



Ticks collected from birds in the northern provinces of South Africa, 2004–2006

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ABSTRACT

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Approximately 3 000 birds, mainly passerines, caught in mist nets in the northern provinces of South Africa, were examined for ticks. A total of 178 ticks, belonging to 14 species, were recovered from 83 birds of 43 different species. *Hyalomma rufipes* was the most numerous tick, with 26 larvae and 109 nymphs collected, followed by *Amblyomma marmoreum*, with 13 larvae and two nymphs. Despite the study being conducted within the distribution range of *Amblyomma hebraeum*, it was not seen on any passerines, whereas three larger species were infested. The potential for small birds to spread ticks with their associated tick-borne pathogens is discussed.

Keywords: *Amblyomma marmoreum*, birds, *Hyalomma rufipes*, migration, northern South Africa, passerines, ticks

INTRODUCTION

Ticks are important vectors of pathogens affecting humans and livestock, and may themselves cause anaemia, hide damage, and wounds resulting in secondary bacterial infections (Fletcher 2007). An understanding of their dispersal mechanisms is cru-

cial towards their effective control. Ticks have very limited locomotor ability and rely on their hosts for dispersal. Migratory birds can serve as hosts for several tick species (Hoogstraal, Kaiser, Traylor, Gaber & Guindy 1961; Hoogstraal, Kaiser, Traylor, Guindy & Gaber 1963; Hoogstraal 1972; Mehl, Michaelsen & Lid 1984; Olsén, Jaenson & Bergström 1995), and may transport these with their associated tick-borne pathogens across geographical barriers such as deserts and oceans. In addition, larger, ground-living birds, such as Francolin, Spurfowl and Guineafowl, are important hosts for the immature stages of certain tick species, and are often heavily infested (Horak & Williams 1986; Horak, Fourie, Novellie & Williams 1991a; Horak, Spickett, Braack & Williams 1991b; Horak & Boomker 1998; Uys & Horak 2005). Although passerines and other small birds usually harbour only small numbers of ticks, they often occur in flocks, and thus, because of their large numbers and extraordinary mobility, have the potential of significantly contributing to pathogen dispersal as well as tick gene flow within a region. It

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is especially birds that may introduce certain tick species with their associated tick-borne pathogens to new areas, once climate change or human impact has made these habitable for them. Birds readily cross fences between wildlife reserves and pastures used by domestic livestock, and may thus transfer both ticks and tick-borne pathogens from their potential wildlife reservoirs to domestic animals. Moreover acaricide resistance is a considerable problem in some regions of Africa (Fletcher 2007), and it is not entirely unlikely that birds play some role in the spread of acaricide-resistant strains of ticks.

Few data sets exist on the ticks that infest small birds in sub-Saharan Africa. However, Horak *et al.* (1991a) have recorded the immature stages of two tick species on four species of small birds in the Eastern Cape Province, South Africa and in a more recent study Van Niekerk, Fourie & Horak (2006) recorded ticks on 39 species of birds in the Free State Province, South Africa. Amongst the latter there were 28 different passerine species. Our objective in the present study was to provide additional data on ticks and the species of birds that they might infest, as well as on the bird species that could be important in spreading ticks.

MATERIALS AND METHODS

The bird-ringing excursions of amateur ornithologists provide a valuable opportunity for the collection of ectoparasites from the birds they have captured. This study was carried out in collaboration with the members of the Pretoria Bird Ringing Club during their activities at various localities in the provinces of Gauteng, Limpopo, Mpumalanga and North

West, South Africa (Table 1). The birds were caught in mist nets and examined for ticks using head-mounted magnifying glasses. The examination concentrated on the head of the birds, especially the eyelids, around the beak and in the ears, where the vast majority of ticks usually occur on passerines (Mehl *et al.* 1984; Smith 2001). The bare skin under the wings, the brood patch and the region around the cloaca were also frequently examined, but these sites yielded no ticks. The examination for ticks increased the handling time of the birds by about one minute. Ticks and other ectoparasites were collected by means of forceps and placed in separate vials containing 70% ethanol, together with a label recording date, ring number, locality and bird species. We have followed the nomenclature proposed by Hockey, Dean & Ryan (2005) for the birds we examined, and their migration and feeding habits are summarized in Appendix 1. Approximately 3 000 birds were examined, but unfortunately the documents recording the exact number were lost.

