Seasonal abundance of adult ixodid ticks infesting cattle belonging to resource-limited farmers in the north-eastern Free State Province of South Africa

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ABSTRACT

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A study was undertaken to determine the seasonal abundance of the ticks infesting cattle owned by resource-limited farmers in the north-eastern Free State Province of South Africa. Infestations of *Boophilus decoloratus* Koch, 1844, *Rhipicephalus evertsi evertsi* Neumann, 1897, *Rhipicephalus follis* Donitz, 1910, *Rhipicephalus gertrudae* Feldman-Muhsam, 1960 and *Rhipicephalus warburtoni* Walker & Horak, 2000, were monitored on cattle of mixed breeds at monthly intervals from May 1998 to April 1999. High tick intensity on the cattle was observed between March and June, with a peak in May to June 1998 for *B. decoloratus* and *R. evertsi evertsi*. Few ticks from the other three species were recovered from the cattle. Small peaks in November to December 1998 for *R. warburtoni,* and in December 1998 for *R. follis* and *R. gertrudae* were observed. Following the winter (June to August), numbers of *B. decoloratus* declined markedly, while those of *R. evertsi evertsi* and other rhipicephalids increased. These results represent the first published information on ticks of veterinary importance infesting cattle in the north-eastern part of the Free State Province.

Keywords: *Boophilus decoloratus*, cattle, *Rhipicephalus evertsi evertsi*, *Rhipicephalus follis*, *Rhipicephalus gertrudae*, *Rhipicephalus warburtoni*, seasonality

INTRODUCTION

Of the roughly 800 tick species known in the world, about 80 ixodid tick species occur in South Africa (Walker 1991). Only eight species are important parasites of cattle in South Africa. These are *Amblyomma hebraeum*, *Boophilus decoloratus*, *Boophilus microplus, Hyalomma marginatum rufipes, Hyalomma truncatum, Rhipicephalus appendiculatus, Rhipicephalus evertsi evertsi* and *Rhipicephalus simus* (Norval 1994).

Except in the north-eastern part of the Free State Province, the seasonal abundance of the above mentioned ticks has been studied extensively in this country. The only study to be conducted in this region describes the burdens and seasonal abundance of ixodid ticks on Merino sheep (Horak, Williams & Van Schalkwyk 1991). In this paper the results on investigation into the seasonal burdens of adult ixodid ticks on cattle owned by resource-limited farmers in this area are reported.

MATERIALS AND METHODS

For the purposes of the study the north-eastern part of the Free State Province was divided into three study sites viz. Harrismith (29°05'E, 28°18'S), Kestell (28°38'E, 28°20'S) and Qwa-Qwa (28°50'E,

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28°35'S). These sites lie at altitudes of 1 300 m, 1465 m and 1600 m above sea level, respectively. This region of the province falls within the grassland biome and has a mean annual rainfall of 800 mm (Moffett 1997).

At each of the sites adult male and female ticks were collected at monthly intervals between May 1998 and April 1999 from different parts of the body of 30 cattle (ten from each study site) grazing on communal pastures and belonging to resource-limited farmers. The ticks from each animal were placed in separate labeled bottles containing 70% alcohol, and were subsequently identified to the species level and counted using a standard stereomicroscope. They were identified according to the methods of Walker (1961). Their identification was confirmed by comparison with reference specimens obtained from the University of the Free State and subsequently re-identified/reconfirmed by Ms Heloise Heyne of the Onderstepoort Veterinary Institute, South Africa.

An unpaired Student's *t*-test was used to compare burdens of the various tick species between the six winter/spring months (May to October 1998) and the six summer/autumn months (November to April 1999). A one-way analysis of variance (ANOVA) test (Barnard, Gilbert & McGregor 1993) was used to determine whether significant differences occurred between the tick counts in winter (May to July), spring (August to October), summer (November to January) and autumn (February to April) of *B. decoloratus* and *R. evertsi evertsi*. This was followed by a multiple range procedure, namely, the Least Significant Difference (LSD) test, to indicate the months responsible for significant variance (Zar 1974). A one-way ANOVA-test followed by a LSD test was also used to determine if any significant variation existed in the seasonality of the tick species between the three study sites (Barnard *et al.* 1993).

