

## A REVIEW OF THE IXODID TICKS (ACARI, IXODIDAE) OCCURRING IN SOUTHERN AFRICA

JANE B. WALKER, Veterinary Research Institute, Onderstepoort 0110

### ABSTRACT

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Eighty-three species of ixodid ticks, as well as several entities that have yet to be described, occur in the Republic of South Africa plus the 4 independent states lying within its borders (Bophuthatswana, Venda, Transkei and Ciskei) and in Namibia, Botswana, Lesotho and Swaziland. They belong to the following genera: *Amblyomma* (8 spp.); *Aponomma* (3 spp.); *Boophilus* (2 spp.); *Cosmiomma* (1 sp.); *Dermacentor* (1 sp.); *Haemaphysalis* (10 spp.); *Hyalomma* (2 spp., one of them with 2 subsp.); *Ixodes* (25 spp.); *Margaropus* (1 sp.); *Rhipicentor* (2 spp.), and *Rhipicephalus* (28 spp.).

The history of tick research in this region is reviewed briefly and advances made by the major contributors to our knowledge are highlighted.

Short comments on each genus are given. These are followed by information on every species known to occur in the region, presented under the following headings: Species diagnosis, under which references to relevant descriptions are listed and, where appropriate, notes on commonly used synonyms, related species and identification problems are included; hosts, indicating whenever possible the preferences of both the adults and the immature stages, as well as differentiating between common and incidental hosts, and distribution in terms of political (not ecological) divisions.

### INTRODUCTION

#### Historical background

Descriptions of ticks that occur in South Africa began to appear in the literature over 200 years ago. In 1778 Baron C. de Geer described 2 species: "*Acarus sylvaticus*", based on a ♀ tick taken from a "Schildkröte" (i.e. a tortoise) at the Cape of Good Hope by Sparrmann, and "*Acarus rhinocerotis*" from a rhinoceros, also at the Cape of Good Hope. Over the years there has been much confusion and controversy about the entities to which his names apply. The current view is that they are the valid names for *Amblyomma sylvaticum* and *Amblyomma rhinocerotis* respectively (Theiler, 1943a; Hoogstraal, 1956).

During the following 66 years another 8 South African ticks were described. Most were common, well-known species, for example *Rhipicephalus sanguineus* (Latreille, 1806) and *Haemaphysalis leachi* (Audouin, 1827), but one, *Cosmiomma hippopotamensis* (Denny, 1843), has rarely been found since it was first discovered.

In 1844 C. L. Koch published his historic work on ticks from different parts of the world in which he laid a large part of the foundation of modern tick systematics, including establishing 5 genera. Eleven ixodids that occur in southern Africa feature in this work, amongst them such important species as *Amblyomma hebraeum*, *Boophilus decoloratus* (as *Rhipicephalus decoloratus*), *Hyalomma marginatum rufipes* (as *H. rufipes*), *Hyalomma truncatum*, *Ixodes pilosus*, *Rhipicephalus capensis* and *Rhipicephalus simus* (Theiler, 1962).

In terms of the number of new tick species he described Koch's contribution to our knowledge has been exceeded only by that of the great French parasitologist L. G. Neumann, of the Veterinary School at Toulouse, in southern France. His interest in South African ticks was stimulated through his close and cordial association with C. P. Lounsbury, who emigrated from the United States of America to take up an appointment as Government Entomologist to the Department of Agriculture, Cape of Good Hope, in 1895. Initially Lounsbury worked on the

insect pests of crops and orchards, then in 1898 he began the detailed, painstaking observations on ticks and tickborne diseases for which he became famous. In 1899 he wrote to Neumann and began sending him specimens. In 1901 Neumann published a description of *Rhipicephalus appendiculatus*, followed in 1904 by descriptions of *Rhipicephalus nitens* and *Ixodes rubicundus*, based on some of Lounsbury's collections. Besides these 3 species Neumann described another 16 that occur in South Africa from specimens obtained from various sources in other parts of the continent.

Lounsbury also sent many ticks, including live specimens for experimental purposes, to G. H. F. Nuttall in England (Keirans, 1985). Nuttall and his Cambridge colleague, C. Warburton, with their collaborators W. F. Cooper and L. E. Robinson of the Cooper organization, made considerable contributions to the systematics of African ticks. Between them they described 9 species that occur in southern Africa, among them *Haemaphysalis silacea* and the genus *Rhipicentor* with its 2 species *R. bicornis* and *R. nuttalli*. Many of their findings were included in books on the Argasidae and on the genera *Ixodes*, *Haemaphysalis* and *Amblyomma*, published under the general title "Ticks—A monograph of the Ixodoidea" (Nuttall, Warburton, Cooper & Robinson, 1908-1926), that remain essential references to this day.

Another renowned tick systematist during the early part of this century was W. Dönitz of Berlin, to whom many tick collections from "Deutsch-Südwest-afrika" (Namibia) and "Deutsch-Ostafrika" (Tanzania) were sent. He published a number of valuable papers on his findings, of which those on the genus *Amblyomma* (Dönitz, 1909) and on various southern African species (Dönitz, 1910) are especially relevant. Subsequently the ticks of Namibia also received attention from Trommsdorff (1914) and Hans Sigwart (1915).

The first overall review of southern African ticks was published in 1908 by C. W. Howard who, like Lounsbury, had emigrated from the United States. It was a particularly remarkable achievement because he was appointed as Assistant Entomologist, Transvaal Department of Agriculture, only in 1905 and by 1908 had moved to Portuguese East Africa (Mozambique).

In February 1912 G. A. H. Bedford arrived from England to take up a post as Entomologist at Onderstepoort, where he worked for 26 years. Referred to later by Theiler (1975) as "a taxonomist *par excellence*", he studied virtually all the parasitic arthropods occurring in South Africa. These included ticks, of which he described 3 new species (*Haemaphysalis cooleyi*, *Ixodes elongatus* and *Rhipicephalus theileri*). In 1932 he published a valuable checklist and host list of the ectoparasites found on South African reptiles, birds and mammals, to which he later added a supplement (Bedford, 1932, 1936). He also began what was obviously intended to be a series of papers on South African ticks, of which only the first part was published (Bedford, 1934).

Following Bedford's early death in 1938 R. du Toit assumed responsibility for work on ticks, and in 1941 described *Rhipicephalus glabroscutatum*. His involvement with these parasites was relatively brief because Gertrud Theiler was appointed at Onderstepoort in 1940 and immediately took over the basic tick research. She undertook this task with enthusiasm and during the following quarter of a century carried out numerous fundamental studies on the systematics of African ticks, assisted for short periods by Britha Robinson and Lois Salisbury. She maintained close and cordial links with other tick workers worldwide and became the doyenne of those in Africa. Her studies culminated in her review of all the known tick species occurring in the Afro-tropical region (Theiler, 1962). Finally in 1975 she published an interesting synopsis of tick research in Africa which amplifies this brief account. Further details regarding the contributions made by many other people to our current knowledge of southern African ticks, for example H. Hoogstraal, D. R. Arthur, F. Zumpt and J. A. T. Santos Dias, will also be found later in the present paper under the accounts of individual genera and species.

#### Scope of this review

All the genera and species of ixodid ticks presently recognized in southern Africa are included. Short comments on each genus are followed by information on the individual species presented under the subheadings species diagnosis, hosts, and distribution.

The sections on species diagnosis include references to descriptions plus notes on commonly used synonyms, related species and taxonomic problems. In these sections the term "undescribed" indicates that the stage(s) referred to have been identified but not as yet formally described, whereas "unknown" indicates that they have not even been recognized.

The sections on hosts include, whenever possible, information on the preferences of both the adults and the immature stages. Their preferred and incidental hosts are also differentiated. Host nomenclature is according to that given in the following publications: reptiles—Broadley (1983), Patterson & Bannister (1987), Boycott & Bourquin (1988); birds—Maclean (1985), and mammals—Meester, Rautenbach, Dippenaar & Baker (1986).

