

Ticks (Acari: Ixodidae) of the One-Humped Camel (*Camelus dromedarius*) in Kenya and Southern Ethiopia: Species Composition, Attachment Sites, Sex Ratio and Seasonal Incidence

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Key words

Camelus dromedarius - Ixodidae - Kenya - Ethiopia.

Summary

An investigation was conducted on ixodid ticks that infested three herds of one-humped camels (*Camelus dromedarius*) in two separate areas of Kenya and one area of Southern Ethiopia. Species composition, attachment sites, sex ratio and seasonal incidence were described. The species observed were *Rhipicephalus appendiculatus*, *R. evertsi evertsi*, *R. praetextatus*^a, *R. pulchellus*, *R. pravus*, *Hyalomma dromedarii*, *H. marginatum rufipes*, *H. truncatum*, *Amblyomma gemma*, *A. lepidum* and *A. variegatum*.

^a On-going scanning electronic microscopy investigations suggest that *R. praetextatus* may be instead *R. muhsamae* [information added at authors' request in Jan. 2002; Editor's note]

INTRODUCTION

Although not mentioned in one of the earliest studies on the one-humped camel (*Camelus dromedarius*) (16), tick infestation is one of the commonest and oldest recognized diseases (5, 7, 14). In Kenya and Southern Ethiopia tick infestation of the one-humped camel is widespread (6, 8, 21, 24, 25). In these regions the main species infesting the camels belong to three genera: *Hyalomma*, *Rhipicephalus* and *Amblyomma*. The large majority of them are three-host species with the exception of the one-host tick *H. detritum scupense* and the two-host tick *H. marginatum rufipes* (24). With the exception of *Hyalomma dromedarii*, which predominantly attaches itself in the nostrils of the camel, all the other species attach themselves at the usual sites in other livestock species: axilla, foot, udder, perineal area and tail (4, 6, 8). Several tick species infesting the camel can transmit different types of virulent theileriosis (*Theileria parva parva*, *T. p. lawrencei*, *T. p. bovis*, *T. annulata*), which cause serious and often fatal clinical diseases in cattle. But no clinical disease has ever been reported in camels (13, 15, 19, 26). The main effect of tick infestation in the one-humped camel is a more or less pronounced anemia and appetite loss with consequent reduced growth rate and productivity, and higher calf mortality (10, 23, 27). Other major causes of loss are abscesses and wounds at the tick attachment site

since these can easily become infected with a myiasis (9) and then serve as wound-feeding to the red and yellow-billed oxpecker (*Buphagus erythrorhynchus*, *B. africanus*), causing enlargement of the wounds and prolonged healing time (1, 20, 30). Tick paralysis in camels is a syndrome that appears to be rare; it has only been reported in Sudan and is apparently caused by *Hyalomma* spp. adults and/or *Rhipicephalus* spp. adults or nymphs (22). Additional information on tick infestation such as species composition, their preferred attachment sites and seasonal incidence is therefore very useful to those who work to improve the health and productivity of camels.

MATERIALS AND METHODS

Of the three herds of the study, Herds 1 and 2 were kept in commercial ranches in Laikipia District in Kenya, and Herd 3 was kept on the outskirts of the town of Gode in Southeast Ethiopia. Table I shows spatial and ecological characteristics of the study areas. Table II gives information on the number and sex of the sampled camels. Tick control strategies in the three herds were more or less the same with occasional use of an acaricide at irregular intervals. However, Herd 1 was closely and permanently associated with cattle (G. Powys, pers. commun.); in all cases the study herds were not treated with an acaricide a month before sampling. Ticks were collected during the wet season (May 1999 and June 2000) and during the dry season (September and October 1999). Ticks were only collected on one side of the body (half-body size) from seven attachment sites: nostril, eye, ear, axilla, front foot, perineal area, and tail. They were preserved in 70% alcohol, examined under a stereomicroscope and identified with available taxonomic keys (12, 18, 29).

