Parasites of Dogs from Indian Settlements in Northwestern Canada: A Survey with Public Health Implications

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ABSTRACT

A total of 959 faecal samples were obtained from dogs in 12 native communities in Northern Saskatchewan, Central and Northern Alberta and the Northwest Territories. All samples were examined using a flotation technique. Samples from an area of endemic human amoebic infections were also examined by a formol-ether sedimentation method. Eighteen necropsies were performed.

Entamoeba histolytica cysts were recovered from dog faeces at Loon Lake, Saskatchewan.

Toxocara canis had low incidence in Saskatchewan and Central Alberta, and appeared to be almost non-existent further North. Toxascaris leonina was found in all areas surveyed. Canine hookworm infections were plentiful in all areas, the highest incidence being recorded from Northern Alberta and Northwest Territories. Many Taenia (or Echinococcus) infections were found consistently in all areas. Only one infection with Dipylidium caninum was discovered.

Metorchis conjunctus infections were found to be common in the Saskatchewan reserves. Infections with Diphyllobothrium sp. were found in all communities with access to good fishing. One specimen of Dioctophyma renale was recovered at necropsy.

Infections with parasites of no known zoonotic importance such as Trichuris, Alaria and Isospora species were also recorded.

RÉSUMÉ

On a recueilli 959 échantillons fécaux chez des chiens de 12 réserves indiennes du nord de la Saskatchewan, du centre et du nord de l'Alberta, ainsi que des Territoires du Nord-Ouest. On examina tous ces échantillons au moyen d'une technique de flottaison. On examina aussi, à l'aide d'une technique de sédimentation au formol-éther, les échantillons provenant d'un réserve où la dysenterie amibienne sévissait à l'état endémique chez les Indiens. On effectua 18 nécropsies.

On décela la présence de kystes de Entamoeba histolytica dans les fèces d'un certain nombre de chiens de Loon Lake, Saskatchewan.

Les infestations à Toxocara canis se révélèrent peu fréquentes en Saskatchewan et au centre de l'Alberta; elles s'avérèrent pratiquement inexistantes, plus au nord. On retrouva Toxascaris leonina dans toutes les régions sur lesquelles portait cette étude. Les infestations par les vers à crochets étaient très nombreuses dans toutes les régions; on en enregistra le plus grand nombre au nord de l'Alberta et dans les Territoires du Nord-Ouest. On décela régulièrement plusieurs infestations à Taenia (ou Echinococcus) dans toutes les réserves. On n'observa qu'une seule infestation à Dipylidium caninum.

Les infestations à Metorchis conjunctus s'avérèrent fréquentes dans les réserves de la Saskatchewan. Celles à Diphyllobothrium spp. se rencontraient dans toutes les réserves où on pouvait facilement s'adonner à la pêche. On observa le parasite Dioctophyma renale une fois, en procédant aux nécropsies.

On découvrit également des affections parasitaires sans importance apparente du point de vue zoonose, impliquant certaines espèces des genres Trichuris, Alaria et Isospora.

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INTRODUCTION

Many species of parasites are known to infect both man and dog. Some, such as *Echinococcus* species or *Toxocara canis*, may be transmitted from dog to man; others, such as *Entamoeba histolytica*, may be transmitted from man to dog. Parasites with indirect life-cycles, such as *Metorchis conjunctus*, may make use of both man and dog as final hosts.

In many of the Indian communities in Northern Canada, relatively large populations of dogs are maintained and there is very close association between man and dog. Dog teams are still used for transport in hunting and trapping.

During the summer of 1971, a survey was conducted to determine the prevalence of parasites, particularly those of possible zoonotic importance, in dogs from 12 Indian settlements in N. Saskatchewan, N. Alberta and the Northwest Territories.

MATERIALS AND METHODS

The areas surveyed are shown in Fig. 1. In each settlement it was possible to sample only a proportion of the dog population, the numbers depending on the time allotted for work in each area and the accessibility and management of dogs in each place. In order to enlist the full cooperation of the owners of the dogs and to ensure that a representative sample of the dog population was obtained, a free rabies vaccination program was carried out in conjunction with this survey.

At the time of rabies vaccination, faecal samples were obtained from the rectums of the dogs and the samples were then stored in 10% formalin in sealed plastic bags. Records were kept of the owner of each dog, quality of management and the prevalent diet of dogs. A total of 959 faecal samples were collected from the 12 settlements.

