DERMACENTOR TICKS ON WILDLIFE AND NEW RECORDS OF PARALYSIS

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ABSTRACT

The second record of paralysis of a mule deer **(Odocoileus hemionus)** by **Dermacentor andersoni** Stiles resulted from infesting a yearling buck with 50 pairs of ticks. A yearling doe previously infested with **D. albipictus** was not paralyzed by the same infestation. Spontaneous infestations of wild and captive mule deer include an engorged nymph of **D. andersoni.** A female of **D. andersoni** weighing 746 mg was removed from a captive moose **(Alces alces).** Infesting a porcupine **(Erethizon dorsatum)** with about 14,800 larvae of **D. andersoni** produced more than 600 pairs of adults in the following year. Fifty pairs of **D. andersoni** applied to the same porcupine yielded a high proportion of engorged females, but the porcupine was not paralyzed.

A coyote **(Canis latrans)** and a skunk **(Mephitis mephitis)** were paralyzed by 50 and 30 pairs of **D. andersoni** respectively. Few or no larvae or nymphs engorged on the skunk or on two laboratory fitches, whereas many engorged on rabbits used as controls. This suggests that Mustelidae may be resistant or unattractive to immature **D. andersoni.** Unconfirmed cases of tick paralysis in foxes have been reported. A new record is included of **D. andersoni** on a marmot **(Marmota monax).**

INTRODUCTION

In British Columbia, some success has attended efforts to estimate populations and infestations of *Dermacentor andersoni* Stiles on small rodents, particularly chipmunks *(Eutamias* spp.) and white footed mice *(Peromyscus* spp.), but methods have not yet been developed of making repeated estimates of infestations on deer, coyotes and porcupines. Practicable methods might involve telemetry, game fences and immobilising drugs. This paper deals with experimental and unintentional infestations of these hosts, and also of moose *(Alces alces)* and skunk *(Mephitis mephitis)* which are less common visitors. Unusual records are included of *D. andersoni* on *Marmota monax* and *M. caligata.*

When engorged ticks[2] are referred to, weights are sometimes given, to provide information on the degree of engorgement and potential egg production (Wilkinson, 1968, Table VII). Weights are not given when the ticks could not be detached for weighing, or when they were obviously not fully engorged. Increasing degrees of engorgement of the female ticks are described by the colours red, tan, and gray, which are familiar to those working with *D. andersoni.*

Mule deer, Odocoileus hemionus hemionus

In the first record of paralysis of a mule deer by *D. andersoni* (Wilkinson, 1965), the ticks engorged on a fawn which showed classical paralysis and recovery. Since then there have been other records of *D. andersoni* engorging on wild deer and on a zoo animal, and one trial with laboratory-reared deer. Records from wild deer in the spring tick season are scarce because the hunting season is closed.

Deer snared by Game Department officials, or shot in springtime in the Kamloops area, have yielded many *D. albipictus* but few *D. andersoni.* There were no engorged female *D. andersoni* on these deer even in areas known to be infested with hungry adults. This may still be due to inadequate sampling, as indicated by two documented samples of ticks sent in by Mr. B. Gates, Game Biologist, B.C. Dept. of Recreation and Conservation, taken from deer found near Carpenter Lake in the Lillooet District. Lot 5546 contained 4 male and 13 female *D. andersoni.* The largest females weighed 442,500 and 436 mg. There was one engorged female and one male *D. albipictus.* The deer, a buck about 10 months old, was unable to stand when it was killed about 4 April 1968. A superficial autopsy of the slightly decomposed body a week later showed no injuries to account for the original disability, suggesting that it may have been paralyzed by *D. andersoni.*

Lot 5584, was from an aged female deer in very poor condition, shot near Cedarvale Creek and Carpenter Lake on 11 April 1968. The ticks were distributed as follows:

	D. andersoni			*D. albipictus*	
	male	female	nymph	male	female
ears				285	116
rest of head	4	1 engorged 2 large tan	1		
brisket	1			15	16
perianal area				16	11

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[2] "Tick" in this paper refers to **D. andersoni,** except where another specific name is given. The foci of interest in this work are areas associated with cattle-paralysis, mainly in the **Pinus ponderosa Agropyron spicatum** zone. (Wilkinson, 1967).

