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SOME AVIAN AND MAMMALIAN HOSTS OF *AMBLYOMMA HEBRAEUM* AND *AMBLYOMMA MARMOREUM* (ACARI: IXODIDAE)

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ABSTRACT

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Large numbers of birds, wild mammals and domestic stock from a variety of localities within the Republic of South Africa were examined for infestation with the ixodid ticks *Amblyomma hebraeum* and *Amblyomma marmoreum*.

Every warthog (*Phacochoerus aethiopicus*), Burchell's zebra (*Equus burchelli*), impala (*Aepyceros melampus*) and kudu (*Tragelaphus strepsiceros*) from the Kruger National Park in the north-eastern Transvaal Lowveld was infested with *A. hebraeum*. In the eastern Cape Province every helmeted guinea fowl (*Numida meleagris*), scrub hare (*Lepus saxatilis*) and kudu from the Andries Vosloo Kudu Reserve; all but 1 of the 22 domestic cattle examined on the farm "Bucklands"; and all Angora goats plus nearly all Boer goats examined on the farm "Brakhill" were infested with this tick. Most animals examined appeared to be good hosts of the immature stages, and the larger the host species the greater the chances of it harbouring large numbers of adult ticks. The largest animals examined, such as eland, buffalo, giraffe and rhinoceros, harboured very large numbers of adult *A. hebraeum*.

No adult *A. marmoreum* was recovered from any host. However, 50 % or more of helmeted guinea fowl and kudu from the Andries Vosloo Kudu Reserve; helmeted guinea fowl, scrub hares and eland (*Taurotragus oryx*) from the Mountain Zebra National Park; helmeted guinea fowl, kudu, domestic sheep, goats and cattle on the farm "Bucklands", and caracal (*Felis caracal*) from the Cradock and Southwell areas of the eastern Cape Province were infested with immature *A. marmoreum*. In the Bontebok National Park in the south-western Cape Province more than 35 % of scrub hares, vaal ribbok (*Pelea capreolus*) and bontebok (*Damaliscus dorcas dorcas*) were infested with immature ticks.

INTRODUCTION

Amblyomma hebraeum is a 3-host tick utilizing certain birds and many small, medium-sized and large mammals as hosts for its immature stages, while the adults seem to prefer the larger mammals (Theiler, 1962; Norval, 1974; Horak, 1982; Horak, Potgieter, Walker, De Vos & Boomker, 1983). Reptiles may also be infested (Theiler, 1962; Walker & Schulz, 1984; Dower, Petney & Horak, unpublished data, 1986).

The South African tortoise tick, *Amblyomma marmoreum*, also a 3-host tick, is found on reptiles, particularly tortoises, in all stages of its development (Theiler, 1962; Norval, 1975). The immature stages may also infest insectivores, lagomorphs and birds (Theiler, 1962; Norval, 1975). The helmeted guinea fowl (*Numida meleagris*) is a particularly favoured host (Horak & Williams, 1986).

Norval (1974, 1975) examined small numbers of various hosts for the presence of both these *Amblyomma* species but no comparative data, obtained by regular examinations of a number of host species over prolonged periods of time, are available. Not only would this information be of value when planning control strategies, particularly against *A. hebraeum*, but it would also indicate potential reservoirs of *Cowdria ruminantium*, which is transmitted by this tick.

During the past 8 years numerous birds and mammals have been slaughtered at regular intervals over periods of 12 months or more at several localities. These animals were all processed for total tick recovery as described by Horak, Meltzer & De Vos (1982) and Horak, Sheppey, Knight & Beuthin (1986). The ticks recovered from the mammals were counted as described by Horak, Potgieter, Walker, De Vos & Boomker (1983) while those on the birds were counted as described by Horak & Williams (1986). In addition certain very large mammals were also processed for tick recovery as and when they became available.