Preserved faecal samples were later examined by a modification of Sheather's sugar flotation technique (7). Samples taken from dogs at Loon Lake, Saskatchewan were also examined by Ritchie's formol-ether sedimentation technique (18). This technique was used to aid in revealing possible signs of amoebic infections in dogs since human amoebic infections are known to be endemic in this particular area.

In comparing the effectiveness of the flotation procedure and the sedimentation technique, it was found that *Taenia*-type eggs were demonstrable more readily by flotation (ratio approximately 4:1); hookworm and ascarid eggs were also more readily demonstrated by this technique (approximate ratios 2:1 and 3:1 respectively). *Metorchis* eggs were found more often by the sedimentation method (ratio 2:1), whereas *Alaria* eggs were revealed equally well by the two techniques.

It was also possible to make post-mortem examinations on dogs in some of the settlements in Alberta and the Northwest Territories. Unfortunately it was possible to perform only eighteen such necropsies. No necropsies were performed in Saskatchewan settlements.

The stomachs and intestines of necropsied dogs were removed, longitudinally bisected and the contents examined. Visible gastro-intestinal parasites were removed and preserved in 10% formalin for later examination.

Parasites obtained at necropsy requiring differentiation at the species level were *Taenia pisiformis* and *T. serialis*. This was done on the basis of the length of rostellar hooks. In *Taenia pisiformis* the size of the large hooks range from 225 - 294 μ and the small hooks range from 132 - 180 μ. In *Taenia serialis* the large hooks on the rostellum are 135 - 170 μ and the small ones 68 - 120 μ (21).

RESULTS

Results are presented in four sections, according to geographical location.

1. *Saskatchewan settlements* — Loon Lake and La Ronge. The percentages of faecal samples containing eggs of various parasites in dogs over six months old and in dogs under six months old are shown in Table I.

With the exception of about 15 sled dogs at La Ronge, the dog population at Loon Lake and La Ronge consisted of household pet dogs or strays, mainly of mixed parentage. The sled dogs were chained close to owners' homes while the remainder of

the dog population was free to roam at will. A good number of these dogs made their homes in crawl spaces under houses or under porch steps.

Many of the dogs did not appear well cared for. Some people living on the reserves indicated that many dogs had to fend for themselves in the winter months of the year.

The diet of the dogs, according to the children in the communities, consisted largely of wildlife and fish with some table scraps. Rabbit fur, fish bones and tapeworm proglottides were seen in many of the dogs' faeces.

