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THE IXODID TICK BURDENS OF VARIOUS LARGE RUMINANT SPECIES IN SOUTH AFRICAN NATURE RESERVES

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ABSTRACT

HORAK, I. G., POTGIETER, F. T., WALKER, JANE B., DE VOS, V. & BOOMKER, J., 1983. The ixodid tick burdens of various large ruminant species in South African nature reserves. *Onderstepoort Journal of Veterinary Research*, 50, 221–228 (1983).

The ixodid tick burdens of eland (*Taurotragus oryx*), greater kudu (*Tragelaphus strepsiceros*), nyala (*Tragelaphus angasi*), bushbuck (*Tragelaphus scriptus*) and giraffe (*Giraffa camelopardalis*) in the Kruger National Park, Transvaal; of African buffalo (*Syncerus caffer*) and nyala in the Hluhluwe Game Reserve, Natal; and of gemsbok (*Oryx gazella*) in the Mountain Zebra National Park, an eland in the Thomas Baines Nature Reserve and an eland and greater kudu in the Andries Vosloo Kudu Reserve, eastern Cape Province, were determined.

The tick burdens of animals shot at the same time and locality are compared, and the attachment sites of some tick species on some of the hosts are given.

INTRODUCTION

During the past few years a number of surveys have been undertaken to determine the ixodid tick burdens of various wild ruminants in the Republic of South Africa. In this way the tick burdens of greater kudu (*Tragelaphus strepsiceros*); springbok (*Antidorcas marsupialis*); impala (*Aepyceros melampus*); blesbok (*Damaliscus dorcas phillipsi*); bontebok (*Damaliscus dorcas dorcas*), and vaal ribbok (*Pelea capreolus*) have been ascertained in different localities (Knight & Rechav, 1978; Horak, Meltzer & De Vos, 1982; Horak, 1982; Horak, Brown, Boomker, De Vos & Van Zyl, 1982; Horak, De Vos & De Klerk, 1982).

In this paper additional data are given on greater kudu, plus information on tick burdens of nyala (*Tragelaphus angasi*), bushbuck (*Tragelaphus scriptus*), eland (*Taurotragus oryx*), African buffalo (*Syncrus caffer*), giraffe (*Giraffa camelopardalis*) and gemsbok (*Oryx gazella*).

MATERIALS AND METHODS

The animals examined were either culled specifically for survey purposes or were shot or found dead because of injury or disease. The species of animals examined and the localities in which they were obtained are summarized in Table 1.

Ixodid ticks were recovered from these animals using the methods described by Horak *et al.* (1982). The skins of the nyala and buffalo from the Hluhluwe Game Reserve, however, were not immersed in a tick detaching agent but were transported in a weak solution of formalin in plastic bags to the laboratory at Onderstepoort. There they were scrubbed and washed in the same manner as the other skins.

Immature ticks and adult, unengorged *Boophilus decoloratus* were counted and identified by examining all the collected material, or representative samples of it, under a stereoscopic microscope. The representative samples were obtained by increasing the volume of the collected material to approximately 800 mℓ by the addition of water. The material was thoroughtly mixed by rapidly pouring it from one container to another and then pouring exactly ½ of it into 1 of the containers. This ½ could be further divided after making it up to approximately 800 mℓ and following the same procedure as mentioned above. The usual size of the samples examined varied between ½ and ¼ of the total, and an attempt was made to count and identify at least 300 immature ticks from each animal. The smallest samples examined were $^{1}/_{64}$th of the material form the skins of the buffaloes' necks, bodies and upper legs.

TABLE 1 Species of animals examined and localities in which they were obtained

Animals examined	Province	Locality	Co-ordinates	Altitude (m)	Vegetation as classified by Acocks (1975)
Eland	Transvaal (Kruger National Park)	Near Pretoriuskop	25°10′S; 31°16′E	600	Lowveld Sour Bushveld
Giraffe		Near Lower Sabie	25°07′S; 31°55′E	180	Lowveld
Greater kudu, bushbuck		Skukuza	24°58′S; 31°36′E	262	Lowveld
Greater kudu, bushbuck, nyala		Near Pafuri	23°27′S; 31°19′E	305	Mixed Bushveld
African buffalo, nyala	Natal	Hluhluwe Game Reserve	28°07′S; 32°03′E	150–450	Zululand Thornveld and Lowveld
Gemsbok	Cape Province	Mountain Zebra National Park	32°15′S; 24°41′E	1 200–1 957	Karroid *Merxmeullera* Mountain Veld replaced by Karoo
Eland		Thomas Baines Nature Reserve	33°23′S; 26°28′E	335–518	False Macchia, Eastern Province Thornveld and Valley Bushveld
Eland, greater kudu		Andries Vosloo Kudu Reserve	33°07′S; 26°40′E	300–450	Valley Bushveld