RESULTS

The method of trapping birds in mist nets is suitable only for small birds, and most of the birds caught were passerines. Out of a total of approximately 3 000 birds examined, belonging to 43 species, we recovered 178 ticks from 83 of them. The ticks comprised 48 larvae, 124 nymphs and six adults belonging to 14 species (Table 2). Among these were one *Argas*, one *Hyalomma* and an *Ixodes* species that we could not identify. The birds that harboured most ticks were Olive Thrush and Cape Robin-Chat. The most numerous tick collected was *Hyalomma rufipes*, comprising 26 larvae and 109 nymphs. The second most common species was *Amblyomma*

TABLE 1 Localities at which ticks were collected from birds in the northern provinces of South Africa

No.	Locality	Coordinates	
1	Buffelsdrift, Pretoria	25°35' S	28°20' E
2	Colbyn, Pretoria	25°44' S	28°15' E
3	Groenkloof, Pretoria	25°47' S	28°12' E
4	Jaleoda	25°57' S	28°35' E
5	Ntsinini, Sagewood cottage	25°36' S	30°23' E
6	Nylsvley	24°39' S	28°42' E
7	Olifantskop	23°58' S	27°28' E
8	Rietvlei	25°55' S	28°18' E
9	Samrand, Midrand	25°55' S	28°08' E
10	Suikerbosrand NR, Kareekloof gate	26°31' S	28°10' E
11	Sunbird Hill, Kameelfontein	25°38' S	28°24' E
12	Wakkerstroom	27°21' S	30°06' E
13	Retirement forest, Wakkerstroom	27°18' S	30°19' E

TABLE 2 Ticks collected from 83 infested birds in the northern provinces of South Africa (immature stages when not otherwise indicated)

Tick and bird species	Bird species names	No.		Localities*
		Birds	Ticks	
Argas species				
Cardinal Woodpecker	<i>Dendropicos fuscescens</i>	1	1	7
Amblyomma hebraeum				
Swainson's Spurfowl	<i>Pternistis swainsonii</i>	1	1	1
Southern Yellow-billed Hornbill	<i>Tockus leucomelas</i>	2	2	7
Double-banded Sandgrouse	<i>Pterocles bicinctus</i>	1	1	7
Amblyomma marmoreum				
Double-banded Sandgrouse	<i>Pterocles bicinctus</i>	1	2	7
Cattle Egret	<i>Bubulcus ibis</i>	1	2	1
Brown-crowned Tchagra	<i>Tchagra australis</i>	2	2	7, U
Red-headed Weaver	<i>Anaplectes melanotis</i>	1	1	7
Red-billed Quelea	<i>Quelea quelea</i>	1	1	7
Cinnamon-breasted Bunting	<i>Emberiza tahapisi</i>	6	7	7
Haemaphysalis elliptica				
Rattling Cisticola	<i>Cisticola chiniana</i>	1	1	1
Levillant's Cisticola	<i>Cisticola tinniens</i>	2	3	3, 12
Long-tailed Widowbird	<i>Euplectes progne</i>	1	1	8
Haemaphysalis hoodi				
Striped Pipit ¹	<i>Anthus lineiventris</i>	1	1	5
Hyalomma glabrum				
Red-billed Quelea	<i>Quelea quelea</i>	1	1	7
Cinnamon-breasted Bunting	<i>Emberiza tahapisi</i>	1	1	7
Hyalomma rufipes				
Striped Kingfisher	<i>Halcyon chelicuti</i>	1	3	11
Red-faced Mousebird	<i>Urocolius indicus</i>	1	1	7
Laughing Dove	<i>Streptopelia senegalensis</i>	1	1	7
Brown-crowned Tchagra	<i>Tchagra australis</i>	3	13	1, 7, 10
Southern Boubou	<i>Laniarius ferrugineus</i>	2	2	1, 5
Crimson-breasted Shrike	<i>Laniarius atrococcineus</i>	1	1	7
Common Fiscal	<i>Lanius collaris</i>	1	1	1
Magpie Shrike	<i>Corvinella melanoleuca</i>	1	1	1
Southern Black Tit	<i>Parus niger</i>	2	4	7
Ashy Tit	<i>Parus cinerascens</i>	3	7	7
Dark-capped Bulbul	<i>Pycnonotus tricolor</i>	2	2	3
Black-chested Prinia	<i>Prinia flavicans</i>	1	1	10
Sabota Lark	<i>Calendulauda sabota</i>	1	2	7
Kurrichane Thrush	<i>Turdus libonyanus</i>	2	2	3, 5
Olive Thrush	<i>Turdus olivaceus</i>	2	26	10
Marico Flycatcher	<i>Bradornis mariquensis</i>	2	5	7
Southern Black Flycatcher	<i>Melaenornis pammellaina</i>	2	3	6, U
Cape Robin-chat	<i>Cossypha caffra</i>	7	25	1, 10, U
Wattled Starling	<i>Creatophora cinerea</i>	1	1	10