2. *Settlements in Central Alberta* — Wabasca-Desmarais, Driftpile, Sucker

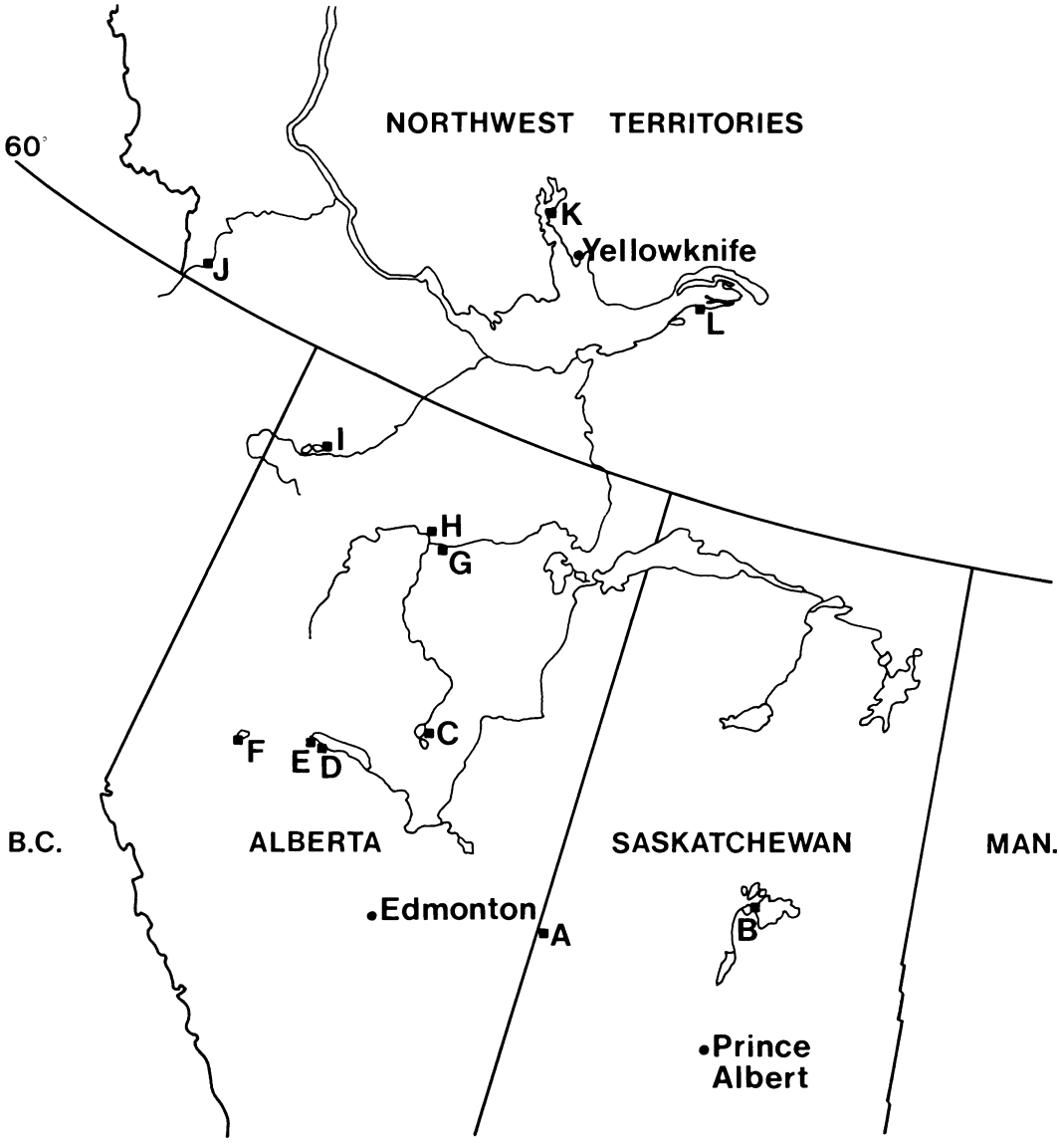

Fig. 1. Map showing Indian settlements surveyed (estimated human population in brackets).

A. Loon Lake (350)
B. La Ronge (800)
C. Wabasca-Desmarais (1500)
D. Driftpile (360)
E. Sucker Creek (300)
F. Sturgeon Lake (600)
G. Fox Lake (400)
H. Jean d'Or Prairie (300)
I. Habay Assumption (800)
J. Fort Liard (240)
K. Fort Rae (1200)
L. Snowdrift (240)

Creek and Sturgeon Lake. The percentages of faecal samples positive for various parasites in dogs of the two age groups are shown in Table II.

The dog populations of these areas consisted mainly of pet animals or watch dogs. The dogs were allowed to run free and were often seen in groups travelling between households. An exception to this description would be the situation at Wabasca-Desmarais where a majority of the dogs were large work dogs which were kept chained in groups near the owners' homes. In general, the dogs were well cared for and received a diet of raw fish, raw wild meat and table scraps. The smaller pet dogs had much contact with the children and were often seen in the owners' homes.

Two necropsies were performed at Wabasca-Desmarais and *Taenia pisiformis* was found in both animals; however, no *Taenia* eggs could be isolated from the faecal specimens of these dogs.

Eight necropsies were performed in the Driftpile area; *Taenia pisiformis* was found in all the dogs and *T. serialis* was isolated from one dog. *Taenia* eggs could be isolated from the faeces of only three of the eight dogs.

TABLE I. Results from Faecal Samples, Loon Lake and La Ronge

	Loon Lake[a]		La Ronge	
Estimated dog population	80		80	
Age category of dogs	[b]>6m	[b]<6m	>6m	<6m
Number of dogs sampled in each age category	(48)	(11)	(36)	(11)
Percentage of samples positive:				
Toxocara canis	0	27	4	46
Toxascaris leonina	0	9	22	9
Hookworms	31	46	39	18
Taenia or *Echinococcus*	54	64	50	27
Diphyllobothrium sp.	0	9	22	18
Metorchis conjunctus	25	9	44	27
Alaria sp.	29	27	0	0
Trichuris sp.	4	9	4	0
Isospora sp.	8	9	0	0
Entamoeba histolytica	0	9	0	0
Entamoeba coli	0	9	0	0
Endolimax nana	2	0	0	0

[a]Loon Lake samples were examined by both flotation and sedimentation techniques.
[b]>6m = dogs over six months of age
<6m = dogs under six months of age