RESULTS

A total of 4 546 adult ticks belonging to five species were collected over the 12-month period. The tick species, in decreasing order of relative abundance, were *B. decoloratus* (53.19 %), *R. evertsi evertsi* (44.74%), *Rhipicephalus follis* (0.97%), *Rhipicephalus gertrudae* (0.7 %) and *Rhipicephalus warburtoni* (0.4 %). The mean burden of *B. decoloratus* was 80.6 ± 3.87 and that of *R. evertsi evertsi* 67.8 ± 3.05 (Table 1).

Seasonal variations among the three localities for the five tick species collected were small and mostly not significant, and their data were therefore combined. Significant differences in tick burdens for the six winter/spring months (May to October) and the six summer/autumn months (November to April) were found for most species. *Boophilus decoloratus* occurred in significantly higher numbers during the autumn and winter months (February to June) than during the spring and summer (August to January), with 88.2 % of the total tick burden occurring in autumn and winter (Table 2).

TABLE 1 The diversity, mean total count (± S.E.) and the relative abundance of ticks on cattle (n = 30) from May 1998 to April 1999

Tick species	Mean ± S.E.	Relative abundance
Boophilus decoloratus	80.6 ± 3.87	53.19
Rhipicephalus evertsi evertsi	67.8 ± 3.05	44.74
Rhipicephalus follis	1.47 ± 0.37	0.97
Rhipicephalus gertrudae	1.07 ± 0.28	0.7
Rhipicephalus warburtoni	0.6 ± 0.21	0.4

TABLE 2 Differences in tick burdens during the six winter/spring months (May to October 1998) and six summer/autumn months (November 1998 to April 1999). Percentages of the total are shown in brackets

Tick species	Six winter/spring months	Six summer/autumn months	*P*-value
Boophilus decoloratus	1 698 (70.2)	720 (29.8)	$P < 0.05$
Rhipicephalus evertsi evertsi	1 166 (57.3)	868 (42.7)	$P < 0.05$
Rhipicephalus follis	16 (36.4)	28 (63.6)	$P < 0.05$
Rhipicephalus gertrudae	8 (25)	24 (75)	$P < 0.05$
Rhipicephalus warburtoni	6 (33.3)	12 (66.7)	$P < 0.05$

Rhipicaphalus evertsi evertsi also showed considerable seasonal variation, with significantly higher tick burdens in June and December 1998, and March to April 1999. The seasonal variations of the other rhipicephalids (*R. follis*, *R. gertrudae* and *R. warburtoni*) also showed some significant differences (Table 2).

The seasonal abundance of *B. decoloratus*, *R. evertsi evertsi*, *R. follis*, *R. gertrudae* and *R. warburtoni* is graphically illustrated in Fig. 1 and 2.

DISCUSSION

Diversity

A total of five tick species was collected from the cattle ($n = 30$) in each study site over the 12-month study period. This observation is in line with that reported by Punyua, Latif, Nokoe & Capstick (1991), that it is rare to find more than six species infesting their hosts in one ecological zone. Most of the tick species identified in the present study are primarily parasites of wild and domestic ruminants (Walker 1991). The absence of suitable wild animal hosts in the study area intensifies the dominant role played by cattle, sheep and goats in the population dynamics of the tick species collected. Because of the dense livestock population in the communal grazing areas, the expected fast rate of tick development on the ground due to high summer temperatures and the good rains that fell during the study period, the success rate of host-finding by the ticks was considered to be high (Dreyer, Fourie & Kok 1998).