Tick and bird species	Bird species names	No.		Localities*
		Birds	Ticks	
Lesser Masked-weaver	<i>Ploceus intermedius</i>	1	1	7
Southern Masked-weaver	<i>Ploceus velatus</i>	4	19	7, 11
Red-billed Quelea	<i>Quelea quelea</i>	3	3	4, 7
Blue Waxbill	<i>Uraeginthus angolensis</i>	1	1	1
Pin-tailed Whydah	<i>Vidua macroura</i>	1	1	7
Cape Longclaw	<i>Macronyx capensis</i>	1	9	10
<i>Hyalomma</i> species				
Cinnamon-breasted Bunting	<i>Emberiza tahapisi</i>	1	1	7
<i>Ixodes pilosus</i> group				
Levaillant's Cisticola	<i>Cisticola tinniens</i>	1	1	2
Yellow-crowned Bishop	<i>Euplectes afer</i>	1	1	4
<i>Ixodes</i> species				
Bar-throated Apalis	<i>Apalis thoracica</i>	2	2	5
Cape Robin-chat	<i>Cossypha caffra</i>	1	1	5
Blue Waxbill	<i>Uraeginthus angolensis</i>	1	1	11
<i>Ixodes spinae</i>				
Southern Red Bishop ^{1, 2}	<i>Euplectes orix</i>	1	1	9
<i>Ixodes theilerae</i>				
Cape Batis ²	<i>Batis capensis</i>	1	1	13
Olive Thrush ³	<i>Turdus olivaceus</i>	1	1	10
Cape Weaver ^{1, 2}	<i>Ploceus capensis</i>	1	1	10
<i>Rhipicephalus (Boophilus) decoloratus</i>				
Three-banded Plover	<i>Charadrius tricollaris</i>	1	1	1
<i>Rhipicephalus turanicus</i>				
Marsh Owl ⁴	<i>Asio capensis</i>	1	3	6

* Numbers in this column refer to localities in Table 1

¹ Tick species identity uncertain

² Adult tick: female

³ The same bird also carried two nymphs of *H. rufipes*

⁴ Adult ticks: one female, two males

U = unknown

marmoratum, with 13 larvae and two nymphs. Five specimens of *Haemaphysalis elliptica* were also recovered, one of these from a Rattling Cisticola and three from Levaillant's Cisticola. No other ticks were found on Cisticola. Between one and four specimens of the remaining tick species were collected. *Amblyomma hebraeum* was not found on any of the smaller birds, but was present on Swainson's Spur-

fowl, Southern Yellow-billed Hornbill and Double-banded Sandgrouse. A single *Rhipicephalus (Boophilus) decoloratus* larva was collected from a Three-banded Plover.

The only adult ticks recovered were *Ixodes spinae*, *Ixodes theilerae* and *Rhipicephalus turanicus*. The sole *Argas* specimen was a larva collected from a Cardinal Woodpecker.

