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INCIDENCE AND DISTRIBUTION OF EIMERIA GADI (FIEBIGER, 1913) IN THE HADDOCK

by

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SUMMARY

The coccidian parasite, Eimeria gadi described by Müller in 1842 and by Fiebiger in 1913 has been found in the swim bladders of haddock caught on the Nova Scotia fishing banks. The degree and percentage rate of infection is high, reaching 58% infection rates in samples from Emerald bank. There is a seasonal and geographical variation in the infection rate and the results suggest that the heavily infected fish die off. There was no correlation between sex and the degree or rate of infection. Fish below 35 - 40 cm were not infected but above this size there was no correlation between size an degree of infection.

With the exception of a single specimen of fourbeard rockling, no other gadoid species were found to be infected. Fiebiger had found cod, pollock, and haddock infected in the eastern Atlantic.

The parasite may well be responsible for heavy mortalities in haddock stocks and its effect should be considered when setting catch quotas.

The filling of the swim bladder air space by the parasite would interfere with sonar detection of the fish.

Minced fish prepared from fish frames left after filleting may be contaminated by the parasite.

The parasite could serve as a population marker.

INTRODUCTION

The coccidian parasite, Eimeria gadi, was first described by Müller and Retzius who noted that infected cod swim bladders were filled with yellow matter, consisting of groups of three or four capsules. He termed the parasite a 'psorosperm', a group later considered to be among the myxosporidians. It was not described again until Fiebiger (1913) gave a detailed account of its occurrence in gadoid species. His first encounter with the parasite came during a cruise in 1906 on board a trawler in Icelandic waters. After examining some of the gadoids he reported, 'I observed rather frequently the presence of a yellow creamy mass in the air bladders of fish, which reminded me of thickened pus. Only after my return I discovered under the microscope that this mass to the greater part consisted of coccidian spores.' Fiebiger originally named the parasite Goussia gadi but later changed it to its present name, Eimeria gadi.

Our introduction to E. gadi was similar to Fiebiger's first encounter. On board a trawler on Emerald bank, crewmen cleaning haddock pointed out to us the apparent diseased state of the swimbladders. Subsequent microscopic examination (Fig. 1) revealed the presence of large numbers of spores. Dr. Glen Hoffman, Eastern Fish Disease Laboratory, West Virginia, kindly identified these for us as spores of E. gadi. The surprising aspect to us was the heavy extent of the infection in individual fish and the high percentage of infected fish. This initial observation led us to examine the incidence and distribution of the parasite in haddock stocks and among other gadoid species on the Nova Scotian fishing banks.

MATERIALS AND METHODS

Commercial catches of haddock from known areas of the fishing banks were examined at Halifax and Lunenburg, Nova Scotia. While on board the research vessel E.E. Prince, we examined the swim bladders of all gadoid species caught. A rather arbitrary classification of the degree of infection was established. The criteria were:

Normal or zero infection	- interior of swim bladder silvery white, gas gland pinkish-red.
Light infection	- small amount of yellow, waxy material near the gas gland. (Presence of spores confirmed by microscopic examination.)
Medium infection	- usually a white semi-viscous material filling less than half of the swim bladder.
Heavy infection	- varied from a white semi-viscous material filling more than half of the swim bladder, to a solid yellowish material filling and distending the swim bladder. In heavy infections there often appeared to be a thin membrane surrounding the parasite and separating it from the swim bladder wall.

Length, weight, and sex were determined for many of the fish samples.

RESULTS AND DISCUSSION

The incidence and distribution of E. gadi in the swimbladder of the haddock is given in Table 1. A total of 2233 fish were examined. The approximate location of the fishing banks is shown in Figure 2. There is a higher rate of infection on Emerald bank and the rate drops off towards the western banks to a low value on Georges bank. Fiebiger reported an incidence of 5% in some instances but the levels here reached a high of 58% infection on Emerald bank.

Examination of the Emerald Bank values show an increase in the infection rate from April to October, while the rate of heavy infection declined from 31.9% of the infected fish in June to 19.3% in July and 8.1% in October. This rapid decline in heavily infected fish could indicate a high selective mortality of heavily infected haddock.