Relative abundance and distribution

Boophilus decoloratus was the most abundant species on the cattle grazing on the communal pastures at the three study sites, and on average constituted 53.19 % of the total tick burden. The observation of *B. decoloratus* as the most abundant species correlates with findings from a similar study conducted in Zimbabwe, where *B. decoloratus* was also found to be the most commonly occurring species in over-grazed tribal areas (Norval 1979). According to Norval (1977) the tick species occurring most commonly in tribal areas are one-host ticks such as *B. decoloratus*, and two-host ticks such as *H. marginatum rufipes* and *R. evertsi evertsi*. One limiting factor for three-host ticks in communal areas is the limited numbers of hosts available for immature stages due to the extensive hunting and trapping of birds and mammals as food by hungry people in over-populated areas (Norval

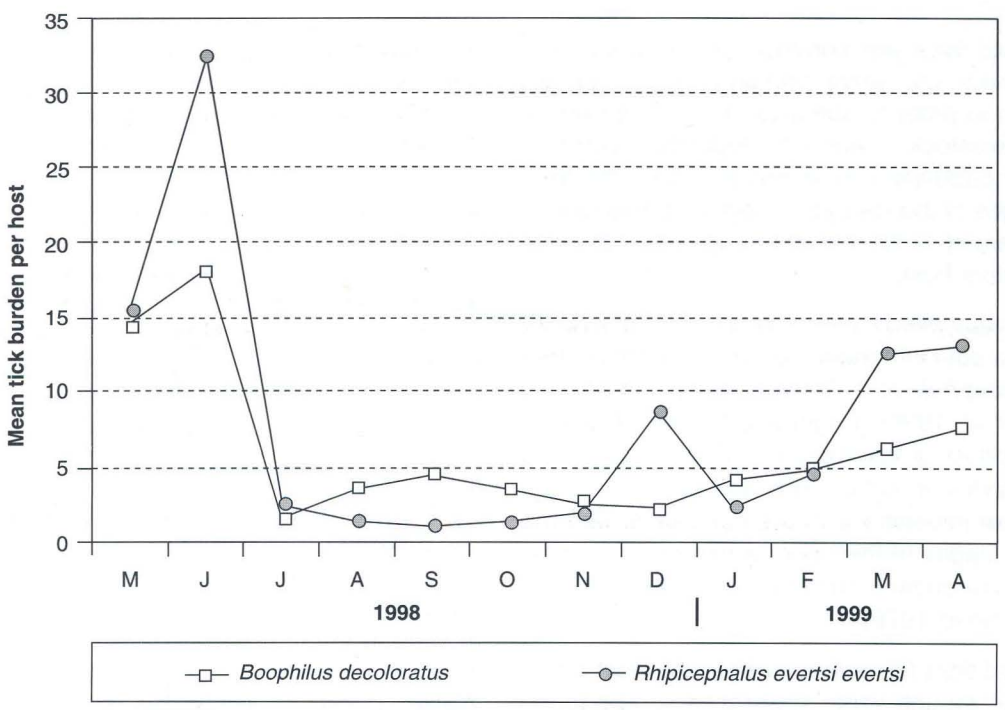

FIG. 1 Mean monthly *Boophilus decoloratus* and *Rhipicephalus evertsi evertsi* burdens from May 1998 to April 1999

