

## Helminth and arthropod parasites of indigenous goats in the northern Transvaal

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### ABSTRACT

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Helminth and arthropod parasites of 60 female indigenous goats of three age groups on a farm in the northern Transvaal were collected, identified and counted. Anoplocephalid tapeworms were present in the two younger groups of goats, while larvae of *Taenia hydatigena* were recovered from all three groups. Eight species and two genera of nematodes were found in the youngest goats, five species and three genera in the middle group and six species and two genera in the oldest goats. *Strongyloides papillosus* was the most numerous and most prevalent nematode in the youngest goats, while *Haemonchus contortus* was most numerous and most prevalent in both older groups.

Adult *H. contortus* was most abundant during the summer months, while *S. papillosus* occurred in the youngest goats during the cooler months (April to September). No pattern of seasonal abundance could be established for the other nematodes.

Only ixodid ticks were recovered and of the nine species present, the immature stages of *Amblyomma hebraeum* were most numerous and prevalent. *Boophilus decoloratus* was present from October to January and in August, and the adults of a *Rhipicephalus* sp. (near *R. pravus*) from January to March and during May. *Rhipicephalus simus* was present from October to January.

### INTRODUCTION

Indigenous goats are widespread in Africa and play an important role in the culture and economies of particularly the indigent farming communities. These goats are usually not immunized against diseases and are seldom, if ever, treated against internal or external parasites. This has led to the natural selec-

tion of a small, hardy animal that supposedly has a high degree of resistance to parasites and diseases, and can exist with little or no veterinary intervention.

Surveys of the helminth and arthropod parasites of Angora and Boer goats have been done in the eastern Cape Province (Rechav 1982; Boomker, Horak & MacIvor 1989b; Fivaz, Horak & Williams 1990; Horak, Knight & Williams 1991c) and of ticks infesting Angora goats in the south-western Orange Free State (Fourie & Horak 1991). However, in South Africa, only the ticks of indigenous goats have been investigated and that in a survey in the north-western Transvaal (Rechav & De Jager 1991).

The purpose of the current investigation was to determine the seasonal abundance of helminths and arthropods parasitizing indigenous goats in the northern Transvaal.

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## MATERIALS AND METHODS

The survey was conducted on the farm "Delftzyl" (24°35'–24°43'S, 29°14'–29°17'E; altitude approximately 850 m), situated near the village of Roedtan in the northern Transvaal. The farm extends over about 2 000 ha of predominantly Mixed Bushveld with small areas of Springbok Flats Turf Thornveld (Acocks 1988) and is divided into northern and southern sections of approximately equal size, separated by a road. Summers are warm to hot and winters are cool with occasional frost. Rain falls mainly during summer. Small numbers of indigenous cattle are present on the western part of the farm, while impalas, (*Aepyceros melampus*), kudu (*Tragelaphus strepsiceros*), common duikers (*Sylvicapra grimmia*), steenbok (*Raphicerus campestris*), warthogs (*Phacochoerus aethiopicus*), as well as black-backed jackals (*Canis mesomelas*), and caracal (*Felis caracal*), occur on both sections and on neighbouring farms.

"Delftzyl" is a government research farm where, in addition to the wild animals, only indigenous domesticated animals are kept and only the ruminants are allowed to roam freely. Both the grazing and browsing potential are good, and stock numbers are carefully maintained to prevent deterioration of the vegetation. In order to maintain the populations as naturally as possible, none of the domestic animals are treated against endo- or ectoparasites.

This survey was conducted on the eastern section of the farm, where, for the preceding three years, only goats and wild animals had been present. The goats were kraaled at night to limit predation by caracal and were returned to the pastures every morning.

A total of 60 female goats were selected according to age from a flock of about 300 animals. The animals selected remained with the flock until they were slaughtered. At the commencement of the survey during October 1990, 25 of these were 1–2 weeks old (age group 1), 12 were 12–13 months old (age group 2) and 23 were 24–25 months old (age group 3). Two goats of each age group were slaughtered each month from October 1990 to March 1991. During April 1991, three goats of age groups 1 and 3 were slaughtered, after which two goats of these age groups were slaughtered each month until August 1991. The last two goats of age group 1 were killed during September 1991.

The carcasses were processed for helminth recovery as described by Boomker, Horak & De Vos (1989a). Representative samples, each consisting of one tenth of the ingesta of the abomasum, the small intestine and the large intestine, were made. These were examined with a stereoscopic microscope and all the worms removed and counted. The washings of the hearts, lungs and livers, as well as the di-

gests of the respective parts of the intestinal tract were similarly examined *in toto*. All the worms were identified with the aid of a compound microscope with interference contrast lighting.

