THE EFFECT OF CLIMATE ON THE SEASONAL ACTIVITY AND ABUNDANCE OF *AMBLYOMMA VARIEGATUM* (FABRICIUS, 1794) (ACARINA: IXODIDAE) ON TRADE CATTLE IN IBADAN, NIGERIA

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TICKS
AMBLYOMMA
SEASONAL ACTIVITY
CATTLE
NIGERIA

ABSTRACT: *Amblyomma variegatum* (Fabricius, 1794) (Acarina: Ixodidae) is a tropical tick found in all the ecological zones of Nigeria. It parasitises all livestock, but is most common on cattle of the zebu type. *A. variegatum* is a 3-host tick. In Nigeria, cattle are reared in the Savannah zone of Northern Nigeria and only brought down to the South (forest zone) where Ibadan is located, to be slaughtered for food. Cattle are not reared in the South because of the adverse effect of *Glossina* sp. on them. In Ibadan, there is only one rainy season per year and this period coincides with the high incidence of *A. variegatum* adult females on trade cattle during the rains.

In this study, it was observed that climatic factors such as rainfall, temperature, humidity and sunshine affect the seasonal appearance of the adults, larvae and nymphs of *A. variegatum* on trade cattle.

TIQUES
AMBLYOMMA
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BÉTAIL
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RÉSUMÉ : *Amblyomma variegatum* (Fabricius, 1974) (Acarina : Ixodidae) est une tique tropicale que l'on rencontre dans toutes les zones écologiques du Nigéria. Elle parasite tous les animaux d'élevage, mais elle est surtout commune sur le bétail du type zebu. *A. variegatum* est une tique à trois hôtes. Au Nigéria, le bétail est élevé dans la zone de Savannah, au Nord du Nigéria, et il ne redescend dans le Sud (zone forestière), où se trouve Ibadan, que pour être abattu pour sa viande. Le bétail n'est pas élevé dans le Sud à cause de l'effet adverse de *Glossina* sp. sur lui. A Ibadan cette période coïncide avec une incidence élevée de femelles adultes d'*A. variegatum* sur le bétail du commerce pendant les pluies.

Dans cette étude, on a observé que les facteurs climatiques tels que la pluviosité, la température, l'humidité et l'ensoleillement, affectent l'apparition saisonnière des adultes, des larves et des nymphes d'*A. variegatum* sur le bétail du commerce.

INTRODUCTION

Amblyomma variegatum is a tropical ixodid tick found in all the ecological zones of Nigeria. It is not only a vector of protozoan parasites and viruses, but also causes anaemia in cattle. HEATH (1974) observed that the immature stages of *Ixodes holocyclus* are sensitive to desiccation which influences their seasonal abundance. It had been observed that the activity period of adult *Amblyomma* sp. is the late rainy season, while that of the immatures is the dry season (BRANAGAN, 1973 a, b; MOHAMMED 1974; DIPEOLU, 1975a, b; NORVAL, 1977). NORVAL (1977) also observed that, through diapause, the activity in some species of ixodid ticks is regulated by seasonal and climatic changes in some stages of their life cycle.

While NEWSON (1978) implicated rainfall as the

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principal factor initiating activity in adult R. *appendiculatus*, other researchers observed that low temperatures greatly prolonged the developmental periods of A. *variegatum* (DIPEOLU & OGUNJI, 1980; EKPENYONG & AKINBOADE, 1990). NORVAL (1977) noted that in A. *hebraeum* adult activity is regulated by the combined influence of temperature, humidity and day length. He observed that under cool humid conditions, temperature assumed a dominant regulatory role whereas under warm, dry conditions, humidity was of greater importance. MOHAMMED (1974) associated the engorgement and oviposition of female *Amblyomma variegatum* with wet seasons, when the relative humidity was high. ARTHUR (1962), while referring to ixodids in general opined that relative humidity and precipitation have little or no influence on the duration of the development periods. EKPENYONG & AKINBOADE (1991), however, showed that while relative humidity affects the seasonal incidence of the unengorged adult female *A. variegatum*, once engorged, it does not affect preoviposition, oviposition and eclosion pattern of the eggs. SHORT & NORVAL (1981) observed that by regulating their seasonal occurrence, ticks can ensure that the most desiccation-sensitive stages of their life cycle occur at times of the year that are most suitable for their survival.

