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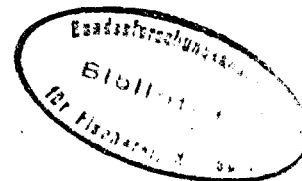
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Nematode infestation and feeding
habits of Icelandic seals

by

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1. Introduction

In connection with research on the codworm problem the Icelandic Fisheries Laboratories began in 1972 to collect information about the Icelandic seal stocks mainly aiming at the estimation of the population size and to locate the main breeding areas (Arnlaugsson, 1973). In 1975 investigation concerning the infestation of seals by ascaridoid nematodes and feeding habits of seals was started.

This paper deals with the information that have been collected on the nematode infestation and the food residues found in the stomachs of those seals.

2. Materials and methods

Sampling was done in cooperation with the Marine Research Institute, either by shooting the seals when hauled out on a beach or by collecting stomachs and intestines from seals drowned in fishermen's nets or shot by fishermen on open sea. Stomachs of 49 common seals (Phoca vitulina), 9 grey seals (Halichoerus grypus) and 9 ringed seals (Pusa hispida) were collected and in most cases the intestines were also saved.

Samples were taken from various locations around Iceland. Samples taken especially for this purpose were examined fresh but samples from fishermen were usually frozen.

The stomachs were cut open and the content weighed. When more than one type of food item was found in a stomach, they were weighed separately. Small intestines were cut longitudinally and identifiable food residues collected. All nematodes were collected, killed in glacial acetic acid when from fresh samples, and preserved in 70% isopropyl alcohol. Before identification the nematodes were cleared in lactophenol or creosote when necessary.

3. Results

3.1. Feeding habits

There was considerable difference between the two methods of sampling. The percentage of empty stomachs was much higher in the samples of seals that were shot when hauled out as shown for common seals in table 1. Seals shot when hauled out give poor information about their food selection.

The samples of common seals are mostly from late winter (March-April). This must be kept in mind when the results are considered. The results (table 2) indicate that at least for a part of the year the capelin (Mallotus villosus), which is then very abundant, is the most common food item, both as percentage of weight and frequency of occurrence. Next in the row are sandeels (Ammodytes sp.) and codlike species, mainly cod (Gadus morhua). Frequency of occurrence of otoliths in intestine (table 3) shows similar results, i.e. the occurrence of capelin is highest, followed by sandeels and cod.

The number of grey seals is small but the results indicate that the feeding habits of this species resemble those of the common seal (table 4).

The ringed seals are only visitors at the coast of Iceland and are in most cases seen in late winter (March-April) at the North coast. They seem mainly to be feeding on capelin (table 5).

3.1:1. Discussion

These results do not show any significant difference between the feeding habits of common seals and grey seals. In this survey no sandeels were found in the stomachs of the grey seals, but in a study on food of seals by using seal-excreta (Eldon, 1977) the grey seals in Faxafloi and Breidafjörður was found to feed heavily on sandeels, at least in January and February.

Of 30 stomachs from common seals containing food residues 21 (70%) contained only 1 food item and when only considering freshly eaten food about 85% of the stomachs contained single food item. Similar trend seems also to be true for the grey seals. The results indicate that the seals of Iceland feed mainly on fish and tend to prey on that fish species which is most abundant or easiest to catch at the moment. A difference in feeding habits of the seals according to the time of year, and also possibly a difference between areas, is therefore likely to exist because of variation in the available food. At present the sample size is too small to make any definite conclusions on this.

3.2. Nematode infestation

Nematodes have been identified from the following number of stomachs and intestines:

	<u>Stomachs</u>	<u>Intestines</u>
Common seal	36	26
Grey seal	6	5
Young grey seal (3 months old)	3	3
Ringed seal	9	7

Four species of ascaridoid nematodes were found. Those were Phocanema decipiens (Krabbe, 1878), Myers 1959; Phocascaris cystophorae, Berland 1963; Contracaecum osculatum, (Rud., 1802), Baylis, 1920; and Anisakis sp. which according to Pippy and von Banning (1975) is Anisakis simplex (Rud., 1809, det. Krabbe, 1878). No effort was made to distinguish between larval stage of P. cystophorae and C. osculatum, and are here referred to as Phocascaris sp. larva, Berland 1963.

