

**DISTRIBUTION, SEASONAL ACTIVITY AND DISEASE  
RELATIONSHIP OF IXODID TICKS (ACARINA : IXODIDAE)  
PARASITISING LIVE-STOCK IN ZAMBIA**

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**INTRODUCTION**

Ticks are known vectors of agents that cause many economically important diseases in domestic live-stock causing heavy economic losses to animal industry. As a number of Ixodid tick species are a matter of concern to cattle, sheep and goat farmers in Zambia; therefore, faunistic and ecological work on these parasites is of considerable significance. The continued threat of acaricidal resistance and the ever increasing price of these compounds are further factors which stimulates concerted efforts in tick ecology and indeed entire tick ecosystem. Recent studies on ticks in Zambia were carried out by MacLeod, 1970; MacLeod and Colbo 1976, MacLeod et al, 1977 and MacLeod and Mwanaumo, 1978. These mainly deal with infestation pattern of ticks.

**MATERIAL AND METHODS**

In planning effective dip management a sound knowledge of distribution and population density of target species in relation to season is a pre-requisite in an efforts to plan more efficient control programmes. To achieve this objective the Livestock and Pest Research Centre of National Council for Scientific Research during the past decade carried out the systematic surveys throughout the country for the collection of ticks in different season. Tick samples though obtained in a random manner from most areas but in sufficient numbers to give an accurate indication of distribution, abundance, hosts and seasonal occurrence of the majority of tick species, especially those parasitic on domestic hosts. Most of these collections were made by trained staff during field trips designed to cover particular areas during a national survey of tick infestation patterns and during the long-term studies on tick and tick-borne diseases chiefly *Theileriosis* in Zambia. The collections were usually made by deticking both domestic and wild animals; or by flagging; cone swooping; and blanket sweeping in pastures.

**RESULTS**

The available data on ticks parasitising livestock in Zambia reveals the presence of 30 species on cattle (Table 1), with varying degree of infestation.

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TABLE 1

Ixodid tick species found on livestock in Zambia.

<i>Amblyomma eburneum</i>	<i>Rhipicephalus hurti</i>
<i>Amblyomma hebraeum</i>	<i>Rhipicephalus masseyi</i>
<i>Amblyomma lepidum</i>	<i>Rhipicephalus muehlensi</i>
<i>Amblyomma variegatum</i>	<i>Rhipicephalus neavei</i>
<i>Boophilus decoloratus</i>	<i>Rhipicephalus punctatus</i>
<i>Boophilus microplus</i>	<i>Rhipicephalus reichenowi</i>
<i>Haemaphysalis aciculifer</i>	<i>Rhipicephalus sanguineus</i>
<i>Haemaphysalis (Rhipistoma) leachii</i>	<i>Rhipicephalus sculptus</i>
<i>Hyalomma rufipes</i>	<i>Rhipicephalus simus</i>
<i>Hyalomma truncatum</i>	<i>Rhipicephalus sulcatus</i>
<i>Ixodes cavipalus</i>	<i>Rhipicephalus simus</i>
<i>Rhipicephalus appendiculatus</i>	<i>Rhipicephalus sulcatus</i>
<i>Rhipicephalus capensis</i>	<i>Rhipicephalus supertritus</i>
<i>Rhipicephalus compositus</i>	<i>Rhipicephalus tricuspis</i>
<i>Rhipicephalus evertsi evertsi</i>	<i>Rhipicephalus turanicus</i>
<i>Rhipicephalus longus</i>	<i>Rhipicephalus zambeziensis</i>

The subject of this paper is limited to the most common ticks of cattle and commonly referred to as cattle ticks. Gross total of adult specimens taken from cattle are shown in Table 2, rounded to the nearest hundred for clarity and they are arranged in

TABLE 2

Approximate total number of adults (both sexes) of the most common species of ticks collected from cattle during the survey.

Sl.No.	Tick species	Nos.
1	<i>Boophilus microplus</i>	1,60,000
2.	<i>Boophilus decoloratus</i>	70,600
3.	<i>Amblyomma variegatum</i>	47,400
4.	<i>Rhipicephalus appendiculatus</i>	28,000
5.	<i>Rhipicephalus evertsi evertsi</i>	12,800
6.	<i>Rhipicephalus compositus</i>	11,900
7	<i>Rhipicephalus tricuspis</i>	10,300
8.	<i>Hyalomma truncatum</i>	7,400
9.	<i>Rhipicephalus simus</i>	6,000
10.	<i>Rhipicephalus sanguineus</i>	3,700
11.	<i>Rhipicephalus punctatus</i>	3,200
12.	<i>Hyalomma rufipes</i>	1,600

order of total number of specimens which have been collected and identified. Each specimens without exception, has been critically studied under the stereomicroscope.

#### DISTRIBUTION, SEASONAL ACTIVITY AND DISEASE RELATIONSHIP OF CATTLE TICKS IN ZAMBIA *BOOPHILUS MICROPLUS*

**Distribution** : *Boophilus micorplus* is confined to the elevated plateau region of greatly reduced relief, shallow Chambeshi valley, Bangweulu depression and on elongated plateau strip of northern and eastern regions (Fig.1). This is a one host tick and a primary parasite of cattle.

**Seasonal Activity** : *Boophilus microplus* is a one host tick and breeds continually throughout the year; the engorged adult, larvae and nymph can be collected at any time of the year but in varying numbers. A summary of collection data shows (Fig.2) that it has an active period during the cold dry season i.e., April to July. In the hot and humid season i.e. from the beginning of August there is a sudden decline in population, followed by a secondary rise in September and a high incidence in January which is the peak of rainy season. *Boophilus microplus* has more than two generations in a year.

**Disease Relationships** : These have not been studied in detail in Africa but *Boophilus microplus* is important as the vector of red water or texas fever (*Babesia bigemina*) and anaplosmosis or gall sickness (*Anaplasma marginale*) in relation to cattle.

#### *Boophilus decoloratus*

**Distribution** : *Boophilus decoloratus* is widely distributed in country (Fig.3) and has been collected in large numbers. In northern-eastern region of the country this tick has been replaced by *Boophilus microplus* to a great extent on domestic cattle. However, this tick has been found on wild animals in South Luangwa National Park. This is also a one-host tick and a primary parasite of cattle.

**Seasonal Activity** : Like *Boophilus microplus* this tick also breeds continuously throughout the year. The population starts building up towards the end of the rainy season and reaches its peak in May, then it shows gradual decline till October (Fig.4). There is a slight increase in population at the beginning of rainy season in November but then there is a sudden decline till the end of rainy season. It has more than two generations in a year.

**Disease Relationship** : *Boophilus decoloratus* is known to transmit agents of *Anaplasmosis* and *Babesiosis*.

#### *Amblyomma variegatum*

**Distribution** : *Amblyomma variegatum* is the commonest and most important tick in Zambia and is found in almost every type of the country from faulted valleys of

