THE POTENTIAL ROLE OF WINTER TICK (*DERMACENTOR ALBIPICTUS*) IN THE DYNAMICS OF A SOUTH CENTRAL ONTARIO MOOSE POPULATION

Dale L. Garner[1] and Mike L. Wilton[2]

[1]Faculty of Environmental and Forest Biology, College of Environmental Science and Forestry, State University of New York, Syracuse, New York 13210; [2]Ontario Ministry of Natural Resources, Whitney, Ontario KOJ 2MO

ABSTRACT: A die-off of moose, apparently winter tick-related, occurred in Algonquin Provincial Park, Ontario, Canada in 1992. Hair-loss surveys showed the highest proportion of moose ever recorded in the most severe categories. Adult females had the severest hair-loss of all age classifications, followed by calves and adult males, respectively. Forty-three carcasses were found during routine field activities. Examination of a number of carcasses revealed either heavy tick infestations or severe hair-loss and depleted fat reserves. The median age of adult carcasses was 9.5 years. Nine newborn calves were found dead during spring cow-calf surveys. Six of the nine calves were stillborn, two died shortly after birth, and one calf was apparently crushed by its mother. In addition, 8 of 26 (31%) radio-collared adult females did not produce calves in 1992 compared to approximately 15% in the previous and following years. We suggest that the winter tick plays a more important role in moose population dynamics than previously thought.

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The winter tick (*Dermacentor albipictus*) is an important ectoparasite of moose throughout much of Canada and the northern United States (Anderson and Lankester 1974). Infestations of ticks on moose cause the animal to groom vigorously (Samuel 1991) producing extensive, premature winter hair-loss (Samuel and Barker 1979, Glines and Samuel 1984, McLaughlin and Addison 1986, Samuel *et al.* 1986, Welch *et al.* 1990), anemia (Glines and Samuel 1989) and depletion of fat reserves (McLaughlin and Addison 1986).

Epizootics of winter ticks have also been associated with moose die-offs (Webb 1959, Berg 1975, Samuel and Barker 1979, Addison and Smith 1981, Glines and Samuel 1989) and evidence that ticks actually cause death in moose exists (Glines and Samuel 1989). Whether winter tick is the proximate or ultimate cause of death in moose is unimportant; that moose infested with winter ticks do die and that die-offs are sometimes substantial (Samuel and Barker 1979, Addison and Smith 1981) is of paramount concern to managers.

Although much information exists regarding the ecology of the winter tick (Wilkinson *et al.* 1982, Drew and Samuel 1985, Drew *et al.* 1985, Drew and Samuel 1986, Zarnke *et al.* 1990, Samuel and Welch 1991) and the resultant alopecia in individual moose (McLaughlin and Addison 1986, Samuel *et al.* 1986), little has been presented regarding the implications of tick-related die-offs to moose management. The objectives of this paper are to describe the magnitude of a recent die-off (1992) of moose in Algonquin Provincial Park (APP), Ontario, with respect to the influence of winter tick and to discuss implications to moose population dynamics.

STUDY AREA

APP is located on the "Algonquin Plateau", an area of high ground between Georgian Bay and the Ottawa River valley, in south central Ontario (45° 39'N, 78° 39'W). APP is approximately 7314 km^2 in area and is characterized by two distinct geographical portions.

The western portion of APP is characterized by uplands of moderately rolling rock ridges with stony silty granitic sand tills.

Vegetation within the western portion is predominantly a hardwood/hemlock (*Acer saccharum, Fagus grandifolia, Betula lutea, Tsuga canadensis*) forest association.

The eastern portion of APP consists of broad upland areas and fairly broad depressions which are overlain with sandy moraines, terraces and outwash plains. Soils in the eastern half are comprised of a shallow to moderately deep mantle of sand and silty sand. A pine/poplar (*Pinus strobus, Populus* spp.) forest association is characteristic of the eastern portion of APP.

Moose are ubiquitous in APP and the present population is estimated to number approximately 4450 animals (O.M.N.R. file reports).

METHODS

Information on the moose herd in APP was gathered from a variety of sources. As part of a long-term study, in mid-March (1984-1992; O.M.N.R. file reports), a hair-loss survey was conducted using rotary-wing aircraft. Each moose was viewed to determine the sex and age of the individual and the amount of hair-loss observed. Hair-loss was recorded as none, light, moderate, severe, or very severe following methods outlined by E. M. Addison (O.M.N.R. file reports).

