

PARASITES OF DOMESTIC AND WILD ANIMALS IN SOUTH AFRICA. XXVIII. HELMINTH AND ARTHROPOD PARASITES OF ANGORA GOATS AND KIDS IN VALLEY BUSHVELD

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ABSTRACT

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Two adult Angora goats were slaughtered each month for 24 consecutive months on a farm in Valley Bushveld in the eastern Cape Province. On the same farm 2 Angora goat kids were slaughtered each month for 2 consecutive years from the time they were 1 week old until they reached 12 months of age. All these goats were processed for the recovery of helminth and arthropod parasites.

Fourteen nematode species, 2 nematode genera and 1 cestode species were recovered. Worm burdens were generally low in the adult goats. Nematode burdens increased erratically in the kids reaching the greatest numbers when they were 1 year old. The tapeworm, *Moniezia expansa*, was present in kids at 3 or 4 months of age and had usually disappeared by the time they reached 7 months of age.

The goats harboured 12 species of ixodid ticks, 1 louse species and the larvae of an oestrid fly. The seasonal abundances of 4 of the tick species were determined.

INTRODUCTION

Angora goats are farmed extensively in the Karoo and Valley Bushveld regions of the eastern Cape Province. They are mainly browsers (Aucamp, 1979), but will graze when placed on artificial pastures.

A number of studies on the parasites of these animals in the Valley Bushveld have already been published. Horak (1987a) and Boomker, Horak & MacIvor (1989) have examined the internal parasites, MacIvor & Horak (1984), Horak (1987b) and Fivaz, Horak & Williams (1990) have reported on both the helminth and arthropod parasites, and Rechav (1982), Horak & Knight (1986) and MacIvor & Horak (1987) on the ticks infesting Angora goats. Horak (1987b) and Fivaz *et al.* (1990) have also recorded the parasite burdens of kids from 1 week to 5 or 6 months of age. The research of Fivaz *et al.* (1990) was conducted on goats grazing irrigated Kikuyu grass pastures on a farm in the Valley Bushveld region, while the other surveys were done on goats browsing natural vegetation in this region.

Numerous surveys of parasites of domestic and wild animals have already been conducted on the farm "Bucklands", the locality of the present survey. These include kudu (Knight & Rechav, 1978; Boomker, Horak & Knight, 1991), Angora goats and cattle (Rechav, 1982), Dorper sheep, Angora goats, cattle, kudu, scrub hares and helmeted guineafowls (Horak & Knight, 1986), scrub hares (Horak & MacIvor, 1987), cattle (MacIvor & Horak, 1987), Angora goat kids (Horak, 1987b), Dorper sheep (Horak, Williams & Van Schalkwyk, 1991) and helmeted guineafowls (Horak, Spickett, Braack & Williams, 1991). Two studies on the seasonal abundance of free-living tick larvae have also been conducted on the farm (Rechav, 1982; Petney & Horak, 1987).

The present paper records the abundance of nematode and arthropod parasites of adult Angora goats slaughtered at monthly intervals over a 24 month period on the farm "Bucklands". It also describes the parasite burdens of Angora goat kids from the time they were 1 week of age until they

were 12 months old, during 2 consecutive years. The results presented in this paper are a direct extension of those reported by Horak & Knight (1986) and Horak (1987a,b).

MATERIALS AND METHODS

Study site

The farm "Bucklands" (33° 06' S, 26° 41' E) is 5 480 ha in extent and is situated 28 km north-east of Grahamstown in the eastern Cape Province. The vegetation is classified as Valley Bushveld (Acocks, 1988). A more detailed description of it has been given by Rechav (1982). At the time of the survey there were approximately 185 cattle, 300 Dorper sheep, 4 000 Angora goats and 300 free-ranging kudu on the farm.

Survey animals

Two 4–6 year old Angora goats, that had not been treated with an anthelmintic or an acaricide during the preceding 3 months, and which ran with a flock of adult Angora goats, were slaughtered at monthly intervals from February 1985 to January 1987. Except for August 1988 when no kids were slaughtered, 2 Angora goat kids, born during September of 2 consecutive years (1986 and 1987), were slaughtered at approximately monthly intervals from the time they were 1 week old until they were 12 months of age. These kids ran with their dams until weaning and thereafter with goats of their own age. With the exception of the kids born during September 1986, which were accidentally treated with a cestocide during January 1987 and with a nematocide in April 1987, no other antiparasitic treatments were administered.