There was no paralysis. *D. albipictus* contributed most of the tick burden and the large number of males indicated that the burden of female *D. albipictus* had been greater. Not every tick on the deer was collected. This appears to be the first published record of an engorged nymph of *D. andersoni* from a mule deer.

A semi-tame mule deer buck and a doe in a zoo near Kamloops were examined for ticks in April 1967. The deer pen occupied 0.8 ha in sagebrush-ponderosa pine vegetation naturally infested with *D. andersoni*. Two female *D. andersoni* in the large tan stage (178,144 mg) and 3 in the medium tan were removed from the buck on 7 April, and 2 medium and 1 small tan females on 9 April (Lot 5480). One male was found on the doe. It appeared that most of the female ticks on the buck would have engorged normally; no marked skin reactions were seen.

The results of experimental infestations of captive deer are given here in detail because no similar work appears to have been published. A mule deer doe born in 1967 was infested with about 1100 larvae of *D. albipictus* on 19 October 1967, by distributing the larvae over the head, ears, back and legs. The larvae had hatched at room temperatures and were placed in an outdoor enclosure on 3 October. The larvae used for infesting had ascended to the grass tips, indicating that their summer diapause was ended (Wilkinson, 1967). A mule deer buck, also born in 1967, was left uninfested, separated from the doe by a fence from the day of infestation. During the course of the experiment the buck was accidentally together with the doe for a few hours, but the only *D. albipictus* seen on it was one nymph 1.5 mm long. Both animals were examined at about weekly intervals. Progress of the infestation on the doe was as follows; 23 October. Larvae attached but undistended; on the back, but not the ears. 1 November. Larvae distended, creamy white. One nymph on anus. 8 November. Light brown nymphs 1.5-2 mm long, undistended, mainly on neck, withers and rump.

8 November-17 January. Nymphs remained undistended. Weather cold, snow melted slowly in hair on 21 December. On 17 January, estimate of 30+ nymphs on withers, 6+ on neck, 2+ on rump, 0 on perianal region.

23 January. One nymph 5 mm long on edge of white hair near tail. One 2 mm long; remainder 1.5 mm long. Coat starting to shed.

6 February. Rump, near white patch, 1 male. Elsewhere 5 nymphs 3-5 mm long; remainder 2 mm or less.

20 February. Rump 1 male, withers and neck 2 females; 1 flat female, many nymphs 1.5 to 5 mm long on rump, withers, neck. Left ear, 2 nymphs, 2 mm long.

18 March. Ears, 2 females, 2 nymphs; withers 1 female, 3 nymphs; anus 2 females, 1 male.

21 March. One ¾-fed female near anus.

25 March. Three half-engorged females on brisket, one removed.

27 March. Final removal-2 red females, 1 male. Probably about 10 engorged females dropped off previously. The doe, estimated to weigh 36 kg, was immobilised with 2.6 mg succinyl chloride given intramuscularly in 1.3 cc distilled water, for this check.

To infest the deer with *D. andersoni*, the ticks were shaken on to the back. They walked on the outside of the guard hairs for several minutes, before burrowing towards the skin. The deer were examined at least once daily from three days after infestation, while they were being fed and petted and they were fully immobilised for the final close examination. Records were kept of the susceptibility of the deer to paralysis by ticks, the percentage of female ticks engorging within a time limit, and the places of attachment on the deer (Table I).

It was concluded that a light infestation with *D. albipictus* starting with 1000 larvae, which produced about 100 nymphs and finally some tens of adults, did not prevent engorgement of *D. andersoni* females on the doe. Whether *D. albipictus* provides protection against paralysis from *D. andersoni* is unknown; an answer would necessitate repetitions of the trial, distributed appropriately between sexes and age groups of deer. The paralysis of the buck was the first record of paralysis of a yearling mule deer.

In an attempt to paralyze both animals, the deer were reinfested with 100 pairs of *D. andersoni* each on 13 May 1968, by shaking the ticks into loose cloth collars round their necks. A check four days later revealed only one unattached male on the buck and observations ceased. The deer were together, and such factors as mutual grooming, summer pelage, or the mode of infestation, may have contributed to the failure of the ticks to engorge. It is possible that immune reactions were involved.

