

**DIEL OVIPOSITION CYCLE OF Aedes albopictus
(DIPTERA:CULICIDAE) AT PERADENIYA, SRI LANKA.**

S.H.P.P. Karunaratne and F.P. Amerasinghe

Department of Zoology, University of Peradeniya, Sri Lanka.

ABSTRACT

The diel oviposition cycle in Aedes albopictus (Skuse) was investigated under natural conditions at a site at Peradeniya, Sri Lanka. The pattern of egg laying demonstrated was essentially unimodal, most of the activity occurring between 1300-1900 hrs. with a sharp peak during the hour before sunset (1700-1800 hrs). Oviposition also occurred immediately after sunrise but the level of activity is considered too low to indicate evidence of bimodality in the cycle.

INTRODUCTION

The mosquito Aedes (Stegomyia) albopictus (Skuse) is a vector of dengue virus and a potential vector of other viral diseases as well as sub-periodic filariasis in the Oriental and Southeast Asian regions. Successfully adapted to both sylvan and peridomestic habitats in its geographic range, it is a diurnally active, man-biting species that

breeds mainly in natural and artificial containers (see reviews by Huang, 1972, 1979). Studies on the breeding biology of this species around the Central Province city of Kandy, Sri Lanka, have shown it to occur abundantly in natural bamboo stumps, kitul-palm stumps and tree holes in wooded terrain (Amerasinghe, 1982), and to show significant oviposition preferences in relation to container type and height above ground (Amerasinghe and Alagoda, 1984). Observations on the diel oviposition cycle of this species under natural conditions in a shaded garden habitat are presented in this paper.

MATERIALS AND METHODS

The study was conducted at a shaded site within the garden around the Departments of Botany and Zoology at the University of Peradeniya, situated 8 km. west of the city of Kandy, where a previous investigation showed Ae. albopictus and several other container breeding mosquitoes to oviposit freely in bamboo traps (Amerasinghe and Alagoda, 1984).

Freshly cut internodes of the Giant Bamboo (Dendrocalamus giganteus Munro) approximately 7-10 cm. in diameter and 60 cm. in height, were used as ovitraps. These were seasoned by immersion in water for two weeks prior to use (Harris, 1942). Aedes albopictus and many other container breeding species normally deposit their eggs on the sides of the container just above the water line. Thus the upper inner surface of each trap was lined by a rectangular strip of absorbent paper to serve as a suitable removable oviposition surface (Corbet, 1963). The traps were filled with strained pond water to within 5-8 cm. of the top, taking care to ensure that the bottom margin of the absorbent strip was 2-3 cm. below the water level. All the traps were placed at ground level, the preferred oviposition level of Ae. albopictus (Amerasinghe and Alagoda, 1984), and were covered by polythene tops secured with rubber bands except during periods of trap exposure.

Mosquito oviposition in these traps during 25 diel cycles was observed during August-October 1982. Each 24-hr. cycle was divided into 14 periods of which 13 were of 1 hr. duration each (0600-1900 hrs.), with a single overnight period of 11 hrs. duration (1900-0600 hrs.). The time scale was adjusted so that 1800 hrs. always correlated with the

time of official sunset of that particular day (Lumsden, 1952). Two bamboo traps were exposed during each time period; there were thus 28 trap exposures during each of the 25 diel cycles, i.e. a total of 700 trap-exposures.

The absorbent lining of each trap was removed at the end of its exposure period and examined for the presence of mosquito eggs under the microscope. Eggs of different types were identified and counted. Egg samples of each type were allowed to hatch and the identifications confirmed from the resulting immature and adult stages.

During the study period, daily atmospheric temperature varied from 28.82 ± 1.45 (maximum) to $19.64 \pm 0.96^\circ\text{C}$ (minimum), while relative humidity ranged from 60-95%. Light rain was recorded for short periods (totalling 23.5 hrs.) mainly during the morning and mid-day periods in 12 of the 25 diel cycles.