Parasite recovery

The lungs, liver, abomasum, small intestine and large intestine of each goat were processed for helminth recovery as described by Boomker *et al.* (1989). Two aliquots, each representing $\frac{1}{50}$ th of the volume of the ingesta of the latter 3 organs, were made. These aliquots and the other material were examined under a stereoscopic microscope and the worms counted. Adult worms and larvae were collected, cleared in lactophenol and identified under a standard microscope.

The skins of the goats were processed for ectoparasite recovery as described by Horak, Meltzer &

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TABLE 1 Helminths recovered from 48 adult Angora goats on the farm "Bucklands" in Valley Bushveld

Helminth species	Total numbers of worms recovered			Number of animals infected
	4th stage	Adults	Total	
<i>Cooperia pectinata</i>	0	700	700	7
<i>Haemonchus contortus</i>	0	1 277	1 277	19
<i>Nematodirus spathiger</i>	1 767	4 092	5 859	31
<i>Oesophagostomum venulosum</i>	0	126	126	19
<i>Skrjabinema</i> sp.	49 825 (all stages)	—	49 825	45
<i>Strongyloides papillosus</i>	25	10 525	10 550	37
<i>Ostertagia/Teladorsagia</i> spp.	636	—	636	18
<i>Ostertagia ostertagi</i>	—	5	5	1
<i>Teladorsagia circumcincta</i>	—	16 277	16 277	47
<i>Teladorsagia trifurcata</i>	—	160	160	3
<i>Trichostrongylus</i> spp.	87	—	87	5
<i>Trichostrongylus axei</i>	—	5 370	5 370	35
<i>Trichostrongylus colubriformis</i>	—	125	125	2
<i>Trichostrongylus pietersei</i>	—	764	764	10
<i>Trichostrongylus rugatus</i>	—	73 944	73 944	46
<i>Trichuris</i> sp.	0	6	6	4

TABLE 2 Helminths recovered from 50 Angora goat kids on the farm "Bucklands" in Valley Bushveld

Helminth species	Total numbers of worms recovered			Number of animals infected
	4th stage	Adults	Total	
<i>Cooperia</i> spp.	25	—	25	1
<i>Cooperia pectinata</i>	—	375	375	7
<i>Cooperia punctata</i>	—	150	150	1
<i>Haemonchus contortus</i>	0	202	202	12
<i>Nematodirus helvetianus</i>	0	25	25	1
<i>Nematodirus spathiger</i>	1 100	3 825	4 925	21
<i>Oesophagostomum venulosum</i>	0	132	132	18
<i>Skrjabinema</i> sp.	47 825 (all stages)	—	47 825	31
<i>Strongyloides papillosus</i>	0	5 400	5 400	27
<i>Teladorsagia circumcincta</i>	25	901	926	9
<i>Trichostrongylus</i> spp.	5 985	—	5 985	10
<i>Trichostrongylus axei</i>	—	3 870	3 870	25
<i>Trichostrongylus pietersei</i>	—	325	325	10
<i>Trichostrongylus rugatus</i>	—	40 085	40 085	28
<i>Trichuris</i> sp.	0	159	159	30
Cestodes		Scolecex	Total	
<i>Moniezia expansa</i>		48	48	13

De Vos (1982). The processed material was examined under a stereoscopic microscope and the arthropods collected, identified and counted.

Oestrid fly larvae were collected from the nasal passages and sinuses as described by Malan, Reinecke & Scialdo (1981).

RESULTS

Helminths

The total numbers of helminths recovered from the 48 adult goats examined on "Bucklands" are summarized in Table 1.

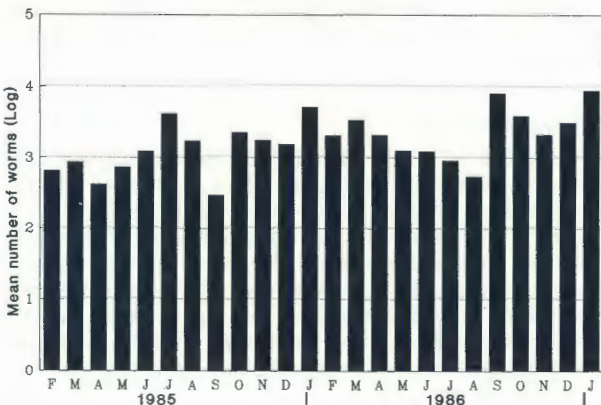


FIG. 1 The seasonal abundance of nematodes in adult Angora goats on the farm "Bucklands" in Valley Bushveld

Twelve species of nematodes and 2 nematode genera were recovered, of these *Trichostrongylus rugatus* followed by *Skrjabinema* sp. were the most abundant. The most prevalent worms were *Teladorsagia circumcincta* followed by *Trichostrongylus rugatus*.

