

Species composition and geographic distribution of ticks infesting cattle, goats and dogs in a temperate and in a subtropical region of south-east Africa

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ABSTRACT

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The species and distribution of ticks infesting cattle, goats and dogs in the eastern region of the Eastern Cape Province, South Africa and Maputo Province, Mozambique were determined from collections made from these animals at 72 localities in the former region and 30 in the latter. Eleven ixodid and one argasid species were recovered in the Eastern Cape Province and 15 ixodid species in Maputo Province. The most common ticks infesting cattle and goats in both provinces were *Amblyomma hebraeum*, *Rhipicephalus (Boophilus) microplus*, *Rhipicephalus appendiculatus* and *Rhipicephalus evertsi evertsi*. The dominant species on dogs were *Haemaphysalis elliptica* and *Rhipicephalus simus*. The geographic distributions of the major species and some of the minor species in both regions were plotted. The partial or complete displacement of the indigenous tick *Rhipicephalus (Boophilus) decoloratus* by the introduced species *R. (B.) microplus* was a major feature of both surveys.

Keywords: Cattle, dogs, Eastern Cape Province, geographic distribution, goats, ixodid ticks, Maputo Province, Mozambique, South Africa

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INTRODUCTION

Various authors have documented the ixodid tick species infesting domestic animals and wildlife in South Africa (Theiler 1962; Walker 1991; Walker, Keirans & Horak 2000). Furthermore, Theiler and her co-workers, in a series of papers published in the 1940s and 1950s, have plotted the specific localities at which many of these ticks were collected and Howell, Walker & Nevill (1978) have converted the latter into maps. However, with the exception of the various *Rhipicephalus* spp. mapped by Walker *et al.* (2000), the published geographic distributions of many species that occur in South Africa are based on surveys conducted approximately 60 years ago (Theiler 1962). The ticks infesting domestic and wild animals in Mozambique have also been well documented (Theiler 1943, 1962; Tendeiro 1954; Dias

1993), but their geographic distributions are largely unknown.

Some of the more recent data for the Eastern Cape Province is that of Baker (1982), who summarized the results of acaricide resistance studies he and his co-workers had conducted, and plotted the localities in the eastern region of the Eastern Cape Province at which resistant strains of various tick species had been collected. Latterly Nyangiwe, Horak & Bryson (2006) collected ticks from dogs at 40 localities in this region and plotted the distributions of four of the eight species that they had recovered. In Maputo Province Neves, Afonso & Horak (2004) and De Matos, Siteo, Neves, Bryson & Horak (2008) collected ten species of ticks from dogs and plotted the distribution of two of these. To our knowledge no other recent data are available for these regions.

Walker (1991) listed 77 species of ixodid ticks that occur in South Africa, and two new species, *Rhipicephalus oreotragi* and *Rhipicephalus warburtoni* have subsequently been added to the list (Walker *et al.* 2000). Thirty-seven of these ticks have been recorded on domestic animals. The names of two of these 37 species, namely *Haemaphysalis leachi* and *Hyalomma marginatum turanicum*, neither of which occur in South Africa, have been reinstated as *Haemaphysalis elliptica* and *Hyalomma glabrum*, both of which are valid indigenous species (Apanaskevich & Horak 2006; Apanaskevich, Horak & Camicas 2007). A third species, *Hyalomma marginatum rufipes* has recently been raised to species level, namely *Hyalomma rufipes* (Apanaskevich & Horak 2008).

Dias (1993) recorded 59 ixodid tick species in Mozambique, and listed 26 of these as parasitizing domestic animals. Of the latter 26 species *Amblyomma theileri* has been synonymized with *Amblyomma hebraeum* (Camicas, Hervy, Adam & Morel 1998), *Haemaphysalis humerosoides* is considered a synonym of *Haemaphysalis leachi* (Camicas *et al.* 1998), and *Rhipicephalus reichenowi* is considered a synonym of *Rhipicephalus planus* (Walker *et al.* 2000). We now also know that the tick Dias identified as *Rhipicephalus capensis* does not occur in Mozambique and, although he listed *Rhipicephalus sanguineus* from cattle, in our opinion the latter tick is more likely to be *Rhipicephalus turanicus*. The recent surveys of Neves *et al.* (2004) and De Matos *et al.* (2008) have added *H. elliptica*, *Haemaphysalis spinulosa*, *Ixodes cavipalpus*, a *Rhipicephalus* sp. (near *R. pravus*) and *R. turanicus* to the species listed by Dias (1993).

Several of Dias' studies on the ticks of Mozambique commenced more than 50 years ago and although he probably listed nearly all the species that occur there, he unfortunately did not always record the localities at which particular species were collected. Furthermore, the civil war that ended during the 1990s and its consequences for humans, livestock and wildlife, plus the livestock restocking programme that followed, have probably all had an effect on the species composition and geographic distribution of ticks in Mozambique. Thus with the exception of the surveys conducted by Neves *et al.* (1994) and De Matos *et al.* (2008), there is little current information on the ticks that occur there.

The present studies were undertaken in an attempt to rectify this situation for both the eastern region of the Eastern Cape Province, South Africa and for Maputo Province, the most southerly of the ten provinces of Mozambique. At the same time this provided the opportunity to compare the species composition of ticks infesting cattle, goats and dogs in a temperate region with that of ticks infesting the same host species in a subtropical region, both with long coastlines.