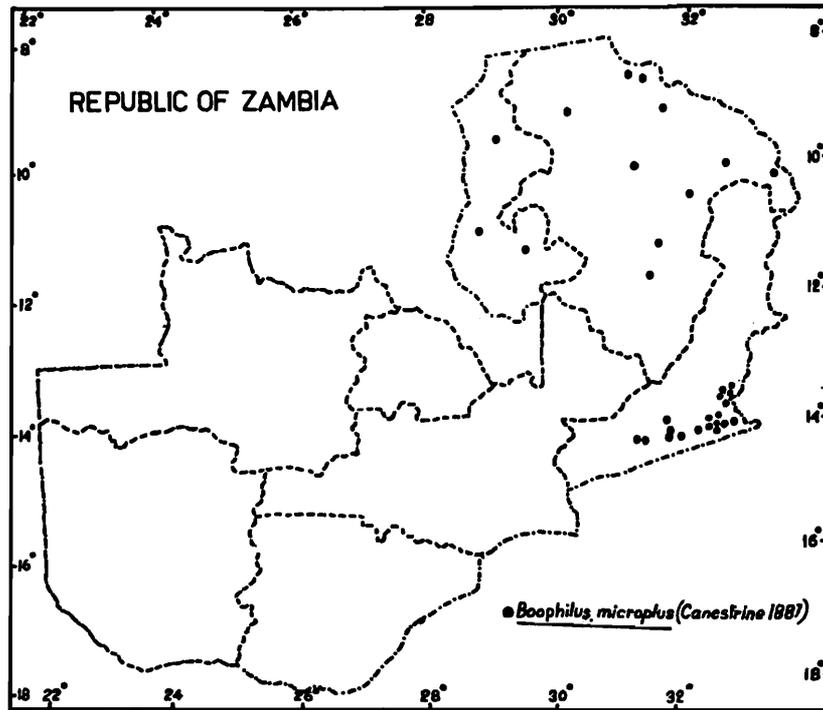


Fig. 1. Distribution of *Boophilus microplus* in Zambia

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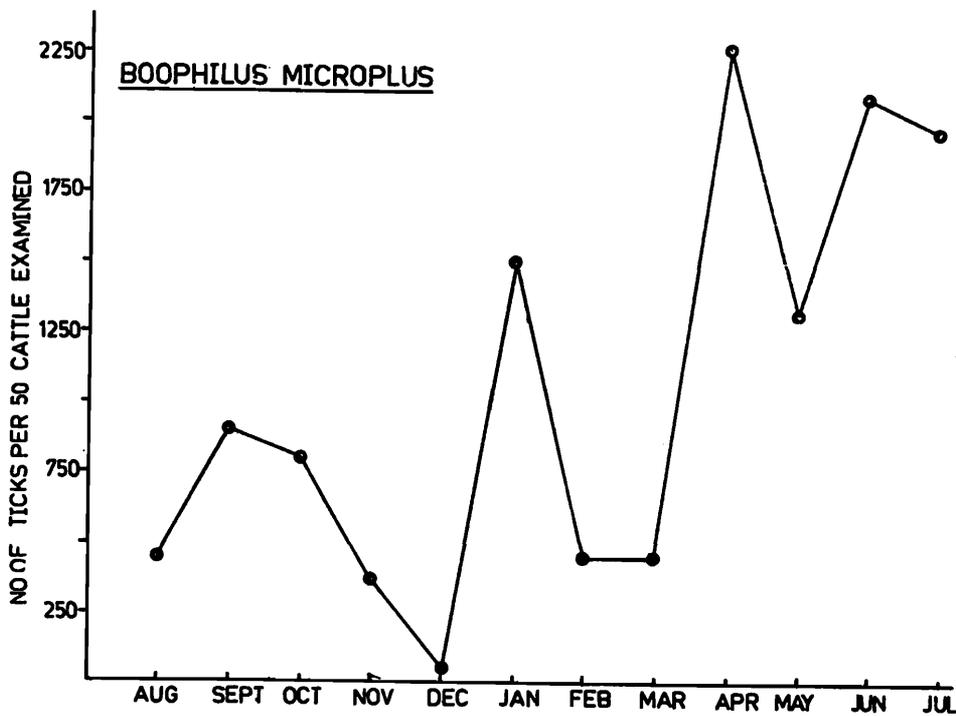


Fig. 2. The seasonal incidence curve of adult of *Boophilus microplus* in Zambia on cattle.

Fig. 2. The seasonal incidence curve of adut of *Boophilus microplus* in Zambia on cattle.

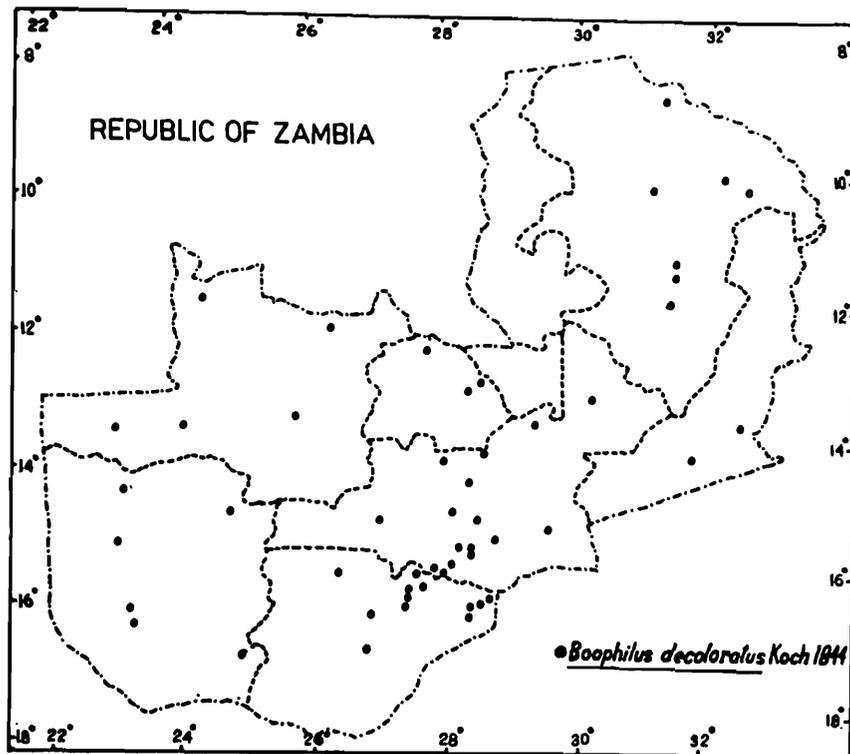


Fig. 3. Distribution of *Boophilus decoloratus* in Zambia.

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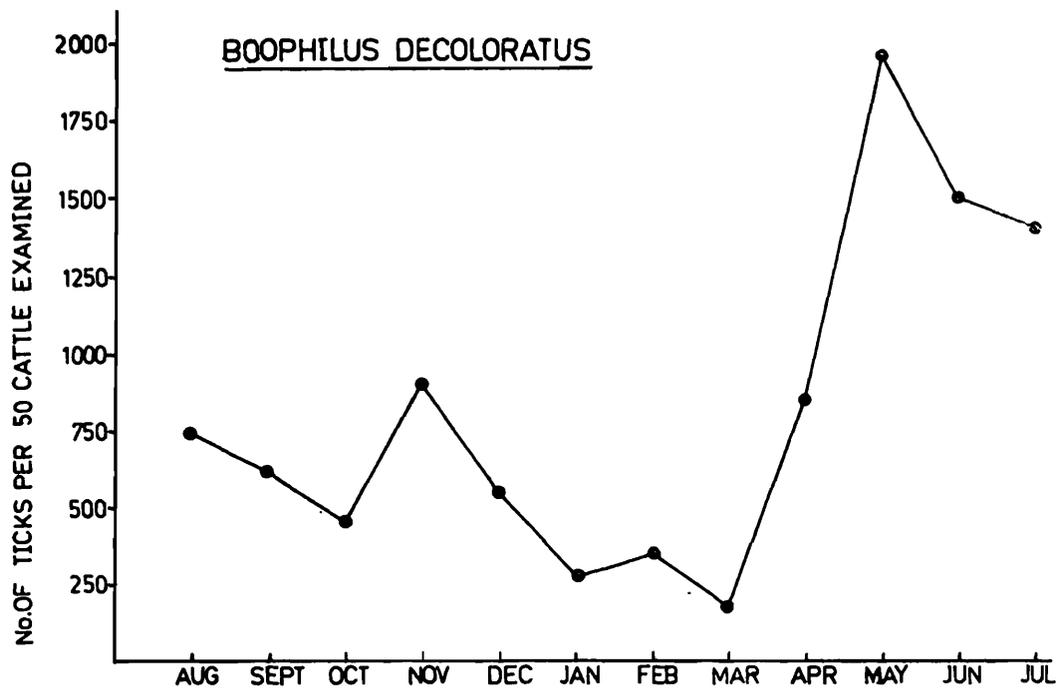


Fig. 4. The seasonal incidence curve of adult of *Boophilus decoloratus* in Zambia on cattle.

Fig. 4. The seasonal incidence curve of adut of *Boophilus decoloratus* in Zambia on cattle.

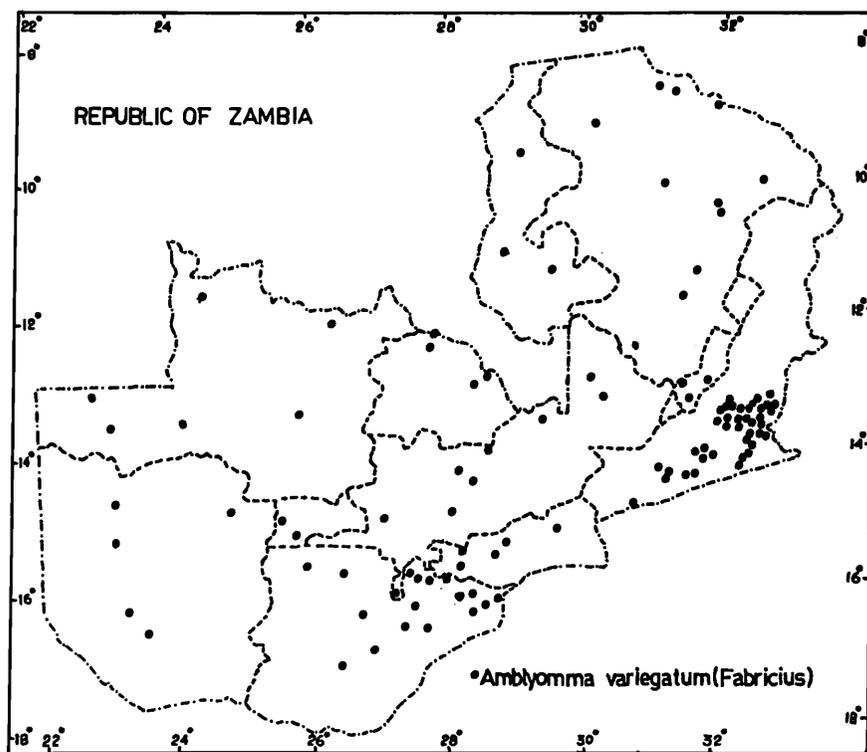


Fig. 5. Distribution of *Amblyomma variegatum* in Zambia.

