Arthropod parasites of impalas in the Kruger National Park with particular reference to ticks

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Adult male and female impalas *Aepyceros melampus* were examined for ectoparasites at monthly intervals for a period of 17 and 15 months, respectively, at Skukuza and north of Malelane in the southern Kruger National Park, Mpumalanga, South Africa. A total of 34 male and 31 female impalas were examined and *Boophilus decoloratus* was the most abundant and prevalent ixodid tick collected. In addition to this tick of which both the mean immature and adult burdens were large, the impalas also harboured large numbers of immature and few adult ticks of other species. Comparisons were also made between male and female animals and between the two localities for the six major tick species and four louse species collected. Male animals from north of Malelane harboured significantly more ($p<0.05$) adult *Rhipicephalus appendiculatus* than did females from the same locality, which in turn harboured significantly more *Damalinia aepycerus* than the males. There were no differences in the tick and lice burdens between male and female impalas examined around Skukuza. Significantly more ($p<0.05$) *Amblyomma hebraeum* immatures, *Amblyomma marmoreum* larvae, *Damalinia elongata* nymphs and adults and *D. aepycerus* nymphs, and significantly fewer ($p<0.05$) *Rhipicephalus evertsi evertsi* immatures and *R. appendiculatus* nymphs were collected from impalas around Skukuza than from those examined north of Malelane. In addition the life stage compositions of populations of various ixodid tick species were compared on impalas, kudus, nyalas and cattle from several localities. With few exceptions the cattle harboured greater percentages of adult *A. hebraeum, R. appendiculatus* and *R. evertsi evertsi* than did the antelopes, which conversely harboured greater percentages of immature ticks.

Keywords: arthropod parasites, impala, lice, ticks

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Introduction

Wild artiodactyls not only serve as hosts for a variety of ticks of veterinary importance (Horak 1982; Horak, Potgieter, Walker, De Vos & Boomker 1983) but they may also suffer mortality owing to tick infestations (Ferrar & Kerr 1971; Lightfoot & Norval 1981; Melton 1987). Mortality frequently occurs amongst animals introduced into new areas (Fourie & Vrahimis 1989) or animals under nutritional stress (Lightfoot & Norval 1981; Melton 1987). This is often evident in small wildlife parks where a high host density can lead to excessive tick burdens resulting in high mortalities (Ferrar & Kerr 1971).

Game ranching in combination with livestock farming is a common practice in South Africa. On these mixed farms the judicious selection of the wild animal species that are to be kept with the domestic stock is important. Cattle for instance carry a larger proportion of adult ticks than impalas *Aepyceros melampus*, which, however, are efficient hosts for the immature stages of a number of tick species (Horak 1982). Thus when cattle and impalas occur sympatrically the latter will make an important contribution to the adult ticks on the cattle.

The distribution of ticks is affected by a number of factors such as vegetation, habitat and climate (Theiler 1966). Wild animals with a wide geographic distribution range may therefore be infested with different tick species in different regions of their distribution. In order to determine the host status of wild artiodactyls for ticks, sampling should consequently be done in various habitats within the distribution range of the host species. The specific objective of the present study was to determine the species diversity and numbers of ectoparasites infesting impalas in a Lowveld Veld Type habitat of the Kruger National Park, Mpumalanga.

Material and Methods

At monthly intervals from January 1980 until May 1981 adult male impalas from north (25–30 km) of Malelane and from around Skukuza were shot and examined for ectoparasites. Impala near Malelane were sampled in mixed bushwillow woodlands, and those near Skukuza in Sabie Crocodile thorn thickets. Female animals at each of these localities were examined from March 1980 to May 1981. Ectoparasites were collected, identified and counted as described by Horak, Boomker, Spickett & De Vos (1992).

A total of 32 (17 male and 15 female) and 33 (17 male and 16 female) impalas were examined from the northern Malelane region and from around Skukuza, respectively. The tick burdens of the adult male and female impalas examined from the two localities were compared using two-tailed paired t tests on log (count + 1) transformed data.

Table 1 Mean arthropod parasite burdens of 65 impalas in the Kruger National Park. Numbers of animals infested are given in parentheses

Ixodid ticks	Larvae	Nymphs	Males	Females	Total number recovered
Amblyomma hebraeum	554.4(65)	101.4(65)	0.9(26)	0.2(6)	42691
Amblyomma marmoreum	15.7(16)	–	–	–	1020
Boophilus decoloratus	1476.0(65)	718.5(65)	290.5(65)	137.9(65)	170482
Rhipicephalus appendiculatus	118.0(37)	60.1(30)	9.4(33)	5.6(30)	12556
Rhipicephalus evertsi evertsi	288.9(63)	50.8(51)	1.9(45)	0.7(27)	22246
Rhipicephalus zambeziensis	225.2(34)	73.1(26)	12.9(36)	6.4(36)	20646

Lice	Nymphs	Adults	Total number recovered
Damalinia aepycerus	55.8(34)	23.2(26)	5136
Damalinia elongata	116.9(25)	64.9(24)	11816
Linognathus aepycerus	44.9(30)	25.8(29)	4596
Linognathus nevelli	19.8(12)	12.9(15)	2124

Results

The mean numbers of arthropod parasites collected from the impalas are summarized in Table 1. Six ixodid tick species, of which *Boophilus decoloratus* was the most prevalent, parasitized the impalas. Except for *Amblyomma marmoreum*, of which only the larvae were collected, all developmental stages of the other ticks were present on the impalas. With the exception of *B. decoloratus* the mean number of adult ticks was less than 20 per animal. Both biting and sucking lice (*Damalinia* spp. and *Linognathus* spp.) occurred on the impalas (Table 1.). Mean lice burdens were, however, relatively low and less than half the animals were infested.

