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PARASITES OF DOMESTIC AND WILD ANIMALS IN SOUTH AFRICA. XIII. THE SEASONAL INCIDENCE OF ADULT TICKS (ACARINA: IXODIDAE) ON CATTLE IN THE NORTHERN TRANSVAAL*

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ABSTRACT

LONDT, J. G. H., HORAK, I. G. & DE VILLIERS, I. L., 1979. Parasites of domestic and wild animals in South Africa. XIII. The seasonal incidence of adult ticks (Acarina: Ixodidae) on cattle in the northern Transvaal. *Onderstepoort Journal of Veterinary Research*, 46, 31–39 (1979).

Ticks were collected over a period of 13 months, at approximately fortnightly intervals, from 6 Africaner oxen kept on the farm Nylsvley in the Naboomspruit District. The 8 species of Ixodidae collected were, in order of abundance, *Rhipicephalus appendiculatus*, *R. evertsi evertsi*, *Hyalomma marginatum rufipes*, *H. truncatum*, *Amblyomma hebraeum*, *R. simus*, *Boophilus decoloratus* and *Ixodes cavipalpus*. The relative abundance of adult ticks of these species, their predilection feeding sites and seasonal fluctuations in numbers are discussed.

Résumé

PARASITES DES ANIMAUX DOMESTIQUES ET SAUVAGES EN AFRIQUE DU SUD. XIII. FREQUENCE SAISONNIÈRE DE TIQUES ADULTES (ACARINA: IXODIDAE) SUR GROS BÉTAIL DANS LE NORD DU TRANSVAAL

On a récolté, sur un laps de temps de 13 *mois et avec une périodicité approximativement bimensuelle, les tiques de* 6 *têtes de bétail Afrikander à la ferme de Nylsvley dans le district de Naboomspruit. Dans l'ordre d'abondance, les* 8 *espèces d'Ixodidés qui ont été récoltées de la sorte sont:* Rhipicephalus appendiculatus, R. evertsi evertsi, R. simus, Hyalomma marginatum rufipes, H. truncatum, Amblyomma hebraeum, Boophilus decoloratus *et* Ixodes cavipalpus. *On discute l'abondance relative des tiques adultes de ces espèces, leurs lieux d'alimentation préférés et les fluctuations saisonnières de leurs effectifs.*

INTRODUCTION

The northern Transvaal is an important cattle ranching area, most of the farms being large and devoted to meat production. Although Thomas (1962), working in the Louis Trichardt district, has contributed meaningfully to our understanding of ticks in this region, there is no information regarding the seasonal fluctuations in tick numbers for these parts. Such information is of great importance when planning acaricide application programmes and researching alternative means of control.

The present investigation was undertaken as part of the South African Savanna Ecosystem Project on the farm Nylsvley (24° 29′ S; 28° 42′ E; Altitude ±1 100 m), in the Naboomspruit district of the northern Transvaal. Regular collections of ticks were made over a period of 13 months from a group of cattle kept on the farm specifically for this purpose.

MATERIALS AND METHODS

The farm: Nylsvley is situated in a region of the northern Transvaal classified as Mixed Bushveld (Acocks, 1975). This is a summer rainfall region and at Nylsvley practically no rain falls between May and September. The winters are usually frost-free and monthly mean temperatures range from approximately 12 °C during July to approximately 22 °C from October to February. For decades cattle have grazed the area of the farm utilized in the survey only from January to the beginning of May, since the presence of *Dichapetalum cymosum* (gifblaar) renders it unsuitable for domestic stock during the remainder of the year. In recent years, however, the farm has been developed as a nature reserve by the Transvaal Provincial Administration. Wild antelope species have been encouraged to breed at Nylsvley and fairly large herds of impala (*Aepyceros melampus*) and numbers of kudu (*Tragelaphus strepsiceros*) are to be found. These animals are probably important in the maintenance of tick populations.

The survey cattle: Six Africaner yearling oxen were selected from a herd of about 220 Africaner and Africaner-type cattle brought on to the farm in January 1976. The main herd was removed in May 1976, leaving the survey cattle plus 2–10 other animals (used in another project) on the farm until March 1977. Although Thomas (1962) showed that Africaner cattle carry significantly fewer ticks than Herefords, it was thought that, as Africaners make up the bulk of ranch cattle in the Transvaal and were available at Nylsvley, they should be used in this investigation. One of the survey animals died during September 1976 from gifblaar poisoning and had to be replaced during the course of the work. The replacement was in all respects similar to the animal that died and certainly no differences in its tick susceptibility were evident.

The sampling period: Ticks were removed from the survey cattle at approximately fortnightly intervals from 10 February 1976–10 March 1977, a total of 29 separate sampling days.

The sampling method: Total tick counts of the sort undertaken by Thomas (1962) and Baker & Ducasse (1967) were not possible for practical reasons. Instead, 6 clearly defined sites on each host animal were selected for study because of their importance as feeding sites for the different stages of the commoner cattle ticks (Baker & Ducasse, 1967). All the ticks on these sites were removed, either by hand or with forceps, and taken to the laboratory for study. The ear pinnae and lower border of the dewlap were scraped with a sharp knife for the removal of the immature stages of *Rhipicephalus appendiculatus*, but this sampling method was not used on the other predilection sites. The sites studied were as follows:

1. *Pinna*: (Site 4 of Baker & Ducasse, 1967). Both surfaces of a single ear of each bovine were sampled. This site is important for all stages of *R. appendiculatus*. The actual ear passage was not included.

* This survey forms part of the South African Savanna Ecosystem Project

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TABLE 1 Relative abundance of tick species collected from cattle in the Nylsvley Nature Reserve

Species	Number of ticks					Percentage
	Larvae	Nymphae	Adults		Total	
			♂	♀		
R. appendiculatus	1742	2438	7313	3985	15 478	69,08
R. e. evertsi	5	0	2299	1686	3 990	17,81
H. m. rufipes	0	0	693	444	1 137	5,07
H. truncatum	0	0	546	345	891	3,98
A. hebraeum	32	34	495	271	832	3,71
R. simus	0	0	28	22	50	0,22
B. decoloratus	0	2	2	23	27	0,12
I. cavipalpus	0	0	0	2	2	0,01
Totals	1779	2474	11376	6778	22 407	100,00

2. *Neck*: (Sites 7, 8 and part of 6 of Baker & Ducasse, 1967). This site included the lateral surfaces of the neck, the dewlap and the mane. Only one side of each bovine was sampled. This is an important site for all stages of *Boophilus decoloratus* and *R. appendiculatus* larvae.