In the present paper the data for *A. hebraeum* and *A. marmoreum* have been extracted from the total tick burdens of all these animals. Some of the findings applicable to individual host species have already been published (Horak, De Vos & Brown, 1983; Horak, De Vos & De Klerk, 1984; Horak & Williams, 1986; Horak, Knight & De Vos, 1986; Horak, Sheppey, Knight & Beuthin, 1986). However, no host comparisons for *A. hebraeum* and *A. marmoreum* have been made from these data.

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MATERIALS AND METHODS

Localities

The localities at which the animals were examined are summarized in Table 1.

Hosts

The hosts examined are listed in Table 2, in ascending order of size where feasible. The common names suggested by McLachlan & Liversidge (1978) for the birds and by Smithers (1983) for the mammals have been used.

Tick burdens

The tick burdens of the various host species at the particular localities at which they were examined have been compared. In addition the tick burdens of 15 adult male and 15 adult female kudu (older than 48 months), shot over a 2 year period at the same time and in the same locality in the Kruger National Park, were compared using a Wilcoxon matched-pairs signed-ranks test.

Using the Mann-Whitney U-test, the tick burdens of warthog examined in the Kruger National Park during October and November of a year of normal rainfall (1980; total rainfall 660 mm) were compared with those of warthog shot in the same months during a severe drought (1982; total rainfall 427 mm, of which 202,5 mm fell during January).

RESULTS

A. hebraeum

Kruger National Park

The mean tick burdens of each host species examined in the Kruger National Park are summarized in Table 3.

Blue wildebeest were poor hosts of all stages of development, while warthog were poor hosts of the immature stages and impala and Burchell's zebra poor hosts of the adults. The kudu harboured large numbers of immature ticks and, with the warthog, fair numbers of adults.

TABLE 1 The localities within the Republic of South Africa at which animals were examined for *Amblyomma hebraeum* and *Amblyomma marmoreum*

Province	Locality	Co-ordinates	Vegetation as classified by Acocks (1975)
Transvaal	Southern Kruger National Park	South of 24°24′S between 31°15′E and 31°55′E	Arid Lowveld and Lowveld
Natal	Hluhluwe Game Reserve	28°07′S; 32°03′E	Zululand Thornveld and Lowveld
Cape Province	Addo Elephant National Park	33°27′S; 25°44′E	Valley Bushveld
	Andries Vosloo Kudu Reserve	33°07′S; 26°40′E	Valley Bushveld
	Graaff-Reinet area	32°15′S; 24°32′E	False Karroid Broken Veld and False Central Lower Karoo
	Bontebok National Park	34°02′S; 20°25′E	False Macchia and Coastal Renosterbosveld
	"Brakhill"	33°33′S; 25°25′E	Valley Bushveld
	"Bucklands"	33°05′S; 26°41′E	Valley Bushveld
	Cradock area	32°10′S; 25°38′E	False Upper Karoo and False Karroid Broken Veld
	Mountain Zebra National Park	32°15′S; 25°41′E	Karroid *Merxmeullera* Mountain Veld replaced by Karoo
	Southwell area	33°32′S; 26°41′E	Eastern Province Thornveld, Valley Bushveld and Alexandria Forest
	Thomas Baines Nature Reserve	33°23′S; 26°28′E	False Macchia, Eastern Province Thornveld and Valley Bushveld

TABLE 2 The birds and mammals examined for *Amblyomma hebraeum* and *Amblyomma marmoreum*

