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INTERSTADIAL COMPETITION FOR SITES OF ATTACHMENT TO HOSTS 
IN A ONE-HOST REPTILE TICK IN SENEGAL

BY G. H. HESSE*

TIQUES
LOCALISATIONS
PARASITAIRES
LARVAIRES
NYMPHAIRES
ADULTES
VARANS
SENÉGAL

RÉSUMÉ : Les deux espèces de varans au Sénégal (Varanus niloticus L., 1766, et Varanus exanthematicus Bosc, 1792) ont la même tique monotrope de reptile Aponomma flavomaculatum (Lucas, 1846) (Ixodoidea : Ixodidae). Sur les deux espèces d’hôtes, les tiques adultes femelles s’attachent principalement dans les régions protégées des jambes, surtout dans les « axillae », où la chance d’être dérangé est minimale et les conditions pour le repas sont optimales. La densité de femelles adultes est peu considérable et les mâles adultes ne prenant pas de nourriture doivent éventuellement attendre longtemps avant de trouver une femelle. Durant cette phase d’inactivité les mâles s’attachent sur l’hôte à des places où ils sont protégés tout en pouvant percevoir les signaux pheromonaux des femelles, par exemple dans les cavités nasales et autour de l’orifice du cloaque. Comparé au nombre de mâles inactifs, peu de mâles se trouvant en phase d’activité à la recherche d’une femelle ont été découvert. Les nymphes et les larves semblent choisir les endroits assurant des conditions optimales pour prendre le repas de sang ainsi qu’un abri sûr. Les nymphes ont surtout été trouvé sur les jambes et « axillae », tandis que les larves s’attachent de préférence sur les côtés latéraux protégés par les bords postérieurs des écailles. Il est proposé que la raison la plus vraisemblable pour le changement des lieux de fixation des différents stades de la tique est la compétition « interstadiale ». Ce mécanisme semble avoir été établi depuis longtemps durant l’évolution, car les différents stades s’attachent à leurs lieux préférés aussi en absence d’autres stades ou durant un taux d’infestation peu élevé.

SUMMARY : Two monitor lizard species in Senegal (Varanus niloticus Linné, 1766 and Varanus exanthematicus Bosc, 1792) have the same one-host reptile tick, Aponomma flavomaculatum (Lucas, 1846) (Ixodoidea : Ixodidae). In both host species adult female ticks attach mainly in covered areas of the legs, especially in the axillae, where there is minimal disturbance with optimal feeding conditions. Adult female density is very low and nonfeeding adult males may have to wait a long time before locating a mate. During this phase the males attach on the host in places where they are protected but can also receive female pheromone signals, eg. in nasal cavities and around the cloacal orifice. Compared with inactive males few adult males in the activity phase of mate searching were found. The immature stages appear to choose those sites which provide optimal feeding with minimal disturbance. The nymphs are found mainly on the legs and axillae while larvae attach preferentially on the lateral body sites and on the neck, where they are protected under the posterior edges of scales. It is proposed that the most likely reason for change of attachment site in the stages of the tick is interstadial competition. This mechanism seems to be long established in evolutionary terms, because the stages attach on the preferred sites when other stages are absent, or infestation rate is very low.

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1. Monotrope = à un seul hôte.

INTRODUCTION

Determination of the ecological niche of a parasite on its host is important for elucidation of the relationship between the two organisms and goes some way towards explaining why parasites of different taxa are restricted to particular sites on the host. Several explanations of differential distribution have been proposed: (I) site preference is a result of adaptation by the parasite before it colonises that host, (II) different preference for attachment sites is the result of niche segregation following interspecific competition, (III) aggregation of species in specific sites increases the possibility of finding mates in low density infestations (Andrews et al., 1982). Either one or a combination of these hypotheses can explain site differences between parasite taxa, can it also explain site differences for immature and mature stages of one parasite species feeding on the same host?

Inter-specific competition is regarded as one of the major factors determining the distribution of individual species (Jaeger, 1971; Meredith, 1977). Competition for attachment sites in a one-host tick cannot be a mechanism for such inter-specific competitive exclusion but does result in a preference for different attachment sites by various life-stages of a single species. Smyth (1973) was of the opinion however that exclusion in different tick species, or even within single species, on one host is unlikely, as the number of ticks in all life stages is lower than the equivalent attachment sites. Nevertheless if one species or stage is competitively superior to the other, a shift of sites for attachment will occur in the competitively inferior species or stage, especially in a one-host tick.

Aponomma flavomaculatum is one of two species of tick parasitizing monitor lizards (Varanidae) in Senegal. It has sympatric distribution with Aponomma arcum in but unlike it, prefers woodland to gallery forest inhabiting monitor lizards (Aeschlimann, 1967). In the present study only Ap. flavomaculatum were collected from woodland dwelling Varanus niloticus and V. exanthematicus. The general biology and distribution of this one-host reptile tick is described by several authors (Hoogstraal, 1956; Aeschlimann, 1967; Saratsiotis, 1972; Walker et al., 1978).

MATERIALS AND METHODS

Data records of the lizards include location of trapping, body size and sex of each Varanus spec.; data records of the ticks include life stages and attachment sites on the host. The preferred sites were divided into five major groups: neck, nasal cavities, body areas (incl. midback, lateral sides), cloaca and legs (incl. forelegs, hindlegs, axillae and claw-interspaces). Significance values (t-Test after Student) were performed to determine whether there were stage-specific preferences for attachment sites on the two host species. The monitor lizards were caught in Senegal in the following localities: Fété Olé, Richard Toll, Diatta-counda, Nianing, Bandia and near Dakar.

