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# The role of *Hyalomma* ticks in foot infestations and temporary lameness of sheep in a semi-arid region of South Africa

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**ABSTRACT**

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An outbreak of lameness amongst Merino lambs, associated with the presence of *Hyalomma* ticks, was investigated on a farm in the south-western Free State, South Africa. The purpose was to follow the progress of the condition and to determine the extent of involvement of the two *Hyalomma* species which occur in the region. The flock of experimental sheep ($n = 460$) ranged free in natural veld under extensive farming conditions. During September and October 1993, adult ewes and lambs in this flock were examined at weekly intervals to determine tick identity, abundance and attachment-site preferences on lame and unaffected animals. Lameness occurred only among lambs, of which 68 were affected during the 8-week period. *Hyalomma* ticks tended to aggregate and mean numbers of ticks/aggregation were significantly higher on lame lambs ($\bar{x} = 11,3$) than on either the unaffected lambs ($\bar{x} = 6,9$) or the ewes ($\bar{x} = 7,1$). Most tick aggregations (72,4%) on the lame lambs occurred on the lower legs and feet, 34 out of 55 of these on the fetlocks or interdigital clefts. *Hyalomma truncatum* dominated (> 97%) on all animals examined. Only 15,8 % of the *Hyalomma marginatum rufipes* recovered from the lame animals were attached to the legs. At two other localities at which *H. marginatum rufipes* was more abundant, or even dominant, few ticks attached to the lower legs or feet. Those that did were mostly *H. truncatum* (> 90%). Both *H. marginatum rufipes* and *H. truncatum* may attach to the same ventral and anogenital body regions, but *H. truncatum* has a tendency to attach also to the feet and lower legs. Although attachment of one or a few ticks in the axillar region or upper legs may cause lameness in sheep, the attachment of ticks to the interdigital clefts and fetlocks almost always causes lameness. The latter condition is more likely to occur in regions where *H. truncatum* dominates.

**Keywords:** *Hyalomma*, foot infestations, temporary lameness, sheep, semi-arid region

## INTRODUCTION

Large areas of South Africa are used for extensive sheep farming and in many regions tick-related diseases are responsible for increased production costs. Among the most notorious diseases of small livestock is Karoo tick paralysis (Spickett & Heyne 1988), caused by a toxin produced by *Ixodes rubicundus*. Although other ticks may have less dramatic effects, they are not necessarily less important to the small-livestock industry. *Rhipicephalus evertsi evertsi* may also cause paralysis, and *Amblyomma hebraeum* may transmit *Cowdria ruminantium*, the cause of heartwater, while others may transmit other pathogens or merely cause lesions prone to secondary infection (Howell, Walker & Nevill 1983).

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Certain tick species are known to be associated with lameness in sheep. Some of these ticks, namely *Rhipicephalus lounsburyi, Rhipicephalus neumanni* (Walker 1990), *Rhipicephalus glabroscutatum* (MacIvor 1985; Horak & Knight 1986; MacIvor & Horak 1987) and the nymphs of *Amblyomma marmoreum* (Kok & Fourie, unpublished observations 1994), have a specific preference for attachment to the feet of sheep and other ruminants, while other ticks, e.g. *A. hebraeum* (MacIvor & Horak 1987), *Hyalomma marginatum rufipes* (Howell *et al.* 1983), *Hyalomma truncatum* (Hamel 1987), *Rhipicephalus punctatus* (Kok & Fourie, unpublished observations 1993) and *Rhipicephalus simus* (Horak, personal communication 1995) may occasionally attach to the feet.

Although *H. marginatum rufipes* and *H. truncatum* are among the most widely distributed ticks in South Africa, lameness of sheep associated with these ticks seems to occur only periodically in localized regions, and to affect mainly young animals. Little has been published in this regard and only Hamel (1987) has given some quantitative information concerning the role of *H. truncatum* in lameness of Karakul sheep in an arid region of Namibia.

Severe outbreaks of lameness associated with the presence of *Hyalomma* ticks occurred among Merino lambs on a farm in the south-western Free State during two consecutive years (1992–1993). In this paper we report on the results of an investigation of the 1993 outbreak and associated observations extending to a few other localities. The purpose of the study was to follow the progress of the condition among affected animals and to determine the extent of involvement, relative densities and attachment preferences of the two *Hyalomma* spp. which occur in the region.