MATERIALS AND METHODS

Localities

During 2004 and 2005 ticks were collected from cattle, goats, dogs and the vegetation at 72 localities in the eastern region of the Eastern Cape Province, South Africa. This region lies between 30°22' and 32°39' S, and 27°45' and 29°55' E, and the terrain rises from sea level in the south to approximately 2 000 m in the north-east in the Drakensberg mountain range. Its inland climate is classified as that of plateau slopes, and its approximately 250 km long Indian Ocean seaboard has a subtropical coastal climate. Summer rainfall varies between 500 and 1 000 mm annually, and winter rainfall between 125 and 375 mm. Midsummer mean daily temperatures vary between 15.0 °C and 25.0 °C and those of mid-winter between 7.5 °C and 17.5 °C. The vegetation along the coast is described as Coastal Forest and Thornveld. Adjacent to the latter in the west lies a strip of vegetation described as Eastern Province Thornveld and in the east a strip described as Ngongoni Veld. With the exception of ribbons of Valley Bushveld along rivers courses, the inland vegetation, including that in the mountainous north, is described as Highland Sourveld (Acocks 1988).

In 2004, 2005 and 2006 ticks were also collected at 30 localities spread throughout Maputo Province,

Mozambique, from the same host species as in the Eastern Cape Province, and from the vegetation. The southern boundary of this province is approximately 500 km north-east of the northern limit of the Eastern Cape Province survey region. Maputo Province is located between 24°15' and 26°52' S, and 31°48' and 33°05' E, and has a climate classified as subtropical lowveld. Its coastline is approximately 320 km long, and the landscape rises from the Indian Ocean in the east to about 800 m above sea level in the Lebombo mountain range in the west. Annual summer rainfall varies between 500 and 750 mm and winter rainfall between 125 and 250 mm. Mid-summer mean daily temperatures vary between 25.0 °C and 27.5 °C and midwinter temperatures between 15.0 °C and 20.0 °C. The vegetation along the coast is described as shrubland with patches of wetland, mangrove and deciduous trees along riverbanks and dunes. Inland it is dominated by woodland and associations of savannah and mopane (*Colophospermum mopane*) in the north-west district of Magude. The inland vegetation in the south is dominated by forest from the mountain district of Namaacha to the southern Mozambican border.

Animals

Whenever possible, ticks were collected from five approximately year-old cattle, five goats and five dogs at each of the sampling sites (Nyangiwe *et al.* 2006; Nyangiwe & Horak 2007; De Matos *et al.* 2008). However, the prescribed numbers of animals at the stipulated number of localities were not always realised. In addition, ticks were collected from 24 dogs at two villages in south-west Maputo Province during a rabies inoculation campaign, as well as from two dogs at two villages in the south-east of the province (De Matos *et al.* 2008). The geographic coordinates of each site at which ticks were collected were recorded and used to plot the distributions of the various tick species.

Tick collections

Ticks were collected from the ears, bodies, bellies, feet, tails and peri-anal regions of the cattle and goats on the single occasion that each locality was visited. To minimize stress to the dogs as well as injuries to the researchers, they were often muzzled and thereafter restrained by their owners. The collections of ticks from the animals were not intended to be exhaustive, and focused mainly on adult ticks, but several nymphs of *A. hebraeum* and *Rhipicephalus appendiculatus* were also collected. In addition, questing ticks were collected by dragging flannel

strips over the vegetation as described by Horak, Gallivan, Spickett & Potgieter (2006), for a distance of 100 m at three places close to each of the collection sites. The ticks recovered from the animals and the flannel strips were placed in 70 % ethyl alcohol in internally labelled vials and transported to laboratories in South Africa or Maputo, where they were identified and counted using stereoscopic microscopes.

RESULTS AND DISCUSSION

A total of 11 ixodid tick species and one argasid species were recovered in the eastern region of the Eastern Cape Province (Table 1), and 15 ixodid tick species in Maputo Province (Table 2). *Amblyomma hebraeum*, *Rhipicephalus (Boophilus) microplus*, *R. appendiculatus* and *Rhipicephalus evertsi evertsi* were most prevalent on cattle, goats and the vegetation, and *H. elliptica* on dogs in both provinces (Tables 1 and 2). Furthermore, a large number of cattle and dogs in Maputo Province were infested with *Rhipicephalus simus* (Table 2).

Amblyomma hebraeum

This tick was present mainly in the coastal region of the eastern part of the Eastern Cape Province, where the vegetation is described as Coastal Forest and Thornveld interspersed with Valley Bushveld (Acocks 1988). However, a considerable number of collections were also made further inland (Fig. 1A). With the above mentioned exception, the distribution of *A. hebraeum* in the survey region in the Eastern Cape Province is similar to that plotted for it by Howell *et al.* (1978). Estrada-Peña, Horak & Petney (2008) noted that a trend towards more intense periods of drought in the highveld of Zimbabwe favoured the expansion of *A. hebraeum* in this region of that country and that temperature did not have an effect on this expansion. A similar phenomenon could be responsible for the spread of this tick into the higher lying areas of the Eastern Cape Province.

Amblyomma hebraeum was widespread throughout Maputo Province (Fig. 1B). This widespread distribution complements its extensive distribution in South Africa to the south and west of this province as illustrated by Howell *et al.* (1978) and Walker & Olwage (1987).