Order	Species	Common name
Passeriformes	*Anthus similis*	Nicholson's pipit
	Cercomela familiaris	Familiar chat
	Chersomanes albifasciata	Spike-heeled lark
	Certhilauda curvirostris	Long-billed lark
	Galerida magnirostris	Thick-billed lark
Galliformes	*Numida meleagris*	Helmeted guinea fowl
Rodentia	*Rhabdomys pumilio*	Striped mouse
	Otomys unisulcatus	Bush Karoo rat
	Pedetes capensis	Springhaas
Lagomorpha	*Lepus saxatilis*	Scrub hare
	Pronolagus rupestris	Smith's red rock rabbit
Hyracoidea	*Procavia capensis*	Rock dassie
Carnivora	*Felis caracal*	Caracal
Artiodactyla	*Phacochoerus aethiopicus*	Warthog
	Raphicerus melanotis	Grysbok
	Sylvicapra grimmia	Common duiker
	Pelea capreolus	Vaal ribbok
	Redunca fulvorufula	Mountain reedbuck
	Antidorcas marsupialis	Springbok
	Aepyceros melampus	Impala
	Damaliscus dorcas dorcas	Bontebok
	Connochaetes gnou	Black wildebeest
	Connochaetes taurinus	Blue wildebeest
	Tragelaphus strepsiceros	Kudu
	Taurotragus oryx	Eland
	Syncerus caffer	Buffalo
	Giraffa camelopardalis	Giraffe
	Capra hircus	Angora and Boer goats
	Ovis aries	Dorper sheep
	Bos indicus × *Bos taurus*	Beef-type cattle
Perissodactyla	*Equus burchelli*	Burchell's zebra
	Equus zebra zebra	Cape mountain zebra
	Diceros bicornis	Hook-lipped rhinoceros

TABLE 3 The mean burdens of *Amblyomma hebraeum* recovered from animals slaughtered at regular intervals over prolonged periods of time in the Kruger National Park

Host species	Period of examination	Number of animals examined	Percentage infested	Mean numbers of *A. hebraeum* recovered				
				Larvae	Nymphae	Males	Females	Total
Warthog	Jan. 80–Jan. 81	50	100,0	74,5	58,0	10,1	4,4	147,0
Impala	Jan. 80–May 81	134	100,0	739,0	102,0	0,6	0,1	841,7
Blue wildebeest	Dec. 77–Nov. 78	40	85,0	72,0	2,5	0,1	0,0	74,6
Kudu	Apr. 81–Mar. 83	95	100,0	712,4	103,2	6,9	3,1	825,6
Burchell's zebra	Jul. 80–Jul. 81	18	100,0	382,1	60,9	1,4	0,5	444,9

TABLE 4 The burdens of *Amblyomma hebraeum* of 15 adult male and 15 adult female kudu shot at the same time and in the same locality are compared using a Wilcoxon matched-pairs signed-ranks test. The value of T and significance are given

Stage of development	Mean number of ticks recovered		Wilcoxon T value	Significance
	Male kudu	Female kudu		
Larvae	678,3	476,0	37,5	> 0,05
Nymphae	144,7	103,2	20,0	< 0,05
Males	22,1	2,8	0,0	< 0,001
Females	11,1	0,5	0,0	< 0,001

The tick burdens of the adult male and female kudu are summarized in Table 4.

There were significantly more nymphae and adult ticks on the male kudu than on the female kudu.

The tick burdens of the warthog examined during a normal year and during a dry year are summarized in Table 5.

During the drought the warthog carried significantly more larvae, nymphae and male ticks than warthog examined during a normal year. The increase in the number of female ticks on the warthog was also higher during the dry year; the difference approached the 5 % significance level.

Andries Vosloo Kudu Reserve

The mean tick burdens of the animals examined in this reserve are summarized in Table 6.

The helmeted guinea fowl were good hosts of larvae, while the kudu were good hosts of all 3 stages of development.

Large mammals

The individual tick burdens of the very large mammals examined at various localities are listed in Table 7.

TABLE 5 A comparison of the burdens of *Amblyomma hebraeum* of warthog examined during a normal and a dry year using the Mann-Whitney U-test

Months examined	Rainfall (mm) Feb.–Nov.	Number of warthogs examined (sex ratios)	Mean numbers (range) of *A. hebraeum* recovered								
			Larvae	U (sign)	Nymphae	U (sign)	Males	U (sign)	Females	U (sign)	Total
Oct./Nov. 1980	414,5	8 (1 male: 7 females)*	18,6 (0–35)		24,4 (11–44)		7,6 (2–28)		3,3 (1–11)		53,9
Oct./Nov. 1982	165,4	7 (5 males: 2 females)*	416,0 (56–1233)	0 (< 0,001)	259,7 (27–858)	8 (<0,01)	203,1 (12–754)	8 (< 0,01)	88,6 (5–308)	16 (=0,052)	967,4