## MATERIALS AND METHODS

### Main study area

The main study area was the farm Welbekend (29° 34′S, 25°31′E), about 25 km north of the town Jagersfontein. The vegetation type of this region is classified as False Upper Karoo (Acocks 1988). The topography is hilly, but the camp (fenced area of natural veld) in which the studies were conducted is more or less flat. The camp had a history of lameness among sheep, caused by heavy infestations of *Hyalomma* ticks during spring and early summer. "Lameness" in this context is used to describe a condition in which an animal walked or ran with difficulty because of apparent improper muscle function or pain in one or more of its legs.

Sheep were brought into the camp at the beginning of September 1993, prior to which the camp had been free from stock since the previous autumn. The flock consisted of 232 Merino ewes with 228 lambs, aged approximately 4 months. Ten ewes and ten lambs were earmarked for easy identification. At weekly intervals the flock was collected for the following examinations:

- *Ewes.* Tick identity, abundance and position of attachment were determined on the ten marked animals.
- *Lame lambs.* Varying numbers of lambs, including ear-tagged animals, became lame during the study. For each lame lamb, tick abundance and the exact location of all single or aggregated groups of ticks were determined. The term "aggregation" is used here to describe any cluster of two or more ticks. Ticks from each aggregation were removed and kept separate from ticks from other such clusters, for identification and counting.
- *Unaffected lambs.* The remaining ear-marked lambs, which varied in number from week to week, were designated as unaffected lambs. They were examined as indicated for the lame lambs.

### Other localities

Supplementary studies were also carried out on the farm Preezfontein (29°51′S, 25°22′E), about 40 km to the south of the main study area, and on several farms within 10 km of the town Verkeerdevlei (28° 50′S, 26°46′E), about 150 km to the north-east of the main study area.

On the farm Preezfontein, tick loads were determined on 20 Merino and 20 Dorper sheep at 14-d intervals during September and October 1993, as part of the routine investigations in another study. The topography and vegetation of the region is similar to that of the main study area. Half of the Merino and of the Dorper sheep ranged freely in a hill camp and the other half in a plains camp.

In the Verkeerdevlei district, *Hyalomma* and other ticks were collected from Merino sheep on two farms, Gertjie and Sans Souci, during December 1993 and January 1994, in order to determine the species composition of ticks on various body parts. The Verkeerdevlei region is less hilly than the main study area and the vegetation is classified as "Transitional *Cymbopogon-Themeda* veld", a pure grassveld type (Acocks 1988).

### Terminology

The term abundance is used in accordance with Margolis, Esch, Holmes, Kuris & Schad (1982), namely to indicate the number of parasites per host examined. It is the same as relative density and, in the case of lame animals, where all hosts in the sample were infested, it is the same as mean intensity (Margolis *et al.* 1982).

## RESULTS

### Main study area

Lameness occurred among lambs on the farm Welbekend within the first week after the introduction of the flock into the camp. Adult ewes were never affected. Peak infestations with *Hyalomma* ticks occurred during the first 3 weeks of October and declined towards the end of October (Table 1). The largest number of lame lambs ($n$ = 31) was present in the second week of October. The highest abundance of *Hyalomma* ticks was also recorded on the lame lambs during this week (Table 1). The mean abundance of *Hyalomma* ticks during the study period was significantly higher ($P$ < 0,05—Kruskal-Wallis non-parametric test) on the lame lambs ($\bar{x}$ = 10,3; S.E. = 1,3) than on either the unaffected lambs ($\bar{x}$ = 2,2; S.E. = 1,4) or the ewes ($\bar{x}$ = 3,7, S.E. = 1,4) (Table 1). Up to the end of October, 68 lame lambs were recorded at Welbekend. Some of the lambs could have been recorded more than once, during different weeks, as being lame. No lameness was observed after 28 October.

*Hyalomma* ticks were found mostly in aggregations of two or more on hosts of all groups. Hosts usually had only one aggregation each, but occasionally two or three aggregations were noted. Of the 68 lame lambs, 61 had only one aggregation each, six had two aggregations each and one had three. Numbers of *Hyalomma* ticks per aggregation were significantly higher ($P$ < 0,05—Kruskal-Wallis non-parametric test) on the lame lambs ($\bar{x}$ = 11,34; S.E. = 1,0; max. = 71; $n$ = 76) than on either the unaffected lambs ($\bar{x}$ = 6,9; S.E. = 2,7; max. = 12; $n$ = 11) or the ewes ($\bar{x}$ = 7,06; S.E. = 1,6; max. = 28; $n$ = 34). The frequency distribution of numbers of ticks per aggregation on the lambs (lame as well as unaffected) is shown in Fig. 1.