The information on distribution is given primarily according to political, not ecological, divisions. As used here the term "southern Africa" implies the Republic of South Africa and the 4 independent states lying within its borders (Bophuthatswana, Venda, Transkei and Ciskei), plus Namibia, Botswana and Swaziland. Some records from Lesotho are also included, though no formal tick survey has ever been carried out there and few data are

available.

The transmission of human and animal pathogens by the ixodid tick species reviewed here is mentioned under the various genera, but only briefly. References on this subject have been kept to a minimum. In particular those cited by Neitz (1956) in his comprehensive review of this subject have been omitted.

#### GENUS *AMBLYOMMA* KOCH, 1844

##### Generic characteristics:

- (a) Ornate, i.e. a coloured pattern is usually present on the scutum
- (b) Legs banded
- (c) Hypostome and palps long
- (d) Eyes present
- (e) Festoons present
- (f) Adanal plates in the male absent

This genus, the third largest in the family Ixodidae, is distributed world-wide. The majority of these bont ticks, which are mostly large, colourful species, feature in a monograph by Robinson (1926). This work remains a basic reference even today for most African members of the genus.

Eight species of *Amblyomma* occur in southern Africa. These fall into 2 groups: 4 species whose known hosts are primarily mammals (*hebraeum*, *rhinocerosinus*, *tholloni* and *variegatum*) and 4 that are basically, but not always exclusively, parasites of reptiles (*marmoreum*, *nuttalli*, *sparsum* and *sylvaticum*). The latter group was reviewed in detail in a paper by Theiler & Salisbury (1959) that supersedes the earlier findings on some of these ticks by Robinson (1926).

Economically *A. hebraeum* and *A. variegatum* are 2 of the most important tick parasites of livestock in Africa, mainly because they are the principal vectors of *Cowdria ruminantium*, the causative agent of heartwater in cattle, sheep and goats. The ecology of these ticks, and of other *Amblyomma* spp. that can transmit *C. ruminantium*, was recently reviewed by Petney, Horak & Rechav (1987). In East Africa *A. variegatum* is also a vector of Nairobi sheep disease virus. Both *A. hebraeum* and *A. variegatum* can transmit *Rickettsia conori*, which causes human tick-bite fever (tick-borne typhus).

Adult bont ticks, and sometimes their nymphae, inflict severe bites on animals. These bites result in discomfort and extensive tissue damage, especially to the udders and teats of cows and to hides and skins in general. Often such bites act as routes of infection for various pathogenic organisms (Yeoman & Walker, 1967). For example, the bites of numerous *A. hebraeum* adults and nymphae round the hooves of goats caused skin damage and abscessation resulting in lameness (MacIvor & Horak, 1984, 1987).

#### *Amblyomma hebraeum* Koch, 1844

*Species diagnosis:* Robinson (1926), Arthur (1973), Walker & Olwage (1987).

*Hosts:* Cattle are regarded as the primary domestic hosts of the adults. They also feed readily on sheep, goats, horses and other equines, and sometimes on pigs and dogs. In addition adults have been collected from many species of wild mammals, especially the larger ungulates (Theiler, 1962; Petney *et al.*, 1987). Larvae and nymphae often feed on the same hosts as the adults. They also parasitize

many smaller animals, among them various carnivores (Carnivora, Canidae, Viverridae and Felidae) and hares, especially the scrub hare (*Lepus saxatilis*) (Lagomorpha, Leporidae) (Horak, MacIvor, Petney & De Vos, 1987b; Horak, Jacot Guillarmod, Moolman & De Vos, 1987c). Birds are important hosts of the immature stages, especially ground-feeding species such as the helmeted guinea fowl, *Numida meleagris* (Galliformes) (Theiler, 1962; Horak & Williams, 1986). Sometimes the leopard tortoise, *Geochelone pardalis* (Reptilia, Testudinae) harbours quite large numbers of nymphae (Walker & Schulz, 1984).

**Distribution:** In South Africa *A. hebraeum* occurs in the Transvaal bushveld; much of Swaziland; most of the thornveld and coastal areas of KwaZulu, Natal and the Transkei; in the coastal areas of the eastern Cape Province as far as Humansdorp, and in the Mossel Bay area (Theiler, 1948). Since Theiler's original survey the bont tick has apparently spread in both Swaziland and Natal (Baker & Ducasse, 1967; Howell, Walker & Nevill, 1978; Jagger, Wedderburn & McCartan, 1987; Walker & Olwage, 1987). In Botswana *A. hebraeum* is widespread in North-eastern and Kgatleng Districts and in the eastern parts of Central, Kweneng and Southern Districts. Paine (1982) commented that the bont tick was believed locally to have spread during the previous decade. He had collected a single ♂ in Ghanzi District but did not know whether the tick was actually established there. Extraliminally *A. hebraeum* occurs in Zimbabwe and southern Mozambique.

#### ***Amblyomma marmoreum* Koch, 1844**

**Species diagnosis:** Theiler & Salisbury (1959); Arthur (1975a, b); Walker & Olwage (1987). This species was confused with *A. sparsum*, and sometimes with *A. nuttalli*, by Robinson (1926).

**Hosts:** All stages feed on reptiles, most commonly tortoises (Chelonia, Testudinidae) but also some of the larger snakes, especially the puff adder, *Bitis arietans*, varanids and other lizards (Squamata) (Theiler, 1962; Walker & Schulz, 1984). Unlike the adults, which are specific parasites of reptiles (Hoogstraal & Aeschlimann, 1982), the immature stages, especially the larvae, also feed on a wide range of other animals. They have been collected from cattle, sheep, goats and dogs; various carnivores (Canidae, Viverridae and Felidae), especially black-backed jackals, *Canis mesomelas*, and caracals, *Felis caracal*; a few ungulates (Artiodactyla, Bovidae), the scrub hare, *Lepus saxatilis*, and Smith's red hare, *Pronolagus rupestris* (Lagomorpha, Leporidae) (Norval, 1975b; Horak & Knight, 1986; Horak, Potgieter, Walker, De Vos & Boomker, 1983b; Horak *et al.*, 1987 b, c). Various ground-feeding birds have also been recorded as hosts, particularly the helmeted guineafowl, *Numida meleagris* (Galliformes) (Norval, 1975b; Horak & Williams, 1986).

**Distribution:** In South Africa *A. marmoreum* is widely distributed (Theiler & Salisbury, 1959; Walker & Olwage, 1987). In Namibia, though, there are as yet scattered records only, from Outjo, Okahandja, Windhoek and Gobabis, and from Karasburg District (Theiler & Salisbury, 1959; Heloise Heyne, unpublished data). In Botswana it has been collected on Chief's Island in the Okavango; 100 km east of Maun on the Francistown road, and at Tshebe and Serowe (Theiler & Salisbury, 1959; Walker, Mehltz & Jones, 1978; Paine, 1982). Extraliminally it occurs in Zimbabwe and southern Mozambique.

#### ***Amblyomma nuttalli* Dönitz, 1909**

**Species diagnosis:** Theiler & Salisbury (1959), Arthur (1975a, b). This tick was sometimes confused with *A. marmoreum* by Robinson (1926).

**Hosts:** All stages feed on reptiles. The most commonly recorded hosts are tortoises, including the hinged tortoise, *Kinixys belliana*, and the leopard tortoise, *Geochelone pardalis* (Chelonia, Testudinidae). Leguaans (*Varanus* spp.) are also favoured, as are some of the larger snakes such as the python (*Python sebae*), puff adder (*Bitis arietans*) and gaboon viper (*Bitis gabonica*) (Squamata, Varanidae, Boidae and Viperidae). Theiler & Salisbury (1959) and Theiler (1962) also list various birds and mammals as hosts, often of the immature stages only, but their significance in the maintenance of this species has yet to be established.

**Distribution:** In South Africa *A. nuttalli* is commonest in KwaZulu and Natal. It has also been recorded in the Transvaal at Onderstepoort; in the north-eastern Cape Province at Kuruman, and in the eastern Cape Province at Grahamstown. It is widely distributed extraliminally in the Afrotropical region.