3. *Leg*: (Sites 9, 16 and 17 of Baker & Ducasse, 1967). This site included the axilla, leg (from elbow to fetlock) and foot (below fetlock). Only one foreleg of each survey animal was sampled. This site is important for the feeding of all stages of *B. decoloratus*, nymphae and larvae of *Amblyomma hebraeum* and larvae of *R. appendiculatus*.

4. *Tail*: (Sites 14 and 15 of Baker & Ducasse, 1967). This site included the tail and tail brush, and is important for the feeding of *Rhipicephalus simus* and *A. hebraeum* adults.

5. *Upper perineum*: (Site 13 of Baker & Ducasse, 1967). This site, extending from the base of the tail to about 10 cm below the anus, is very important for the feeding of *Rhipicephalus evertsi evertsi*, *A. hebraeum* and *Hyalomma marginatum rufipes* adults.

6. *Lower perineum*: (Site 12 of Baker & Ducasse, 1967). This site, extending from below the upper perineum to the base of the scrotum, is an important feeding site for *A. hebraeum* adults.

On each occasion the cattle were hand-sprayed with an acaricide containing camphechlor and chlorfenvinphos* immediately after sampling. No other acaricidal treatment was applied.

Experimental Observations

The tick species collected during the survey were, in order of abundance, as follows:

Rhipicephalus appendiculatus
Rhipicephalus evertsi evertsi
Hyalomma marginatum rufipes
Hyalomma truncatum
Amblyomma hebraeum
Rhipicephalus simus
Boophilus decoloratus
Ixodes cavipalpus

Rhipicephalus appendiculatus

Relative abundance (Table 1): Of the 22 407 ticks collected 69,08% were *R. appendiculatus*. All stages were collected but nymphae and larvae were not as frequently found as adults, as the sampling method was not designed for total recoveries of immature ticks. Adult males outnumbered females 1,84:1, which reflects the well-known tendency for males to accumulate on their hosts (Nuttall, 1915). Although clearly the commonest tick species, *R. appendiculatus* did not constitute as large a proportion of the tick community as was recorded by Thomas (1962) in the Louis Trichardt district. He counted only adults of *R. appendiculatus*, *A. hebraeum*, *R. evertsi evertsi* and *Hyalomma* sp. (probably both *H. marginatum rufipes* and *H. truncatum*), the 10 806 *R. appendiculatus* collected from 3 Africaner yearling oxen in 6 months representing 93,44% of the total. Jooste (1966b), working 50 km north of Salisbury, Rhodesia, found that *R. appendiculatus* constituted only 8,46% of the total adult tick population, while *R. evertsi evertsi*, *B. decoloratus* and *H. marginatum rufipes* all occurred in greater numbers.

Feeding sites (Table 2): Although adults were almost entirely confined to the ear pinnae, small numbers were found on all other sites sampled, but especially on the neck and upper perineum. Nymphae and larvae were found predominantly on the ear pinnae but also showed a predilection for the neck region. These findings are entirely in agreement with the previous observations of Thomas (1962) and Baker & Ducasse (1967).

Seasonal incidence (Fig. 1, Table 3): Larvae were recovered in excess of 5 per host animal from April-June 1976 and from February 1977 onwards, the majority being found in April and May 1976. This peak corresponds to the first peak given by Jooste (1966a); no second peak from August–October, as shown by Jooste (1966a), is evident from the present study, however, nymphae had a particularly protracted period of activity, being found in excess of 5 per host from April–November. There was no clearly defined peak of abundance but relatively greater numbers were collected from May–September. This supports the work of Jooste (1966a). Adults demonstrated a very clearly defined peak of activity between November and March with large numbers being collected from December–February. Adults were completely absent during May–September. These results closely parallel the findings of Jooste (1966b) and Matson & Norval (1977) in Rhodesia, and Baker & Ducasse (1967) in Natal, although Matson & Norval (1977) did, however, recover a few adult ticks from June–September.

* Disnis: Agricura

TABLE 2 Feeding site preferences of adult ticks collected from cattle in the Nylsvley Nature Reserve

Tick species	Feeding site						
	Pinna	Neck	Leg	Tail	Upper perineum	Lower perineum	Totals
R. appendiculatus	10 562 (93,5)	339 (3,0)	14 (0,1)	36 (0,3)	276 (2,5)	71 (0,6)	11 298 (100,0)
R.e. evertsi	5 (0,1)	3 (0,1)	6 (0,1)	2 (0,1)	3 926 (98,5)	43 (1,1)	3 985 (100,0)
H.m. rufipes	0	0	0	5 (0,5)	1 110 (97,6)	22 (1,9)	1 137 (100,0)
H. truncatum	15 (1,7)	4 (0,4)	42 (4,7)	160 (18,0)	445 (49,9)	225 (25,3)	891 (100,0)
A. hebraeum	0	25 (3,3)	143 (18,7)	4 (0,5)	114 (14,9)	480 (62,6)	766 (100,0)
R. simus	0	0	0	50 (100,0)	0	0	50 (100,0)
B. decoloratus	1 (4,0)	9 (36,0)	10 (40,0)	0	3 (12,0)	2 (8,0)	25 (100,0)
I. cavipalpus	0	0	2 (100,0)	0	0	0	2 (100,0)

(Percentage of total given in parentheses)

TABLE 3 Summary of approximate peaks of activity of ticks collected during the Nylsvley survey compared with other southern African reports