The aim of this study was to find out how climatic factors may influence the seasonal activities of the immature and adult populations of *A. variegatum* on trade cattle in Ibadan.

MATERIALS AND METHODS

Estimation of abundance and activity

Amblyomma variegatum at various stages of development were detached from trade cattle stationed at the Veterinary Cattle Control Post in Bodija, Ibadan. The ticks were detached at random from 10 cattle picked at random from a herd of cattle stationed there every fortnight. After each collection, the ticks were taken to the Laboratory where they were separated into larvae, nymphs, adult males and adult females.

Area of study

Ibadan is located in the lowland rain forest zone of Nigeria (Fig. 1). This study was carried out for a period of 4 years, January 1983–December 1986. The meteorological data for Ibadan show that the mean monthly temperature for period varied between 28° C and 37° C. The rainy season is usually between March and September, with a maximum total monthly rainfall of 357 mm, recorded in September 1986. The mean monthly relative humidity (RH %) varied between 37 % and 88 %, while the total monthly sunshine hours varied between 111 and 223 hours.

Seasons of Study

In Ibadan, there are two main seasons in the year: the rainy season and the dry season. There is only one rainy season per year in Ibadan. The two seasons were adequately covered for 4-year period, January 1983–December 1986. This exercise was carried out every fortnight for the 4 years of study.

Hosts

The hosts are zebu cattle, bred in the Northern Savannah zones of the country but only transported on foot or on trailers to the South (where Ibadan is) to be slaughtered for food. They are trade cattle reared by the Fulani tribe in Northern Nigeria. Since *Amblyomma variegatum* is a 3-host tick, the unengorged adults, unengorged larvae and unengorged nymphs are always on the vegetation awaiting a passing host, on which to attach. As cattle move from one location to the other, they are bound to be infected and their routes are also infested with adult and immatures of this tick.

RESULTS

Adults

Figs 5, 9, 13 and 17 show that there is a clear seasonal pattern in the abundance of *A. variegatum* on cattle in Ibadan. The males appear first, followed