There appears to be an annual fluctuation in percentage infection in any particular region. The highest levels of infection appear to occur during the summer and early fall. /

The sex of 1160 of the examined haddock was recorded. No significant correlation was found between sex and the degree or percent of infection. Similarly size did not appear to be a significant factor, once the fish reached 35 - 40 cm in length. Below this length the infection rate was essentially zero.

In Table II are listed the other gadoid species which were examined. While Fiebiger reported the presence of E. gadi in cod, pollock, and haddock, we have found it only in haddock and in a single specimen of the fourbeard rockling. While our total sample of other species is small, fishermen and fish market operators who were familiar with the 'sick haddock' condition, also related finding no evidence of the parasite in other species. Why the parasite is specific to haddock in the western Atlantic is not known. It is interesting to note that the condition had not been observed by the large plant processors who received the fish in a gutted condition from the trawlers, removed the fillets and processed the remainder for fish meal with the swim bladder left intact along the back bone. Fish market operators who prepare the fish differently by removing the swim bladder and kidney were familiar with the presence of the parasite although they did not realize what it was. The occurrence of E. gadi is not a recent phenomenon. Fishermen familiar with this condition have recalled that their fathers and grandfathers would not eat such sick haddock. It may also be noted that processing procedures in which fish frames left after filleting are scrubbed to obtain the minced flesh may yield a product contaminated by the parasite.

The exact effect of the parasite upon the fish is unknown. Fiebiger believes that the infection must eventually kill the fish and that a heavily infected animal cannot take part in the spawning migration. If this is the case, the high degree of infection of haddock stocks would mean a high mortality and this factor must be considered in the assessment of haddock quotas.

An incidental effect is that the partly filled or full swim bladder would change the detectability of the fish by sonar, possibly leading to a reduced estimate of the stock or to a mistaken identification of the species.

The only useful purpose which might be served is the use of the parasite for the identification or characterization of haddock populations. This technique requires prior knowledge of the rate of infection for different regions and must take into account seasonal variations.

At present histological and ultrastructural studies of the parasite are in progress. Further studies may explain the specificity of E. gadi for haddock and also the parasites geographical variability. It is also hoped that the extent of its effect (lethal or non-lethal) upon the fish may become more fully understood.

