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Parasites of domestic and wild animals in South Africa. XXXIII. Ixodid ticks on scrub hares in the north-eastern regions of Northern and Eastern Transvaal and of KwaZulu-Natal

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ABSTRACT

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Ixodid ticks were collected from scrub hares (*Lepus saxatilis*) at three localities. Nine tick species were recovered from 24 hares examined at Pafuri, Kruger National Park, Northern Transvaal. The most abundant and prevalent species were *Hyalomma truncatum*, *Rhipicephalus kochi* and a *Rhipicephalus* species (near *R. pravus*). Twelve tick species were collected from 120 scrub hares examined around Skukuza, Kruger National Park, Eastern Transvaal. The immature stages of *Hyalomma truncatum* were most abundant and those of *Amblyomma hebraeum* most prevalent on the hares. No haematozoa were found on blood smears made from these hares.

Thirty-four scrub hares on mixed cattle and game farms near Hluhluwe, north-eastern KwaZulu-Natal harboured 12 tick species. The most abundant and prevalent of these were the immature stages of *Rhipicephalus muehlensi*. Piroplasms, tentatively identified as *Babesia leporis*, were present on blood smears of eight of these hares.

The host status of scrub hares for 18 ixodid tick species or subspecies found in South Africa is tabulated.

Keywords: Ixodid ticks, scrub hares, Transvaal, KwaZulu-Natal, *Hyalomma truncatum, Rhipicephalus kochi, Amblyomma hebraeum, Rhipicephalus muehlensi*

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INTRODUCTION

Several surveys on the ixodid ticks infesting scrub hares (*Lepus saxatilis*) in South Africa have recently been conducted (Horak, Sheppey, Knight & Beuthin 1986; Rechav, Zeederberg & Zeller 1987; Horak & Fourie 1991; Horak, Fourie, Novellie & Williams 1991b; Horak, Spickett, Braack & Penzhorn 1993). These surveys were carried out in the Eastern, Western and Northern Cape Province; the south-western and central Free State; North-West Province; and

Northern and Eastern Transvaal. They indicated that scrub hares are good hosts of the immature and/or adult stages of a large number of ixodid tick species. Some of these ticks are important vectors of disease to animals and man. Not only are scrub hares hosts of the ticks but they may also serve as reservoirs of some of the pathogenic organisms. Most notable of these are the virus that causes Crimean-Congo haemorrhagic fever in humans (Hoogstraal 1979), and *Cowdria ruminantium*, the cause of heartwater in cattle, sheep and goats (Bezuidenhout 1988).

Although several studies on the ticks infesting wild animals in KwaZulu-Natal have been conducted (Baker & Keep 1970; Horak, Potgieter, Walker, De Vos & Boomker 1983; Horak, Keep, Flamand & Boomker 1988; Horak, Keep, Spickett & Boomker 1989; Horak, Boomker & Flamand 1991a), no such investigation involving scrub hares has been done. The present paper records the results of a survey conducted on scrub hares in north-eastern KwaZulu-Natal, and also describes similar surveys on scrub hares in the far north-eastern Northern Transvaal Lowveld as well as in the Eastern Transvaal Lowveld. Hares at the latter locality were the subject of a 4-year survey immediately preceding the present study (Horak *et al.* 1993).

MATERIALS AND METHODS

Survey animals

A total of 183 scrub hares were examined. Twenty-four were from the far north-eastern Northern Transvaal Lowveld and 120 from Eastern Transvaal Lowveld, five from western Northern Transvaal, and 34 from farms in north-eastern KwaZulu-Natal. The hares were shot at night, the hunters using a spotlight and a shotgun.

Tick recovery

The animals were processed for ectoparasite recovery and the ticks counted as described by Horak *et al.* (1986) and Horak & Fourie (1991).

Other parasites

Non-ixodid arthropod parasites collected from the hares, as well as helminths recovered from some of the animals, will be reported separately. Thin blood smears were made from the hares examined around Skukuza, Kruger National Park and in north-eastern KwaZulu-Natal. These were fixed, stained and examined as described by Horak *et al.* (1993).