#### ***Amblyomma rhinocerotis* (De Geer, 1778)**

**Species diagnosis:** Robinson (1926, as *Amblyomma petersi*), Hoogstraal (1956). Immature stages unknown.

**Hosts:** Adults feed primarily on the white and the black rhinoceros, *Ceratotherium simum* and *Diceros bicornis* (Perissodactyla, Rhinocerotidae). It has only occasionally been collected from other animals (Hoogstraal, 1956; Yeoman & Walker, 1967).

**Distribution:** In South Africa this species has been recorded in northern KwaZulu and Natal in Ndumu, Mkuze, Hluhluwe and Umfolozi Game Reserves plus the Corridor area between the latter 2 reserves (Baker & Keep, 1970). Theiler (1962) also lists an old record from the eastern Cape Province in "Kaf-fraria". Extraliminally it has been widely recorded in East and Central Africa.

#### ***Amblyomma sparsum* Neumann, 1899**

**Species diagnosis:** Theiler & Salisbury (1959), Walker & Olwage (1987). Prior to the definitive study of the *Amblyomma marmoreum* group by Theiler & Salisbury this tick was frequently misidentified as *A. marmoreum*.

**Hosts:** Adults of *A. sparsum* favour 2 distinct groups of animals as hosts—some of the larger species of wild mammals on the one hand and various reptiles on the other. Their commonest mammalian hosts are the black rhinoceros, *Diceros bicornis* (Perissodactyla, Rhinocerotidae) and the buffalo, *Syncerus caffer* (Artiodactyla, Bovidae). They have also been collected from various other wild mammals, mostly the larger species, but such records are comparatively rare. Amongst reptiles, tortoises are most commonly parasitized, including specifically the hinged tortoise, *Kinixys belliana*, and the leopard tortoise, *Geochelone pardalis* (Chelonia, Testudinidae). Water and rock leguaans (*Varanus niloticus* and *Varanus exanthematicus*), agamid lizards (*Agama* spp.), pythons (*Python sebae*) and puff adders (*Bitis arietans*) (Squamata, Varanidae, Agamidae, Boidae and Viperidae) may also be infested (Theiler, 1962; Yeoman & Walker, 1967; Walker, 1974; Petney *et al.*, 1987).

**Distribution:** Thus far *A. sparsum* has been found in southern Africa only in northern Namibia. One ♀ was recorded in Outjo District (Heloise Heyne, un-

published data) and a ♂ was collected in 1933 by the Government Veterinary Officer, Grootfontein (Theiler & Salisbury, 1959). Extralimitally it is widely distributed in the Afrotropical region, especially in eastern and central Africa.

***Amblyomma sylvaticum* (De Geer, 1778)**

*Species diagnosis:* Theiler (1943a).

*Hosts:* Reptiles. All stages parasitize tortoises, especially the angulate tortoise, *Chersina angulata*, also the common padloper, *Homopus areolatus*, and the tent tortoise, *Psammobates tentorius* (Chelonia, Testudinidae). The immature stages only have been collected from the spiny agama, *Agama hispida*, and Knox's desert lizard, *Meroles knoxi* (Squamata, Agamidae, Lacertidae), and adults plus nymphae from the mole snake, *Pseudaspis cana* (Squamata, Colubridae).

*Distribution:* This species is known only from South Africa, Cape Province, where it has been recorded in the coastal areas from Port Elizabeth westwards to the Cape peninsula and up the west Cape coast as far as Hondeklip Bay. It may well occur throughout the range of the angulate tortoise (Boycott & Bourquin, 1988). Warburton (1927) also lists 3 collections of *A. sylvaticum* (syn. *Amblyomma latum* Koch, 1884) in the Vienna Museum from "Natal" and "Cape Zelandor". As Theiler (1962) pointed out, these collections should be restudied; this tick has not been recorded in Natal in recent times and the whereabouts of Cape Zelandor is unknown.

***Amblyomma tholloni* Neumann, 1899**

*Species diagnosis:* Robinson (1926), Hoogstraal (1956), Van der Borgh-Elbl (1977), Walker & Olwage (1987).

*Hosts:* This species occurs primarily on the elephant, *Loxodonta africana* (Proboscidea, Elephantidae), from which adults, and sometimes nymphae, have often been collected. If cattle, sheep and goats are kept in areas inhabited by elephants they too may be parasitized by the immature stages of this tick (MacKenzie & Norval, 1980). Various reptiles, birds and other wild mammals have also been listed as hosts (Theiler, 1962; Petney *et al.*, 1987) but they are probably of secondary importance in its maintenance.

*Distribution:* *A. tholloni* is restricted to areas in which elephants occur. In South Africa it has been recorded in the Transvaal, in Sibasa and the Kruger National Park, and KwaZulu, in Ndumu Game Reserve and Tongaland. Extralimitally it is very widely distributed in the Afrotropical region.

***Amblyomma variegatum* (Fabricius, 1794)**

*Species diagnosis:* Hoogstraal (1956), Van der Borgh-Elbl (1977), Walker & Olwage (1987).

*Hosts:* All stages feed on cattle, which are major hosts of this species. Sheep, goats and other domestic animals are infested to a lesser extent (Petney *et al.*, 1987). On wild animals adults are most prevalent on medium-sized to large herbivores. Many species of the order Artiodactyla, in particular, have been recorded as hosts. Herbivores belonging to other orders are much less commonly parasitized by this tick. The immature stages have been found on a few reptiles, various species of birds and many different mammals (Theiler, 1962; Petney *et al.*, 1987).

*Distribution:* In Namibia *A. variegatum* occurs

throughout the eastern Caprivi Strip (Theiler, 1962). In the neighbouring parts of northern Botswana it has been found in Ngamiland in the Kwando River area, also in Chobe District at Kavimba, Kazungulu (Kazungula), Leshomo (Lesomo) and Pandamantenga (Paine, 1982). Extralimitally it is the most widely distributed of the Afrotropical *Amblyomma* species. It has also extended its range considerably outside Africa, eastwards to the Yemen Arab Republic, Madagascar and various islands in the Indian Ocean, and westwards to the Cape Verde islands and islands in the eastern Caribbean (Walker & Olwage, 1987).

GENUS *APONOMMA* NEUMANN, 1899

*Generic characteristics:*

- (a) Hypostome and palps long
- (b) Eyes absent
- (c) Fестоons present
- (d) Adanal plates in the male absent

This genus of small, eyeless ticks, almost all of which are parasites of snakes and/or varanid lizards (leguaans or monitors) (Hoogstraal & Aeschlimann, 1982), was revised by Kaufman (1972). Subsequently Santos Dias (1985) has disagreed with Kaufman's findings regarding the synonymy of some species.

Three *Aponomma* species occur in southern Africa. One (*exornatum*) is ornate while the other 2 (*latum* and *transversale*) are inornate.

***Aponomma exornatum* (Koch, 1844)**

*Species diagnosis:* Theiler (1945a), Kaufman (1972).

*Hosts:* Primarily the water and rock leguaans *Varanus niloticus* and *V. exanthematicus* (Squamata, Varanidae). The adults often attach in the leguaan's nasal passages and sometimes even suffocate captive specimens (Young, 1965). Theiler (1962) also lists this tick from a wide range of other animals, including different reptiles, a bird, and various mammals, but these are thought to be incidental hosts only.

*Distribution:* In South Africa *A. exornatum* is very widely distributed. In Namibia it is recorded in Etosha Game Reserve and at various places in Grootfontein, Omaruru and Windhoek Districts, and in Botswana in Ngamiland and at Kanye. It is probably present throughout the range of its varanid hosts. Apart from the Namib Desert and the southwestern Cape Province *V. exanthematicus* occurs throughout southern Africa, while *V. niloticus* is found along the east flowing rivers, in the Okavango Swamps, and in the lower reaches of the Kunene and Orange Rivers (Patterson & Bannister, 1987). Extralimitally *A. exornatum* is widely distributed in East and parts of Central Africa.

