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# Population dynamics of ticks on indigenous cattle in a pastoral dry to semi-arid rangeland zone of Uganda

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ABSTRACT

Studies on seasonality and population dynamics of ticks on indigenous cattle and their crosses (calves) were carried out in Buruli Ranching Scheme, Nabiswera, Luwero district of Uganda on three treatment groups of animals: group 1 (twice a week dipping), group 2 (once a month dipping) and group 3 (no tick control). During this study, four major species of ticks of economic importance were recorded in decreasing order of abundance: *Rhipicephalus appendiculatus*, *Rhipicephalus evertsi evertsi*, *Amblyomma variegatum* and *Boophilus decoloratus*. Of these ticks, a seasonal pattern of activity was only observed in *R. appendiculatus* ticks, with peak activities occurring during rainy seasons. Greater numbers of ticks were recorded on cows than calves in the three treatment groups, with the exception of *A. variegatum* where the reverse occurred. The mean numbers of ticks per animal were highly significantly different ($p < 0.01$) when group 1 animals were compared with group 2 and 3 animals. However, no significant differences ($p > 0.05$) were observed in mean tick numbers between group 2 and 3 animals. Highly significant differences ($p < 0.01$) were observed in mean tick numbers on cows and calves (more than 12 months old) in different calving seasons. The state of lactation only affected tick counts on cows in group 1; significantly more ticks ($p < 0.01$) were observed in lactating than non-lactating cows. Furthermore, significantly greater ($p < 0.05$) numbers of ticks (with the exception of *B. decoloratus*) were recorded during the second year of study (March 1992–May 1993) than the first year (January 1991–February 1992), despite lower rainfall during the former period.
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**Key words:** Ticks, population dynamics, cattle, Uganda.

## INTRODUCTION

Studies on seasonal occurrences of different developmental stages of ticks are of great significance in the epidemiology of tick-borne diseases and planning of appropriate tick control measures (Norval *et al*., 1992). Knowledge of tick numbers

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on cattle provides useful information on tick population dynamics, dynamics of disease transmission and estimations of resistance of different hosts (Norval *et al*., 1992).

Tick abundances are known to vary with time (season to season and year to year) and space (between habitats and ecological zones) due to interactions of numerous factors, such as host diversity and climate (Norval and Lightfoot, 1982), the levels of resistance of hosts, absence of tick control measures and management practices that affect host behaviour (Punyua and Hassan, 1992). Generally, the seasonal activities of ticks are known to vary from species to species and country to country (Dipeolu, 1989) due to variations in photoperiod (Rechav, 1982; Amoo, 1984; Dipeolu *et al*., 1989), which therefore necessitates their study in various countries and different agroecological zones.

Previous studies in Uganda on population dynamics of ticks on indigenous cattle reported the presence of all species of ticks on hosts throughout the year (Smith, 1969; Kaiser *et al*., 1982, 1991; Matthysse and Colbo, 1987). It was observed that *Rhipicephalus appendiculatus* and *Amblyomma variegatum* had no seasonal pattern of incidence, but the number of *Boophilus decoloratus* fluctuated regularly with a frequency of approximately 3 months (Kaiser *et al*., 1982). These studies were conducted in three out of 21 ecological zones (Langdale-Brown *et al*., 1964) in areas of high rainfall and moderate temperature along Lake Victoria basin, in short grassland of northern Uganda and in montane system in eastern Uganda. However, no information is available on the pattern of seasonal occurrence of ticks in the pastoral dry to semi-arid rangeland zone where the majority of the indigenous cattle are located (Okello-Onen, 1995).

This paper is part of a larger study on the impact of tick control on the productivity of indigenous cattle. The objective was to understand the effects of three major tick management strategies on the population dynamics of ticks on indigenous cattle and their crosses under ranch conditions, so as to plan appropriate tick control strategies.

## MATERIALS AND METHODS

### *Study site*

This study was conducted on a ranch belonging to Incafex Ranches Ltd at Nabiswera, Luwero District, within the Buruli Ranching Scheme. The ranch falls within an East Coast fever-endemic area and is situated 32° 16'E, 01° 28'N in ecological zone 14. The vegetation is mainly dry Combretum–Terminalia–Loudetia savanna and rainfall is bimodal in March–June and August–October.