Climate

Monthly mean maximum and minimum temperatures and total monthly rainfall were recorded at Skukuza.

SURVEY LOCALITIES AND RESULTS

Kruger National Park (KNP)

Pafuri (22°25´S, 31°18´E)

A total of 24 hares were shot at about 2-monthly intervals between March 1992 and April 1993, around this locality in the far north-eastern region of the KNP, Northern Transvaal. The vegetation here is classified as Mixed Bushveld (Acocks 1988) and the landscape described as Limpopo/Levubu Floodplains by Gertenbach (1983). The species and numbers of ixodid ticks recovered from these hares are summarized in Table 1.

Nine tick species were collected, of which *Hyalomma truncatum, Rhipicephalus kochi* and a *Rhipicephalus* sp. (near *R. pravus)* were most abundant and most prevalent. The largest numbers of larvae and nymphs of *H. truncatum*, which is a two-host tick, were present from May to October 1992. The larvae and nymphs of *R. kochi* were recovered from March to October and March to August 1992 respectively, while the adults were present throughout the year. No clear pattern of seasonal abundance was evident for the *Rhipicephalus* sp. (near *R. pravus*).

Skukuza (24°58´S, 31°36´E)

This camp is situated in the southern part of the KNP, Eastern Transvaal, in vegetation classified as Lowveld by Acocks (1988), and a landscape described as Thickets of the Sabie and Crocodile Rivers by Gertenbach (1983). For a period of 2 years (from August 1992 to July 1994), sets of five scrub hares were shot at monthly intervals, within a 25 km radius of Skukuza. A total of 120 hares were collected in this way. The tick burdens of these animals are summarized in Table 2.

The hares harboured 12 ixodid tick species, of which the immature stages of *H. truncatum* and *Rhipicephalus zambeziensis* were the most abundant, and those of *Amblyomma hebraeum* and *H. truncatum*, the most prevalent. The seasonal abundances of *Amblyomma marmoreum, H. truncatum* and *R. zambeziensis* are illustrated in Fig. 1 and the monthly mean maximum and minimum atmospheric temperatures and total monthly rainfall at Skukuza in Fig. 2.

The larvae of *A. marmoreum* were generally present from around March to July, while no clear pattern of seasonal abundance was evident for the nymphs. The immature stages of *H. truncatum* were most numerous from April or May to September. Most *R. zambeziensis* larvae were recovered from April or May to August and nymphs from August or September to October or December. Immature stages of *A. hebraeum* and *Rhipicephalus evertsi evertsi* were present throughout the survey period without exhibiting clear patterns of seasonal abundance.

TABLE 1 Ixodid ticks collected from 24 scrub hares around Pafuri, Kruger National Park

Tick species	Total numbers collected					No. of hares infested
	Larvae	Nymphs	Males	Females	Total	
Amblyomma hebraeum	0	18	0	0	18	7
Amblyomma marmoreum	5	2	0	0	7	3
Boophilus decoloratus	1	0	0	0	1	1
Hyalomma truncatum	336	127	0	0	463	14
Rhipicephalus appendiculatus	0	15	0	0	15	4
Rhipicephalus evertsi evertsi	17	85	0	0	102	9
Rhipicephalus kochi	100	536	93	29(2)	758	17
Rhipicephalus sp. (near *R. pravus*)	192	452	101	24(5)	769	21
Rhipicephalus zambeziensis	13	92	0	0	105	8

( ) = Number of engorging female ticks, i.e. idiosoma of *R. kochi* and *Rhipicephalus* sp. (near *R. pravus*) > 5,5 mm in length

TABLE 2 Ixodid ticks collected from 120 scrub hares around Skukuza, Kruger National Park