***Aponomma latum* (Koch, 1844)**

*Species diagnosis:* Theiler (1945b), Kaufman (1972).

*Hosts:* Many species of snakes (Squamata, suborder Ophidia), especially the larger ones (Theiler, 1962; Kaufman, 1972). The occasional records that these authors list from various lizards, and even from a few mammals, are thought to represent incidental infestations only.

*Distribution:* It is widely distributed in South Africa, but in Namibia has as yet been recorded only at Okahandja and Gobabis, and in Botswana on Xhaga Island (not located, but presumably in the

Okavango swamps). Extraliminally it is very widely distributed in the Afrotropical region.

***Aponomma transversale* (Lucas, 1845)**

*Species diagnosis:* Theiler (1945b), Kaufman (1972). Larva unknown.

*Hosts:* Pythons (Squamata, Boidae), of which *Python sebae*, the African python, is the only host species recorded in southern Africa so far.

*Distribution:* In South Africa 4 collections only have been recorded, of which 2 were from captive pythons in the Johannesburg Zoo and the Cape Town Snake Park. It has also been collected in the eastern Transvaal lowveld, in the Manyeleti Game Reserve (Heloise Heyne, unpublished data), and in Natal at Pietermaritzburg. The true range of this tick probably coincides with that of the African python, which in South Africa occurs in parts of the Transvaal, Swaziland, KwaZulu, Natal, and the north-eastern and eastern Cape Province, also in northern Namibia and in parts of Botswana (Broadley, 1983). The paucity of records of this tick possibly reflects collectors' lack of opportunity, and perhaps enthusiasm, to examine its apparent predilection site on these large, somewhat unmanageable and irascible snakes, their eyelids. Extraliminally it is widely, though discontinuously, recorded in the Afrotropical region.

GENUS *BOOPHILUS* CURTICE, 1891

*Generic characteristics:*

- (a) Inornate
- (b) Hypostome and palps short
- (c) Eyes present, though they are sometimes difficult to see
- (d) Festoons absent
- (e) Adanal plates in the male present

Members of this small, but economically important, genus are commonly known as blue ticks. They are widely distributed in the Afrotropical and Oriental regions, Australia and the New World. Two species only have been recorded in southern Africa.

In a series of papers published during the 1930s W. Minning divided the genus into 3 subgenera, *Boophilus sensu stricto*, *Uroboophilus* and *Palpo-boophilus*, and described several new species. His classification was initially accepted, and some of the names he proposed appear in the South African literature, but it is not now regarded as valid (Hoogstraal, 1956).

The boophilids are one-host ticks. They are important both as vectors of various pathogens and also because they have over the years developed resistance to a wide range of acaricides. The common blue tick, *Boophilus decoloratus*, is the species that is most frequently implicated in the transmission of 3 cattle parasites: *Babesia bigemina*, causing African redwater, also *Anaplasma marginale* and *A. centrale*, causing gallsickness. The pantropical blue tick, *Boophilus microplus*, is a vector not only of *B. bigemina* but also of *Babesia bovis*, causing Asiatic redwater, and of *A. marginale*. In addition both these ticks can transmit *Borrelia theileri*, the cause of spirochaetosis in various domestic animals.

***Boophilus decoloratus* (Koch, 1844)**

*Species diagnosis:* Hoogstraal (1956), Arthur & Londt (1973), Heyne (1986). It was referred to as *Boophilus (Palpo-boophilus) decoloratus* by Theiler (1949b).

*Hosts:* The blue tick is primarily a parasite of the larger domestic and wild ungulates (Artiodactyla, Bovidae, Perissodactyla and Equidae) (Theiler, 1962). Cattle are its main domestic hosts, and very heavy infestations may also develop on horses (Theiler, 1911; Hoogstraal, 1956). Other domestic animals appear to be much less important as hosts (Hoogstraal, 1956; Baker & Ducasse, 1968). In the Kruger National Park it occurs in large numbers on Burchell's zebra, *Equus burchellii* (Horak, De Vos & De Klerk, 1984a), and was the most abundant and most prevalent tick recorded on blue wildebeest, *Connochaetes taurinus* (Horak, De Vos & Brown, 1983c). Numerous blue ticks have also been found on giraffe, *Giraffa camelopardalis*; kudu, nyala and bushbuck, *Tragelaphus strepsiceros*, *T. angasii* and *T. scriptus* respectively, and eland, *Taurotragus oryx* (Horak *et al.*, 1983b), as well as impala, *Aepyceros melampus*. The few species of birds, carnivores and lagomorphs listed as hosts by Theiler (1962) are not thought to be of any significance in the maintenance of this tick.

*Distribution:* In South Africa *B. decoloratus* is widely distributed in the Transvaal, Swaziland, KwaZulu and Natal, the northern and eastern Orange Free State, north-eastern and eastern Cape Province, in the southern coastal belt and in the winter rainfall areas of the western Cape Province (Theiler, 1949b; Howell *et al.*, 1978; Jagger *et al.*, 1987). In Namibia it has been recorded only in localized areas in the north. It is prevalent in much of eastern and south-eastern Botswana and also occurs in Ngamiland around the Okavango swamps and in north-eastern Chobe District (Paine, 1982). Extraliminally it is very widely distributed in the Afrotropical region.

***Boophilus microplus* (Canestrini, 1887)**

*Species diagnosis:* Hoogstraal (1956), Londt & Arthur (1975), Heyne (1986). It was referred to as *Boophilus (Uroboophilus) fallax* by Theiler (1962), but later she became convinced that this species is a synonym of *B. microplus* (Hoogstraal, 1956; Gertrud Theiler, unpublished data).

*Hosts:* Cattle are the primary hosts of this tick. It has only occasionally been collected from sheep, goats and horses (Theiler, 1943b; Hoogstraal, 1956; Mason & Norval, 1980). Records from wild animals are rare. They include the lion, *Panthera leo* (Carnivora, Felidae); grey rhebok, *Pelea capreolus*; sable antelope, *Hippotragus niger*, and buffalo, *Syncerus caffer* (Artiodactyla, Bovidae) (Theiler, 1962, Horak, Sheppey, Knight & Beuthin, 1986b). The indications are, therefore, that its potential host range resembles that of *B. decoloratus*.

*Distribution:* According to Howell *et al.* (1978) and Baker, Jordaan & Robertson (1979), in South Africa *B. microplus* occurs in the Transvaal to the north and east of Pretoria and in the Witbank, Belfast, White River, Barberton, Carolina, Ermelo, Standerton and Wakkerstroom Districts, also in KaNgwane. In Natal it has been found in the north in Ingwavuma, Newcastle, Hlabisa, lower Umfolozi and Mtunzini Districts and at the southern end of the province in Camperdown, Richmond, Ixopo, Umzinto, Port Shepstone and Alfred Districts. It also occurs in the Umzimkulu, Bizana, Flagstaff, Tabankulu, Lusikisiki, Libode, Tsolo, Ngqeleni, Elliotdale, Willowvale and Kentani areas of the Transkei. In the eastern Cape Province it is present in Stutterheim and Victoria East Districts, in the Ciskei at Keiskammahoeck, and in isolated pockets

along the southern Cape coast in the districts of Humansdorp, Knysna, George, Mossel Bay, Heidelberg, Swellendam, Caledon and Robertson. It has been collected at several places in Swaziland (Jagger *et al.*, 1987). As yet, through, *B. microplus* has not been recorded in either Namibia or Botswana. Extraliminally it has been found in parts of East and Central Africa.

GENUS *COSMIOMMA* SCHULZE, 1919

*Generic characteristics:*

- (a) Ornate
- (b) Hypostome and palps long
- (c) Eyes present
- (d) Fестоons present
- (e) Adanal plates in the male present

An extremely rare, monospecific Afrotropical genus.