Most of the tick aggregations (73,7%) on the lame lambs occurred on the lower legs and feet, the remainder were mostly on the axilla/brisket or inguinal regions, with none in the anogenital region (Table 2). Most aggregations (34 out of 56) on the legs and feet were either between the hooves or on the fetlocks. Affected feet were often visibly swollen, and sites where ticks attached, inflamed or ulcerated. Lower percentages of aggregations occurred on the legs and feet of unaffected lambs (27,3%) and the ewes (14,7%). On the ewes most of the aggregations (61,8 %) were present on the axilla/brisket or groin/inguinal regions, and 23,5% in the anogenital region (Table 2). No ticks attached to the anogenital region of the lambs. Even though aggregations of 5–7 ticks occurred on the fetlocks of some adult sheep, and considerably larger aggregations in the axilla/brisket region, none of these sheep became lame.

Only 19 (2,2%) out of a total of 862 ticks collected from all aggregations on lame lambs were *H. marginatum rufipes*, all the rest were *H. truncatum*. Only three *H. marginatum rufipes* specimens were found in aggregations on the legs, the remainder (84,2%) occurred in aggregations in the axilla/brisket region. *H. truncatum* also dominated on unaffected lambs (97,9%; $n$ = 94) and on the ewes (98,5%; $n$ = 260).

### Other localities

At Preezfontein, the numbers of *Hyalomma* ticks remained low during September (abundance < 1, $n$ = 40 hosts), and *H. truncatum* dominated (60–68%) during this period. During October the abundance of *Hyalomma* ticks increased (1,5–3,4) and *H. marginatum rufipes* became dominant (65–82,2%) (Table 3). Infestations of the feet seldom occurred at this locality and no cases of lameness were observed. Only ten out of a total of 350 *Hyalomma* ticks were recovered from the feet and, of these, nine were *H. truncatum*. *Hyalomma* ticks mostly occurred in aggregations in the anogenital, groin and axillar regions, but these consisted of small numbers of ticks because of the low overall abundance.

In the Verkeerdevlei region there was only a slight dominance of *H. truncatum* (48,6–62,5%) in samples of ticks from all body regions, excluding the feet (Table 4). In samples of ticks collected singly or from small aggregations on the feet (between hooves and on fetlocks), *H. truncatum* dominated (96,4–100%) (Table 4). Lameness was seldom observed among animals examined in this region.

## DISCUSSION

Differences in the dominance of either *H. truncatum* or *H. marginatum rufipes* between different regions within their sympatric ranges of distribution is presently not well understood. Marked differences may occur even between adjacent areas. The farms Preezfontein and Welbekend both lie within the same region with the same vegetation, topography and rainfall (400– 500 mm/annum), but differ markedly in the species composition of the two *Hyalomma* ticks on the hosts. The Verkeerdevlei area, on the other hand, falls within a region of somewhat higher rainfall (500–600 mm/annum) with different vegetation and topography, but has a *Hyalomma* species composition which is similar to that at Preezfontein. The almost total absence of *H. marginatum rufipes* at the Welbekend site is difficult to explain, especially since this species can utilize ground-frequenting birds as hosts for the immature stages (Hoogstraal, Kaiser, Traylor, Gaber & Guindy 1961; Horak & Fourie 1991). Bird species which have been found infested with *H. marginatum rufipes* at Preezfontein (Fourie & Kok, unpublished data 1994) also occur at Welbekend, and some of the species, such as wattled starlings (*Creatophora cinerea*) and helmeted guineafowls (*Numida meleagris*), are more or less nomadic and

TABLE 1 Abundance and maximum numbers/host of *Hyalomma* ticks on Merino ewes ($n = 70$), unaffected ($n = 58$) and lame ($n = 68$) Merino lambs at the main study locality, Welbekend, during September and October 1993. The ewes and unaffected lambs were not examined on 7 October