Tick species	Total numbers collected					No. of hares infested
	Larvae	Nymphs	Males	Females	Total	
Amblyomma hebraeum	972	759	0	0	1731	114
Amblyomma marmoreum	389	90	0	0	479	65
Aponomma sp.	1	0	0	0	1	1
Boophilus decoloratus	35	0	1	0	36	9
Haemaphysalis leachi	0	3	0	0	3	2
Hyalomma truncatum	13226	2832	0	0	16058	105
Rhipicephalus appendiculatus	0	8	0	0	8	4
Rhipicephalus evertsi evertsi	659	478	1	0	1138	78
Rhipicephalus sp. (near *R. pravus*)	1	0	5	0	6	3
Rhipicephalus simus	0	1	0	0	1	1
Rhipicephalus turanicus	0	0	0	1	1	1
Rhipicephalus zambeziensis	4036	1650	2	1	5689	85

The highest maximum temperatures were recorded during December 1992 and 1993 and the lowest minima during June 1993 and July 1994. Rain fell mainly from November to March and the summer of 1992/93 was considerably wetter than that of 1993/94.

No haematozoa were found on the blood smears made from these hares.

Western Northern Transvaal

Two scrub hares were shot on the farm "Sandspruit" (24°38´S, 27°40´E) during June 1994 and three on the farm "Looplaagte" (24°33´S, 26°50´E) during September 1994. The vegetation in the "Sandspruit" region is classified as Sour Bushveld and Sourish Mixed Bushveld, and in the "Looplaagte" region as Mixed Bushveld (Acocks 1988). Table 3 summarizes the species and number of ixodid ticks collected from these hares.

The hares were infested with nine tick species, of which *H. truncatum* was the most abundant and prevalent.

North-eastern KwaZulu-Natal

Hluhluwe (28°07´S, 32°03´E)

A total of 34 scrub hares were shot at 2-monthly intervals from March 1993 to March 1994 on four mixed cattle and game farms within a 35 km radius of this town. The vegetation of this region is classified as Zululand Thornveld and Lowveld (Acocks 1988). The species and numbers of ixodid ticks recovered from the hares are summarized in Table 4.

The hares were infested with 12 ixodid tick species, of which the immature stages of *Rhipicephalus muehlensi* were the most abundant and prevalent, but they exhibited no pattern of seasonal abundance. The nymphs of *Rhipicephalus appendiculatus* were most abundant and prevalent during September. The larvae of *Rhipicephalus turanicus* were most prevalent from May to July and the adults from January to July.

Piroplasms, tentatively identified as *Babesia leporis*, were present on the blood smears of eight of these

TABLE 3 Ixodid ticks collected from five scrub hares in western Northern Transvaal

Tick species	Total numbers collected					No. of hares infested
	Larvae	Nymphs	Males	Females	Total	
Amblyomma hebraeum	3	6	0	0	9	3
Amblyomma marmoreum	0	2	0	0	2	1
Hyalomma marginatum rufipes	44	132	0	0	176	3
Hyalomma truncatum	99	144	0	0	243	5
Rhipicephalus appendiculatus	3	12	0	0	15	3
Rhipicephalus evertsi evertsi	33	23	0	0	56	2
Rhipicephalus sp. (near *R. pravus)*	1	6	6	0	13	2
Rhipicephalus turanicus	0	0	0	1	1	1
Rhipicephalus zambeziensis	92	8	0	0	100	4

TABLE 4 Ixodid ticks collected from 34 scrub hares around Hluhluwe, north-eastern KwaZulu-Natal

Tick species	Total numbers collected					No. of hares infested
	Larvae	Nymphs	Males	Females	Total	
Amblyomma hebraeum	311	99	0	0	410	25
Amblyomma spp.	201	48	0	0	249	24
Boophilus sp.	1	1	0	0	2	2
Haemaphysalis hoodi	0	0	2	0	2	1
Haemaphysalis leachi	1	1	0	0	2	1
Hyalomma truncatum	5	0	0	0	5	1
Rhipicephalus appendiculatus	92	281	0	0	373	16
Rhipicephalus evertsi evertsi	146	257	0	0	403	15
Rhipicephalus maculatus	0	26	0	0	26	5
Rhipicephalus muehlensi	841	213	0	0	1054	29
Rhipicephalus turanicus	67	1	72	26(2)	166	26
Rhipicephalus sp.	0	0	0	1	1	1