Moose

In Canada, the moose, *Alces alces andersoni*, was very rare in areas infested with *D. andersoni* before 1920 (Cowan and Guiguet, 1965), and the race *A. a. shirasi* penetrated into the range of *D. andersoni* only in the extreme south of the Canadian Rockies. The winter range of *A. a. andersoni* has now expanded southwards to include numerous tick foci in southern British Columbia. Moose must pick up many ticks even though they are less exposed to ticks than mule deer, because moose tend to leave the tick foci for higher altitudes earlier in the year than mule deer,

TABLE I

Development of female *D. andersoni* on a buck and doe mule deer, and symptoms of paralysis of the buck. Each was infested with 50 male and 50 female ticks (collected 6-8.iii.68 and stored at 5 C) on 18.iii.68. The doe had a concurrent infestation with *D. albipictus* (see text).

	Buck		*Doe*	
Date March 1968	No. & Stage of ticks	Location of ticks. (Symptoms in brackets)	No. & Stage of ticks	Location of ticks
21	10 red and small tan	Back of head and between eyes	2 red 1 small tan	Head Neck
22	9 medium tan 5 medium tan	Head Neck	4 1 1	Between ears Neck Withers
23	13 medium tan	Face and back of head	8 small to large tan	Back of head
	2 medium tan	Neck	3	Back of neck
24	14 medium-large tan	Head	7 medium large tan	Back of head
	4 medium tan	Neck	3+ small to large tan (2 large tans removed)	Withers and neck
25	2 grey ticks removed (480,650 mg)	Not recorded (Rear legs unsteady)	2 grey ticks removed (722,512 mg) 3 grey removed (474, 500,575)	Head Withers
26	10 grey ticks removed	Head and neck (Fell easily, difficulty in getting up)	2 grey of which 1 removed 3 tan	Neck Head
27	7 grey ticks removed 4-5 tans	Head Face (Slight paralysis)	All ticks removed 7 medium tan 1 large tan	Not recorded
28	Remaining ticks removed 4 grey 6 tan	Not recorded (Recovered from paralysis)		
	Total female ticks removed from buck 23 grey (engorged) and 6 tan		Total female ticks removed from doe 6 grey and 10 tan	

often before the season of adult tick activity. We see fresh moose droppings and occasionally moose while collecting ticks, but we are reluctant to shoot them in spring to obtain host records. Moose are not recorded as hosts of *D. andersoni* by Bishopp and Trembley (1945) or Cooley (1938). An opportunity occurred to examine two moose confined with the mule deer in the zoo mentioned above. On 7 April 1967 three female *D. andersoni*, one engorged weighing 746 mg, one partly fed, and one unfed, were removed from the head and neck of one of the moose.

Coyote, Canis latrans

Coyote faeces and coyotes are commonly seen on tick foci in the Kamloops area; the coyotes are probably attracted by the presence of rodents. No case of tick paralysis of a coyote has been recorded in nature and there were no records at Kamloops of *D. andersoni* on coyotes, but there were two records of *D. albipictus*, one of *Ixodes rugosus* and one of *Ixodes sculptus*. Bishopp and Trembley (1945) list

one lot of 15 male and 16 female ticks from a coyote, the females ranging from unfed to partly fed. This may have been the same coyote listed by Henshaw and Birdseye (1911).

A female coyote pup of the year was obtained on 25 May 1968 and infested with 50 male and 50 female *D. andersoni* on 26 August 1968. The coyote was caged over a water tray and 25 pairs of ticks were placed on top of the head, the remainder on the neck and withers. By 30 August, 13 or more females with males, were attached on the head, and other females were attached as follows: base of left ear, 1; base of right ear, 2; withers, 1; neck, 1. A slight disability was noted in the coyote on the evening of the 30th. On 1 September, the rear legs collapsed when the coyote was taken out of the cage, and its movements were unco-ordinated. On 2 September, the inco-ordination was greater and the front legs were weak, with lack of tone in the paws (Fig. 1). All the ticks seen were removed, mostly from the head near the point of release. They consisted of 1 fully engorged female (527 mg), 4 large, 10 medium and 14 small tans plus 20 males, mostly fed. Two large tan females and one male were removed on 4 September. Three males and 5 females, all unfed, were taken from the water tray. The coyote had partly recovered by the 3rd, and was completely recovered on the 4th, when it weighed 4.4 kg. It was thus demonstrated that *D. andersoni* could engorge on and paralyze a coyote. Probably 30 out of the 50 would have engorged had the animal not become paralyzed. This is the first record of tick paralysis in a coyote.