The skins were processed for ectoparasite recovery as described by Horak, Boomker, Spickett & De Vos (1992). All the material collected was examined under a stereoscopic microscope and the parasites were identified and counted.

## RESULTS

The total monthly rainfall is graphically illustrated in Fig. 1. No rain was recorded from April to August 1991.

### Helminths

The helminths recovered from the goats of each age group are listed in Table 1 and the seasonal abundance of the nematodes, excluding *Skrjabinema* spp., is graphically illustrated in Fig. 2 and 3.

#### Age group 1

Three goats were infected with adult *Moniezia expansa* and another three with *Avitellina* spp., and the larvae of *Taenia hydatigena* were present in six animals.

The most abundant and prevalent nematodes were *Strongyloides papillosus*, followed by *Haemonchus contortus*, *Oesophagostomum columbianum*, *Trichostrongylus* spp. and *Skrjabinema* spp. The remaining nematodes were present in less than 50% of the goats.

Total burdens tended to increase with the age of the goats. Those examined during October and November 1990, at approximately 1 and 2 months of age, harboured means of one and 61 adult nematodes, respectively, while those examined during

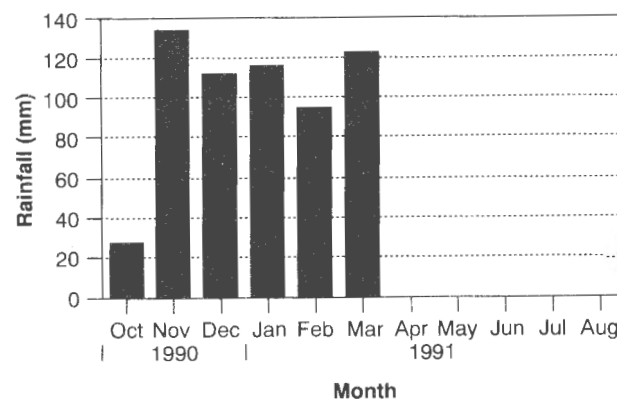


FIG. 1 Total monthly rainfall on the farm "Delftzyl" from October 1990 to August 1991. No rain fell from April to August

TABLE 1 The total helminth burdens of female indigenous goats on the farm "Delftzyl" in the northern Transvaal

Helminth species	Age group 1 (0-12 months) (25 goats)			Age group 2 (13-24 months) (12 goats)			Age group 3 (25-36 months) (23 goats)					
	Number of worms recovered		Percentage of animals infected	Number of worms recovered		Percentage of animals infected	Number of worms recovered		Percentage of animals infected			
	Larvae	Adults		Total	Larvae		Adults	Total		Larvae	Adults	Total
<b>Cestodes</b>												
<i>Avitellina</i> spp.	#	5	12	#	2	8	#	0	0	0	0	0
<i>Moniezia benedeni</i>	#	0	0	#	1	8	#	0	0	0	0	0
<i>Moniezia expansa</i>	#	6	12	#	0	0	#	0	0	0	0	0
<i>Taenia hydatigena</i>	6	#	24	10	#	58	13	#	13	35	35	35
<b>Nematodes</b>												
<i>Cooperia hungi</i>	-	10	4	-	0	0	-	0	0	0	0	0
<i>Cooperia pectinata</i>	-	30	12	-	0	0	-	0	0	0	0	0
<i>Cooperia</i> spp. females	-	0	0	-	10	8	-	0	0	0	0	0
<i>Haemonchus contortus</i>	1 231	3 284	84	1 545	2 998	100	2 365	4 302	6 667	96	96	96
<i>Impatiens tuberculata</i>	0	91	12	0	0	0	0	0	0	0	0	0
<i>Oesophagostomum columbianum</i>	79	710	56	58	231	83	22	555	577	65	65	65
<i>Skrjabinema</i> spp.	0	369	56	0	11	25	0	151	151	57	57	57
<i>Strongyloides papillosus</i>	0	7 354	88	2	524	75	2	467	469	70	70	70
<i>Trichostrongylus colubriformis</i>	-	190	44	-	0	0	-	55	55	22	22	22
<i>Trichostrongylus deflexus</i>	-	0	0	-	30	25	-	21	21	13	13	13
<i>Trichostrongylus faeculentus</i>	-	36	28	-	1	8	-	10	10	4	4	4
<i>Trichostrongylus</i> spp. females	-	288	48	-	15	42	-	126	126	35	35	35
<i>Trichuris</i> spp.	0	196	44	0	70	33	0	312	312	44	44	44
Total nematode burden	1 310	12 558	13 868	1 605	3 890	5 495	2 389	5 999	8 388			
Mean nematode burden	52	502	554	134	324	458	104	261	365			