### *Experimental cattle*

The cows and heifers selected for the study were the East African short-horn Zebu and Zebu × Ankole (Nganda) breeds. Prior to the study, they were treated twice

weekly with the acaricide chlorfenvinfos (Supona, Shell Co.). Herd management was carried out as described by Pegram *et al*. (1991) under similar traditional grazing systems.

*Experimental design*

Eighty-four heifers and cows were randomly divided into three treatment groups of 28 each, which represented the three major tick management strategies under ranch conditions to which the indigenous cattle in the country are exposed. Group 1 animals were dipped twice a week, group 2 animals were dipped once a month and while group 3 were the control. These animals were kept separately, but maintained under similar grazing management. Two bulls, one Friesian and one Boran, were rotated periodically between the herds.

*Sampling of ticks on cattle*

Tick collections were made in a crush by a trained team, each of whom was assigned a specific predilection site from which to collect ticks. Tick counts were performed once a month *in situ* on adult ticks only on one side of the animal body. All the ticks were removed with forceps and differentiated into species, sex and three states of feeding for female ticks: flat, feeding and 'standard ticks' (female ticks which will complete feeding and detach from the host in the following 24 h) (Wharton and Utech, 1970; Wagland *et al*., 1979). The ticks collected from each animal from each treatment group were preserved in 70% alcohol for further identification and recounting in the laboratory. The data for each individual animal were recorded separately. The engorged ticks were placed in bottles with perforated lids, inside desiccators containing a saturated solution of potassium chloride for culturing in the laboratory.

*Dip management*

The dip was calibrated and charged with chlorfenvinfos (Supona) which was used throughout the study period. During the first month of the study, dip wash samples were collected and analysed every week so as to assess the stability of the dip and the stripping rate of the acaricide. Subsequently, dip wash samples were collected once a month during routine data collection.

Dip wash analysis was performed using total calorimetric method as described by McEwan (1981). Based on the recommendation of the manufacturer, a concentration of 0.05% chlorfenvinfos was regarded as optimal. Replenishment of the dip concentration was carried out before each dipping.

*Statistical analysis*

The counts for each tick species on each animal were doubled to give estimates for whole body counts and arithmetic mean counts were obtained for each tick species

on each sampling date. Analysis of tick counts was carried out after logarithmic transformation of data in order to stabilize the variances. Comparisons of statistical differences in mean tick counts per animal, between different treatment groups, calving seasons, investigation dates, age of calves and state of lactation were performed using analysis of variance by the method of general least squares (Harvey, 1977).

## RESULTS

### *Tick species*

During this study, four major species of ticks of economic importance were identified in decreasing order of abundance: *Rhipicephalus appendiculatus*, *Rhipicephalus evertsi evertsi*, *A. variegatum* and *Boophilus decoloratus* (Table 1). Scanty populations of *Hyalomma marginatum rufipes* were encountered, but were not considered in the final analysis of data.

### *Seasonal patterns of tick species*

Generally, more ticks were observed on cows than calves, with the exception of *A. variegatum* where the reverse occurred. Furthermore, very low tick counts were observed on calves aged 0–6 months than the other age groups. Seasonal variation was demonstrated in the population of *R. appendiculatus* on calves and cows, with higher numbers occurring during the rainy seasons than dry seasons (Figs. 1 and 2). However, in the case of *R. evertsi evertsi*, *A. variegatum* and *B. decoloratus* no clear-cut seasonal patterns of infestation were observed.

Considering the three treatment groups, high significant differences ($p < 0.01$) occurred in mean total tick counts per animal between treatment groups of calves and cows. However, no significant differences ($p > 0.05$) occurred in mean total tick counts between group 2 and 3 animals. In addition, no significant differences ($p > 0.05$) were observed in tick counts in different calving seasons in calves below 12 months old, but tick counts differed significantly in cows ($p < 0.05$). The state of lactation had a significant influence ($p < 0.01$) on tick counts, with the lactating cows carrying more ticks than non-lactating cows.