The mean tick and lice burdens of impalas from north of Malelane and from Skukuza are summarized in Table 2. Significantly more immature *Amblyomma hebraeum* and *A. marmoreum* were present on impalas sampled at Skukuza than on those from the Malelane region. Conversely significantly more *Rhipicephalus appendiculatus* nymphs and *Rhipicephalus evertsi evertsi* larvae and nymphs were collected from impalas from the Malelane region. Except for *Damalinia aepycerus* adults, significantly more biting lice were collected from impalas at Skukuza than from the Malelane region (Table 2).

In general the tick and lice burdens on male and female impalas did not differ significantly. However, male impalas from the Malelane region harboured significantly more adult *R. appendiculatus* (both sexes) than did females. Female impalas, in turn, harboured more *D. aepycerus* adults than males. At Skukuza no difference in the tick and lice burdens was evident between sexes.

Discussion

Seventeen ixodid tick species indigenous to South Africa, of which nine include both immature and adult stages, have been collected from impalas (Theiler 1962; Horak 1982; this study). Some of these ticks, namely *A. hebraeum, B. decoloratus, R. appendiculatus* and *R. evertsi evertsi* are of veterinary importance since they can either transmit pathogens or cause tick toxicoses in domestic stock (Howell, Walker & Nevill 1983). The ticks collected from impalas in a Mixed Bushveld region in the Nylsvley Nature Reserve (Horak 1982) differed slightly from those collected from impalas in this study. *Ixodes cavipalpus* and *Hyalomma marginatum rufipes* were not collected from impalas from the Malelane region or from Skukuza. Since few ticks of these species parasitized the impalas at Nylsvley these can be considered incidental infes-

Table 2 Mean numbers of ticks and lice collected from impalas north of Malelane and around Skukuza in the Kruger National Park and statistical comparison of the values

	Larvae			Nymphs			Males			Females		
Ixodid ticks	$\bar{X}(1)$	$\bar{X}(2)$	p	$\bar{X}(1)$	$\bar{X}(2)$	p	$\bar{X}(1)$	$\bar{X}(2)$	p	$\bar{X}(1)$	$\bar{X}(2)$	p
Amblyomma hebraeum	426.0	678.9	S	67.8	133.9	S	0.5	1.2	N	0.1	0.2	N
Amblyomma marmoreum	3.3	27.7	S									
Boophilus decoloratus	1893.0	1071.5	N	885.4	556.6	N	370.3	213.1	N	168.3	108.4	N
Rhipicephalus appendiculatus	170.6	66.8	N	92.8	28.5	S	4.8	13.9	N	3.7	7.5	N
Rhipicephalus evertsi evertsi	483.0	100.6	S	75.8	26.5	S	1.8	2.0	N	0.8	0.6	N
Rhipicephalus zambeziensis	111.3	335.6	N	28.5	116.4	N	4.8	20.8	N	2.5	10.3	N

	Nymphs			Adults		
Lice	$\bar{X}(1)$	$\bar{X}(2)$	p	$\bar{X}(1)$	$\bar{X}(2)$	p
Damalinia aepycerus	14.5	95.8	S	12.6	33.5	N
Damalinia elongata	8.6	221.8	S	7.9	120.2	S
Linognathus aepycerus	23.8	65.2	N	17.5	33.9	N
Linognathus nevelli	1.5	37.5	N	4.3	21.3	N

(1) = Malelane, (2) = Skukuza, S = significant ($p < 0.05$), N = not significant

tations. Impalas from the Malelane region and Skukuza were, however, infested with *Rhipicephalus zambeziensis*, a tick which was not present on animals examined in the Nylsvley Nature Reserve. At the latter locality *R. evertsi evertsi* followed by *R. appendiculatus* were the dominant tick species (Horak 1982). In this study *B. decoloratus* followed by *A. hebraeum* were the dominant species.

There were no differences in the species diversities of arthropod parasites infesting impalas in the Malelane and Skukuza areas. However, significant differences in tick numbers (mainly *A. hebraeum* and *R. evertsi evertsi*) were recorded between impalas in the two areas. These differences are possibly due to the fact that the population densities of buffalo and zebra, which serve as good hosts for the adults of *A. hebraeum* and *R. evertsi evertsi*, respectively, differ between the two regions. The virtual absence of differences in tick burdens between the sexes is significant. This is possibly related to the high degree of reciprocal allogrooming (Mooring & Hart 1992) and selfgrooming which reportedly have a tick-removal function (Hart, Hart, Mooring & Olubayo 1992), as well as the foraging of oxpeckers on the impalas (Hart, Hart & Mooring 1990).

