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THE RELATIONSHIP BETWEEN SEAL ABUNDANCE AND
COD WORM (PHOCANEMA DECIPIENS) INFESTATION IN COD
IN NORWEGIAN COASTAL WATERS.

By

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ABSTRACT

A sample of 52 cods, Gadus morhua, caught close to a grey seal, Halichoerus grypus, haul out site, and a total of 652 cods from 18 commercial catches (average sample size 36 cods) were examined with regard to cod worm infestation. The sampling was carried out from July 1978 to January 1981 in Norwegian coastal waters between 62° and 66° North.

The presence of larval cod worm was recorded in 64% of the examined fishes, and the average infestation in all 704 fishes was 8.5 cod-worms per fish. However, the infestation decreased significantly with increasing distances from the haul out sites of grey seals and common seals, Phoca vitulina. The heaviest infestations were recorded in cod from the outer part of in shore waters, and slightly decreasing towards the fiords, fitting well to the observed distribution of seals. A substantial decrease was also recorded with increasing distance (and depth) off shore from the mentioned grey seal haul out site.

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INTRODUCTION

The distribution of cod, Gadus morhua, infested by cod worm Phocanema decipiens, is correlated to the occurrence of seals. Both common seals, Phoca vitulina, and in particular the grey seal, Halichoerus grypus, is known to be an important vector of cod worm (Mansfield and Beck 1975, Rae 1963 and 1972, Scott and Fisher 1958 and Young 1972).

The infestation in cod is increasing with increasing age of the cod (Young 1972), and Wootten (1978) did not record cod worm in cod less than "market size" in Scottish waters.

Norwegian fishermen claim there has been an increase in cod worm infestation during the 1970-ies, and the aim of collecting the material used in this report was to examine the infestation in commercial cod. However, the material might also be used to demonstrate the correlation between cod worm infestation in cod and the abundance of seal in coastal waters.

MATERIALS AND METHODS

Cods from 18 commercial catches (average sample size 36 cods) were collected in the period 1978-1981 in Norwegian coastal waters between 62°N and 66°N. In addition a sample of 52 cods was collected close to a major grey seal whelping and haul out site. No commercial fishing was conducted at this particular site.

The fillets were screened on lighth tables. Such tables are in common use for this purpose by the fish processing plants.

Age determination is based on analysis of otholits, and conducted by the Marine Research Institute in Bergen. However, otholits were not collected along with some of the samples, and these samples may therefor only provide information on infestation in the actual landings. To compare the infestation in cod from different areas, age specific infestation should be used.

RESULTS

The percent of cod infested and the average infestation in examined cod is presented in Table 1. The sampling sites and the abundances of seals are shown in Figure 1, and the age specific infestations of cod worm in cod from different areas are compared in Table 2.

DISCUSSION

The actual part of the Norwegian coast is very complex with fiords, arcipelagos with larger islands and fringes of noumerous smaller islands and skerries. The major whelping and haul out sites of grey and common seals are located in

the outern fringe of skerries. In sample no 11, caught close to a grey seal haul site, 50 of 52 cods were infested, and the average infestation in 5 years old cod was about 81 cod worms per fish (Table 2). In Fig. 2 this sample is compared with sample 12 and 13, collected 4 km and 12 km off shore from the mentioned haul out site. The infestation in 5 years old cod in these samples were reduced to an average of about 22 and 8 cod worms respectively.

Comparing samle 3 with sample 4 and sample 14 with sample 15 shows a slight decreasing infestation of cod worm further in shore. This fits well to the observed distribution of seals. The samples 3,5,7,11,15,16 and 18 also show that the infestation along the outern part of the coast is also varying with the distance from the major seal colonies. Table 1 shows the same paterns in the context of infestation in "commercial cod" (non aged cod of market size).

Although the samples are to small to provide statistically satisfactory results, they indicate a relationship between seal abundance and infestation in cod even in a scale of few kilometers between samples. Animplication of this is that in shore cod is stationary or have migration patterns that prevent throughout mixing. However, this discussion is out of the scope of the present paper.