Species	Activity periods			Reference
	Larval	Nymphal	Adult	
A. hebraeum	Feb.–May	May–Sep.	Sep.–Jan.	Baker & Ducasse (1967)
	?	?	Aug.–Feb.	Present study
B. decoloratus	All year round			Jooste (1966b)
	November–June			Baker & Ducasse (1967)
	All year round			Present study
H.m. rufipes	?	?	Nov.–Mar.	Jooste (1966b)
	?	?	Nov.–Feb.	Baker & Ducasse (1967)
	?	?	Oct.–Feb.	Matson & Norval (1977)
	?	?	Oct.–Feb.	Present study
H. truncatum	?	?	Jan.–May	Jooste (1966b)
	?	?	March	Matson & Norval (1977)
	?	?	Dec.–Mar.	Present study
I. cavipalpus	?	?	Oct.–Nov.	Matthysse (1954)
	?	?	Nov.–Feb.	Jooste (1966b)
	?	?	Dec.	Present study
R. appendiculatus	Feb.–June & Aug.–Oct.	May–Nov.	Nov.–Feb.	Jooste (1966a, b)
	Feb.–June	Apr.–Sep.	Nov.–Mar.	Baker & Ducasse (1967)
	?	?	Dec.–Feb.	Matson & Norval (1977)
	Feb.–June	Apr.–Nov.	Nov.–Mar.	Present study
R.e. evertsi	?	?	All year	Jooste (1966b)
	November–June		Jan.–May	Baker & Ducasse (1967)
	?	?	All year	Matson & Norval (1977)
	?	?	Sep.–Mar.	Present study
R. simus	?	?	Nov.–Jan. & April–June	Jooste (1966b)
	?	?	Aug.–Jan.	Baker & Ducasse (1967)
	?	?	Sep.–Feb.	Matson & Norval (1977)
	?	?	Oct.–Feb.	Present study

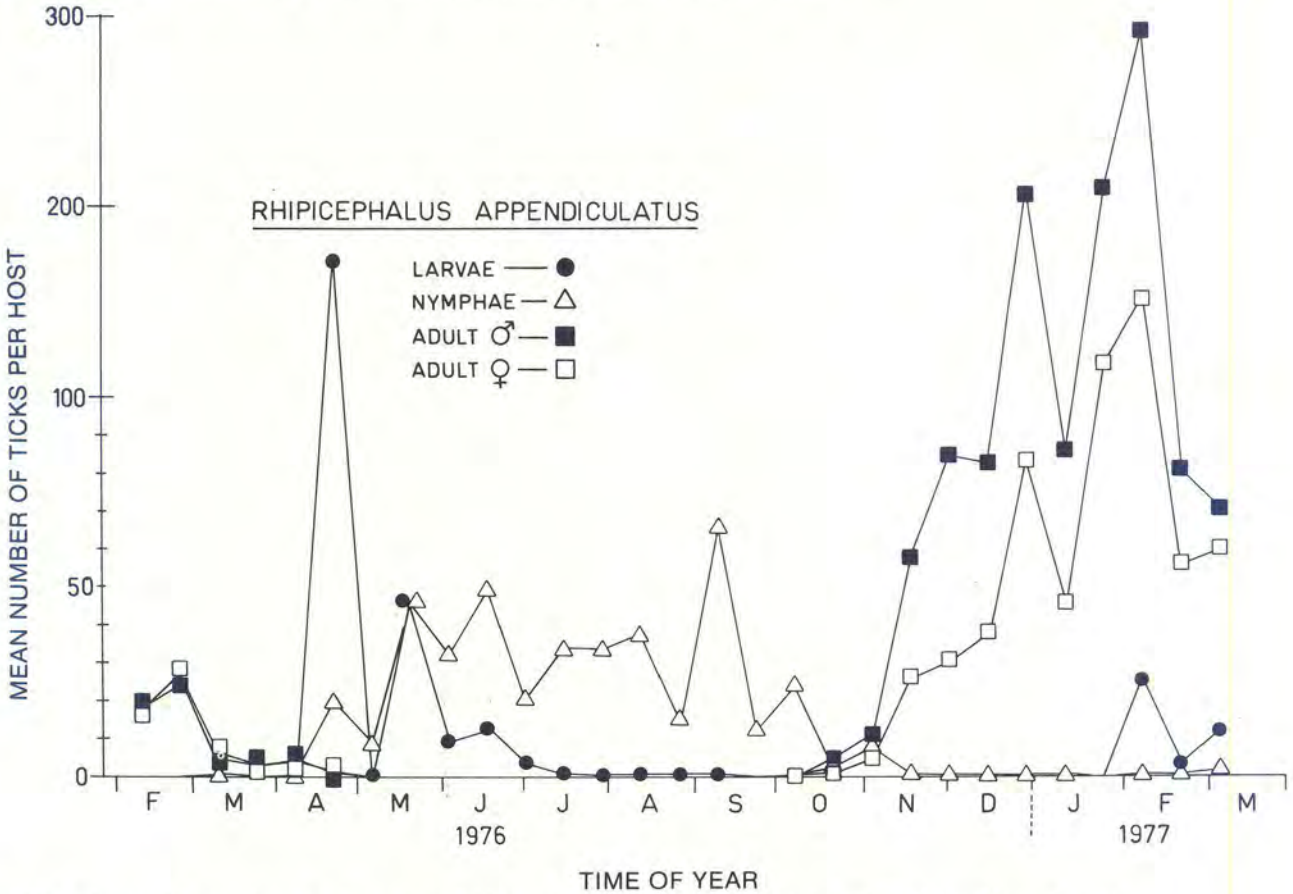

FIG. 1 Seasonal fluctuations in the numbers of *Rhipicephalus appendiculatus* on cattle in the Nylsvley Nature Reserve