RESULTS

Four species of container breeding mosquitoes oviposited on the absorbent linings of the traps (Table 1). The dominant species by far was Aedes albopictus which accounted for nearly 77% of occurrences and 83% of eggs laid in the traps. Two other species Ae. novalbopictus Barraud and Armigeres subalbatus (Coq.) which oviposited frequently in bamboo traps at this site during a previous study (Amerasinghe and Alagoda, (1984) did not occur in substantial numbers during the period of the present investigation (Table 1).

Figure 1 shows the pattern of oviposition activity of Ae. albopictus during the 25 diel cycles investigated, a geometric mean (William's Mean) being used to compute mean oviposition during each exposure period. The major portion of the oviposition activity (87.35%) was recorded between 1300-1900 hrs., with a sharp peak (52.61%) between 1700-1800 hrs., i.e. during the hour immediately preceding sunset. Some activity was also evident immediately following sunrise, but appeared to be too low for the cycle to be considered to be truly bimodal. Egg laying did not occur during the mid-day period and was minimal during the night, with only a single positive trap occurrence with 26 eggs being recorded during the 11 hr. overnight trap

exposure period. Thus the egg laying cycle of Ae. albopictus appears to be basically unimodal, with a distinct late evening peak, in the shaded garden habitat conditions under which the study was performed.

DISCUSSION

Investigations of mosquito oviposition activity under both laboratory and field conditions have shown the presence of unimodal or bimodal cycles in relation to the diel. Unimodal cycles with a late afternoon or evening peak similar to that shown by Ae. albopictus have been demonstrated in species such as Ae. aegypti (L.) (Haddow and Gillett, 1957), Ae. africanus (Theo.), Ae. apicoargenteus (Theo.), Ae. simpsoni (Theo.) and probably Toxorhynchites conradti Grunberg (Corbet, 1963), while bimodal cycles with peak activity around sunset and sunrise occur in Culex nebulosus Theo. (Corbet, 1963), Cx. pipiens fatigans (= quinquefasciatus Say) (De Meillon et al, 1967), Cx. pipiens L. (s.s.) and Cx. restuans Theo. (Macdonald et al, 1981). The low level of oviposition activity shown by Ae. albopictus shortly after sunrise is of interest: this is probably a carry-over of the previous evening's egg-laying activity and not a manifestation of bimodality. Gillett (1962) studying the contributions of individual Ae. aegypti females to the oviposition cycle, found that the first eggs of an individual batch were almost always laid in the evening. On the basis of Gillett's data, Corbet (1963) suggested that the morning oviposition was an extension of the previous evening's activity by females that had not released their full stock of eggs, possibly due to disturbance or unfavourable environmental conditions. A similar phenomenon probably occurs in the closely related Ae. albopictus.

Environmental factors such as rainfall, temperature, humidity and light can significantly alter basic diel rhythms in nature. In sylvan Ae. apicoargenteus the oviposition cycle was unimodal (1400-1800 hrs.) during the rainy season and bimodal (1800-1900 and 0700-0800 hrs.) during the dry season (Corbet, 1963), while in Cx. quinquefasciatus rainfall was shown to significantly alter the basic oviposition pattern (De Meillon et al, 1967). In Ae. africanus, oviposition activity peaked at 1600-1700 hrs. under forest cover, and at 1800-1900 hrs. in open grassland. In the present study, ovitraps placed in an open grassy area failed to attract ovipositing females of Ae.

OVIPOSITION CYCLE OF AEDES ALBOPICTUS

albopictus and thus the effect of gross habitat differences on the egg-laying cycle of this species could not be studied.

Oviposition rhythms appear to be governed more by exogeneous elements than by endogenous (circadian) elements. Under controlled conditions with constant light, egg laying in Ae. aegypti becomes aperiodic (Haddow and Gillett, 1957). Changes in illumination (light-dark or dark-light) rather than endogenous factors appear to act as the major cue for oviposition in this species (Corbet et al, 1960). In Anopheles gambiae Giles (s.l.) the essentially nocturnal oviposition pattern has been found to be dependent on the time of blood-feeding, subsequent environmental temperature (which influences blood meal digestion and ovarian development) and distance from daytime resting sites, and not on endogenous activity rhythms of a circadian nature (McCrae, 1983). It is not known to what extent exogenous and endogenous elements influence oviposition in Ae. albopictus.