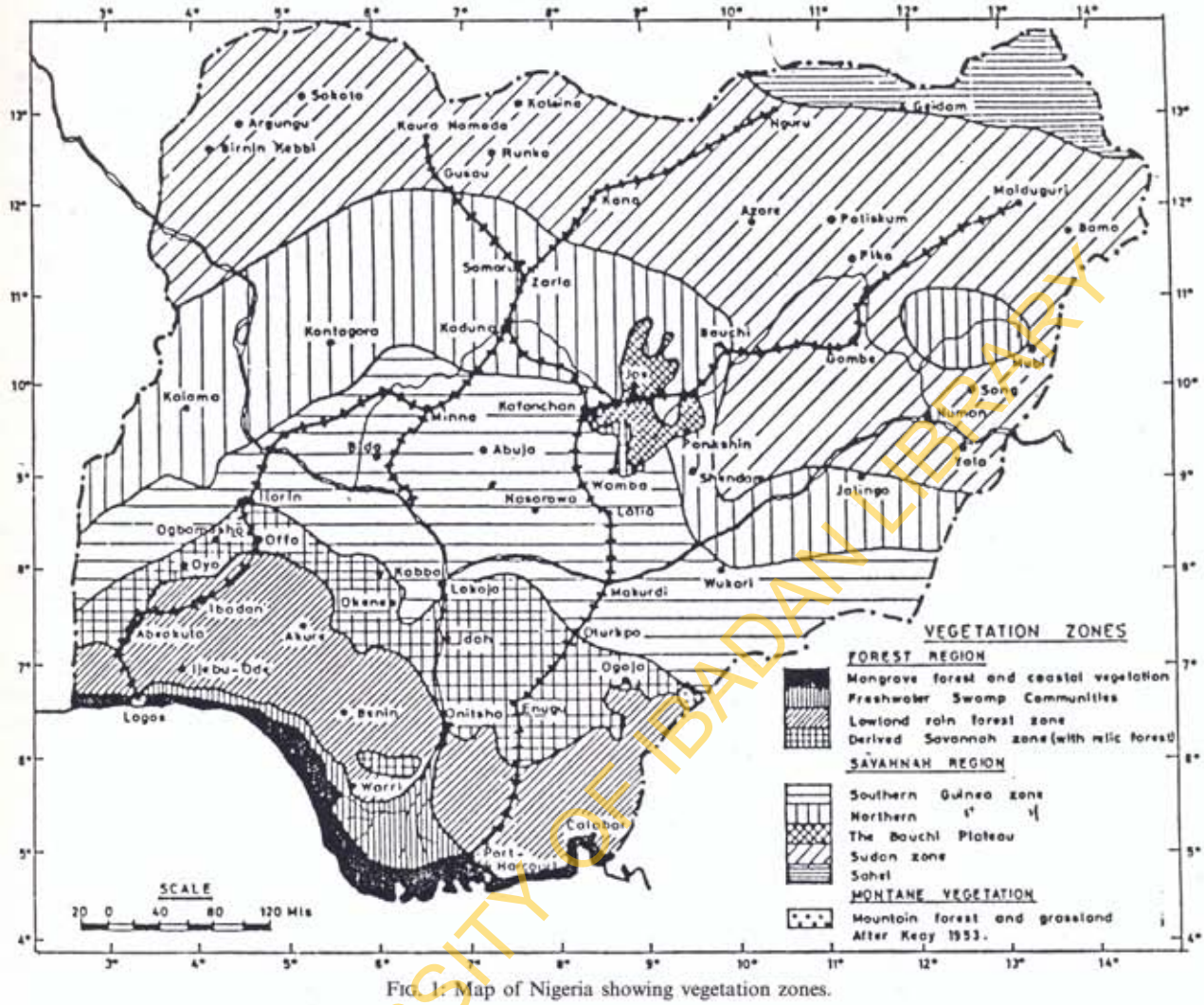

FIG. 1. Map of Nigeria showing vegetation zones.

by the females. The females usually appear on cattle after the first rains. As the rains become established, adult female population increases and engorgement takes place. The seasonal adult increase on cattle generally followed a similar pattern for the 4-year period of study. It was found that the main period of activity for the adult females was during the rainy season. In Ibadan, there is only a single rainy season a year and it was also observed that there was only one generation of *A. variegatum* per year. The adult males usually appeared first and were seen on cattle from January. They increased in number and their population reached a peak in April. As the rains progressed the males seemed to decrease in number while a few engorged females could be seen on cattle. The males were present on cattle throughout the year but their numbers were few between September and January. The activity period for the females was at the peak of the rains as the graphs show (Figs. 5, 9, 13, and 17). They were found on cattle from March, but did not start engorging until after the first rains. It was observed that the intensity of the first rain of the year seemed to determine the timing of the engorged females on cattle. The activity period of the engorged females was usually between June and September. It was during this period that the females were actively