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Table I

Description of study herds and their ecological context

Herd	Herd size	Acaricide treatment	Spatial coordinates	Altitude (m)	Mean annual temp. (C°) *	Annual rainfall (mm)	Vegetation
Herd 1							
Kisima	89 (dry season)	Occasional	0°30 North	1700-1800	25 max-9 min	600-700	Perennial grassland, mixed bushland: <i>Acacia</i> thorn-bush with <i>Acacia</i> trees, <i>Dracaena</i>
Rumuruti (Kenya)	116 (wet season)		36°45 East				
Herd 2							
Ol Ary Nyro (Kenya)	49 (dry season) 50 (wet season)	Occasional	0°36 North 36°23 East	1800-2000	26 max-10 min	790-850	Perennial grassland, mixed bushland: <i>Acacia</i> , <i>Euclea</i> , <i>Carissa</i> , <i>Olea</i>
Herd 3							
Gode (Ethiopia)	20 (dry season) 20 (wet season)	Occasional	5°55 North 43°34 East	350	34 max-21 min	150-400	Annual grassland, desert scrubland: <i>Acacia</i> , <i>Comiphora</i> , <i>Maerua</i> , <i>Zizyphus</i> , <i>Euphorbia</i>

* Data from USAID's African Country Almanac Series and local stations

Table II

Number of male and female (pregnant, lactating, sterile, heifers) camels sampled in each herd in the dry and wet seasons

Season	Camels	Herd 1	Herd 2	Herd 3	Total
Dry	Males	20	0	0	20
	Pregnant females	33	21	0	54
	Lactating females	19	11	17	47
	Sterile females	5	1	0	6
	Heifers	12	16	3	31
	Subtotal		89	49	20
Wet	Males	38	0	0	38
	Pregnant females	35	19	0	54
	Lactating females	16	13	20	49
	Sterile females	8	5	0	13
	Heifers	19	13	0	32
	Subtotal		116	50	20
Total		205	99	40	344

RESULTS

Table III gives the number of male and female ticks and nymphs collected in the three herds during the study period, the tick sex ratio and mean half-body number per camel in each herd during the dry and wet seasons. The total number of ticks collected from the three herds was 31,040 and the proportion of male to female

ticks remained fairly constant in all the herds: 2-3 males for 1 female during the dry season and 4-5 males for 1 female during the wet season. During the dry season the tick load varied from more than 150 ticks per half camel in Herd 1 to 31 ticks per half camel in Herd 2 and 39 ticks per half camel in Herd 3. The situation during the wet season was slightly different with the tick load diminishing to 99 ticks per half camel in Herd 1 but increasing to

40 ticks per half camel in Herd 2 and to 72 ticks per half camel in Herd 3. The mean half-body tick infestation was significantly greater in Herd 1 than in the other herds.

The half-body relative percentage of ticks by host category, attachment site and season varied in the three herds (Table IV). It is obvious that some attachment sites contributed to the tick load

much more than others. In Herd 1, the attachment sites the most heavily infested were the axilla with 30% (dry season) and 32% (wet season), and the perineal area with 44% (dry season) and 41% (wet season) of all the ticks collected. In Herd 2, the attachment sites the most heavily infested were slightly different: the ear with 36% (dry season) and 24% (wet season), and the perineal area with

Table III

Number of male/female/nymph ticks, mean of tick number per camel and male/female ratio in each herd in the dry and wet seasons