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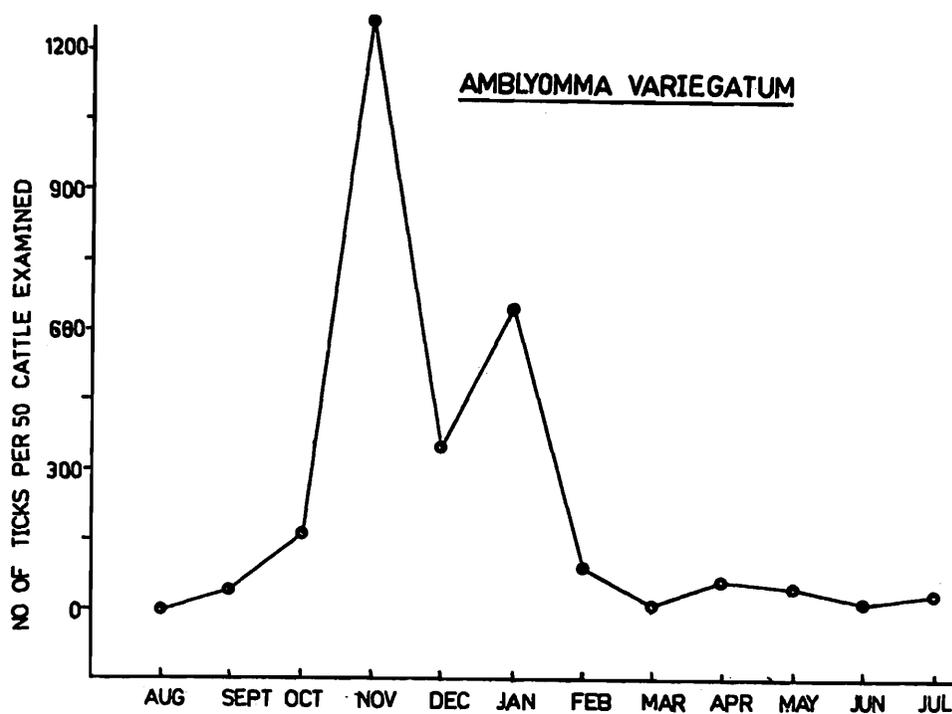


Fig. 6. The seasonal incidence curve of adult of *Amblyomma variegatum* in Zambia on cattle.

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Zambezi, Luangwa and Kafue rivers and the basin of Lake Tanganyika in the north to Mafinga Mountains and Mbala-highlands (Fig.5). It occurs throughout the mountain ranges, massifs, rift valleys wherever there are cattle and is almost ubiquitous in the plains.

**Seasonal Activity** : The adults of this tick have been found on cattle in Zambia almost throughout the year in varying numbers (Fig.6). They start appearing in collection towards the end of dry season, especially in late September and early October. The population gradually starts building up and reaches a peak in the month of November. A large number of engorged females start appearing from late October. There is a sudden decline in population in the month of December due to large number of engorged females leaving the host for egg-laying. The population then increases in January. Adult population show a rapid downward trend in the dry season reaching a minimum in the month of August. This tick has a single generation in Zambia.

**Disease Relationship** : *A. variegatum* is known to transmit heartwater of ruminants, caused by *Cowdria ruminantium*. In Eastern Province of Zambia this tick also transmits chronic theileriosis throughout the year.

### *Rhipicephalus appendiculatus*

**Distribution** : *R. appendiculatus* is the most important species of ticks in Zambia. Generally it is found in almost all the provinces in the country (Fig.7). It occurs in altitude ranging from 300 m in the faulted valley of Luangwa and Zambezi to 1820 m in Mafinga and Mbala highlands. It has also been found uniformly throughout the main plateau region on either side of the main Congo-Zambezi watershed from Kabwe to Isoka which ranges in altitude from 1,230 m to 1535 m; and on southern plateau around Choma and Kalomo in the Southern Province at about 1,200 m; and the eastern plateau at about 1,075 m; there is also a focus of infestation in the upper valley region ranging in altitude from 900 m to 1200 m. On Barotse plain and northern plateau region of North-Western province, the occurrence of this tick is very irregular.

**Seasonal Activity** : The adult of *Rhipicephalus appendiculatus* generally makes their first appearance towards the beginning of rainy season i.e. in November and attains a maximum during January i.e. the peak of rainy season. Thereafter they decrease in number towards the end of rainy season (Fig.8). The larvae are found in cold-dry season and nymph in hot-dried season and adults in rainy season, due to its requirement of high humidity optimum, about 75% and above. This clearly indicates that this tick passes through only one generation per annum.

**Disease Relationships** : *R. appendiculatus* is the chief field vector of the protozoan parasite *Theileria parva*, causative agent of East Coast Fever. It is also capable of transmitting Redwater (*Babesia bigemina*), Pseudo East Coast Fever (*Theileria mutans*), Boutonneuse Fever (*Rickettsia conorii*), and louping ill (virus) experimentally.

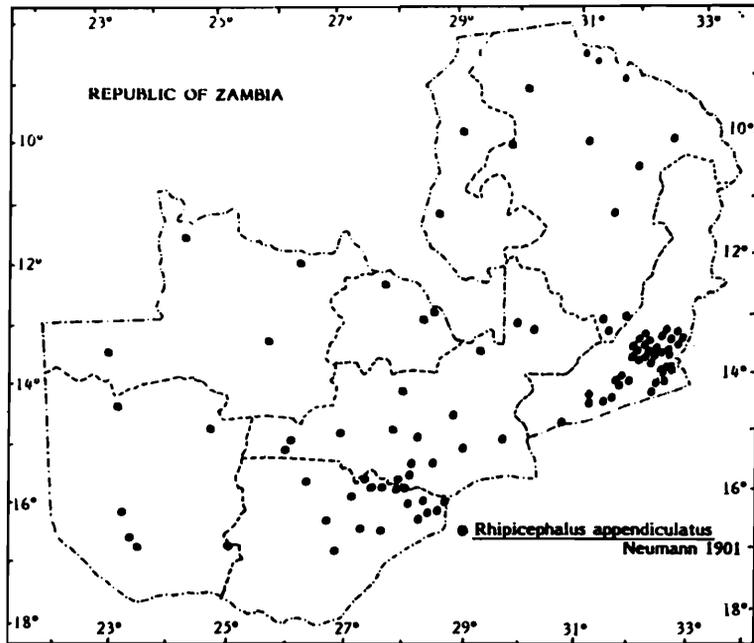


Fig. 7. Distribution of *Rhipicephalus appendiculatus* in Zambia.

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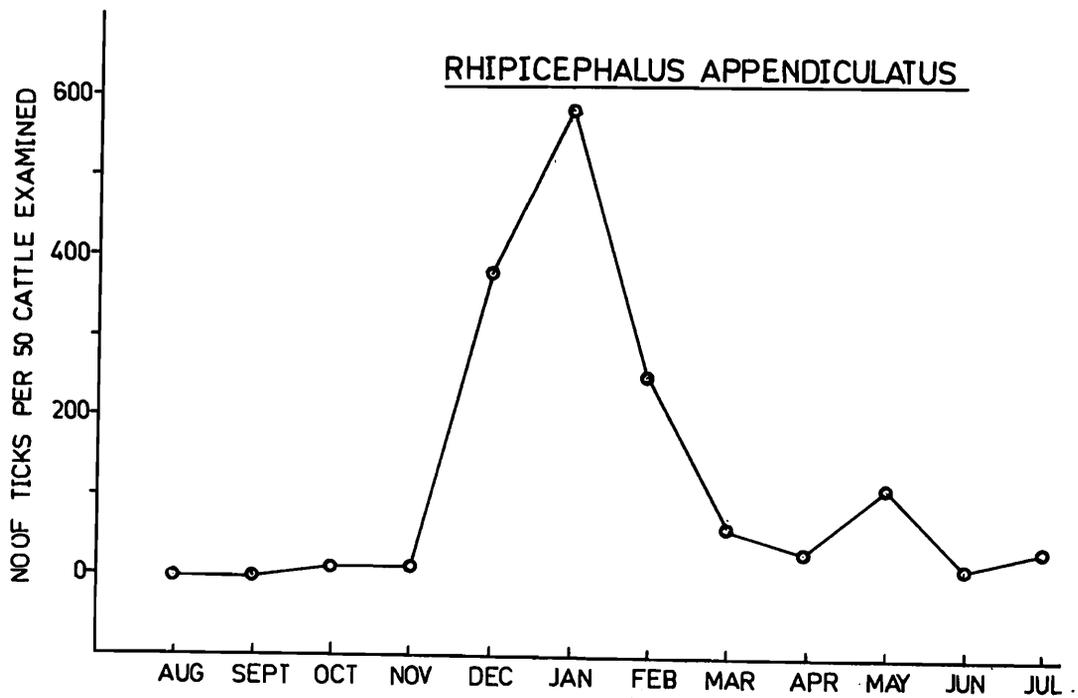


Fig. 8. The seasonal incidence curve of adult of *Rhipicephalus appendiculatus* in Zambia on cattle.

Fig. 8. The seasonal incidence curve of adut of *Rhipicephalus appendiculatus* in Zambia on cattle.

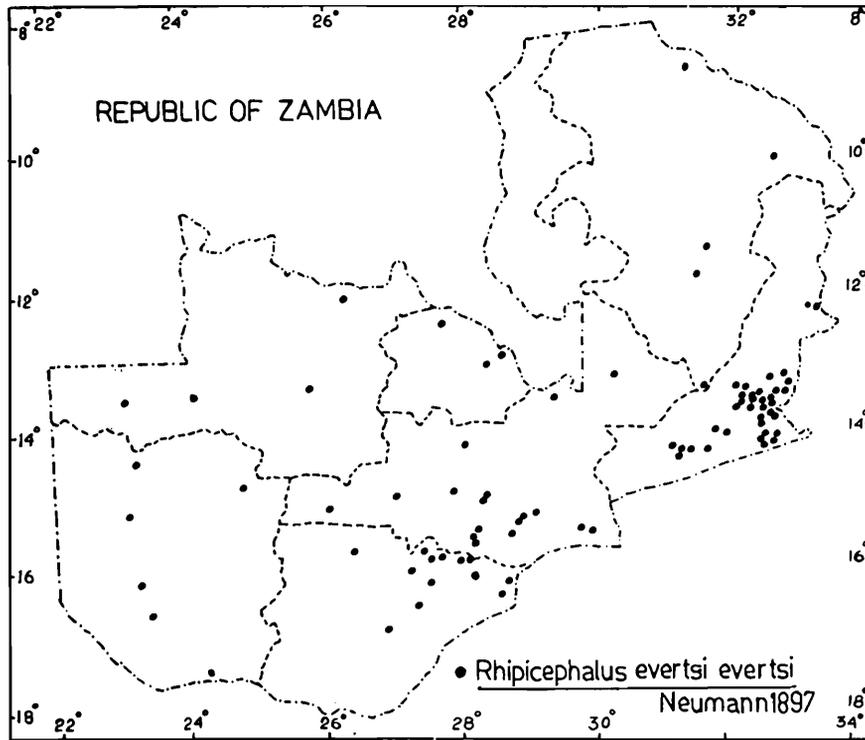


Fig. 9. Distribution of *Rhipicephalus evertsi evertsi* in Zambia.