Excluding the *Skrjabinema* sp., the monthly mean total numbers of nematodes recovered are graphically presented in Fig. 1.

In the first year of the survey, the 6 months during which goats had the highest burdens were July, August and October 1985 to January 1986, in the second year these months were March and Septem-

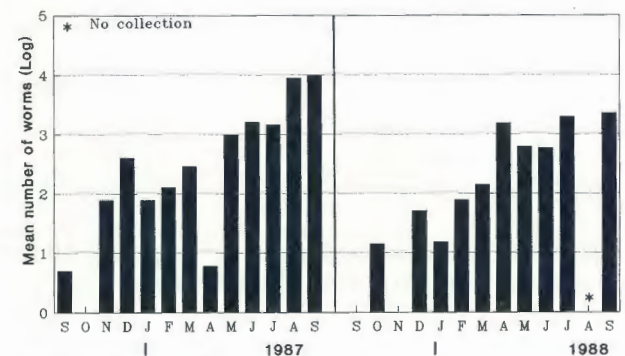


FIG. 2 Helminth infection in consecutive annual crops of Angora goat kids from 1 week to 12 months of age on the farm "Bucklands" in Valley Bushveld

TABLE 3 Ectoparasites recovered from 48 adult Angora goats on the farm "Bucklands" in Valley Bushveld

Ectoparasite species	Total No. of ectoparasites recovered					Number of animals infested
	Larvae	Nymphs	Males	Females	Total	
<i>Ixodid ticks</i>						
<i>Amblyomma hebraeum</i>	156	80	8	8	252	25
<i>Amblyomma marmoreum</i>	523	24	0	0	547	26
<i>Boophilus decoloratus</i>	22	0	0	6 (4)	28	5
<i>Haemaphysalis leachi</i>	2	0	0	0	2	1
<i>Haemaphysalis silacea</i>	1 253	299	38	12 (6)	1 602	43
<i>Hyalomma marginatum rufipes</i>	0	0	1	0	1	1
<i>Ixodes pilosus</i>	2	2	0	0	4	1
<i>Rhipicephalus appendiculatus</i>	1 710	248	20	40 (2)	2 018	40
<i>Rhipicephalus evertsi evertsi</i>	160	8	3	0	171	18
<i>Rhipicephalus glabroscutatum</i>	1 886	808	243	134 (16)	3 071	46
<i>Rhipicephalus sp. (near R. oculatus)</i>	0	0	6	2	8	3
<i>Rhipicephalus simus</i>	0	0	0	2	2	1
Lice	Nymphs		Adults		Total	
<i>Damalinea limbata</i>	63 619		68 092		131 711	48
Oestrid fly larvae	1st stage		2nd stage		3rd stage	Total
<i>Oestrus ovis</i>	87		27		33	147

() = Number of maturing females, i.e. idiosoma of *B. decoloratus* > 4,0 mm; *H. silacea* > 5,0 mm; *R. appendiculatus* > 5,0 mm, and *R. glabroscutatum* > 4,5 mm in length. Females of the other tick species had not started maturing.

TABLE 4 Ectoparasites recovered from 50 Angora goat kids on the farm "Bucklands" in Valley Bushveld

Ectoparasite species	Total No. of ectoparasites recovered					Number of animals infested
	Larvae	Nymphs	Males	Females	Total	
<i>Ixodid ticks</i>						
<i>Amblyomma hebraeum</i>	32	49	2	0	83	20
<i>Amblyomma marmoreum</i>	92	34	0	0	126	24
<i>Boophilus decoloratus</i>	4	0	0	0	4	2
<i>Haemaphysalis leachi</i>	90	0	0	0	90	10
<i>Haemaphysalis silacea</i>	1 355	582	32	24 (14)	1 993	46
<i>Ixodes pilosus</i>	16	2	0	0	18	2
<i>Rhipicephalus appendiculatus</i>	2 154	1 051	20	40 (8)	3 265	42
<i>Rhipicephalus evertsi evertsi</i>	16	12	3	2	33	11
<i>Rhipicephalus glabroscutatum</i>	1 047	241	96	104 (16)	1 488	45
<i>Rhipicephalus simus</i>	0	0	2	6	8	3
Lice	Nymphs		Adults		Total	
<i>Damalinea limbata</i>	131 540		84 501		216 041	49
Oestrid fly larvae	1st stage		2nd stage		3rd stage	Total
<i>Oestrus ovis</i>	75		12		10	97