Haemaphysalis elliptica

When the surveys of Neves *et al.* (2004) and Nyangiwe *et al.* (2006) on the ticks of dogs in Mozambique

TABLE 1 Species and total number of ticks collected from cattle, goats, dogs and the vegetation in the eastern region of the Eastern Cape Province, South Africa

Tick species	Total no. of ticks collected	No. of ticks collected from cattle, goats, dogs and the vegetation and number of these infested							
		Cattle (n = 360)		Goats (n = 360)		Dogs (n = 200)		Vegetation (n = 72)	
		Ticks	No. infested	Ticks	No. infested	Ticks	No. infested	Ticks	Localities positive
<i>Amblyomma hebraeum</i>	734	592	138	68	61	56	19	18	2
<i>Haemaphysalis elliptica</i>	201	-	-	-	-	193	93	8	5
<i>Haemaphysalis spinulosa</i>	1	-	-	-	-	1	1	-	-
<i>Hyalomma rufipes</i>	32	30	21	2	2	-	-	-	-
<i>Ixodes pilosus</i> group	3	-	-	1	1	2	2	-	-
<i>Rhipicephalus (Boophilus) decoloratus</i>	165	25	6	2	1	-	-	138	25
<i>Rhipicephalus (Boophilus) microplus</i>	2 289	968	242	236	113	-	-	1 085	63
<i>Rhipicephalus appendiculatus</i>	4 817	2 159	271	1 924	296	29	19	705	43
<i>Rhipicephalus evertsi evertsi</i>	5 342	1 957	316	2 251	334	2	2	1 132	66
<i>Rhipicephalus sanguineus</i>	25	-	-	-	-	25	7	-	-
<i>Rhipicephalus simus</i>	54	-	-	-	-	54	29	-	-
<i>Otobius megnini</i>	4	4	2	-	-	-	-	-	-
Total	13 667	5 735	-	4 484	-	362	-	3 086	-

TABLE 2 Species and total number of ticks collected from cattle, goats, dogs and the vegetation in Maputo Province, Mozambique

Tick species	Total no. of ticks collected	Number of ticks collected from cattle, goats, dogs and the vegetation and number of these infested							
		Cattle (n = 145)		Goats (n = 129)		Dogs (n = 132)		Vegetation (n = 23)	
		Ticks	No. infested	Ticks	No. infested	Ticks	No. infested	Ticks	Localities positive
<i>Amblyomma hebraeum</i>	3 128	1 588	136	1 130	118	210	33	200	10
<i>Haemaphysalis elliptica</i>	449	-	-	-	-	447	62	2	1
<i>Haemaphysalis</i> sp.	7	-	-	-	-	7	6	-	-
<i>Hyalomma rufipes</i>	1	-	-	-	-	-	-	-	-
<i>Ixodes cavipalpus</i>	11	1	1	7	4	3	1	-	-
<i>Rhipicephalus (Boophilus) microplus</i>	7 486	6 790	129	351	43	-	-	345	17
<i>Rhipicephalus appendiculatus</i>	1 989	1 222	95	514	47	8	6	245	13
<i>Rhipicephalus evertsi evertsi</i>	1 129	593	103	513	83	4	3	19	9
<i>Rhipicephalus kochi</i>	30	9	5	21	8	-	-	-	-
<i>Rhipicephalus longus</i>	4	1	1	3	1	-	-	-	-
<i>Rhipicephalus pravus</i> group	12	8	3	2	2	2	2	-	-
<i>Rhipicephalus sanguineus</i>	153	-	-	-	-	153	17	-	-
<i>Rhipicephalus simus</i>	712	336	102	27	16	346	98	3	3
<i>Rhipicephalus tricuspis</i>	3	-	-	3	1	-	-	-	-
<i>Rhipicephalus turanicus</i>	78	9	7	1	1	68	18	-	-
Total	15 192	10 558	-	2 572	-	1 248	-	814	-