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TABLE 2 The ixodid tick burdens of eland, kudu, nyala, bushbuck and giraffe in the Kruger National Park

Host	Sex	Age	Date culled (C) or died (D)	Numbers of ixodid ticks recovered																							
				Amblyomma hebraeum				*Boophilus decoloratus*				*Rhipicephalus appendiculatus/ zambeziensis*	*Rhipicephalus appendiculatus*			*Rhipicephalus zambeziensis*			*Rhipicephalus evertsi evertsi*				*Rhipicephalus pravus* group	*Rhipicephalus kochi*			*Rhipicephalus simus*	
				L	N	♂	♀	L	N	♂	♀	L	N	♂	♀	N	♂	♀	L	N	♂	♀	L	N	♂	♀	♂	♀
Pretoriuskop																											
Eland*	F	Old	27 Sept 1979 (D)	4 128	1 704	744	153	384	96	144	0		112	352	0	0	16	0	0	64	0	9	0	0	0	0	0	1	0
Eland	M	6 weeks	1 Oct 1979 (C)	328	16	27	6	104	264	80	68	(4)	16	8	0	0	0	0	0	24	80	1	0	0	0	0	0	3	0
Skukuza																											
Bushbuck**	F	Adult	9 Oct 1979 (D)	5	12	2	0	23	31	3	1		9	0	0	0	105	0	0	0	0	1	0	0	0	0	0	0	0
Bushbuck***	M	Yearling	5 Aug 1980 (D)	51	22	4	2	268	114	51	23	(1)	472	3	0	0	604	0	0	8	1	0	0	0	0	0	0	0	0
Bushbuck	M	2 years	31 Oct 1980 (D)	58	79	0	0	162	75	9	0		4	0	1	1	94	1	1	4	6	0	0	0	0	0	0	0	0
Bushbuck****	M	6 months	14 June 1982 (D)	726	4	0	0	698	554	104	50		748	16	0	0	0	0	0	32	48	0	0	0	0	0	0	0	0
Bushbuck	F	Adult	11 Nov 1982 (D)	17	41	10	7	4 977	1 847	680	366	(21)	8	0	0	6	258	2	0	16	0	0	0	0	0	0	0	0	0
Bushbuck	M	Adult	15 Nov 1982 (D)	168	16	10	2	1 436	1 184	720	254	(4)	0	16	0	2	50	2	2	0	0	0	0	0	0	0	0	0	0
Bushbuck*****	F	Adult	17 Nov 1982 (D)	1 798	158	2	0	3 862	86	28	10		24	54	0	0	34	0	0	128	0	4	2	0	0	0	0	0	0
Bushbuck	M	Adult	18 Nov 1982 (D)	256	80	0	0	1 658	636	216	48		0	0	2	0	40	2	2	4	0	0	0	0	0	0	0	0	0
Kudu	M	Sub-adult	31 July 1980 (C)	16	2	0	0	64	0	18	12	(3)	368	16	0	0	96	0	0	8	16	1	0	0	0	0	0	0	0
Kudu	M	Adult	31 July 1980 (C)	80	144	10	3	112	128	144	34	(1)	752	112	0	1	240	1	1	0	0	2	0	0	0	0	0	0	0
Lower Sabie																											
Giraffe†	M	Adult	24 July 1980 (C)	624	272	585	167	2 208	1 600	464	132	(4)	1 376	592	0	0	0	0	0	448	48	2	2	0	0	0	0	0	0
Giraffe††	M	Adult	25 July 1980 (C)	128	160	360	112	192	320	256	137	(8)	80	32	0	0	0	0	0	0	0	10	2	0	0	0	0	2	0
Pafuri																											
Kudu	M	15–18 months	5 Oct 1981 (C)	218	78	4	2	981	1 092	253	156	(8)	0	232	0	0	0	0	0	16	0	4	0	136	48	20	7	0	0
Kudu	M	Adult	5 Oct 1981 (C)	161	56	2	0	643	896	424	102	(6)	0	150	0	0	0	0	0	24	4	0	2	64	66	14	12	0	0
Nyala	M	Adult	6 Oct 1981 (C)	56	4	3	0	32	14	16	10	(2)	28	249	0	0	24	0	0	0	0	0	0	250	308	42	34	0	0
Nyala	M	Adult	7 Oct 1981 (C)	0	12	0	0	121	105	85	30	(6)	24	300	0	0	12	0	0	0	0	0	0	280	200	29	26	0	0
Bushbuck	M	Adult	6 Oct 1981 (C)	8	76	0	0	48	8	4	0		69	148	0	0	44	0	0	1	0	0	0	236	112	34	54	0	0
Bushbuck	M	Old	8 Oct 1981 (C)	48	17	5	3	12	28	4	2	(2)	20	285	0	0	0	0	0	0	0	0	0	56	32	25	20	0	0
Bushbuck	F	Adult	8 Oct 1981 (C)	4	84	0	2	13	12	8	0		16	17	0	0	39	0	0	0	0	0	0	448	217	37	17	0	0