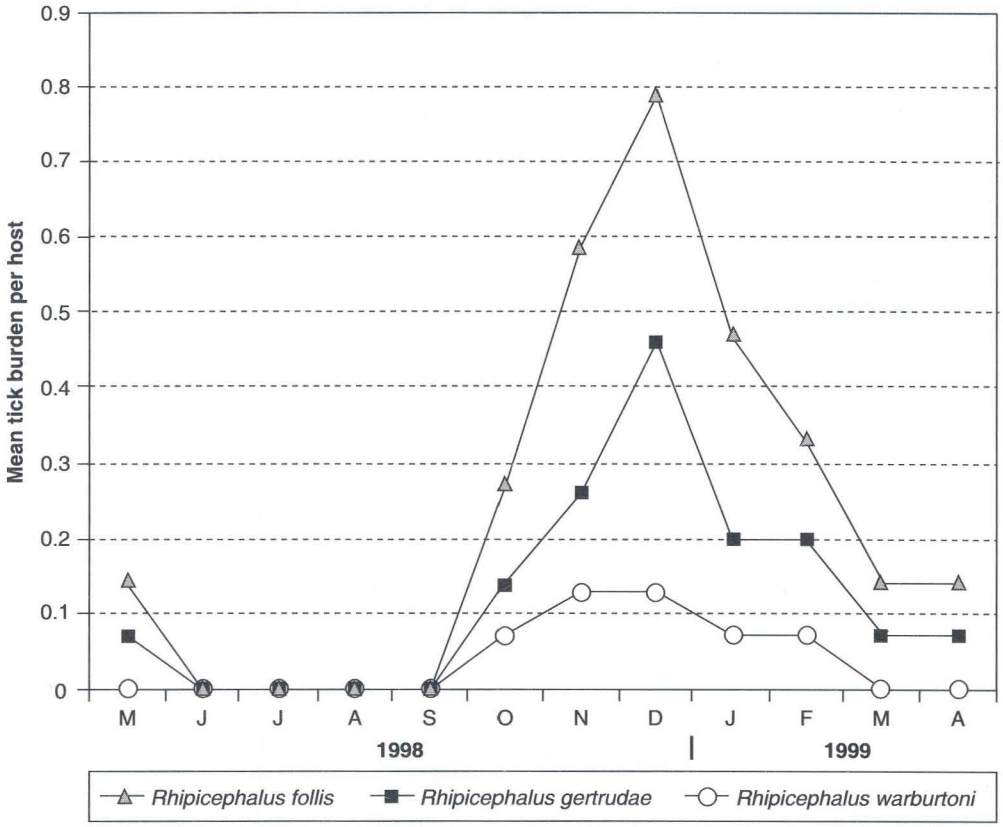

FIG. 2 Mean monthly *Rhipicephalus follis*, *Rhipicephalus gertrudae* and *Rhipicephalus warburtoni* burdens from May 1998 to April 1999

1982). Veld fires are common in the study area under review and serve primarily to burn-off old vegetation in order to stimulate a lush regrowth of grass for livestock. There is no doubt that such fires affect tick population dynamics by killing the free-living stages of the life cycle. Veld fires also reduce the numbers of, or kill wild animal species that serve as alternative hosts.

Rhipicephalus evertsi evertsi is an important vector of *Babesia equi* in horses, *Babesia bigemina*, *Anaplasma marginale* and *Theileria mutans* in bovines (Dreyer *et al.* 1998). Engorging female *R. evertsi evertsi* produce a toxin which can result in "spring lamb paralysis" in lambs, kids and calves. In addition, severe infestations of the ear canals with the immature stages of this species can result in irritation with secondary bacterial infections (Howell, Walker & Nevill 1978).

Red-legged ticks (*R. evertsi evertsi*) are most active in summer, though some specimens can be found throughout the year. In Kwazulu-Natal and the Eastern Cape Province the numbers of immature red-legged ticks begin to increase in early November and are at their peak from January to April. They then slowly decrease again. Adult numbers are highest from January to the end of May (Howell *et al.*1978). Similar observations were made in the present study where peak infestation of this tick species was observed during September 1998 and January-June 1999. *Rhipicephalus evertsi evertsi* was the second most abundant tick species in the present study, comprising 44.74 % of the total tick burden. This was probably due to the availability of other preferred hosts, such as sheep and goats, which grazed together with the cattle.

Other rhipicephalids (*R. follis*, *R. gertrudae* and *R. warburtoni*) were found in small numbers. This might be due to the fact that they feed on wild animals, especially small mammals and rodents. Although their numbers were much lower, they contributed to the tick-worry problem by causing open wounds at their aggregation sites. According to Walker (1991) *R. gertrudae* is widely distributed through the Cape Province, extending into Namibia and eastwards into the southern and central Free

State. Cattle are the most frequently recorded domestic hosts of *R. follis* (Walker 1991) although this tick never occurs in large numbers on any host, except on eland (Horak & Fourie 1992, cited by Dreyer *et al.* 1998). Nevertheless, it is widely distributed with the distribution area including the eastern Free State (Walker 1991).