Season	Tick sex	Herd 1			Herd 2			Herd 3		
		Num.	Mean per camel (SD)	M/F*	Num.	Mean per camel (SD)	M/F*	Num.	Mean per camel (SD)	M/F*
Dry	Female	4117	46.3 (15.4)	2.3	404	8.2 (5.4)	2.7	198	9.9 (5.3)	3
	Male	9523	107.1 (36.7)		1094	22.3 (12.7)		596	29.8 (12.3)	
	Nymph	113	1.3 (1.5)		27	0.7 (1.0)		1	0.1 (0.2)	
	Subtotal	13753	154.5 (49.1)		1525	31.1 (17.7)		795	39.8 (15.3)	
Wet	Female	2264	19.5 (8.5)	4	347	6.9 (3.5)	4.8	311	15.6 (6.4)	3.6
	Male	9032	77.9 (28.0)		1663	33.3 (14.7)		1128	56.4 (46.0)	
	Nymph	191	1.6 (1.9)		29	0.6 (1.2)		2	0.1 (0.3)	
	Subtotal	11,487	99.0 (33.3)		2039	40.8 (17.1)		1441	72.1 (49.1)	
Total num. of ticks	31,040	25,240	123.1	3564	36		2236	55.9		

* Male/female ratio

Table IV

Percentage of tick infestation at various attachment sites in males, pregnant, lactating, sterile and heifer camels in each herd in the dry and wet seasons

Camels		Nostril	Eye (%)	Ear (%)	Axilla (%)	Foot (%)	PA* (%)	Tail (%)
In the dry season								
Herd 1	Males	-	4	5	24	13	52	2
	Pregnant females	-	6	5	32	10	44	4
	Lactating females	-	5	6	32	11	40	5
	Sterile females	-	7	5	29	14	30	15
	Heifers	-	6	6	31	10	43	4
Herd 2	Pregnant females	-	10	35	16	2	26	10
	Lactating females	-	17	22	24	2	21	14
	Sterile females	-	11	11	56	-	22	-
	Heifers	-	5	62	15	1	9	8
Herd 3	Lactating females	39	1	13	4	5	39	-
	Heifers	55	-	14	3	-	28	-
In the wet season								
Herd 1	Males	-	4	8	28	16	38	7
	Pregnant females	-	3	4	32	7	45	9
	Lactating females	-	8	2	33	8	36	13
	Sterile females	-	5	5	31	9	39	12
	Heifers	-	2	7	38	6	42	5
Herd 2	Pregnant females	-	5	25	12	-	27	32
	Lactating females	-	1	18	15	-	39	27
	Sterile females	-	7	19	8	-	32	34
	Heifers	-	5	34	17	-	22	22
Herd 3	Lactating females	27	2	14	14	17	26	1

* Perineal area

21% (dry season) and 30% (wet season) of all the ticks collected. In Herd 3, the attachment sites the most heavily infested were the nostrils with 41% (dry season) and 27% (wet season), and the perineal area with 38% (dry season) and 26% (wet season) of all the ticks collected.

Different classes of animals in Herd 1 showed the same percentages of infestation in all attachment sites during both the wet and dry seasons. In Herd 2, however, during the dry season heifers showed an infestation rate higher in the ears and lower in the perineal area and the eyes compared to all the other productive groups in the herd and also compared to the other herds. In Herd 3, the number of heifers was too low to allow comparison with lactating females.

The identified species, their respective total half-body number and relative percentage in each herd during the dry and wet seasons are shown in Table V. In total eleven species of three different genera were identified with seven in each herd. There were some difficulties in identifying *R. praetextatus* because of its similarity with *R. simus*. After further analysis (P. Hillyard, Natural History Museum, pers. commun.) and because *R. simus* is reported absent from Kenya (29) the identity of this species was confirmed to be *R. praetextatus*¹.

There were marked differences between the herds about the prevalent species. Only three species were present in all three herds during both seasons: *R. pulchellus*, *H. truncatum* and *H. marginatum rufipes*. *R. praetextatus* was present in all the herds only during the wet season. While *H. m. rufipes* was more abundant than *H. truncatum* in Herds 1 and 3, *H. truncatum* was more abundant than *H. m. rufipes* in Herd 2. The remaining species were present in some herds and absent in others. *A. variegatum* and *R. appendiculatus* were only present in Herd 2, while *H. dromedarii*, *A. lepidum* and *R. pravus* were only present in Herd 3.

