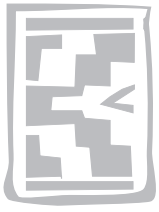

The host status of African buffaloes, *Syncerus caffer*, for *Rhipicephalus (Boophilus) decoloratus*

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ABSTRACT

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The objective of this study was to assess the host status of African buffaloes, *Syncerus caffer*, for the one-host tick *Rhipicephalus (Boophilus) decoloratus*. To this end the *R. (B.) decoloratus* burdens of ten buffaloes examined in three north-eastern KwaZulu-Natal Province (KZN) nature reserves were compared with those of medium-sized to large antelope species in these reserves and in the southern Kruger National Park (KNP), Mpumalanga Province. The *R. (B.) decoloratus* burdens of the buffaloes were considerably smaller than those of the antelopes in the KNP, but not those in the KZN reserves. The life-stage structure of the *R. (B.) decoloratus* populations on the buffaloes, in which larvae predominated, was closer to that of this tick on blue wildebeest, *Connochaetes taurinus,* a tick-resistant animal, than to that on other antelopes. A single buffalo examined in the KNP was not infested with *R. (B.) decoloratus*, whereas a giraffe, *Giraffa camelopardalis*, examined at the same locality and time, harboured a small number of ticks. In a nature reserve in Mpumalanga Province adjacent to the KNP, two immobilized buffaloes, from which only adult ticks were collected, were not infested with *R. (B.) decoloratus*, whereas greater kudus, *Tragelaphus strepsiceros*, examined during the same time of year in the KNP harboured large numbers of adult ticks of this species. African buffaloes would thus appear to be resistant to infestation with *R. (B.) decoloratus*, and this resistance is expressed as the prevention of the majority of tick larvae from developing to nymphs.

Keywords: African buffaloes, ixodid tick, *Rhipicephalus (Boophilus) decoloratus*, *Syncerus caffer,* tick resistance

INTRODUCTION

African buffaloes, *Syncerus caffer,* are large bovids that prefer savanna-type habitats and require a plentiful supply of grass, shade and water for optimal survival. They occur in herds, which increase in size in the dry season, but decrease during the wet season because of the usual abundance of both food and water (Skinner & Smithers 1990). Large numbers of these animals are present in the Kruger National Park (KNP) in north-eastern Mpumalanga and Limpopo Provinces, and in the Umfolozi and Hluhluwe Nature Reserves (recently combined to form the Hluhluwe-iMfolozi Park) in the north-eastern regions of KwaZulu-Natal Province (KZN), with smaller populations in national, provincial and privately owned reserves or in buffalo breeding projects in these and nearly all other provinces of South Africa.

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African buffaloes may be infested with exceptionally large numbers and species of ixodid ticks (Yeoman & Walker 1967; Walker 1974; Horak, Potgieter, Walker, De Vos & Boomker 1983a), and because of their own large size a large percentage of these ticks are usually adults (Horak, MacIvor, Petney & De Vos 1987; Gallivan & Horak 1997). There is, however, some doubt as to their suitability as hosts for the one-host tick *Rhipicephalus (Boophilus) decoloratus*. In Tanzania no *R. (B.) decoloratus* were present in 25 collections from buffaloes examined by Yeoman & Walker (1967), while in Kenya and Zimbabwe only one of 119, and one of 135 collections, respectively, were positive (Walker 1974; Mason & Norval 1980). In north-eastern KZN, South Africa, only one of four fairly exhaustive collections made from buffaloes was positive, and it contained only larvae of this species (Horak *et al.* 1983a).

In an attempt to confirm this observation Norval (1984) infested a tame, hand-reared, tick-free, year-old African buffalo with 10 000 larvae of *R. (B.) decoloratus* on each of three occasions over a period of 3 months. The first infestation yielded 201 engorged females, the second 421, and the third, which was accompanied by considerable irritation and grooming, only 63 engorged females. According to Norval (1984) the latter result is similar to what one would expect on Brahman cattle resistant to *Rhipicephalus (Boophilus) microplus*.