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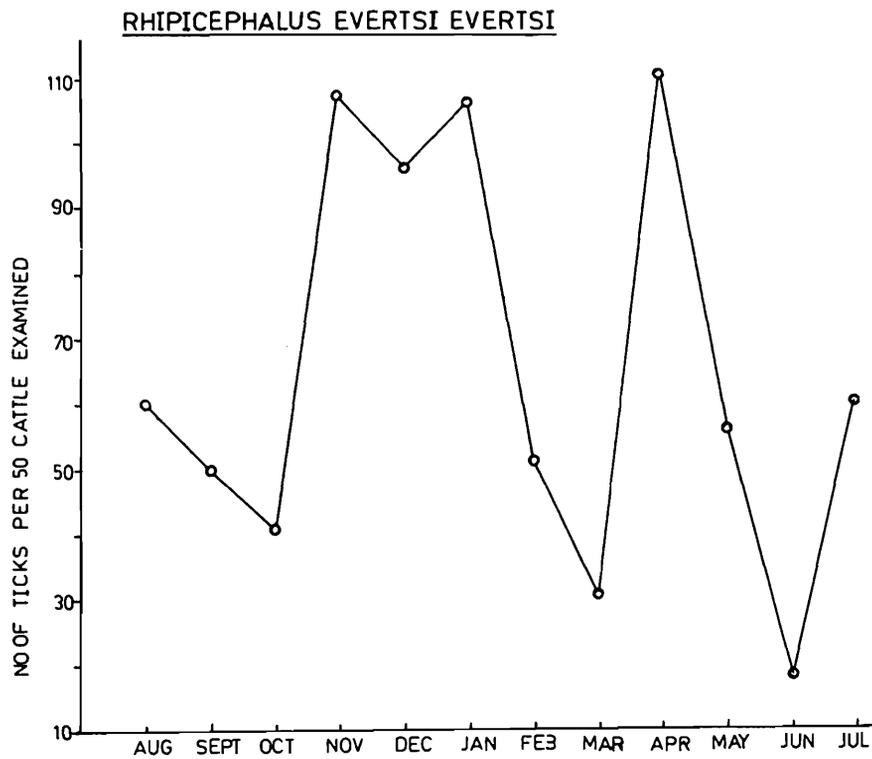


Fig. 10. The seasonal incidence curve of adult of *Rhipicephalus evertsi evertsi* in Zambia on cattle.

Fig. 10. The seasonal incidence curve of adut of *Rhipicephalus evertsi evertsi* in Zambia on cattle.

### *Rhipicephalus evertsi evertsi*

**Distribution** : *R. evertsi evertsi* is present almost throughout the country although not equally distributed in all the provinces (Fig.9). This tick seems to be able to withstand varying conditions and may well be found in many other areas from where it has not yet been reported. This tick is found widely in eastern, central, southern plateau systems and western Barotse plains with some extensions into river valleys and northern highlands.

**Seasonal Activity** : *R. evertsi evertsi* occurred throughout the year, often in substantial numbers. The infestation of this tick occurs in waves (Fig.10). The seasonal cycle in Zambia showed that adults begin to appear in cold-dry season in June and then population slowly builds up and reaches its peak in November and peak of infestation is maintained in the rainy season. There is a sudden decline towards the end of rainy season in March. This decline is due to the dropping off engorged females for egg-laying. The secondary peak of activity, occurs at the beginning of cool-dry season in the month of April. This suggests that *R. evertsi* passes through more than two generations per annum. This tick can withstand both high and low humidity and temperature.

**Disease Relationship** : *R. evertsi evertsi* has been proved to transmit *Theileria parva*, the agent of East Coast Fever, *Theileria mutans* agent of Pseudo East Coast Fever, and *Babesia bigemina*, red water of cattle. Besides these, it is also capable of transmitting the causative agents of biliary fever of horses and of both bovine and equine spirochaetosis.

### *Rhipicephalus compositus*

**Distribution** : There are records of *R. compositus* throughout the whole range of Zambia's physiography from flat plateau at about 600 m in altitude to elevated uplands country, intensely dissected escarpment zones to highlands over 1800 m in altitude (Fig.11). This tick is very rare in southern plateau region and absent in our collections from Choma-Kalomo plateau region.

**Seasonal Activity** : The activity period of *Rhipicephalus compositus* differs from *R. appendiculatus* and *R. Simus* in, that peak infestations occur before the rains, during the hot months of September and October. There is a gradual decline with the onset of rains and gradually diminishes in the cold-dry season (Fig.12). This suggests that this species also pass through only a single generation per annum.

**Disease Relationship** : This tick is known to transmit pathogens of East Coast Fever experimentally.

### *Rhipicephalus tricuspis*

**Distribution** : *R. tricuspis* is almost ubiquitous in Zambia and occurs throughout the main physiographical zones of the country from faulted valleys of Zambezi to Mbala-highlands and Nyika plateau ranging in altitude from 600 m to 1820 m (Fig.13).

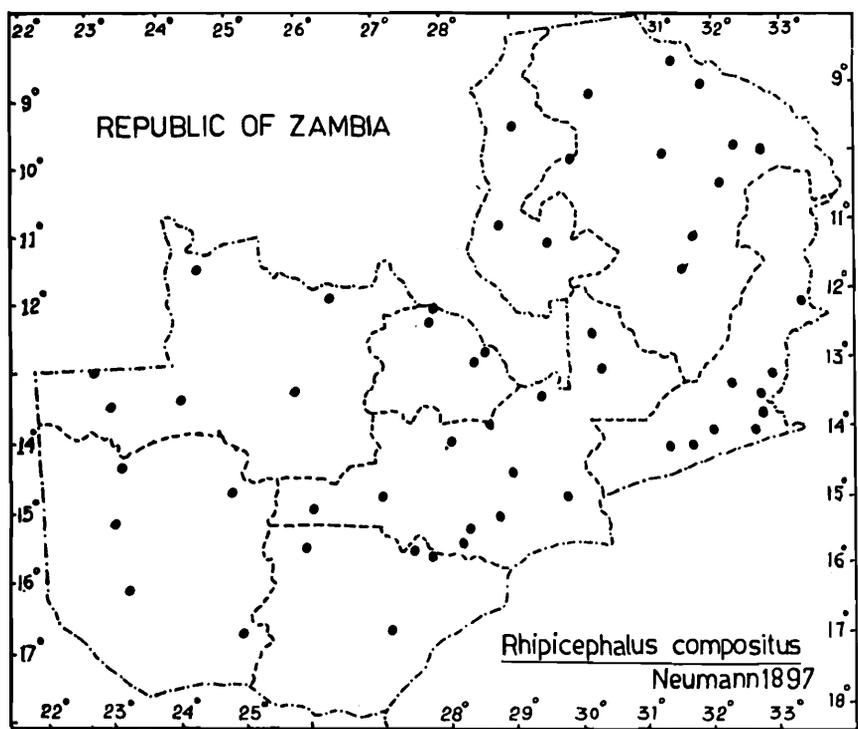


Fig. 11. Distribution of *Rhipicephalus compositus* in Zambia.

Fig. 11. Distribution of *Rhipicephalus compositus* in Zambia.

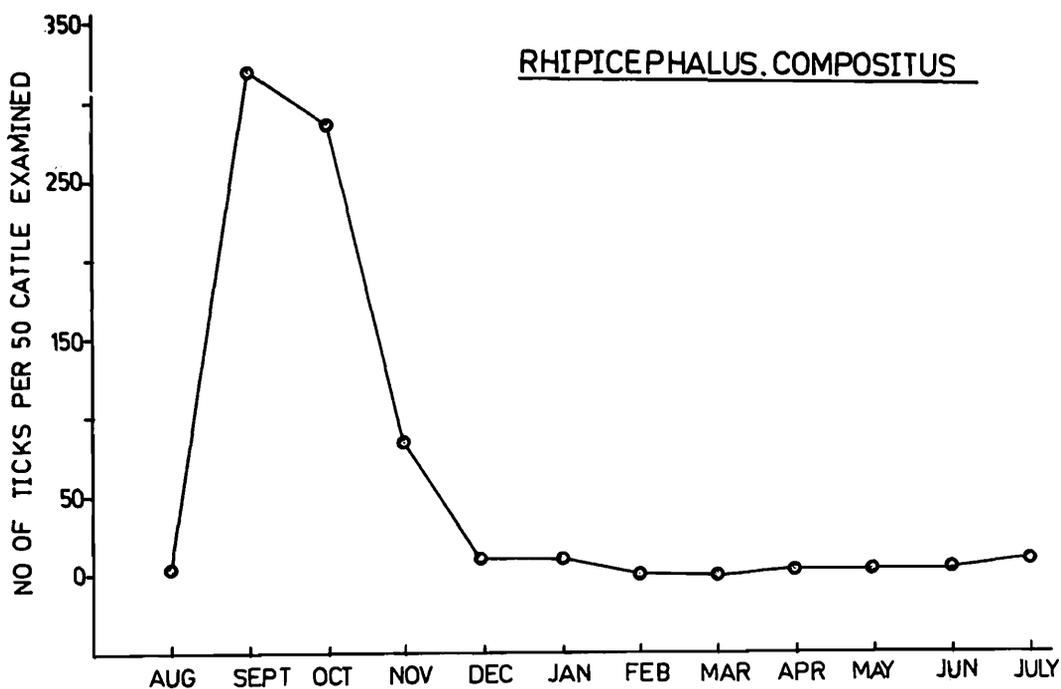


Fig. 12. The seasonal incidence curve of adult of *Rhipicephalus compositus* in Zambia on cattle.