*Cosmiomma hippopotamensis* (Denny, 1843)

*Species diagnosis:* Dönitz (1910, as *Hyalomma hippopotamense*), Arthur (1960). Originally Denny (1843) described the ♂ as *Ixodes bimaculatus* and the ♀ as *Ixodes hippopotamensis*. It has also featured in the literature as an *Amblyomma* and a *Dermacentor*. The adults are large ticks with a black pattern on their pale yellowish scutum and light-coloured mottling on the dorsal surfaces of their legs. Immature stages undescribed.

*Hosts:* The types were recorded from *Hippopotamus amphibius* (Artiodactyla, Hippopotamidae). Adults have since been found on the black rhinoceros, *Diceros bicornis* (Perissodactyla, Rhinocerotidae), which is now regarded as its most likely host (Bezuidenhout & Schneider, 1972). [In a report accompanying 6 adults sent to Onderstepoort for identification in 1960 it was stated that these ticks had been collected from cattle, although they preferred small stock, especially goats. Subsequent enquiries, though, revealed that this information was incorrect (State Veterinarian, Ohopoho, 1960, personal communication; Theiler, 1962; Bezuidenhout & Schneider, 1972)].

*Distribution:* The type locality for this species is recorded merely as "South Africa". Adults have since been collected in southern Africa only in Namibia, Kaokoland, in 1959 at Ohopoho and Otji-janjasemo, and in 1971 at Ondjarrakagha, Otjibobongha, Otjipembi and Ekoto (Bezuidenhout & Schneider, 1972). *C. hippopotamensis* has also been recorded extraliminally in Angola. A morphologically slightly different population occurs in Kenya.

GENUS *DERMACENTOR* KOCH, 1844

*Generic characteristics:*

- (a) Ornate
- (b) Hypostome and palps relatively short and broad
- (c) Eyes present
- (d) Fестоons present
- (e) Adanal plates in the male absent

This relatively large genus is widely distributed in parts of North and Central America, Eurasia and Africa. Several species are extremely important human and animal parasites and some are vectors of various pathogens. Neither of the 2 species present in the Afrotropical region, though, is known to be of any economic importance. These are *Dermacentor*

*circumguttatus*, an elephant parasite that occurs from West Africa eastwards across the continent to western Uganda and Tanzania, and *D. rhinocerinus* (see below).

Morel (1969) placed the 2 African *Dermacentor* spp. in the genus *Amblyocentor* Schulze, 1932 but this classification is not universally accepted. Santos Dias (1963) regarded *Amblyocentor* merely as a sub-genus of *Dermacentor*.

*Dermacentor rhinocerinus* (Denny, 1843)

*Species diagnosis:* Hoogstraal (1956), Arthur (1960), Clifford & Anastos (1964). The adults are large ticks with a striking black and deep gold scutal pattern. Larva undescribed.

*Hosts:* Adults feed primarily on both the white and the black rhinoceros, *Ceratotherium simum* and *Diceros bicornis* (Perissodactyla, Rhinocerotidae). Hoogstraal (1956) also listed it from various domestic animals, a jackal and eland (*Taurotragus oryx*), to which Theiler (1962) added the monitor lizard (*Varanus* sp.), elephant (*Loxodonta africana*), buffalo (*Syncerus caffer*) and roan antelope (*Hippotragus equinus*), but none of these animals are thought to be significant hosts of this species. Clifford & Anastos (1964) noted that adults and nymphae were collected from the nests of rodents and a macrosclid, an indication of the hosts of the immature stages.

*Distribution:* In South Africa *D. rhinocerinus* has been recorded in the Transvaal in the Kruger National Park. In northern Natal it occurs in Ndumu, Hluhluwe and Umfolozi Game Reserves plus the Corridor area between the latter 2 reserves (Baker & Keep, 1970), also at a few points in adjacent areas. In Namibia 1 ♂ was collected from a black rhinoceros at Grootfontein in 1933 (OP 2683 iii) but this species has apparently not been found there since. It has been widely recorded extraliminally in eastern, central, and other parts of southern Africa.

GENUS *HAEMAPHYSALIS* KOCH, 1844

*Generic characteristics:*

- (a) Inornate
- (b) Hypostome and palps short
- (c) Eyes absent
- (d) Fестоons present
- (e) Adanal plates in the male absent

Much of our knowledge of this genus, the second largest in the family Ixodidae, is based on research carried out from 1955-85 by H. Hoogstraal and his colleagues. Their findings on the Afrotropical species were published in a series of papers under the general heading "Notes on African *Haemaphysalis* ticks". In these papers individual species were described, or redescribed, and Hoogstraal progressively developed his ideas regarding the subgenera, species groupings and relationships of the African haemaphysalids. His final conclusions were incorporated in a major study on tick and mammal coevolution with particular reference to *Haemaphysalis* species throughout the world (Hoogstraal & Kim, 1985).

Ten species of these small, light brown, eyeless ticks are currently known to occur in southern Africa. These fall into 4 of the 14 subgenera discussed by Hoogstraal & Kim (1985), as follows: *Ornithophysalis* (*hoodi*); *Haemaphysalis* (*silacea*); *Kaiseriana* (*aciculifer*, *parmata*), and *Rhipistoma* (*cool-eyi*, *hyracophila*, *leachi*, *pedetes*, *spinulosa*, *zumpti*).

1973; Horak, Knight & De Vos, 1986a), and smaller numbers on the gemsbok, *Oryx gazella* (Artiodactyla, Bovidae) (Horak *et al.* 1983b). Another bovid, the eland, *Taurotragus oryx*, was recorded as a host by Gertrud Theiler (unpublished data).

**Distribution:** *M. winthemi* has been recorded only in southern Africa. In South Africa it has been found in the Transvaal at a few places in the west and north-west, also in the south-eastern Highveld; in Lesotho; at scattered points in the Orange Free State, especially in the south and west; in the higher parts of southern Natal and the Transkei; at places in the north-eastern and eastern Cape Province, in the Cape Midlands and in areas bordering on the Karoo in the southern and western Cape Province (Theiler & Salisbury, 1958; Theiler, 1962; Horak *et al.*, 1986a). Records in Namibia from Windhoek and Rehoboth District, and in Botswana from Francistown, are thought to represent introductions only (Theiler, 1962).

GENUS *RHIPICENTOR* NUTTALL & WARBURTON, 1908

**Generic characteristics:**

- (a) Inornate
- (b) Hypostome and palps short
- (c) Eyes present
- (d) Festoons present
- (e) Adanal plates in the male absent
- (f) Males with coxa IV much larger than the others and bearing 2 spurs

This exclusively Afrotropical genus, containing only 2 species, was reviewed by Theiler (1961). Care is necessary to avoid confusing these ticks with *Rhipicephalus* spp.

*Rhipicentor nuttalli* can cause paralysis, which may be fatal, in dogs (Theiler, 1962; Norval & Colborne, 1985).

***Rhipicentor bicornis* Nuttall & Warburton, 1908**

**Species diagnosis:** Theiler (1961). Nymph unknown.

**Hosts:** Adults parasitize domestic dogs, and sometimes cattle. Wild hosts are primarily Carnivora, including the bat-eared fox, *Otocyon megalotis*, and jackal, *Canis* sp. (Canidae); genets, *Genetta* sp. (Viverridae), and the cats, especially the cheetah, *Acinonyx jubatus*; leopard, *Panthera pardus*, and lion, *Panthera leo*, also 2 smaller species, the serval, *Felis serval*, and African wild cat, *Felis lybica* (Felidae). It has been recorded once from the eland, *Taurotragus oryx* (Artiodactyla, Bovidae). Hosts of the immature stages unknown.

**Distribution:** South Africa, Transvaal, in the Waterberg and at Onderstepoort, and Namibia, where it is widely distributed in the northern part of the country, and is also recorded in the south from Bethanien District. Extralimitally it is widely distributed in Central Africa.