ACKNOWLEDGEMENT

We wish to thank Mr. T.S.B. Alagoda for field and technical assistance.

REFERENCES

- Amerasinghe, F.P. (1982). Observations on the mosquitoes (Diptera: Culicidae) of Udawattakele Forest, Sri Lanka. J. Natn. Sci. Coun. Sri Lanka, 10 (1): 81-98.
- Amerasinghe, F.P. and Alagoda, T.S.B. (1984). Mosquito oviposition in bamboo traps, with special reference to Aedes albopictus, Aedes novalbopictus and Armigeres subalbatus. Insect Sci. Appl., 5(6): 493-500.
- Corbet, P.S. (1963). The oviposition cycles of certain sylvan culicine mosquitoes (Diptera: Culicidae) in Uganda. Ann. Trop. Med. Parasitol., 57: 371-381.
- Corbet, P.S., Haddow, A.J. and Gillett, J.D. (1960). Observations on the oviposition cycle of Aedes

- (Stegomyia) aegypti VI. Ann.Trop.Med.Parasitol., 54: 156-164.
- De Meillon, B., Sebastian, A. and Khan, Z.H. (1967). Time of arrival of gravid Culex pipiens fatigans at an oviposition site, the oviposition cycle and the relationships between time of feeding and time of oviposition. Bull.Wld.Hlth.Org., 36: 39-46.
- Gillett, J.D. (1962). Contributions to the oviposition cycle by the individual mosquitoes in a population. J. Insect Physiol., 8: 665-681.
- Haddow, A.J. and Gillett, J.D. (1957). Observations on the oviposition cycle of Aedes (Stegomyia) aegypti (Linnaeus). Ann.Trop.Med.Parasitol., 51: 159-169.
- Harris, W.V. (1942). Notes on culicine mosquitoes in Tanganyika territory. Bull.ent.Res., 33: 181-193.
- Huang, Y-M. (1972). Contributions to the mosquito fauna of southeast Asia. XIV. The subgenus Stegomyia of Aedes in southeast Asia. I - The Scutellaris group of species. Contr.Am.Entomol.Soc., 9(1): 1-109.
- Huang, Y-M. (1979). Medical entomology studies - XI. The subgenus Stegomyia of Aedes in the Oriental region with keys to the species (Diptera: Culicidae). Contr. Am.Entomol.Soc., 15(6): 1-79.
- Lumsden, W.H.R. (1952). The crepuscular biting activity of insects in the forest canopy in Bwamba, Uganda. A study in relation to the sylvan epidemiology of yellow fever. Bull.ent.Res., 42: 721-760.
- Macdonald, R.S., Madder, D.J. and Surgeoner, G.A. (1981). Diel periodicity of oviposition by Culex pipiens and Culex restuans in southern Ontario. Proc.Ent. Soc. Ontario, 112: 39-40.
- McCrae, A.W.R. (1983). Oviposition by African malaria vector mosquitoes. I. Temporal activity patterns of caged, wild caught, freshwater Anopheles gambiae Giles sensu lato. Ann.Trop.Med.Parasitol., 77: 615-625.

OVIPOSITION CYCLE OF AEDES ALBOPICTUS

TABLE 1

MOSQUITOES OVIPOSITING IN BAMBOO TRAPS
 (25 Diel Cycles, 28 Trap-Exposures/Cycle)

Species	Positive Cycles	Positive Traps	Total Eggs
<u>Aedes (Stegomyia)</u> <u>albopictus</u> (Skuse)	22	50	1964
<u>Aedes (Stegomyia)</u> <u>novalbopictus</u> Barraud	02	02	29
<u>Armigeres (Armigeres)</u> <u>subalbatus</u> (Coquillett)	07	08	352
<u>Tripteroides (Rachionotomyia)</u> <u>affinis</u> (Edwards)	04	05	22

LEGEND FOR FIGURE

FIGURE 1: Histogram showing the diel oviposition cycle of Aedes albopictus. The x-axis shows clock time (hours), and the y-axis shows the William's mean number of eggs per trap exposure period, expressed as a percentage (Mw%).

FIGURE 1