( ) = Number of engorging female ticks, i.e. idiosoma of *R. turanicus* > 5,5 mm in length

TABLE 5 The host status of scrub hares for various ixodid tick species which are not just occasional or accidental parasites

Tick species	Immature stages		Adult ticks	
	Host status	Value [a] (max. 200)	Host status	Value [a] (max. 100)
Amblyomma hebraeum	Good	119	–	–
Amblyomma marmoreum	Fair	55	–	–
Hyalomma marginatum rufipes	Fair	77	–	–
Hyalomma marginatum turanicum	Preferred	165	–	–
Hyalomma truncatum	Preferred	131	–	–
Ixodes sp. (near *I. pilosus*) [b]	Fair	61	Good	47
Rhipicephalus appendiculatus	Fair	72	–	–
Rhipicephalus evertsi evertsi	Fair	77	–	–
Rhipicephalus exophthalmos [c]	–	—	Fair	34
Rhipicephalus glabroscutatum	Fair	68	–	–
Rhipicephalus kochi	Fair	60	Preferred	68
Rhipicephalus muehlensi	Good	116	–	–
Rhipicephalus nitens	Preferred	147	Preferred	100
Rhipicephalus oculatus	Specific		Specific	
Rhipicephalus sp. (near *R. pravus)*	Good	103	Preferred	91
Rhipicephalus sp. (near *R. punctatus*) [d]	Good	91	Preferred	87
Rhipicephalus turanicus	–	23	Preferred	71
Rhipicephalus zambeziensis	Preferred	120	–	–

[a] Sum of prevalence and mean tick burden
[b] McKay (1994) describes this as the "hairless palp" species of the *I. pilosus* complex
[c] Previously referred to as *Rhipicephalus* sp. (near *R. oculatus*) by Horak & Fourie (1991)
[d] Previously referred to as *Rhipicephalus punctatus* by Horak & Fourie (1991)

