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# *Parelaphostrongylus tenuis* in New Brunswick: The Parasite in White-tailed Deer (*Odocoileus virginianus*) and Moose (*Alces alces*)

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ABSTRACT: Research was initiated in 1983 to investigate the ecology of *Parelaphostrongylus tenuis* in New Brunswick. The objectives were to determine the prevalence and intensity of infection in white-tailed deer, and to determine whether or not moose feces contained first stage larvae, signifying the completion of the life cycle of *P. tenuis* in this host. Forty-nine percent of deer pellet samples were positive and 60% of deer heads contained adults of *P. tenuis*. None of the moose pellet samples contained first stage larvae.

*Key words:* *Parelaphostrongylus tenuis*, meningeal worm, *Odocoileus virginianus*, white-tailed deer, *Alces alces*, moose, moose sickness.

The meningeal worm, *Parelaphostrongylus tenuis*, develops in the central nervous system of white-tailed deer (*Odocoileus virginianus*) usually without causing neurological disorder. Adult worms frequent the subdural spaces of the brain, and first stage larvae ($L_1$) are excreted in the mucus covering the feces of deer (Anderson and Prestwood, 1981). Moose (*Alces alces*) either succumb to the parasite before the worms mature and reproduce, or eggs are deposited on the meninges or in the neuropile and are unable to enter the blood stream to be carried to the lungs to complete the life cycle (Anderson and Prestwood, 1981).

The population of white-tailed deer in New Brunswick in 1984 was increasing in numbers and a preliminary sampling found a high proportion to be infected with *P. tenuis*. The moose population was also increasing, and there exists, therefore, the apparent anomaly of increasing numbers of moose and deer sharing common range. Also, the report of first stage larvae similar to those of *P. tenuis* in moose feces in Nova Scotia has led to some questions concerning the pathology of *P. tenuis* in moose (Hansen, 1975; Brown, 1983).

The primary objectives of the present study were to determine (1) the prevalence and intensity of *P. tenuis* in white-tailed deer in New Brunswick, and (2) whether or not moose were passing first stage larvae of *P. tenuis* in their feces, thus suggesting completion of the life cycle of *P. tenuis* in this host.

Fresh feces were collected from white-tailed deer and moose in various regions of the Province. Although most samples were collected off the snow from December through March, some fresh samples were collected at other times of the year. Fresh moose feces were obtained from hunters who removed them while field-dressing their moose. Samples were examined using the Baermann technique (50 g of deer feces or 100 g of moose feces with the first 10 ml of filtrate examined).

Sixty deer heads from road-kills (summer 1983) and from hunter-kills (fall 1984) were collected. These heads were frozen, and then sawed in half enabling examination of the brain and surrounding areas. The subdural spaces and folds of the brain were examined for adults of *P. tenuis*. Small cuts were made in the areas surrounding the venous sinuses to allow examination. The brain was then removed, and the floor of the cranium was examined. Any nematodes found were identified, and then placed in 70% alcohol with 5% glycerin.

Two moose heads were obtained from road-kills, one in the summer of 1983 and one in the summer of 1984. The head of an additional moose, which had died showing signs of "moose sickness" in 1984, was

examined. Examination of moose heads was similar to that of deer except that the whole brain was examined by tearing it into small pieces in water and decanting. This was to release worms imbedded in the brain tissue.

In 1983 and 1984, 91 samples of deer feces were collected. Forty samples were examined carefully for first stage larvae and many low intensity infections were noted. Seventy-eight percent contained first stage larvae (sample size ranged from 5 to 11 for five counties: Albert, Kings, Queens, Saint John and Sunbury). The remaining 51 samples were examined less intensely, and infections of low intensity may have been missed. Only 27% of these samples contained larvae (sample size ranged from 3 to 36 for three counties: Albert, Sunbury and Restigouche/Northumberland). Combining both data sets, the prevalence of larvae was ≥49%. Of 61 moose fecal pellet samples examined carefully (sample size ranged from 1 to 16 for eight counties: Albert, Sunbury, Saint John, York, Queens, Charlotte, Westmorland, and Restigouche/Northumberland), none contained larvae.