DISCUSSION

Most ticks were recovered from birds that feed mainly on the ground, in particular members of the family *Turdidae*. This agrees with the results of an earlier study conducted elsewhere (Olsén *et al.* 1995). Only a few of the mainly arboreal bird species that we examined harboured ticks, e.g. the Dark-capped Bulbul and the Lesser Masked-

Weaver (see Appendix 1). Because these species are often caught in nets, it is sometimes possible to detect even a low rate of tick infestation on them.

After an exhaustive study of numerous specimens of all stages of development of the subspecies of the *Hyalomma marginatum* group, Apanaskevich & Horak (2008) concluded that these ticks should be treated as independent species, namely *H. margi-*

APPENDIX 1 Species characteristics of the tick-infested birds in the study (Hockey *et al.* 2005)

Bird species	Migration habits	Feeding habitats
Swainson's Spurfowl*	Resident and sedentary	On ground
Cardinal Woodpecker*	Resident and sedentary	In trees
Southern Yellow-billed Hornbill*	Resident and sedentary. Rarely forms small flocks during dry season and drought	Mainly on the ground
Striped Kingfisher*	Resident, with some local movement	Mainly on ground in arid areas
Red-faced Mousebird*	Generally resident, locally nomadic in response to phenology of fruiting trees. Altitudinal migrant	Flowers and fruits
Marsh Owl*	Resident where habitat is stable, otherwise nomadic	Lives on ground, eats rodents
Laughing Dove*	Largely sedentary with some local nomadic movements	Open ground
Double-banded Sandgrouse*	Sedentary. May move in search of water	On ground
Three-banded Plover*	Sedentary. Partial intra-African migrant in response to seasonal rainfall	On open shores
Cattle Egret*	Moves over large distances	On ground
Brown-crowned Tchagra	Resident and sedentary	On ground
Southern Boubou	Resident and sedentary	On ground
Crimson-breasted Shrike	Resident and sedentary, but may move locally to riverine woodland during non-breeding season	On ground and in trees
Cape Batis	Resident. Altitudinal migration	In trees
Common Fiscal	Mostly resident and sedentary, possibly nomadic	Small prey usually eaten on ground
Magpie Shrike	Resident and generally sedentary, but may move locally in response to drought and fires	Mostly on ground
Southern Black Tit	Resident	Mainly in trees, eats earthworms after rain
Ashy Tit	Resident and locally nomadic	In bushes, less frequently on ground
Dark-capped Bulbul	Sedentary. Some local dispersal linked to food availability	In trees, occasionally on ground
Rattling Cisticola	Resident	Low in grass or bushes, or on ground
Levailant's Cisticola	Mostly resident, may undertake local movements	Low down in vegetation

Bird species	Migration habits	Feeding habitats
Black-chested Prinia	Resident. Probably locally nomadic	In bushes, less frequently on ground
Bar-throated Apalis	Resident and sedentary. Some winter movements to lower altitudes	Partly on ground
Sabota Lark	Resident and sedentary, locally nomadic in drier part of range	On ground
Kurrichane Thrush	Mainly resident. Some altitudinal migration	On ground
Olive Thrush	Mostly resident, altitudinal migrant, and in response to drought	Mostly on ground
Marico Flycatcher	Resident	Mostly on ground
Southern Black Flycatcher	Resident	Partly on ground
Cape Robin-Chat	Altitudinal migrant	Spends much time on ground
Wattled Starling	Nomadic	Mostly on ground
Lesser Masked-Weaver	Resident, sedentary and local nomad	In tree canopies
Cape Weaver	Mostly resident and sedentary, with some local movements. 5% move >100km	On ground
Southern Masked-Weaver	Resident, sedentary and partial migrant	On ground, grass stems and trees
Red-headed Weaver	In Botswana, moves out of deciduous woodland in dry season; in Zimbabwe, range contracts in non-breeding season	Mainly in trees, bushes and creepers
Red-billed Quelea	Large scale movements throughout range	On ground
Yellow-crowned Bishop	Resident and locally nomadic. Migratory in West Africa	On ground or directly from plants
Southern Red Bishop	Resident and sedentary, some local movement in non-breeding season	Both on ground and perched in vegetation
Long-tailed Widowbird	Resident and sedentary, local movement in non-breeding season.	Largely on ground
Blue Waxbill	Mostly resident. May move nomadically in winter	On ground and in vegetation
Pin-tailed Whydah	Resident and sedentary. Nomadic in non-breeding season	Eat seeds on ground
Cape Longclaw	Resident. Form groups on burnt ground in winter	On ground
Striped Pipit	Resident and sedentary, possibly with some local movement	On ground
Cinnamon-breasted Bunting	Resident, but migrant from Nov-Dec to April-May	On ground