An opportunity to do tick counts on African buffaloes arose when one of these animals was slaughtered in the KNP for survey purposes and ten were slaughtered during a survey to determine the prevalence of bovine tuberculosis in buffaloes in the north-eastern KZN nature reserves. An additional two animals were immobilized for other purposes in a north-eastern Mpumalanga Province nature reserve and were also examined for ticks. The main objective of the present communication is to compare the *R. (B.) decoloratus* burdens of these buffaloes with those of medium-sized and large antelopes in the KZN nature reserves and in the KNP.

MATERIALS AND METHODS

During September 1985 a single buffalo was shot near Satara tourist rest camp in the southern KNP, Mpumalanga Province. During June and July 1994 four buffaloes were darted and then shot in the Umfolozi Nature Reserve, four in the Hluhluwe Nature Reserve, and two in the Eastern Shores Nature Reserve, all in north-eastern KZN. The animals were skinned and their skins were processed for tick recovery as described by Horak, Boomker, Spickett & De Vos (1992). Two buffaloes were immobilized and carefully examined for adult ticks in the Mtethomusha Nature Reserve, Mpumalanga Province, adjacent to the south-western boundary of the KNP. The ticks recovered from all the buffaloes were identified and counted. Their burdens of *R. (B.) decoloratus* are compared with those of medium-sized and large antelopes processed in the same way, namely impalas, *Aepyceros melampus*, greater kudus, *Tragelaphus strepsiceros*, and blue wildebeest, *Connochaetes taurinus*, in the KNP, and nyalas, *Tragelaphus angasii*, in the north-eastern KZN nature reserves (Horak, De Vos & Brown 1983b; Horak *et al*. 1992; Horak, Boomker & Flamand 1995; Horak, Gallivan, Braack, Boomker & De Vos 2003). The tick burden of the single buffalo examined in the KNP is also compared to that of a giraffe, *Giraffa camelopardalis*, shot at the same time and place. The tick burdens of the KZN buffaloes are compared with those of nyalas and impalas examined in north-eastern KZN reserves during the same time of year, but not in the same year as the buffaloes. While the adult tick burdens of the buffaloes examined in the Mtethomusha Nature Reserve during July 1999 are compared with those of greater kudus examined in the south of the KNP during July 1981 and 1982. With the exception of some of the nyalas, the length of the idiosoma of engorging female *R. (B.) decoloratus* collected from the animals was measured. Those ticks of which the idiosoma measured 4.0 mm or more, were regarded as standard females, i.e. female ticks that will engorge and detach within the next 24 h.

RESULTS

The *R. (B.) decoloratus* burdens of individual buffaloes are summarized in Table 1. The largest number of ticks of this species were collected from the only buffalo calf examined, an animal approximately 6 months of age. The overall ratio of larvae to nymphs to males and females on all the buffaloes was 10.5: 1.8: 1.6: 1.0. If, however, the tick burden of the calf is excluded from the comparison, the ratios are 36.1: 2.8: 1.6: 1.0.

The numbers of *R. (B.) decoloratus* on the slaughtered buffaloes are compared with those on impalas and greater kudus in the KNP, and on nyalas in the north-eastern KZN reserves in Table 2. The overall ratio of the various life stages on the 305 antelopes examined is 10.7: 5.7: 2.0: 1.0.

In Table 3 the *R. (B.) decoloratus* burdens of the buffaloes are compared with those of nyalas, im-

TABLE 1 Numbers of *Rhipicephalus (Boophilus) decoloratus* collected from African buffaloes in five nature reserves in South Africa