Fig. 1. Coyote paralyzed by **D. andersoni** on 2 September 1968. Animal recovered after the ticks were removed.

Porcupine, Erethizon dorsatum nigrescens and E. d. epixanthium

Little has been published on the host-potential of this interesting rodent. Jellison (1933) reported that it is an important host of all parasitic stages of *D. andersoni*. Bishopp and Trembley (1945) record only adult ticks. The Erethizontidae evolved in South America and travelled north in the late Pliocene (Dawson, 1967) whereas the ancestors of many of the present hosts of North American ticks crossed from Eurasia, via Beringia. The porcupine's ability to sustain heavy infestations of all stages indicates a long adaptation to *D. andersoni*.

A porcupine captured alive near Stump Lake on 5 May 1967 was caged over a water tray. It yielded ticks as follows until it died on 9 May: 5 May; females weighing 948 and 710 mg. 7 May; females weighing 900, 870, 768, 615, and 503 mg. 9 May (after death); females weighing 628, 617, 550 and 842 mg, 2 engorging nymphs and 23 males. 10 May; 1 engorged nymph and 1 *Ixodes* larva. Most of the females were on the underside (cf. Wilkinson & Lawson, 1965). Two porcupines, probably of subspecies *epixanthium*, were obtained at Onefour, Alberta on 29 April 1964. One, which was shot, carried 7 male and 4 female ticks, the other, which was found dead, carried 10 males and 5 females.

Figures for porcupines abundance on tick foci

cannot yet be given, but faeces and lairs, and signs of feeding by porcupines on pines, occur regularly in tick foci, especially in the ponderosa pine-wheatgrass zone. The porcupines themselves are not often seen, and their numbers may be limited by the availability of suitable refuges or some unknown factor. An indication of the potential yield of ticks from a porcupine was obtained by infesting a caged porcupine outdoors on 26 June 1967 with larvae from 933 mg of eggs. The eggs and larvae had been kept at room temperatures. Assuming 16.6 eggs/mg and 90% hatch, this represents about 14,800 larvae. The following year 740 male and 622 female ticks were collected from the cage between 26 February and 29 May, when activity ceasd. A white mouse enclosed in metal mesh attracted one nymph on 23 April 1968 and another flat nymph was seen. The porcupine was returned to the cage from its winter quarters on 3 May and remained until 2 July 1968 so that any nymphs present could feed. Only two male ticks appeared in 1969.

On 2 July 1968, 50 male and 50 female ticks from the spring collection mentioned above were placed on the porcupine, which was caged over water. Forty-five fed and partly fed females were recovered, averaging about 502 mg. These should yield an average of 317 mg of eggs each (Wilkinson, 1968, Table VII). If all 622 females had fed on the porcupine, the multiplication factor in one year calculated from egg weights, would have been about 199. This figure would not be reached in nature because many of the hungry ticks would die before engorging and ovipositing, but it illustrates the importance of porcupines in maintaining tick populations without the necessity for other hosts. The porcupine weighed 8.6 kg on 16 October 1967 and 14.2 kg on 3 May 1968.

Mustelidae

Weasels probably occur regularly on tick foci. At Stump Lake two weasels were caught in Sherman traps. The weasel caught on 20 July 1967 was identified provisionally as *Mustela erminea* and that on 7 August 1968 as *Mustela frenata nevadensis*. Two nymphs of *Ixodes kingi* were found on the first and 1 female and 30 nymphs of *I. kingi* on the second, with an unattached nymph of *D. andersoni*. Considering the extensive travels of weasels in rodent haunts, a heavier infestation with *D. andersoni* would have been expected.

Striped skunks *(Mephitis mephitis)* are probably infrequent visitors to foci of *D. andersoni*. I have not seen them during many hours of flagging for ticks and trapping on tick foci. Cowan and Guiguet (1965) state that "open fields, marshes and streamside thickets mixed with dense cover are the favoured haunts of this animal in British Columbia", and this does not describe tick foci. The following records of skunks killed on roads show that they carried only *Ixodes* ticks, even though they were within the general distribution of and season for *D. andersoni:* — Herbert, Saskatchewan 10.v.66-1 nymph of *I. kingi;* Kamloops, B.C., 17.vii.68, 1 nymph of *I. marmotae.*