ACKNOWLEDGMENTS

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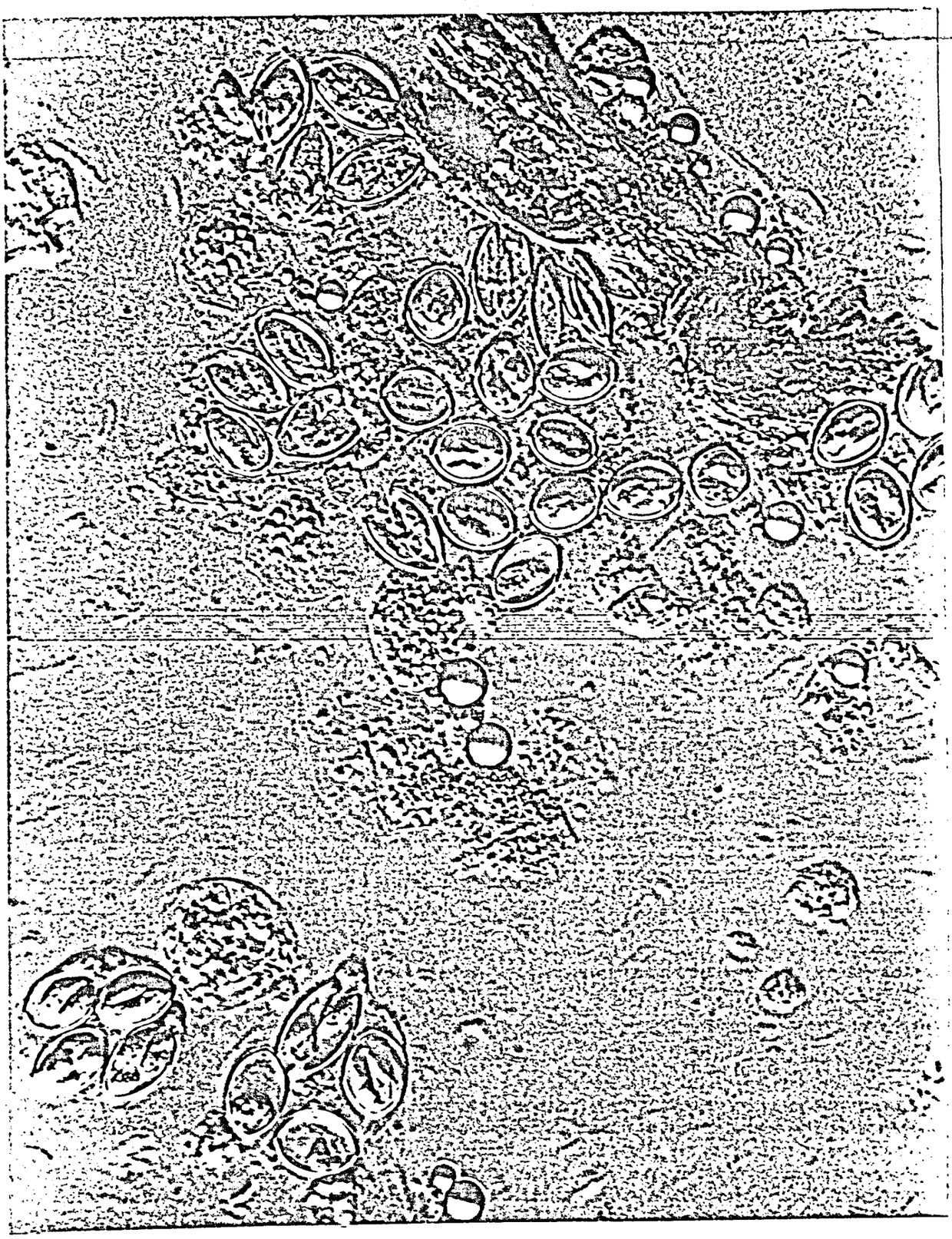

Figure 1. Photomicrograph of a wet mount of Eimeria gadi from haddock. The parasite is approximately 15 μ long.

Table 1. Incidence and distribution of *Eimeria gadi* in the swimbladder of the haddock *Melanogrammus aeglefinus*.

Location	Date	N*	O*	L*	M*	H*	% Infected
Sable Island Bank	Jan./74	100	77	17	4	2	23
Emerald Bank	Apr./73	23	17	2	4	0	26.1
	June/73	161	89	29	20	23	44.7
	July/73	180	92	27	44	17	48.9
	Oct./73	64	27	10	24	3	57.8
	Jan./74	129	97	20	11	1	24.8
	Apr./74	24	18	1	5	0	25
	June/74	148	83	29	24	12	43.9
		729	423	118	132	56	41.98
Off Halifax	Aug/73	119	64	19	36	0	46.2
	Sept/73	96	52	37	6	1	45.8
	Oct./73	163	130	30	3	0	20.2
	Nov./73	109	88	21	0	0	18.3
	Dec./73	96	62	29	5	0	35.4
		583	396	136	50	1	32.1
La Have Bank	Apr./74	184	122	31	24	7	33.7
	Aug./74	191	148	16	21	6	22.5
		375	270	47	45	13	28.0
Shelf South of La Have Bank	Oct./73	28	22	1	4	1	21.4
	Aug/74	107	59	10	23	15	44.8
		135	81	11	27	16	40.0
Browns Bank	Oct./73	30	22	7	1	0	26.7
	June/74	120	92	23	0	5	23.2
	Aug/74	138	129	3	4	2	6.5
		288	243	33	5	7	15.6
Georges Bank	Aug/74	23	22	1	0	0	4.4
TOTAL		2233	1512	363	263	95	32.3

* N - Number of Fish
O - No infection
L - Light infection
M - Medium infection
H - Heavy infection