Fig. 12. The seasonal incidence curve of adut of *Rhipicephalus compositus* in Zambia on cattle.

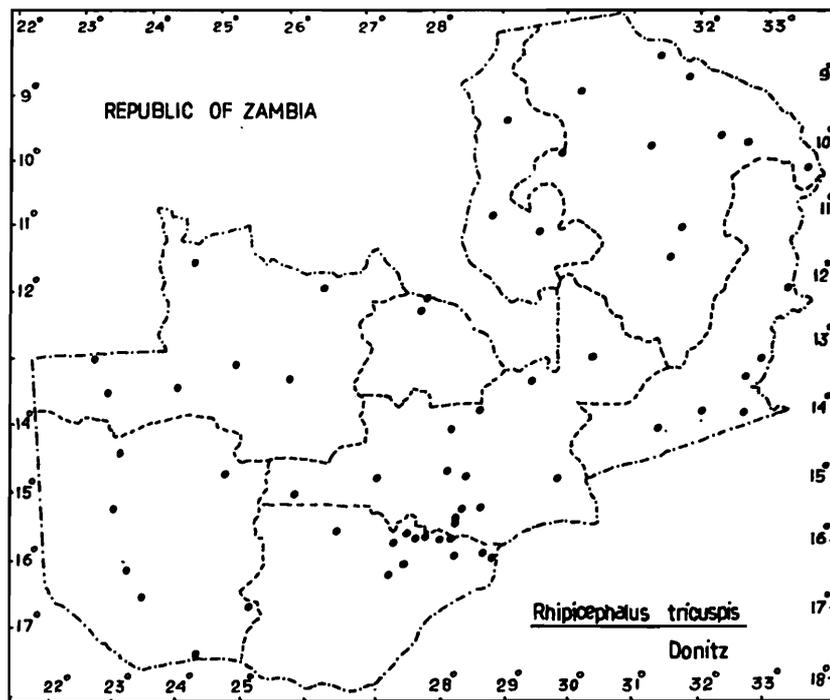


Fig. 13. Distribution of *Rhipicephalus tricuspis* in Zambia.

Fig. 13. Distribution of *Rhipicephalus tricuspis* in Zambia.

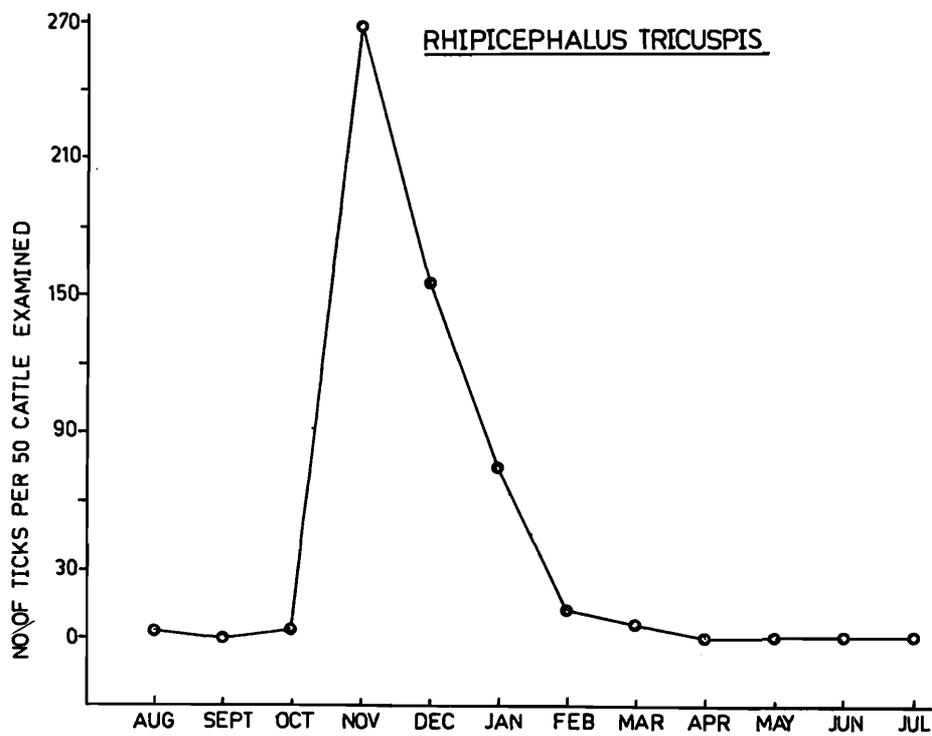


Fig. 14. The seasonal incidence curve of adult of *Rhipicephalus tricuspis* in Zambia on cattle.

Fig. 14. The seasonal incidence curve of adult of *Rhipicephalus tricuspis* in Zambia on cattle.

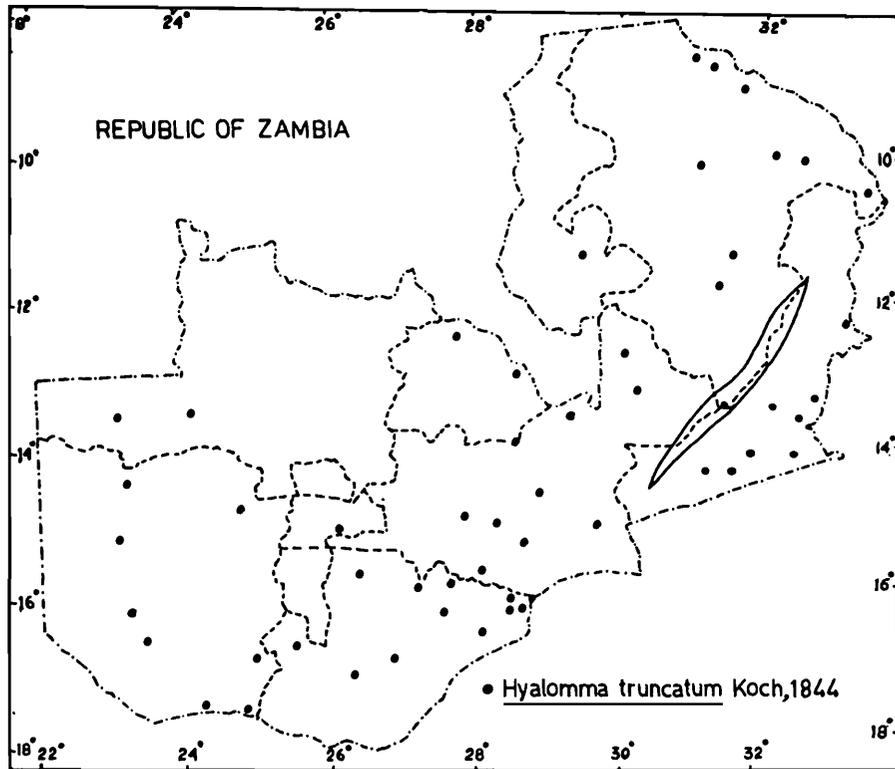


Fig. 15. Distribution of *Hyalomma truncatum* in Zambia.

Fig. 15. Distribution of *Hyalomma truncatum* in Zambia.

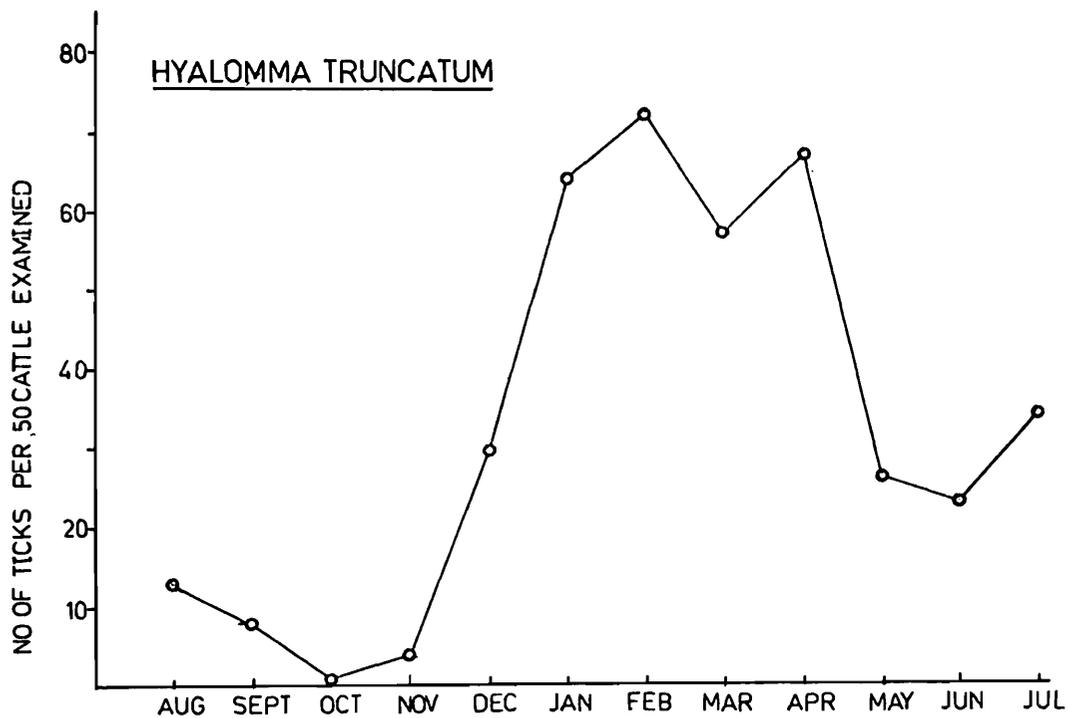


Fig. 16. The seasonal incidence curve of adult of *Hyalomma truncatum* in Zambia on cattle.

