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Distribution and prevalence of *Dracunculus* spp. (Nematoda: Dracunculoidea) in mammals in Ontario

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Within Ontario *Dracunculus insignis* (Leidy 1858) Chandler 1942, a common parasite of raccoon, *Procyon lotor* (L) (prevalence > 50%), and mink, *Mustela vison* Schreber (prevalence > 50%), is apparently confined to the southern part of the province. In this area *D. insignis* was also found in fisher, *Martes pennanti* (Erxleben); and *Dracunculus* sp. was found in short-tailed weasel, *Mustela erminea* (L), muskrat, *Ondatra zibethicus* (L), and opossum, *Didelphis marsupialis* (L). The distribution of *D. insignis* coincides with that of raccoon in Ontario, and it is suggested that raccoon may be a reservoir host for this species and that mink became incorporated into its life cycle secondarily. *Dracunculus lutrae* Chrichton and Beverley-Burton 1973 of the otter, *Lutra canadensis* (Schreber), was found across the entire province and, in most areas, the prevalence exceeded 75%. During the trapping season (October–April) larvigerous females were found in 20 (44.4%) of 45 otter infected with *D. lutrae* in southern Ontario, but were absent from the limbs of 132 infected otter from northern Ontario.

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En Ontario, la répartition de *Dracunculus insignis* (Leidy 1858) Chandler 1942, parasite commun du raton-laveur, *Procyon lotor* (L) (fréquence >50%), et du vison, *Mustela vison* Schreber (fréquence >50%), semble limitée à la portion sud de la province. Dans cette région, *D. insignis* parasite aussi la martre, *Martes pennanti* (Erxleben); *Dracunculus* sp. parasite l'hermine, *Mustela erminea* (L), le rat musqué, *Ondatra zibethicus* (L) et l'opossum, *Didelphis marsupialis* (L). La répartition de *D. insignis* coïncide avec celle du raton-laveur en Ontario et il est possible que ce mamifère serve de "réservoir" au parasite, alors que le vison se serait introduit dans le cycle vital de façon secondaire. *Dracunculus lutrae* Crichton et Beverley-Burton 1973, parasite de la loutre, *Lutra canadensis* (Schreber), se trouve dans toute la province et, dans la plupart des régions, la fréquence du parasitisme dépasse 75%. Un échantillonnage durant la saison du piégeage (octobre à avril), en Ontario du sud, a révélé que 20 (44.4%) sur 45 loutres infectées portaient des femelles de *D. lutrae* pleines de larves, alors qu'en Ontario du nord on n'a trouvé aucune femelle portant des larves dans les membres des 132 loutres infectées examinées.

[Traduit par le journal]

Introduction

Two species of the genus *Dracunculus* are known to occur in Ontario. *Dracunculus insignis* (Leidy 1858) Chandler 1942 was initially reported in the province by Chitwood (1933) and subsequently by Fyvie (1964, 1966), Webster and Casey (1970), and Gibson and McKiel (1972). *D. lutrae* Crichton and Beverley-Burton 1973 has only, as yet, been reported from Ontario. Fyvie (1966) indicated the distribution of guinea worm (presumed to be *D. insignis*) in Ontario but did not include prevalence data.

The present study indicates the prevalence and distribution of *D. insignis* and *D. lutrae* in Ontario.

This paper represents the second part of a study on the biology of *Dracunculus* spp. in wildlife from Ontario (Crichton 1972).

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Materials and Methods

Between October and April of 1969–1972, the carcasses of 1147 mammals, of 13 species, were obtained and examined. These were: 289 raccoon (*Procyon lotor* (L)); 359 mink (*Mustela vison* Schreber); 203 otter (*Lutra canadensis* (Schreber)); 139 marten (*Martes americana* (Turton)); 19 fisher (*Martes pennanti* (Erxleben)); three long-tailed weasel (*Mustela frenata* Lichtenstein); five short-tailed weasel (*M. erminea* (L)); six timber wolf (*Canis lupus* (L)); five red fox (*Vulpes vulpes* (L)); six beaver (*Castor canadensis* Kuhl); 105 muskrat (*Ondatra zibethicus* (L)); seven lynx (*Lynx canadensis* Kerr), and one opossum (*Didelphis marsupialis* L). Animals were obtained from fur trappers and by live-trapping. The methods used in examining carcasses have been outlined previously (Crichton and Beverley-Burton 1973).