TABLE 1

Comparison of mean tick numbers per animal on cows and calves under different acaricidal treatment

| | Twice a week dipping | | Once a month dipping | | No tick control | |
|---|---|---|---|---|---|---|
| Tick species | Cows | Calves | Cows | Calves | Cows | Calves |
| *R. appendiculatus* | 4.60 | 2.80 | 61.0 | 55.2 | 55.6 | 53.4 |
| *R. evertsi evertsi* | 0.80 | 0.50 | 7.6 | 5.1 | 7.0 | 4.4 |
| *A. variegatum* | 0.10 | 0.10 | 3.7 | 4.5 | 5.2 | 8.3 |
| *B. decoloratus* | 0.02 | 0.03 | 2.9 | 2.1 | 2.7 | 2.3 |

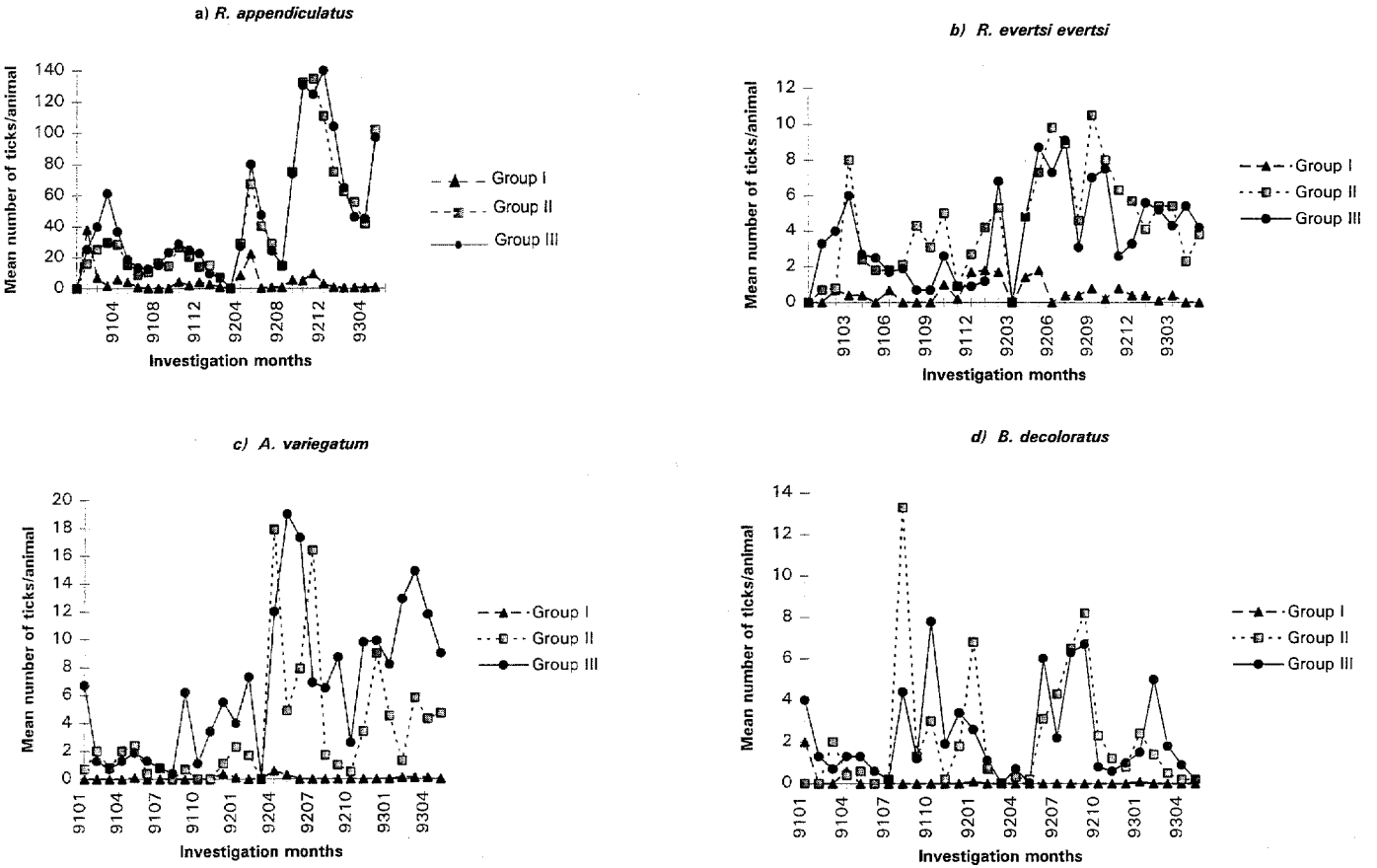


Fig. 1. Mean number of adult tick species on calves (zebu cross) dipped twice a week (I), once a month (II) and not dipped (III).