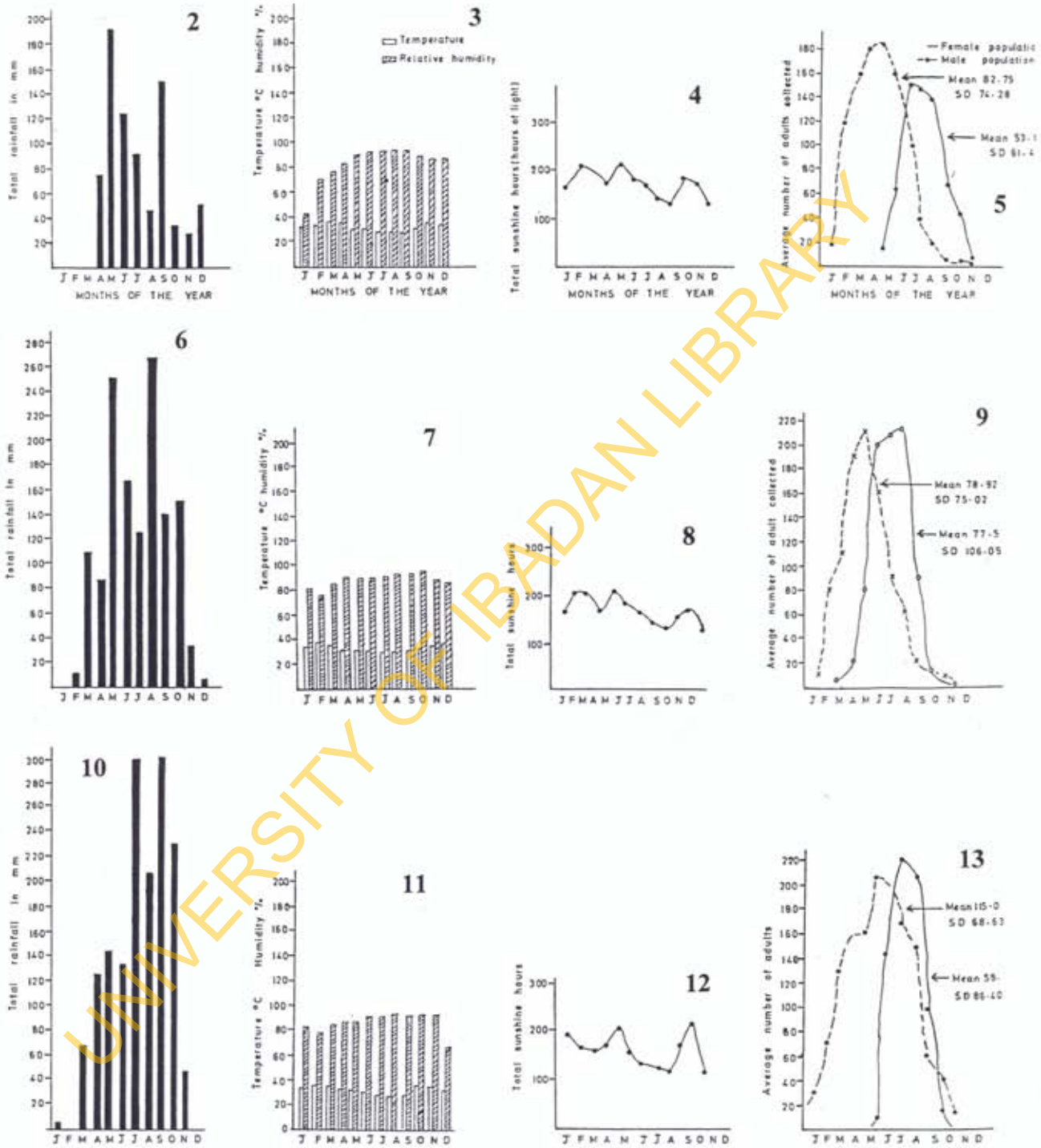

FIG. 2–13: Rainfall (2, 6 & 10), temperature/humidity (3, 7, 11), total sunshine hours (4, 8, 12) and seasonal abundance of *A. variegatum* adult populations on cattle (5, 9, 13) in Ibadan for 1983 (2-5), 1984 (6-9) and 1985 (10-13).