***Rhipicentor nuttalli* Cooper & Robinson, 1908**

**Species diagnosis:** Theiler (1961). Nymph undescribed.

**Hosts:** Adults are recorded from domestic dogs, and a donkey. The most commonly recorded wild hosts are the South African hedgehog, *Atelerix frontalis* (Insectivora, Erinaceidae) and porcupine, *Hystrix africaeaustralis* (Rodentia, Hystricidae). It has also been found on a genet, *Genetta* sp. (Carnivora, Viverridae); brown hyaena, *Hyaena brunnea*, and

“hyaena” (Hyaenidae); and cheetah, *Acinonyx jubatus*; leopard, *Panthera pardus*; lion, *Panthera leo*, and “wild cat” (Felidae). Hosts of the immature stages are unknown.

**Distribution:** South Africa, Transvaal, in a belt stretching from the Waterberg southwards to the Pretoria area and beyond as far as Potchefstroom and Heidelberg Districts; Cape Province, in Richmond, Hanover, Grahamstown and especially Clanwilliam Districts; Namibia, at various places from Windhoek northwards, and Botswana at Nokanen, Ngamiland; Lobatse and in the Tati Concession. It occurs extralimitally in Zimbabwe.

GENUS *RHIPICEPHALUS* KOCH, 1844

**Generic characteristics:**

- (a) Most species inornate but 4 ornate, i.e. with a colour pattern on their scutum (*maculatus* and, in East Africa, *pulchellus*, *humeralis*, and *dux*)
- (b) Hypostome and palps short
- (c) Basis capituli usually hexagonal
- (d) Eyes present
- (e) Festoons present
- (f) Adanal plates in the male present

This is the largest genus in southern Africa, comprising 28 species plus one entity that has yet to be described and several others whose taxonomic status is at present uncertain. Some of the information presented below is based on my re-examinations of specimens in the Onderstepoort Tick Collection. I. G. Horak (personal communications) has also kindly allowed me to incorporate some of his unpublished data on the following species: *arnoldi*; *capensis sensu stricto*; *foliis*; *glabroscutatum*; *lounsburyi*; *oculatus*; a new species near *oculatus*, and *punctatus*.

It presents many taxonomic problems, especially to the beginner. As early as 1912 Cecil Warburton, in the opening paragraph of one of the most perceptive papers ever published on this genus, summarized the situation thus: “The identification of species of *Rhipicephalus* is likely to give more trouble than is the case with any other genus of Ixodidae, for while, on the one hand, there are few species which depart greatly from the general type, on the other hand the range of variation within the species is extremely great”. Often this variability is dependant on nutrition, as was shown by Warburton’s colleagues G. H. F. Nuttall (1913) and N. Cunliffe (1914) in their classic studies on *Rhipicephalus appendiculatus* and *R. sanguineus* respectively. Recently it has also been shown that, under laboratory conditions, hybridization between certain closely related species can occur (Zivkovic, Pegram, Jongejan & Mwase, 1986; Wouters, 1989; Wouters, Berkvens & Gomes, 1989).

Considerable advances in our knowledge of this genus were made by Gertrud Theiler. In 1949 she produced a valuable review of many little known rhipicephalids, then in 1953 she and Britha Robinson published a detailed study of 6 of the lesser known species. Some of Theiler’s taxonomic decisions are not now regarded as valid, but it must be remembered that when she did much of her early taxonomic research it was difficult, if not impossible, for her to study the numerous type specimens that had been deposited in museum collections in Britain and Europe. This factor undoubtedly contributed largely to the erroneous conclusions that she sometimes reached. In later years she herself queried

several of her earlier decisions, either in papers or in discussions with the writer.

During the 1940s F. Zumpt also published a series of papers in which he discussed many *Rhipicephalus* spp. His interpretation of interspecific relationships was, however, seriously hampered by the fact that he did not include the immature stages in his studies.

In recent years the use of scanning electron microscopy has greatly facilitated our understanding of this genus.

Several species of *Rhipicephalus* are known vectors of pathogens affecting domestic and wild animals, and to a lesser extent man, in Africa. By far the most important of these is the brown ear tick, *R. appendiculatus*, which is the primary vector of *Theileria parva parva*, the protozoon causing East Coast fever of cattle in East and Central Africa. It can also transmit other pathogens, including *Theileria parva bovis*, *Theileria parva lawrencei*, *Theileria taurotragi*, *Ehrlichia bovis*, and Nairobi sheep disease virus, as well as *Rickettsia conori*, the causative agent of tick-bite fever in man (De Vos, 1981). Other vectors of the *Theileria* spp. affecting cattle are *R. zambeziensis*, which can transmit all the *T. parva* group parasites plus *T. taurotragi* (Lawrence, Norval & Uilenberg, 1983); *R. duttoni*, which transmits *T. parva lawrencei* in Angola (Da Graça & Serrano, 1971), and *R. evertsi evertsi*, which can sometimes transmit *T. parva parva*, though it is apparently not a very efficient vector of this organism.

Recently *R. simus*, which was shown to be capable of transmitting *Anaplasma marginale* by Sir Arnold Theiler, has also proved to be a vector of *Anaplasma centrale* (Potgieter & Van Rensburg, 1987), and *R. evertsi evertsi*, long known to carry *Babesia equi*, has now been established as a vector of *Babesia caballi* (De Waal & Potgieter, 1987). *R. sanguineus*, the most cosmopolitan member of the genus, is a vector of *Babesia canis*, *Ehrlichia canis*, and *Hepatozoon canis* in dogs, as well as *R. conori* in man.

Some *Rhipicephalus* spp. are known to secrete toxins that can have deleterious effects on their hosts. For example, cattle that are heavily infested with *R. appendiculatus* may develop a syndrome known as brown ear tick toxicosis. Other species have been associated with paralysis of animals and man. Among these are *R. evertsi evertsi*, which sometimes causes spring lamb paralysis, and *R. simus*, which has occasionally been reported as causing paralysis in man. Recently Fourie, Horak & Marais (1988a) described cases of paralysis in Angora goats caused by an *R. pravus*-like tick that is now believed to be *R. punctatus* (see below).

#### ***Rhipicephalus appendiculatus* Neumann, 1901**

*Species diagnosis:* Walker, Norval & Corwin (1981).

*Hosts:* All stages often feed on the same animals, and this tick has an extremely wide host range. It will parasitize all species of domestic animals, especially cattle, on which very large infestations may occur. Sheep and goats are of secondary importance only. Dogs and cats are rarely infested. It has also been recorded from numerous species of wild animals. Its preferred hosts are Artiodactyla; many species carry all stages but the smaller antelopes are usually infested by the immature stages only. It has been found less commonly on Primates (usually small infestations only); Carnivora (mostly immature stages on the smaller species of Canidae, Viverridae and Felidae, and adults on the Hyaenidae and larger

Felidae); Proboscidea (occasional adult ticks); Perissodactyla (especially Equidae); and Rodentia (a few species are recorded as hosts of the immatures, but sometimes all stages are present on the Hystricidae). Immature stages only are recorded from various species of Insectivora, Hyracoidea, the smaller species of Rodentia; the Lagomorpha, Leporidae, and birds (Aves), including both non-passerines and passerines (Theiler, 1962; Norval, Walker & Colborne, 1982).

*Distribution:* In southern Africa *R. appendiculatus* occurs from south-eastern Botswana eastwards across the Limpopo River, through the Transvaal Bushveld south of the Soutpansberg and into parts of the Lowveld, including the southern end of the Kruger National Park. It also occurs in a salient of the Bushveld extending into the northern end of the Kruger National Park at Pafuri, near the Zimbabwe and Mozambique borders. From the Transvaal Lowveld its distribution extends southwards through Swaziland, most parts of Natal below c. 1500 m, the Transkei, and the coastal areas of the eastern Cape as far as Port Elizabeth. Thus it is present in various types of bushland and thornveld, but not in open grassland (Lessard, L'Eplattenier, Norval, Kundert, Dolan, Croze, Walker, Irvin & Perry, 1990).