1. On-going scanning electron microscopy investigations suggest that *R. praetextatus* may be instead *R. muhsamae* [information added at authors' request in Jan. 2002; Editor's note]

In Herd 1, *R. pulchellus* was the most abundant species with 92% (dry season) and 80% (wet season) of all the ticks identified. *H. m. rufipes* was present in the dry (3 %) and wet seasons (5%). *H. truncatum* was present in the dry (1%) and wet seasons (2%). *A. gemma* was present in the dry (2%) and wet seasons (3%). *A. variegatum*, *A. lepidum*, *H. dromedarii*, *R. appendiculatus*, *R. e. evertsi*, and *R. pravus* were completely absent.

In Herd 2, *R. appendiculatus* and *R. praetextatus* were the prevalent species. *R. appendiculatus* accounted for 56% (dry season) and 31% (wet season) of all the ticks identified. *R. praetextatus* accounted for 22% (dry season) and 39% (wet season) of all the ticks identified. *A. variegatum* was also relatively abundant with 9% (dry season) and 6% (wet season) of all the ticks identified. Other species collected were *R. pulchellus* with 6% (dry and wet seasons), *H. truncatum* with 3% (dry season) and 14% (wet season), and *R. e. evertsi* with 2% (dry season) and 1% (wet season). *A. gemma*, *H. dromedarii* and *R. pravus* were completely absent.

In Herd 3, the prevalent species were *H. dromedarii* and *H. m. rufipes*. *H. dromedarii* was abundant with 63% (dry season) and 46% (wet season) of all the ticks collected. *H. m. rufipes* was present with 26% (dry season) and 11% (wet season). Other less common species present were *R. pulchellus* with 5% (dry season) and 18% (wet season), *H. truncatum* with 4% (dry season) and 10% (wet season), *A. gemma* with 1% (dry season) and 2% (wet season). Interestingly, *R. pravus* and *R. praetextatus*, while completely absent during the dry season, were present during the wet season with 9 and 3%, respectively, of all the ticks collected. *A. variegatum*, *R. appendiculatus* and *R. e. evertsi* were completely absent.

Nymphs were of minor importance. Their percentages in Herds 1 and 2 varied between 1 and 2% of all the ticks collected, while in Herd 3 their number was negligible. The nymphs collected in Herd 1 belonged to the genus *Rhipicephalus*, while the nymphs collected in Herd 2 belonged to that of *Amblyomma*.

Table V

Total half-body number of ticks per species and per herd according to the season

Tick name	Herd 1		Herd 2		Herd 3		Total
	Dry season (89 camels)	Wet season (116 camels)	Dry season (49 camels)	Wet season (50 camels)	Dry season (20 camels)	Wet season (20 camels)	
<i>Amblyomma gemma</i>	302	327	-	-	11	36	676
<i>A. lepidum</i>	-	-	-	-	-	2	2
<i>A. variegatum</i>	-	-	134	113	-	-	247
<i>Hyalomma dromedarii</i>	-	-	-	-	499	666	1165
<i>H. marginatum rufipes</i>	441	526	18	17	206	154	1362
<i>H. truncatum</i>	109	191	42	295	35	150	822
<i>Rhipicephalus appendiculatus</i>	2	6	859	632	-	-	1499
<i>R. evertsi evertsi</i>	7	35	27	28	-	-	97
<i>R. praetextatus</i>	102	979	334	794	-	39	2248
<i>R. pravus</i>	-	-	-	-	-	136	136
<i>R. pulchellus</i>	12,677	9232	84	131	43	256	22,423
Nymphs: <i>Rhipicephalus</i> sp.	113	191	-	-	-	-	304
Nymphs: <i>Amblyomma</i> sp.	-	-	27	29	-	-	56
Nymphs: other species	-	-	-	-	1	2	3
Total	13,753	11,487	1525	2039	795	1441	31,040
Total (per herd)	25,240		3564		2236		