Fig. 16. The seasonal incidence curve of adut of *Hyalomma truncatum* in Zambia on cattle.

**Seasonal Activity** : The adults of *R. tricuspis* starts appearing in the hot months and the population reaches its peak on or about the onset of rains. The activity is maintained during the early part of the rainy season but then there is a gradual decline till March and no adults of this tick are usually found till August. This pattern also suggests a single generation of this species per annum (Fig. 14).

**Disease Relationship** : *R. tricuspis* has been proved to transmit agents of *Q fever* and is also known to cause paralysis in sheep and lamb.

### *Hyalomma truncatum*

**Distribution** : *H. truncatum* has been collected frequently between 900 m to 1200 m in altitude in low to moderate infestation. It has also been found at Mbala-highlands and Mafinga mountains in the north eastern plateau region of the country where the altitude is over 1500 m. The foci of infestation of this tick is mainly from Kalahari region in the west to Kafue flats, central plateau, broken hill country and lesser eastern plateau of the country (Fig. 15).

**Seasonal Activity** : The adult of *Hyalomma truncatum* are found in substantial numbers from the beginning of rainy season till the end of cold-dry season (Fig. 16). The peak of activity is from middle of rainy season to the beginning of cold-dry season. The population gradually declines from May with a slight build up in July then there is a sudden decline till September. In view of the activity pattern there is a possibility of more than one generation of tick per annum.

**Disease Relationship** : *Hyalomma truncatum* is known to transmit the virus of sweating sickness, a disease that affects cattle, sheep, goats and pigs. It is also known to transmit causative agents of east coast fever of cattle under laboratory conditions.

### *Rhipicephalus simus*

**Distribution** : *R. simus* almost ubiquitous in Zambia and has been recorded from most parts of the country (Fig. 17). It is distributed throughout the whole range of Zambia's physiography, from faulted valley of Zambezi and Luangwa river a tributary of Zambezi-Zaire Divide; Luangwa-Lake-Malawi divide, Bangweulu depression, Mbala highlands and Barotse plains. These area range in altitude from 310 m to 1820 m.

**Seasonal Activity** : The adults of *Rhipicephalus simus* starts appearing during hot-dry months of September and October and gradually population builds up throughout November at the onset of rains, reaches its peak by middle of rainy season, thereafter the size of infestation decreases gradually through the end of rainy season (Fig.18). Numbers occurring during cool months are negligible. The activity pattern of this tick suggests only one generation per annum.

**Disease Relationship** : *R. simus* has been proved to transmit East Coast Fever of Cattle and gall sickness (*Anaplasma marginale*).

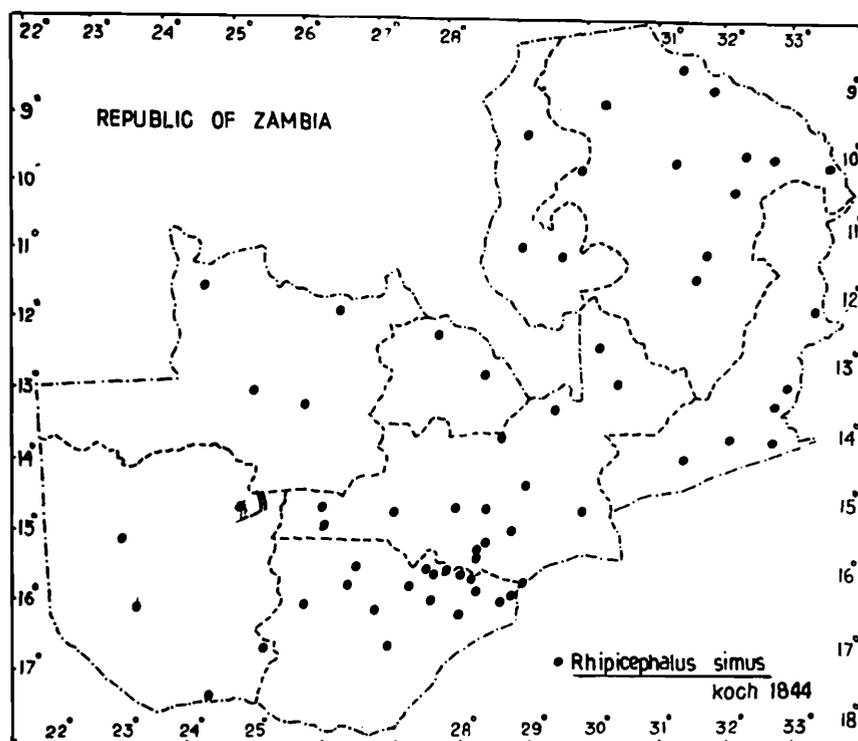


Fig. 17. Distribution of *Rhipicephalus simus* in Zambia.

Fig. 17. Distribution of *Rhipicephalus simus* in Zambia.

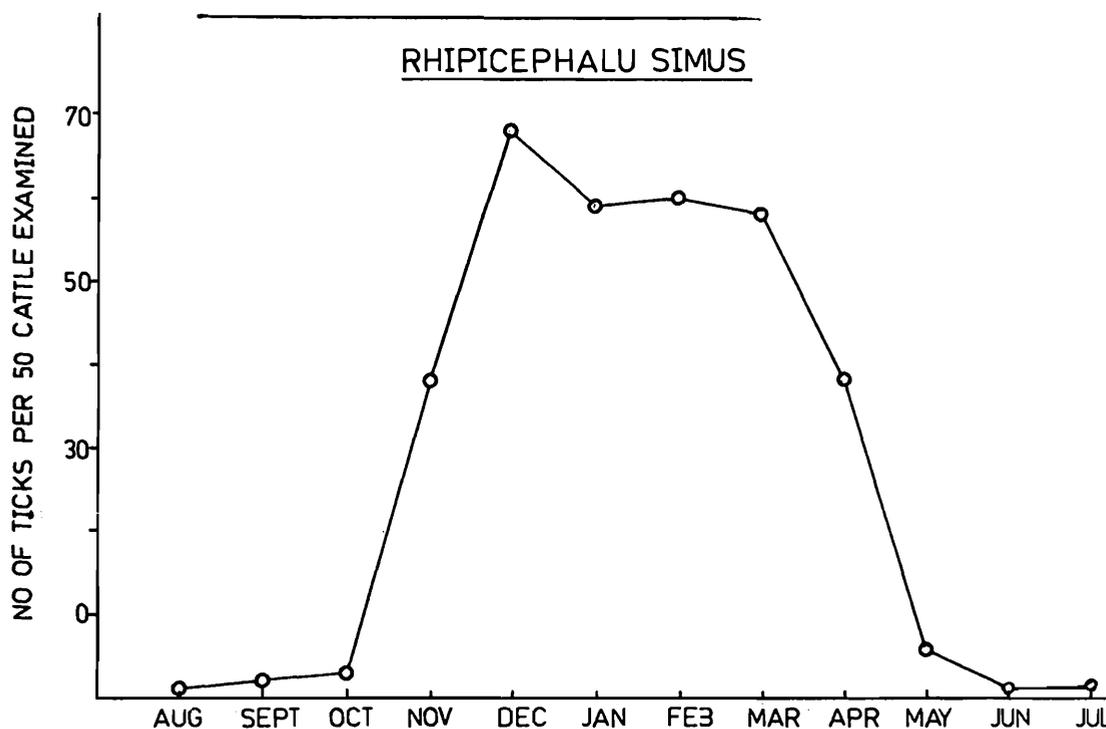


Fig. 18. The seasonal incidence curve of adult of *Rhipicephalus simus* in Zambia on cattle.

Fig. 18. The seasonal incidence curve of adut of *Rhipicephalus simus* in Zambia on cattle.

