

THE RESTING AND HOUSE FREQUENTING BEHAVIOR OF *MANSONIA ANNULIFERA*, *MA. UNIFORMIS* AND *MA. INDIANA*, THE VECTORS OF MALAYAN FILARIASIS IN KERALA STATE, INDIA

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Abstract. *Mansonia annulifera*, was recorded to be an endophilic species, preferring to rest indoors, while *Ma. uniformis* was exophilic, having a predilection for outdoor resting habitats, eg bushes and shrubs. *Ma. indiana* did not show a clear preference to either of these biotopes. In indoor resting collections, the unfed proportion of *Ma. uniformis* was significantly higher during post-dusk compared to day hours ($p < 0.05$), indicating that this exophilic species enters houses during dusk hours for feeding. The full fed proportion was higher during day hours compared to dusk/night hours. The semigravid proportion showed a significant reduction during post-dusk hours ($p < 0.05$). These findings suggest that after having a blood-meal this species rest indoors and leave the houses for outdoor resting sites during the dusk hours on the subsequent night.

INTRODUCTION

Understanding of the resting and house frequenting behavior of vector mosquito is crucial in organizing an adulticidal control measure against them. The vectors of *Brugia malayi*, in the Shertallai region of Kerala, India are *Mansonia annulifera*, *Ma. uniformis* and *Ma. indiana*. *Ma. annulifera* has been reported to be an endophilic species (Iyengar, 1938), while *Ma. uniformis* is exophilic (Chow *et al.*, 1954; Antonipulle *et al.*, 1958; Pal *et al.*, 1960). However, a quantification of the endo-exophilic nature of these mosquitos has not been attempted so far in this region. Besides, the house frequenting behavior of *Mansonioides*, especially that of the exophilic *Ma. uniformis* still remains obscure. Therefore, a systematic field oriented study was designed to examine these aspects in Shertallai, an endemic area of lymphatic filariasis due to *B. malayi*. The topography and climate of the study area, Shertallai 'taluk' have been described elsewhere (Pradeep Kumar, 1990).

MATERIAL AND METHODS

Indoor (human dwellings) resting mosquitos were collected using aspirator tubes and torches in

eight fixed catching stations (Aroor, Kadakkapalli, Kurupankulangara, Areeparambu, Shertallai town, Pallipuram, Muhamma, Mararikulam), spread over the entire study area. Collections were made during morning hours (0800 to 0900), spending a total of six man hours at each station, at monthly intervals for a period of four years (1986-1990). In addition, the night resting population of *Mansonioides* was sampled in two villages (Mararikulam north, Muhamma) from 1800 to 2100 hours, spending two man hours each during 1800-1900 hours, 1900-2000 hours and 2000-2100 hours, for a period of one year (1987-1988). The aim was to understand whether there were any differences in the resting densities in day and night hours and thereby to delineate the house frequenting behavior of these mosquitos. The data on the resting densities and the abdominal status of different species of *Mansonioides* during different hours of night and day were subjected to statistical analysis.

Cattle shed resting populations were also sampled, following usual procedures for a period of one year (1987-1988). Outdoor resting populations of mosquitos were sampled, using sweep-nets and drop-net cages (Service, 1976) in two villages, Kurupankulangara and Muhamma, during the same

period. The proportions of individual species of *Mansonioides* obtained in indoor and outdoor resting sites were compared with each other, using the 'Z proportion test' to quantify their endo-exophilic nature.

In addition, four exit traps and two entry traps (Service, 1976) were set up in selected houses located in different villages of the 'taluk' and mosquitos captured from these traps daily for a period of one year (1989-1990), were identified and the abdominal condition of *Mansonioides* specimens recorded.

RESULTS AND DISCUSSION

Indoor resting collections (day hours) in human dwellings conducted during the study period in the 'taluk' yielded 4,872 *Mansonioides* specimens. Among them, *Ma. annulifera* constituted 85.9%, *Ma. uniformis*, 12.7% and *Ma. indiana*, 1.4%, their average densities (PMD) being 3.29, 0.25 and 0.01, respectively.

The average resting densities (PMD) estimated for day and night in fixed catching stations (human dwellings) in two localities, were 1.94 and 2.56 for *Ma. annulifera*, 0.44 and 1.12 for *Ma. uniformis* and 0.007 and 0.035 for *Ma. indiana*, respectively.