The distribution of *R. appendiculatus* as shown by Theiler (1949c) and Howell *et al.* (1978, Map 7) is in part incorrect. This tick is not now thought to occur in the north-western and northern Transvaal, between the Soutpansberg and the Limpopo River, where it was in the past confused with *R. zambeziensis*. It is sympatric with *R. zambeziensis* in parts of the Transvaal. In the Fauresmith area the tick referred to by Theiler (1949c) as a separate "variety or subspecies of *R. appendiculatus*" has now been identified as *R. punctatus* (see below). Furthermore, *R. appendiculatus* does not occur in the coastal areas of Cape Province, between Port Elizabeth and Cape Town, where it was confused with *R. nitens* (see below).

Extralimally *R. appendiculatus* is widely distributed in East and Central Africa (Lessard *et al.*, 1990).

#### ***Rhipicephalus arnoldi* Theiler & Zumpt, 1949**

*Species diagnosis:* Theiler & Zumpt (1949).

*Hosts:* All stages prefer hares, especially red hares, *Pronolagus* spp., (sometimes called red rock rabbits) (Horak & Fourie, 1986), occasionally also the scrub hare, *Lepus saxatilis*, and Cape hare, *Lepus capensis* (Lagomorpha, Leporidae). Immature stages only have been collected from the caracal, *Felis caracal* (Carnivora, Felidae) (Horak *et al.*, 1987c); rock dassie, *Procavia capensis* (Hyracoidea) (Horak & Fourie, 1986), also the striped mouse, *Rhodomys pumilio*, and a "field mouse" (Rodentia, Muridae).

*Distribution:* South Africa, Transvaal, at Makapan Caves, Naboomspruit, Onderstepoort and Potchefstroom; Orange Free State, Fauresmith; and Cape Province, at various points in Richmond, Murraysburg, Graaff-Reinet and Cradock Districts. Extralimally it has been recorded in Zimbabwe. [Records from the Sudan (Hoogstraal, 1956) are now considered incorrect].

#### ***Rhipicephalus capensis* group**

Theiler (1962), in her review of the distribution of *R. capensis* in South Africa, commented that this specific name 'appears to be a catchall for "capensis-



one of the most widely distributed species in the Afrotropical region.

#### ***Rhipicephalus evertsi mimeticus* Dönitz, 1910**

*Species diagnosis:* Sousa Dias (1950). This subspecies has banded legs, so can easily be mistaken for a *Hyalomma* by the unwary. Otherwise it closely resembles *R. e. evertsi* morphologically. Immature stages undescribed.

*Hosts:* All stages frequently feed on the same animals. It apparently parasitizes the same hosts as *R. e. evertsi*, i.e. all the domestic herbivores and, amongst wild animals, Hartmann's mountain zebra, *Equus zebra hartmannae* (Perissodactyla, Equidae) (Horak, Biggs & Reinecke, 1984b), and various species of Artiodactyla. It is also recorded from the lion, *Panthera leo* (Carnivora, Felidae).

*Distribution:* Namibia, mostly north of the Tropic of Capricorn (Horak *et al.*, 1984b; Heloise Heyne, unpublished data, 1989), and western and southern Botswana (Walker *et al.*, 1978; Paine, 1982). Extraliminally it occurs in Angola and western Zaïre.

#### ***Rhipicephalus follis* Dönitz, 1910**

*Species diagnosis:* Theiler (1949a). [The description of *R. follis* by Theiler & Robinson (1953b) refers to another species: see *R. lounsburyi*]. In the past this tick has frequently been misidentified as *R. capensis* (Theiler, 1950a, 1962). Immature stages undescribed.

*Hosts:* The adults feed almost exclusively on the large herbivores. Amongst domestic animals cattle are the most frequently recorded hosts. Most wild hosts are antelopes, especially the eland, *Taurotragus oryx* (Artiodactyla, Bovidae). Adults have also been recorded once from a cheetah, *Acinonyx jubatus*, and larvae from the caracal, *Felis caracal* (Carnivora, Felidae) (Horak *et al.*, 1987c). The preferred hosts of the immature stages are, however, rodents (Rodentia, Muridae).

*Distribution:* Present indications are that *R. follis* occurs only in South Africa, where it is widely distributed in the south-eastern Transvaal; central Orange Free State, Natal, and Cape Province, primarily in the south-east but with a few records from the southern coastal areas [Horak *et al.*, 1986a, 1987c, both as *Rhipicephalus* sp. (near *R. capensis*); Horak *et al.*, 1989; J. B. Walker, unpublished data].

#### ***Rhipicephalus gertrudae* Feldman-Muhsam, 1960.**

*Species diagnosis:* Feldman-Muhsam (1960). This tick was included under *R. capensis* by Theiler (1950a, 1962). Biggs & Langenhoven (1984), who studied the seasonal incidence of ticks on cattle on a farm in Windhoek District, Namibia, were unable to distinguish *R. gertrudae* consistently from another *R. capensis* group tick occurring in the same area. Immature stages undescribed.

*Hosts:* The adults are almost exclusively parasites of the larger herbivores. Amongst domestic animals this species has been recorded from cattle, sheep, goats, horses and a donkey. Wild animal hosts include the mountain zebra, *Equus zebra* (Perissodactyla, Equidae), various large antelope species (Artiodactyla, Bovidae), and the porcupine, *Hystrix africae australis* (J. B. Walker, unpublished data). Hosts of the immature stages have not as yet been recorded but are likely to be small mammals, probably rodents.

*Distribution:* In South Africa *R. gertrudae* is

widely distributed in Cape Province, including parts of the Karoo (Williston and Fraserburg Districts). In the east it extends into the southern and central Orange Free State, and in the west northwards through Namakwaland into Namibia (J. B. Walker, unpublished data; Heloise Heyne, unpublished data). It is not thought to occur extraliminally.

#### ***Rhipicephalus glabroscutatum* Du Toit, 1941**

*Species diagnosis:* Du Toit (1941)

*Hosts:* All stages feed on goats, and to a lesser extent on sheep and cattle (MacIvor, 1985). Their wild animal hosts are primarily various large and small antelopes, especially browsers such as kudu, *Tragelaphus strepsiceros*, and eland, *Taurotragus oryx* (Artiodactyla, Bovidae), plus the Cape mountain zebra, *Equus zebra zebra* (Perissodactyla, Equidae) (Young *et al.*, 1973; MacIvor 1985, Horak *et al.*, 1986a). The immature stages also feed on the scrub hare, *Lepus saxatilis* (Lagomorpha, Leporidae) (Horak & Knight, 1986).

*Distribution:* This species is recorded only in South Africa, Cape Province, primarily in the south-east but with a few records from the central and southern parts of the province (MacIvor, 1985), also from the west coast at Langebaan, Hopefield District.

#### ***Rhipicephalus kochi* Dönitz, 1905**

*Species diagnosis:* Clifford, Walker & Keirans (1983). [Note that Yeoman & Walker (1967) resurrected the name *Rhipicephalus jeanneli* Neumann, 1913 for the East African highland tick listed as *R. kochi* in Theiler (1962)].

*Hosts:* In South Africa adults and nymphae have been recorded from kudu, *Tragelaphus strepsiceros*; nyala, *Tragelaphus angasii*, and bushbuck, *Tragelaphus scriptus* (Artiodactyla, Bovidae) (Horak *et al.*, 1983b), also the warthog, *Phacochoerus aethiopicus* (Suidae) (Horak, Boomker, De Vos & Potgieter, 1988b), and scrub hare, *Lepus saxatilis* (Lagomorpha, Leporidae). Extraliminally it has been recorded from a very wide range of both domestic and wild animals, mostly Artiodactyla, Bovidae and Suidae, but including various species of Carnivora, Felidae; Proboscidea; Perissodactyla, Rhinocerotidae and Equidae; Rodentia, Hystricidae; Lagomorpha, and Macroscelidea, and even a ground-feeding bird, the black-bellied korhaan, *Lissotis melanogaster* (Aves) (Clifford *et al.*, 1983).

