Factors Influencing the Potential Establishment of the Winter Tick (Dermacentor albipictus) in Alaska

Authors: Zarnke, Randall L., Samuel, W. M., Franzmann, Albert W., and Barrett, Richard

Source: Journal of Wildlife Diseases, 26(3) : 412-415

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-26.3.412

Journal of Wildlife Diseases, 26(3), 1990, pp. 412–415

Factors Influencing the Potential Establishment of the Winter Tick (*Dermacentor albipictus*) in Alaska

Randall L. Zarnke,[1] W. M. Samuel,[2] Albert W. Franzmann,[3] and Richard Barrett,[4] [1] Alaska Department of Fish and Game, 1300 College Road, Fairbanks, Alaska 99701, USA; [2] Department of Zoology, University of Alberta, Edmonton, Alberta, Canada T6G 2E9; [3] Alaska Department of Fish and Game, 34828 Kalifornsky Beach Road, Suite B, Soldotna, Alaska 99669, USA; [4] Alaska State/Federal Animal Health Lab, 500 South Alaska Street, Palmer, Alaska 99645, USA

ABSTRACT: The winter tick (*Dermacentor albipictus*) is not known to occur in Alaska. Survival and development of free-living (i.e., non-host-associated) stages of the tick were studied at three sites in central and southern Alaska. Female ticks survived, oviposited, and eggs hatched at all sites. Hatch success was low at one site where summer temperatures were low. Results suggest that establishment of winter ticks in Alaska following accidental translocation is possible, but several factors would affect such establishment.

Key words: Winter tick, *Dermacentor albipictus*, tick survival and development, Acari, epizootiology, Alaska, experimental field study.

The northern limit of *Dermacentor albipictus* in North America is not well-defined. Wilkinson (1967) has proposed that an isopleth of 1,500 accumulated day degrees over 42 F (5.6 C) could be the northern boundary. In western North America this isopleth, as presented by Wilkinson (1967), extends through the southern Northwest Territories and northern British Columbia in Canada, and the southern tip of Alaska (USA). Klein (1965) found "*Dermacentor* sp." during examination of 46 Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) in southeastern Alaska. Samuel (1989) suggests that winter ticks may occur as far north as 62°N latitude. Although both reports indicate that winter ticks occur in areas geographically close to Alaska, the winter tick apparently does not occur naturally in Alaska.

Dermacentor albipictus infects many species of mammals in North America. Moose (*Alces alces*) (Anderson and Lankester, 1974) are a major host, but elk (*Cervus elaphus*), deer (*Odocoileus* spp.), horses, and cattle (Bishopp and Trembley, 1945; Arthur, 1960) also may be infected. Moose populations are contiguous from Alberta and British Columbia to Alaska, but populations of winter ticks apparently are not (Wilkinson, 1967; Samuel, 1989). The question arises as to whether or not *D. albipictus* could become established in Alaska if it were introduced into the state by means of a translocated host.

Objectives of this study were to determine if (1) engorged female ticks could survive in Alaska, (2) these same ticks could oviposit, and (3) any resulting eggs would hatch. Results of experiments from Edmonton, Alberta, Canada (53°33′N, 113°25′W) are presented for comparison.

Detached, engorged adult female *D. albipictus* (n = 215) that had fed on captive moose (n = 146 ticks) were collected in mid-April near Edmonton, Alberta (Canada) in 1984 and 1986 and from a freshly dead moose (n = 69 ticks) near Jackson, Wyoming (USA, 43°55′N, 110°40′W) in mid-April 1985. Ticks were stored at 3 C and sent to Fairbanks, Alaska (USA, 64°50′N, 147°50′W) within 8 days after collection.

To prevent escape of the ticks, individual ticks were placed in separate 20 × 75 mm glass vials. A 10-mm diameter hole was drilled in the vial cap and the hole was covered with a fabric mesh (largest opening in fabric approximately 0.10 × 0.25 mm). Several such vials were then placed inside a 22 × 27 cm zippered cylindrical bag constructed of the same fabric material. The bag was hung at ground level inside a 34 × 105 cm cylindrical hardward cloth cage (mesh size 3 mm). The cage was secured upright inside a 28 × 56 cm galvanized washtub that had been half filled with soil and native vegetation. The number of ticks at each study site ranged from 15 to 24 depending upon availability of ticks in any particular year.

Tick enclosures were placed (1) on the roof of a shed near Fairbanks, Alaska, between 23 and 28 April 1984 to 1986, (2) on the roof of an office building in Palmer, Alaska (61°35'N, 149°10'W) between 23 and 27 April 1984 to 1986, and (3) at ground level near Soldotna, Alaska (60°30'N, 151°04'W) between 24 and 28 April 1984 to 1986 (Fig. 1). Two identical enclosures were placed on opposite sides of a building (north- and south-facing) at the Soldotna site. The climate, topography, geology, flora, fauna, etc., of these areas have been described previously (Selkregg, 1974). Ticks were examined for survival and oviposition, and eggs were examined for eclosion at approximately 7- to 10-day intervals from late April until mid-October 1984 to 1986. Weather information for Alaska was obtained from the National Climatic Data Center (Climatological Data, 1984, 1985, 1986). Day-degrees is defined as [(Daily maximum temperature F + Daily minimum temperature F) ÷ 2] − 42.