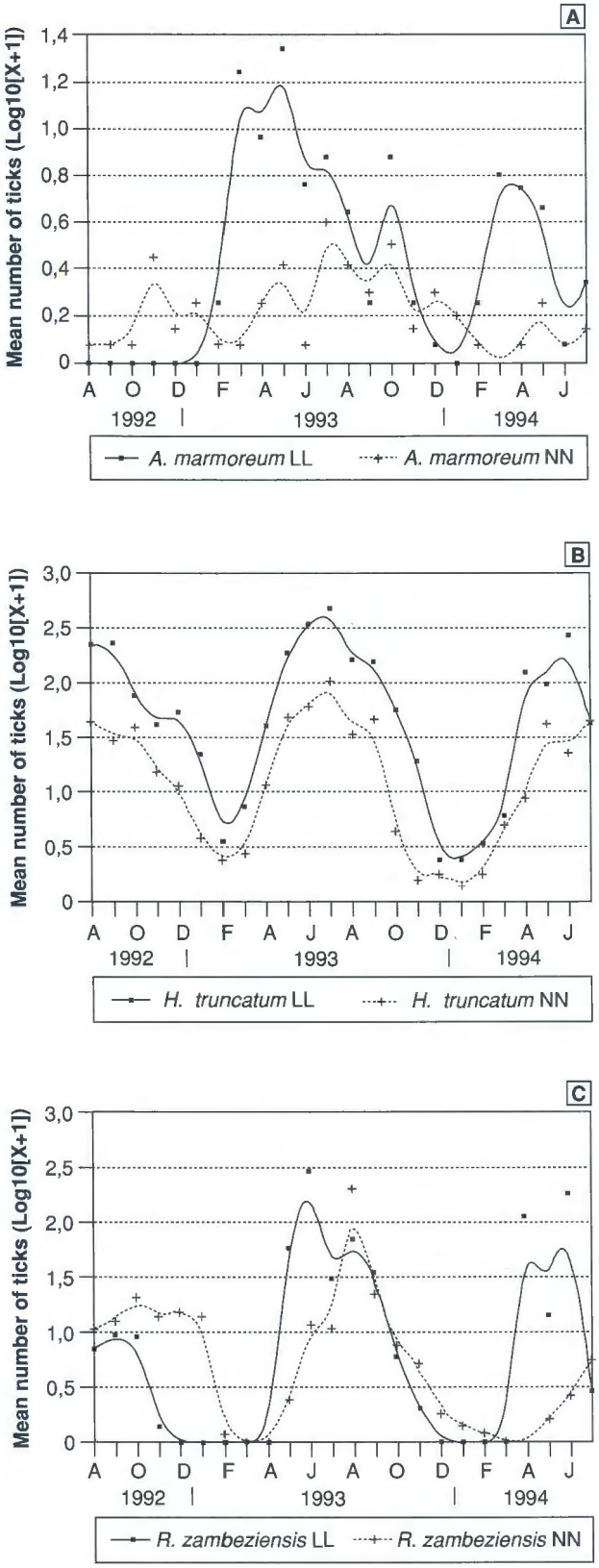

FIG. 1 The seasonal abundance of (A) *Amblyomma marmoreum*, (B) *Hyalomma truncatum* and (C) *Rhipicephalus zambeziensis* on scrub hares around Skukuza, Kruger National Park

hares. A representative blood smear (SM6160) has been deposited in the collection of the Protozoology Division, Onderstepoort Veterinary Institute.

DISCUSSION

Basic data regarding tick abundance, prevalence and seasonality were provided in earlier surveys (Horak *et al.* 1986, 1991b, 1993; Horak & Fourie 1991) and only new findings will be discussed here.

The host status of scrub hares for 13 species or subspecies of ixodid ticks occurring in South Africa was tabulated and discussed by Horak & Fourie (1991). Reassessing their data with the benefit of additional findings from a subsequent survey (Horak *et al.* 1993) and the present study, we have added six tick species or subspecies to their list and removed one. The latest studies have also made it possible to define the host status of scrub hares for some tick species more precisely, and the amended list is presented in Table 5.

For the definition of the host status of scrub hares for a given tick species, we suggest that at least 20 hares should be examined at a particular locality within a specific area, preferably over a period of one year. The percentage of these hares infested, plus their mean tick burden, can then be calculated. Where sets of 20 or more hares have been examined at more than one locality, the values should be calculated for each locality, and the mean used to assign host status.

The values for the various host-status categories for immature ticks are as follows:

Fair	(40–79)
Good	(80–119)
Preferred	(≥ 120)

These values are based on the fact that up to 100% of scrub hares can be infested with the immature stages of a particular tick and that on scrub hares the mean immature burdens of individual species seldom exceed 100 ticks, thus resulting in a potential maximum value of 200.

The values for the various host-status categories for adult ticks are:

Fair	(20–39)
Good	(40–59)
Preferred	(≥ 60)

These values are derived from the fact that because of the tendency towards seasonality in adult ticks, seldom more than 80% of hares are infested and mean burdens on these animals rarely exceed 20 ticks, giving a potential maximum value of 100.