Carcasses were obtained from 13 of the 21 administrative districts of the Ontario Ministry of Natural Resources as demarcated in 1969 (Fig. 1).

Results

D. insignis in Raccoon and Mink

The prevalence of *D. insignis* in raccoon and mink is indicated in Table 1. In Ontario *D. insig-*

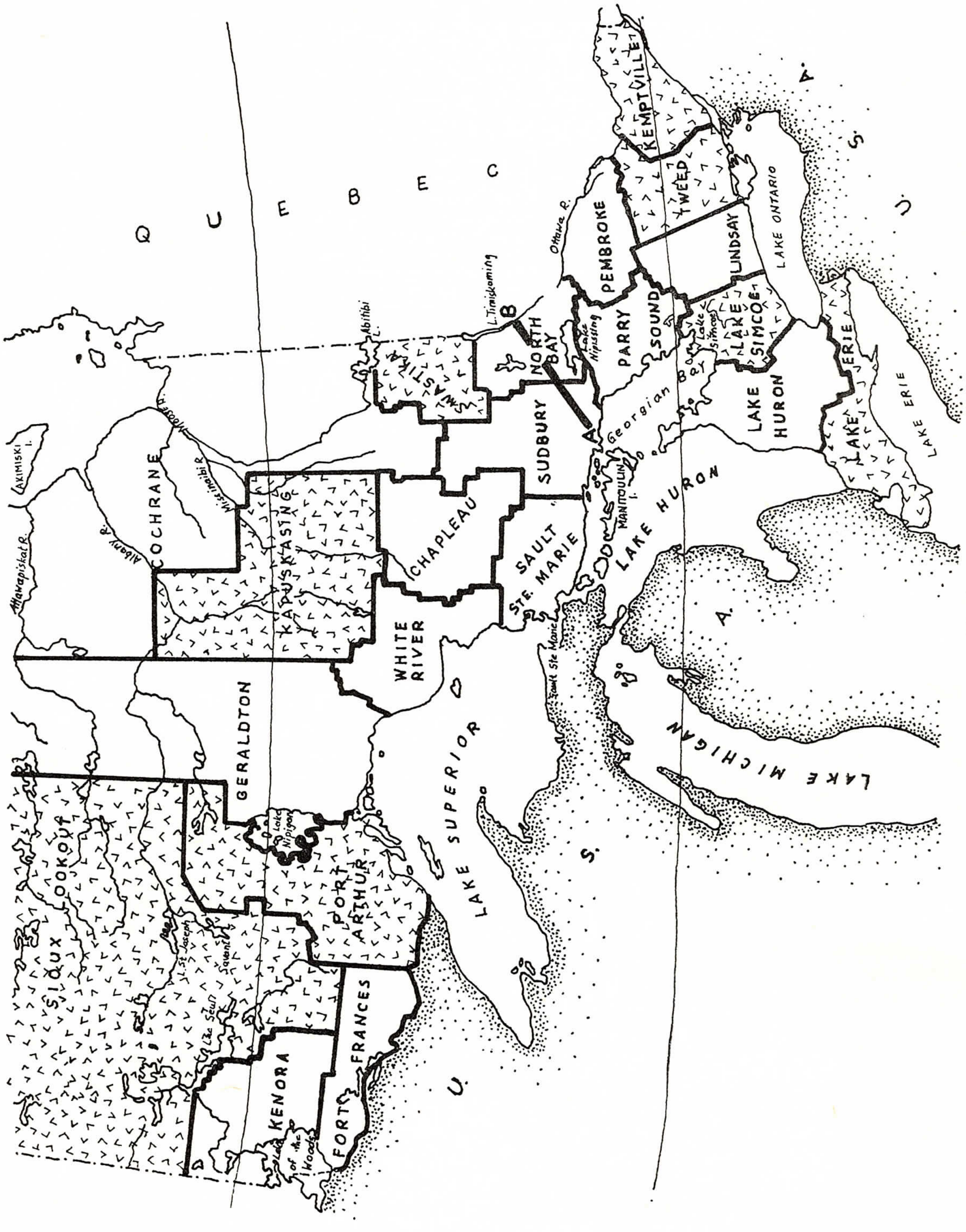
QUEBEC
U.S.A.
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
Georgian Bay
KENORA
FORT FRANCES
SIOUX LOOKOUT
PORT ARTHUR
GERALDTON
KAPUSKASING
COCHRANE
WHITE RIVER
CHAPLEAU
SAULT STE. MARIE
SUDBURY
NORTH BAY
SWASTIKA
PARRY SOUND
PEMBROKE
LINDSAY
TWEED
KEMPTVILLE
LAKE SIMCOE
LAKE HURON
LAKE ERIE
AKIMISKI I.
Ottawa R.
Moose R.
Albany R.
Lake Nipigon
Lake Nipissing
MANITOULIN I.
A
B