Tables VI, VII and VIII show the preferred attachment sites of all the species collected, their relative percentages and the sex ratio of the prevalent species by herd during the dry and wet seasons. They reveal how each species of ticks did not uniformly infest all the attachment sites but consistently preferred some attachment sites. The species preference remained largely the same in all the herds and during both the dry and wet seasons. *A. gemma*, *A. variegatum*, *A. lepidum*, *R. pulchellus*, *R. praeustus*, *R. e. evertsi* and *H. m. rufipes* largely preferred the perineal area and/or the axilla. On the other hand, *H. truncatum* was also found on the foot. *Hyalomma dromedarii* preferred almost exclusively the nostril, although it was also found in other areas. *R. appendiculatus* was found mainly in the ear and to a lesser degree in the eye, *R. praeustus* preferred the tail but was also found on the axilla, perineal area and foot. Interestingly, the foot was the area where most of the nymphs were collected.

The sex ratio of the prevalent species at their preferred attachment sites was consistent with the one generally acknowledged: more males than females particularly during the wet season. However, *R. appendiculatus* and *R. praeustus* in Herd 2, and *R. praeustus* and *H. m. rufipes* in Herd 1 during the wet season showed a male/female ratio much more biased towards males than the general herd ratio (7-10 males per female).

DISCUSSION

Differences in tick load per half camel were obvious particularly between Herd 1 and the other two herds. The reasons for these

differences are unclear. The high tick load in Herd 1 compared to Herds 2 and 3 was probably related to an insufficient tick control strategy in Herd 1 combined with its permanent closeness with cattle. Other differences may have been related to the marked differences in the ecological background between Herds 1 and 2 and Herd 3 (Table I). The tick load per half camel in Herds 2 and 3 was similar to those measured in other nomadic camel herds (6) and was higher in the wet season reflecting the increased reproductive rates of many species of ticks during the wet season. The opposite happened in Herd 1, where there was per half camel a high tick load in the dry season and a low tick load in the wet season. It was unclear why this happened. An acaricide treatment, not mentioned by the herders (!), was highly suspected to be responsible for this anomaly.

The total (all species combined) sex ratio skewed towards males: 2-3 males per female during the dry season and 3.5 to 4.8 males per female during the wet season. This was normal since males stay on the host longer than females (31). This situation was also present, when the sex ratio of the prevalent species in the three herds was analyzed. However, the fact that *R. appendiculatus* and *R. praeustus* in Herd 2, and *R. praeustus* and *H. m. rufipes* in Herd 1 showed a sex ratio much more biased towards males during the wet season may confirm that these species are particularly sensitive to desiccation and therefore more active during the wet season (18, 29).

The eleven species of ticks collected were not uniformly distributed in the three studied herds. *R. pulchellus* was the most

Table VI

Half-body percentage of ticks per species at various attachment sites in Herd 1 in the dry and wet seasons, and sex ratio of the main species

Tick name	Nostril	Eye		Ear		Axilla		Foot		Perineal area		Tail		Sample size
		%	SR*	%	SR*	%	SR*	%	SR*	%	SR*	%	SR*	
In the dry season														
<i>Amblyomma gemma</i>	-	-	-	-	-	15	1.6	4	-	81	1.6	-	-	302
<i>A. variegatum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	0
<i>Hyalomma dromedarii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	0
<i>H. marginatum rufipes</i>	-	-	-	-	-	-	-	-	-	100	1.6	-	-	441
<i>H. truncatum</i>	-	-	-	-	-	20	21	21	10.5	35	2.8	24	7.7	109
<i>Rhipicephalus appendiculatus</i>	-	-	-	50	-	50	-	-	-	-	-	-	-	2
<i>R. evertsi evertsi</i>	-	-	-	-	-	-	-	-	-	100	-	-	-	7
<i>R. praeustus</i>	-	-	-	-	-	7	-	4	-	13	-	76	-	102
<i>R. pulchellus</i>	-	6	2.6	6	2.4	32	2.4	11	3	42	2.1	4	2	12,677
Nymphs	-	-	-	-	-	12	-	77	-	1	-	10	-	113
In the wet season														
<i>A. gemma</i>	-	-	-	-	-	15	4.4	5	7.5	80	5.7	-	-	327
<i>A. variegatum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	0
<i>H. dromedarii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	0
<i>H. m. rufipes</i>	-	-	-	-	-	1	-	-	-	99	7.7	-	-	526
<i>H. truncatum</i>	-	-	-	1	-	11	-	26	-	44	-	18	-	191
<i>R. appendiculatus</i>	-	-	-	83	-	-	-	-	-	-	-	17	-	6
<i>R. evertsi evertsi</i>	-	-	-	-	-	-	-	-	-	100	-	-	-	35
<i>R. praeustus</i>	-	-	-	-	-	3	5.2	2	2	12	9.7	83	12.9	979
<i>R. pulchellus</i>	-	5	2.8	6	2.9	38	2.8	9	3.6	40	4.8	2	5.3	9232
Nymphs	-	2	-	3	-	8	-	84	-	2	-	1	-	191