* There is no statistical difference between the burdens of the male and female warthog

TABLE 6 The mean burdens of *Amblyomma hebraeum* of guinea fowl, scrub hare and kudu in the Andries Vosloo Kudu Reserve

Host species	Period of examination	Number of animals examined	Percentage infested	Mean numbers of *A. hebraeum* recovered				
				Larvae	Nymphae	Males	Females	Total
Guinea fowl	May 84–Jan. 86	33	100,0	379,8	22,5	0,0	0,0	402,3
Scrub hare	Feb. 85–Jan. 86	20	100,0	36,5	16,2	0,0	0,0	52,7
Kudu	Feb. 85–Jan. 86	12	100,0	854,9	169,2	34,5	19,5	1 078,1

TABLE 7 The numbers of *Amblyomma hebraeum* recovered from very large animals at various localities

Host	Locality	Date	Total numbers of *A. hebraeum* recovered				
			Larvae	Nymphae	Males	Females	Total
Eland	Kruger Park	September 1979	4 128	1 704	744	153	6 729
Eland	Andries Vosloo	March 1983	1 159	52	1 195	134	2 540
Eland	Thomas Baines	April 1982	6 352	320	1 443	189	8 304
Eland	Thomas Baines	July 1984	13 696	113	60	42	13 911
Eland	Thomas Baines	July 1984	6 731	200	19	6	6 956
Buffalo	Hluhluwe	September 1978	339	203	270	83	895
Buffalo	Hluhluwe	September 1978	148	405	323	49	925
Buffalo	Hluhluwe	September 1978	712	407	1 092	248	2 459
Buffalo	Hluhluwe	September 1978	220	228	347	167	962
Buffalo	Thomas Baines	November 1985	309	815	1 036	284	2 444
Giraffe	Kruger Park	July 1980	624	272	585	167	1 648
Giraffe	Kruger Park	July 1980	128	160	360	112	760
Hook-lipped rhinoceros	Addo Park	April 1985	293	394	832	379	1 898

TABLE 8 The mean burdens of *Amblyomma hebraeum* recovered from animals slaughtered at regular intervals over a prolonged period of time on the farms "Brakhill" and "Bucklands"

Host and locality	Period of examination	Number of animals examined	Percentage infested	Mean numbers of *A. hebraeum* recovered				
				Larvae	Nymphae	Males	Females	Total
"Brakhill"								
Angora goats	Feb. 83–Jan. 84	24	100,0	419,1	74,1	12,3	3,8	509,3
Boer goats	Feb. 83–Jan. 84	24	91,7	232,4	55,8	4,8	2,8	295,8
Scrub hare	Jan. 83–Dec. 83	48	43,8	2,1	0,6	0,0	0,0	2,7
Grysbok	Jan. 83–Dec. 83	12	75,0	21,7	3,3	0,0	0,0	25,0
Duiker	Jan. 83–Dec. 83	12	75,0	71,3	4,3	0,0	0,0	75,6
Kudu	Jan. 83–Dec. 83	12	66,7	176,8	2,4	0,1	0,1	179,4
"Bucklands"								
Angora goats	Feb. 85–Jan. 86	24	45,8	2,7	1,3	0,0	0,0	4,0
Dorper sheep	Feb. 85–Jan. 86	24	37,5	1,3	1,7	0,0	0,0	3,0
Calves	Feb. 85–Jan. 86	22	100,0	57,2	7,5	15,4	6,3	86,4
Guinea fowl	May 85–Jan. 86	14	50,0	30,6	0,2	0,0	0,0	30,8
Scrub hare	Feb. 85–Jan. 86	23	13,0	0,1	< 0,1	0,0	0,0	< 0,2
Kudu	Mar. 85–Dec. 85	5	80,0	17,4	1,6	0,4	0,0	19,4