Fig. 1.

nis is a common parasite in the southern part of the province from the region of lakes Ontario and Erie northward to the line A–B (Fig. 1; Table 2). North of this line it was found in only two mink: one from the Sault St. Marie and one from the Chapleau administrative districts. Table 2 summarizes, on a comparative basis, the prevalence of *Dracunculus* spp. in all host species from the northern and southern regions.

TABLE 1

Prevalence of *Dracunculus insignis* in 289 raccoon and 359 mink, and *D. lutrae* in 203 otter in Ontario

District	*D. insignis*		*D. lutrae*
	Raccoon	Mink	Otter
Kenora	—	0/4	7/11
Fort Francis	—	0/21	2/2
Geraldton	—	0/4	4/5
Cochrane	—	0/10	7/7
White River	—	0/26	15/16
Chapleau	0/2	1/70	86/98
Sault St. Marie	—	1/30	9/11
Sudbury	—	—	2/2
North Bay	2/3	10/20	8/8
Parry Sound	—	2/3	16/17
Pembroke	—	0/3	2/2
Lake Huron	9/66*	15/48*	—
Lake Huron	152/218	30/39	—
Lindsay	—	48/81	20/24

*These were the first animals examined (1969); and the small number of infected animals in this sample may reflect the inexperience of the investigator in searching for worms. Thus, these data are presented separately.

TABLE 2

Comparison of the prevalence of *Dracunculus* spp. in northern and southern Ontario*

	North	South
D. insignis		
Raccoon	0/2	154/221† (69.6%)
Mink	2/165 (1.2%)	90/146† (61.6%)
Fisher	0/9	7/10
D. lutrae		
Otter	132/152 (86.8%)	46/51 (90.1%)
Dracunculus sp.		
Marten	0/139	—
Long-tailed weasel	0/3	—
Short-tailed weasel	0/2	1/3
Timber wolf	0/6	—
Red fox	0/4	0/1
Lynx	0/7	—
Beaver	0/6	—
Muskrat	0/4	1/101
Opossum	—	1/1

*In the present study "northern Ontario" is that area north of the line A–B in Fig. 1. "Southern Ontario" is that area south of this line.
†The data from the first year are excluded.

To determine if prevalence data were lower as a result of not examining the flesh remaining on pelts, both pelts and carcasses of 75 raccoon and 19 mink (included in Tables 1 and 2) from the Lake Huron District were examined in the autumn of 1970. The prevalence of *D. insignis* based on carcass data only was 44 (58.7%) in raccoon, and 12 (63.2%) in mink. Inclusion of the pelt data increased the prevalence to 53 (70.7%) of the raccoon, and 16 (84.2%) of the mink. Thus, the actual prevalence of *D. insignis* in raccoon and mink in Ontario must be higher than the data (Tables 1 and 2) indicate.

There was no statistically significant difference ($P = 0.05$) in the number of male and female raccoon and male and female mink infected with *D. insignis*.

An attempt was made to determine the intensity of infection with *D. insignis* in the intact carcasses of 87 raccoon and 16 mink (included in Tables 1 and 2). In the autumn of 1970, an average of 1.4 ♂♂ (maximum (max.) 28) and 3.1 ♀♀ (max. 26) were found in 54 raccoon; in the spring of 1971, an average of 3.4 ♂♂ (max. 32) and 4.7 ♀♀ (max. 13) were found in 33 raccoon. The apparent increase in intensity from autumn to spring was probably attributable to the depletion of adipose deposits which had hindered the examination of carcasses taken in the autumn. Mink, similarly examined only in the autumn of 1970, harbored an average of 1.0 ♂♂ (max. 5) and 2.7 ♀♀ (max. 12).