* *Haemaphysalis aciculifer* 2 ♂♂, ***Ixodes* sp. 6 nymphae, ****Ixodes* sp. 1 larva, 2 nymphae, *****Ixodes* sp. 28 larvae, ******Ixodes* sp. 16 larvae, ( ) = No. of ♀♀ *B. decoloratus* between 4,0 and 7,0 mm in lenght, † *Hyalomma truncatum* 6 ♂♂, †† *H. truncatum* 4 ♂♂, 4 ♀♀, L = Larvae, N = Nymphae

Maturing *B.decoloratus* females and adult ticks of other species where separated out by macroscopically examining the material *in toto* after the representative sample had been examined, and the ticks were identified and counted under the stereoscopic microscope.

The immature stages of the *Ixodes* spp. recovered were not specifically identified. No attempt was made to differentiate the larval stages of *Rhipicephalus appendiculatus, Rhipicephalus maculatus, Rhipicephalus muehlensi* and *Rhipiciphalus zambeziensis* when 2 or more of these species were present on the same host.

RESULTS

Kruger National Park

A total of 10 ixodid tick species were recovered from the animals examined in this park (Table 2). The adult eland and the giraffe harboured large numbers of adult *Amblyomma hebraeum*. At Skukuza, in the south of the park, nymphae of *R. zambeziensis* were more numerous than those of *R. appendiculatus*. At Pafuri, in the north, the converse was true. Larvae of the *Rhipicephalus pravus* group and nymphae and adults of *Rhipicephalus kochi* constituted a large proportion of the total tick burdens on all the animals at Pafuri. These ticks, however, were absent on all the animals from the localities in the south of the park. The kudu at Pafuri harboured considerably more *A. hebraeum* and *B. decoloratus* than the nyala or bushbuck shot during the same week from the same locality. These in turn harboured more *R. zambeziensis* and *R. kochi* and generally more *R. pravus* group larvae than the kudu.

Not only did the numbers of *B. decoloratus* harboured by the 3 antelope species at Pafuri differ considerably, but there was also a difference in the proportional distribution of this tick on the various hosts (Table 3).

TABLE 3 The proportional distribution of *Boophilus decoloratus* on kudu, nyala and bushbuck at Pafuri

Host	Mean No. of *B. decoloratus* recovered	Percentage of *B. decoloratus* recovered from			
		Head	Neck, body and upper legs	Lower legs and feet	Tail
Kudu	2 274	29,0	34,4	36,1	0,5
Nyala	207	14,5	4,9	79,9	0,7
Bushbuck	46	37,4	5,8	53,2	3,6

Approximately equal proportions of the *B. decoloratus* burden were recovered from the heads; the necks, bodies and upper legs; and lower legs and feet of the kudu. On both the nyala and bushbuck more than 50% of the ticks were recovered from the lower legs and feet and very few from the necks, bodies and upper legs.