An other interesting aspect is that while the infestation is increasing with the age of cod younger than five years, this seems not to be the case for 6 years old and older cod. This is possibly due to influx of larger migrating cod from areas with less cod worm infestation, or simply an effect of small sample sizes.

The correlation between abundances of seals and relative infestaation of cod worm in fish, do not nessesarily meen that the number of seals are decisive to the amount of cod worm in an area. Seals feeding on pelagic fish species are not likely to be important vectors of cod worm, and changes in availability of different food species to the seals might have significant impact on the cod worm infestation (Bjørge 1984). This aspect is not well investigated or documented, and should be paid more attention i particular in areas where severe cod worm problems have to be managed.

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Table 1. Incidence of cod worm in cod from Norwegian coastal waters between 62° and 66° North.

Sampl no.	Month-Year	No. of cod	Percent of cod infested	Average infestation
1	11-79	47	51	3.6
2	10-80	26	88	5.9
3	01-81	30	97	23.0
4	10-80	50	90	11.5
5	11-79	63	79	4.8
6	11-79	40	35	3.5
7	10-79	40	10	0.1
8	10-80	30	73	2.3
9	10-79	40	10	0.2
10	01-81	30	93	10.6
11	07-78	52	96	32.0
12	07-78	37	87	10.4
13	07-78	23	65	3.2
14	10-80	28	100	32.4
15	10-79	41	54	1.6
17	11-79	40	60	2.9
18	11-79	37	24	1.9
19	01-81	30	63	2.8
		704	64	8.5

Table 2. Age specific infestation of cod worm in cod from Norwegian coastal waters between 62° North and 66° North. N=number of cod, cw= average infestation of cod worm and sd = standard deviation.

Sample no.	Age of cod																										
	2 years			3 years			4 years			5 years			6 years			7 years			8 years			9 years					
	N	cw	sd	N	cw	sd	N	cw	sd	N	cw	sd	N	cw	sd	N	cw	sd	N	cw	sd	N	cw	sd	N	cw	sd
3	3	4.7	3.8	14	12.7	6.0	6	34.7	20.5	2	32.5	-	2	64.5	-	1	8	-	2	6	-	0					
4	11	3.0	2.4	23	7.8	5.4	10	19.0	16.9	5	28.0	21.9	0			1	30	-	0			0					
5	20	3.6	4.7	26	4.6	6.6	9	6.6	8.9	3	4.7	2.5	2	7.5	-	1	40		0			2	7	-			
6	16	0.4	0.9	11	1.3	3.6	7	3.0	4.1	5	11.4	24.4	0			1	5		0			0					
7	32	0	-	7	0.4	0.5	0			1	0		0			0			0			0					
9	10	0.4	1.3	18	0.1	0.3	10	0.1	0.3	1	0		0			0			0			0					
11	2	0.5	-	24	12.3	10.5	15	33.2	23.1	8	81.1	40.7	2	101.0	-	1	43	-	0			0					
12	0			14	4.9	5.8	16	9.0	7.8	5	22.2	10.7	2	36.0	-	0			0			0					
13	1	1	-	7	2.6	3.3	7	3.3	6.2	3	7.7	13.3	1	2	-	4	1.8	1.3	0			0					
14	3	4.7	2.5	14	15.8	11.8	6	41.2	28.0	3	43.0	58.0	1	150		1	107										
15	0			0			5	1.2	1.6	14	1.5	1.8	13	0.8	1.2	7	0.7	0.7	1	26		0					
16	0			9	8.8	14.8	5	7.0	10.9	3	4.0	6.0	3	11.0	9.5	0			0			0					
17	8	1.6	2.4	22	2.3	3.2	7	4.0	2.2	2	4.5	-	0			0			0			0					
18	11	0.2	0.6	15	1.6	3.5	5	2.2	3.0	2	3.0	-	4	7.5	13.1	0			0			0					