- Not applicable

# Does not occur in ruminants

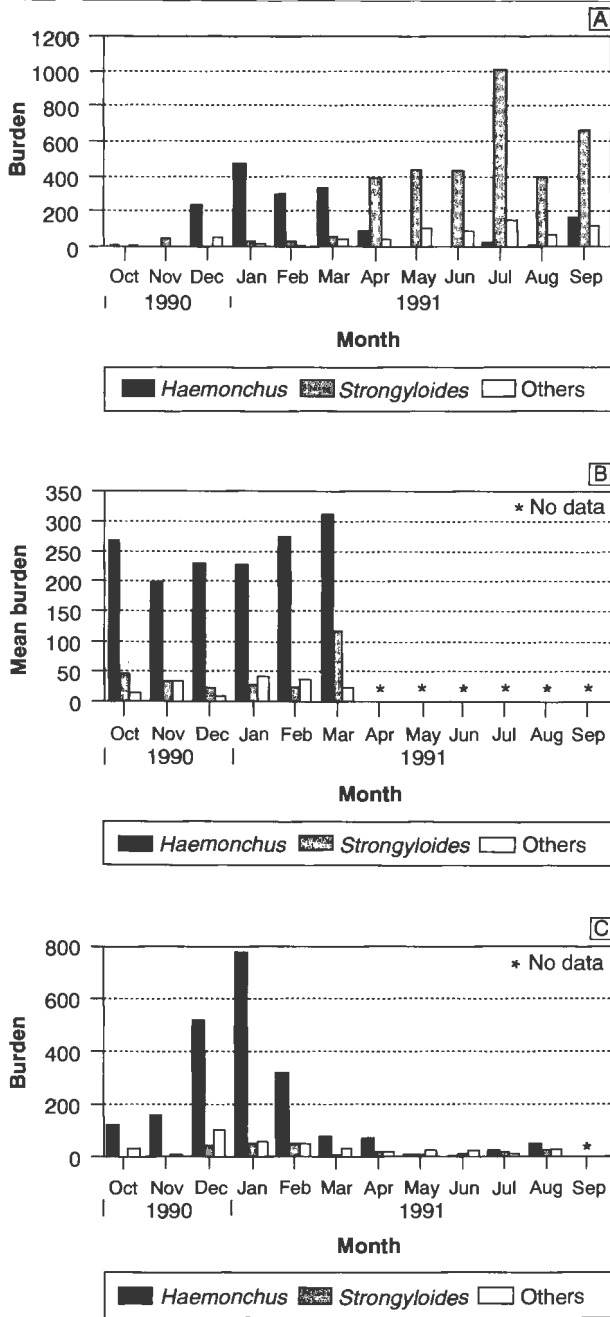


FIG. 2 The seasonal abundance of adult nematodes, excluding *Skrjabinema* spp., in (A) age group 1, (B) age group 2 and (C) age group 3 of indigenous goats on the farm "Delftzyl"

August and September 1991, at approximately 10 and 11 months of age, had mean burdens of 464 and 974 adult nematodes, respectively. The largest burden of 1 176 adult nematodes was recovered during July 1991 and consisted mainly of *S. papillosus*.

Adult *H. contortus* were present in peak numbers from December 1990 to March 1991 and 4th-stage larvae during March 1991.