TABLE 9 The mean numbers of *Amblyomma hebraeum* and *Amblyomma marmoreum* recovered from caracal from the Cradock, Graaff-Reinet and Southwell areas

Locality	Period of examination	Number of caracal examined	*A. hebraeum*			*A. marmoreum*		
			Percentage of caracal infested	Mean numbers recovered		Percentage of caracal infested	Mean numbers recovered	
				Larvae	Nymphae		Larvae	Nymphae
Cradock	May 84–Mar. 85	18	0,0	0,0	0,0	61,1	12,2	0,0
Graaff-Reinet	May 84–Sep. 84	10	0,0	0,0	0,0	40,0	3,4	0,1
Southwell	Sep. 84–Jan. 86	22	31,8	5,5	< 0,1	90,9	58,7	0,6

TABLE 10 The mean burdens of *Amblyomma marmoreum* on a variety of birds and mammals examined in the Bontebok National Park, the Andries Vosloo Kudu Reserve and the Mountain Zebra National Park

Host and locality	Period of examination	Number of animals examined	Percentage infested	Mean numbers of *A. marmoreum* recovered		
				Larvae	Nymphae	Total
Bontebok National Park						
Scrub hare	Apr. 83–Feb. 84	11	45,5	2,7	0,4	3,1
Vaal ribbok	Feb. 83–Feb. 84	30	36,7	3,2	0,1	3,3
Bontebok	Feb. 83–Feb. 84	16	37,5	1,9	0,3	2,2
Andries Vosloo Kudu Reserve						
Guinea fowl	May 84–Jan. 86	33	84,8	8,6	1,2	9,8
Scrub hare	Feb. 85–Jan. 86	20	30,0	1,6	0,2	1,8
Kudu	Feb. 85–Jan. 86	12	66,7	98,3	0,0	98,3
Mountain Zebra National Park						
Larks, chats and pipits	Mar. 84–May 85	27	0,0	0,0	0,0	0,0
Guinea fowl	Feb. 84–Dec. 85	16	81,3	55,3	0,9	56,2
Striped mouse	Mar. 84–Dec. 85	30	0,0	0,0	0,0	0,0
Bush Karoo rat	Mar. 84–Dec. 85	38	5,3	0,1	0,0	0,1
Springhaas	Feb. 84–Dec. 85	16	0,0	0,0	0,0	0,0
Red rock rabbit	Nov. 82–Dec. 85	28	21,4	0,4	0,1	0,5
Scrub hare	Feb. 83–Dec. 85	26	50,0	3,0	0,4	3,4
Rock dassie	May 83–Dec. 85	25	16,0	0,1	< 0,1	0,1
Mountain reedbuck	Nov. 83–Dec. 85	18	16,7	0,6	0,1	0,7
Springbok	Nov. 83–Dec. 85	18	0,0	0,0	0,0	0,0
Black wildebeest	May 83–Dec. 85	9	0,0	0,0	0,0	0,0
Cape mountain zebra	Feb. 83–Oct. 85	15	26,7	12,0	0,1	12,1
Eland	May 83–Dec. 85	11	72,7	15,2	0,0	15,2

TABLE 11 The mean burdens of *Amblyomma marmoreum* recovered from animals slaughtered at regular intervals over a prolonged period of time the farm "Bucklands"

Host species	Period of examination	Number of animals examined	Percentage infested	Mean numbers of *A. marmoreum* recovered		
				Larvae	Nymphae	Total
Angora goats	Feb. 85–Jan. 86	24	58,3	6,6	0,5	7,1
Dorper sheep	Feb. 85–Jan. 86	24	50,0	1,8	0,2	2,0
Calves	Feb. 85–Jan. 86	22	81,8	39,8	0,6	40,4
Guinea fowl	May 85–Jan. 86	14	50,0	0,6	0,5	1,1
Scrub hare	Feb. 85–Jan. 86	23	26,1	3,9	< 0,1	4,0
Kudu	Mar. 85–Dec. 85	5	60,0	4,4	0,0	4,4

With the exception of eland, which were good hosts of all stages of development, the very large animals appeared to be better hosts of adult than of immature ticks.