* Sex ratio

Table VII

Half-body percentage of ticks per species at various attachment sites in Herd 2 in the dry and wet seasons, and sex ratio of the main species

Tick name	Nostril	Eye		Ear		Axilla		Foot		Perineal area		Tail		Sample size
		%	SR*	%	SR*	%	SR*	%	SR*	%	SR*	%	SR*	
In the dry season														
<i>Amblyomma gemma</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	0
<i>A. variegatum</i>	-	-	-	-	66	11.6	1	m	31	12.7	2	1	134	
<i>Hyalomma dromedarii</i>	-	-	-	-	-	-	-	-	-	-	-	-	0	
<i>H. marginatum rufipes</i>	-	-	-	-	-	-	-	-	100	-	-	-	18	
<i>H. truncatum</i>	-	-	-	-	21	-	5	-	36	-	38	-	42	
<i>Rhipicephalus appendiculatus</i>	-	20	1.9	63	2.2	7	1	1	1.5	7	2.6	2	1.3	859
<i>R. evertsi evertsi</i>	-	-	-	-	4	-	-	-	96	-	-	-	27	
<i>R. praetextatus</i>	-	-	-	-	25	2.3	1	f	36	5.4	38	2.2	334	
<i>R. pulchellus</i>	-	1	-	-	42	-	1	-	50	-	6	-	84	
Nymphs	-	4	-	4	-	30	-	51	-	-	-	11	27	
In the wet season														
<i>A. gemma</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	0
<i>A. variegatum</i>	-	-	-	-	43	3.1	-	-	57	4.8	-	-	113	
<i>H. dromedarii</i>	-	-	-	-	-	-	-	-	-	-	-	-	0	
<i>H. m. rufipes</i>	-	-	-	-	-	-	-	-	100	-	-	-	17	
<i>H. truncatum</i>	-	-	-	-	10	2.2	-	-	16	3.2	74	4.6	295	
<i>R. appendiculatus</i>	-	13	4	76	4.8	2	m	-	6	m	3	m	632	
<i>R. evertsi evertsi</i>	-	-	-	-	4	-	-	-	96	-	-	-	28	
<i>R. praetextatus</i>	-	-	-	-	17	2.7	-	-	42	6.8	41	5.9	794	
<i>R. pulchellus</i>	-	-	-	2	-	17	-	-	72	5.8	9	-	131	
Nymphs	-	-	-	-	69	-	-	-	3	-	28	-	29	

* Sex ratio

f = females only; m = males only

abundant species in Herd 1. However, this species is found on a wide range of hosts, with cattle as the main host (29). The abundance of this tick on camels of Herd 1 may indicate that these camels were always closely associated with cattle (G. Powys, pers. commun.).