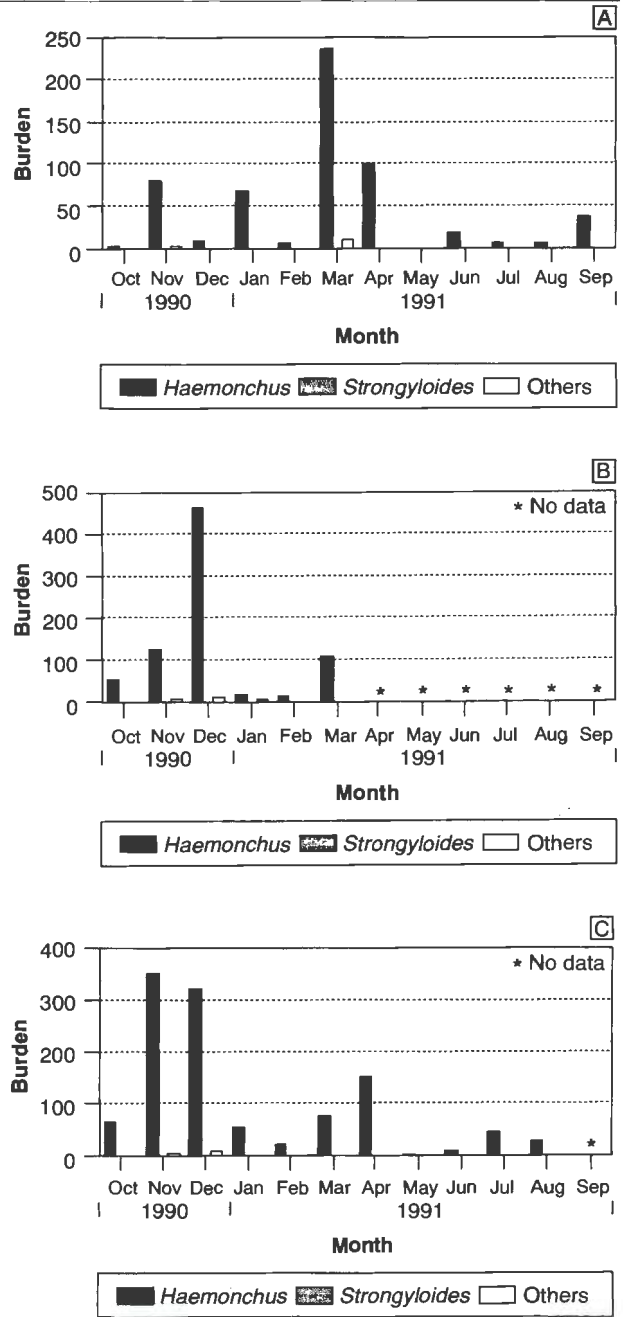


FIG. 3 The seasonal abundance of larval nematodes in (A) age group 1, (B) age group 2 and (C) age group 3 of indigenous goats on the farm "Delftzyl"

*S. papillosus* infected 95.6% of the kids and increased from a mean of 56 worms per animal during March to almost 400 during April 1991. Peak numbers were recorded during July 1991.

Although *Trichostrongylus* spp. were not recovered during the initial stages of the survey, they became more numerous from May 1991 onwards, and the largest burden of 131 worms was recovered from a goat examined during September 1991.



No *O. columbianum* were present from October to December 1990 nor during February 1991. A peak burden of 120 worms was recorded during July 1991, with between five and 60 worms being recovered during the other months. Fourth-stage larvae were present only in those goats examined during November 1990 and March 1991.

Few *Skrjabinema* spp. were recovered from the goats, the most being 145 from an animal examined during June 1991. These nematodes were more numerous during the cooler months.

#### Age group 2

One goat was infected with adult *Avitellina* spp. and another with *Moniezia benedeni*, and the larvae of *T. hydatigena* were present in seven animals.

All the goats were infected with *H. contortus*, which was the most numerous and the most prevalent nematode. *O. columbianum* was next most prevalent, followed by *S. papillosus*. *Trichostrongylus* spp. were present in 58% of the goats and the remaining nematodes in less than 35% of the animals.

Adult nematode burdens in this age group varied only slightly—from a mean of 318 during October 1991 to a mean of 468 during March 1991 (Fig. 2b). The largest burden in a single animal consisted of 506 nematodes, recovered during October 1990, and the smallest 50, from a goat examined during November 1990.

Adult *H. contortus* were present in fairly constant numbers from October 1990 to March 1991 (Fig. 2b). Fourth-stage larvae were present in peak numbers during December 1990.

Small numbers of *O. columbianum* were present each month and only two goats were not infected. Fourth-stage larvae were present during November and December 1990 and January 1991.

#### Age group 3

No adult tapeworms were recovered, but eight animals were infected with the larvae of *T. hydatigena*.

*H. contortus* was the most numerous and most prevalent nematode. *O. columbianum* was the next most numerous, followed by *S. papillosus*. Total burdens ranged from 1 099 in an animal examined during December 1990, to five in a goat examined during April 1991.

Adult *H. contortus* were present in peak numbers from December 1990 to February 1991, and 4th-stage larvae during November and December 1990.

Small numbers of *O. columbianum* were present each month except during August 1991, when none were found. Peak numbers were present during December 1990, when a mean of 70 worms per

goat was recovered. Fourth-stage larvae were present only during November and December 1990.