In trials with a tame, obese, castrated male skunk, surgically deprived of stink glands, we found that adult ticks fed on the animal more slowly than on favoured hosts, and larvae did not attach. Thirty male and 30 female *D. andersoni* were liberated on the back of the animal on 23 May 1968. The cage was suspended over water. The female ticks engorged slowly and were only half or less engorged by 1 June. They weighed 228, 144, 128, 135, 110, 21, 28, 20 mg. The ticks were removed because the skunk was showing lack of co-ordination and weakness of the rear legs. Next day the skunk had recovered. This is the first record we know of tick paralysis in a skunk. The skunk was placed in an outdoor cage, in a site known to be suitable for development of *D. andersoni*, and was infested with about 6000 larvae on 10 September 1968. No fed larvae were seen on the skunk or in the water tray during the next three days.

To check the apparent unsuitability of Mustelidae for immature stages of *D. andersoni*, a trial was set up comparing the same skunk and two laboratory fitches *(Mustela putorius?)* with laboratory rabbits. About 5000 larvae each were applied to the skunk, both of the fitches and two rabbits, caged individually. All the cages were kept in bags. On 27 September the rabbits' bags yielded 205 and 34 larvae, the skunk and fitches' bags nothing. Next day the rabbits' bags yielded 195 and 260 larvae, the skunk's bag one well-fed larva and the fitches' nothing. No further feeding larvae were seen on the fitches or the skunk on 30 September, so observations stopped. The rabbits were kept in the bagged cages until 4 October when six and no fed larvae were recovered.

The only other member of the Mustelidae that is common near tick foci in this province is the badger, *Taxidea taxus taxus*. Marten, fisher, mink, wolverine and spotted skunk would rarely encounter *D. andersoni*. In the Kamloops records, one of the two records of ticks from badgers is *D. andersoni*. This is an unfed nymph, still in the collection in damaged condition, taken on 12 July 1934, on range land northeast of Kamloops. Bishopp and Trembley (1945) record only one tick, a male, from badger. This is quite probably the same dead male tick collected by Henshaw and Birdseye (1911). Thus there is no evidence as yet that *D. andersoni* feeds successfully on badgers.

Marmota monax and *caligata*

It seems appropriate to present here a hitherto unpublished host record for *D. andersoni*. *Marmota monax petrensis* occurs in part of the range of *D. andersoni* in British Columbia (Cowan and Guiguet, 1965) but is comparatively rare. It is doubtful whether it has been checked for infestation in the U.S.A. where it is rare in the range of *D. andersoni*. One *M. monax* collected on 21 May 1939 yielded a nymph and another two engorged female ticks of *D. andersoni*. Both marmots came from a collection of four made by the late E. R. Buckell at Wigwam Mine (Lat. 50° 50', Long. 118° 00'), at about 2500 ft. altitude. The same site yielded another unusual record on 10 June 1939, when one engorged and four or more flat nymphs of *D. andersoni* were secured from *Marmota caligata* by J. D. Gregson. *M. caligata* is usually associated with high altitudes above timberline. The ticks from *M. caligata* are preserved on a slide; those from the *M. monax* are evidently lost.

Fox, *Vulpes fulva*

Tick-infested paralyzed foxes were reported from Dog Creek in April 1966, by a Mrs. M. Elgood who sent unfed *D. andersoni* adults emerging from soil washed down in the spring. A picture of a fox which had been kept captive after recovery from this "paralysis", was sent in by Mr. Lesowski, Conservation Officer, Department of Recreation and Conservation at Williams Lake, but a definite diagnosis of tick paralysis was not made. Marsh (1929) reported tick paralysis of a blue fox by a wood tick in Montana.

DISCUSSION

The present evidence on susceptibility of deer shows that *D. andersoni* will engorge on mule deer in nature, but there is also a suggestion that the infestation on many deer is not so heavy as would be expected from the number of ticks encountered (cf. low infestations of deer with *D. variabilis* in Nova Scotia (Dodds, Martell, & Yescott, 1968).

Further experiments will be necessary to test whether does can be paralyzed, and whether prior infestation with *D. albipictus* protects deer from paralysis by *D. andersoni*.

This paper thus adds captive mule deer, coyote and skunk to the list of animals susceptible to paralysis (Gregson 1958). Reports on mule deer and foxes suggest that they may have been suffering from tick paralysis in nature. The apparent repellence or resistance of Mustelidae to the immature stages of *D. andersoni* should be tested by further experiments.

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