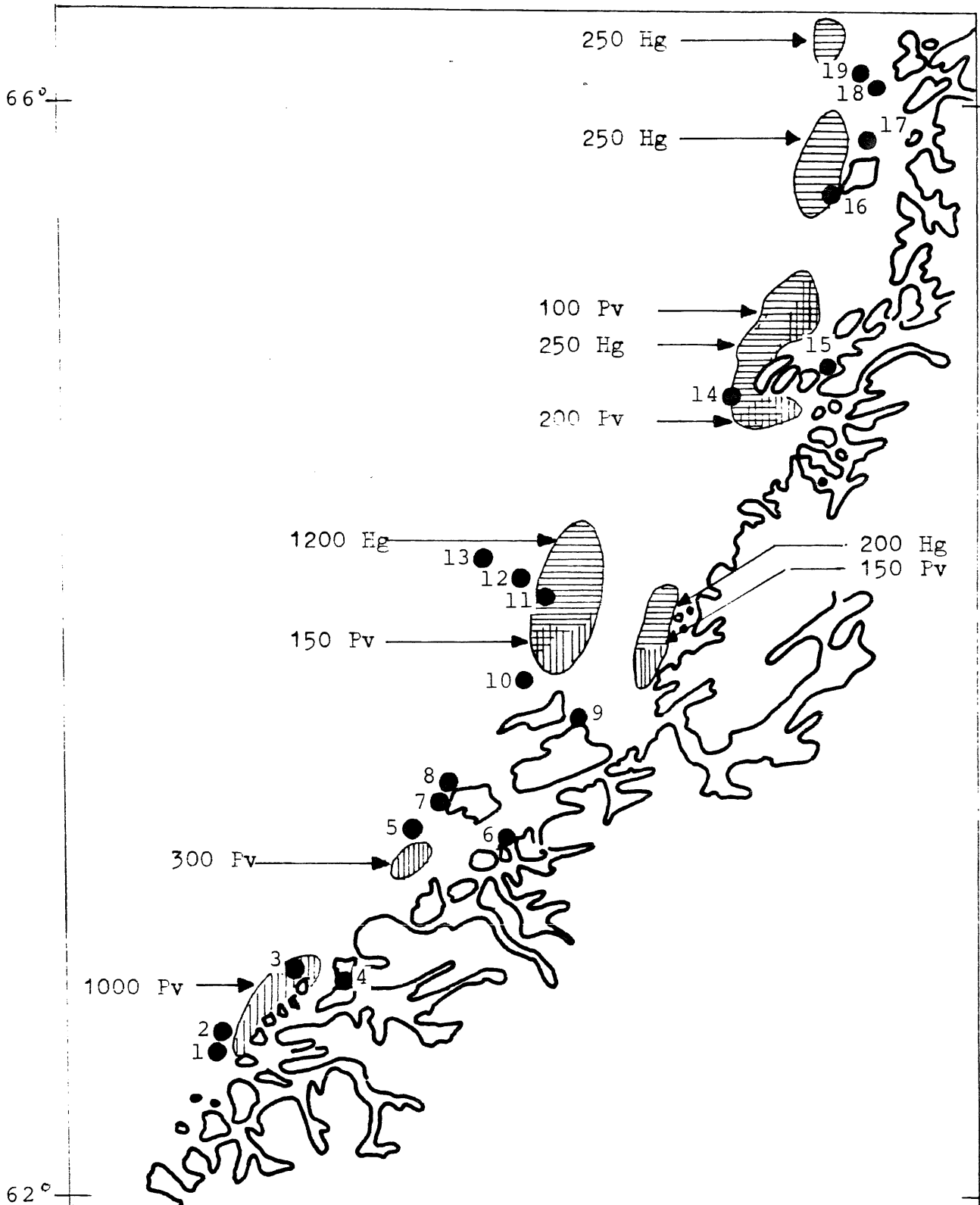


Fig.1 Areas with whelpling haul out sites of the major seal colonies on the Norwegian coast between 62° and 66° North. Vertically hatched = common seal areas and horizontally hatched = grey seal areas. The numbers of seals are also indicated, Pv = common seals and Hg = grey seals. The location for sampling of cod are illustrated with black circles.