Farms

The mean tick burdens of wild and domestic animals examined at regular intervals on the farms "Brakhill" and "Bucklands" are summarized in Table 8.

On "Brakhill" the Angora goats harboured greater numbers of each developmental stage of *A. hebraeum* than did the Boer goats. Of the wild animals only the kudu were infested with adult ticks.

The cattle on "Bucklands" carried fairly large burdens of adult *A. hebraeum* in relation to the numbers of immature ticks recovered from any of the hosts. Kudu were the only other hosts on "Bucklands" that were infested with adult ticks.

The mean tick burdens of caracal examined on farms in the Cradock, Graaff-Reinet and Southwell areas are summarized in Table 9.

No *A. hebraeum* were recovered from the caracal from the Cradock or Graaff-Reinet areas, but both these regions fall outside the distribution area of this tick. A few immature *A. hebraeum* were recovered from 7 of the 22 caracal examined at Southwell.

A. marmoreum

Nature reserves

No *A. marmoreum* were recovered from the animals examined in the Kruger National Park.

The mean tick burdens of a variety of animals examined in the Bontebok National Park, the Andries Vosloo Kudu Reserve and the Mountain Zebra National Park are summarized in Table 10.

No adult ticks were recovered and very few nymphae. The kudu in the Andries Vosloo Kudu Reserve and the helmeted guinea fowl in the Mountain Zebra National Park harboured the greatest mean numbers of larvae.

Farms

No *A. marmoreum* were recovered from the animals examined on the farm "Brakhill". The mean burdens of the animals examined on "Bucklands" are summarized in Table 11.

With the exception of the scrub hares, on which the incidence of infestation was 26,1 %, infestation rates were 50 % or higher on all the host species examined. No adult ticks were recovered and cattle had the highest mean burdens of immature ticks.

The mean burdens of *A. marmoreum* on the caracal are summarized with those of *A. hebraeum* in Table 9. Caracal at each of the 3 localities at which they were examined were infested. The highest incidence of infestation and the largest mean burdens were recorded at Southwell.

DISCUSSION

We have used only the data on *A. hebraeum* and *A. marmoreum* that were obtained by using the methods described by Horak *et al.* (1982) for the recovery of ticks from dead ungulates and those of Horak & Williams (1986), Horak, Sheppey, Knight & Beuthin (1986) and Horak, Jacot Guillarmod, Moolman & De Vos (unpublished data, 1986) for the recovery of ticks from dead guinea fowl, scrub hares and carnivores respectively. This has been done because the tick burdens determined by these methods have proved to be accurate and close to the actual numbers of ticks present (MacIvor, Horak, Holton & Petney, 1987), a fact that is not verifiable for tick burdens determined on live animals or by collecting ticks visually from dead animals.

Because these methods were used throughout the various surveys the data for the different host species are directly comparable.

A. hebraeum

The size of the host species does not appear to have a strong influence on the total tick load. With certain exceptions, however, the larger host species tended to carry more adult ticks. Generally speaking the relatively small hosts such as guinea fowl, hares, caracal, grysbok and duiker will harbour only immature ticks. With the exception of warthog and possibly domestic goats, hosts that are slightly larger, such as impala, will harbour immature ticks and on occasion small numbers of adult ticks. The larger hosts such as kudu, and the warthogs and domestic goats, will harbour immature ticks as well as larger numbers of adult ticks. The very large hosts, such as cattle, eland, buffalo and giraffe, will harbour immature ticks plus numerous adults. If the tick burden of the 1 rhinoceros examined is typical of hosts of this size, these extremely large animals possibly harbour few immature ticks but large numbers of adults.