The fact that *H. dromedarii* was prevalent in Herd 3 but totally absent in Herds 1 and 2 can be explained by the different ecological requirements of this tick: lower altitude and dry environment (18, 25, 28). It is interesting to note that contrary to other collections (8) the attachment sites of this tick was not limited to the nostrils as it was also present at other sites. Different ecological adaptations also explain the presence in Herd 3 only of two other closely associated species (18), *A. lepidum* and *R. praeus*. Both species are adapted to arid zones and low rainfall (18, 28, 29). *R. praeus*, particularly, is a species sensitive to the length of the dry season, preferring areas with a long continuous six-month dry season (18, 29). The fact that these two species were collected during the wet season confirms the existing knowledge that they are more active during the wet season (25).

R. praetextatus was collected in Herds 1 and 2 in both seasons but in Herd 3 only during the wet season. This data may be explained by the fact that Herd 3 is at the limit of the ecological conditions preferred by this species. *R. praetextatus* occurs in a wide range of ecological conditions. However, it needs a minimum mean annual rainfall of 250 mm (29). The need of this species for adequate humidity was also confirmed by the fact that it was always

collected in greater numbers in the three study herds during the wet season. This confirms other studies stating that this species is more active during the wet season (18, 29).

R. appendiculatus and *A. variegatum* were only found in Herd 2. Their association is well documented (18, 21). Although both are mainly cattle ticks they are able to infest camels (24). Their absence in Herd 3 is easy to explain with the lack of sufficient rainfall (18, 28, 31) and vegetation cover (12), but their absence in Herd 1 is much more difficult to explain. It may be the consequence of a slightly lower rainfall and a higher temperature (2, 3).

A. gemma was present in Herd 1 and also in Herd 3 under very different ecological conditions. The complete absence of this species in Herd 2 is difficult to explain. It might be that the higher rainfall in the area (over 750 mm) of Herd 2 was an efficient obstacle to the development of this species as it happens in Tanzania (31).

R. e. evertsi was rare in all the herds although the distribution of this species is similar to that of *R. praetextatus* (18). It may be an indication that the host, in this case the camel, is not the preferred host for this species. Previous reports confirm that *R. e. evertsi* appears as a species not well adapted to camels (12, 18, 25).

Although *H. m. rufipes* and *H. truncatum* were present in all the three herds in both seasons, confirming that their association is common in East Africa (18,25), their ratios were different.

Table VIII

Half-body percentage of ticks per species at various attachment sites in Herd 3 in the dry and wet seasons, and sex ratio of the main species

Tick name	Nostril		Eye		Ear		Axilla		Foot		Perineal area		Tail		Sample size
	%	SR*	%	SR*	%	SR*	%	SR*	%	SR*	%	SR*	%	SR*	
In the dry season															
<i>Amblyomma gemma</i>	-		-		-		18		-		82		-		11
<i>A. variegatum</i>	-		-		-				-		-		-		0
<i>Hyalomma dromedarii</i>	65	2.3	1	1.5	18	3.6	3	2.8	4	5.3	9	46	-		499
<i>H. marginatum rufipes</i>	0		-		-		0.50		0.50		99	2.3	-		206
<i>H. truncatum</i>	-		-		3		17		40		40		-		35
<i>Rhipicephalus appendiculatus</i>	-		-		-		-		-		-		-		0
<i>R. evertsi evertsi</i>	-		-		-		-		-		-		-		0
<i>R. praetextatus</i>	-		-		-		-		-		-		-		0
<i>R. pulchellus</i>	-		7		19		14		-		60		-		43
Nymphs	-		-		100		-		-		-		-		1
In the wet season															
<i>A. gemma</i>	-		-		-		-		22		75		3		36
<i>A. lepidum</i>	-		-		-		100		-		-		-		2
<i>A. variegatum</i>	-		-		-		-		-		-		-		0
<i>H. dromedarii</i>	58	5.8	2	2.7	25	2.3	1	m	8	3.8	6	5.5	-		666
<i>H. m. rufipes</i>	-		-		-		-		9	3.7	91	2.3	-		154
<i>H. truncatum</i>	-		-		-		9		43		47		1		150
<i>R. appendiculatus</i>	-		-		-		-		-		-		-		0
<i>R. evertsi evertsi</i>	-		-		-		-		-		-		-		0
<i>R. praetextatus</i>	-		3		3		33		51		8		3		39
<i>R. pravus</i>	-		2	f	1	m	68	1.2	15	1.2	10	3.7	4		136
<i>R. pulchellus</i>	-		5	1.4	10	7.3	29	3.6	24	11.2	32	8.2	-		256
Nymphs	-		-		100		-		-		-		-		2