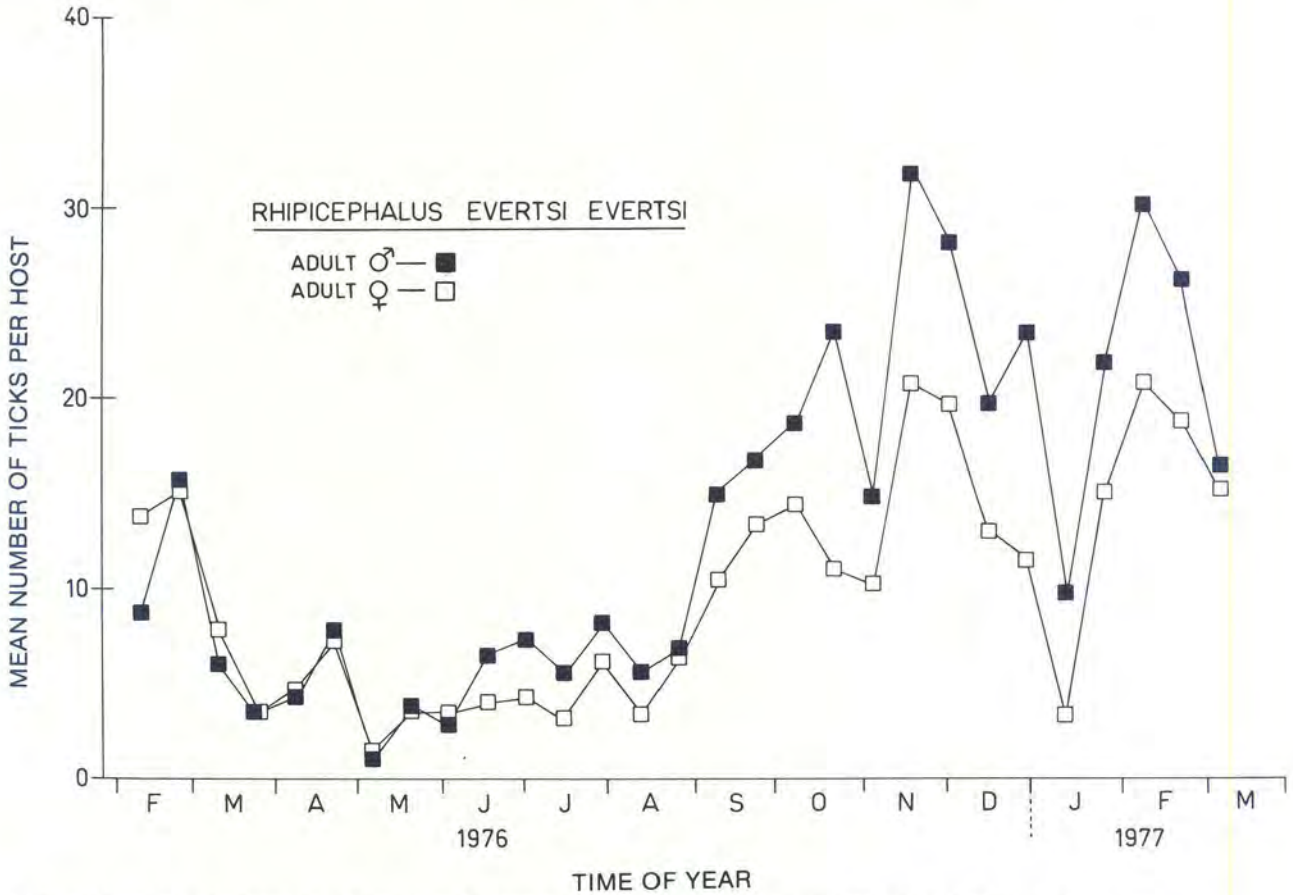

FIG. 2 Seasonal fluctuations in the numbers of *Rhipicephalus evertsi evertsi* on cattle in the Nylsvley Nature Reserve

Rhipicephalus evertsi evertsi

Relative abundance (Table 1): *R. evertsi evertsi* was the second commonest tick species collected. Whereas Thomas (1962) collected only 527 (2,49%) of this species out of a total tick count of 21 196 (Africaner oxen only), nearly 18% of ticks collected in the present survey were *R. evertsi evertsi*. Jooste (1966b), on the other hand, found it to be the most abundant species (42,67%) in her survey north of Salisbury. As the present sampling procedure really did not cover the immature stages, over 94% of which occur in the ear passages (Baker & Ducasse, 1967), the figure of 17,81% is undoubtedly an understatement of this tick's importance. Adult males outnumbered females 1,36:1.

Feeding sites (Table 2): The 5 larval ticks recovered were all found on the ear pinnae and must represent individuals at the extreme of their normal feeding site deep in the ear passages. Adults were found almost exclusively in the anal region, although individuals were also found in all other feeding sites sampled. This is in accordance with the findings of other workers.

Seasonal incidence (Fig. 2, Table 3): Adults were present throughout the year, as shown by Jooste (1966b), but clearly displayed an increased summer activity. Mean numbers of male and female ticks were below 10 per host between March–August 1976 and above 10 from September–March 1977. This relationship is not clearly evident from Jooste's (1966b) Rhodesian survey and Baker & Ducasse (1967) give the adult peak of activity in Natal as "January to the end of May". This obvious difference cannot be explained. Matson & Norval (1977) suggested that infestation occurred in waves and that during September–March the waves were 4 months apart with the interval increasing to 6 months between April–August on the Rhodesian Highveld.

Hyalomma marginatum rufipes

Relative abundance (Table 1): *H. marginatum rufipes*, the third most commonly collected ixodid tick, represented 5,07% of the collection. Thomas (1962), who counted all *Hyalomma* species together, found that they only represented 1,01% of the ticks collected from Africaner oxen. This tick was also the third most commonly collected species in Jooste's (1966b) survey in Rhodesia, representing 9,25% of the collection. Adult males outnumbered females 1,56: 1. Immature stages were not collected from the cattle.

Feeding sites (Table 2): Adult *H. marginatum rufipes* were almost entirely taken from the upper perineum. A few individuals, however, were collected from the lower perineum and tail but none from any other sites. These findings agree well with those of Baker & Ducasse (1967).

Seasonal incidence (Fig. 3, Table 3): *H. marginatum rufipes* was present on all but 2 sampling days. The species demonstrates a clear summer peak of abundance between October–February similar to that recorded by Matson & Norval (1977) in Rhodesia. Jooste (1966b) and Baker & Ducasse (1967) record a peak of abundance between November–March and November–February respectively.

