TEMPERATURE AND RAINFALL EFFECTS ON OVIPOSITION DENSITY OF *ARMIGERES SUBALBATUS* IN GELIOYA, SRI LANKA

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Climate change is expected to have a considerable impact on mosquito population dynamics. This underscores the necessity of gaining better understanding of the biology and behaviour of *Armigeres* **subalbatus** mosquitoes, which are vectors for several ***diseases including*** **Brugia pahangi**. The purpose of this study was to link meteorological factors and *Ar. subalbatus* oviposition density to examine the potential effects of temperature and rainfall.

In this study, we conducted hourly ovitrap surveillance in Kandy, Sri Lanka for seven diel cycles to investigate the oviposition activity of *Ar. subalbatus,* which is the most prevalent vector species in this area. Ovitrap collections were made hourly for seven 24-hour cycles, with eggs counted on absorbent paper. Pearson Correlation test at a 0.05 significance level was used to explore the relationships between temperature and rainfall and oviposition density.

Our results confirmed the biphasic crepuscular behaviour of *Ar. subalbatus* with a small peak of oviposition activity at dawn and a larger peak at dusk. Hourly maximum temperatures showed a negligible correlation to egg population (r=0.054, *P*= 0.802) while a marginally positive trend was observed between rainfall and egg population (r=0.221, *P*= 0.3), suggesting that rainfall may play a role in the population dynamics of *Ar. subalbatus.* Rainfall provides breeding sites, hatching of eggs following oviposition while temperature affects mosquito activity and development.

The results highlight the importance of rainfall as a factor that can have a potential impact on mosquito population dynamics and subsequent spread of mosquito-borne diseases.

Keywords: Temperature, rainfall, oviposition, *Armigeres*

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INTRODUCTION

The emergence of many infectious vector-borne diseases such as Dengue, Malaria, Chikungunya and Japanese Encephalitis is directly influenced by changing environmental conditions (Ogden & Gachon, 2019). The biology, bionomics and life history of mosquitoes which influence disease outbreaks are affected by climate change. While temperature is considered to have a strong impact on the development and survival of the eggs to the larval stage and subsequently to the adult stage, rainy seasons are associated with higher mosquito populations and increased incidence of mosquito-borne diseases due to the increased number of breeding grounds (Shaman & Day, 2007). In this paper, the influence of temperature and rainfall regimes is studied.

Armigeres subalbatus (Coquillet) mosquitoes which are zoophilic or anthropophilic and are found close to human dwellings in small collections of water, particularly, those containing foul water or water with high organic content (Muslim et al., 2013; Rajavei, 1992). They lay desiccation-resistant eggs on moist surfaces near standing water (Day, 2016). The biting cycle of *Armigeres subalbatus* is crepuscular, exhibiting two peaks of activity, a smaller one at dawn and a larger one at dusk (Pandian & Chandrashekaran, 1980).

The aim of this study was to assess the effect of climatic factors on the oviposition cycle of *Ar. subalbatus*. The objectives were to (1) observe whether the mosquitoes exhibited a diel oviposition cycle confirming the predominantly crepuscular behaviour of *Ar. subalbatus*, (2) analyse the relationship between mosquito oviposition and temperature and (3) study the effect of rainfall on oviposition strength of *Ar. subalbatus*.

METHODOLOGY

Study site

The study was conducted from September 19- 25, 2021 for 7 days. It was carried out on the premises of a home garden habitat in Gelioya 7°12'31.6"N 80°34'41.1"E**,** southwest of the city of Kandy, Sri Lanka. The sample population was the mosquitoes that exist in the study locations, of which *Armigeres subalbatus* made up a majority of the mosquito fauna.

Ovitrap collections

The ovitrap corresponded to a 6L capacity plastic bucket half-filled with the stimulus solution and lined with an oviposition substrate (60 cm × 20 cm piece of absorbent paper), as described by Weerasekara & Amerasinghe (1995). The composition of the solution used was 90g of commercial cattle feed to 3L of water. The mixture was allowed to ferment for 4 days to disperse the foul smell to attract the *Armigeres* mosquitoes. Gravid females deposit eggs preferentially on the wet walls of container habitats just above the waterline (Weerasekara & Amerasinghe, 1995). Four ovitraps with fermented mixture were deployed over the duration of the study period. The ovitraps were placed at ground level in a shady area.