Males, immature females (fourth-stage larvae and unfertilized adults), and fertilized females containing eggs were most frequently found in the subcutaneous tissues of the thoracic, abdominal, and inguinal areas. They were infrequently found beneath the latissumus dorsi. Larvigerous females were usually found in the intermuscular fascia of the legs; on one occasion, one was found on the head of a mink, and on another, a worm was wrapped around the lower portion of one testis.

FIG. 1. Map of the province of Ontario showing administrative districts of the Ontario Ministry of Natural Resources as demarcated in 1969. The line A–B on the map and referred to in the text is our addition. Stippled areas were not sampled.

D. lutrae in Otter

Generally, otter pelts were not available but examination of carcasses revealed that *D. lutrae* was a common parasite of otter in all areas sampled (Table 1).

An attempt was made to determine the intensity of infection with *D. lutrae* in 42 intact otter carcasses obtained from the Chapleau District (included in Tables 1 and 2). These animals, examined in the autumn of 1969, harbored an average of 4.6 ♂♂ (max. 24) and 3.3 ♀♀ (max 39).

Males, immature females (fourth-stage larvae and unfertilized adults), and fertilized females containing eggs were most frequently found in fascia beneath the latissimus dorsi. They were also located in subcutaneous tissue of the inguinal area, occasionally under subcutaneous tissue of the thorax and abdomen, and infrequently associated with the axillary nerves and blood vessels. Males and females were often in close association beneath the latissimus dorsi. Females containing larvae were found in the intermuscular fascia of the lower legs.

Dracunculus sp. in Other Mammalian Hosts

The results of examining various other species of mammals from Ontario for *Dracunculus* sp. are summarized in Table 2.

Male and female worms found in fisher in the Parry Sound and Lindsay districts were identified as *D. insignis*. Female worms were collected from short-tailed weasel, muskrat, and opossum from the Lake Huron District, and from badger (*Taxidea taxus* (Schreber)) from Manitoba; in the absence of male worms specific identification was not possible. Guinea worms were collected from hosts other than raccoon, mink, and otter in Ontario in only those areas where *D. insignis* was found.

Discussion

The distributions of *D. insignis* and *D. lutrae* overlap in the southern part of Ontario. *D. insignis* is almost entirely confined to this region while *D. lutrae* is much more widespread occurring north into the Cochrane District and west to the provincial boundary. The distribution of guinea worm reported by Fyvie (1966) is remarkably similar to that of *D. insignis* observed in the present study.

A higher prevalence of *D. insignis* in mink was observed in southern Ontario, where raccoon are abundant, than in northern regions, where raccoon are seldom found and prevalence in mink is extremely low. This raises the possibility that raccoon may serve as a reservoir of the infection which passes over to mink. There is some experimental evidence (Crichton 1972) that mink may be somewhat refractory to infection with *D. insignis* compared with raccoon.

Another explanation for the virtual absence of *D. insignis* in northern Ontario might be the lack of a suitable intermediate host. It is known, however, that an intermediate host, *Cyclops vernalis*, used in the laboratory, is common in the Chapleau District and, as it is such an ubiquitous form in shallow bodies of water, it is almost certainly present in other districts sampled for guinea worm. Thus, it is possible that the limited distribution of *D. insignis* reflects the absence of a paratenic host in northern areas.

The present data indicate that *D. lutrae*, which, apparently, only occurs in otter, is widely distributed in Ontario. Fyvie (1966) examined carcasses from northern and southern Ontario obtained during the period October to April, but guinea worm was found only in otter in southern Ontario.

During the intramammalian development of guinea worm, immature worms, unfertilized females, and males are found in the subcutaneous and intermuscular connective tissue. Only after fertilization do the females increase in size and migrate to the limbs. Fyvie (personal communication) found females in the limbs of otter but never recovered males or small females. In the present study, female worms were found in the limbs of 20 (44.4%) of 45 infected otter killed during the period October–April, in southern Ontario. In contrast, they were never found in the limbs of infected otter (132) north and west of the North Bay District during the same period of the year. This regional variation in location of worms within the host during the trapping season explains Fyvie's distribution pattern and why she never recovered guinea worm from otter in the north.

The possible reasons for this variation will be discussed in a subsequent paper concerning the development of mammalian guinea worms in Ontario.

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