Certain host species seem to have a natural resistance to infestation. Among them is the blue wildebeest, which harbours few ticks of any species (Horak, De Vos & Brown, 1983). Others, such as the eland, seem to be highly susceptible to ticks of all species (Horak, Potgieter, Walker, De Vos & Boomker, 1983).

Susceptibility to tick infestation also seems to vary within a particular host species, e.g. the adult male kudu we examined were more susceptible to infestation than were the females. Similar observations have been made for *Boophilus microplus* on male and female domestic cattle (Seifert, 1971; Utech, Seifert & Wharton, 1978). Perhaps these differences also occur between juvenile and adult animals within a species.

In the case of domestic stock, management practices will also largely dictate the size of tick loads. On the farm "Brakhill" goats in a particular camp were not treated with an acaricide for 3 years, consequently the Angora and Boer goats which ran in this camp became fairly heavily infested with *A. hebraeum*. Although the Angora goats and Dorper sheep on the farm "Bucklands" were not treated for 8-12 weeks prior to slaughter, most of the other domestic animals on the farm had been treated with an acaricide at approximately monthly intervals for several years. This resulted in a marked reduction in the numbers of *A. hebraeum* on the goats and sheep as well as on the wild animals examined on "Bucklands" (Horak & Knight, 1986; Petney & Horak, 1987). It so happened, though, that the cattle examined on this farm ran with others in a small group that were only treated with an acaricide if their tick burdens were exceptionally large. Hence the larger tick burdens on the cattle slaughtered on "Bucklands".

Seasonal changes, and particularly marked climatic changes, can influence the size of tick burdens. These changes probably work in several ways.

During a severe drought animals will be nutritionally stressed and their resistance to infestation lowered (O'Kelly & Seifert, 1969), consequently their tick burdens may increase. Because of the nutritional stress the animals may attempt to conserve energy by grooming less efficiently (O'Kelly & Seifert, 1969) and this will also result in higher burdens.

During drought animals usually concentrate in areas where moisture and greenery are present, which perhaps leads to an associated concentration of parasites in these areas. This will in turn result in higher burdens on animals already stressed by the effects of drought.

A. marmoreum

No adult ticks were recovered: this stage of development is specific for tortoises and other large reptiles (Hoogstraal & Aeschlimann, 1982). But, contrary to the finding of Hoogstraal & Aeschlimann (1982) that all stages of development of this tick are host specific for reptiles, our study shows that the larvae utilize a very wide range of hosts.

Host species size does not appear to be important in determining the magnitude of the immature tick burden. In fact guinea fowl, caracal, kudu, eland and Cape mountain zebra as well as domestic goats and cattle can all be regarded as fairly good hosts of the larval stage. As we did not examine tortoises or other reptiles we cannot compare their burdens of immature ticks with those of the warm-blooded animals.

Although individual animals harboured fairly large burdens of larvae the mean larval burdens were generally low. The burdens of nymphae were very small and this developmental stage may, like the adults, prefer tortoises.

Should acaricidal treatment be instituted against *A. marmoreum*, the emphasis will have to be on the larvae occurring on domestic stock since the adults, and possibly the nymphae, occur mainly on tortoises and are relatively inaccessible. The numbers of *A. marmoreum* larvae on domestic animals may even exceed those of *A. hebraeum*, as observed on the farm "Bucklands". Although the use of acaricides on this farm led to a marked reduction in the numbers of *A. hebraeum* (Horak & Knight, 1986; Petney & Horak, 1987), it apparently had no effect on the numbers of *A. marmoreum* (Horak & Knight, 1986).

C. ruminantium is only rarely transmitted transovarially by *A. hebraeum* (Bezuidenhout & Jacobsz, 1986) and most transmission occurs trans-stadially. The same probably applies to other ticks of the genus *Amblyomma*. Because very few nymphae and exceptionally few adults of *A. marmoreum* are found on domestic stock trans-stadial transmission from larvae through nymphae or from nymphae through adults is unlikely. Consequently this tick cannot be regarded as an important vector of *C. ruminantium* even when larval numbers on domestic stock exceed those of *A. hebraeum*.

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