* Sex ratio

f = females only; m = males only

H. m. rufipes was more abundant than *H. truncatum* in Herds 1 and 3, while it was the opposite in Herd 2, where *H. truncatum* was much more abundant than *H. m. rufipes*. The different proportions of *H. m. rufipes* and *H. truncatum* in the three herds confirm the more xerophilic attitude of *H. m. rufipes* and the higher tolerance of *H. truncatum* to rainfall and altitude (18, 25). It may also indicate a greater stock density in Herd 1 area (smaller ranch) and/or overgrazing in Herd 3, which neighbored a town (17).

It seems that there was no relationship between sex, characteristics of host and tick load. The only apparent relationship was found in Herd 2, where heifers had consistently a low number of ticks in the perineal area compared to pregnant, lactating and sterile females.

This may simply be explained by the fact that the surface of the perineal area is smaller in heifers than in older females. More probably, the explanation lies in the fact that the species of ticks preferring this area, *H. m. rufipes* and *H. truncatum*, were present in low numbers in Herd 2.

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Résumé

Dioli M., Jean-Baptiste S., Fox M. Tiques (Acari : Ixodidae) du dromadaire (*Camelus dromedarius*) au Kenya et dans le Sud éthiopien : espèces identifiées, localisation sur l'animal, sex-ratio et fluctuation saisonnière

Une enquête a été menée sur les tiques (Ixodidae) de trois troupeaux de dromadaires (*Camelus dromedarius*) dans deux régions distinctes du Kenya et dans une région du sud de l'Éthiopie. L'étude décrit les espèces représentées, leurs localisations préférentielles sur l'animal et leur fluctuation saisonnière. Les espèces observées ont été les suivantes : *Rhipicephalus appendiculatus*, *R. evertsi evertsi*, *R. praetextatus*¹, *R. pulchellus*, *R. pravus*, *Hyalomma dromedarii*, *H. marginatum rufipes*, *H. truncatum*, *Amblyomma gemma*, *A. lepidum* et *A. variegatum*.

¹ Des travaux en cours à l'aide de la microscopie électronique à balayage suggèrent que *R. praetextatus* pourrait en fait être *R. muhsamae* [information ajoutée à la demande des auteurs en janv. 2002 ; Ndlr]

Mots-clés : *Camelus dromedarius* - Ixodidae - Kenya - Éthiopie.

Resumen

Dioli M., Jean-Baptiste S., Fox M. Garrapatas (Acari: Ixodidae) del camello de una giba (*Camelus dromedarius*) en Kenia y Etiopía del Sur: composición de las especies, sitios de fijación, relación de sexos e incidencia estacional

Se llevó a cabo una investigación en garrapatas Ixodidae que infestaron tres hatos de camellos de una giba (*Camelus dromedarius*), en dos áreas distintas de Kenia y un área de Etiopía del Sur. Se describe la composición de las especies, los sitios de fijación, la relación entre sexos y la incidencia estacional. Las especies observadas fueron: *Rhipicephalus appendiculatus*, *R. evertsi evertsi*, *R. Praetextatus*¹, *R. pulchellus*, *R. pravus*, *Hyalomma dromedarii*, *H. marginatum rufipes*, *H. truncatum*, *Amblyomma gemma*, *A. lepidum* y *A. variegatum*.

¹ Investigaciones actuales, mediante microscopía electrónica por «scan», sugieren que *R. praetextatus* podría ser *R. muhsamae* [información agregada a petición de los autores en enero 2002; nota del Editor]

Palabras clave: *Camelus dromedarius* - Ixodidae - Kenia - Etiopía.