Hluhluwe Game Reserve

Nine species of ixodid ticks were recovered from the buffalo and nyala shot in this reserve (Table 4). The buffalo were excellent hosts of all stages of development of *A. hebraeum*, the larvae of *Rhipicephalus* spp., the nymphae of *R. appendiculatus*, the nymphae and adults of *R. maculatus* and the adults of *Rhipicephalus simus*. The nyala were excellent hosts of the nymphae and adults of *R. muehlensi*, good hosts of the larvae of *Rhipicephalus* spp., and fair hosts of the nymphae of *R. appendiculatus* and *R. maculatus*. The majority of adult *A. hebraeum* and adult *R. maculatus* were recovered from the less hairy undersides of the buffalo, from the axilla to the escutcheon, while the majority of *R. meuhlensi* were recovered from the heads of the nyala.

Mountain Zebra National Park

Seven ixodid tick species were recovered from the gemsbok shot in this park (Table 5). Of these *Margaropus winthemi* and *Rhipicephalus glabroscutatum* were the most numerous.

Thomas Baines and Andries Vosloo Reserves

Nine ixodid tick species were recovered from the eland from the Thomas Baines Reserve, and 8 and 7 species from the eland and kudu, respectively, from the Andries Vosloo Reserve (Table 6).

The eland from the Thomas Baines Reserve haboured large numbers of all stages of development of *A. hebraeum, Haemaphysalis silacea* and *Rhipicephalus evertsi evertsi* plus larvae and adults of *R. appendiculatus*. The eland from the Andries Vosloo Reserve was heavily infested with larvae and adults of *A. hebraeum* and moderately infested with adult *R. appendiculatus* and *R. glabroscutatum*. The kudu, which had either died or been shot because of injury or exhaustion while being translocated, were moderately to heavily infested with all stages of development of *H. silacea* and the immature stages of *A. hebraeum, R. appendiculatus, R. evertsi evertsi* and *R. glabroscutatum*.

The proportional distributions of some of the ticks infesting the kudu are summarized in Table 7.

The larvae and nymphae of *A. hebraeum, H. silacea* and *R. glabroscutatum* and the *R. appendiculatus* larvae showed a preference for the lower legs and feet. The nymphae and adults of *R. appendiculatus* and larvae and nymphae of *R. evertsi evertsi* preferred the heads of the kudu. The largest proportion of male *H. silacea* were found on the neck, body and upper legs of the kudu, while the number of females found on the tail exceeded the total number of females attached elsewhere.

DISCUSSION

Several ticks had probably detached and left the skins of the animals that had died as a result of injury or disease before the carcasses of these animals could be brought to the laboratories and processed for tick recovery. This fact must be borne in mind when considering the tick burdens of these animals; they might have been considerably larger had it been possible to collect them immediately after the host's death.

The large number of dead bushbuck that were examined at Skukuza can be ascribed to the fact that these animals come into the staff village at night during the winter and spring months. Here they browse on the green garden shrubs and, if alarmed, may jump into a garden fence and break their necks. Others, dazzled by the bright headlights, are killed by cars.

With the exception of those of the buffaloes and the single eland from the Thomas Baines Reserve, none of the tick burdens harboured by the animals were particularly large. It is perhaps interesting to speculate what the total tick burdens of the buffaloes and the eland might have been had *B. decoloratus* also been present in large numbers in the Hluhluwe and Thomas Baines Reserves. The eland had a broken tooth and was emaciated, conditions which possibly made the animal more susceptible to infestation and accounted for its large tick burden. The buffaloes, however, were apparently all healthy.

The really large burdens of most developmental stages of the majority of tick species carried by the buffaloes suggest that, in those regions where these animals still occur, they must be regarded as amongst the most important hosts of ixodid ticks. This observation supports that of Dinnik, Walker, Barnett & Brocklesby (1963), who

TABLE 4 The ixodid tick burdens of buffalo and nyala in the Hluhluwe Game Reserve