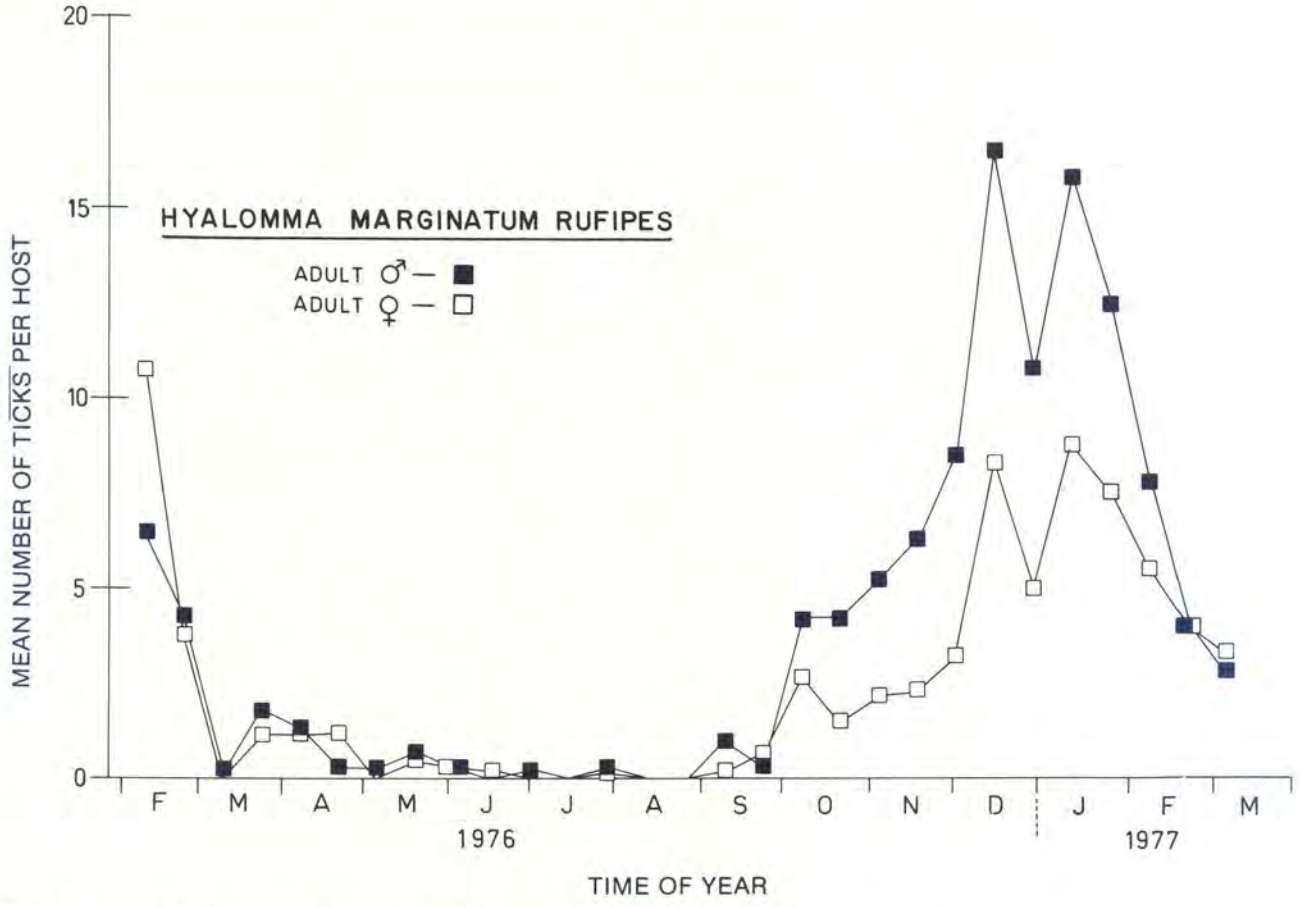

FIG. 3 Seasonal fluctuations in the numbers of *Hyalomma marginatum rufipes* on cattle in the Nylsvley Nature Reserve