In South Africa *R. warburtoni* (the brown paralysis tick) has been recorded in the North-West, Northern and Mpumalanga Provinces, the central, south-western and north-eastern Free State Province and the adjacent northern part of the Eastern Cape Province (Horak & Fourie 1992). In certain areas the brown paralysis tick causes paralysis of sheep and goats (Fourie & Kok 1992) but a threshold infestation density of ticks is required to induce it. The relative abundance of *R. warburtoni* was low (0.4 %) but its occurrence in the study area still poses a potential threat of paralysis to small stock. The most important host for immature stages of this tick is the rock elephant shrew, *Elephantulus myurus* (Fourie, Horak & Marais 1988). The natural habitat of the rock elephant shrew is rocky outcrops with an abundance of cracks and crevices to provide shelter (Du Toit 1993), and it is thus reasonable to assume that the adult ticks will also be more abundant in areas with rocky outcrops and hills (Fourie & Horak 1990).

Seasonality

The fact that *B. decoloratus* was a dominant species is not surprising as the Free State Province lies at the centre of its (*B. decoloratus*) geographic distribution (Dreyer *et al.* 1998). In the present study significant differences in seasonal burdens of this one-host tick occurred, with the highest infestations recorded in June 1998. This is in accordance with results obtained by Dreyer *et al.* (1998) in the central Free State, where *B. decoloratus* was abundant from May to June but scarce from July to January. In a study by Rechav (1982) in the eastern Cape, no definite pattern of seasonal occurrence was observed but the lowest numbers on hosts were also seen in early spring, with peaks in summer and autumn (February to June). The various peaks in adult infestation resulting in population 'waves', indicate the completion of several generations in one year (Punyua *et al.* 1991). In the present study, the three peaks in May/June 1998, December and March/April, most probably indicated that the blue tick produced three generations during the year (Dreyer *et al.* 1998). A similar seasonal periodicity with three generations was observed by Dreyer *et al.* (1998) in the Botshabelo and Thaba Nchu areas of the Free State Province.

According to Rechav (1982), temperature is probably the main regulating factor in the seasonal patterns of the blue tick. The slow development of eggs in the field during the cold winter and also the longer pre-oviposition period of females (Robertson 1981, Rechav 1982) will result in low numbers of adult ticks in the early spring (Dreyer *et al.* 1998).

The presence of the two-host tick species *R. evertsi evertsi* throughout the year with small fluctuations in the winter months was also observed by Punyua *et al.* (1991), Fivaz & De Waal (1993) and Dreyer *et al.* (1998). In the present study, the peak observed from May to June resembled the January to May peak on cattle in a KwaZulu-Natal study (Baker & Ducasse 1967), the April to May peak in a study in the Eastern Cape (Rechav, 1982), the March to May peak in a study on sheep in the Free State (Horak *et al.* 1991), and the March-May peak on cattle in the Botshabelo and Thaba Nchu areas (Dreyer *et al.* 1998). Results obtained in the present study indicated that temperature, and specifically the winter temperature, was probably the major factor regulating seasonal activity of the red-legged tick.

Rhipicephalus gertrudae and R. follis adults are typically summer ticks with most occurring during the spring and summer months in the present study. There were significantly higher burdens in summer months (October to February) than during the rest of the year. It appeared as if the above two species, as well as *R. warburtoni*, displayed a seasonally regulated life-cycle and passed through only one generation in the 12 months. According to Matson & Norval (1977) and Dreyer *et al.* (1988) the minimum duration of a tick's life-cycle increases from one to three host ticks as a result of the increased proportion of the life-cycle spent off the host (non-parasitic phase) (Matson & Norval 1977). In the present study a peak was observed in December 1998 for *R. follis* and *R. gertrudae* although the ticks were active from October to April or May. Results of studies conducted on cattle in the south-western Free State (Fourie, Kok & Heyne 1996) and central Free State Province (Dreyer *et al.* 1998) show the peaks of *R. gertrudae* in September and January.

Rhipicephalus warburtoni showed a similar seasonal pattern as that of *R. follis* and *R. gertrudae*, but has its peak in November-December 1998. Similarly, *R. warburtoni* was active only during the

warmer months in a study on cattle in the central Free State (Dreyer *et al.* 1998) and in the south-western Free State Province where a peak was recorded in January (Fourie *et al.* 1996). In a study on a commercial farm in the southern part of Free State *R. warburtoni* was also present during January and April, and from September to November (Fourie & Horak 1990).

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