In late winter of each year, a memo was sent to all O.M.N.R. staff requesting information regarding all recovered moose carcasses. Staff were asked to map the location of dead animals, collect a tooth when possible, determine the sex and record the presence or absence of ticks and the animal's physical appearance. As many carcasses as possible were re-visited by a biologist to gather additional or missed information. Femur fat reserves were visually inspected (Cheatum 1949) in a number of moose exhibiting either severe hair-loss or heavy tick infestation.

From mid-May to early-June annual cow-calf surveys were conducted in APP (Addison *et al.* 1985). Crews searched islands and peninsulas while walking abreast, maintaining contact with one another visually, by voice, or through the use of portable radios, to find cows with newborn calves. Additional information on calf production was gathered while collaring cows for research purposes (Garner, unpubl. data).

RESULTS

In 1992, moose were classified into all five hair-loss severity categories. The highest proportion of the sample occurred in categories representing some hair-loss (Table 1). Adult females (i.e., animals >1 year of age) had the most severe hair-loss, followed by calves and adult males, respectively.

A total of 43 apparent tick-related deaths in moose were found by O.M.N.R. staff during routine field activities (Table 2). The median age of adult dead moose that were aged (n=12) was 9.5 years. Visual examination of femur marrow in 8 moose exhibiting either heavy tick infestation or severe hair-loss revealed uniform fat depletion.

Table 1. Percent hair-loss in moose observed during March 1992, in Algonquin Provincial Park, Ontario.

	NONE	LIGHT	MODERATE	SEVERE	VERY SEVERE	n
BULLS	0	72	21	7	0	14
COWS	5	34	45	8	8	38
CALVES	9	45	32	9	5	22
UNKNOWN	0	0	100	0	0	1

Table 2. Age classification of moose carcasses from tick-related mortality found during spring of 1992, in Algonquin Provincial Park, Ontario.

	Juvenile	Yearling	Adult	Unknown
Males	4	1	10	-
Females	5	3	8	-
Unknown	1	3	0	8

Nine newborn calves were found dead during spring cow-calf surveys. Six of the nine calves were stillborn, two died shortly after birth as determined by necropsy and the presence of hoof caps, and one calf was apparently crushed by its mother when she accidently lay on it. In addition, 8 of 26 (31%) radio-collared adult females (≥2 yr at parturition) did not produce calves in 1992.

DISCUSSION

As early as 1909, Ernest Thompson Seton recognized the winter tick as an important "enemy" of moose. While much has been learned about the autecology of winter tick, only a few authors have implicated this organism's potential role in moose population dynamics (e.g., Webb 1959, Berg 1975). The hair-loss survey of 1992 revealed the highest proportion of moose ever recorded in APP in the two most severe categories. Similarly, more apparent tick-related deaths in moose were observed than in any previous year.

Evidence that ticks actually cause death in moose exists (Glines and Samuel 1989). The magnitude of losses observed in this study suggests that winter ticks may be a more important cause of moose mortality than previously thought. Peterson (1955) suggested that the most serious effects of tick parasitism were manifested in a reduction of vitality in moose, making them more vulnerable to other factors, such as diseases, predation, abortion, and malnutrition. An examination of femur marrow in several moose either heavily infested with ticks or showing severe hair-loss in this study revealed depleted fat reserves.

The stillborn calves found dead in 1992 indicate manifestations of stress in cow moose similar to that observed in female deer of northern latitudes. Verme (1977) found that after extremely severe winters, up to 70% of the fawn crop can be expected to perish shortly after birth. In all of the previous spring cow-calf surveys, only 1 dead calf was found in any year (O.M.N.R. file reports).

The number of radio-collared adult females that failed to produce calves in 1992 was notable. The previous year's and the following year's proportion (n = 26, 24, respectively) of non-productive adult females was less than half that observed in 1992. Whether or not severe tick infestations were responsible for the low productivity is unknown; however, the coincidence is compelling.

We believe that only a fraction of the actual number of moose that died in APP in 1992 as a result of heavy tick infestation and subsequent hair-loss were found. Based on the numbers of carcasses observed in APP, before and after parturition, we suggest that the winter tick plays an important role in determining future moose population densities. In addition to the immediate losses prepartum, there may be a latent population effect of winter tick through neonatal losses. Additional work is needed to examine the confounding effects of population size and weather, including potential interactions with winter ticks, in limiting moose numbers.

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