TABLE II. Results from Faecal Samples, Central Alberta

	Wabasca-Desmarais		Driftpile		Sucker Creek		Sturgeon Lake	
Estimated dog population	250		50		55		100	
Age category of dogs	>6m[a]	<6m	>6m	<6m	>6m	<6m	>6m	<6m
Number of dogs sampled in each age category	(98)	(24)	(34)	(5)	(17)	(7)	(52)	(17)
Percentage of samples positive:								
Toxocara canis	2	4	3	0	6	57	0	6
Toxascaris leonina	4	4	3	0	0	29	2	0
Hookworms	40	25	32	0	29	29	50	6
Taenia/Echinococcus	29	38	71	0	24	29	56	12
Diphyllobothrium sp.	14	21	6	0	6	0	2	0
Metorchis conjunctus	1	0	0	0	0	0	0	0
Alaria sp.	3	4	0	20	0	0	0	0
Trichuris sp.	0	4	0	0	0	0	2	0
Isospora sp.	4	8	0	20	0	0	2	6

[a]>6m = dogs over six months of age
<6m = dogs under six months of age

Necropsy of a mature bitch and three of her month-old pups (Sucker Creek area) revealed heavy infection of all pups with *Toxocara canis* while the bitch harboured only a small number of adult *T. canis*.

3. *Settlements in Northern Alberta* — Fox Lake, Jean d'Or Prairie and Habay Assumption. Results from faecal samples are shown in Table III.

Fox Lake and Jean d'Or Prairie are small isolated settlements located near the Peace River in northern Alberta. The dog population in both communities was very high and was equal to or greater than the human population in both cases. The vast majority of the dogs were sled dogs which were kept in groups (a "team" of dogs (five to seven dogs) chained individually in a small area adjacent to the owner's home). The dogs were generally in poor physical condition. The diet consisted of a cereal gruel and occasional wild game; apparently the dogs did not receive water regularly or in sufficient quantity.

Habay Assumption is a large more modern community which is much less isolated than either Fox Lake or Jean d'Or Prairie. The dog population consisted almost entirely of large sled dogs which were chained in groups, usually in the bush areas adjacent to the owner's home. The dogs were in better physical condition and were provided with a cereal gruel and wild meat diet and ample water was available.

Three necropsies were performed in the

TABLE III. Results from Faecal Samples, Northern Alberta

	Fox Lake		Jean d'Or Prairie		Habay Assumption	
Estimated dog population	500		200		400	
Age category of dogs	[a]>6m	<6m	>6m	<6m	>6m	<6m
Number of dogs sampled in each age category	(85)	(17)	(31)	(23)	(95)	(21)
Percentage of samples positive:						
Toxocara canis	0	0	0	0	0	0
Toxascaris leonina	24	53	13	48	14	33
Hookworms	93	59	78	56	79	71
Taenia/Echinococcus	44	65	48	35	41	48
Diphyllobothrium sp.	7	12	0	0	5	10
Metorchis conjunctus	0	0	0	0	0	0
Alaria sp.	1	6	7	0	1	0
Trichuris sp.	0	0	0	0	0	0
Isospora sp.	2	35	10	22	7	5

[a] >6m = dogs over six months of age
<6m = dogs under six months of age

TABLE IV. Results from Faecal Samples, Northwest Territories

	Fort Liard		Fort Rae		Snowdrift	
Estimated dog population	195		1000		205	
Age category of dogs	>6m	<6m	>6m	<6m	>6m	<6m
Number of dogs sampled in each age category	(97)	(5)	(91)	(52)	(76)	(6)
Percentage of samples positive:						
Toxocara canis	0	0	1	0	0	0
Toxascaris leonina	36	0	19	25	13	17
Hookworms	86	60	76	31	92	33
Taenia/Echinococcus	26	0	10	6	30	0
Diphyllobothrium sp.	20	0	45	65	22	50
Dipylidium caninum	0	0	1	0	0	0
Metorchis conjunctus	0	0	1	0	0	0
Alaria sp.	3	0	2	0	0	0
Trichuris sp.	2	0	0	0	0	0
Isospora sp.	12	60	6	25	7	0

Habay Assumption area and *Taenia pisiformis* and *Uncinaria* were isolated from all the animals.

4. *Settlements in the Northwest Territories* — Fort Liard, Fort Rae, Snowdrift. Results from faecal samples are shown in Table IV.

Fort Liard, Fort Rae and Snowdrift are communities where the activities of hunting and trapping still form the basis of the local economy. Consequently, the dog populations in all three communities were large, there being nearly as many dogs as people. With few exceptions the dogs in these areas were sled dogs.

