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Potential Vertical Transmission of Winter Ticks (*Dermacentor albipictus*) from Moose (*Alces americanus*) Dams to Neonates

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ABSTRACT: North American moose (*Alces americanus*) frequently become infested with winter ticks (*Dermacentor albipictus*). During capture of neonatal moose in northeastern Minnesota, US, in May–June 2013 and 2014, we recovered adult ticks from neonates, presumably vertically transferred from dams, heretofore, not documented. Infestations on neonates may have population-level implications.

North American moose (*Alces americanus*) have been known to experience intense infestations of winter ticks (*Dermacentor albipictus* [Acari: Ixodidae]; Samuel 2004). Infestations have averaged ~33,000 ticks/moose, with some individuals carrying >100,000 ticks (Samuel and Welch 1991). Extrinsic and intrinsic factors contribute to tick-related mortality events, which can reach massive scales (Samuel 2004). Moose calves and yearlings may be more vulnerable than adults to the effects of ticks, perhaps contributing to population declines (Musante et al. 2010).

Winter ticks are one-host ticks. Larvae infest moose in autumn, and engorged adults drop off the following spring (Samuel 2004). Infestation can cause alopecia from excessive grooming, loss of body condition, and pronounced blood loss (Wünschmann et al. 2015). Ticks may act as vectors for a variety of pathogens (Aubry and Geale 2011).

In the process of collaring moose neonates, we documented the presence of adult winter ticks, heretofore, not reported in the literature, to our knowledge. We also discuss health-related implications at the population level.

We conducted this study in a 6,636-km^2 area of northeastern Minnesota, US, between 47°00′N and 47°56′N latitude, and 89°57′W and 92°17′W longitude. The area is Northern Superior Upland (Severud et al. 2015).

We monitored GPS-collared, preparturient cow moose during calving season to locate neonatal moose in May–June 2013 and 2014 (Severud et al. 2014, 2015). Neonates were fitted with a GPS collar (GPS PLUS VERTEX Survey-1 GLOBALSTAR collar, Vectronic Aerospace GmbH, Berlin, Germany), which allowed rapid responses to mortalities. We minimized handling time to decrease the risk of maternal abandonment of calves. Captures followed guidelines established by the American Society of Mammalogists (Sikes et al. 2011) and were approved by the University of Minnesota's Institutional Animal Care and Use Committee (Protocol 1302-30328A). Ticks were opportunistically collected from neonates that were subsequently retrieved alive following abandonment by their dams (DelGiudice et al. 2015) and from calf carcasses. We identified ticks to species, sex, and life stage (Animal Disease Eradication Division 1965).

We collared 49 calves from 31 dams in May 2013 and 25 calves from 19 dams in May–June 2014 (Severud et al. 2014, 2015). In 2013, one calf carcass had four adult ticks attached to its head (three engorged females, one male; Table 1). In 2014, live, unattached adult ticks were collected from neonates abandoned by their dams (Severud et al. 2014). We collected 13 adult ticks (one female, 12 male) from four live calves (two sets of twins) on 9 and 16 May, and one adult tick (male) from one carcass on 16 May. Additionally, one investigator found one adult male tick attached to her head on 6 June after departing from a calf mortality site.

TABLE 1. Summary of winter ticks (*Dermacentor albipictus*) observed on collared moose (*Alces americanus*) neonates and handlers, northeastern Minnesota, May–June 2013–14. Calf and tick sexes are abbreviated F for females and M for males.

Year	Capture date	Recovery date	Calf age (d)	Calf sex	No. M ticks	No. F ticks	Tick status
2013	15 May	1 June	17.5	F	1	3	Attached/ engorged
2014	8 May	9 May	3.7	M	3[a]	0[a]	Roaming
2014	8 May	9 May	3.7	F	3[a]	0[a]	Roaming
2014	13 May	16 May	4.1	M	1	0	Roaming
2014	14 May	16 May	3.4	M	2	1	Roaming
2014	14 May	16 May	3.4	F	4	0	Roaming
2014	23 May	6 June	9.6	M	1	0	On handler

[a] Ticks from these twins were pooled upon collection, so it is unknown which twin hosted which ticks. We have assumed one-half/calf.

Because unengorged adult winter ticks are not known to be free living, we assume these ticks originated from infested dams.

To our knowledge, this is the first report of winter ticks infesting moose neonates. This is also the first report of winter ticks switching hosts in free-ranging populations; however, movement of ticks among closely grouped cattle has been suspected (Aubry and Geale 2011). The prevalence and intensity of infestation is likely greater than observed because few of our cohort were inspected thoroughly because of limitations in handling time. During two capture seasons, we observed adult ticks on six calves of 74 (8%). We observed no ticks on 13 intact carcasses thoroughly examined at the University of Minnesota's Veterinary Diagnostic Laboratory during May–June 2013. One of two partial carcasses recovered during May 2013 was infested. In 2014, of nine calves that were retrieved after being abandoned by their dams and more thoroughly checked by handlers, five were infested with ticks (56%).

