PRODUCTIVITY OF WINTER TICKS (DERMACENTOR ALBIPICTUS) COLLECTED FROM MOOSE KILLED ON ONTARIO ROADS[1]

Edward M. Addison and Lynn M. Smith
Wildlife Research Section, Ontario Ministry of Natural Resources, P.O. Box 50, Maple, Ontario L0J 1E0

Abstract: Adult female winter ticks, Dermacentor albipictus, were collected from moose killed on Ontario roads in April and May. Fifty-one partially engorged ticks in 1979 and 271 partially engorged ticks in 1980 were maintained in incubators held at 26°C and 22°C respectively. Ticks began laying eggs 9-13 days following death of the moose. The number of eggs laid was positively correlated to the weight of the female ticks ($r^{22°C}$ = +0.81, $r^{26°C}$ = +0.78). Many ticks laid 2000 - 6000 eggs and some laid an estimated 8000 - 10,000 eggs. The incubation period was 31.5 ± 1.0 (30-34) days at 26°C and 47 ± 2.87 (22-52) days at 22°C. The significance of the results to the moose-winter tick association is discussed.

The winter tick, Dermacentor albipictus, is known from the east to the west coast in southern and central Canada, from many northern and Rocky Mountain states of United States, southward into Texas and Mexico (Cooley

[1]Ontario Ministry of Natural Resources, Wildlife Research Section Contribution No. 81-08.

1938, Bishopp and Trembley 1945, Wilkinson 1967). Two recognized morphs of winter tick occur, the albipictus morph and the nigrolineatus morph. Ticks in the present study are members of the albipictus morph which is the larger and generally the more northern and western of the two forms (Bishopp and Wood 1913, Bishopp and Trembley 1945, Ernst and Gladney 1975).

The infestation of livestock with winter tick in the southwestern United States has stimulated study of the development, seasonal activity patterns and productivity of the winter tick on livestock. (Bishopp and Wood 1913, Howell 1939, Drummond 1967, Drummond et al. 1969, Ernst and Gladney 1975). However, cervids are considered the natural hosts of winter tick (Howell 1939). Addison et al. (1979) documented the seasonal activity and abundance of winter ticks on moose collected in northern Ontario. Samuel and Barker (1979) studied the patterns of hair loss, intensities of tick infestation, and the distribution of ticks on moose found dead during a large dieoff of moose in Elk Island National Park. A smaller dieoff of moose heavily infested with winter ticks occurred in the Alfred Bog of southeastern Ontario during the winter of 1978-79 (Addison, unpubl.). The Alfred Bog dieoff has confirmed the need for more intensive study of winter ticks from moose and the moose-winter tick association. The present study describes the productivity and early laboratory colonization of winter ticks recovered from moose killed on Ontario highways.

METHODS

Moose hides infested with adult winter ticks were collected from moose killed on Ontario roads during April and May. Some female ticks voluntarily detached from hides, others were removed by gently twisting the ticks counter-clockwise. Each female tick was weighed, put in a petri dish, then placed in a plexiglas container within an incubator.

In 1979, the incubator was held at 26 $\pm$ 1^{o}C and 30-50% relative humidity (RH). The humidity was maintained using moist paper towels and a fan over a pan of water. In 1980, the incubator was held at 22 $\pm$ 1^{o}C and ticks in petri dishes were held over saturated solutions of potassium sulphate and sodium sulphate. The solutions produced 70-80% RH.

Ticks were examined daily to record the first date of oviposition. The preoviposition period of a tick was defined as the time from death of the moose to the first egg laid. Following oviposition numerous egg clusters were weighed and eggs within these clusters were counted to obtain an average egg weight. The number of eggs in remaining clusters was estimated by weight. Egg clusters were examined daily for the first hatched larva. The incubation period was defined as the time from the first egg laid to the first larva hatched within a cluster. The female ticks and egg clusters were held in darkness except when removed from the incubators for examination.

RESULTS

In 1979, 51 ticks were collected from a cow moose killed on May 12 in Algonquin Provincial Park. In 1980, 229 ticks were removed from a yearling bull killed on April 16 in Algonquin Park and 42 ticks were from a yearling cow killed on May 10 in Calder Township near Cochrane.

The preoviposition period in 1979 was either 10 days (43 ticks) or 11 days (8 ticks). In 1980, the average preoviposition time was 11 days and 96% of 252 ticks had preoviposition periods of 9-13 days. Nine ticks which had a longer period (14-18 days) were only slightly larger than half the size of those laying earlier. Conversely the ticks with a preoviposition period of 9 days were 25% heavier than the average tick.