In Edmonton, Alberta, 26 ticks were placed in screen-wire cages (described by Drew and Samuel, 1986) and placed in an open, early growth aspen (*Populus tremuloides*) copse at the University of Alberta Ellerslie Research Station on 24 April 1987. Cages used in Alberta were less elaborate because (unlike Alaska) escape would not represent a threat of introduction and establishment of a new parasite. These cage differences may have resulted in microhabitat differences and therefore affected tick development. Ticks were examined weekly until 2 January 1988.

Survival and oviposition of engorged female *D. albipictus* were high at all sites (Table 1). Eclosion success by mid-September was high at Fairbanks, Palmer and Edmonton, but low at the two Soldotna sites. In fact, eggs only hatched at Soldotna on one of five occasions.

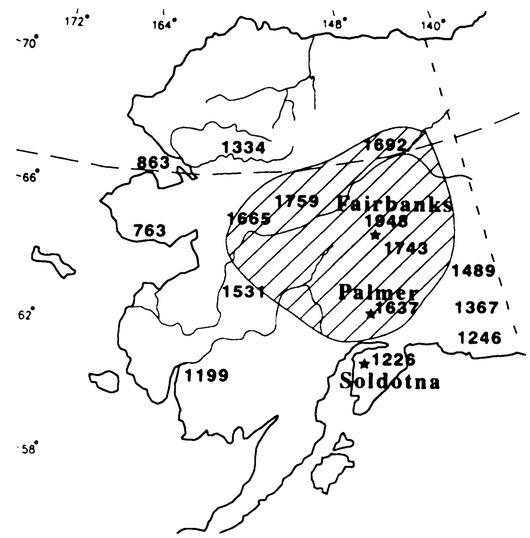

FIGURE 1. Cumulative day-degrees above 42 F (5.6 C) for selected sites in Alaska. Hatched area delineates 1,500 day-degree area (see text for details); dashed line represents arctic circle.

The median date of oviposition was approximately 31 May at Edmonton, 1 June at Fairbanks, 6 June at Palmer, 16 June at Soldotna-south, and 29 June at Soldotna-north. Oviposition occurred over periods ranging from as short as 4 days at Fairbanks in 1984 and 7 days at Edmonton to as long as 72 days at Soldotna-south in 1986. The median date of hatch was approximately 26 August at Edmonton, 19 August at Fairbanks, and 28 July at Palmer (based on 1 year of data). No eggs hatched at Soldotna-north. Timing of hatch was not recorded for the single year in which eggs hatched at Soldotna-south.

At Fairbanks and Edmonton, egg masses ranged in size from 1 mm to 1 cm diameter. The larger masses contained an estimated 1,000–3,000 eggs. Subjective estimates of percent hatch for individual vials at Fairbanks ranged from 0 to 75%. Approximately 90% of the eggs hatched at Edmonton. Such data were not collected at other sites.

Results from Alaska indicate that the environmental conditions necessary for survival and development of *D. albipictus* were met at Palmer and Fairbanks. Ex-

TABLE 1. Survival of adult female *Dermacentor albipictus*, oviposition and ecolosion at four sites in Alaska.

Location	Date experiment begun	Number engorged female (EF) ticks	Number (%) of live EF on 15 June	Number (%) EF that oviposited by 15 July	Number (%) successful EF[a]
Fairbanks					
1984	23 April	16	10 (63)	10 (100)	10 (100)
1985	25 April	18	14 (78)	14 (100)	12 (86)
1986	28 April	24	12 (50)	12 (100)	11 (92)
Total		58	36 (62)	36 (100)	33 (92)
Palmer					
1984	27 April	19	19 (100)	19 (100)	19 (100)
1985	23 April	16	15 (94)	12 (80)	12 (100)[b]
1986	28 April	24	24 (100)	21 (87)	7 (33)[c]
Total		59	58 (98)	52 (90)	38 (84)
Soldotna-North					
1984	26 April	15	15 (100)	15 (100)	0
1985	24 April	18	15 (83)	3 (20)	0
1986	28 April	24	11 (46)	9 (82)	0
Total		57	41 (72)	27 (62)	0
Soldotna-South					
1984	24 April	17	17 (100)	14 (82)	10 (71)
1985	28 April	24	19 (79)	19 (100)	0
Total		41	36 (87)	33 (92)	10 (30)
Grand totals		215	171 (80)	148 (86)	81 (55)
Edmonton, Alberta					
1987	24 April	26	22 (85)	21 (95)	20 (95)

[a] Successful engorged female is defined as a blood-engorged female that laid eggs that hatched by 15 September.
[b] Vials not checked between 27 June (0 hatched) and 14 October (all 12 hatched).
[c] Experiment terminated 21 August.

periments there resulted in viable larvae all 3 yr. In contrast, few live larvae were produced at the two Soldotna sites. Because survival of female ticks and success of oviposition were high (77%) at Soldotna, it was the incubation period (length of time between egg-laying and hatching) that was most negatively affected. Drew and Samuel (1986) suggest that the incubation period for *D. albipictus* is temperature dependent. If so, the 30-yr average of 1,226 day-degrees at Soldotna (Fig. 1) was probably below the minimum threshold for complete egg development and eclosion. Thirty-year average day-degrees for the Palmer and Fairbanks areas were 1,673 and 1,948, respectively.