Day time cattle shed resting collections were unproductive, indicating that a very small proportion of cattle biting mosquitos rests inside cattle sheds during day time. By spending 144 man hours in one year, only 14 *Ma. annulifera* and 8 *Ma. uniformis* were obtained from cattle sheds during the day, the average per man hour density being 0.097 and 0.056, respectively.

Outdoor resting collections using sweep nets among bushes and shrubs, involving 132 man hours, yielded only 7 *Ma. annulifera* and 44 *Ma. uniformis*. However, by using drop net cages 9 *Ma. annulifera*, 160 *Ma. uniformis* and 2 *Ma. indiana* were collected, from a total area of 325 m², their average outdoor resting density (estimated per 10 m²) being 0.43, 5.85 and 0.06, respectively. Thus a total of 222 specimens of *Mansonioides* were collected resting outdoors, of which *Ma. uniformis* constituted 91.89%, *Ma. annulifera*, 7.21% and *Ma. indiana*, 0.90%.

Exit traps set up in different localities yielded 104 specimens of *Ma. annulifera* and 54 specimens

of *Ma. uniformis*.

The variations in the proportions of individual species of mosquitos in different types of resting collections could give an indication of the resting behavior of a species. Statistical analysis of the differences in the proportions of the three species of *Mansonioides* obtained in indoor and outdoor resting collections clearly illustrates the endophily of *Ma. annulifera*, the proportion indoor being significantly higher ($Z \text{ cal.} = 29.75; p < 0.05$) and the exophily of *Ma. uniformis*, the proportion outdoor of this species being significantly greater ($Z \text{ cal.} = 31.17; p < 0.05$). *Ma. indiana* was encountered in indoor and outdoor habitats almost equally ($Z \text{ cal.} = 0.32; p > 0.05$).

The analysis of abdominal conditions of indoor resting mosquitos could also provide an idea about the resting behavior of mosquitos. According to Rao (1981) the full fed:semigravid (FF:SG) ratio will be one or less than one for an indoor resting species and it should be more than one for an outdoor resting species. In the present study, the FF:SG ratio was more than one for all the three species of *Mansonioides*, ie 2.1:1 for *Ma. annulifera*, 3.6:1 for *Ma. uniformis* and 4:1 for *Ma. indiana*, indicating a certain degree of exophily for all three species.

Thus it would seem that analysis of the FF:SG ratio of indoor resting specimens alone would not give a clear indication of the resting behavior of *Mansonioides*. The reason for this observation is clearly illustrated in the present study.

The indoor (human dwellings) resting densities of *Mansonioides* was lower during day time compared to night hours. The resting densities of *Ma. annulifera* recorded at different hours of night (1800 to 2100 hours) showed no significant differences compared to those estimated in daytime. However, for *Ma. uniformis* there was a significant increase in the densities during 2000-2100 hours ($T = 2.18; p = 0.04$) compared to day time collections.

The analysis of abdominal status revealed a higher proportion of unfed mosquitos during night hours for both *Ma. annulifera* and *Ma. uniformis* (Fig 1), suggesting an influx of unfed specimens during dusk hours. This influx was significantly higher for *Ma. uniformis* ($Z = 2.99, p < 0.05$) unlike that of *Ma. annulifera* ($Z = 0.94$;

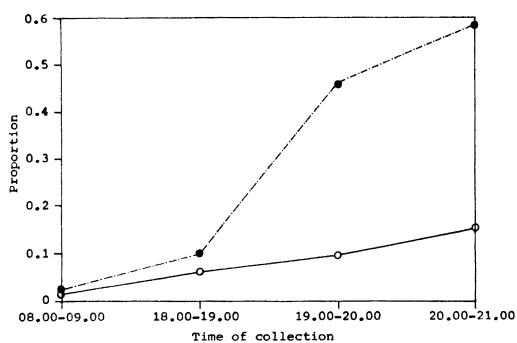


Fig 1—Proportion of unfed *Ma. annulifera* (○) and *Ma. uniformis* (●) through different hours.