The collections were made for each hour for 24-hour cycles. Seven 24-hour cycles were carried out. At the end of each hour, an absorbent paper was replaced with a fresh one. Each of the removed absorbent papers were dried and the number of eggs laid was counted using a hand lens. Identification of the mosquito was using the hand lens to observe *Ar. subalbatus* eggs as described by Kirti & Kaur (2014). Samples of eggs removed before drying were allowed to hatch and reared to adult stage for species confirmation using taxonomic keys described by Amerasinghe (1995).

Meteorological data

Climate datasets for the temperature for each hour were obtained from the Sri Lankan Meteorological Department. The rainfall was measured using a rain gauge and recorded hourly.

Statistical analysis

For the statistical analysis, several parameters were considered: the mean percentage number of eggs for each hour during the study period, mean temperature and mean rainfall for each hour during the study period.

To evaluate the relationship between the eggs collected and the factors investigated (mean temperature and mean rainfall), the correlation among experimental variables was evaluated using Pearson's correlation coefficient analysis with SPSS version 20. The threshold for statistical significance was set at $P<0.05$.

RESULTS AND DISCUSSION

A total of 9060 eggs were collected from 7 days of sampling from all four ovitraps. Adults and larva were reared only for species identification. Eggs of other mosquito species were not found in the ovitrap. Figure 1 describes the mean percentage number of eggs collected for the study area for 7 days of ovitrap surveillance. The highest number of eggs that was recorded in the two hours coincide with the time of local sunset (1700-1900 hours) and a secondary peak spanning sunrise (0600-0700 hours). All the catches showed definite bimodality. Negligible numbers of eggs or no eggs were laid during 2300-0100 hours of observations for all the days. This confirms the crepuscular activity pattern of *Ar. subalbatus.* The oviposition activity pattern of *Ar. subalbatus* is similar to its biting profile, which too is characterized by crepuscular activity (Pandian & Chandrashekaran, 1980). Therefore, both rhythmic behavioural patterns occur during the same time. The rate of change of light intensity appears to be the trigger for the onset of biting in *Ar. subalbatus* and other crepuscular species (Rajavel et al., 1992), which likely triggers oviposition as well.

Table 1: *Oviposition by Armigeres mosquitoes in response to temperature and rainfall Regimens during 7 days of sampling*

Time	Mean number of eggs± SE	Mean temperature per hour (°C)	Mean rainfall per hour(mm)
1-2	0.25 ± 0.25	22	0.00
2-3	0.09 ± 0.09	23	0.00
3-4	0.17 ± 0.17	23	0.00
4-5	0.71 ± 0.48	23	0.00
5-6	1.53 ± 0.95	23	0.19
6-7	9.22 ± 1.50	24	0.00
7-8	4.32 ± 0.92	25	0.07
8-9	3.21 ± 0.68	26	0.07
9-10	1.69 ± 0.50	27	0.07
10-11	1.44 ± 0.46	28	0.03
11-12	2.54 ± 1.92	28	0.04
12-13	1.47 ± 1.04	29	0.00
13-14	0.64 ± 0.41	29	0.06
14-15	1.09 ± 0.55	28	0.00
15-16	2.09 ± 0.64	28	0.13

16-17	3.19	±	1.46	27	0.06
17-18	11.97	±	4.58	26	0.00
18-19	22.62	±	6.69	26	0.16
19-20	19.27	±	5.17	25	0.03
20-21	8.83	±	3.53	24	0.00
21-22	2.61	±	2.07	24	0.13
22-23	1.05	±	0.94	24	0.00
23-24	0.00	±	0.00	23	0.00
24-1	0.00	±	0.00	23	0.00