*Distribution:* In South Africa *R. kochi* has been found at Pafuri, at the northern end of the Kruger National Park (Horak *et al.*, 1983b, 1988b), and Ndumu, in KwaZulu. Extraliminally it is widely distributed in East and Central Africa.

#### ***Rhipicephalus longiceps* Warburton, 1912**

*Species diagnosis:* Theiler (1949a). Immature stages unknown.

*Hosts:* This rare tick has been recorded once from cattle. Wild animal hosts all belong to the Artiodactyla: the klipspringer, *Oreotragus oreotragus*, and gemsbok, *Oryx gazella* (Bovidae), also warthog, *Phacochoerus aethiopicus* (Suidae) (Horak, Biggs, Hanssen & Hanssen, 1983a).

*Distribution:* Namibia, on the farm "Okonjima" (20° 51' S, 16° 40' E); at Omandumba, Omaruru; Okahandja (Santos Dias, 1958); near Sukses, and on the farm "Lichtenstein-Süd" (22° 51' S, 17° 01' E), near Windhoek. Extraliminally it occurs in Angola.

**Rhipicephalus lounsburyi Walker, 1990**

*Species diagnosis:* Walker (1990). It was originally described as *Rhipicephalus follis* by Theiler & Robinson (1953b).

*Hosts:* The only domestic animals recorded thus far are sheep. It has been collected from the following wild ungulates (Artiodactyla, Bovidae): bontebok, *Damaliscus dorcas*, and grey rhebok, *Pelea capreolus* (Horak *et al.*, 1986b), also the black wildebeest, *Connochaetes gnou*; eland, *Taurotragus oryx*, and mountain reedbuck, *Redunca fulvorufula*. The hosts of the immature stages are still unknown.

*Distribution:* It has been recorded only in South Africa, most commonly in eastern Cape Province, especially in the mountainous areas of Barkly East, Dordrecht and Cradock Districts. In western Cape Province it has been found near Swellendam (Horak *et al.*, 1986b) and between Clanwilliam and Graafwater, and once in Natal, in the Impendle area.

**Rhipicephalus lunulatus Neumann, 1907**

*Species diagnosis:* Walker, Keirans, Pegram & Clifford (1988). It was synonymized with *Rhipicephalus tricuspis* by Theiler (1949a, 1962), but this finding was never universally accepted.

*Hosts:* The adults will parasitize almost all species of domestic animals, especially cattle and often dogs. Amongst wild animals *R. lunulatus* has an extremely wide host range. The commonest hosts include the African buffalo, *Syncerus caffer*, and many species of large and small antelopes (Artiodactyla, Bovidae), also the bushpig, *Potamochoerus porcus*, and warthog, *Phacochoerus aethiopicus* (Suidae). It has been collected quite frequently from various carnivores (Canidae, Viverridae and Felidae). A few records, probably representing accidental records only, exist from other mammals, including man, and 2 from water birds (Aves). Hosts of the immature stages are unknown.

*Distribution:* In South Africa it occurs in the northern and eastern Transvaal and Natal, and in Botswana mainly in and around the Okavango delta, also in the east at Tshesebe. Extralimitally it is very widely distributed in the Afrotropical region.

**Rhipicephalus maculatus Neumann, 1901**

*Species diagnosis:* Theiler & Robinson (1953b).

*Hosts:* All stages often feed on the same hosts. This tick has sometimes been collected from cattle, and very occasionally from sheep and goats, but not from other domestic animals. The adults, and sometimes the immature stages, occur on many of the larger game animals, e.g. the large cats and hyaenas (Carnivora, Felidae and Hyaenidae); the elephant, *Loxodonta africana* (Proboscidea); both species of rhinoceros, *Diceros bicornis* and *Ceratotherium simum*, and Burchell's zebra, *Equus burchellii* (Perissodactyla, Rhinocerotidae and Equidae); the buffalo, *Syncerus caffer*, and various large antelopes (Artiodactyla, Bovidae), and the wild pigs (Suidae) (Baker & Keep, 1970; Horak *et al.*, 1983b). The immature stages have been collected from some of the smaller carnivores, including the civet, *Civettictis civetta* (Viverridae) and serval, *Felis serval* (Felidae); and the smaller antelopes, impala, *Aepyceros melampus*, and various duikers (Baker & Keep, 1970); also the rock dassie, *Procavia capensis* (Hyracoidea), and scrub hare, *Lepus saxatilis* (Lagomorpha, Leporidae).

*Distribution:* South Africa, in the coastal areas of northern Natal, often in the same places as *R. muelh-*

*lensi*. It occurs extralimitally in eastern Africa, mainly in the coastal regions of Mozambique, Tanzania and Kenya.

**Rhipicephalus muelhensi Zumpt, 1943**

*Species diagnosis:* Salisbury (1959).

*Hosts:* All stages often feed on the same hosts. This tick sometimes occurs, in very small numbers, on cattle, and very occasionally on sheep and goats. It is commonest on various species of large and small wild antelopes, especially nyala, *Tragelaphus angasii*, and bushbuck, *Tragelaphus scriptus* (Artiodactyla, Bovidae) (Horak *et al.*, 1983b, 1988a), and on the wild pigs (Suidae). It has also been recorded from various small carnivores (Canidae and Mustelidae); the elephant, *Loxodonta africana* (Proboscidea), both species of rhinoceros, *Diceros bicornis* and *Ceratotherium simum*, and Burchell's zebra, *Equus burchellii* (Perissodactyla, Rhinocerotidae and Equidae) (Baker & Keep, 1970).

*Distribution:* South Africa, in the coastal areas of northern Natal, often in the same places as *R. maculatus*. It occurs extralimitally in the coastal areas of eastern Africa.

**Rhipicephalus neumanni Walker, 1990**

*Species diagnosis:* Walker (1990).

*Hosts:* Primarily sheep, and to a lesser extent goats. It has been found once on a horse, and once on a gemsbok, *Oryx gazella* (Artiodactyla, Bovidae) (J.B. Walker, unpublished data).

*Distribution:* South Africa, Cape Province, in scattered localities in the Karoo, and Namibia, mainly in Bethanien and Keetmanshoop Districts, plus one record from north of Windhoek at Omandumba, Omaruru (J.B. Walker, unpublished data). It is not known to occur extralimitally.

**Rhipicephalus nitens Neumann, 1904**

*Species diagnosis:* Neumann (1904). Immature stages undescribed. It was listed by Zumpt (1949) as a synonym of *R. appendiculatus*. Subsequently Theiler (1962) commented: "Present day findings tend to show that this is a valid species .....". Keirans (1985) also regarded it as valid.

*Hosts:* All stages will feed on the same host (Horak *et al.*, 1986b). Amongst domestic animals it strongly favours sheep, sometimes feeds on goats, and occasionally occurs on dogs (Horak *et al.*, 1987c). Known wild animal hosts are mostly antelopes: bontebok, *Damaliscus dorcas dorcas*; springbuck, *Antidorcas marsupialis*, and grey rhebok, *Pelea capreolus* (Artiodactyla, Bovidae) (Horak, Meltzer & De Vos, 1982a; Horak, Brown, Boomker, De Vos & Van Zyl, 1982b; Horak, De Vos & De Klerk, 1982c; Horak *et al.*, 1986b). Others include the mountain zebra, *Equus zebra* (Perissodactyla, Equidae) (J.B. Walker, unpublished data) and especially the scrub hare, *Lepus saxatilis* (Lagomorpha, Leporidae) (Horak *et al.*, 1986b).

*Distribution:* South Africa, Cape Province, mainly in the southern coastal strip from Port Elizabeth westwards, in association with Cape shrubland (*fynbos*) vegetation (White, 1983). It has also been found, again in association with fynbos, between Grahamstown and Paterson. Howell *et al.* (1978) erroneously included the distribution zone of *R. nitens* with that of *R. appendiculatus*.

**Rhipicephalus oculatus Neumann, 1901**

*Species diagnosis:* Neumann (1901). Immature