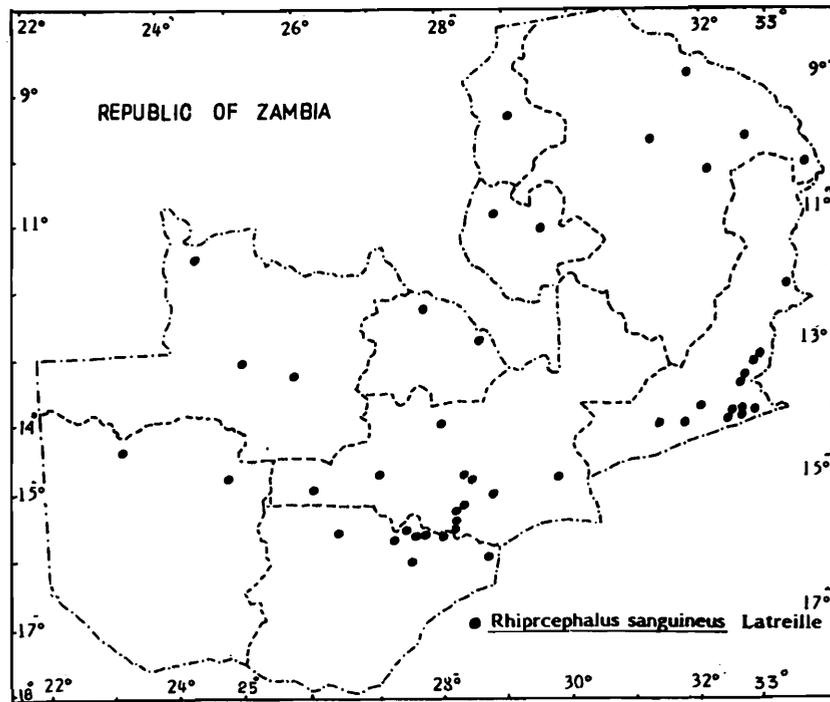


Fig. 19. Distribution of *Rhipicephalus sanguineus* in Zambia.

Fig. 19. Distribution of *Rhipicephalus sanguineus* in Zambia.

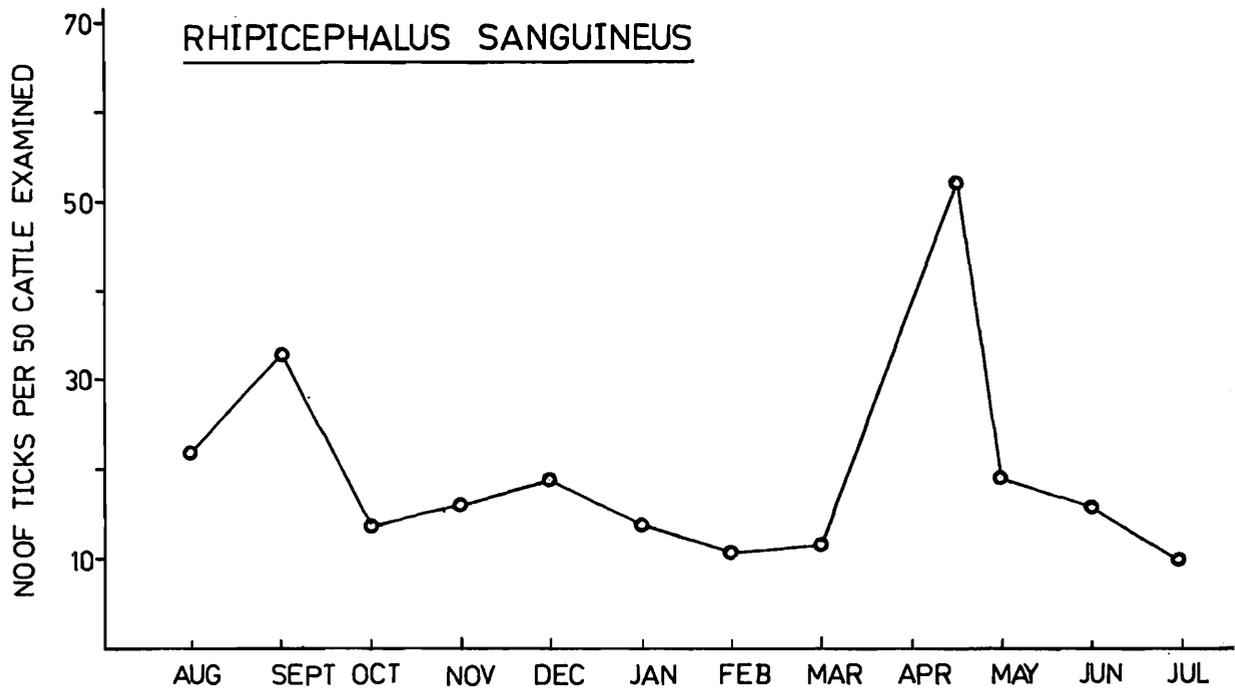


Fig. 20. The seasonal incidence curve of adult of *Rhipicephalus sanguineus* in Zambia on cattle.

Fig. 20. The seasonal incidence curve of adut of *Rhipicephalus sanguineus* in Zambia on cattle.

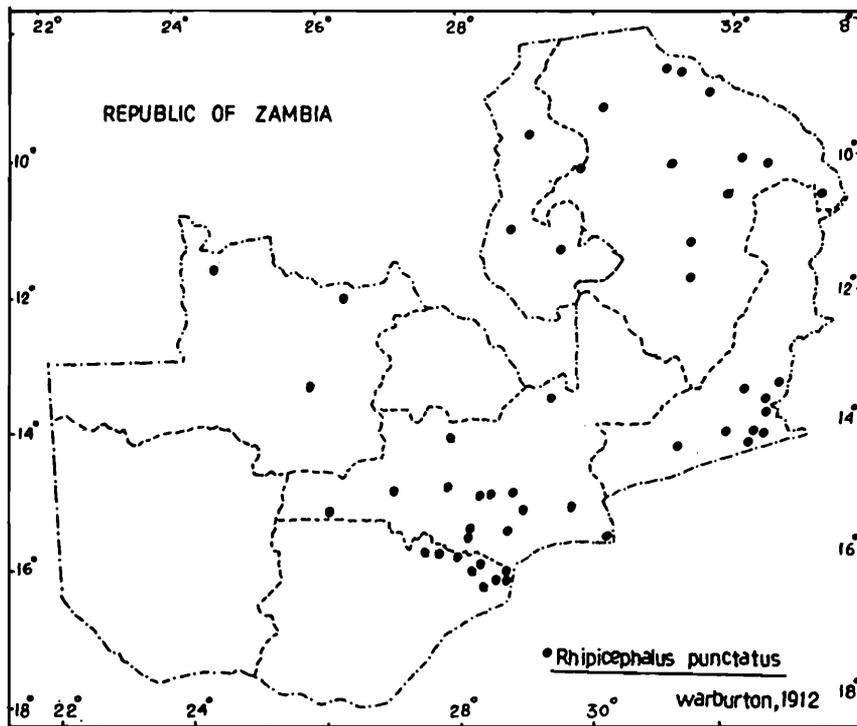


Fig. 21. Distribution of *Rhipicephalus punctatus* in Zambia.

Fig. 21. Distribution of *Rhipicephalus punctatus* in Zambia.

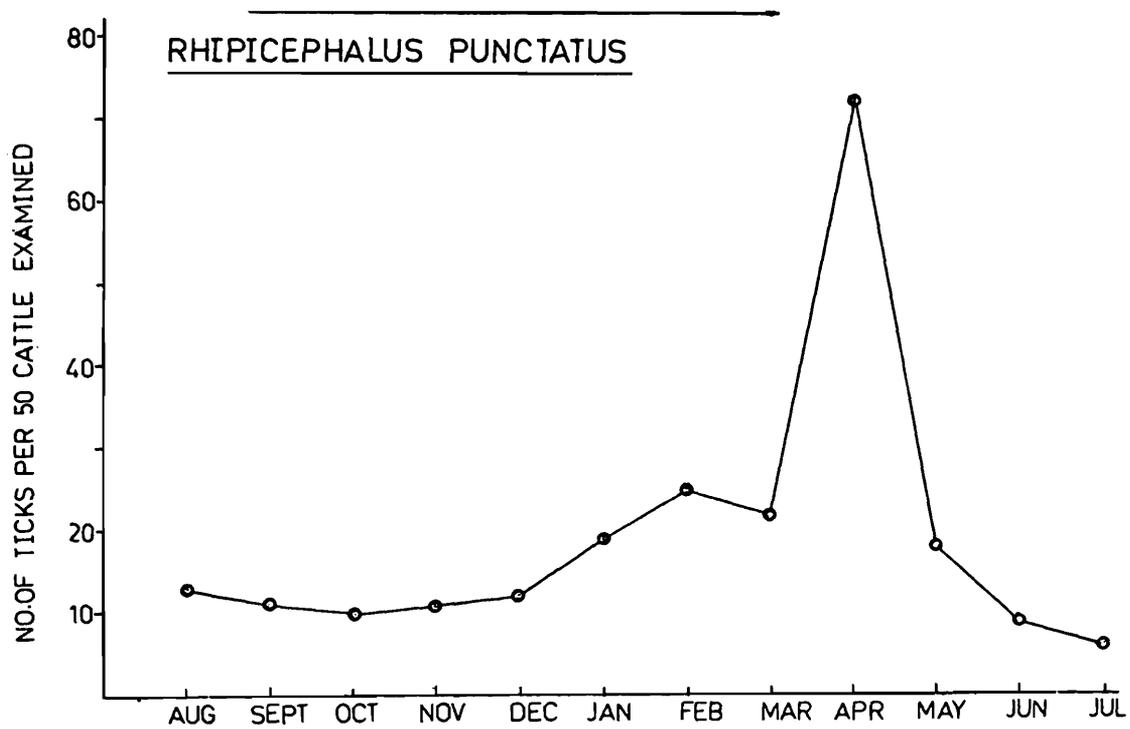


Fig. 22. The seasonal incidence curve of adult of *Rhipicephalus punctatus* in Zambia on cattle.

Fig. 22. The seasonal incidence curve of adut of *Rhipicephalus punctatus* in Zambia on cattle.