$p > 0.05$). From these observations it could be inferred that unfed *Ma. uniformis* enters houses for feeding, after a temporary shelter outdoors following oviposition/emergence. The higher proportion of full fed (*Ma. annulifera* - 0.59 and *Ma. uniformis* - 0.81) during day hours indicates that a major proportion of fed mosquitos rest in the nearest available site just after feeding. The full fed proportions encountered for *Ma. annulifera* and *Ma. uniformis* during dusk hours were only 0.21 and 0.15, respectively (Fig 2). This reduction may be attributed to the transformation of full fed to semigravid by that time. However, this difference for *Ma. uniformis* exceeded that of *Ma. annulifera* suggesting a certain degree of exodus of the former species in dusk hours. The semigravid proportion of *Ma. annulifera* and *Ma. uniformis* increased respectively from 0.37 and 0.17 in day hours to 0.64 and 0.75 during 1800-1900 hours (Fig 3).

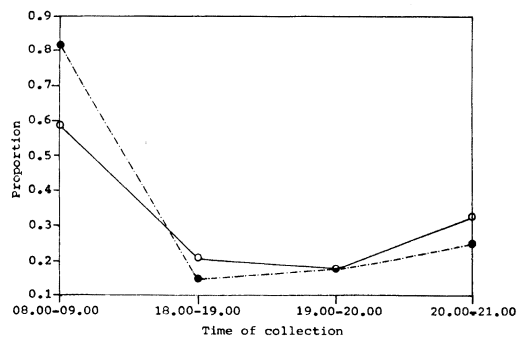


Fig 2—Proportion of full fed *Ma. annulifera* (○) and *Ma. uniformis* (●) through different hours.

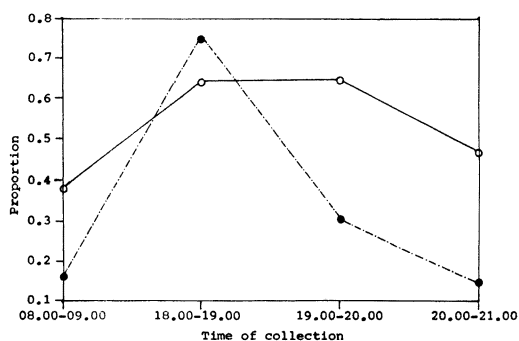


Fig 3—Proportion of semigravid *Ma. annulifera* (○) and *Ma. uniformis* (●) through different hours.

This increased semigravid proportion was maintained for *Ma. annulifera* in the subsequent hours. However, the proportion of semigravid reduced drastically in the case of *Ma. uniformis* (Z cal. for 1900-2000 hours = 3.18; $p < 0.05$ and Z cal. for 2000-2100 hours = 5.45; $p < 0.05$), indicating exodus of this species during this period. Thus it could be concluded that *Ma. uniformis* leaves the houses in pre-dusk/dusk hours on the subsequent night of feeding in search of resting sites outdoors. In spite of this exodus, its indoor resting density increased during dusk hours owing to the influx of unfed ones which enter houses for feeding.

Further, the analysis of abdominal condition of *Mansonioides* collected in exit traps showed that among *Ma. annulifera*, 70.2% constituted semigravid/gravid mosquitos which leave the house for oviposition. The gravid proportion of this species was significantly higher (24.04%) than that of *Ma. uniformis* ($X^2 = 4.13$; $p = 0.04$) suggesting a greater endophily of *Ma. annulifera*. 61.11% of *Ma. uniformis* captured in exit traps constituted the unfed/full fed group of mosquitos which leave the house for resting outdoors. Interestingly, the abdominal condition '3' (Sella, 1920) was higher (35.19%) than '2' (16.67%) suggesting that this species rest one day after feeding and leave the house on the subsequent night.

The present study reveals the endophily of *Ma. annulifera* and the exophily of *Ma. uniformis*. *Ma. indiana*, the less prevalent vector species was encountered almost equally both indoors and outdoors. The exophilic *Ma. uniformis* enters indoor habitats only during dusk hours for blood feed-

ing. After feeding it rests on the nearest site available, mostly indoors. Before the subsequent night, it leaves the houses for outdoor resting sites. This exodus occurs mainly during nightfall, ie about 24 hours after blood feeding, its peak biting activity being at dusk hours (Pradeep Kumar *et al*, 1989).

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