*Skrjabinema* spp. were recovered only during the cooler months.

*Trichostrongylus* spp. were most numerous from December 1990 to February 1991, when all three species were present. Few worms were recovered, the most being 60 from goats slaughtered during February and August 1991. During the remaining months the goats were either uninfected or infected with only one species.

With the exception of February, May and June 1991, when none were recovered, *Trichuris* spp. were present in many of the goats, the largest burden being 62 worms. No pattern of seasonal abundance was evident.

#### Arthropods

Only ixodid ticks were recovered and the species and numbers present on the goats, irrespective of age group, are summarized in Table 2.

Small numbers of nine species were present. The immature stages of *Amblyomma hebraeum* were the most prevalent and the most abundant. The greatest number of adult ticks belonged to a *Rhipicephalus* sp. (near *R. pravus*).

Despite the small numbers, patterns of seasonal abundance were evident for some of the ticks. *Boophilus decoloratus* was present from October to January and in August, the *Rhipicephalus* sp. (near *R. pravus*) from January to March and during May, and *Rhipicephalus simus* from October to January.

## DISCUSSION

### Helminths

The inverse relationship between the ages of the goats, and both the numbers of tapeworms and the number of goats infected, follow the observations of Horak *et al.* (1991c) in Angora goats and is probably due to the development of immunity (Reinecke 1983).

The larvae of *T. hydatigena* appear to accumulate in the goats as they get older. The infected kids in age group 1 harboured one larva each, and the infected goats in age groups 2 and 3, 1,43 and 1,63 larvae, respectively. This could indicate that domestic dogs and jackals on the farm, both of which are known hosts of the adult tapeworms (Verster 1969), are heavily infected, and that the larvae survive for a long time in infected animals.

*Cooperia pectinata* were probably acquired from cattle (Reinecke 1983) and *Cooperia hungi* from im-

TABLE 2 Ixodid ticks recovered from 60 female indigenous goats on the farm "Delftzyl" in the northern Transvaal

Tick species	Total number of ticks recovered					Number of animals infested
	Larvae	Nymphs	Males	Females	Total	
<i>Amblyomma hebraeum</i>	200	12	0	0	212	15
<i>Amblyomma marmoreum</i>	26	0	0	0	26	8
<i>Boophilus decoloratus</i>	36	6	4	4	50	12
<i>Haemaphysalis leachi</i>	0	0	2	2	4	2
<i>Hyalomma truncatum</i>	0	0	2	2	4	2
<i>Rhipicephalus appendiculatus</i>	0	2	0	0	2	1
<i>Rhipicephalus evertsi evertsi</i>	80	2	0	0	82	9
<i>Rhipicephalus</i> sp. (near <i>R. pravus</i> )	0	0	14	10	24	9
<i>Rhipicephalus simus</i>	0	0	10	2	12	6
TOTAL	342	22	32	20	416	35

palas (Round 1968), and as very few were found, they should be regarded as accidental parasites.

*H. contortus* was the most prevalent and most numerous nematode in all the goats examined during this survey and followed the expected pattern of summer abundance recorded in sheep in the summer rainfall areas (Horak 1978a). The recovery of small numbers of adults and 4th-stage larvae during winter suggests that arrested development does not occur to any significant degree in the region in which the survey was conducted.

*Impalaia tuberculata* is primarily a parasite of antelope (Boomker 1990) but has previously been recovered from cattle running with impala in a nature reserve in the northern Transvaal (Horak 1978c). Its occurrence in only three kids in age group 1 indicates that it is an accidental parasite.

*O. columbianum* has become a fairly rare nematode in goats and sheep in South Africa because of regular anthelmintic treatment, especially with the benzimidazoles (Reinecke 1983). The high prevalence (>50% in all three age groups) reflects the absence of anthelmintic treatment.

*Skrjabinema* spp. have been recovered in large numbers from Angora and Boer goats in the eastern Cape Province (Boomker *et al.* 1989a; Horak *et al.* 1991c). These are reputedly non-pathogenic nematodes about which little is known (Reinecke 1983). Their presence in small numbers in this survey possibly reflects the unsuitability of the environment rather than the insusceptibility of the hosts.

Like the tapeworms, *S. papillosus* also appears to infect mainly younger ruminants (Reinecke 1983). It is generally more numerous during winter and should be regarded as a definitive parasite of indigenous goats.