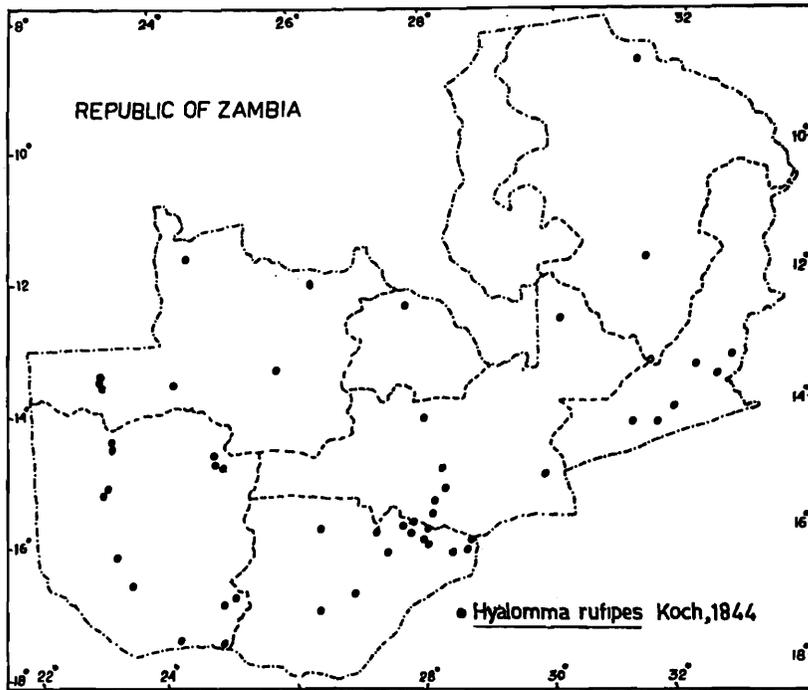


Fig. 23. Distribution of *Hyalomma rufipes* in Zambia.

Fig. 23. Distribution of *Hyalomma rufipes* in Zambia.

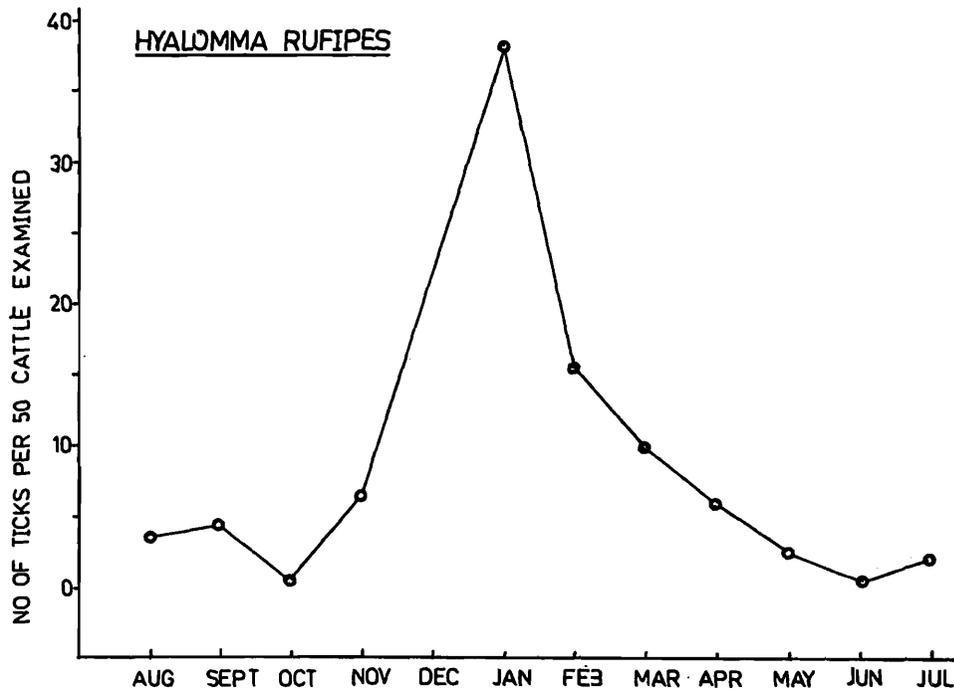


Fig. 24. The seasonal incidence curve of adult of *Hyalomma rufipes* in Zambia on cattle.

Fig. 24. The seasonal incidence curve of adult of *Hyalomma rufipes* in Zambia on cattle.

*Rhipicephalus sanguineus*

**Distribution** : *Rhipicephalus sanguineus* is fairly well distributed in the country (Fig.19). It has been found in most of the physiographic zones from the faulted river valleys to highlands in the north eastern plateau region. It ranges in altitude from about 300 m to 1800 m. It seems to be more common between altitude 900 m to 1200 m. It appeared very rarely in collection from Barotse plains.

**Seasonal Activity** : The adults of *R. sanguineus* are active initially on stock about the beginning of hot and humid months and the population gradually decline with the onset of rains and remains at very low ebb almost throughout the rainy season. The population reaches peak in April at the beginning of cold-dry season and then there is a sudden decline throughout the cold-dry season (Fig.20). This pattern suggests that probably there is more than one generation per annum.

**Disease Relationship** : *Rhipicephalus sanguineus* is a cosmopolitan species and serves as a principal vector of Boutonneuse Fever, "Indian Tick Typhus" caused by *Rickettsia conori*. It is also a vector of Rocky-Mountain spotted fever in warmer north of America.

*Rhipicephalus punctatus*

**Distribution** : *R. punctatus* is widely distributed in the country (Fig.21). It is mainly confined on main plateau region on either side of Congo-Zambezi water-shed; on eastern plateau in Eastern Province and faulted valleys of lower Zambezi ranging in altitude from 300 m to 1800 m. It is very rare in Barotse plain and have been collected so far towards the border of Kalahari sands in Sesheke plains at an altitude of about 600 m. It has also been found in lake basin area of Lake Tanganyika.

**Seasonal Activity** : The adults of *R. punctatus* are active initially with the onset of rains, and the population rise steadily through the rainy season and reaches its peak in April towards the end of rainy season, there after declining sharply in May and remaining at low level till the next season (Fig. 22). The activity pattern suggests one generation of this species per annum.

**Disease Relationship** : These have not been studied.

*Hyalomma rufipes*

**Distribution** : *Hyalomma rufipes* is fairly well distributed in Zambia except in Luapula Province where it has not yet been found. This tick occurs throughout the central plateau, broken hill country, lesser eastern plateau, kafue flats and Kalahari region (Fig. 23). It is essentially a tick of the central plateau and medium altitude.

**Seasonal Activity** *Hyalomma rufipes* occurred in substantial numbers throughout the rainy season and in lower number throughout the cool and hot months (Fig. 24). The single peak activity of this tick shows that it passes through one generation per annum in contrast to *H. truncatum* in which infestation occurs in two waves.

*Disease Relationship* : These have not been studied but the close association of this tick with vector species during rainy season calls for investigations.

## DISCUSSION

The life-cycles of an Ixodid tick may be either uninterrupted or co-ordinated with seasonal climatic changes (Balashov, 1968). The life-cycle of ixodid species found in the present study fall into two broad categories. The one-host tick *B. decoloratus* and *B. microplus* and the two host tick *R. evertsi* passes through more than two generations per annum. The two host-tick *Ilyalomma truncatum* apparently passes through more than one generation. The other two host-tick *H. rufipes*, appears to have a seasonally regulated life-cycle and passes through only one generation per annum. The same is true with three-host ticks *R. appendiculatus*, *R. compositus*, *R. punctatus*, *R. simus*, *R. tricuspis* and *A. variegatum*. The minimum duration of the life-cycle usually increases from one to three-host ticks, as a result of the increased part of the life-cycle spent off the host (non-parasitic phase). The advantage of the short duration, uninterrupted-one and two host-life-cycles is that populations are able to build up rapidly under favourable conditions. A disadvantage is that under adverse, dry season conditions mortality in the desiccation sensitive egg and unfed larval stages is likely to be high. Multi-host ticks which pass through only one generation per annum are able to over-come the high egg and larval mortality by ensuring that these stages are present in the environment when conditions are most suitable for their survival. The adult activity of Ixodid ticks is regulated in some cases by day length while in others temperature, rainfall and high humidity in others. In number of species probably the adults and nymphs are able to pass unfavourable period by diapause or quiescence. The period of quiescence undoubtedly plays an important role in many tick-cycles, in allowing both survival under adverse conditions and seasonal regulation of the life-cycle. The ticks do seek residence on host during the hot and dry period in order to survive on cattle to produce the next generation.

This would then be a most suitable strategic period to control tick population in pastures and on animals.

## SUMMARY

Thirty species of Ixodid ticks were found on cattle of which 12 are most common and are known as cattle ticks and are cause of concern to domestic live stock industry in Zambia. The *Seasonal Activity* of the adults of 12 Ixodid tick species was studied on cattle herds in the country with notes on their *Distribution* and *Disease Relationships*. Species studied were *Boophilus microplus*, *Boophilus decoloratus*, *Amblyomma variegatum*, *Rhipicephalus appendiculatus*, *Rhipicephalus evertsi evertsi*, *Rhipicephalus compositus*, *Rhipicephalus tricuspis*, *Ilyalomma truncatum*, *Rhipicephalus simus*, *Rhipicephalus sanguineus*, *Rhipicephalus punctatus*, *Ilyalomma rufipes*. It has been observed that ticks do seek residence on host during the hot and dry period in order to

survive on cattle to produce the next generation. This would then be a most suitable period to control tick population in pastures and on animals.

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