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Parasites of Moose (*Alces alces*) from an Agricultural Area of Eastern Ontario

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ABSTRACT: Viscera of 16 moose and hide samples of 24 moose (*Alces alces*) shot in eastern Ontario in 1985 were examined for parasites. Two species of trematodes, one species of cestode, five species of nematodes and one species of tick were recovered. One nematode species, *Trichuris discolor*, is reported for the first time from moose. Our results suggest that the parasite fauna of the moose may have been influenced by the absence or scarcity of other species of wild cervids or carnivores and by the presence of domestic livestock.

Key words: Moose, *Alces alces*, parasites, survey, *Trichuris discolor*.

Most parasites of moose (*Alces alces*) in North America may have been acquired from other wildlife following the colonization of the continent by moose (Anderson and Lankester, 1974). Some parasites have adapted successfully to moose because they can occur in moose independent of other ruminant populations. However, the occurrence of other parasites in moose is determined partly by the presence of other vertebrate species which act as reservoirs for infection (Samuel et al., 1976). Thus, we examined moose from an "insular moose population" in a forest surrounded by agricultural land to establish if the presence of other vertebrates, in particular domestic ruminants, may have influenced the parasite fauna of this host.

The Larose Forest (45°22′N, 75°10′W) is 8,900 ha in size and is unique moose habitat because it is isolated from contiguous moose range and is within an agricultural area consisting mainly of dairy farms. There are small numbers of white-tailed deer (*Odocoileus virginianus*) and coyotes (*Canis latrans*), but there are no timber wolves (*Canis lupus*). Moose within the Larose Forest are thought to have originated from the Laurentian Highlands of southwestern Quebec. The Ottawa River and a minimum of 25 km of agricultural land separate the Laurentians from Larose Forest.

Moose were shot by hunters in October 1985. They ranged in age from 0.5 to 12.5 yr. Heart, lungs, liver, spleen, kidneys, stomach, large and small intestine were collected from the hunters when available. Samples were frozen whole as soon as possible after collection.

During necropsy, hearts, livers, spleens and kidneys were sliced at 1-cm intervals, visually examined and palpated. Lungs were sliced open along the bronchioles to look for nematodes, then palpated for cysts of *Echinococcus granulosus*. The portions of the gastrointestinal tracts examined separately were the rumen, reticulum, omasum, abomasum, small intestine (anterior 9 m and 15-cm sections of each remaining meter), cecum and large intestine (anterior 2 m). For each section, the contents were washed through two sieves (2.0 and 0.5-mm mesh), then examined. Walls of the sections of the gastrointestinal tracts were also washed and examined. Trematodes and cestodes were fixed in 10% formalin. Nematodes were preserved in glycerin-alcohol. Samples of hides, each approximately 225 cm^2, collected from the forequarters of moose, were placed in a hot agitated solution of 10% KOH until the hair was dissolved. The hide was washed and removed, and the KOH solution was passed through a 0.5-mm sieve to collect ectoparasites. Ectoparasites were fixed in 70% ethanol. Representative specimens of all parasites have been deposited in the Parasite Collection, National Museum of

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TABLE 1. Prevalence and range of parasite infections from moose in eastern Ontario, 1985.

Parasite	Museum accession number[a]	Prevalence		Range[c]
		n[b]	%	
Trematoda				
Paramphistomum cervi	1606, 1607	16	81	1–310
Zygocotyle lunata	1646	16	19	1–10
Cestoda				
Moniezia expansa	1632	16	13	—
Nematoda				
Nematodirella alcidis	1620–1622	16	100	3–1,009
Dictyocaulus viviparus	1623, 1624	13	15	1–2
Trichuris ovis	1625, 1626	16	13	1
Trichuris discolor	1627–1630	16	25	1–2
Setaria sp.	1631	—	—	1
Arthropoda				
Dermacentor albipictus	1633	24	100	24–1,250

[a] All numbers have prefix NMCP1987- (National Museum of Natural Sciences, Ottawa, Ontario, Canada).
[b] No parasites recovered from livers (n = 4), hearts (n = 4), spleens (n = 13) or kidneys (n = 7).
[c] Range of parasites recovered; necropsies incomplete.

Natural Sciences, Ottawa, Ontario, Canada K1A 0M8 (Nos. NMCP1987-1606, 1607, 1620–1633, 1646).

Nine species of parasites were collected from the viscera of 16 moose and hide samples of 24 moose (Table 1). Two species of trematodes, one species of cestode, five species of nematodes and one species of tick were found. Data for mean intensities of infection are not presented because samples of viscera were sometimes incomplete and because the entire intestinal tract was not examined. However, intensities were not considered large enough to have affected the health of moose.