*Trichostrongylus deflexus* is a parasite of a variety of antelope (Boomker 1990) and fills the niche in these hosts occupied by *Trichostrongylus colubriformis* in sheep. It was not recovered from age group 1, but occurred in almost equal numbers in age groups 2 and 3. On the other hand, *T. colubriformis* was present in larger numbers in age group 1 than in age group 3, and was not found in age group 2, probably because no goats of this group were examined during the cooler months. Although present country-wide, *Trichostrongylus falculatus* is found mainly in the more arid regions, where it infects a number of domestic and wild ruminants (Horak 1981).

The presence of the *Trichostrongylus* spp. in such small numbers implies that either the environment is unsuitable for the free-living stages or that indigenous goats are less susceptible to infection. Horak (1978a) also recovered only small numbers of *Trichostrongylus* spp. from sheep on dry-land pastures in the eastern Transvaal. He did, however, recover larger numbers from impalas on a nature reserve close to "Delftzyl" (Horak 1978b).

The increase in the total nematode burdens of the indigenous goat kids from 1–12 months of age is similar to that noted in Angora goat kids in the eastern Cape Province (Horak *et al.* 1991c) and impala lambs on a nature reserve close to the present study site (Horak 1978b). The low burdens in the very young kids probably result from a diet consisting mainly of milk and only small amounts of vegetation containing infective larvae.

#### Ixodid ticks

The immature stages of *A. hebraeum* infest a large number of large and small host species, including goats, while the adults prefer very large animals (Horak, MacIvor, Petney & De Vos 1987a). Rechav & De

Jager (1991) recovered fairly large numbers of adult ticks from indigenous goats in the north-western Transvaal, while Horak *et al.* (1991c) recovered a few from Angora goats in Valley Bushveld in the eastern Cape Province on a farm where regular tick control was practised.

Even though the larvae of *Amblyomma marmoreum* may also infest a large variety of large and small hosts (Horak *et al.* 1987a), all stages of development prefer the mountain tortoise (Dower, Petney & Horak 1988). Fairly large numbers of larvae have been recovered from Angora goats in Valley Bushveld (Horak *et al.* 1991c).

The preferred hosts of *B. decoloratus* are domestic cattle and kudu (Baker & Ducasse 1967; Horak *et al.* 1992). Goats and sheep can also be infested but do not appear to be very efficient hosts (Rechav & De Jager 1991; Horak, Williams & Van Schalkwyk 1991a). On sheep and kudu the largest numbers of this tick are present in early summer (Horak *et al.* 1991a, 1992), a finding confirmed in the present study.

The *Haemaphysalis leachi* recovered from the goats probably originated from the dogs or jackals on the farm. The immature stages of this tick have previously been recovered from Angora goats (Fivaz *et al.* 1990; Horak *et al.* 1991c).

The small numbers of *Hyalomma truncatum* are probably more a reflection of the unsuitability of the habitat than of the indigenous goat as a host. Larger numbers have been recovered from goats in a more favourable habitat in the south-western Orange Free State (Fourie & Horak 1991).

Rechav & De Jager (1991) and Horak *et al.* (1991c) have recovered both immature and adult *Rhipicephalus appendiculatus* from indigenous and Angora goats. The total of two nymphs on only a single goat in the present survey probably reflects the unsuitability of the particular habitat for this tick.

Adult *Rhipicephalus evertsi evertsi* have been recovered from indigenous goats in the north-western Transvaal (Rechav & De Jager 1991), but in the present survey only immature ticks were recovered. Zebras and eland are the preferred hosts of all stages of development of this tick (Horak, Fourie, Novellie & Williams 1991b), and sheep can harbour fairly large numbers of adults (Horak *et al.* 1991a).

All stages of development of the *Rhipicephalus* sp. (near *R. pravus*) have recently been recovered from scrub hares in the north-western and north-eastern Transvaal (Horak, Spickett, Braack & Penzhorn 1993), while goats seem to harbour only the adult stages. Angora goats are a preferred host of the adults of a closely related species, *Rhipicephalus punctatus*, in the south-western Orange Free State (Fourie & Horak 1991).

The preferred hosts for adult *Rhipicephalus simus* are monogastric animals such as zebras, carnivores and warthogs (Horak, De Vos & De Klerk 1984; Horak, Jacot Guillarmod, Moolman & De Vos, 1987b; Horak, Boomker, De Vos & Potgieter 1988), but cattle and sheep can also be infested (Horak 1982; Horak *et al.* 1991a). The early to mid-summer abundance on the goats in the present study is earlier than that observed on most other host species on which the ticks are most numerous in late summer.

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