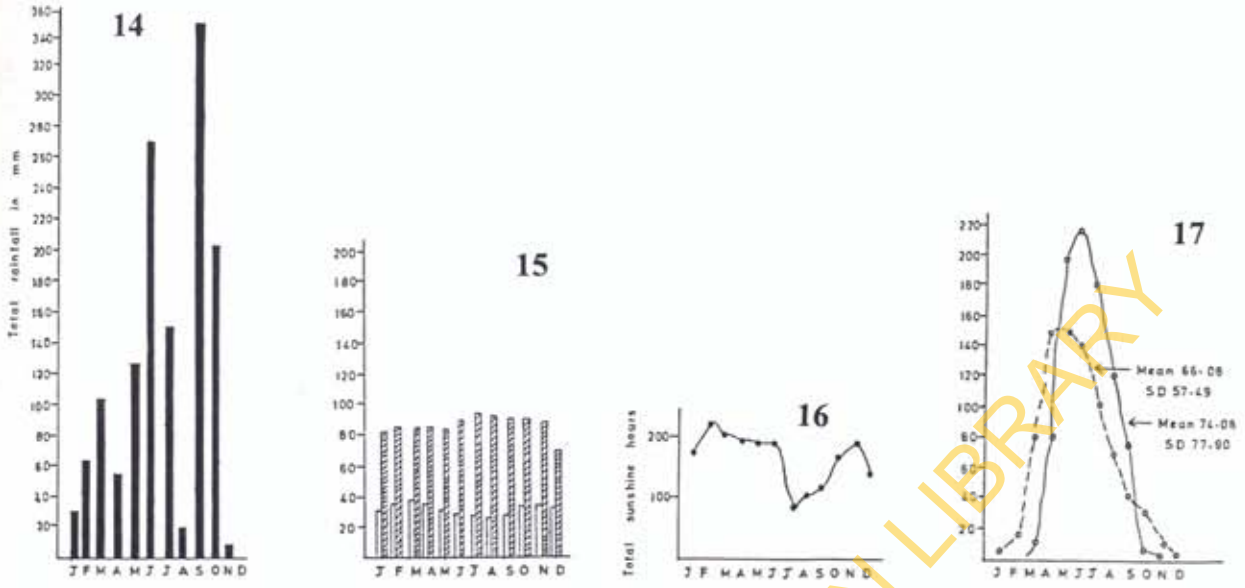

FIG. 14–17: Rainfall (14), temperature/humidity (15), total sunshine hours (16) and seasonal abundance of *A. variegatum* (17) in Ibadan for 1986.

engorging and laying eggs. It was also observed that during this period, June–September, the monthly total sunshine hours was slightly reduced (Figs. 4, 8, 12, and 16); rainfall was heavier (Figs. 2, 6, 10 and 15); and the relative humidity was slightly higher (Figs. 3, 7, 11 and 15). Of all these climatic factors, rainfall seemed to be the most important. Generally, it was observed that the earlier the onset of the first rains in a particular year and the greater its intensity, the earlier the engorged females appeared on cattle. There is, therefore, a definite correlation between heavy rainfall and the high incidence of engorged *A. variegatum* females on cattle. Female population, therefore, increases with decreasing temperature, decreasing daylength, increasing humidity and increased rainfall.

Larvae

The larvae also showed similar patterns of abundance during the 4-year period of study. The main activity period for the larvae was during the rainy season. They were found on cattle from August and population levels reached their peak in September and October. Population levels gradually declined after October, and by December hardly any larvae were found on cattle (Figs. 18, 19, 20 and 21).

Nymphs

The activity period for the nymphs was during the dry season. They started appearing on cattle by late October. Population levels reached their peak in December and January (figs. 18, 19, 20 and 21). By February no nymphs were found on cattle. Their population levels started building up again by November.

DISCUSSION

The present results show that climatic factors have a regulatory effect on the activity of *Amblyomma variegatum*. The major factor regulating the seasonal abundance of *A. variegatum* seems to be rainfall. There is a definite correlation between rainfall and high incidence of the adult females on cattle in Ibadan. As a result of the one season of rainfall per year, there is only one generation of *A. variegatum* per year in Ibadan. This observation agrees with the findings of WILSON (1944, 1946,

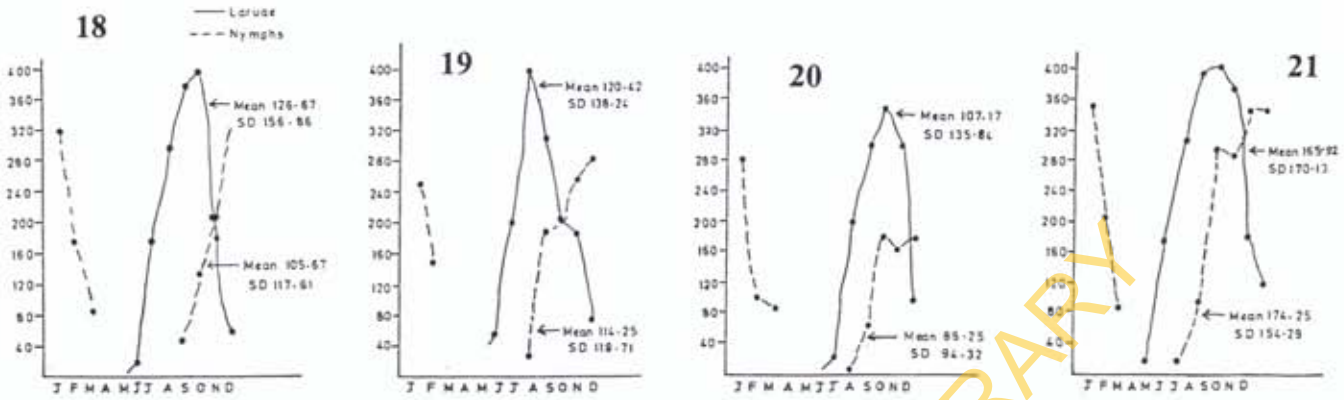

FIG. 18–21: Seasonal abundance of *A. variegatum* immature stages on cattle in Ibadan, for 1983 (18), 1984 (19), 1985 (20) and 1986 (21).

