An Evaluation of Burning for Control of Winter Ticks, Dermacentor albipictus, in Central Alberta

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introduced. Observations were made for 2 wk. The results showed that eight out of 12 parasites attached themselves to the skin of the fish within a period of 2–7 days.

The cause of the mortality among fishes in the pond was not determined. Bacteriological examination revealed the presence of *Aeromonas hydrophila* in some of the fish, but its role in the mortality was not determined.

This is the first record for this leech in Iraq. Voucher specimens of the leech have been deposited in the Iraqi Natural History Museum (Parasitology Section) and assigned Accession No. HIF37.

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An Evaluation of Burning for Control of Winter Ticks, *Dermacentor albipictus*, in Central Alberta

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The winter tick, *Dermacentor albipictus*, is a one-host tick found on moose and other large ungulates throughout much of North America. Infestation of moose is seasonal; larvae are acquired in autumn, nymphs overwinter on the host, develop to adults in early spring, and adults engorge and drop off the host from February to May (Glines, 1983, The winter tick, *Dermacentor albipictus* (Packard, 1869): Its life history, development at constant temperatures, and physiological effects on moose, *Alces alces* L., M.Sc. Thesis, Univ. Alberta, Edmonton, Alberta, 143 pp.; Drew, 1984, Reproduction and transmission of the winter tick, *Dermacentor albipictus* (Packard), in central Alberta, M.Sc. Thesis, Univ. Alberta, Edmonton, Alberta, 220 pp.). Under field conditions in central Alberta, egg laying begins in early June and egg hatching occurs in late August and early September (Drew, 1984, op. cit.).

Since 1977, many dead and moribund moose have been found annually in central Alberta. Most have had high numbers of *D. albipictus* and premature loss of winter hair (Samuel and Barker, 1979, Proc. N. Am. Moose Conf. Workshop 15: 303–348). Numbers of ticks per moose in this area often exceeded 50,000 (Samuel and Barker, 1979, op. cit.; Glines, 1983, op. cit.). The high numbers of ticks cause infested moose to groom and remove much of their winter hair 2–3 mo prematurely (Glines, 1983, op. cit.; Drew, 1984, op. cit.).

Other workers (Jacobson and Hurst, 1979, J. Wildl. Dis. 15: 43–47; Oldham et al., 1981, Brush Manage. and Range Improvements, Texas Agric. Exp. Stat., College Station, Texas, 152 pp.; Roberts, 1955, Fla. Entomol. 38: 17–20) have shown that prescribed burning reduces numbers of some tick species. Because of the annual problems with *D. albipictus* in central Alberta, the development of a practical program of tick management is desirable. The purpose of this study was to investigate the effects of a prescribed burn on survival and productivity of engorged female *D. albipictus*.

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TABLE 1. Survival of engorged female (EF) and recovery of larval *Dermacentor albipictus* after a prescribed burn in Elk Island National Park, Alberta, in spring 1982.

Site no.	Habitat type	No. EF released	Estimated no. EF that survived[a]	EF survival (%)	Number larvae flagged	Duff burned (%)
1	Dense canopy aspen, moderate shrub understory	33	0	0	0	75
2	Dense canopy aspen, moderate shrub understory	33	6	18.2	18,888	25
3	Dense canopy aspen, moderate shrub understory	33	0	0	0	75
4	Willow overstory, grassy understory	33	0	0	64	75
5	Open canopy aspen, grassy understory	33	0	0	9	50
6	Open canopy aspen, grassy understory	33	1	3.0	1,913	50
7	Grassland	33	1	3.0	1,114	75
8	Grassland	33	0	0	2	100
	Total	264	8	3.0	21,990	$\bar{x}$ = 67

[a] Based on the numbers of larvae flagged per site in autumn 1982, and an average of 3,000 larvae produced per EF (Drew, 1984, op. cit.).

The prescribed burn was conducted on 12 May 1982 in Elk Island National Park, about 40 km east of Edmonton, Alberta. The primary purpose of the burn was to kill old-growth aspen (*Populus tremuloides*), initiate browse regeneration, and open areas for expansion of existing grasslands. The availability of large numbers of engorged female *D. albipictus* from ongoing studies and the timing and location of the burn provided a suitable test for burning as a potential control method for winter ticks.