Host	Sex	Age	Date slaughtered	Numbers of ixodid ticks recovered																							
				Amblyomma hebraeum				*Boophilus decoloratus*		*Haemaphysalis silacea*			*Rhipicephalus* spp.	*Rhipicephalus appendiculatus*			*Rhipicephalus maculatus*			*Rhipicephalus muehlensi*			*Rhipicephalus evertsi evertsi*			*Rhipicephalus simus*	
				L	N	♂	♀	L	♀	N	♂	♀	L	N	♂	♀	N	♂	♀	N	♂	♀	N	♂	♀	♂	♀
Buffalo	M	Sub-adult	6 Sept 1978	339	203	270	83	0	0	0	0	2	5 896	5 509	20	1	3 106	40	9	81	4	2	0	8	1	18	6
Buffalo	F	Adult	6 Sept 1978	148	405	323	49	0	0	0	1	0	5 220	6 221	0	0	1 933	31	27	0	14	18	0	12	10	39	20
Buffalo	F	Adult	7 Sept 1978	712	407	1 092	248	64	0	0	0	0	5 792	5 275	6	3	4 073	268	68	64	0	0	0	9	1	9	4
Buffalo	F	Adult	7 Sept 1978	220	228	347	167	0	0	0	0	0	9 704	5 552	12	9	6 376	284	120	1	0	0	1	7	1	4	13
Nyala*	M	Sub-adult	8 Sept 1978	40	34	5	0	24	16	8	1	0	3 552	1 672	0	1	152	3	4	312	206	72	0	1	0	0	0
Nyala**	M	Sub-adult	8 Sept 1978	192	26	2	0	0	0	0	2	2	2 232	856	0	0	872	0	0	2 000	369	218	0	0	0	0	0

* = *Ixodes pilosus* 1 ♂, 5 ♀♀

** = *Ixodes* sp. 16 larvae; *Ixodes* sp. 1 ♀ (probably *I. pilosus* but damaged)

L = Larvae

N = Nymphae

TABLE 5 The ixodid tick burdens of 2 gemsbok shot in the Mountain Zebra National Park

Age	Numbers of ixodid ticks recovered																	
	Amblyomma marmoreum	*Hyalomma truncatum*		*Hyalomma marginatum turanicum*		*Margaropus winthemi*		*Rhipicephalus* sp.	*Rhipicephalus* sp. (near *R. capensis*)		*Rhipicephalus evertsi evertsi*				*Rhipicephalus glabroscutatum*		
	N	♂	♀	♂	♀	N	♂	♀	L	♂	♀	L	N	♂	♀	N	♂	♀
Young adult	2	1	2	14	3	22	88	81	4	9	7	8	0	27	15	2	103	51
Adult	0	3	1	18	14	20	56	34	8	3	9	0	3	38	10	4	111	40

L = Larvae
N = Nymphae

remarked that buffalo in Uganda were so heavily infested with ticks that it was not possible to make total collections of these parasites. In contrast, Carmichael (1976) recovered only small burdens of adult ticks from 100 buffalo in Botswana. These animals had been immobilized in a foot-and-mouth disease investigation during which all visible ticks were collected. Carmichael (1976) attributed the small number of ticks partly to the fact that the collections were made towards the end of the seasonal long, dry period, and partly to the overall climate, which is sufficiently harsh to prevent the buildup of large numbers.

The composition of the burden of some tick species was undoubtedly related to the season during which the animals were slaughtered or had died. The majority of animals in the Kruger National Park and all the animals in the Hluhluwe Game Reserve were slaughtered or died during the months July–October (winter–spring) and generally carried fairly large numbers of nymphae of *R. appendiculatus*. This is the season in Southern Africa when nymphae of this tick reach peak numbers and few adults are present (Baker & Ducasse, 1967; Short & Norval, 1981 a, b,; Horak, 1982). Similarly, the large numbers of larvae of *R. appendiculatus* recovered from the eland and kudu during April and June, respectively, in the eastern Cape Province reflect the fact that these animals were examined in autumn and early winter, seasons when larvae of this tick reach peak numbers (Baker & Ducasse, 1967; Short & Norval, 1981 a, b; Horak, 1982.)