* = non-passerine species

natum, *H. rufipes*, *H. isaaci* and *H. turanicum*, and we have followed their recommendation. *Hyalomma rufipes* was the most prevalent tick species on small birds in our survey as well as in other studies (Hoogstraal *et al.* 1961; Van Niekerk *et al.* 2006). Adult *H. rufipes* feed on large ungulates (Norval 1982), and the immature stages feed on birds (Horak *et al.*

1991b; Uys & Horak 2005; Van Niekerk *et al.* 2006), and hares (Horak & Fourie 1991). It is patchily distributed in Africa, Europe and Western and Central Asia (Walker, Bouattour, Camicas, Estrada-Peña, Horak, Latif, Pegram & Preston 2003), and is the most important vector of Crimean-Congo haemorrhagic fever (CCHF) virus to humans in South Africa

(Horak, Swanepoel & Gummow 2002). In Africa it may also transmit *Anaplasma marginale*, *Rickettsia conorii* and *Babesia occultans* (Walker *et al.* 2003). Unlike other tick species, of which the immature stages tend to infest mainly larger birds, *H. rufipes* is found on passerines (Cumming 1998) as well as on larger species such as Crested Francolin and Helmeted Guineafowl (Horak *et al.* 1991b; Uys and Horak 2005). It is a two-host tick, which, like its close relative *H. marginatum*, probably remains attached to the host for 12 to 26 days from the start of feeding of the larva to detachment of the engorged nymph (Hueli 1979). This prolonged period of attachment plays an important role in the long-distance transportation of ticks with their associated tick-borne pathogens.

The immature stages of *Hyalomma glabrum*, which we collected from two birds, infest hares and birds (Apanaskevich & Horak 2006). This tick, which was previously thought to be *Hyalomma turanicum*, a known vector of CCHF, has recently been re-established as a valid species (Apanaskevich & Horak 2006).

Adult *A. marmoreum*, the second most common species recovered in this study, feed nearly exclusively on tortoises (Horak, McKay, Heyne & Spickett 2006). Its immature stages feed on a wide range of hosts, including tortoises and birds (Horak *et al.* 2006; Van Niekerk *et al.* 2006). This tick may play a role in the transmission of *Ehrlichia ruminantium* to domestic ruminants (Norval & Horak 2004). *Amblyomma hebraeum*, which in the present study was collected from three of the larger bird species, is the major vector of *E. ruminantium* in South Africa (Norval & Horak 2004). It also transmits *Theileria mutans* to cattle, and *Rickettsia africae* to humans. Its distribution is confined to south-eastern Africa (Walker *et al.* 2003), and it is the tick species of which the immature stages have most often been recorded biting humans in South Africa (Horak, Fourie, Heyne, Walker & Needham 2002). The adults prefer large ungulates, while the immature stages parasitize large and small ungulates as well as large ground living birds (Walker *et al.* 2003). Within its distribution range the immature stages of *A. hebraeum* are the most common ticks found on Helmeted Guineafowl (Horak & Williams 1986; Horak *et al.* 1991b), and they are also common on Crested Francolin (Uys & Horak 2005). Despite large numbers of birds being examined in earlier studies, adult ticks were not encountered on them (Horak & Williams 1986; Horak *et al.* 1991b; Uys & Horak 2005). *Amblyomma hebraeum* is apparently not spread by small birds,

as no ticks of this species were collected from passerines and other small birds in our study, even though it was conducted within the distribution range of the tick.