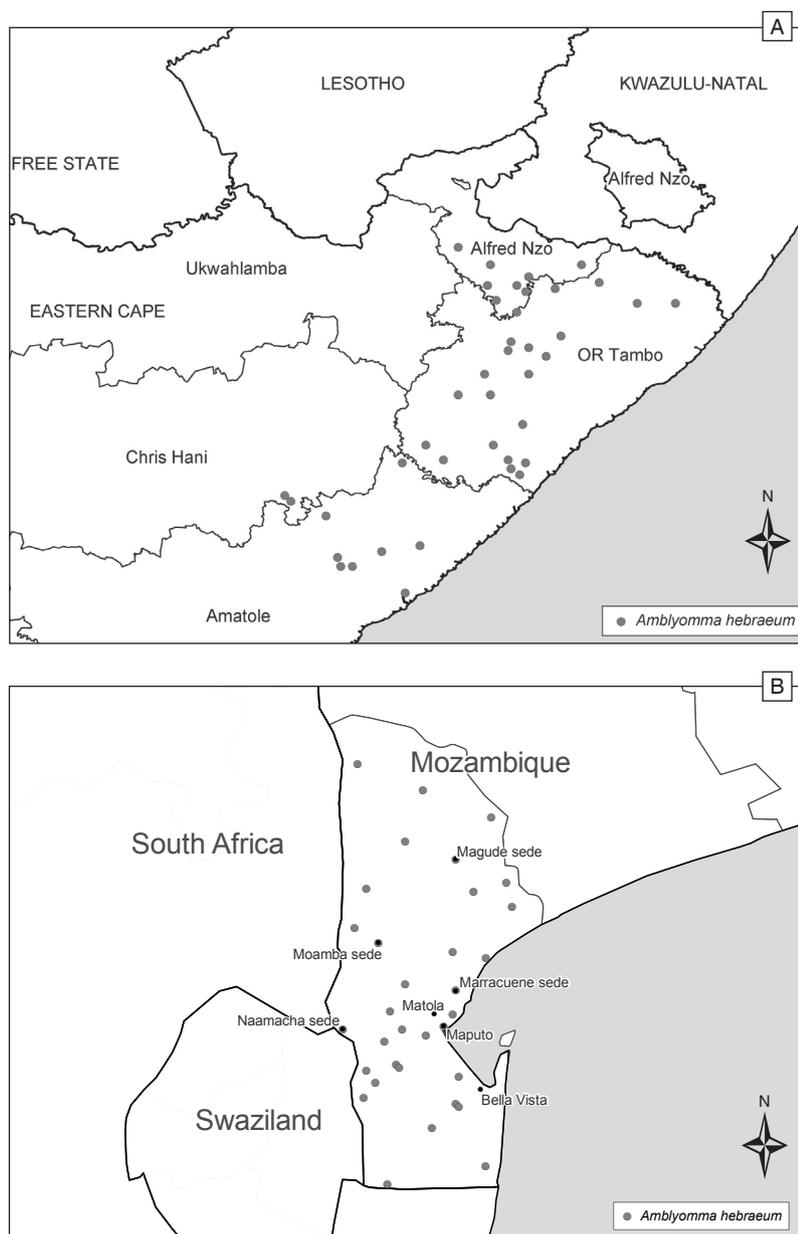


FIG. 1

The geographic distribution of *Amblyomma hebraeum* in (A) the eastern region of the Eastern Cape Province, South Africa, and (B) Maputo Province, Mozambique

and in the Eastern Cape Province were published this tick was referred to as *H. leachi*. It has subsequently been re-established as an old taxon, namely *H. elliptica*, originally described by Koch in 1844 from the Cape of Good Hope (Apanaskevich *et al.* 2007). Nyangiwe *et al.* (2006) and De Matos *et al.* (2008) have plotted the geographic distribution of *H. elliptica* in the eastern region of the Eastern Cape Province and in Maputo Province and these maps will not be repeated here. Although collections were made at only 20 of the 40 localities at which dogs were examined in the Eastern Cape Province, these were spread nearly throughout the survey region, leading us to believe that the tick is as widespread

in this region as illustrated by Howell *et al.* (1978). In Maputo Province it was collected at 26 of the 27 localities at which dogs were examined.

Norval (1984) has suggested that wherever there are dogs and adequate numbers of rodents to act as hosts for its immature stages, *H. leachi* (*H. elliptica*) is likely to be present. The distribution map of Howell *et al.* (1978) portrays a more extensive distribution for *H. leachi* (*H. elliptica*) in the east of South Africa, adjacent to Mozambique, than in the west of the former country. The widespread distribution of *H. elliptica* in Maputo Province thus supplements the already extensive distribution of this tick in the south-east of the sub-continent.

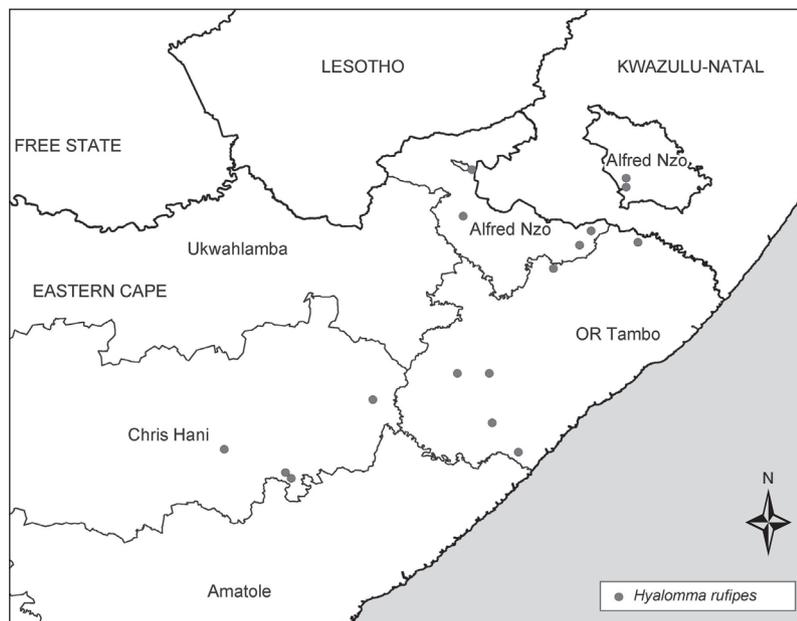


FIG. 2

The geographic distribution of *Hyalomma rufipes* in the eastern region of the Eastern Cape Province, South Africa

***Hyalomma* spp.**

Hyalomma rufipes was present at 16 localities in the Eastern Cape Province (Fig. 2), and its distribution in this region is similar to that mapped for it by Howell *et al.* (1978). Walker (1991) states that *H. rufipes* is absent in many of the moister eastern regions of South Africa. Its presence in the Eastern Cape survey region may thus reflect a trend towards slightly drier conditions in this area.

Hyalomma rufipes was collected at only one locality in Maputo Province. This is not surprising, as its distribution as illustrated by Howell *et al.* (1978), shows that it is not present in north-east KwaZulu-Natal or in the Kruger National Park, South Africa, immediately to the south and to the west of Maputo Province. Furthermore, Dias (1993) states that the distribution of *H. rufipes* is restricted to the drier regions of some of the more northerly provinces of Mozambique, namely Inhambane, Sofala, Tete and Niassa.

No *Hyalomma truncatum* were collected in either of the survey regions. The north-eastern limits of this tick's distribution in South Africa appear to coincide with the Lebombo mountain range that lies between the Kruger National Park in the west and Maputo Province in the east (Howell *et al.* 1978). During the cooler months of the year nearly every scrub hare, *Lepus saxatilis*, in the Kruger National Park is infested with the immature stages of *H. truncatum* (Horak, Spickett, Braack & Penzhorn 1993), and most giraffes, *Giraffa camelopardalis*, with adults throughout the year (Horak, Golezardy & Uys 2007).