1950) in Malawi; BRANAGAN (1973 a, b) and NEWSON (1978) in Kenya. Figs 5, 9, 13, 17–21 show from analysis that the standard deviation (SD), the mean and the coefficient of variation (VV) of the population of *A. variegatum* for the four years varied widely in value and are, therefore, drawn from a normal population with a common variance. HOOGSTRAAL (1956) inferred that these findings could also apply to areas of Africa which have a single rainy season per year. This observation was also made for *A. variegatum* by STRICKLAND (1961), DIPEOLU (1975 a, b) and MOHAMMED (1974) in Nigeria. Contrary to the findings of STRICKLAND (1961) that the adult population of this species was entirely absent during part of the dry season, the adult males were found on cattle almost throughout the year.

NORVAL (1977) observed that in *A. hebraeum*, adult activity was regulated by the combined influences of temperature, humidity and day length. The effect of temperature in the tropics is not great since the extreme minimum temperature of 12.5° C recorded in Ibadan does not last for more than a few hours. Temperature in Ibadan seems to be fairly constant, though it can be seen that during the rainy season, the temperature was slightly reduced (Figs. 3, 7, 11 and 15). It was observed that during the period of adult female activity, the temperature was lower, day length shorter and humidity was high. STRICKLAND (1961) had concluded that the seasonal geographic pattern shown by ticks in Nigeria was influenced by various factors of which humidity was the most important. In this study, however, humidity though important was not as important as rainfall. It was observed that, the timing and the intensity of the first rain of the year was crucial in determining when the females will begin to engorge. Generally, if the rains are early then the engorged females appear early, but if the rains are late, then the engorged females appear late.

In 1983, for example, the first rain of the year came late and fell in April, subsequently, the first engorged females were seen on cattle in May, whereas in 1986 the first rain fell in January and the first engorged females were found on cattle as early as March. This, therefore, confirms that female engorgement is affected by the onset of the early rains.

The general pattern of abundance of *A. variegatum* in Ibadan follows a definite pattern. Immediately after the rains, the females engorge, drop off and start laying eggs. The eggs hatch into larvae still during the rains. The active period for the adult females and larvae is during the rainy season. It can, therefore, be inferred that the timing of the larval peak is dependent on the timing of the female activity peak and the duration of the pre-eclosion period. As the dry season approaches, the female adults die out after oviposition, but the males can still be found on cattle. The larvae moult into nymphs. By November and December, nymphs are

at their peak, and by February and March the nymphs have moulted into adults. The activity period of the nymphs is during the dry season.

In conclusion, it can be said that climatic factors definitely play an important role on the seasonal abundance of *A. variegatum*. It was observed that the adults and larvae were active on cattle only once a year during the rainy season, the adults preceding the larvae. The nymphs on the other hand were predominant during the dry season, but by March most of them have moulted into adults. Contrary to the views of many researchers in this field that humidity was the most important factor that influenced the seasonal incidence of this species, it was observed that humidity, though important, may not be the determining factor. The determining factor seemed to be rainfall. The first rainfall of the year was critical in determining the appearance of the first engorged females since it is only after this that the adult females will engorge. Although the seasonal incidence of *A. variegatum* is shown to be determined by the combined influence of rainfall, humidity, temperature and day length, it was only in the adult female stage that this effect was most obvious. It was curious that the males emerged before the females. The mechanism which regulates the early emergence of the males is unknown, but RECHAV & KNIGHT (1983) suggested that this could be caused by either a shorter feeding period for the nymphs that would moult into males, or a shorter moulting period for nymphs that produce males. Various ticks have been known to exhibit one or both of these mechanisms. In arthropods generally, pheromones play an important role in attracting the females for mating purposes after the males have attached to the host. This phenomenon has not yet been proved in the case of *Amblyomma variegatum*. In *R. glabroscutatum*, the feeding period of nymphs producing males was found to be shorter than for those of nymphs producing females (KNIGHT, NORVAL & RECHAV, 1978), unlike in *Rhipicephalus evertsi eversti* where the moulting period for the nymphs producing males was shorter than that for nymphs moulting to females (RECHAV, KNIGHT & NORVAL, 1977). The reason for this mechanism in *A. variegatum* is not clear.

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