Engorged female specimens of *D. albipictus* were collected from March to April 1982 from bedding sites of free-ranging moose in the Park and from captive moose housed at the University of Alberta Biomedical Animal Center, Ellerslie, Alberta. A total of 264 engorged females was collected and stored at 10 C until 3 May 1982. Thirty-three females were released in each of eight sites in the designated burn site in the Park on 3 May 1982 (Table 1). Release sites were marked with surveyor's flagging tape and metal poles.

Immediately after the burn, all release sites were checked for degree of duff burned, presence or absence of engorged females, and the status of a few of the females found. Each site was flagged for larvae four times from 4 October to 1 November 1982 using a 0.5 sq m white flannel cloth on a wooden pole. Larvae on the flags were counted using a small vacuum apparatus in the laboratory (Drew, 1984, op. cit.).

Engorged females released into cages in three unburned sites in similar habitats at Elk Island Park in spring 1982, were used as controls for survival and productivity (see Drew, 1984, op. cit., for details).

An estimated 97% of the engorged females died in the burn (Table 1). Survival was highest in a dense-canopy, aspen site (Table 1, site 2) where burning was incomplete (25% of the duff and litter). In the control sites, survival of engorged females after snowmelt averaged 60% to the onset of oviposition (June).

Recovery of larvae by flagging in autumn indicated that a few of the engorged females survived the burn. Variable, but low numbers of larvae were recovered at six of the eight release sites (Table 1), suggesting that the burn was effective in reducing, but not in eliminating, the numbers of larvae available to moose in autumn.

Prescribed burning is effective in reducing populations of *Amblyomma americanum* (Jacobson and Hurst, 1979, op. cit.; Oldham et al., 1981, op. cit.) and *Ixodes scapularis* (Roberts, 1955, op. cit.) in grassland habitats where the vegetation is almost totally burned (Wright, 1974, J. Range Manage. 272: 417–419).

Burning of forested habitats usually removes the leaf litter but does not completely burn the duff layer (Smith, 1968, Tall Timbers Fire Ecol. Conf. 8: 41–45; Lyon, 1969, Tall Timbers Fire Ecol. Conf. 9: 213–227). Variability in vegetation density, amount of fuel, and moisture content of the fuel make control and predictions of the degree of burning difficult (Brown and Davis, 1973, Forest Fire: Control and Use, McGraw-Hill, New York, 686 pp.; Pyne, 1984, Introduction to Wildland Fire, J. Wiley and Sons, New York, 455 pp.). Controlled burning in oak-hickory woodlots was not effective in reducing numbers of *A. americanum* due to incomplete burning of the duff (Hoch et al., 1972, J. Med. Entomol. 9: 446–451).

Burning may also be unreliable for control of winter ticks in central Alberta due to these factors. Success probably will be determined by the habitat type being burned, weather conditions prior to the burn, and the fuel load in the burn site. A slow, hot fire must be maintained by a sufficient quantity of fuel to ensure adequate burning of the duff and litter layer to kill engorged females. The period between snowmelt and leaf out in spring is probably the best time of year for burning to control the numbers of engorged females that survive and lay eggs and, thus, for reducing the numbers of larvae available for transmission in autumn.

An autumn burn to reduce numbers of larvae probably would be very effective because most larvae are at or near the tips of vegetation waiting for a host (Drew, 1984, op. cit.). These larvae do not descend to the duff once they have ascended vegetation, a behavior that increases their susceptibility to fire. A hot, fast fire possibly would kill a large proportion of the larvae, but would have to be done between early September and early October before the period of peak transmission (Drew, 1984, op. cit.). However, an autumn burn would also decrease the amount of forage available to ungulates during the winter following the burn. An annual, rotating schedule for burning small areas might alleviate this problem and provide an effective means for reducing numbers of ticks per moose in areas of high intensities of infestation.

The moose–winter tick–vegetation system is complex. Proposed here is a short-term strategy for impacting one component of the system—the tick. Fire's impact on other components of the system may influence tick numbers in opposite ways over a longer time-frame. For example, regrowth of vegetation following fire in boreal regions creates abundant food for moose potentially resulting in increased moose densities (see review of Telfer, 1984, *In* Northern Ecology and Resource Management, R. Olson et al. (eds.), Univ. of Alberta Press, Edmonton, Alberta, pp. 145–182). The influence of increasing densities of moose on numbers of ticks is unknown, but an increase in numbers of ticks seems like a reasonable result.