***Ixodes* spp.**

Three ticks belonging to the *Ixodes pilosus* group of species were recovered at three sampling sites in the Eastern Cape Province, one from a goat and one each from two dogs. These collection localities lie within the distribution range mapped for this group of ticks by Howell *et al.* (1978). Eleven *Ixodes cavipalpus* were collected from a calf, four goats and a dog at a single locality in Maputo Province. Although Dias (1993) listed five species of *Ixodes* that occur in Mozambique, he did not include *I. cavipalpus* amongst these. According to Walker (1991) the latter tick is possibly the most widely distributed *Ixodes* sp. in the Afrotropical region, and has been collected from a wide variety of hosts (Theiler 1962).

Rhipicephalus (Boophilus) spp.

Rhipicephalus (B.) decoloratus was collected at 29 of the 72 survey localities in the Eastern Cape Province (Fig. 3A), compared to not one of the 30 localities in Maputo Province. Conversely *R. (B.) microplus* was present at nearly every sampling locality in both provinces (Fig. 3B, C).

Howell *et al.* (1978) mapped the distributions of both these ticks in South Africa. At that time *R. (B.) decoloratus* was widespread in the eastern region of the Eastern Cape Province, whereas the distribution of *R. (B.) microplus* was restricted to coastal pockets. Using their own more recently obtained data, Baker, Jordaan & Robertson (1981) and Baker (1982) illustrated a considerably more extensive

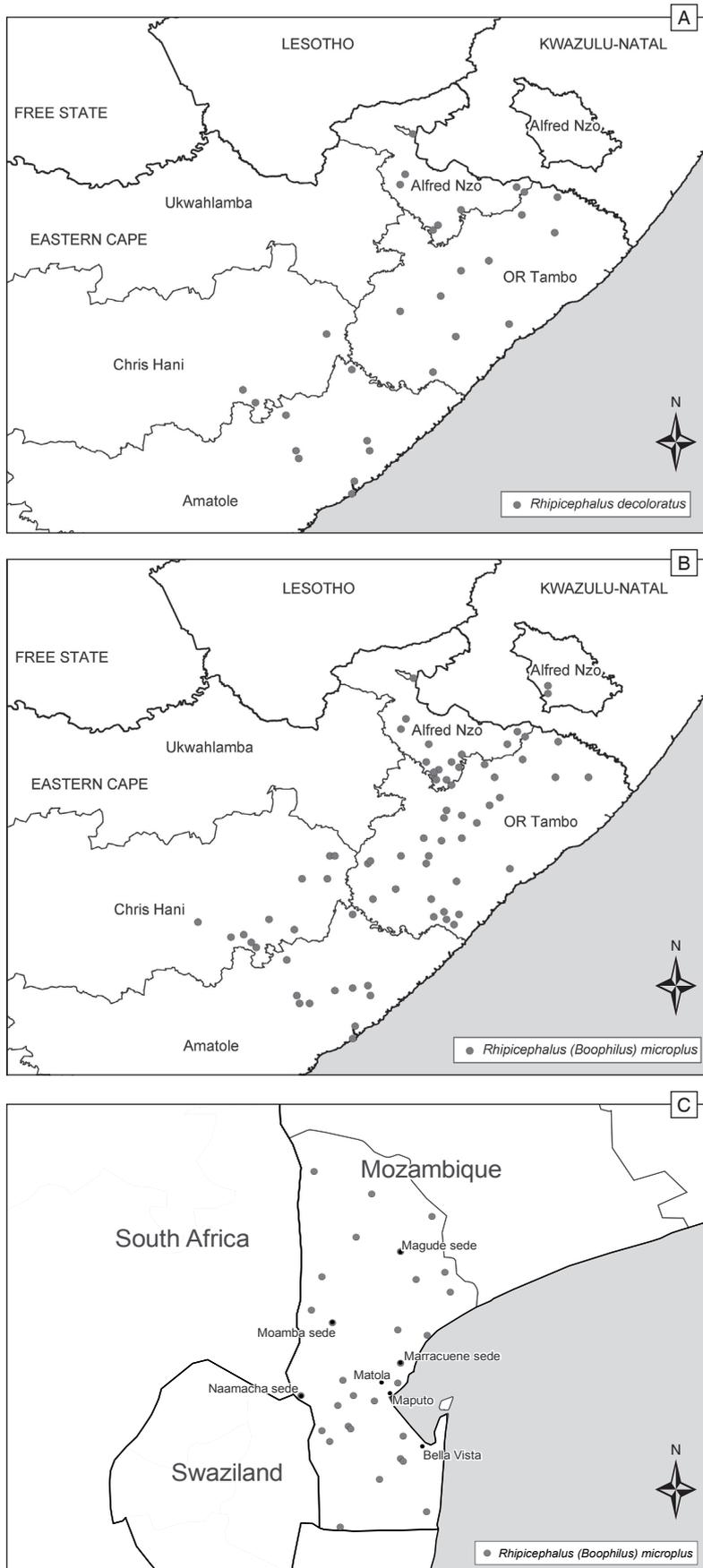


FIG. 3

The geographic distribution of *Rhipicephalus (Boophilus) decoloratus* in (A) the eastern region of the Eastern Cape Province, South Africa, and of *Rhipicephalus (Boophilus) microplus* in (B) the eastern region of the Eastern Cape Province and (C) Maputo Province

distribution for the latter tick in this region. The results of the present survey indicate that *R. (B.) microplus* has further extended its range, and that the 1978 distribution pattern of the two ticks has now been reversed. In the present study a single nymph and 26 adult *R. (B.) decoloratus* were collected from six cattle and a goat at four localities in the Eastern Cape Province, and questing larvae from the vegetation at 25 localities. In contrast 16 nymphs and 1 288 adult *R. (B.) microplus* were collected from 242 cattle and 113 goats at 69 of the 72 localities surveyed, and 1 085 larvae from the vegetation at 62 localities in this province.