Host	Date	Locality	Number of *Rhipicephalus (Boophilus) decoloratus*				
			Larvae	Nymphs	Males	Females	Total
Buffalo 1*	July 1999	Mtethomusha reserve	–	–	0	0	0
Buffalo 2*	July 1999	Mtethomusha reserve	–	–	0	0	0
Buffalo 3	Sept 1985	Kruger National Park	0	0	0	0	0
Buffalo 4	June 1994	Umfolozi reserve	590	28	8	4 (0)	630
Buffalo 5**	June 1994	Umfolozi reserve	234	178	186	120 (8)	718
Buffalo 6	June 1994	Umfolozi reserve	180	0	2	0	182
Buffalo 7	June 1994	Umfolozi reserve	200	0	0	0	200
Buffalo 8	June 1994	Hluhluwe reserve	288	82	48	28 (2)	446
Buffalo 9	June 1994	Hluhluwe reserve	6	0	0	6 (0)	12
Buffalo 10	June 1994	Hluhluwe reserve	10	2	2	2 (0)	16
Buffalo 11	June 1994	Hluhluwe reserve	116	0	2	0	118
Buffalo 12	July 1994	Eastern Shores	8	0	0	0	8
Buffalo 13	July 1994	Eastern Shores	44	0	0	0	44
Total			**1 676**	**290**	**248**	**160 (10)**	**2 374**
Ratio			**10.5**	**1.8**	**1.6**	**1.0**	
Total excluding buffalo calf no. 5			**1 442**	**112**	**62**	**40 (2)**	**1 656**
Ratio			**36.1**	**2.8**	**1.6**	**1.0**	

* = Immobilized and examined only for adult ticks
** = Calf, approximately 6 months old
( ) = Number of standard female ticks, i.e. with idiosoma > 4.0 mm in length

TABLE 2 Total numbers of *Rhipicephalus (Boophilus) decoloratus* collected from African buffaloes and antelopes at various localities in South Africa

Host (number examined)	Locality	Number of *Rhipicephalus (Boophilus) decoloratus*				
		Larvae	Nymphs	Males	Females	Total
Buffalo (1)	Kruger National Park	0	0	0	0	0
Buffaloes (10)	KwaZulu-Natal	1 676	290	248	160 (10)	2 374
Ratio		**10.5**	**1.8**	**1.6**	**1.0**	
Impalas (135)	Kruger National Park	226 612	101 981	37 724	18 024 (355)	384 341
Kudus (95)	Kruger National Park	161 815	107 711	35 959	18 140 (360)	323 625
Nyalas (75)	KwaZulu-Natal	11 905	5 355	2 100	1 313*	20 673
Total (305)		**400 332**	**215 047**	**75 783**	**37 477**	**728 639**
Ratio		**10.7**	**5.7**	**2.0**	**1.0**	

( ) = Number of standard female ticks, i.e. with idiosoma > 4.0 mm in length
* = Length of idiosoma of maturing females not measured

palas and kudus examined during the same time of year (but not in the same year), at the same localities, or in a locality adjacent to that in which the buffaloes were examined. The mean tick burdens of the buffaloes examined in KZN exceeded those of nyalas and impalas examined at the same localities, but the life-stage ratios on the buffaloes were markedly skewed in favour of larvae. The buffalo examined in the KNP was not infested, but a giraffe examined at the same time and locality harboured a small burden of *R. (B.) decoloratus*. The immobilized buffaloes examined for adult ticks in the Mthetomusha Nature Reserve, adjacent to the KNP, were not infested, whereas all eight kudus examined in the south of the KNP were infested with adult ticks.

The life-stage structure of the *R. (B.) decoloratus* population on buffaloes in north-eastern KZN is compared in Table 4 to that of this tick on blue wildebeest in the KNP. The tick life-stage ratios on the wildebeest, which are tick-resistant animals, were 21.0 larvae: 4.0 nymphs: 1.4 males: 1.0 females.