If, as we contend, summer conditions at Palmer and Fairbanks are suitable for development of *D. albipictus*, the question arises as to why this parasite has not become established in Alaska. Moose populations are contiguous from Alaska to the Canadian provinces where *D. albipictus* is enzootic. Theoretically, the parasite could occur throughout the host's range, as well. One plausible explanation is that a natural barrier, related to climate, exists in northwestern British Columbia and/or the Yukon Territory of Canada (Samuel, 1989). Accumulated day-degrees above 42 F (5.6 C) constitute the basis for Wilkinson's (1967) proposed northern range limit for *D. albipictus* in Canada. Considering Wilkinson's (1967) isopleth (see his Fig. 5), Alaskan weather data (Fig. 1), and present results, it appears that *D. albipictus* could survive and become established in much of interior Alaska's moose range if it were able to broach this natural barrier.

Another closely related factor in tick survival is the length of winter. In Alaska, cold temperatures and snow cover tend to come earlier in autumn and last later in spring than in areas (e.g., central Alberta) typical for *D. albipictus*. Early cold and snow in autumn would bury and/or kill host-seeking larvae on vegetation. Late winter cold and snow kills engorged adult female ticks recently disengaged from moose (Drew and Samuel, 1986).

An alternative explanation for the absence of *D. albipictus* in Alaska relates to the pre-historic invasions of ancestral moose into North America. Invasion occurred in two waves separated by tens of thousands of years (Bubenik, 1986). Descendents of the first wave populated much of North America, but not Alaska. Moose currently found in Alaska descended from the second wave. Perhaps *D. albipictus* evolved with those moose descended from the first invasion but not with those from the second invasion.

The acknowledged subspecies of moose are readily distinguishable. This suggests little mixing of populations. Perhaps the absence of *D. albipictus* in Alaska is a result of lack of movement of infested moose from the south. Other possible contributing factors include (1) genetic differences of moose from Alaska and moose from more southerly areas, (2) densities of moose, and (3) habitat-tick relationships (Drew and Samuel, 1986).

This study was supported by Federal Aid in Wildlife Restoration Projects W-22-2 and by the Natural Sciences and Engineering Research Council of Canada (operating grant to WMS).

LITERATURE CITED

ANDERSON, R. C., AND M. W. LANKESTER. 1974. Infectious and parasitic diseases and arthropod pests of moose in North America. Le Naturaliste Canadien 101: 23–50.

ARTHUR, D. A. 1960. Ticks: A monograph of the Ixodidae. Part V. On the genera *Dermacentor*, *Anocentor*, *Cosmiomma*, *Boophilus*, *Margaropus*. Cambridge University Press, London, England, 251 pp.

BISHOPP, F. D., AND H. L. TREMBLEY. 1945. Distribution and hosts of certain American ticks. The Journal of Parasitology 31: 12–54.

BUBENIK, A. B. 1986. Taxonomic position of *Alcinae* Jerdon, 1874 and the history of the genus *Alces* Gray, 1821. Alces 22: 1–67.

CLIMATOLOGICAL DATA, ALASKA. 1984. Vol. 70. National Oceanic and Atmospheric Administration, Environmental Data and Information Service, National Climatic Data Center. Asheville, North Carolina, 401 pp.

CLIMATOLOGICAL DATA, ALASKA. 1985. Vol. 71. National Oceanic and Atmospheric Administration, Environmental Data and Information Service, National Climatic Data Center. Asheville, North Carolina, 390 pp.

CLIMATOLOGICAL DATA, ALASKA. 1986. Vol. 72. National Oceanic and Atmospheric Administration, Environmental Data and Information Service, National Climatic Data Center. Asheville, North Carolina, 402 pp.

DREW, M. L., AND W. M. SAMUEL. 1986. Reproduction of the winter tick, *Dermacentor albipictus*, under field conditions in Alberta, Canada. Canadian Journal of Zoology 64: 714–721.

KLEIN, D. R. 1965. Ecology of deer range in Alaska. Ecological Monographs 35: 259–284.

SAMUEL, W. M. 1989. Locations of moose in northwestern Canada with hair loss probably caused by the winter tick, *Dermacentor albipictus* (Acari: Ixodidae). Journal of Wildlife Diseases 25: 436–439.

SELKREGG, L. 1974. Alaska Regional Profiles. Alaska Environmental Information and Data Center, Anchorage, Alaska, 1629 pp.

WILKINSON, P. R. 1967. The distribution of *Dermacentor* ticks in Canada in relation to bioclimatic zones. Canadian Journal of Zoology 45: 517–537.

Received for publication 9 May 1988.