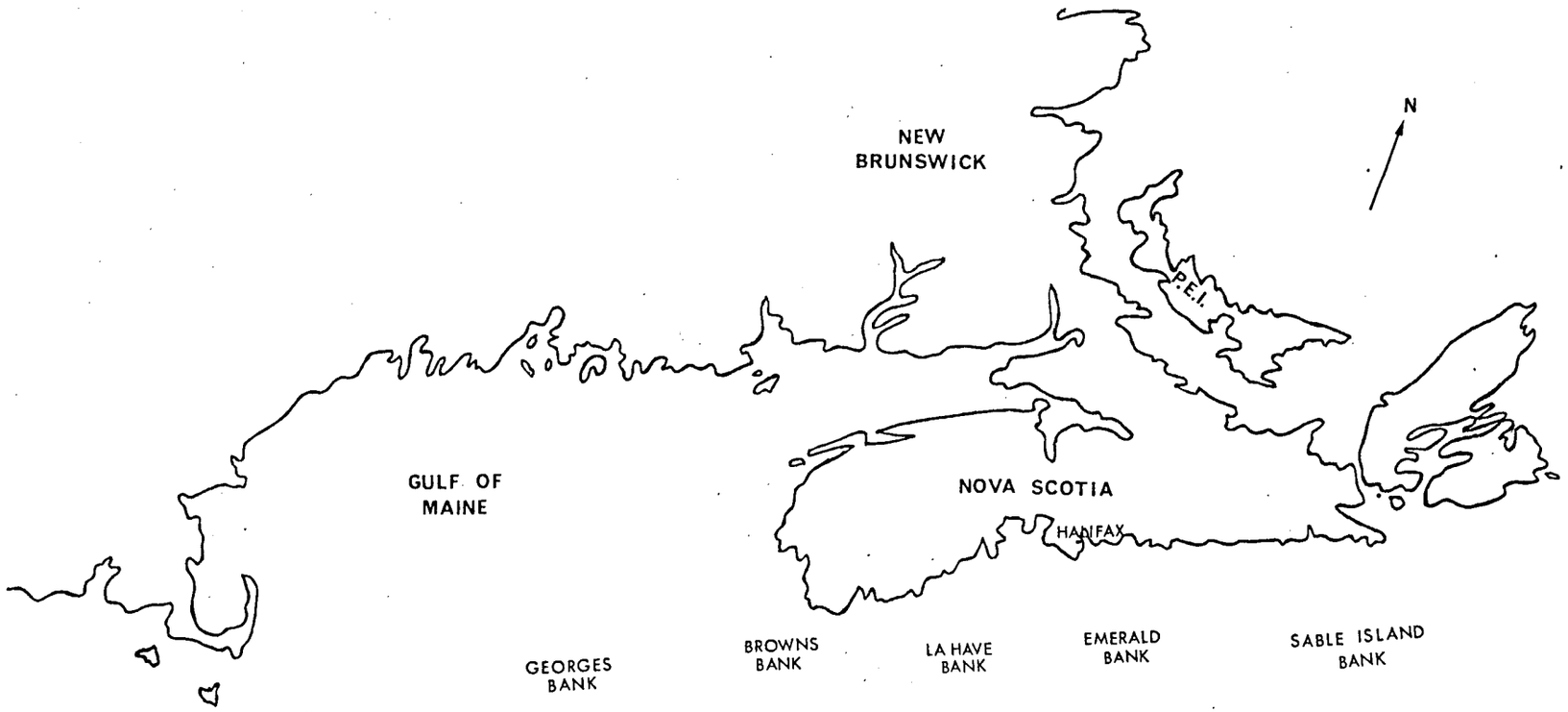

Figure 2. Map showing approximate sampling locations.

Table II - Other gadoid species checked for the presence of Eimeria gadi.

COD	-	92 examined, no infections observed.
CUSK	-	56 examined, no infections observed.
SILVER HAKE	-	34 examined, no infections observed.
WHITE HAKE	-	34 examined, no infections observed.
FOUR BEARD ROCKLING	-	1 examined, one infection observed.
POLLOCK	-	33 examined, no infection observed.