of infestation has decreased from 1977/78 to 1982/84. In the first period more than 50% of the seals had more than 1000 nematodes whereas in 1982/84 most of the seals had fewer than 500 nematodes in their stomachs.

DISCUSSION

According to Bjørge (1984) *P. decipiens* was the most abundant species in adult Grey Seals in 1977 and 1978, constituting more than 90% of the total count. *A. simplex* and *C. osculatum* amounted to less than 5% and less than 2%, respectively. The same frequences are found in a sample taken at Froan in 1985 (Bjørge 1987). The detected decrease in parasitic nematodes in Grey Seals in Sør-Trøndelag county from 1977/78 to 1983/84 therefore must imply a decrease of *P. decipiens* infestation.

In an attempt to halt the increase in numbers of coastal seals in Norway a tentative five years culling program was initiated in 1980. The program included a total cull of 1220 Grey Seals through 1980—84 of which 690 in Sør-Trøndelag. Less then 50% of these seals were killed and most of them were taken during the autumn of 1984 (Wiig 1987b).

According to Wiig (1987c) the breeding stock of Grey Seals at Froan increased from 1974 to 1983 with 70—80%. A halt in this increase was indicated by the pup counts in 1985 to 1987. The halt is probably due to the culling in 1984 and 1985. The decrease in the infestation of seals from 1977/78 to 1982/84 therefore cannot be explained as an accumulated effect of decreased infestation in the fish due to lower numbers of seals, but rather as an effect of changes in food habits or in the availability of prey species. A change in the abundance of *P. decipience* in Grey Seals with change in prey species has been documented in Canadian waters (Stobo and Beck 1985).

The life cycles of *P. decipience* and *A. simplex* show many similarities. However, *P. decipience* follows a benthic food chain whereas *A. simplex* follows a pelagic food chain (Bjørge 1979). In addition, the larval *P. decipience* infects the muscles of the fish and is therefore economically more important than *A. simplex* which infect the viscera. Changes in the species distribution of parasitic nematodes in Grey Seals therefore may be related to a transition from benthic to pelagic food items of the seals (Bjørge 1984).

As pointed out by Bjørge (1984) a major ecological event like the breakdown of the herring stocks in Norwegian coastal waters may have caused the increased infestation of cod worm during the 1970's. In the 1980's, however, the herring stocks on the Norwegian coast have again increased (Anon. 1986) while the infestation of *P. decipience* in the stomachs of Grey Seals has decreased. A likely hypothesis which remains to be tested is therefore that Grey Seals in Sør-Trøndelag have changed their diet from cod and other benthic fishes to pelagic herring.

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