The recovery of large numbers of adult *A. hebraeum* from the eland, giraffe and buffalo in the Transvaal during winter and spring does not appear to be in accord with the findings of Norval (1977) and Knight & Rechav (1978) in the eastern Cape Province, or of Londt, Horak & De Villiers (1979) and Horak (1982) in the northern Transvaal. These authors all found adult *A. hebraeum* reached peak numbers during the summer months. In Natal, Baker & Ducasse (1967) recorded peak adult activity on cattle between September and January, a finding which more closely approximates to the present ones. It would, however, be necessary to examine eland, giraffe and buffalo at regular intervals throughout the year in the Kruger and Hluhluwe Parks to determine when the actual peaks in adult numbers occur and the number of ticks present at such times.

The very large numbers of adult *A. hebraeum* recovered from the eland, buffalo and giraffe, in comparison with the numbers collected from the somewhat smaller hosts such as kudu, nyala and bushbuck, suggest that the larger the host the more favourable it is for adult ticks of this species. The findings of Knight & Rechav (1978) support this contention in that, in a 13-month survey of the ticks of kudu in the eastern Cape Province, the greatest mean number of adult *A. hebraeum* they recovered from these animals was only 19. In a similar survey in the northern Transvaal, Horak (1982) recovered a mean of 80 adult *A. hebraeum* from cattle examined during February 1977, but impala from the same locality never harboured more than 1 adult tick of this species.

The *B. decoloratus* infestations encountered on animals in the Kruger National Park were never very large and, in general, adult ticks accounted for only a minor proportion of nearly every burden. However, a fairly high proportion of the adult females were over 4,0 mm in length, which probably indicates that they would engorge and detach within the next 24 h. In Australia, Wharton & Utech (1970) found that once the females of *Boophilus microplus* (which are somewhat larger than those of *B. decoloratus*) had reached a length of 4,5 mm they would complete their engorgement and drop within 24 h.

R. kochi has previously been recorded once only in South Africa, from an impala, also at Pafuri (Gertrud Theiler, unpublished data, 1964, as *Rhipicephalus neavei*). The numbers encountered in the present survey indicate that it must be regarded one of the major species of the Pafuri region.

Both host preference and host habitat probably played a role in the composition of the tick burdens of the buffalo and nyala in the Hluhluwe Game Reserve. The buffaloes generally prefer the savanna for grazing, while the nyala are found in the denser bush. From the findings in this survey it would appear that adult *A. hebraeum, R. evertsi evertsi, R. appendiculatus, R. maculatus* and *R. simus* prefer buffalo as hosts and that *R. muehlensi* prefers nyala. Adults of *Ixodes pilosus* were also found on nyala.

The Mountain Zebra National Park has a mean annual rainfall of only 398 mm, and the ticks recovered from the gemsbok there are mostly species associated with semi-arid conditions. *M. winthemi* is a 1-host tick which reaches peak numbers during the winter (Howell, Walker & Nevill, 1978), and the infestation may have been declining with the approach of summer. This might explain the absence of larvae and the relatively small numbers of nymphae recovered.

The numbers of ticks and tick species recovered from the gemsbok exceeded those recovered from blesbok slaughtered in the Mountain Zebra Park at the same time

TABLE 6 The ixodid tick burdens of eland and kudu in the eastern Cape Province

Host	Sex	Age	Date culled (C) or died (D)	Numbers of ixodid ticks recovered																							
				Amblyomma hebraeum				*Boophilus decoloratus*				*Haemaphysalis silacea*				*Ixodes* spp.		*Ixodes pilosus*		*Rhipicephalus appendiculatus*				*Rhipicephalus evertsi evertsi*				*Rhipicephalus glabroscutatum*			
				L	N	♂	♀	L	N	♂	♀	L	N	♂	♀	L	N	♂	♀	L	N	♂	♀	L	N	♂	♀	L	N	♂	♀
Thomas Baines Reserve																															
Eland*	M	Adult	29 April 82 (C)	6 352	320	1 443	189	16	48	13	4	3 600	432	881	264	304	80	4	10	4 760	40	1 185	222	992	144	127	18	0	0	0	0
Andries Vosloo Kudu Reserve																															
Eland**	M	Adult	4 March 83 (C)	1 159	52	1 195	134	0	0	0	0	331	32	179	24	0	0	0	2	94	0	205	165	152	40	49	6	880	156	198	164
Kudu	F	Adult	16 June 82 (D)	64	0	0	0	0	0	0	0	2 607	293	219	13	252	16	0	12	1 027	88	26	12	48	40	2	0	40	24	1	4
Kudu	M	Sub-adult	17 June 82 (C)	586	16	0	0	0	0	0	0	5 542	930	361	64	73	16	0	4	2 610	177	8	0	128	50	0	0	976	584	1	0
Kudu	F	Adult	17 June 82 (D)	625	52	0	0	0	0	0	0	1 497	226	83	13	0	0	0	0	2 341	376	46	10	321	80	0	0	5 846	1 296	6	1
Kudu	F	Adult	18 June 82 (D)	650	35	0	0	0	0	0	0	3 806	532	264	51	98	0	0	0	1 340	100	18	6	48	72	0	0	1 248	468	4	3
Kudu	M	Sub-adult	18 June 82 (D)	128	3	0	0	0	44	0	0	407	499	42	15	0	0	0	0	321	33	0	0	13	28	2	0	877	1 346	9	2