Vertical transmission of winter ticks has implications for disease transmission that may lead to population-level effects. Although adult ticks are reported to have fed and dropped from adult moose by April (Samuel 2004), and peak moose calving in northeastern Minnesota is mid May (McGraw et al. 2014; Severud et al. 2014, 2015), later drop-off dates have been observed in northeastern Minnesota and Ontario, Canada (Terry 2014; E. Addison pers. comm.). We collected unengorged adult ticks throughout May–June (Table 1). A study in Algonquin Provincial Park in Ontario found adult ticks dropping from moose as late as the calving season but never found calves to be infested ($n=40$–50 calves, E. Addison pers. comm.). Experimentally infested moose in Alberta, Canada, still hosted small numbers of male ticks in May (Drew and Samuel 1989). *Anaplasma phagocytophilum*, *Borrelia burgdorferi*, and *Francisella*-like endosymbionts have been isolated from winter ticks found on white-tailed deer (*Odocoileus virginianus*) and cattle (Kocan et al. 1992; Baldridge et al. 2009; Aubry and Geale 2011); winter ticks could, therefore, potentially be implicated in vertical transmission of pathogens from dams to calves. The effects of any pathogens transmitted to calves are currently unknown.

Winter tick infestation of neonatal moose could result in life-long adverse effects on fitness if infestations are great enough to cause appreciable blood loss or pathogen transmission. This could lead to a possible demographic effect.

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LITERATURE CITED

Animal Disease Eradication Division. 1965. *Manual on livestock ticks for animal disease eradication division personnel*. US Department of Agriculture, Hyattsville, Maryland, 142 pp.

Aubry P, Geale DW. 2011. A review of bovine anaplasmosis. *Transbound Emerg Dis* 58:1–30.

Baldridge GD, Scoles GA, Burkhardt NY, Schloeder B, Kurtti TJ, Munderloh UG. 2009. Transovarial transmission of *Francisella*-like endosymbionts and *Anaplasma phagocytophilum* variants in *Dermacentor albipictus* (Acari: Ixodidae). *J Med Entomol* 46:625–632.

DelGiudice GD, Severud WJ, Obermoller TR, Wright RG, Enright TA, St-Louis V. 2015. Monitoring movement behavior enhances recognition and understanding of capture-induced abandonment of moose neonates. *J Mammal* 96:1005.

Drew ML, Samuel WM. 1989. Instar development and disengagement rate of engorged female winter ticks, *Dermacentor albipictus* (Acari: Ixodidae), following single-and trickle-exposure of moose (*Alces alces*). *Exp Appl Acarol* 6:189–196.

Kocan AA, Mukolwe SW, Murphy GL, Barker RW, Kocan KM. 1992. Isolation of *Borrelia burgdorferi* (Spirochaetales: Spirochaetaceae) from *Ixodes scapularis* and *Dermacentor albipictus* ticks (Acari: Ixodidae) in Oklahoma. *J Med Entomol* 29: 630–633.

McGraw AM, Terry J, Moen R. 2014. Pre-parturition movement patterns and birth site characteristics of moose in northeast Minnesota. *Alces* 50: 93–103.

Musante AR, Pekins PJ, Scarpitti DL. 2010. Characteristics and dynamics of a regional moose *Alces alces* population in the northeastern United States. *Wildl Biol* 16:185–204.

Samuel B. 2004. *White as a ghost: Winter ticks and moose*. Federation of Alberta Naturalists, Edmonton, Alberta, Canada, 100 pp.

Samuel WM, Welch DA. 1991. Winter ticks on moose and other ungulates: Factors influencing their population size. *Alces* 27:169–182.

Severud WJ, DelGiudice GD, Obermoller TR, Enright TA, Wright RG, Forester JD. 2015. Using GPS collars to determine parturition and cause-specific mortality of moose calves. *Wildl Soc Bull* 39:616–625.

Severud WJ, DelGiudice GD, Obermoller TR, Foshay KJ, Wright RG. 2014. Using GPS collars to determine moose calving and cause-specific mortality of calves in northeastern Minnesota: Progress report on second field season. In: *Summaries of wildlife research findings 2013*, Cornicelli L, Carstensen M, Grund MD, Larson MA, Lawrence JS, editors. Minnesota Department of Natural Resources, St. Paul, Minnesota, pp. 40–56.

Sikes RS, Gannon WL, The Animal Care and Use Committee of the American Society of Mammalogists. 2011. Guidelines of the American Society of Mammalogists for the use of wild mammals in research. *J Mammal* 92:235–253.

Terry J. 2014. *The habitat of winter ticks (*Dermacentor albipictus*) in the moose (*Alces alces*) range of northeast Minnesota.* MS Thesis, University of Minnesota, Duluth, Minnesota, 65 pp.

Wünschmann A, Armien AG, Butler E, Schrage M, Stromberg B, Bender JB, Firshman AM, Carstensen M. 2015. Necropsy findings in 62 opportunistically collected free-ranging moose (*Alces alces*) from Minnesota, USA (2003–2013). *J Wildl Dis* 51:157–165.

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