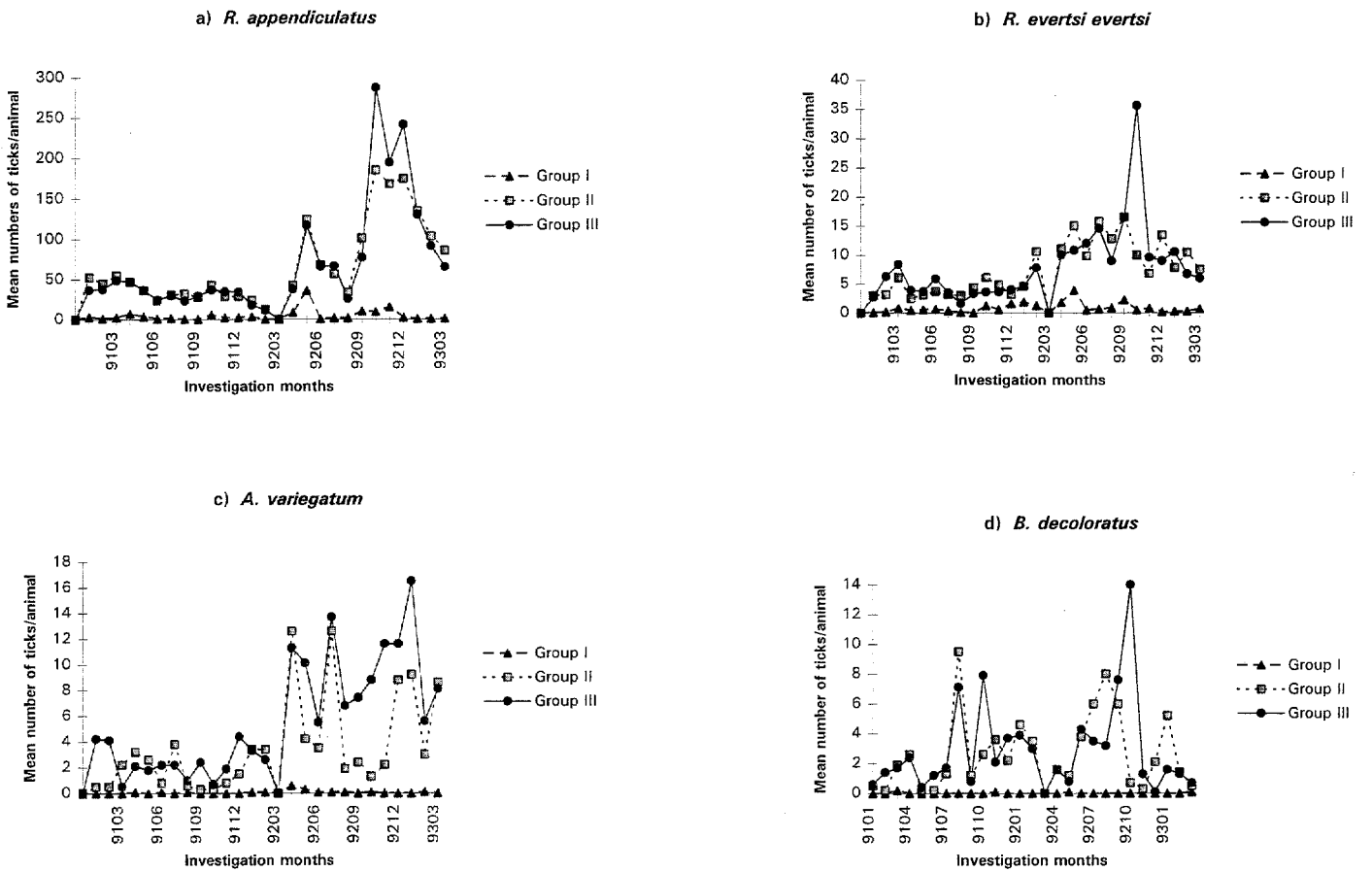


Fig. 2. Mean number of adult tick species on zebo cows dipped twice a week (I), once a month (II) and not dipped (III).