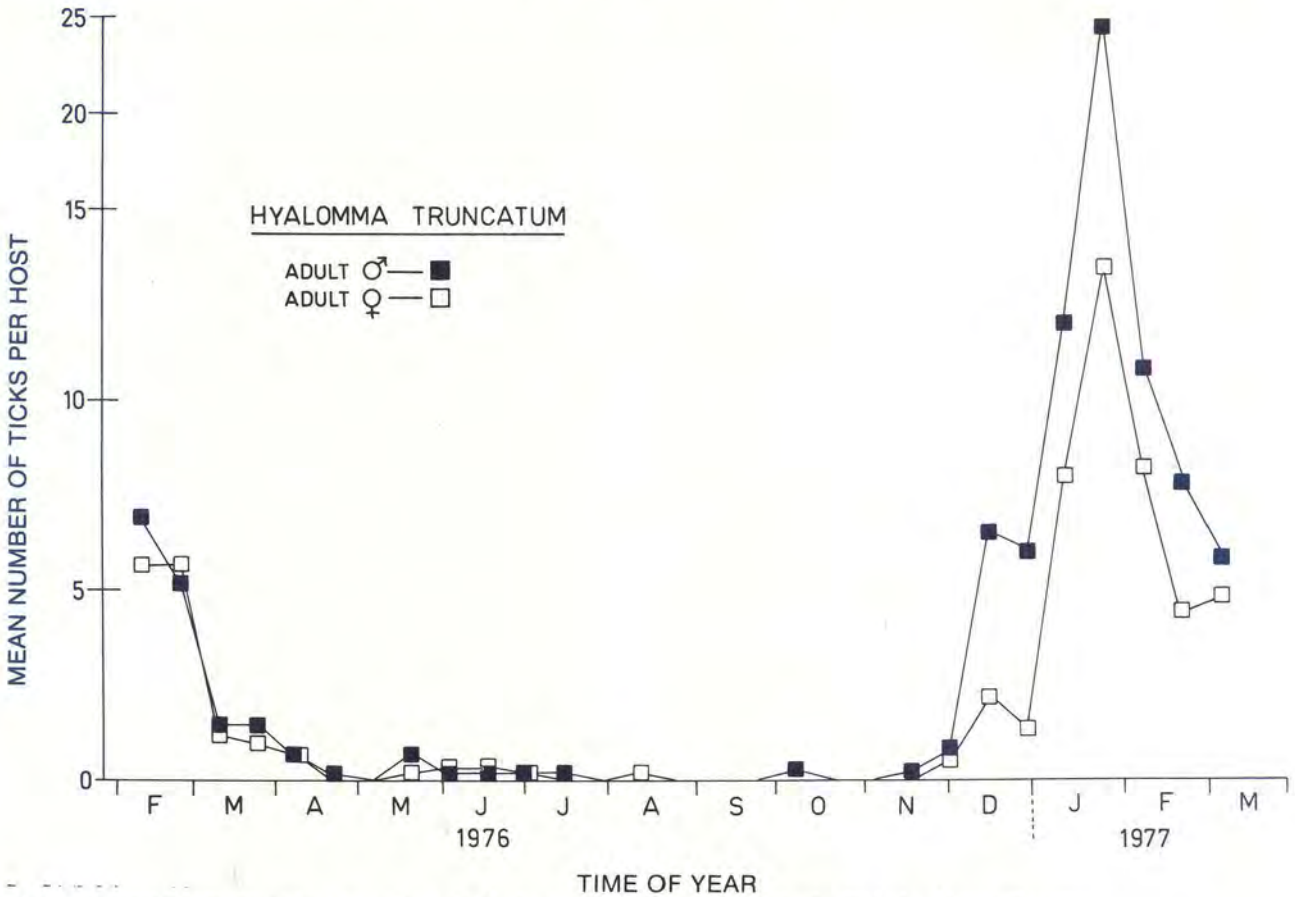

FIG. 4 Seasonal fluctuations in the numbers of *Hyalomma truncatum* on cattle in the Nylsvley Nature Reserve

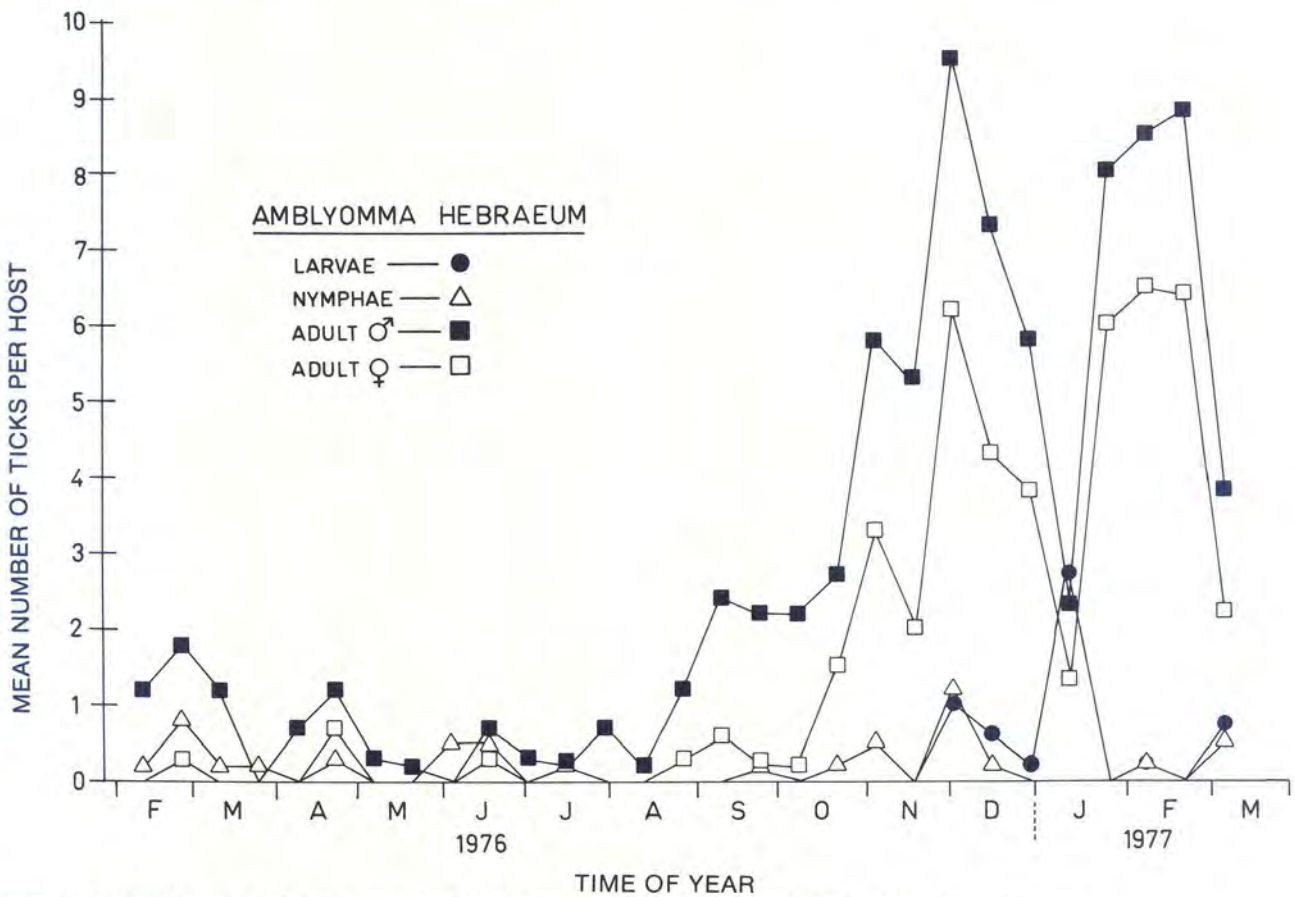

FIG. 5 Seasonal fluctuations in the numbers of *Amblyomma hebraeum* on cattle in the Nylsvley Nature Reserve

Hyalomma truncatum

Relative abundance (Table 1): 3,98% of the ticks collected throughout the survey were *H. truncatum*. Thomas (1962) did not deal specifically with this species, probably classing it with *H. marginatum rufipes*. Jooste (1966b), however, places *H. truncatum* well down on her list as it represented only 1,64% of the total tick count. Adult males outnumbered females 1,58: 1. Immature stages were not recovered from the cattle.