RESULTS

73% of the examined V. niloticus specimens and 80% of the V. exanthematicus specimens were parasitized with all life stages of Ap. flavomaculatum, no other tick species was found. Only those lizards ≥ 30 cm body length (excluding tail) were infested; at and above this size no correlation of infestation level and life stage of the host could be found. Table 1 gives the preferred sites of attachment of all life stages of the tick on both host species.

On both lizard species Ap. flavomaculatum females have preferred attachment sites on legs (axillae) and lateral body sides. Males attach mainly in the nasal cavities and around the cloacal orifice, a few males were found near female feeding places. Nymphs were located on legs and body areas, larvae on the neck and on lateral body parts.

Table 2 gives the attachment sites of Ap. flavomaculatum life stages on the two lizard host spe-
No statistically significant differences in the attachment sites of the ticks various life stages on the two host species were found.

### TABLE 1: The attachment sites on Varanus niloticus (n = 9) and Varanus exanthematicus (n = 7) of immature and mature stages of the tick Aponomma flavomaculatum in Senegal.

<table>
<thead>
<tr>
<th>Ticks attachment sites</th>
<th>No.</th>
<th>Females %</th>
<th>Males %</th>
<th>Nymphs %</th>
<th>Larvae %</th>
</tr>
</thead>
<tbody>
<tr>
<td>V. niloticus neck</td>
<td>1</td>
<td>6.3</td>
<td>2.1</td>
<td>8.5</td>
<td>51.5</td>
</tr>
<tr>
<td>V. exanthem. nasal</td>
<td>0</td>
<td>0.0</td>
<td>1.2</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>V. niloticus body</td>
<td>3</td>
<td>18.7</td>
<td>15.2</td>
<td>58.7</td>
<td>57.2</td>
</tr>
<tr>
<td>V. exanthem. areas</td>
<td>5</td>
<td>38.5</td>
<td>35.0</td>
<td>21.4</td>
<td>14.6</td>
</tr>
<tr>
<td>V. niloticus body</td>
<td>3</td>
<td>18.7</td>
<td>15.2</td>
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<td>5</td>
<td>38.5</td>
<td>35.0</td>
<td>21.4</td>
<td>14.6</td>
</tr>
<tr>
<td>V. niloticus head</td>
<td>11</td>
<td>68.7</td>
<td>9.3</td>
<td>78.0</td>
<td>42.9</td>
</tr>
<tr>
<td>V. exanthem. legs</td>
<td>8</td>
<td>46.1</td>
<td>18.2</td>
<td>22.7</td>
<td>17.0</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Studies on a number of tick species have shown that preference for particular attachment sites are common and differ between species (NELSON et al., 1975). It is also known that attachment sites for immature and mature stages of a one-host tick on the same host are different. The aggregation of males of Ap. flavomaculatum on scaleless parts (nasal cavities, cloacal orifice) and somewhat fewer in the neighbourhood of the feeding females can be explained on the basis of two male activity phases. In the first or inactive phase, they remain attached at a single site on the host, waiting for female mating signals (pheromones). They do not feed and attach at those sites with a scaleless surface where they can fasten and be protected from mechanical disturbance. Freedom from disturbance is very important because female density is very low and males may have to wait for extended periods before locating a mature female. Indeed, I studied one Varanus skull with 22 males still in the two nasal cavities! The second, or activity phase, of the males is mate searching following female signal reception. From Table 1 it is clear that near the attachment sites...
of females a few males are found. So we have, on one host, males inactive waiting for female signals and a few males active in mate searching. Similar results were found in Australian reptile ticks where the male attachment site is characterised as: a place where males (I) can quickly receive female sex-pheromone signals, and (II) are safe from disturbance in the quiescent phase thereby increasing the opportunity for finding mates in low density infestations (Andrews and Petney, 1981; Andrews et al., 1982).

The attachment preference for the females is related to efficient feeding with minimal disturbance, this means attaching in protected areas. For the reptile ticks mechanical influence through the moving host prevent attachment on the ventral body parts, on the outer sides of the legs and on the head. Protected areas are the aforementioned nasal cavities and cloaca (occupied by the males), neck, axillae and the caudo-lateral sides of the legs. The axillae are areas of high vascularisation with only small scales and thin skin and a majority of gorging female ticks were found in these regions, the lower number found on other protected body areas could be a result of feeding competition.

Investigations on Australian reptile ticks have shown that Aponomma hydrosauri and Amblyomma labrum males preferentially attach on the midback and in the tympanal aerea of their host, while females attach most in the axillae of the forelegs. In Amblyomma labrum males attach in the tympanal aerea, and females in the ears and on the neck. In all three cases each species was the only on the host. In sympatric populations they show interrelationships which are explainable on the basis that interspecific competition is for space for efficient reception of female signals (Andrews and Petney, 1981; Andrews et al., 1982). In the present study most of the nymphs of Ap. flavomaculatum were found near the female’s attachment sites, because they require similar conditions for optimal feeding. The larvae, competitively inferior to adults and nymphs, attach mainly on the neck and on lateral body sides, where they are protected under the larger scales. They are covered nearly 1/3 with the scale, so that movement of the host cannot dislodge larvae in these less protected body areas.

Even the lizards with a low density of ticks, or infested with only one stage, show the same attachment patterns as those parasitized with a great number of ticks in every stage. For example small lizards, only infested with larvae, had them mainly on neck and lateral body sides, which implies that interstadial competition can be presumed as a long-term adaptation of these tick species to that host species. The same mechanism has been proposed for the Australian reptile ticks when different species on one host in parapatric distribution have different preferences as a result of competition. Andrews and Petney (1981) predict that ticks of each species would attach to the same sites on a host irrespective of whether another tick species is attached or not.

On a reptile host with only few efficient attachment available, interstitial and interspecific competition is an adapted mechanism of long-established parasit-host relationship.

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References