Rumen trematodes, *Paramphistomum* spp., not reported commonly from Alberta (Samuel et al., 1976; Stock and Barrett, 1983), were common in moose from northwestern Ontario (Lankester et al., 1979). Kennedy et al. (1985) determined that the moose of northwestern Ontario were infected with two species of *Paramphistomum*, *Paramphistomum cervi* and *P. liorchis*, the latter species reported previously in deer of North and South America (Prestwood et al., 1970; Eduardo, 1982b). Following the criteria of Eduardo (1982a, b) and Kennedy et al. (1985), the species in this study were all *P. cervi*. The absence of *P. liorchis* from this study might be explained, at least in part, by the low densities of deer. Alternatively, *P. liorchis* may be a species which can cycle in moose independent of high densities of deer. This may be the case in northern Ontario. *Zygocotyle lunata*, normally a parasite of waterfowl, has been reported previously from moose in western Canada (Samuel et al., 1976; Stock and Barrett, 1983) and is not unique to moose in agricultural areas.

Only one species of cestode was collected. Because the scolex was absent, identification was based on the structure of the proglottids, which was consistent with descriptions of *Moniezia expansa* (Monnig, 1956). *Moniezia expansa* or *Moniezia* sp. are reported commonly from moose (Wallace, 1934; Samuel et al., 1976). Notable by their absence were larval stages of *E. granulosus*, a very common parasite from moose in parts of eastern North America (Addison et al., 1979a) including the Laurentians (McNeill and Rau, 1987). The apparent absence of *E. granulosus* may be attributed to the scarcity or ab-

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sence of timber wolves, the definitive hosts, from the study area.

The most prevalent and abundant helminth in this study was the intestinal nematode *Nematodirella alcidis*. Lichtenfels and Pilitt (1983) distinguished four species of the genus *Nematodirella* from wild ruminants in North America, based on the number and pattern of cuticular ridges. Specimens from this study agreed consistently with the description of the species recovered from moose, *N. alcidis*. Although whole male specimens of lungworms were not found in this study, the species was distinguished from others in the genus *Dictyocaulus* by the size of the eggs within the female. They were consistent with *D. viviparus* (Monnig, 1956). This species was reported in 0–18% (Samuel et al., 1976) and 17% (Stock and Barrett, 1983) of moose from Alberta. Two species of whipworms were recovered from the ceca of the moose from Larose Forest. *Trichuris ovis* has been reported previously from moose (Stock and Barrett, 1983). *Trichuris* sp. ranges in prevalence from 0 to 85% in moose from different regions of Alberta (Samuel et al., 1976). Stock and Barrett (1983) suggested that the presence of *T. ovis* in moose might indicate an interaction between sylvatic and domestic animals. Based on the morphological characteristics established by Knight (1971, 1983), *Trichuris discolor* was recovered also from moose in this study. This is the first known record of *T. discolor* from moose. The presence of *T. discolor* in moose may be an indicator also of parasite transmission between livestock and moose. *Trichuris discolor* is normally a parasite of cattle (Beveridge and Green, 1981) and is implicated as the cause of mortality in some dairy cattle from Quebec (Frechette et al., 1973). The distribution of *T. discolor* in moose should be established through future parasitological surveys. *Setaria* spp. are found normally in the abdominal cavity of their hosts and, although they were not examined for specifically, three specimens of *Setaria* sp. were recovered while washing the intestines. The specimens could not be specifically identified because they were all immature females. In Alberta, Samuel et al. (1976) reported both *Setaria yehi* and *Setaria labiatopapillosa* from moose, although *S. labiatopapillosa* was believed to be a parasite primarily in bison (*Bison bison*).

The winter tick, *Dermacentor albipictus*, was the only ectoparasite recovered. Winter ticks are known from many regions in Ontario (Gregson, 1956; Addison et al., 1979b). This species was considered as a principal cause of mortality in about three-fourths of a small isolated moose herd near the Larose Forest (unpubl. data). *Dermacentor albipictus* is common on cattle in southwestern Texas (Drummond, 1967) and is considered to be a pathogen of heavily infested cattle and horses exposed to harsh winter conditions (Cameron and Fulton, 1926–1927). However, livestock in northeastern North America are not known to be infested with *D. albipictus*. Possibly, the winter tick was introduced into the Larose Forest by moose when they first occupied the area.

Many species of parasites in the present study are known from moose in other parts of North America and may have been brought to the Larose Forest by moose. Nevertheless, the results of this survey do suggest an agreement with the hypothesis of Samuel et al. (1976) that parasite faunas of moose may depend, to some extent, on the parasites of sympatric vertebrates. The scarcity of any other wild cervids and absence of timber wolves may explain partly why parasites such as *P. liorchis* and *E. granulosus* were not found in our survey. The recovery of at least one species, *T. discolor*, suggests that the moose may have acquired part of their helminth fauna from domestic livestock.

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