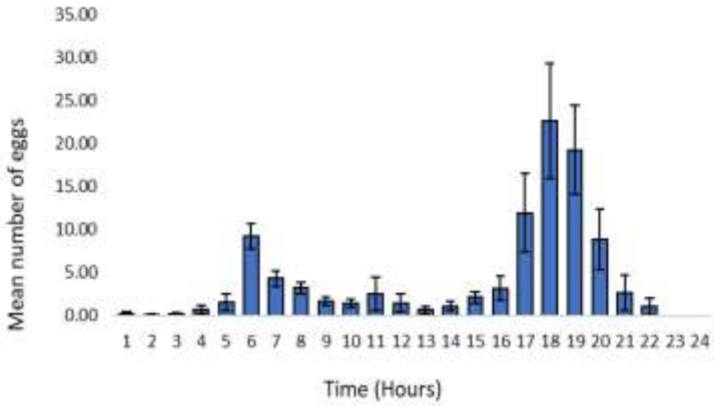

***Figure 1:** Mean number of the total eggs collected in study areas from 7 days of sampling*

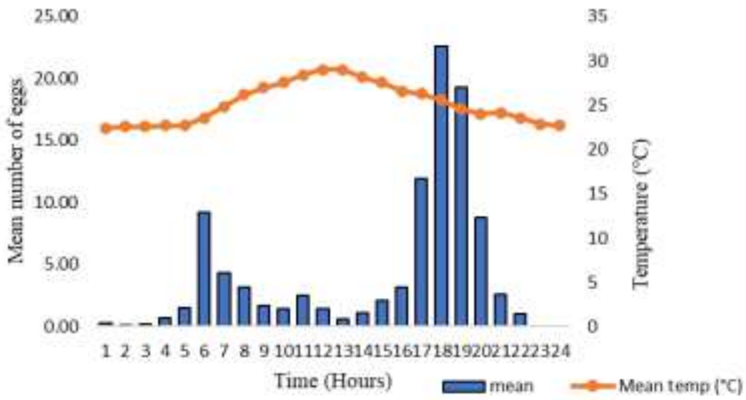

***Figure 2:** Relationship between mean number of eggs collected in the ovitrap and mean temperature of the hour*

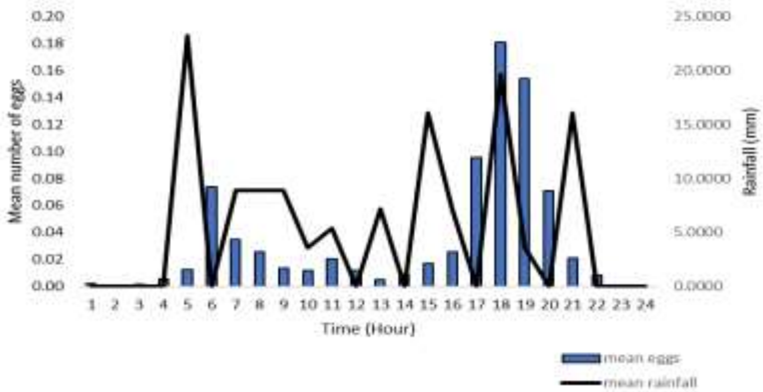

Figure 3: *Relationship between mean number of eggs collected in the ovitrap and mean rainfall of the hour*

The mean number of eggs collected has also been correlated with the amount of rain in the study area and temperature using the Pearson Correlation test at a 0.05 significance level (Figures 2 and 3). The correlation between the mean number of eggs and temperature was not found to be statistically significant (r=0.054, *P*= 0.802). For the correlation between the mean number of eggs and rainfall, a low positive correlation of (r=0.221, *P*= 0.3) was observed. Rainfall provides breeding sites, hatching of eggs following oviposition (Igbinosa, 1989) while temperature affects mosquito activity and development (Abiodun et al., 2016).

CONCLUSIONS/RECOMMENDATIONS

The findings of this study suggest that principal climate variables temperature and rainfall influence the oviposition strength of *Ar. subalbatus*. By studying the seasonal fluctuations of this mosquito species, control measures can be implemented to control vector populations. This knowledge can have importance for our understanding of mosquito immunity and pathogen transmission, and for how different life-history stages of *Ar. subalbatus* and other vectors of diseases may respond to changing climates.

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