() = Number of maturing females, i.e. idiosoma of *H. silacea* > 5,0 mm; *R. appendiculatus* > 5,0 mm, and *R. glabroscutatum* > 4,5 mm in length. Females of the other tick species had not started to mature.

ber 1986 to January 1987. However, the differences in the magnitude of the worm burdens were not statistically significant (t test, $P = 0,05$).

The total numbers of helminths recovered from the 50 goat kids are summarized in Table 2.

Thirteen nematode species were recovered and *Skrjabinema* sp. followed by *Trichostrongylus rugatus* were the most abundant and *Skrjabinema* sp. and *Trichuris* sp. the most prevalent. Thirteen of the kids were infected with *Moniezia expansa*.

Excluding the *Skrjabinema* sp., the monthly nematode burdens of the kids are illustrated in Fig. 2.

No worms were recovered during October from the 1986 crop of kids and during September and November from the 1987 crop of kids. In both years infection increased erratically but steadily reaching the highest levels when the kids were 12 months old. The final worm burden (September 1987) was significantly higher (t test, $P = 0,05$) in the first crop of kids than in the second (September 1988).

Both kids of the 1986 crop examined during January 1987 were infected with *M. expansa*. The remaining kids of that crop were thereafter acciden-

tally treated with a cestocide. Two kids each harboured 1 cestode later in the survey. All the kids examined of the next year's crop were infected with *M. expansa* from December 1987 to February 1988 as well as 1 each during March, April and July 1988.

Arthropods

The total numbers of ectoparasites recovered from the adult goats are summarized in Table 3.

The goats were infested with 12 species of ixodid ticks, of which *Rhipicephalus glabroscutatum* was the most abundant and prevalent. They were also all infested with *Damalinea limbata* and less than half with the larvae of *Oestrus ovis*.

The arthropod parasites recovered from the kids are summarized in Table 4.

The kids were infested with 10 ixodid tick species of which *Rhipicephalus appendiculatus* was the most abundant and *Haemaphysalis silacea* the most prevalent. With 1 exception they were all infested with *D. limbata* and 18 harboured the larvae of *O. ovis*.

Only *Amblyomma marmoreum*, *H. silacea*, *R. appendiculatus* and *R. glabroscutatum* exhibited

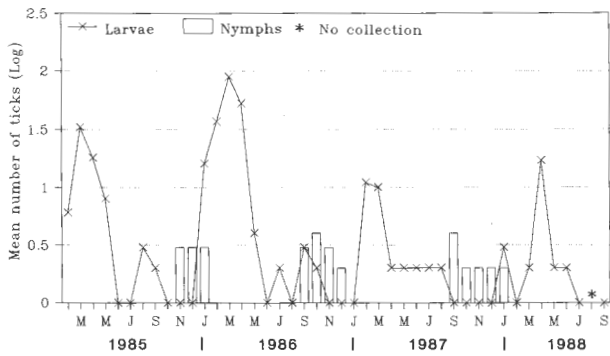


FIG 3 The seasonal abundance of *Amblyomma marmoreum* on Angora goats and kids on the farm "Bucklands" in Valley Bushveld

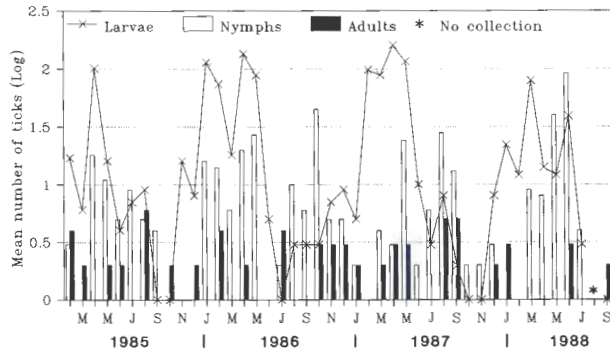


FIG 4 The seasonal abundance of *Haemaphysalis silacea* on Angora goats and kids on the farm "Bucklands" in Valley Bushveld