At the time Dias (1993) compiled his lists of the ticks of Mozambique he stated that *R. (B.) decoloratus* was common wherever there were cattle, in all regions of the country, and that it was also present on several wild mammals. In support of this observation greater kudu, *Tragelaphus strepsiceros*, and impalas, *Aepyceros melampus*, in the Kruger National Park, South Africa, to the west of Maputo Province, harbour very large numbers of *R. (B.) decoloratus* and no *R. (B.) microplus* (Horak, Boomker, Spickett & De Vos 1992; Horak, Gallivan, Braack, Boomker & De Vos 2003). This implies that in earlier times wildlife and probably also domestic cattle in Maputo Province were very likely to have been infested with *R. (B.) decoloratus*. This is no longer the case for domestic stock, as it appears as if the latter tick has now been displaced by *R. (B.) microplus*. Displacement has also been reported in Zimbabwe (Mason & Norval 1980), the Eastern Province of Zambia

(Berkvens, Geysen, Chaka, Madder & Brandt 1998) and Tanzania (Lynen, Zeman, Bakuname, Di Giulio, Mtui, Sanka & Jongejan 2008).

The reasons for this displacement are numerous. The total length of the life cycle of *R. (B.) microplus* is slightly shorter than that of *R. (B.) decoloratus* (Arthur & Londt 1973; Londt & Arthur 1975), and female *R. (B.) microplus* produce slightly more eggs than those of *R. (B.) decoloratus* (Spickett & Malan 1978). Its spread may thus be enhanced by its slightly shorter life cycle and slightly higher egg production. Moreover, cross mating between the two species results in sterile eggs being produced (Spickett & Malan 1978), and although male ticks prefer to mate with conspecific females (Norval & Sutherst 1986), they will also mate with females of the other species (Spickett & Malan 1978). The males of *R. (B.) microplus* are sexually mature a few days sooner than those of *R. (B.) decoloratus* (Londt & Arthur 1975), and thus in mixed infestations they have a greater chance of mating with females of their own species. Furthermore, if the sex ratio of male to female *R. (B.) microplus* is similar to that of *R. (B.) decoloratus* on naturally infested hosts, viz. approximately 2:1 (Horak *et al.* 1992, 2003), the excess numbers of *R. (B.) microplus* males could mate with *R. (B.) decoloratus* females, rather than the converse happening. As females apparently mate only once, the cross-mated females would produce sterile eggs and *R. (B.) microplus* would consequently constitute an ever-increasing proportion of future mixed populations of the two ticks.

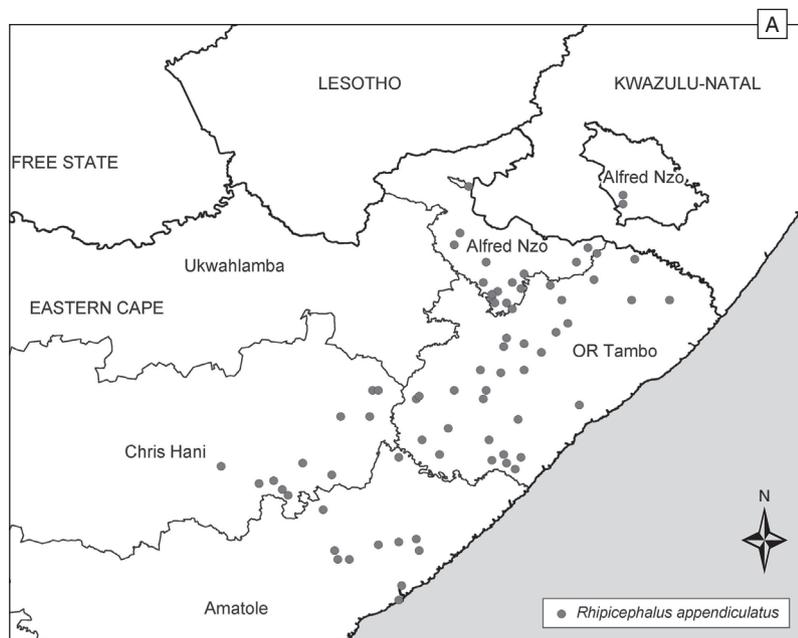
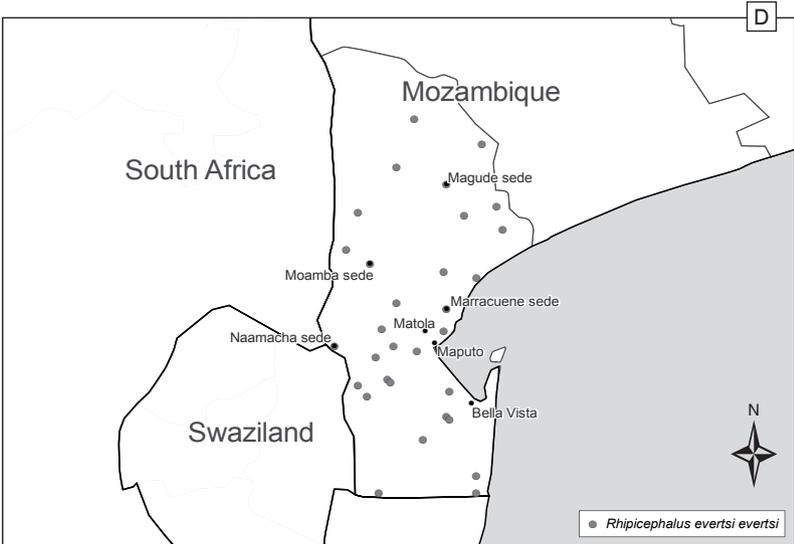
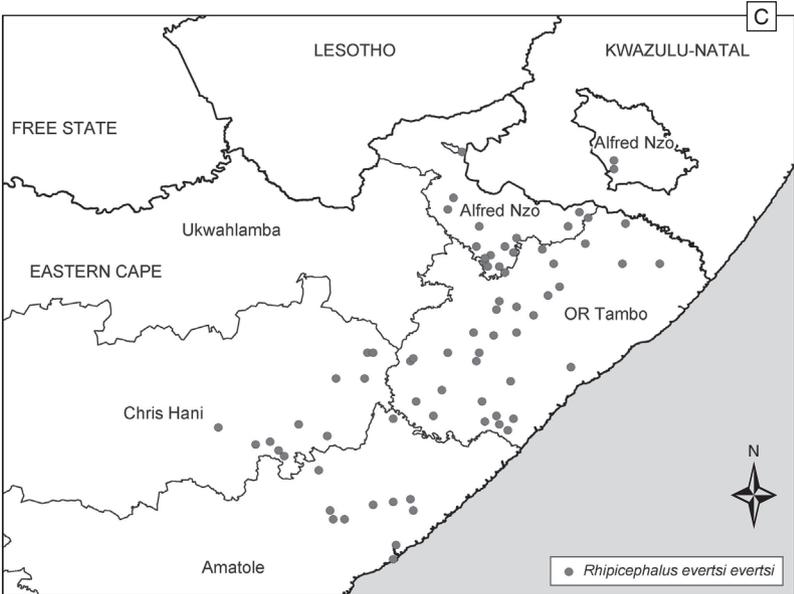
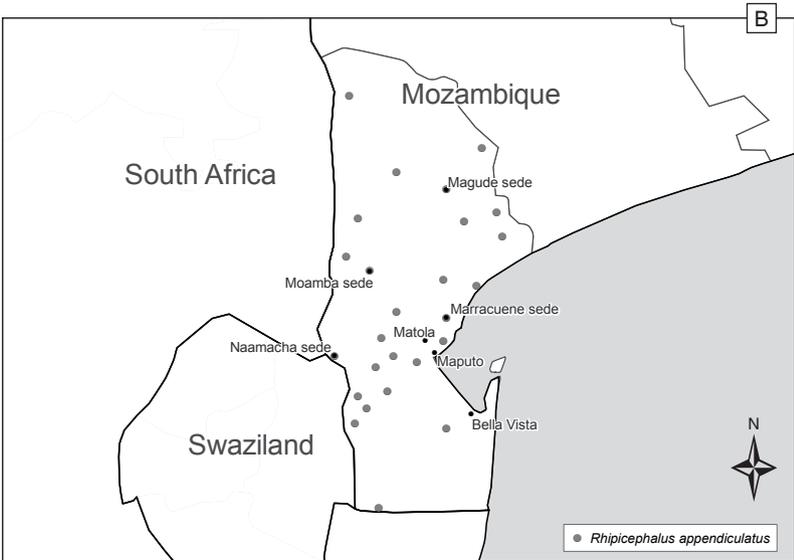