All of the northern communities have strict regulations requiring dogs to be confined either by chain or in compounds. At Fort Rae the confining areas for dogs were particularly close to people's homes. At Fort Liard and Snowdrift on the other hand, dogs were usually chained a good distance from people's homes.

Dogs in all three communities appeared to be highly valued by people; this was shown by the good care that the dogs received. The diet of the dogs consisted of fish and wildlife, with fish predominating at Fort Rae and Snowdrift. The dogs at Fort Liard received less fish in their diet, since the fishing here was relatively poor.

One necropsy was performed on a 12 year old dog at Fort Liard and the following parasites were found: *Dioctophyma renale, Taenia pisiformis, T. serialis, Diphyllobothrium latum* and *Uncinaria stenocephala.*

DISCUSSION

Toxocara canis is known to infect man. This species has very rarely been found to reach maturity in a human host, but larval infections are well known, particularly in young children, causing the clinical syndrome of visceral larva migrans (VLM) (5, 6). The syndrome is characterized by chronic eosinophilia, with eosinophilic granulomatous lesions in an enlarged liver together with some degree of pulmonary infiltration (4). In our survey, relatively few dogs over six months of age were found to have *T. canis* eggs in their faecal samples. Eggs of *T. canis* were not found in the samples from seven of the 12 settlements surveyed, and the highest percentage of samples from older dogs with patent infections was six at Sucker Creek. This result is similar to the findings of Ehrenford (11) and Sprent (20) who showed that few dogs over six months old had patent infections whereas a higher incidence of patent infections was found in younger dogs. In this survey it was not possible to obtain samples from many young dogs in every area, but the incidence of *T. canis* in those dogs under six months of age was relatively high in Saskatchewan settlements (Table I). In Central Alberta few young dogs showed patent infections except at Sucker Creek where four of seven were infected. Eggs were not found in samples from Northern Alberta and the Northwest Territories, except for one which came from an adult dog in Fort Rae. Fort Rae is a community with a heavy population of dogs concentrated in a small area with poor sanitary conditions. At Fort Rae it was possible to sample 52 dogs under six months of age. The 52 pups represented 21 litters, but none of these animals showed signs of a patent *T. canis* infection. Thus it would seem unlikely that human infections with this parasite would be of significance in this or the other more northern settlements surveyed.

It has been asserted, with relatively little supporting evidence, that *Toxascaris leonina* also causes VLM in man (5). This species occurred in dogs in every area surveyed, the incidence being slightly higher in Northern Alberta and the Northwest Territories than in the southern areas.

The infective larvae of dog hookworms can penetrate human skin and cause cutaneous larva migrans (5). Such human infections have been shown to occur with *Ancylostoma* species and also with *Uncinaria stenocephala* (3). Due to the overlap in the size range of eggs of *Ancylostoma* species and *Uncinaria stenocephala,* it was felt that it was not possible to make an absolute distinction between the two genera of hookworms on the basis of egg morphology alone, and results from faecal samples are recorded simply as "hookworms". However, the majority of eggs revealed in samples did fit into the size range typical of *Uncinaria stenocephala,* and all hookworms recovered at necropsy belonged to this species. The incidence of hookworm infection was high in all areas, particularly so in the Northwest Territories, where 75 - 92% of samples from older dogs were positive (Table IV). The

fact that the majority of animals here were tethered sled dogs, confined to a relatively small area of ground could help explain this high incidence. Human infections in these areas, where it is not uncommon to walk barefoot in the summer, are a distinct possibility. Hookworms have previously been recorded from dogs at Fort Chipewyan, Alberta (19) where 11% were found infected. Cameron *et al* (9) also stated that dogs in other areas of Northern Alberta and the Northwest Territories were infected with hookworms, but no figures of incidence were given.

The eggs of *Taenia* and *Echinococcus* species cannot be distinguished in faecal samples. A high incidence of such eggs was found in faecal samples from all areas. At necropsy, several dogs which had negative faecal samples were found to be harbouring *Taenia* species, and thus the actual incidence of these parasites was likely to be higher than that indicated by faecal sampling. *Taenia pisiformis* was the most common tapeworm of that genus recovered at necropsy. This would imply that rabbits or hares were commonly eaten by these dogs. Unfortunately, the field conditions under which necropsies had to be performed did not allow the careful study required to reveal *Echinococcus* adults, and thus no information on the incidence of this important genus was obtained. Previous reports (17, 22, 24) indicate that dogs in northern parts of Alberta and British Columbia and in the Northwest Territories and Alaska have been found to harbour *Echinococcus granulosus*. Also, Holmes and Podesta (14) found 72% of wolves from the forested regions of Alberta to be infected. Human cases of the associated hydatid infections occur in central and northern parts of Saskatchewan, Alberta and British Columbia and in the Northwest Territories; Wolfgang and Poole (24) found that 31% of over 2,000 native patients from northwestern Canada showed positive skin reactions to hydatid fluid antigen.