Tables 6 and 7 show the mean number and frequency of occurrence of those 4 nematode species found in the common seals. P. decipiens was by far the most common species and matures in the seal stomach. P. cystophorae seems to mature mainly in the uppermost part of the small intestine (duodenum) and was the second most common species found in adult stage in the common seal. C. osculatum matures in the stomach and was the least common of the 3 species found adult. A. simplex was not found as an adult in common seals.

In the grey seals the same 4 nematode species were found (table 8), but the worm infestation was considerably higher than in the common seals. P. decipiens was most common of the adult nematodes, followed by C. osculatum and P. cystophorae. A. simplex was found adult in one case and only one individual (female).

Of 3 young grey seals, about 3 months old (table 9), 2 had already been infested with some nematodes, but the incidence was low.

The infestation of ringed seals was low and no mature nematodes were found (table 10).

3.2.1. Discussion

P. decipiens (the codworm) is the most common species found to mature in the seals, but in the April sample of common seals there is a reduction in number and occurrence of this nematode. At the same time the number of Phocascaris sp. larvae in the stomach and adult P. cystophorae in the

small intestines increases. These changes in nematode fauna coincides with a change in the food of the seals, in April the capelin becomes the main food item. In examination of 100 capelins the following number of larval nematodes were found: 18 Phocascaris sp., 7 Thynnascaris aduncum and 3 A. simplex. The capelin was not found to harbour P. decipiens larvae. If the seals feed only on capelin for some time, this would decrease the infestation of P. decipiens but increase that of P. cystophorae, as found in the April sample.

Of the 3 species of fish found to be of major importance as food of seals only the cod is known to be infested with the codworm and therefore probably the main source of P. decipiens infection of Icelandic seals.

The seals at Iceland can hardly be considered an important final hosts for A. simplex.

References

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Table 1. Number of common seals examined

	<u>N</u>	<u>Empty</u>	<u>Percent empty</u>
Shot when hauled out	20	15	75
From fishermen's nets or shot on open sea	29	5	17

Table 2. Stomach content of common seals from the coast of Iceland. Percentage of weight of food residues from each month, total percentage of weight and total frequency of occurrence.

Month	Stomachs		Cod-spec.	Capelin	Sandeels	Flatfishes	Redfish (<u>Sebastes</u> sp.)	Other fish species	Unidentif. food resid.
	N	Empty							
January	4	2	15						85
February	1	1							
March	8	1	52		32		16		
April	22	8	9	89		+		1	+
May	2	0	31	69					
June	2	1				(100)			
July	2	0		58		42			
August	3	2			(100)				
September	0								
October	0								
November	5	4			90	10			
December	0								
Total	49	19							
% weight			22	40	28	5	4	+	1
% freq.		40	20	29	12	10	2	6	4

Table 3. Frequency of occurrence of otoliths found in the small intestines of common seals (N=38).

	<u>Percentage frequency</u>
Cod-species	26
Capelin	42
Sandeels	29
Flatfishes	16
Redfish	5
Unidentified	11

Table 4. Stomach content of grey seals from the coast of Iceland. Percentage of weight of food residues and frequency of occurrence. (N=9, Empty=3).

	<u>Cod-sp.</u>	<u>Capelin</u>	<u>Flatf.</u>	<u>Redf.</u>	<u>Catf.</u>	<u>Unidentif. food resid.</u>
% of weight	31	33	18	5	13	+
% frequency	33	22	11	11	11	11

Table 5. Stomach content of ringed seals from the coast of Iceland. Percentage of weight of food residues and frequency of occurrence. (N=9, Empty=1).

	<u>Cod-species</u>	<u>Capelin</u>	<u>Crustacea</u>
Percentage of weight	3	96	1
Percentage frequency	22	56	11

Table 6. Nematodes found in the stomachs of the common seals.