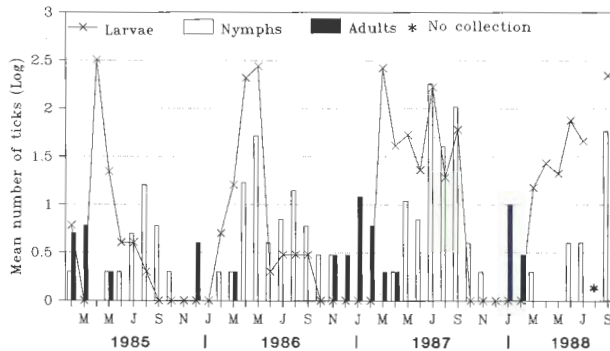


FIG 5 The seasonal abundance of *Rhipicephalus appendiculatus* on Angora goats and kids on the farm "Bucklands" in Valley Bushveld

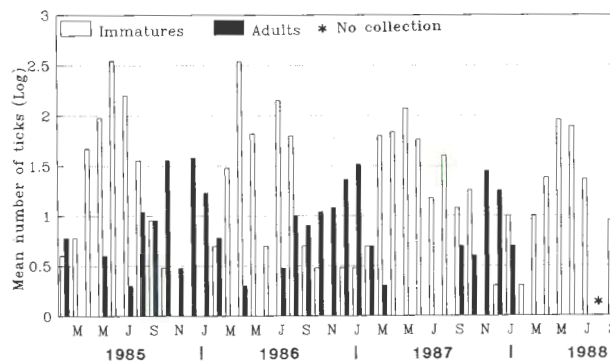


FIG 6 The seasonal abundance of *Rhipicephalus glabroscutatum* on Angora goats and kids on the farm "Bucklands" in Valley Bushveld

clear patterns of seasonal abundance on both the goats and the kids and these are illustrated in Fig. 3-6.

Comment: Slaughtering of adult goats and kids overlapped from September 1986 to January 1987. The tick burdens of the adult goats alone are illustrated in the figures from February 1985 to August 1986, those of the adults and kids combined from September 1986 to January 1987, and those of the kids alone from February 1987 until the end of the survey in September 1988.

The larvae of *A. marmoreum* were usually present in the largest numbers from February to April and the nymphs during the period September to January. The larvae of *H. silacea* were generally most abundant from January to June and the nymphs erratically from around March to September. *R. appendiculatus* larvae were present from about March to September and the nymphs from about April or May till September. The largest numbers of adults were present during January and February. The larvae and nymphs of the 2-host tick, *R. glabroscutatum* have been combined and were most abundant from February or March to August or September and the adults from about September to February.

DISCUSSION

Helminths

The nematode burdens are low considering that the adult goats were only occasionally treated with an anthelmintic while 1 crop of kids was treated twice and the other never. The reasons for this are probably three-fold. Firstly the climate of the Valley Bushveld is harsh, adversely affecting the survival of the free-living stages, secondly ground cover and hence protection for the free-living larvae in the form of grass is sparse, and thirdly Angora goats are mainly browsers and because of this they generally feed above ground level and thus do not ingest many infective larvae.

Boomker *et al.* (1989) recovered 8 nematode species and 2 nematode genera from adult Angora goats on the farm "Brakhill" in Valley Bushveld near Uitenhage in the eastern Cape Province. Excluding *Skrjabinema* sp. they recorded mean burdens of 595 worms. They also recovered 12 nematode species, 2 nematode genera and mean burdens of 1 170 worms from Boer goats on the same farm. The mean burden of 2 414 worms, excluding *Skrjabinema* sp., recovered from the adult goats in the present survey probably indicates a milder climate, greater ground cover and more grazing at "Bucklands". Nine species of nematodes and two nematode genera were common to the goats at the 2 localities.

Excluding *Cooperia pectinata*, *Cooperia punctata*, *Nematodirus helvetianus* and *Ostertagia ostertagi*, which are normally parasites of cattle, all the helminths harboured by the goats at "Bucklands" are definitive parasites of goats and sheep. Kudu examined on the farm at the same time were infected only with a race of *Cooperia rotundispiculum* (Boomker *et al.*, 1991), but no cross-infection to the goats apparently took place.

Seasonal abundance

At "Brakhill" Boomker *et al.* (1989) recorded increases in the abundance of helminths in goats from August or September to January or February. This

corresponds with the period September or October to January observed in the present survey. They suggested that these increases could be due to a rise in temperature coupled with rainfall during spring, causing the grass to sprout and the goats to graze, rather than browse, and hence ingest more infective larvae. Similar arguments could support the increase in infection in the adult goats at "Bucklands" during spring.