With the exception of *B. decoloratus*, significantly higher tick counts ($p < 0.01$) were observed during the second year of study (March 1992–February 1993) than the first year (March 1991–February, 1992). Interactions between treatment and years ($p < 0.01$) and biological variations among the animals also influenced mean tick counts ($p < 0.05$).

## DISCUSSION

During this study, *R. appendiculatus* ticks were consistently the most abundant of the four commonest tick species. This may be because cattle are widely believed to be the primary host for this tick to which their resistance has been reported to be low under field conditions (Lightfoot and Norval, 1981; Kaiser *et al*., 1982; ). The other tick species, *R. evertsi evertsi*, *A. variegatum* and *B. decoloratus*, occurred in very low numbers, suggesting that they are less abundant under field conditions.

The lower numbers of *R. appendiculatus*, *R. evertsi evertsi* and *B. decoloratus* on calves than cows suggest that calves are less attractive to ticks than cows because they are protected by some form of innate, age-related resistance (Barnett and Bailey, 1955; Sutherst *et al*., 1979). Since the host-seeking activities of these ticks involves awaiting hosts at vantage positions on vegetation, they have greater chances of attaching on cows than calves because of body surface area. It is also possible that these differences may be attributed to continuous selective grooming of the calves' heads, ears and necks by their respective dams (Fivaz and de Waal, 1993) or grazing management practices, since calves under 3 months of age are rarely released to graze with their dams.

On the contrary, more *A. variegatum* ticks occurred on calves than cows. Unlike with other species of ticks, this difference may be due to stronger hypersensitivity reactions (i.e. licking, rubbing, scratching and natural grooming) that ultimately dislodged ticks (de Castro and Newson, 1993) in cows than calves. It is also possible that the cows, through exposure, could have developed 'learned tick avoidance behaviour' and could recognize and avoid unfed *Amblyomma* ticks in pasture by means of visual, olfactory and tactile stimuli (Bonsma, 1981; Sutherst *et al*., 1986).

A seasonal pattern of activity was clearly demonstrated in *R. appendiculatus* ticks, with peak activities occurring during rainy seasons. This suggests that environmental factors such as rainfall have great influence on the population of this tick as observed earlier in Tanzania (Yeoman, 1966; Tatchell and Easton, 1986), Uganda (Kaiser *et al*., 1982) and Zimbabwe (Norval and Perry, 1990). The absence of seasonal patterns of activity in the other tick species is evidence that their activities are not affected by weather parameters.

The highly significant differences ($p < 0.01$) obtained in mean tick numbers between the three treatment groups of cows and calves were mainly attributed to very low tick numbers occurring on group 1 animals (dipped twice a week) compared to group 2 and 3 animals (dipped once a month and not dipped).

However, comparisons of the mean tick numbers between group 2 and 3 animals did not significantly differ ($p > 0.05$), suggesting that dipping cattle once a month did not provide solutions to the tick burden and may be unnecessary. The mean tick numbers did not significantly differ ($p > 0.05$) between calving seasons in calves below 12 months old, but differed significantly ($p < 0.05$) in cows. This suggests that the effects of calving seasons on tick numbers are only manifest in animals older than 12 months. The state of lactation did not significantly ($p > 0.05$) influence the tick numbers on group 2 and 3 cows because these animals usually carried large numbers of ticks. However, in group 1 cows, significantly higher numbers of ticks ($p < 0.01$) were observed on lactating than non-lactating cows. This implies that since lactation is associated with stress, the lactating cows are therefore more susceptible to tick infestation than non-lactating cows.

The higher abundance of *R. appendiculatus*, *R. evertsi evertsi* and *A. veriegatum* ticks during the second year of study (March 1992–May 1993) than in the first year (January 1991–February 1992), despite the low rainfall obtained during the former period, explains the importance of microclimatic conditions and vegetation in influencing the survival and development of ticks. The lack of differences in the population of *B. decoloratus* ticks between these two periods implies that this tick is insensitive to fluctuations in environmental factors. This is probably because all the developmental processes of the life cycle stages take place on the same host. The differences in tick numbers within each treatment group could be attributed to variations in host resistance among the animals.

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