Feeding sites (Table 2): *H. truncatum* was found on all the sites sampled. The upper perineum was more commonly infested than any other site, but both lower perineum and tail were well infested. These predilection sites are in general agreement with those given by Hoogstraal (1956).

Seasonal incidence (Fig. 4, Table 3): Adults have a clearly defined summer peak of abundance from December–March, the majority being collected in late January. This peak is 2 months earlier than that shown by Jooste (1966b) and Matson & Norval (1977) for Rhodesian populations. As these peaks are so clearly defined, there can be no doubt that *H. truncatum* reaches a peak earlier in this part of the northern Transvaal.

Amblyomma hebraeum

Relative abundance (Table 1): 3,71% of ticks collected were *A. hebraeum*. Although Thomas (1962) collected relatively fewer *A. hebraeum* in his study (3,06%) this was his second commonest species (after *R. appendiculatus*). Neither Jooste (1966b) nor Matson & Norval (1977) found any *Amblyomma* in their Rhodesian surveys. Males in this survey outnumbered females by 1,83: 1. Immature stages, though collected in a number of samples, were probably far commoner than indicated. The sampling of these stages from all the sites except the ear pinnae was bound to have been inadequate.

Feeding sites (Table 2): Larvae were found predominantly on the neck, although a few were also found on the legs and ears. Nymphae were commoner on the legs with fewer being collected from the neck and lower perineum. These findings agree with those of Baker & Ducasse (1967), although the number of larvae recovered in the present survey was very small. Adults were found predominantly on the lower perineum, although they were collected on all sites other than the ear pinnae.

Seasonal incidence (Fig. 5, Table 3): Larvae were recovered in very small numbers in December 1976 and during the first 3 months of 1977. It is impossible to comment on their annual peaks of abundance. Baker & Ducasse (1967) give larval activity as February–May, and nymphal activity as May–September, but, since nymphae were collected in very low numbers throughout this survey, no clearly defined peaks could be recorded. Adults in this survey exhibited a fairly well-defined summer peak of abundance from August–February. Baker & Ducasse (1967) stated that "adult activity started at the beginning of September and declined towards the end of January".

Rhipicephalus simus

Relative abundance (Table 1): Only 0,22% of ticks collected were *R. simus*, with males outnumbering females by 1,27: 1. Jooste (1966b) found this species occupied much the same proportion (0,23%) of the tick population in Rhodesia. Immature stages were not collected on the cattle.

Feeding sites (Table 2): All 50 adult ticks were taken from the tails of the survey animals. Baker & Ducasse (1967) collected them from a number of different sites but the tail-brush was the most attractive.

Seasonal incidence (Fig. 6, Table 3): *R. simus* adults, although collected in relatively low numbers, displayed a clear peak of abundance between October–February. This agrees well with the wet-season peak in Rhodesia recorded by Jooste (1966b) and Matson & Norval (1977), although the latter authors recovered ticks from September onwards. Jooste (1966b) also found an autumn peak from April–June which was not recorded during the present survey. Baker & Ducasse (1967) give the adult activity period as August–January which appears to be somewhat earlier than in the Transvaal.

Boophilus decoloratus

Relative abundance (Table 1): This tick was rarely collected at Nylsvley and represented only 0,12% of the total tick count. This observation tends to be supported by Thomas (1962) who ignored the species in his northern Transvaal investigation. Jooste (1966b), on the other hand, found *B. decoloratus* to be the second most abundant species (29,73%) in Rhodesia, but not Matson & Norval (1977), who found only very small numbers. Low numbers in the survey area at Nylsvley may be a result of the infrequent presence of cattle in this area of the farm. *B. decoloratus* is certainly more commonly found on a number of other northern Transvaal cattle farms. Female ticks outnumbered males by 11,5: 1, but this was probably because few specimens were collected and the males, being small, were missed.

Feeding sites (Table 2): *B. decoloratus* was found on all sampling sites except the tail, but apparently preferred the necks and legs of the host animals. This finding is in keeping with the more detailed study of Baker & Ducasse (1967) in an area of Natal where *B. decoloratus* was the most abundant tick.

Seasonal incidence (Fig. 6, Table 3): No clearly defined peak of activity emerged since only small numbers were collected.

Ixodes cavipalpus

Relative abundance (Table 1): Only 2 females were collected at Nylsvley and this appears to be the southernmost record of this species. Hoogstraal (1956) gives its distribution in southern Africa as Angola, Zambia and Malawi, while Jooste (1966b) studied its occurrence on cattle in the Goromonzi area of Rhodesia.

Feeding sites (Table 2): Both individuals were found feeding on the legs of the survey animals.

Seasonal incidence (Fig. 6, Table 3): Both females were collected in December. Matthysse (1954) collected adults from cattle in Zambia in October–November, while Jooste (1966b) recorded this species on cattle in Rhodesia between November and February. The indications therefore are that this species is active in the adult stage in early to the middle of summer.