Haemaphysalis elliptica (formerly *H. leachi*) (Apanaskevich, Horak & Camicas 2007), the third most common tick collected (Table 2), is a major vector of *Babesia canis* to dogs, and can transmit *R. conorii* to humans. It is a parasite of large domestic and wild carnivores, and is widespread in southern Africa (Apanaskevich *et al.* 2007). True *H. leachi* is found in the Nile delta and north-east Africa (Walker *et al.* 2003). The immature stages of *H. elliptica* are not common parasites of birds. Van Niekerk *et al.* (2006) recovered a single nymph from birds in Free State Province, while Horak *et al.* (1991b) collected only three larvae and two nymphs from 118 Helmeted Guineafowl, as opposed to 23 778 *A. hebraeum* and 2 387 *A. marmoreum* larvae and nymphs from the same birds in a habitat in which all three tick species were abundant.

It is not known whether *Haemaphysalis hoodi* and *I. theileri*, which parasitize birds, and *I. spinae* which infests birds, hyraxes and rodents (Cumming 1998), or *Ixodes pilosus*, which parasitizes wild and domestic ungulates and dogs, transmit any pathogens (Walker *et al.* 2003).

Rhipicephalus (Boophilus) decoloratus transmits *Babesia bigemina*, *A. marginale* and *Borrelia theileri*, the first two of which are causes of cattle diseases of immense veterinary importance in South Africa. This is a one-host tick (Walker *et al.* 2003), and should be considered an accidental parasite of birds, on which it is unlikely to complete its life cycle. *Rhipicephalus turanicus* belongs to the *Rhipicephalus sanguineus* complex, and could be a vector of *Rickettsiae* of the Spotted fever group (Matsumoto, Ogawa, Brouqui, Raoult & Parola 2005). Large carnivores and large ground-living birds are hosts of the adults of this species (Walker, Keirans & Horak 2000), which we collected from a Marsh Owl.

Argasids are typically endophilic (burrow or nest-dwelling) (Hillyard 1996), and this may explain why an *Argas* species was found on a woodpecker.

We found no tick species in this study that had not previously been recorded in the same stage of development on birds (Cumming 1998; Walker *et al.* 2003). Our results agree with those of previous surveys in that the immature stages of *H. rufipes* are the most common tick species found on passerines and other small land birds, followed by *A. mar-*

moreum, while other ticks seem to be rare or occasional parasites (Horak *et al.* 1991a; Van Niekerk *et al.* 2006).

Strangely, none of the ticks recovered in this study were from migratory birds that breed in temperate regions, and which travel large distances every day during the migration seasons. Few South African birds migrate regularly. Red-billed Quelea and Cinnamon-breasted Bunting are nomadic when not breeding (Sinclair, Hockey & Tarboton 2002), and may therefore be important in long distance dispersal of ticks. Sedentary birds like Cape Robin-Chat may move within their distributional range during winter, or to KwaZulu Natal, where they are seen as winter visitors (Sinclair *et al.* 2002). Some species are altitudinal migrants, e.g. Bar-Throated Apalis and Cape Robin-Chat (Hockey *et al.* 2005). Almost all bird species move about in search of food and water, particularly during harsh environmental conditions, and may thereby also transport ticks.

CONCLUSION

Birds that feed on the ground are predisposed to tick infestation, but there are also considerable differences among tick species in their predisposition and ability to infest birds. The immature stages of *H. rufipes* and *A. marmoreum* infest small birds, like passerines, but they may also infest larger birds. Conversely the immature instars of *A. hebraeum* infest larger birds, but apparently not passerines. The overall widespread distribution of *H. rufipes* may in part be ascribed to its tendency to infest passerines. Ticks (including acaricide-resistant ticks) with their associated tick-borne pathogens may be dispersed over large distances via bird migration. Smaller birds, through their huge numbers, may play a role as hosts for ticks, but no ticks of medical or veterinary importance seem to use small birds as maintenance hosts.

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