| Date | Abundance and maximum number of ticks/host ([ ]) | | |
|---|---|---|---|
| | Ewes | Unaffected lambs | Lame lambs |
| 9 September | 3,2 ($n = 10$) [15] | 7,7 ($n = 3$) [21] | 7,0 ($n = 7$) [14] |
| 16 September | 1,7 ($n = 10$) [7] | 1,5 ($n = 8$) [4] | 5,2 ($n = 4$) [8] |
| 23 September | 0,8 ($n = 10$) [4] | 0,2 ($n = 9$) [1] | 6,2 ($n = 6$) [10] |
| 30 September | 0,6 ($n = 10$) [4] | 1,5 ($n = 10$) [10] | 7,3 ($n = 4$) [13] |
| 7 October | – – – | – – – | 16,0 ($n = 2$) [24] |
| 14 October | 7,2 ($n = 10$) [20] | 1,2 ($n = 9$) [11] | 17,0 ($n = 31$) [78] |
| 21 October | 9,5 ($n = 10$) [28] | 2,2 ($n = 9$) [10] | 13,0 ($n = 12$) [27] |
| 28 October | 3,0 ($n = 10$) [11] | 1,1 ($n = 10$) [5] | 11,0 ($n = 2$) [18] |
| Mean | 3,7 [11,7] | 2,2 [8,8] | 10,3 [24,0] |
| S.D. | 3,4 [7,2] | 2,2 [6,5] | 4,6 [22,8] |

TABLE 2 Frequency of distribution of *Hyalomma* tick aggregations on certain body regions of adult Merino ewes ($n = 70$), unaffacted ($n = 58$) and lame ($n = 68$) Merino lambs at the main study locality, Welbekend

| Body region | Frequency of distribution | | |
|---|---|---|---|
| | Ewes | Unaffected lambs | Lame lambs |
| Interdigital clefts | 0 | 0 | 24 |
| Fetlocks | 4 | 1 | 10 |
| Legs | 1 | 2 | 22 |
| Axillae/brisket | 16 | 3 | 19 |
| Groins/inguinal | 5 | 5 | 1 |
| Anogenital | 8 | 0 | 0 |
| Total | 34 | 11 | 76 |

TABLE 3 Species composition of *Hyalomma* ticks collected from routinely examined Merino ($n = 20$) and Dorper ($n = 20$) sheep on the farm Preezfontein, from September to mid-November 1993

| Date of sample | *H. truncatum* | | *H. marginatum rufipes* | |
|---|---|---|---|---|
| | No. | (%) | No. | (%) |
| 3 September | 6 | (66,7) | 3 | (33,3) |
| 16 September | 12 | (60,0) | 8 | (40,0) |
| 30 September | 17 | (68,0) | 8 | (32,0) |
| 14 October | 21 | (35,0) | 39 | (65,0) |
| 1 November | 32 | (23,7) | 103 | (76,3) |
| 15 November | 18 | (17,8) | 83 | (82,2) |

TABLE 4 Species composition of *Hyalomma* ticks collected from the feet and other body regions of Merino sheep on two farms, Gertjie and Sans Souci, in the Verkeerdevlei district, between 23 December 1993 and 14 January 1994

| Sample | Total no. | Ticks on feet | | Ticks on other regions | |
|---|---|---|---|---|---|
| | | No. | % *H. truncatum* | No. | % *H. truncatum* |
| Pooled adults from several sheep (Sans Souci, Jan. 1994) | 175 | 55 | 96,4 | 120 | 62,5 |
| Pooled adults from several sheep (Gertjie, Jan. 1994) | 42 | 5 | 100,0 | 37 | 48,6 |
| Pooled adults from several sheep (both farms, Dec. 1993) | 32 | 23 | 100,0 | 9 | 55,6 |
| Adults from fetlocks of several sheep (both farms, Dec. 1993) | 47 | 47 | 97,9 | – | – |
| Females only from several sheep (both farms, Dec. 1993) | 22 | – | – | 22 | 59,1 |

known to move about over large areas. The three study sites fall well within the range of distribution of *H. marginatum rufipes*, but are fairly close to the limit of the distribution of *H. truncatum* as determined by Theiler (1956), especially in the Verkeerdevlei area.

As far as the occurrence of lameness among lambs is concerned, our observations can be summarized as follows:

- In all three regions where studies were conducted, namely Welbekend, Preezfontein and Verkeerdevlei, *Hyalomma* ticks attached to the ventral aspects of the body as well as to the legs and feet of lambs and adult sheep.
- Lameness occurred in the region where *H. truncatum* dominated completely, namely at the main study area, Welbekend.