The major problem in determining the prevalence of *P. tenuis* in deer and moose using the presence of larvae in feces as an indicator, is the accurate identification of first stage larvae of *P. tenuis*. These larvae can be confused easily with those of two other metastrongylids, *P. odocoilei* and *P. andersoni* (Anderson, 1963; Prestwood, 1972; Platt, 1978). Parker (1966) found that the mean prevalence of *P. tenuis* in white-tailed deer feces in Nova Scotia was 53%. More recently, Hansen (1975) found a prevalence of 68% while Brown (1983) found a prevalence of 65% in white-tailed deer. Bindernagal and Anderson (1972) found a 63% prevalence in white-tailed deer feces in Quebec and Ontario, 49% in Manitoba and 9% in eastern and central Saskatchewan.

Another indicator of prevalence is the presence of adults of *P. tenuis* in the heads of deer, although Anderson (1963) indicated that prevalence tends to be lower than when feces are examined. A mean intensity of 2.8 adult *P. tenuis* was recovered from 60% of the 60 deer heads collected in Sunbury, York and Queens counties and from some deer of unknown origin within the Province. Adults of *P. tenuis* were found in various areas on and around the brain, the most common location (26 of 60 deer examined) was along the tentorium (particularly in females, $n = 21$). Other adults of *P. tenuis* were found on the central, dorsal and ventral dura mater and on the falx cerebri.

The heads of the two healthy moose yielded no adults of *P. tenuis*. The animal showing signs of "moose sickness" contained two adults of *P. tenuis*, one partially penetrating the cerebellum and the other penetrating the cerebrum.

The presence of larvae of *P. tenuis* in moose feces, assuming that they could be positively identified as such, would indicate clearly that moose could serve as a definitive host for this parasite. In Nova Scotia, Hansen (1975) reported that about 6% of 104 moose fecal pellet samples were infected with a *P. tenuis*-like first stage larvae, and Brown (1983) found about 13%. Brown (1983) concluded that many moose appeared to be surviving with *P. tenuis* and that *P. tenuis* was not a major mortality factor in moose in Nova Scotia. Without (1) carefully checking the musculature of the moose for adults of *P. andersoni* or *P. odocoilei*, or (2) experimentally exposing the first stage larvae found in moose feces to snails and thereby allowing them to develop to the infective stage which can be identified (Ballantyne and Samuel, 1984), such conclusions cannot be substantiated. It is quite possible that another metastrongylid exists in the moose of Nova Scotia. Our results do not support those of Hansen (1975) or Brown (1983) since infection was not found in 61 moose fecal samples from several counties of New Brunswick where infected deer existed.

With the low number of moose deaths attributed to "moose sickness" in New Brunswick over the past decade and the absence of *P. tenuis*-like larvae in moose feces, it can be assumed that moose are not acquiring infective larvae from the gastropod intermediate host. Because of the high prevalence of infection in deer, it seems probable that moose are feeding in areas different from those utilized by deer. Since infection occurs mainly in late June and July (Upshall et al., 1986), this might be the principal time when these two species utilize different habitats. A study by Kearney and Gilbert (1976) of habitat utilization by deer and moose at Ontario's Himsworth Game Preserve showed only overlap in alder type forest during spring and summer where neither moose nor deer commonly feed. A recent study in New Brunswick on habitat use by moose and deer (Trimper, 1984) showed little overlap in habitats from mid-May to mid-October. It was found that the areas where infections of *P. tenuis* could be transmitted and contracted are spruce-maple-birch which deer and moose both occasionally use. It would appear that either a spatial and/or behavioral separation of deer and moose is the major factor resulting in the low prevalence of infection of moose with *P. tenuis* in New Brunswick.

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