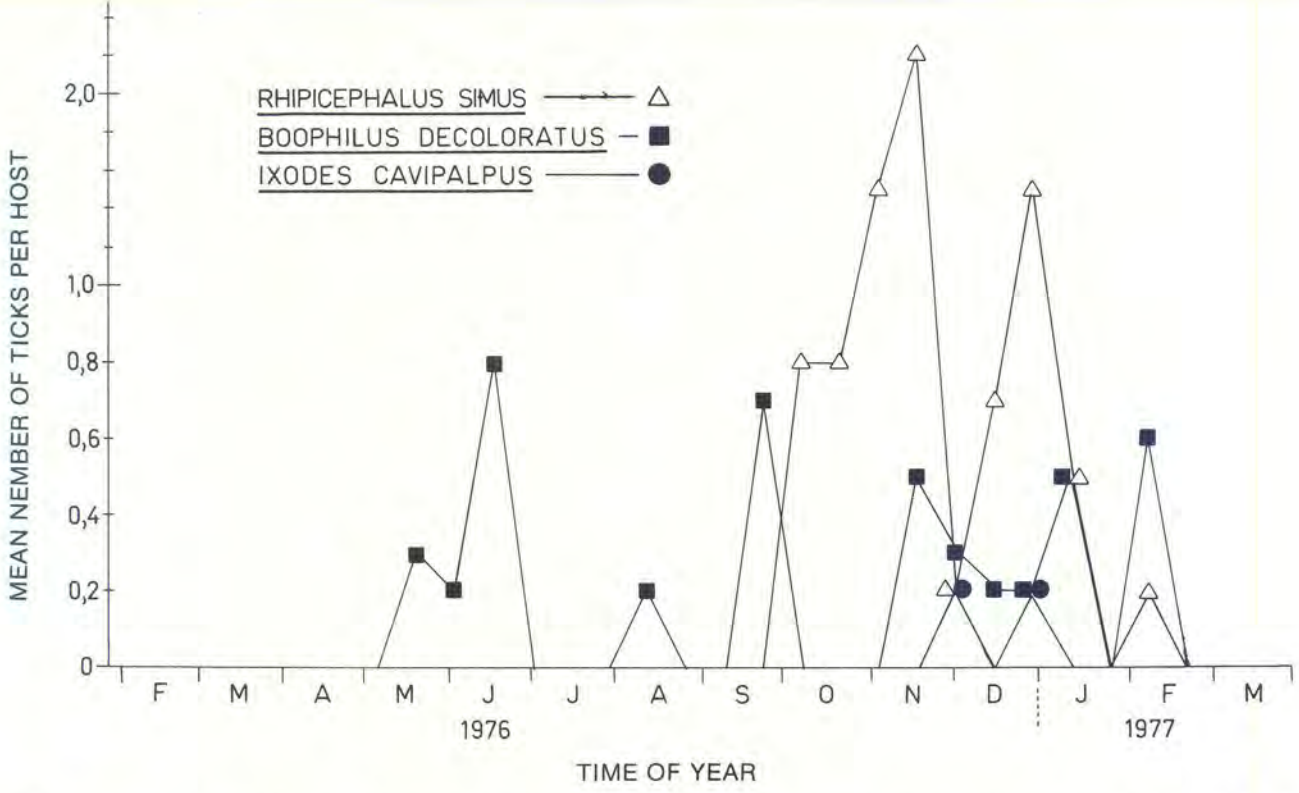

FIG. 6 Seasonal fluctuations in the numbers of *Rhipicephalus simus*, *Boophilus decoloratus* and *Ixodes cavipalpus* on cattle in the Nylsvley Nature Reserve

Discussion

The survey was conducted over a period of only 13 months and thus, but for 2 months, the seasonal incidence from year to year cannot be compared. Ticks were collected from cattle, however, from March–May 1975 (Horak, unpublished data) and during February and March 1976 and 1977 in the present survey. A comparison of the numbers of adult *R. appendiculatus*, *R.e. evertsi* and *A. hebraeum* recovered during these 3 periods indicates a very marked increase during 1977.

The immature stages of *R. appendiculatus* and *A. hebraeum* are active from February–September and those of *R.e. evertsi* from November–June (Baker & Ducasse, 1967), and utilize other hosts besides cattle (Theiler, 1962). Until 1976 all cattle were removed annually from the study area during May and returned the following January. During those years the immature stages were presumably sustained from May–December by impala and other antelope, and the counts of adult ticks on cattle from March–May 1975 (Horak, unpublished data) and during the same months in 1976 in the present survey were remarkably similar. The continuous presence of cattle in the survey area during 1976, not only supplied additional hosts for the immature stages, but these hosts were also present during the period of peak immature activity. Thus larger numbers of immature ticks than in previous years were probably able to develop into adults, accounting for the particularly large numbers of adult ticks encountered from November 1976–February 1977.

The numbers of *H.m. rufipes* and *H. truncatum* recovered during February and March 1976 and 1977 support the above hypothesis. Both these ticks accounted for a fairly large proportion of the total population (Table 1), but neither would appear to feed on cattle during the immature phase of their life cycles (Hoogstraal, 1956). Thus the presence of cattle throughout the year, instead of just from January–May, should not result in an increase in their numbers. No increase is evident if the tick numbers for February and March 1976 are compared with those of 1977.

All the cattle were hand-sprayed with a highly effective combination of acaricides at approximately 14-day intervals immediately after sampling. This regimen, however, was inadequate judging by the large numbers of adult ticks recovered in succeeding months. Theiler (1943) noted that the larvae and nymphae of *R. appendiculatus* only feed on the host for 3–7 days, while Norval (1974) found that the larvae of *A. hebraeum* feed for 4–15 days and the nymphae for 5–13 days. Thus 2-weekly treatments would only affect ticks of these species present at the time of treatment, while large numbers could attach, engorge and drop off during the intervening periods.

The larvae and nymphae of *R.e. evertsi*, a two-host tick, require approximately 17 days to complete their feeding period and usually attach in the internal parts of the ears (Rechav, Knight & Norval, 1977). Although this period is longer than the 14 days between acaricide applications, the attachment site deep in the external ear canal probably affords some protection for the ticks.

In those areas of South Africa where regular acaricide treatment is necessary, the majority of farmers apply such acaricides weekly from October–May, that is at the time when adult ticks are visible and tick-borne diseases are present, and at 2-weekly

intervals from June–September when the animals are thought to be tick-free because the small immature stages pass unnoticed. It is obvious, however, that effective acaricidal control of ticks, whose immature stages occur in peak numbers from February–November, can only be assured by continuous short-interval treatment throughout the year.

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