TABLE 3 Total numbers of *Rhipicephalus (Boophilus) decoloratus* collected from African buffaloes and antelopes examined during the same time of year at the same or adjacent localities

Host (number examined)	Locality	Number of *Rhipicephalus (Boophilus) decoloratus*				
		Larvae	Nymphs	Males	Females	Total
Buffaloes (10)	KwaZulu-Natal reserves	1 676	290	248	160 (10)	2 374
Nyalas (13)	KwaZulu-Natal reserves	452	200	26	36 (10)	714
Impalas (2)	KwaZulu-Natal reserves	52	34	30	36 (0)	152
Buffalo (1)	Kruger National Park	0	0	0	0	0
Giraffe (1)	Kruger National Park	0	4	37	8 (2)	47
Buffaloes (2)*	Mtethomusha reserve	–	–	0	0	0
Kudus (8)**	Kruger National Park	–	–	2 448	1 245 (38)	3 693

* = Immobized and only adult ticks collected
** = Only adult ticks taken into consideration
( ) = Number of standard female ticks, i.e. with idiosoma > 4.0 mm in length

TABLE 4 Numbers of *Rhipicephalus (Boophilus) decoloratus* collected from African buffaloes and blue wildebeest

Host (number examined)	Locality	Number of *Rhipicephalus (Boophilus) decoloratus*				
		Larvae	Nymphs	Males	Females	Total
African buffaloes (10)	KwaZulu-Natal reserves	1 676	290	248	160 (10)	2 374
Mean **Ratio** **Ratio excluding buffalo calf no. 5 in Table 1**		167.6 **10.5** **36.1**	29.0 **1.8** **2.8**	24.8 **1.6** **1.6**	16.0 (1.0) **1.0** **1.0**	237.4
Blue wildebeest (47)	Kruger National Park	19 722	3 805	1 271	940 (88)	25 738
Mean **Ratio**		419.6 **21.0**	81 **4.0**	27 **1.4**	20 (1.9) **1**	547.6

( ) = Number of standard female ticks, i.e. with idiosoma > 4.0 mm in length

DISCUSSION

It is arguable as to whether *R. (B.) decoloratus* was brought to southern Africa on the cattle of the early herdsmen that came to this country from further north in Africa or whether it is actually a parasite of wild herbivores in this country and has adapted to cattle. Whatever the tick's origin, wherever its distribution overlaps that of cattle, impalas, bushbuck, *Tragelaphus scriptus*, greater kudus, nyalas and Burchell's zebras, *Equus burchelli*, in South Africa these animals have all proved to be excellent hosts (Baker & Ducasse 1967; Horak *et al*. 1983a, 1992, 1995, 2003; Horak, De Vos & De Klerk 1984).

Rhipicephalus (Boophilus) decoloratus is a one-host tick and where exhaustive tick collections have been made the approximate life-stage structure of parasitic populations is larvae 11: nymphs 6: males 2: females 1 (Table 2). This stepped-down population structure probably results from the loss of larvae and newly-moulted nymphs, followed by the loss of nymphs and newly-moulted adults at the time of the larval and nymphal moults respectively. The 2: 1 ratio of males to females is most likely a consequence of two factors, namely the greater loss of engorging females, because of their larger size, than of males during grooming, and the persistence of males on cattle, and probably other hosts, after females originating from the same infestation have detached (Londt 1976). In systems in which tick predation by red-billed oxpeckers, *Buphagus erythrorhynchus,* occurs naturally, or is encouraged, engorged female *R. (B.) decoloratus* would be a preferred food item of these birds (Bezuidenhout & Stutterheim 1980), thus further affecting the male: female ratio.

Not all large wild herbivores are susceptible to infestation with *R. (B.) decoloratus*, and blue wildebeest seem to have an innate resistance to infestation with this and other ticks (Horak *et al*. 1983b). Although larval burdens may be fairly large on blue wildebeest, there is a sharp decline in numbers between the larval and the nymphal stages, resulting in a life-

stage structure of larvae 21: nymphs 4 (Table 4). If one were to exclude the tick burden of the KZN buffalo calf, which harboured fairly substantial numbers of nymphs and adult ticks, the life-stage structure on buffaloes would be 36.1 larvae to only 2.8 nymphs. This skewed life-stage distribution is underscored by the fact that only one of four buffaloes exhaustively examined for ticks in the Hluhluwe Nature Reserve during September 1978 was infested with *R. (B.) decoloratus* and then harboured only 64 larvae (Horak *et al*. 1983a). The apparent resistance of African buffaloes to infestation with *R. (B.) decoloratus* probably stems from an ancient association between these animals and the tick, and seems to be similar to that in indigenous Nguni cattle in South Africa (Spickett, De Klerk, Enslin & Scholtz 1989).