The term, specific host, is applicable when scrub hares (or the closely related Cape hares) are, apart

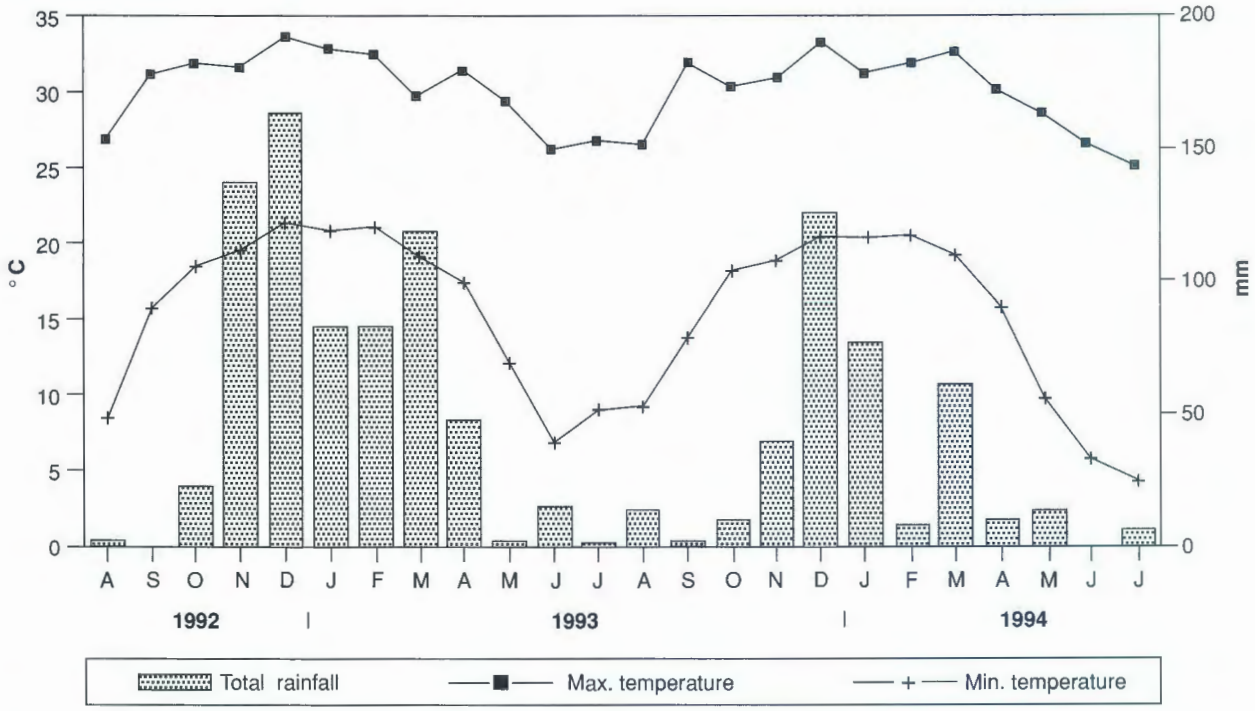

FIG. 2 Mean monthly maximum and minimum atmospheric temperatures and total monthly rainfall at Skukuza, Kruger National Park from August 1992 to July 1994

from accidental infestations on other animals, the only hosts of a particular tick.

Of the 18 tick species or subspecies listed in Table 5, only one can be considered a specific parasite of scrub hares. This is *Rhipicephalus oculatus* (not encountered in the present study) which, with the exception of the Cape hare (*Lepus capensis*), is rarely recovered from any other host species (Keirans, Walker, Horak & Heyne 1993).

When scrub hares or Cape hares are examined within the habitats of the two *Hyalomma* species found in South Africa, both usually carry large burdens of the immature stages of these ticks. However, several rodent species and ground-frequenting birds may also be infested, albeit with lesser numbers of immature *H. truncatum* or of the two subspecies of *Hyalomma marginatum,* respectively, thus denying the hares specific host status for these ticks.

Scrub hares are preferred hosts of the immature stages of four tick species and the adults of five, but they share this status with other animals present within the distribution range of a particular tick. In addition to the 18 ticks listed in Table 5, a further 16 species have been collected from scrub hares in this country during this and other surveys (Horak *et al.* 1986, 1991b, 1993; Horak & Fourie 1991). Most of these ticks are probably accidental infestations reflecting a particular tick's abundance at a specific locality rather than the hare's propensity as a host. Scrub hares may, however, yet prove to be fair or good hosts for the immature stages of four of these ticks, namely *Haemaphysalis leachi, Haemaphysalis silacea, Rhipicephalus maculatus* and *Rhipicephalus simus.* Scrub hares were, in fact, listed as good hosts of the latter tick by Horak & Fourie (1991), but the more recent data cast some doubt on that finding.