FIG. 4

The geographic distribution of *Rhipicephalus appendiculatus* in (A) the eastern region of the Eastern Cape Province, South Africa and (B) Maputo Province, Mozambique, and of *Rhipicephalus evertsi evertsi* in (C) the eastern region of the Eastern Cape Province and (D) Maputo Province

FIG. 4 (*cont.*)



In southern Mozambique this displacement has been augmented by the decimation of livestock and wildlife during the war of independence and the civil strife that followed. This alone possibly led to the near extinction of *R. (B.) decoloratus* in this region. When restocking with cattle commenced after the war, *R. (B.) microplus* was probably introduced or reintroduced on these animals, whereas few of the larger wildlife species, and with them *R. (B.) decoloratus*, have returned to Maputo Province.

Rhipicephalus appendiculatus

This tick was collected at 70 of the 72 collection localities in the eastern region of the Eastern Cape Province (Fig. 4A) and, with the exception of the most southerly region of Maputo Province, where it was collected at only one locality, it was also widespread throughout Maputo Province (Fig. 4B).

Its distribution in South Africa, as illustrated by Walker *et al.* (2000), indicates that it is absent, or only sparsely present, in north-east KwaZulu-Natal, where this province abuts on the southern border of Maputo Province. The tick's scant distribution in north-east South Africa thus supports its sparseness or absence in the south of Maputo Province. Its widespread presence in the remainder of Maputo Province adds this region to its already widespread distribution in south-east Africa.

Rhipicephalus evertsi evertsi

Rhipicephalus evertsi evertsi is widespread throughout both survey regions (Fig. 4C, D), confirming its position as one of the most widely distributed *Rhipicephalus* species in sub-Saharan Africa (Walker *et al.* 2000). Although domestic and wild equids are probably the preferred hosts of all stages of development of this tick (Norval 1981), cattle, goats and sheep are also good hosts, while dogs are seldom infested (Walker *et al.* 2000). This pattern of host infestation is also apparent in the present surveys (Tables 1, 2).

The tick distribution maps published by Walker *et al.* (2000) for *Rhipicephalus* spp. in sub-Saharan Africa, illustrate the widespread distribution of *R. e. evertsi* in the eastern half of South Africa, but do not include a single site in southern Mozambique. This we are sure is due to a lack of reportage and not actual absence. Its presently recorded widespread distribution in Maputo Province (Fig. 4D), complements its distribution in the adjacent regions of South Africa (Walker *et al.* 2000).

Rhipicephalus kochi

This tick has a very limited distribution in South Africa. It is present only in the far north-east regions of KwaZulu-Natal and Limpopo Provinces where these border on Mozambique (Walker *et al.* 2000), and it is thus usually only encountered on wild animals in South Africa. It was collected from cattle and goats in Maputo Province within the distribution range recorded for it in this region by Walker *et al.* (2000).