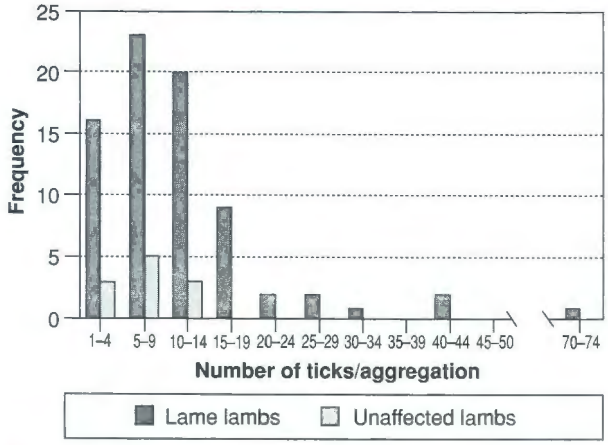


FIG. 1 Frequency distribution of numbers of *Hyalomma* ticks/aggregation on lame and unaffected Merino lambs at the main study locality, Welbekend

- Only lambs became lame and this occurred in those animals with relatively higher *Hyalomma* tick burdens and with tick aggregations on the feet or lower legs.
- In regions of less complete dominance of *H. truncatum*, or with *H. marginatum rufipes* dominance, lameness occurred either sporadically or not at all.
- In the latter regions the few ticks that did attach to the feet or lower legs were almost exclusively *H. truncatum*.

From these observations we conclude that *H. marginatum rufipes* and *H. truncatum* may both attach in the axilla/brisket, groin/inguinal and—though not on lambs in our main study areas—the anogenital regions. *Hyalomma truncatum*, but not *H. marginatum rufipes*, also has a tendency to attach to the feet and lower legs. Although attachment of one to a few specimens of either of these species in the axillary region or upper legs may cause lameness in lambs, the attachment of ticks to the interdigital clefts and fetlocks almost always results in lameness. The latter condition is more likely to occur in regions where *H. truncatum* dominates, either seasonally or geographically.

Hamel (1987) gave quantitative data on the involvement of *H. truncatum* in foot infestations of Karakul sheep in Namibia. Numbers of ticks per aggregation were slightly higher ($\bar{x}$ from 11,07–18,3) than in our findings, but this was mostly because of aggregations of up to 52 ticks on the tails of the Karakul sheep. Infestations of the feet were similar to those we found. Although our studies showed that lameness was mostly associated with aggregations of about ten ticks, located either on a fetlock or in an interdigital cleft, we often found cases in which two or three ticks caused lameness, particularly when these ticks attached in the axillary or brisket region where they affected host muscles used during walking. Inflammation, edema and ulceration were usually evident at attachment sites, but the severe abscess formation to which MacIvor & Horak (1987) refer, seldom occurred. In one case, a few ticks attached just above the hock of a lamb and affected the gastrocnemius tendon or the superficial flexor tendon so badly that the animal was completely disabled and had to be destroyed. In less severe cases lame animals from which the ticks were removed, recovered within a day or two. Long mouthparts, such as those of *Hyalomma* ticks, can cause considerable tissue damage (MacIvor & Horak 1987) and inflammation. These, together with any associated secondary infections, can result in lameness. However, the possible toxic nature of salivary-gland secretions cannot be ruled out, especially in those cases where a few ticks attached to the axillary or brisket region caused lameness. It is difficult to explain why only young animals were affected, but this may be related either to behavioural differences or to differences in resistance to ticks between young and older animals. Further study is needed to obtain more specific data in this regard. The Karakuls to which Hamel (1987) referred were also young animals (5–8 months).

Treatment becomes essential when sheep are affected by *Hyalomma* ticks to the point that lameness occurs. In young animals, normal growth is probably impaired even when they do not actually become lame, an effect which still needs to be quantified. Pyrethroid pour-ons can be used effectively against *Hyalomma* ticks on Merino sheep only when applied to the area of attachment. Hamel (1987) reported that backline, belly-line and sponge treatment of axillae and groins with a flumethrin pour-on eliminated all ticks, even those on the feet, within a week. However, a proper interpretation of Hamel's findings is difficult because no controls were kept and the treated animals remained in a paddock where tick pressure seemed to be low. Our experience with various pyrethroids, including flumethrin, has shown that the control of *Hyalomma* ticks on the feet is difficult (Fourie & Kok, unpublished data 1994). More studies are needed regarding the efficacy of pour-ons for this type of treatment. Hamel (1987) also pointed out that their efficacy may differ between hairy and woolly breeds of sheep.

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