The kids were born during September of each year, but showed no real increase in infection until April or May of the following year. Their small worm burdens during the first few months of their lives, at a time when infective larvae were available, judging by the burdens of the older goats, could be due to the fact that the major portion of their diet consisted of milk. Fivaz *et al.* (1990), determined the worm burdens of Angora goat kids at approximately monthly intervals from birth to 5 months of age on irrigated Kikuyu grass pastures on the farm "Kranzdrift", which is located close to "Bucklands" in Valley Bushveld. These kids also failed to acquire significant infections before they were 3 months old.

The kids on "Bucklands" must, however, have been doing some grazing by December or January as they had ingested the intermediate host of *M. expansa*. It was only when they were 12 months old, in September of the following year, that they exhibited peak nematode burdens, thus confirming the availability of infection at this time. The acquisition of infection by the kids is not unlike that recorded for free-ranging impala lambs in the northern Transvaal (Horak, 1978). These animals, which are generally born during November and December, also harboured the largest nematode burdens at 12 months of age.

There was no evidence of seasonally arrested larval development in the kids or adult goats, a phenomenon also noted by Boomker *et al.* (1989). They ascribed this to the relatively mild winters experienced in the Valley Bushveld and hence no necessity for nematodes to overwinter in the host animal. The increases in the nematode burdens of the animals during spring were thus not a consequence of the maturation of arrested overwintering larvae.

Cooperia spp.

The presence of these worms in the goats was probably the result of cross-infection from cattle on the farm.

Haemonchus contortus

Very few worms were recovered from any of the goats or from young Dorper sheep examined at the same time (Horak, 1987a). The Valley Bushveld thus appears to be an unsuitable habitat for this nematode, a fact supported by the findings of Boomker *et al.* (1989). Fivaz *et al.* (1990), who examined Angora yearlings and kids on irrigated pastures on "Kranzdrift" close to "Bucklands", also recovered very few *H. contortus*.

Nematodirus spp.

The *N. helvetianus* infection probably resulted from cross-infection from cattle on the farm. *Nematodirus spathiger*, although widespread in South Africa, is particularly common along the coast of the Cape Province and the adjacent inland regions (Horak, 1981). It is resistant to adverse conditions because development to the infective stage takes place within the egg (Reinecke, 1983), hence its abil-

ity to survive in the Valley Bushveld. The burdens of the adult goats and kids did not appear to differ substantially although slightly more larvae were recovered in the older animals.

Oesophagostomum venulosum

The geographic distribution of this nematode is limited to the south-eastern, southern and south-western Cape Province (Horak, 1987a; Reinecke, Kirkpatrick, Swart, Kriel & Frank, 1987). The Valley Bushveld regions of the eastern Cape Province seem to be at the limits of its distributional range and hence the small number of worms recovered, as also recorded by Boomker *et al.* (1989).

Ostertagia and Teladorsagia spp.

The *O. ostertagi* infection probably resulted from cross-infection from cattle.

Teladorsagia circumcincta generally prefers a temperate climate with high rainfall (Levine, 1980; Reinecke, 1983). Its recovery as one of the major parasites of the adult goats in the present survey, conducted in a region with comparatively low rainfall and very high summer temperatures, is surprising. In the kids it can be considered a minor parasite indicating a difference in either the method or timing or age of infection between the 2 age groups of goats. On the irrigated pastures of "Kranzdrift", *Teladorsagia circumcincta* was a major parasite of both kids and yearling Angora goats and no *Teladorsagia trifurcata* were recovered (Fivaz *et al.* 1990).

On the farm "Brakhill" Boomker *et al.* (1989) recovered no *Teladorsagia trifurcata* from Angora goats while 25 % of Boer goats were infected. In the present study *Teladorsagia trifurcata* accounted for less than 1 % of the total adult *Teladorsagia* burden of the adult goats. The kids harboured no *Teladorsagia trifurcata*. If *Teladorsagia circumcincta* and *Teladorsagia trifurcata* conform to the concept of major and minor species, as described by Lichtenfels, Pilitt & Lancaster (1988), Angora goats appear to be particularly poor hosts of the minor species *Teladorsagia trifurcata*.

Skrjabinema sp.