***Rhipicephalus pravus* group**

This group of ticks comprises several apparently closely related species. All stages of development of some of these have been illustrated and described (Walker *et al.* 2000), whereas others remain innominate and undescribed.

One of the latter ticks has been designated *Rhipicephalus* sp. (near *pravus*) and its distribution stretches across southern Africa from northern Namibia in the west, through Botswana and northern South Africa to southern Mozambique in the east (Walker *et al.* 2000), while the distribution of another, designated *Rhipicephalus* sp. (near *punctatus*) extends from south-western Angola in the west, through Zambia and Zimbabwe to northern Mozambique in the east (Walker *et al.* 2000). The tick collected in Maputo Province resembles the *Rhipicephalus* sp. (near *pravus*) entity, and its distribution corresponds with that of the latter tick as illustrated by Walker *et al.* (2000). Adult ticks of this species infest a variety of domestic and wild hosts, including hares, and the immature stages infest elephant shrews and hares (Walker *et al.* 2000). In the present survey three cattle, two goats and two dogs were infested with adult ticks (Table 2).

Rhipicephalus sanguineus

All stages of development of *R. sanguineus* are nearly exclusively parasites of domestic dogs (Walker *et al.* 2000), and adult ticks were collected only from dogs in both survey regions, at two localities in the Eastern Cape Province and at eight in Maputo Province (Fig. 5A). The free-living stages of this tick's life cycle have adapted to the environment in and around the resting places of dogs in man-made structures such as sheds, dog kennels and human dwellings, whence they quest for their hosts (Horak 1982; Walker *et al.* 2000). Its presence on dogs at ten of the rural sampling localities in the present surveys suggests that these animals were, at least for some



FIG. 5
Geographic distribution of (A) *Rhipicephalus sanguineus*, (B) *Rhipicephalus simus*, and (C) *Rhipicephalus turanicus* in Maputo Province, Mozambique

part of the day, chained, or caged at the homes of their owners, or that they had a preferred resting place in or next to these homes.

Rhipicephalus simus

Nyangiwe *et al.* (2006) and De Matos *et al.* (2008) have mapped the geographic distribution of *R. simus* in the eastern region of the Eastern Cape Province and in Maputo Province based on collections from dogs. Although *R. simus* is widespread in the moister regions of southern Africa, adult ticks are seldom collected in large numbers (Walker *et al.* 2000). In the eastern region of the Eastern Cape Province it was collected only from dogs, and then only from 14 of the 53 localities at which dogs were examined. Its absence on cattle in the Eastern Cape at the same localities at which infested dogs were present is difficult to explain. In contrast slightly more cattle than dogs were infested in Maputo Province, where *R. simus* was widespread and present at 24 of the 30 localities sampled (Fig. 5B).

The immature stages of this tick are reliant on rodents as hosts (Petney, Horak, Howell & Meyer 2004), and Horak, Spickett & Braack (2000) have recorded a significant increase in the numbers of questing adult *R. simus* on the vegetation in the southern Kruger National Park in the year following a rodent explosion at the same locality. The small number of hosts infested with adult *R. simus* in the Eastern Cape Province compared with the large number in Maputo Province could possibly reflect differences in both the overall abundance and species richness of the rodent fauna in the two regions.

Rhipicephalus turanicus

The inability to distinguish this tick from *R. sanguineus* has created many problems as to their identities, host preferences, life cycles and geographic distributions. The studies of Pegram, Clifford, Walker & Keirans, (1987a) and Pegram, Keirans, Clifford & Walker (1987b) have addressed this problem, but have, as yet, not solved it. This is probably mainly due to the widespread distributions of both of these ticks and with these the inevitable geographic variability in their morphology. In her review of the ixodid ticks of southern Africa Walker (1991) reported that *R. turanicus* was present in scattered localities in Transvaal Province, South Africa (a province that has now been divided into the four northern provinces of this country) and from Bergville in KwaZulu-Natal Province. The newfound ability to identify this tick with greater certainty resulted in Walker *et al.*

(2000) recording it at 11 localities in South Africa 9 years later. It is now frequently collected in South Africa from dogs, hares and larger birds and also questing from the vegetation, but has as yet not been found in the Eastern Cape Province. A total of 78 adult *R. turanicus* was collected in Maputo Province, mainly from dogs, but cattle and a goat were also infested (Table 2). It was particularly prevalent in the central region of Maputo Province, but collections were also made in the far south and north of the province (Fig. 5C).

Questing adult ticks have been collected from the vegetation in the southern Kruger National Park, South Africa, to the west of Maputo Province, where they are most abundant during the late summer and autumn (Horak *et al.* 2000). As with *R. simus* the immature stages of this tick are reliant on rodents as hosts (Walker *et al.* 2000), and Horak *et al.* (2000) recorded an increase in the numbers of questing adult ticks on the vegetation in the Kruger National Park in the year after a rodent explosion. We assume that Dias (1993) did not recognize *R. turanicus* as a separate species and included it with *R. sanguineus* in his list of ticks for Mozambique.

***Rhipicephalus* spp.**

A number of unconfirmed locality records for *Rhipicephalus longus* exist in central and northern Mozambique (Walker *et al.* 2000), and the present collection is the furthest south to date.

Rhipicephalus tricuspis has been reported in the northern provinces of South Africa and in central and northern Mozambique, with a single record just north of Maputo Province (Walker *et al.* 2000). Three ticks were collected from a single goat in Maputo Province in the present survey (Table 2).

Otobius megnini

A single calf, at each of two localities in the eastern region of the Eastern Cape Province, was infested with the nymphs of the argasid tick, *Otobius megnini* (Table 1). No argasid ticks were collected in Maputo Province.

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