	<i>P. decipiens</i>		<i>C. osculatum</i> Adults	<i>P. cystophorae</i> Adults	<i>Phocascaris</i> sp. Larvae	<i>A. simplex</i>	
	Ad.	Larv.				Ad.	Larv.
January \bar{X}	64.0	86.0	2.8	0	7.5	0	17.0
(N=4) % freq.	75	100	75	0	100	0	75
Feb. (N=1)	114	533	1	0	4	0	25
March \bar{X}	44.9	67.6	0.1	0.1	7.9	0	44.8
(N=8) % freq.	100	100	13	13	88	0	100
April \bar{X}	6.9	41.6	1.8	0.4	237.6	0	14.3
(N=14) % freq.	43	50	21	21	100	0	79
May (N=1)	89	42	43	8	44	0	3
June (N=2) \bar{X}	9.0	17.5	0	0	2.0	0	0
July (N=1)	0	0	0	2	521	0	16
November \bar{X}	30.4	22.8	2.2	0	4.8	0	0.8
(N=5) % freq.	100	100	60	0	80	0	40
Total \bar{X}	30.1	60.9	2.6	0.4	111.6	0	18.7
(N=36) % freq.	72	78	33	17	94	0	75

Table 7. Nematodes in the intestines of the common seals.

	P. decipiens		C. osculatum Adults	P. cystophorae Adults	Phocascaris sp. Larvae	A. simplex	
	Ad.	Larv.				Ad.	Larv.
Jan. (N=4) \bar{X}	9.0	12.3	0.5	1.0	1.0	0	2.8
% freq.	25	50	25	75	50	0	75
March (N=2) \bar{X}	0	2.0	0	1.5	3.5	0	2.5
% freq.	0	50	0	50	50	0	100
April (N=14) \bar{X}	0	1	0	8.7	32.6	0	5.5
% freq.	0	7	0	71	100	0	57
June (N=1)	1	0	0	4	0	0	0
Nov. (N=5) \bar{X}	0.4	0	0	1.6	0.4	0	0.2
% freq.	20	0	0	40	20	0	20
Total (N=26) \bar{X}	1.5	2.1	0.1	5.4	18.0	0	3.6
% freq.	12	15	4	65	69	0	54

Table 8. Nematodes found in stomachs and intestines of grey seals.

	P. decipiens		C. osculatum Adults	P. cystophorae Larvae	Phocascaris sp. Larvae	A. simplex	
	Ad.	Larv.				Ad.	Larv.
<u>Stomachs</u>							
N = 6 \bar{X}	187.8	507.2	57.8	19.3	277.2	0.2	227.0
% freq	100	100	100	67	100	17	83
<u>Intestines</u>							
N = 5 \bar{X}	12.6	17.0	14.0	24.0	69.4	0	12.2
% freq.	80	80	80	100	80	0	80

Table 9. Nematodes found in 3 months old grey seals.

	P. decipiens		C. osculatum Adults	P. cystophorae Larvae	Phocascaris sp. Larvae	A. simplex	
	Ad.	Larv.				Ad.	Larv.
<u>Stomachs</u>							
N = 3 \bar{X}	2.3	12.0	2.3	2.3	4.7	0	35
% freq.	33	67	33	33	67	0	67
<u>Intestines</u>							
N = 3 \bar{X}	0	0	0.3	6.7	3.3	0	0.3
% freq.	0	0	33	67	67	0	33

Table 10. Nematodes found in stomachs and intestines of ringed seals.

	P. decipiens		C. osculatum Adults	P. cystophorae Adults	Phocascaris sp. Larvae	A. simplex	
	Ad.	Larv.				Ad.	Larv.
<u>Stomachs</u>							
N = 9 \bar{X}	0	0.2	0	0	2.9	0	0.6
% freq.	0	22	0	0	67	0	44
<u>Intestines</u>							
N = 7 \bar{X}	0	0.7	0	0	0.9	0	0.4
% freq.	0	14	0	0	43	0	43