No specific identification was made of this nematode, which may commonly be encountered in grazing antelope species and in goats as discussed by Boomker *et al.* (1989). It has been excluded from the determination of total worm burdens, as well as of seasonal abundance, because of its different type of life cycle and apparent non-pathogenicity (Reinecke, 1983).

Strongyloides papillosus

The majority of kids and adult goats were infected, differing markedly from the findings of Boomker *et al.* (1989) on "Brakhill" and Fivaz *et al.* (1990) on "Kranzdrift" where none of the goats were infected. The absence of infection in the kids until they reached 3 months of age in the present survey, seems to discount a milk-borne infection as described by Moncol & Grice (1974).

Trichostrongylus spp.

Trichostrongylus axei is a parasite of domestic livestock (Levine, 1980; Reinecke, 1983) that may compete with *H. contortus* or *Teladorsagia circumcincta* for space in the abomasa of sheep (Reinecke, 1977). This may have happened on the irrigated pastures of "Kranzdrift" where large numbers of *Teladorsagia circumcincta* were recovered but no

Trichostrongylus axei (Fivaz *et al.*, 1990). In the present survey moderate numbers of both the latter worms were present.

Trichostrongylus colubriformis appears to be a parasite more of sheep than of goats and seems to prefer more temperate climates than the Valley Bushveld (Horak, 1981).

Trichostrongylus pietersei was originally described from sheep and Angora goats in the Karoo (Le Roux, 1932), but it seems to prefer the milder climate of the coastal regions of the eastern and southern Cape Province (Rossiter, 1964; Muller, 1968). Small numbers only were encountered in the adult goats and kids on "Bucklands".

Trichostrongylus rugatus must be considered as one of the dominant species in goats and sheep in the eastern Karoo and eastern, southern and south-western Cape Province (Viljoen, 1964; Barrow, 1964; Rossiter, 1964; Horak, 1987a; Reinecke *et al.*, 1987; Boomker *et al.*, 1989). Its dominance may even be enhanced on irrigated pastures in the Valley Bushveld, where it and *Teladorsagia circumcincta* have caused the death of kids and yearling Angora goats (Fivaz *et al.*, 1990).

Trichuris sp.

No specific identification of the *Trichuris* sp. recovered was made. The fact that the majority of kids were infected and few of the adult goats, may indicate that older animals develop a degree of resistance.

Moniezia expansa

This was the only cestode recovered. It appeared during December or January when the kids were 3 or 4 months old and disappeared in May. The kids of the 1986 crop were unfortunately treated with a cestocide towards the end of January 1987, and but for the 2 kids examined in January and some much later in the year, no other kids of this crop were infected. This seemed to indicate that infection was acquired only in December or January and that the cestodes recovered from February to April in the kids examined during 1988 had actually survived from the December and January infections. The spontaneous disappearance of *Moniezia benedeni* with increasing age of the host has also been recorded in blue wildebeest calves (Horak, De Vos & Brown, 1983).

Arthropods

The total tick burdens of the goats were probably lower than could be expected because of the regular treatment of the other livestock on the farm with an acaricide, thus reducing the number of ticks questing for hosts from the ground or from the vegetation. Some species were more drastically affected than others and this will be dealt with later. Whereas the individual nematode species did not exhibit clear patterns of seasonal abundance, some of the ticks did.

While nematode burdens increased with the age of the kids, this did not occur with the ticks. The kids were born at a time of low tick infestation, as evidenced by the burdens of the adult goats. Thereafter their burdens fluctuated seasonally in the same manner as did those of the older animals and have been included on the same graphs.

Amblyomma hebraeum

This tick was the most severely affected by the acaricidal treatment applied to the other domestic

livestock on the farm. Free-ranging kudu, scrub hares and helmeted guineafowls on the farm harboured total mean burdens of this tick of 19, less than 1 and 36 respectively. The same animal species on the adjacent Andries Vosloo Kudu Reserve, where no acaricidal treatment was applied, harboured 1 318, 53 and 464 ticks respectively (Horak & Knight, 1986). Not only were the numbers of parasitic ticks affected, but the numbers of free-living larvae on the vegetation were also drastically reduced on the farm compared with the reserve (Petney & Horak, 1987).

The small numbers of ticks recovered made it impossible to determine their seasonal abundance on the goats.