The resistance of hosts to ticks can be expressed in several ways. In the case of *R. (B.) decoloratus* on African buffaloes and blue wildebeest, resistance interferes with the development of larvae to nymphs, but apparently not with the development of nymphs to adults, nor with the engorgement of female ticks (Table 4). In blue wildebeest this resistance appears to be innate and is present in very young calves (Horak *et al*. 1983b). In African buffaloes resistance would seem to be acquired in that young calves and tick-naïve animals are susceptible to infestation with *R. (B.) decoloratus* and only become resistant after repeated infestations (Norval 1984, Table 1). Although a large proportion of *R. (B.) decoloratus* larvae may develop to adults on apparently susceptible hosts such as impalas and greater kudus (Horak *et al*. 1992, 2003), only a small percentage of the resultant females engorge (Table 2), seemingly because of a degree of resistance in these animals. Of the total of 36 164 female ticks on the impalas and kudus examined in the KNP only 715 (2%) were of standard size (Table 2). Furthermore females that do mature on resistant animals may fail to reach full engorgement before detaching, and these smaller ticks will produce fewer eggs than fully engorged females.

In contrast to blue wildebeest, which are resistant to infestation with a large variety of tick species (Horak *et al*. 1983b), African buffaloes seem to be resistant only to infestation with *R. (B.) decoloratus*. In support of this contention the ten buffaloes examined in the north-eastern KZN nature reserves during the current surveys were infested with a total of ten ixodid tick species and their total burdens varied from 5 911 to 58 498 ticks. *Rhipicephalus (Boophilus) decoloratus* accounted for only 2 374 out of the total of 236 845 ticks collected from these animals, of which 229 920 of the latter were immature and 6 925 adults. This is still a large number of adult ticks considering that it was midwinter and that most adult ticks are encountered on wildlife and on domestic cattle in South Africa during summer (Baker & Ducasse 1967; Rechav 1982; Horak *et al.* 1984, 1992, 1995, 2003). However, this large number of adult ticks on buffaloes even during winter is not surprising considering that the larger the host species the more adult ticks it is likely to harbour (Horak *et al.* 1987; Gallivan & Horak 1997). African buffaloes and eland, *Taurotragus oryx*, are the largest wild bovids in South Africa and consequently, irrespective of the season, are usually infested with more adult ticks than other host species (Horak *et al*. 1983a, 1987). The absence, or virtual absence, of adult *R. (B.) decoloratus* on the buffaloes is thus the more conspicuous.

Judging by the small tick burdens of impalas and nyalas examined at the same localities in north-eastern KZN as the buffaloes (Table 3), this region is marginal for *R. (B.) decoloratus*. Because of their large size and hence the amount of meat that can be obtained from them, buffaloes that are to be culled are usually slaughtered in winter to avoid the carcass being exposed to both the heat of the sun and to exploitation by blowflies. The same applies in respect of heat stress in buffaloes that are to be chemically immobilized for any length of time. Winter is a season during which the numbers of *R. (B.) decoloratus* on wildlife may be at their lowest (Horak *et al.* 1984, 1992), and hence it is not an ideal time during which to compare the tick burdens of various host species, particularly if the region is marginal for *R. (B.) decoloratus*.

CONCLUSION

African buffaloes appear to acquire resistance to infestation with the one-host tick *R. (B.) decoloratus*, and this resistance is expressed as the prevention of the majority of tick larvae from developing to nymphs. The correctness of this conclusion can, however, only be verified when buffaloes are exhaustively examined for ticks at a locality in which susceptible hosts belonging to other species are heavily infested with *R. (B.) decoloratus*.

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