The size of the partially engorged ticks and the eggs produced by individual ticks varied a great deal during both years (Table 1). However, the number of eggs laid was positively correlated with the size of the tick (r^{1979} = +0.78, y^{1979} = -471.6 + 8092.3x; r^{1980} = +0.81, y^{1980} = -524 + 9764x).

In 1979, 21 egg clusters representing 46,947 eggs were weighed and the number of eggs counted. The average egg weight/cluster ranged from 42 to 66 µg. In 1980, 41 egg clusters representing 120,510 eggs were treated similarly and the average egg weight/cluster ranged from 34 to 78 µg. The overall average egg weight for 1980 was greater than for 1979 (Table 1).

The incubation period was synchronous when eggs developed at 26^{o}C. It was 30 days for 8(16%) clusters, 31 days for 22(43%) clusters, 32 and 33

Table 1. Oviposition data for female Dermacentor albipictus from moose.

	1980	1979
Temperature (°C)	22	26
Ticks		
No. ovipositing	271	51
Weight (g)	0.47 ± 0.17(0.07-0.99)[a]	0.39 ± 0.12(0.17-0.81)
Eggs		
No. laid/tick	4147 ± 2108 (185-10063)	2707 ± 1323 (765-7159)
Weight (ug)	63.3 ± 8.4 (34-78)	55.8 ± 5.2 (42-66)
Incubation period (days)	47 ± 2.9 (22-52)	31.5 ± 1.0 (30-34)

[a] mean ± 1 S.D. (range).

days for each of 10(20%) clusters and 34 days for the 1 remaining egg cluster. Although the incubation period ranged from 22-52 days at 22°C (Table 1), 86% of 205 clusters had an incubation period of 44-49 days.

DISCUSSION

Female winter ticks in previous studies have dropped from live animals and were thought to have fed to repletion. In the present study most ticks were considered to be partially engorged since their feeding was interrupted by the death of the moose. However, some of the larger ticks may have been almost fully engorged because the moose were killed during April and May which is the time ticks probably drop from live moose.

The production of viable larvae from partially engorged winter ticks suggests that tick infested moose which die in April are a source of larvae for infesting moose the following autumn. However, Howell (1939) observed little development of winter tick eggs at 15°C in California. In British Columbia winter tick larvae did not hatch from eggs held at 10°C and at 15°C larvae were not observed until about 5 months after eggs were removed from a 10°C environment (Wilkinson 1967). Within moose range, March or April temperatures probably are not consistently high enough for partially engorged females to produce viable offspring.

The marked differences in the weight of female ticks in the 1979 and 1980 samples likely reflect the more fully engorged state of the ticks in the 1980 experiments. The large ticks from moose were heavier than the replete females from cattle in Texas (Drummond et al. 1969) and were

comparable in weight to the fully engorged ticks of mule deer origin which had subsequently fed on cattle (Ernst and Gladney 1975). Fully engorged winter ticks from moose may be larger than winter ticks from cattle in Texas.

The preoviposition periods of winter ticks held at each temperature during the present study were synchronous and were generally similar to preoviposition periods reported for winter ticks of cattle origin held at 27°C (Drummond et al. 1969). However, detailed comparisons of preoviposition periods between studies must consider temperature and humidity during the studies (see Sweatman 1967).

For many species of ticks, the number of eggs laid is positively correlated to the size of the female tick (Sweatman 1967, Drummond and Whetstone 1975, Davey et al. 1980a, Davey et al. 1980b). Drummond et al. (1969) demonstrated this relationship for D. albipictus from cattle in Texas and the present study confirms the same for D. albipictus from Ontario moose.

Winter ticks of moose origin in the present study are as productive or more productive than winter ticks from cattle in Texas. The slope of the regression of eggs laid to tick weight in 1979 (b = 8092.3) is less than that observed by Drummond et al. (1969) for ticks disturbed (b = 8632.5) and undisturbed during oviposition (b = 9192.3). However, the slope for our 1980 sample is greater (b = 9764) than those observed by Drummond et al. (1969). The maximum number of eggs/egg cluster in previous studies is 4411, 4877, and less than 6000 (Bishopp and Wood 1913, Howell 1939, Drummond et al. 1969) as compared to 10,063 in the present study. However

7-35 times more egg clusters were examined in the present study. Further study using fully engorged ticks of moose origin will clarify if winter ticks from the two different hosts and from different parts of winter tick range vary greatly in their potential egg production.