Amblyomma marmoreum

The adults of this tick prefer tortoises as hosts (Theiler, 1962; Norval, 1975), while the immature stages can be found on tortoises as well as many other animals (Dower, Petney & Horak, 1988; Horak, MacIvor, Petney & De Vos, 1987). Their presence on the goats is thus not unusual, and their seasonal abundance is similar to that described by Fivaz *et al.* (1990) and Horak, Williams & Van Schalkwyk (1991) on goats and sheep in the eastern Cape Province.

Boophilus decoloratus

This tick appears to be rare in the Valley Bushveld regions of the eastern Cape Province (Knight & Rechav, 1978; Rechav, 1982; Horak & Knight, 1986). The small numbers presently recovered confirm this.

Haemaphysalis leachi

The immature stages prefer rodents (Hussein & Mustafa, 1985) and the adults carnivores (Norval 1984; Horak, Jacot Guillarmod, Moolman & De Vos, 1987). The larvae recovered on the goats must be considered accidental infestations. The larger numbers on the kids are probably a reflection of the fact that they were kept closer to human habitation and were thus more likely to be exposed to dogs and the offspring of their ticks.

Haemaphysalis silacea

This tick is common in the Valley Bushveld regions (Howell, Walker & Nevill, 1978). It has a wide host range including goats, sheep, cattle, kudu and helmeted guineafowls. (Knight & Rechav, 1978; Rechav, 1982; Horak & Knight, 1986). The seasonal abundance of the immature stages on the goats was not unlike that on kudu from the same farm (Knight & Rechav, 1978).

Rhipicephalus appendiculatus

Horak, Williams & Van Schalkwyk (1991) have discussed the distributional boundaries of this tick in the eastern Cape Province. The farm "Bucklands" is situated fairly close to the south-western limit of its distribution, which lies approximately 50 km to the west.

Goats are better hosts of adult *R. appendiculatus* than are sheep (Horak & Knight, 1986), their longer ears probably affording better attachment sites. On both the adult goats and the kids, female ticks considerably outnumbered males, an unusual occurrence for this species (Kaiser, Sutherst & Bourne, 1982). The seasonal abundance on the goats is similar to that described for kudu and Angora goats on "Bucklands" (Knight & Rechav, 1978; Rechav, 1982).

Rhipicephalus glabroscutatum

The geographical distribution of this tick in the eastern Karoo and eastern Cape Province has been described by MacIvor (1985). Its original hosts were probably eland, kudu, bushbuck, mountain reedbuck and common duiker (MacIvor & Horak, 1987; Horak, Fourie, Novellie & Williams, 1991), but it now also attaches to the feet and lower limbs of goats, sheep and cattle (Horak & Knight, 1986). On goats the adults, with those of *A. hebraeum*, are a contributing cause to the development of lameness and foot abscesses (MacIvor & Horak, 1987).

The seasonal abundance of the immature and adult stages corresponds closely to that already described on several host species (MacIvor & Horak, 1987; Horak, Fourie, Novellie & Williams, 1991).

Rhipicephalus sp. (near R. oculatus)

This tick is fairly common in the Valley Bushveld regions of the eastern Cape Province, where in addition to Angora goats, adults may be found on sheep, cattle, kudu and scrub hares (Horak & Knight, 1986).

Other ixodid ticks

The small numbers of other species recovered are more a reflection of the geographic limits of distribution of these ticks rather than the suitability of Angora goats as hosts.

Damalinea limbata

This is the most commonly encountered biting louse of Angora goats in the eastern Karoo and the eastern Cape Province. In the present survey it was the most prevalent and abundant of all the parasites recovered. The kids were already infested by 1 week of age. Individual burdens fluctuated considerably and no clear pattern of seasonal abundance could be established.

Oestrus ovis

This fly is widespread in South Africa and close to 74 % of sheep and goats are infested with its larvae (Horak, 1977; Horak & Butt, 1977). Although the prevalence of infestation in the 2 hosts is the same, sheep harbour greater numbers of larvae than do goats (Horak 1977; Horak & Butt, 1977). In the present survey both sets of kids born in consecutive years became infested for the first time during December when they were 3 months old. Although a smaller proportion of kids (36 %) than adult goats (48 %) was infested the mean total burdens of infested kids and goats were reasonably similar (5.4 and 6.4 larvae respectively). Horak & Butt (1977) recovered a mean burden of 4.4 larvae from goats slaughtered at the Johannesburg Municipal Abattoir. The goats' habit of sneezing and snorting probably dislodges many larvae, thus accounting for their smaller burdens when compared with those of sheep. This may, however, also be due to better fly avoidance behaviour of the goats.

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