Amblyomma spp.

The presence of *A. hebraeum* and *A. marmoreum* on scrub hares has been extensively discussed by Horak & Fourie (1991) and Horak *et al.* (1993). Judging by the small numbers of *A. hebraeum* collected from three scrub hares at Pafuri and 18 examined around Shingwedzi in an earlier survey (Horak *et al.* 1993), and from the 24 hares examined at Pafuri in this study, the north-eastern region of the KNP is not a good habitat for this tick.

In addition to *A. hebraeum* and *A. marmoreum, Amblyomma nuttalli* is present in KwaZulu-Natal where it parasitizes reptiles, particularly tortoises, leguaans and some of the larger snakes (Walker 1991). As we are unable to distinguish the immature stages of this tick from those of *A. marmoreum,* we have listed immature ticks resembling these on the hares in KwaZulu-Natal, as *Amblyomma* spp.

Aponomma sp.

Ticks of this genus generally infest snakes and/or varanid lizards (Walker 1991). The single larva re-

covered from a hare near Skukuza should be regarded as an accidental infestation.

Boophilus sp.

As suggested by Horak *et al.* (1993), ticks of this genus should be considered accidental infestations on scrub hares.

Haemaphysalis spp.

H. hoodi normally infests ground-feeding birds (Walker 1991) and the ticks on a hare from Hluhluwe are probably an accidental infestation. The immature stages of *H. leachi* or *H. spinulosa*, which we are unable to differentiate, are frequently recovered from scrub hares (Horak *et al.* 1986, 1993; Horak & Fourie 1991), and these animals may yet prove to be good hosts for these ticks.

Hyalomma spp.

Scrub hares are the preferred hosts of the immature stages of *H. truncatum* and of *H. marginatum turanicum* (Horak & Fourie 1991; Horak *et al.* 1991b, 1993). They may yet be found to be good or preferred hosts of *H. marginatum rufipes* when more hares have been examined within the distribution zone of this tick. The small number of *H. truncatum* collected from the hares near Hluhluwe, compared to the large numbers on the hares in the Eastern and Northern Transvaal, is probably a consequence of the moist coastal climate of this habitat. These ticks generally prefer the drier regions of South Africa (Howell, Walker & Nevill 1978).

Rhipicephalus spp.

Scrub hares are good hosts of the immature stages of the *Rhipicephalus* sp. (near *R. pravus*) and preferred hosts of its adults and of the immature stages of *R. zambeziensis* (Horak & Fourie 1991; Horak *et al.* 1993; Table 5). They may also harbour small numbers of immature *R. simus* (Horak *et al.* 1993).

R. kochi has been found in South Africa at Pafuri in north-eastern Northern Transvaal (Clifford, Walker & Keirans 1983; Horak *et al.* 1983) and Ndumu in northern KwaZulu-Natal (Walker 1991). The adults and nymphs, and probably also larvae (which at the time were included with other larvae and identified as *Rhipicephalus* spp.), infest bushbuck, nyalas and kudus, and all stages infest scrub hares (Horak *et al.* 1983, 1993). The present study establishes scrub hares as fair hosts for the immature stages and preferred hosts for the adults. In their revision of the taxonomic status of *R. kochi*, Clifford *et al.* (1983) recorded eight collections of adults from hares and one collection of nymphs and an adult from a four-toed elephant shrew (*Petrodromus tetradactylus*).