The large difference in weight of eggs from the ticks held at 22°C and 26°C reflects the lower humidity at which eggs were maintained at 26°C. Many more eggs were desiccated when held at 30-50% RH (26°C) than at 70-80% RH (22°C). Weight of eggs of cattle origin (μ = 65 μg) differed little from weight of eggs of moose origin (μ = 63 μg) when they were held at 70% or greater RH (Drummond et al. 1969, present study).

The incubation period of D. albipictus eggs is strongly influenced by temperature (Howell 1939, Wilkinson 1967). It is generally longer at lower temperatures. Under controlled laboratory conditions Howell (1939) reported incubation times of 35-36 days at 25°C and 29-30 days at 30°C. At 27°C Drummond et al. (1969) recorded incubation times of 24-27 days. The incubation period of 30-34 days for eggs held at 26°C in the present study is longer than that observed by Drummond et al. (1969) and shorter than that observed by Howell (1939) at generally similar temperatures. An incubation period of 101-110 days is reported for winter tick eggs in the external environment in southern British Columbia (Wilkinson 1967).

Study of the ovipositional biology of winter ticks demonstrates some of the physical environmental factors influencing survival and hatching of eggs. It also provides insight into the potential of 1 year's crop of ticks to contribute to transmission of ticks to moose during the following year. In addition it demonstrates similarities between winter ticks from

different hosts in diverse parts of winter tick range.

ACKNOWLEDGEMENTS

The authors are grateful to Mike Wilton and the fish and wildlife staff of Algonquin Park District and to Craig Greenwood and fish and wildlife staff of Cochrane District of the Ontario Ministry of Natural Resources. These people kindly offered winter ticks and infested moose carcasses. We wish, in particular, to thank Damien Joachim, Doug Fraser, Sue Cocker and others who assisted us in the laboratory.

REFERENCES

ADDISON, E. M., F. J. JOHNSON, and A. FYVIE. 1979. Dermacentor albipictus on moose (Alces alces) in Ontario. J. Wildl. Dis. 15: 281-284.

BISHOPP, F. C., and H. L. TREMBLEY. 1945. Distribution and hosts of certain North American ticks. J. Parasitol. 31: 1-54.

_____, and H. P. WOOD. 1913. The biology of some North American ticks of the genus Dermacentor. Parasitology 6: 153-186.

COOLEY, R. A. 1938. The genera Dermacentor and Otocentor (Ixodidae) in the United States, with studies in variation. Bull. U.S. Natn. Inst. Health 171. 90pp.

DAVEY, R. B., J. GARZA, Jr., G. D. THOMPSON, and R. O. DRUMMOND. 1980a. Ovipositional biology of the southern cattle tick, Boophilus microplus (Acari:Ixodidae), in the laboratory. J. Med. Entomol. 17: 117-121.

_____, _____, _____, and _____. 1980b. Ovipositional biology of the cattle tick, Boophilus annulatus (Acari:Ixodidae), in the laboratory. J. Med. Entomol. 17: 287-289.

DRUMMOND, R. O. 1967. Seasonal activity of ticks (Acarina:Metastigmata) on cattle in southwestern Texas. Ann. Entomol. Soc. Amer. 60: 439-447.

_____, and T. M. WHETSTONE. 1975. Oviposition of the Cayenne tick, Amblyomma cajennense (F.), in the laboratory. Ann. Entomol. Soc. Amer. 68: 214-216.

_____, _____, S. E. ERNST, and W. J. GLADNEY. 1969. Biology and colonization of the winter tick in the laboratory. J. Econ. Entomol. 62: 235-238.

ERNST, S. E., and W. J. GLADNEY. 1975. Dermacentor albipictus: hybridization of the two forms of the winter tick. Ann. Entomol. Soc. Amer. 68: 63-67.

HOWELL, D. E. 1939. The ecology of Dermacentor albipictus (Packard). Proc. 6th Pac. Sci. Congr. Pac. Sci. 4: 439-458.

SAMUEL, W. M., and M. J. BARKER. 1979. The winter tick, Dermacentor albipictus (Packard, 1869) on moose, Alces alces (L.), of central Alberta. Proc. N. Am. Moose Conf. Workshop 15: 303-348.

SWEATMAN, G. K. 1967. Physical and biological factors affecting the longevity and oviposition of engorged Rhipicephalus sanguineus female ticks. J. Parasitol. 53: 432-445.

WILKINSON, P. R. 1967. The distribution of Dermacentor ticks in Canada in relation to bioclimatic zones. Can. J. Zool. 45: 517-537.