L = Larvae N = Nymphae

* Ixodes sp. 3 ♀♀; *Rhipicephalus* sp. (near *R. capensis*) 12 ♂♂, 1 ♀ and *Rhipicephalus simus* 20 ♂♂, 4 ♀♀

** *Hyalomma marginatum rufipes* 31 ♂♂, 6 ♀♀; *R. simus* 1 ♂, 1 ♀

TABLE 7 The proportional distribution of several tick species on 5 kudu in the Andries Vosloo Kudu Reserve

Tick species	Stage of development	Total No. recovered	Percentage recovered from			
			Head	Neck, body and upper legs	Lower legs and feet	Tail
Amblyomma hebraeum	Larvae	2 053	11,7	19,1	69,0	0,2
	Nymphae	106	15,1	5,7	76,4	2,8
Haemaphysalis silacea	Larvae	13 859	9,6	8,8	81,1	0,5
	Nymphae	2 480	6,1	7,4	85,8	0,7
	Male	969	1,2	39,2	35,5	24,1
	Female	156	1,3	34,6	0,6	63,5
Rhipicephalus appendiculatus	Larvae	7 639	22,7	21,6	55,0	0,7
	Nymphae	774	54,8	24,8	18,6	1,8
	Male	98	98,0	2,0	0,0	0,0
	Female	28	85,7	14,3	0,0	0,0
Rhipicephalus evertsi evertsi	Larvae	558	93,9	2,9	2,9	0,3
	Nymphae	270	90,4	6,7	2,9	0,0
Rhipicephalus glabroscutatum	Larvae	8 987	4,1	11,8	82,2	1,9
	Nymphae	3 718	1,5	7,7	88,9	1,9

(Horak *et al.*, 1982). The gemsbok appeared to be under some stress in this park, which may not be a natural habitat of these animals (Ansell, 1971), and were not thriving, factors which may have made them more susceptible to tick infestation, as has been found with cattle under stress infested with *B. microplus* (Utech, Seifert & Wharton, 1978).

During a 13-month long survey of ticks on kudu on farms adjoining the Andries Vosloo Kudu Reserve, Knight & Rechav (1978) shot 2 kudu during June 1976 and 2 during June 1977. These authors visually examined certain areas on these kudu and removed, counted and identified the ticks they found (Knight, personal communication, 1982). They recovered no immature or adult *R. glabroscutatum* or *R. evertsi evertsi* and few larvae of *A. hebraeum, H. silacea* and *R. appendiculatus* from these animals. It is possible that these ticks were not present, or were present only in small numbers, but it is more likely that the techniques they used were not as sensitive as those employed in the present survey. Their survey did indicate, however, that the larvae and nymphae of *H. silacea* and *R. appendiculatus* can reach peak numbers during June.

Because they had recovered no immature *R. glabroscutatum* from any of the kudu examined in their survey, Knight & Rechav (1978) stated: "This indicates that the immature stages feed on other hosts, possibly small mammals, as does *Rhipicephalus simus* Koch or, even on birds, as is the case with *Hyalomma marginatum rufipes* Koch." The present findings contradict this statement in that fairly large numbers of immature *R. glabroscutatum* were recovered from nearly every host that was infested with adults of this species.

Perhaps the most significant finding of the present investigation is that large numbers of ticks may be found on apparently healthy wild animals. These burdens will probably be even larger if the recovery techniques used in the present survey are further improved.

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