Impalas may carry large burdens of immature ticks. A dead impala ram has been found with about 50 000 *R. appendiculatus* larvae and nymphs (Lightfoot & Norval 1981). Impalas under nutritional stress can also become heavily infested with ticks (Lightfoot & Norval 1981). It has been suggested that compared to cattle, impalas carry fewer adult ticks (Macleod, Colbo, Madbouly & Mwanaumo 1977; Horak 1982). The percentage composition of larvae, nymphs and adults in specific tick populations on cattle, impalas, nyalas and kudus is summarized in Table 3. For *A. hebraeum* the values for impalas, nyalas and kudus are remarkably similar. On these hosts adult ticks constituted only 1 or 2% of the population. Values for adults of up to 49% have been recorded on cattle (Table 3). With the exception of nyalas in the Mkuzi Game

Table 3 The life stage composition of ixodid tick populations on various antelope species and on cattle

Tick species	Larvae(%)	Nymphs(%)	Adults(%)	Host	Locality	Reference
Amblyomma hebraeum	90	9	1	impalas	Nylsvley	Horak 1982
	84	15	1	impalas	KNP	This study
	88	10	2	kudus	AVKR	Horak et al. 1992
	86	13	1	kudus	KNP	Horak et al. 1992
	84	15	1	nyalas	UGR	Horak et al. 1995
	88	11	1	nyalas	MGR	Horak et al. 1995
	33	18	49	cattle	Nylsvley	Horak 1982
	66	9	25	cattle	Bucklands*	Horak & Knight 1986
Boophilus decoloratus	56	27	17	impalas	KNP	This study
	50	33	17	kudus	KNP	Horak et al. 1992
	44	30	26	nyalas	UGR	Horak et al. 1995
	72	21	7	nyalas	MGR	Horak et al. 1995
Rhipicephalus appendiculatus	67	28	5	impalas	Nylsvley	Horak, 1982
	61	31	8	impalas	KNP	This study
	77	14	9	kudus	AVKR	Horak et al. 1992
	60	16	24	kudus	KNP	Horak et al. 1992
	71	16	13	nyalas	UGR	Horak et al. 1995
	72	5	23	nyalas	MGR	Horak et al. 1995
	56	22	22	cattle	Bucklands*	Horak & Knight 1986
	11	16	73	cattle	Nylsvley	Londt et al. 1979
	51	21	28	cattle	Nylsvley	Horak 1982
Rhipicephalus evertsi evertsi	70	28	2	impalas	Nylsvley	Horak 1982
	84	15	1	impalas	KNP	This study
	63	31	6	kudus	AVKR	Horak et al. 1992
	89	9	2	kudus	KNP	Horak et al. 1992
	98	0	2	nyalas	UGR	Horak et al. 1995
	50	46	4	cattle	Bucklands*	Horak & Knight 1986
	52	6	42	cattle	Nylsvley	Horak 1982
Rhipicephalus zambeziensis	71	23	6	impalas	KNP	This study
	80	12	8	kudus	KNP	Horak et al. 1992

AVKR = Andries Vosloos Kudu Reserve; KNP = Kruger National Park; MGR = Mkuzi Game Reserve; UGR Umfolozi Game Reserve; *Bucklands farm shares a boundary with the Andries Vosloo Kudu Reserve.

Reserve the ratios for *B. decoloratus* on impalas, kudus and nyalas were also fairly similar. Impalas harboured a greater percentage of nymphs, but a smaller proportion of adult *R. appendiculatus* than kudus and nyalas. The very high percentage (73%) of adults collected from cattle at Nylsvley can be attributed to the sampling method used (destructive *versus* live sampling). Live sampling of hosts as employed in the study by Londt, Horak & De Villiers (1979) will result in a bias towards adult ticks. In the case of *R. evertsi evertsi*, which is a two-host tick, impalas, kudus and nyalas harboured large percentages (94–98%) of larvae and nymphs combined but only between 1 and 6% of adults. The proportions of immature *R. zambeziensis* on impalas (94%) and kudus (92%) were similar.

When impalas and domestic stock such as sheep, goats and cattle are grazed together, the impalas will make an important contribution towards the adult tick burdens of these animals because they are efficient hosts for the immature stages. Impalas will, however, not be able to sustain large tick populations in the absence of animals such as cattle which are efficient hosts of the adult ticks (Horak 1982).

It has been suggested that the proportion of adult ticks carried by animals appears to be in direct relationship to the physical size of the host species (Horak *et al.* 1983; Horak 1984; Horak, MacIvor, Petney & De Vos 1987). Data presented in this study indicate that this is not universally true and that a high degree of variation can occur. For data of this nature to be comparable samples should be representative of the various seasons of the year. Because the seasonal occurrence of immature and adult three-host ticks is out of phase (Minshull & Norval 1982; Petney, Horak & Rechav 1987) short-term sampling and inadequate sample sizes will result in bias towards either immature or adult ticks.

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