Human infection with *Entamoeba histolytica* has been known to be endemic in Northwestern Saskatchewan for over 12 years. This is the only known area of high endemicity in Canada. One dog at Loon Lake was found to be shedding *E. histolytica* cysts. Although clinical cases of *E. histolytica* infections in dogs have been recorded from various parts of the world, dogs have very rarely been found to pass cysts in the faeces during natural infections (2, 10, 15, 16), and for this reason dogs have not generally been considered as a significant reservoir of infection for man. Dogs are known to eat human faeces and may readily become infected with *E. histolytica* in this way. The incidence of infection in dogs on this reserve and the possibility of a canine reservoir of infection invite further study.

Metorchis conjunctus and *Diphyllobothrium latum* are parasites which make use of dog and man as final hosts, the final host becoming infected by eating the intermediate host fish.

Metorchis conjunctus was found to be infecting a relatively high proportion of dogs in the Saskatchewan settlements, Loon Lake and La Ronge (Table I). One dog at Wabasca-Desmarais, Alberta and one at Fort Rae, NWT were also found infected. Apart from these two isolated cases, the distribution of *M. conjunctus* in the areas surveyed corresponds with the findings of Cameron (8). Samples from Loon Lake were examined by sedimentation and flotation techniques, while only the flotation technique was used on samples from other areas. The sedimentation technique was found to be more efficient in revealing *M. conjunctus* infections, thus the incidence of infection in areas other than Loon Lake may have been higher than that shown in these results.

Human infections with *M. conjunctus* occur at La Ronge; an incidence of 25-30% is recorded on B reserve, with lower incidence in surrounding areas (Eaton, R.D.P., unpublished data). Human infections are not known to occur at Loon Lake. The difference in incidence in the La Ronge and Loon Lake areas is thought to be due to the difference in species of fish eaten by the people. Cameron (8) examined several fish species and found only the common sucker, *Catostomus commersonii*, to be an intermediate host for *M. conjunctus*. At Loon Lake, suckers are fed to dogs, but other species, notably pickerel and whitefish, are preferred by humans whereas at La Ronge, in the B reserve area, few fish other than suckers are readily caught and both man and dogs eat them. It is the habit for people to smoke the fish lightly over open fires in this area.

Diphyllobothrium species were harboured by dogs in all areas surveyed except Jean d'Or Prairie in N. Alberta. The incidence

in dogs was correlated with access to good fishing areas in the settlements surveyed. *D. latum* infections in both dogs and man were recorded by Saunders (19) at Fort Chipewyan, Alberta. Wolfgang (23) recorded patent infections in faecal samples from Indian and Eskimo patients coming from Northern Quebec, Ontario, Manitoba and the Arctic coast. A 30% incidence in man has been recorded from the La Loche area in Saskatchewan, and infections occur along the length of the Churchill river system (Eaton, R.D.P., unpublished data).

Dioctophyma renale, the 'giant kidney worm', is also a parasite which makes use of fish as second intermediate hosts. It can infect dogs and, very rarely, has been found to infect man also (13). Ehrenford and Snodgrass, in 1955 (12), stated that 121 canine infections have been recorded in North America. Cameron *et al* (9) found a sled dog infected in Manitoba. In our survey, one dog from Fort Liard, NWT was found infected with *D. renale* at necropsy. The incidence of canine infections would not be revealed by examination of faecal samples.

Dipylidium caninum is recorded as one of the most common tapeworms of the dog in North America and elsewhere, and this species may also occasionally infect man when man ingests the intermediate flea host (25). Only one canine infection was revealed in this survey; it was from an adult dog at Fort Rae, NWT.

Of the parasites without known zoonotic importance, *Alaria* infections were found in a large proportion of dogs at Loon Lake, Saskatchewan, but only sporadically elsewhere. The species of *Alaria* is not known; *Alaria arisaemoides* has been recorded from Saskatchewan dogs recently by Allen and Mills (1). *Trichuris* infections were rarely found in this survey; only two of 599 dogs in Northern Alberta and Northwest Territories showed patent infections. Similarly, relatively few *Isospora* infections were apparent from the survey.

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