In South Africa *R. maculatus* is confined to the coastal regions of north-eastern KwaZulu-Natal (Walker 1991). The preferred hosts of the adults are mammals with thick hides such as elephants, black and white rhinoceroses, buffaloes and bushpigs (Baker & Keep 1970; Horak *et al.* 1983, 1991a; Walker 1991). The same authors have also recorded the immature stages on rhinoceroses, buffaloes, some smaller antelope species, bushpigs and scrub hares. The absence of larvae and the relatively low numbers of nymphs on the scrub hares examined near Hluhluwe, are probably more a reflection of the scarcity of large wild hosts for the adults on the farms on which the hares were shot than the suitability of the hares as hosts for the immatures. The examination of scrub hares in close proximity to buffaloes in northern KwaZulu-Natal should establish the host status of the former for the immature stages of *R. maculatus*.

The distribution of *R. muehlensi* in South Africa closely corresponds to that of *R. maculatus* (Walker 1991). In contrast, however, the preferred hosts of the adults, nymphs and probably larvae (which at the time were lumped with other larvae and identified as *Rhipicephalus* spp.) are nyalas and bushbuck (Horak *et al.* 1983, 1988). Nymphs (and larvae that probably belong to this species) have also been collected in large numbers from red duikers (Horak *et al.* 1991a). The large proportion of infested scrub hares and the relatively high numbers of ticks collected from them indicate that these animals are good hosts for the immature stages of this tick.

The recovery of only one *R. turanicus* adult from 120 scrub hares examined around Skukuza confirms the result of the previous survey conducted there when only four adults were collected from 240 scrub hares (Horak *et al.* 1993). The Hluhluwe region of KwaZulu-Natal is apparently a more favourable habitat than Skukuza, as 26 of the 34 scrub hares examined were infested. Furthermore, 67 larvae and a nymph were collected from these animals. According to Walker (1991) the hosts of the immature stages of *R. turanicus* are unknown.

Norval, Daillecourt & Pegram (1983) recorded large infestations of adult *R. turanicus* (referred to by them as *Rhipicephalus* sp.) on the ears of sheep and goats in Zimbabwe. In this survey the preferred site of attachment of the adults was on the ears of the hares. According to Pegram, Clifford & Keirans (1987) the majority of known records of this tick indicate that the adults are active mainly in the late rainy to early dry season. In Zambia for instance, 90% of collections were made between March and July. In Zimbabwe, however, 83,7% of collections of *R. turanicus* were taken in the warm, wet season (November to April) (Norval *et al.* 1983). In KwaZulu-Natal adults were present on the hares throughout the year, the greatest percentage of animals being infested from January to July (warm, wet to cool, dry season).

The collections of *R. turanicus* from hares in western Northern Transvaal, north-eastern Eastern Transvaal

and north-eastern KwaZulu-Natal in the present study, add to the localities at which this tick has been recorded in South Africa (Pegram *et al.* 1987).

The recovery of the immature stages of *R. zambeziensis* from four of the five hares in western Northern Transvaal confirms the presence of this tick in the region as described by Norval, Walker & Colborne (1982).

General

The total number of ticks collected from scrub hares around Skukuza from August of one year to July of the next year generally closely corresponds to total rainfall over the same period (Spickett, Horak, Heyne & Braack 1995). During this period in 1992/93 a total of 14 856 ticks were collected from 60 hares, compared with 10293 ticks from the same number of hares in the considerably drier 12 months of 1993/94. During 1991/92, an even drier year than 1993/94, a total of only 9280 ticks were collected from an equal number of scrub hares (Spickett *et al.* 1995).

Babesia leporis

This species was originally described from European hares, *Lepus europaeus* (Levine 1988). As these animals are closely related to scrub hares (Skinner & Smithers 1990) they may harbour the same *Babesia* species. We suggest that *R. turanicus* could be the vector of this parasite. Only five of the 360 scrub hares examined around Skukuza were infested with this tick (Horak *et al.* 1993; Table 2) and none were infected with *Babesia*. Around Hluhluwe 26 of the 34 scrub hares surveyed harboured the tick and eight of the hares were infected with the *Babesia*.

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