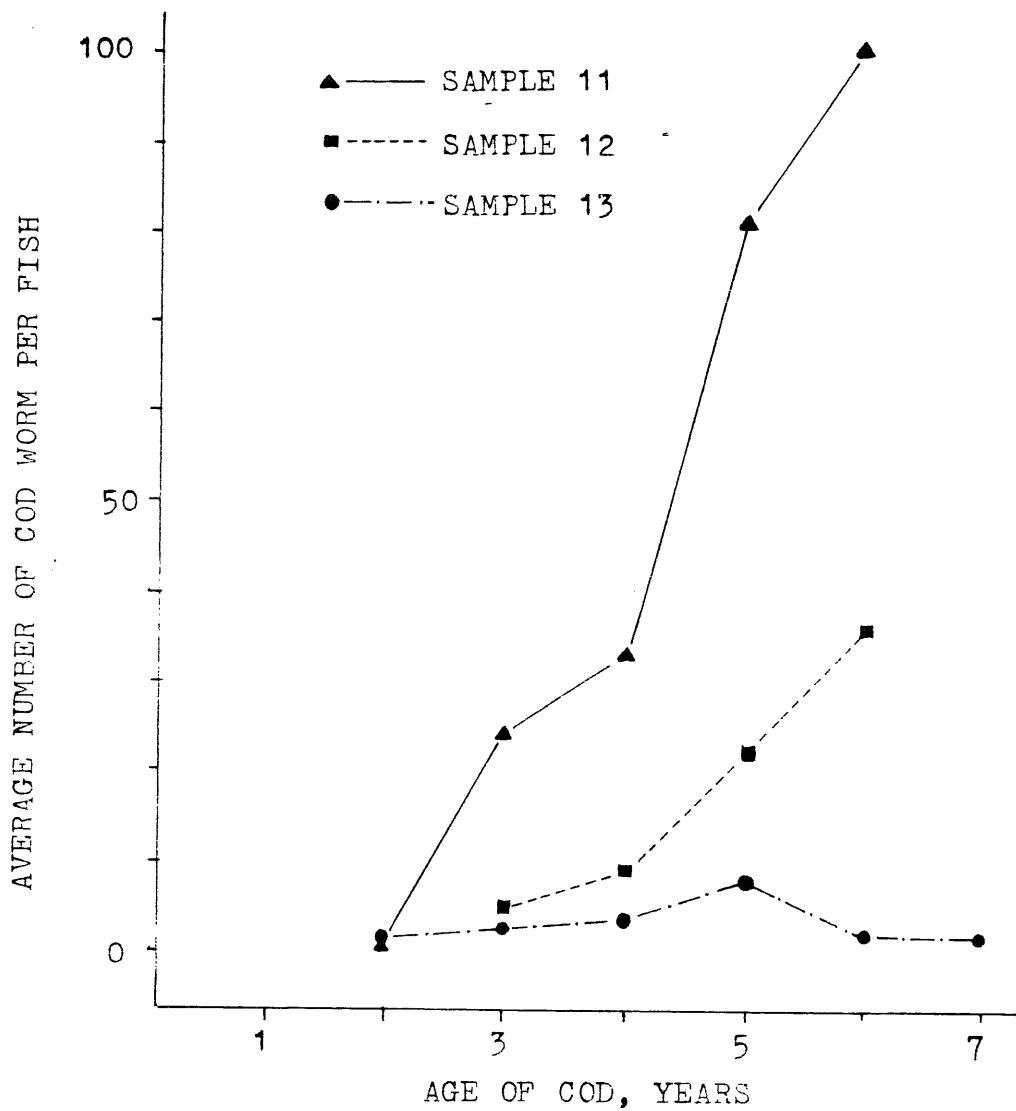


Fig. 2. The infestation of cod worm in cod caught close to a grey seal whelping and haul out site (sample 11) compared with the infestation in cod caught 4 km (sample 12) and 12 km (sample 13) off shore.

