STUDIES ON BITING DENSITY AND BITING CYCLE OF *CULEX QUINQUEFASCIATUS*, SAY IN KHON KAEN CITY, THAILAND

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Abstract. Biting density and biting cycle of *Culex quinquefasciatus* in Khon Kaen City were examined during November 1994 to October 1995. Biting activity of the mosquito was assessed by using the indoor human bait method. Trapped mosquitos were identified and carefully dissected to determine their parities. Climatory data *ie* temperature, relative humidity and rainfall were also recorded during the study. The densities of mosquito ranged from 1.6/man/hour in December to 9.2/man/hours in March with the average of 5.0/man/hours. The lowest biting density was obseved in winter and higher densities were in summer and rainy seasons. The temperature was the most important variable that influenced the biting density in each month of the year ($p<0.05$). The biting cycle showed that the mosquito active throughout the night, with peak activity at 22.00-23.00 hours. Parous rate of the mosquito ranged from 33.3% in Febuary to 71.9% in November with the average of 47.3%. The biting proportion of parous mosquitos was high during the early hours of the night and gradually decreased until 06.00 hours, whereas that of the nulliparous mosquitos showed an increasing trend from 18.00 to 06.00 hours. The biting cycle of the parous mosquito reached the peak activity at 21.00-22.00 hours, 1 hour ahead of the peak for nulliparous mosquito. These findings suggested that *Cx. quinquefasciatus* in Khon Kaen City may be able to transmit bancroftian filariasis if they were exposed to microfilaria carrier individuals.

INTRODUCTION

Culex quinquefasciatus is the important vector of urban form of nocturnally periodic *Wuchereria bancrofti* in Sri Lanka (Samarawickrema, 1967), Burma (DeMeillon and Sebastian, 1967), India (Rozeboom *et al,* 1968). In Thailand, the division of Epidemiology (1995) reported that 0.12-3.28% of the people of Tak Province who live along the border of Thailand and Myanmar were infected with *W.bancrofti.* The preliminary experiment demonstrated the *Cx. quinquefasciatus* in those areas can transmit *W.bancrofti* (Division of Epidemiology, 1995). An understanding on the biting density, behavior and cycles of the mosquito is very important as biting cycle of *Cx. quinquefasciatus* coincides with the periodicity of microfilaria intensity (DeMeillon and Sebastian, 1967). There have been report on biting density, biting cycle and behavior of *Cx. quinquefasciatus* in different parts of the world (Sasa *et al,* 1965; DeMeillon and Sebastian, 1967; Samarawickrema, 1967; Rozeboom *et al,* 1968; Rajagopalan *et al,* 1977; Sucharit *et al,* 1981; Gowda and Vijayan, 1993). The present study was undertaken for the first time on biting density and biting cycle of *Cx.quinquefasciatus* in Khon Kaen City. Although at present the city has no problem of filariasis, with the increasing urbanization, tourism and imported labor from various endemic areas, there is a possibility that filariasis may be transmitted here in the presence of existing mosquito vectors.

MATERIALS AND METHODS

Study site

Khon Kaen Province is one of 19 provinces in the northeast region of Thailand. It is divided into 20 districts. Khon Kaen City is a municipal area (urban area) of the Muang district. It spreads over 40 km^2. with the population of 147,349 (1996 Census). Sam Liem, a densely populated residential area of the city, was chosen as the study area for this study.

Methods

The study was undertaken during November 1994 to October 1995. Indoor biting rate at night were assessed twice a month. One catcher sat inside a house exposing his arms and legs as baits and caught all mosquitos attempting to bite by means of an aspirator. Hourly catches were kept in

separate tubes and brought to the laboratory, identified and dissected for parity using the established procedure (Detinova, 1962; WHO, 1975). This method is based on the presence of ovariole "skeins" following oviposition. Mosquitos which have ovariole skeins were designated as nulliparous and without skeins were designated as parous. The number of *Cx. quinquefasciatus* collected and parities status were recorded. Other climatory data *ie* temperature, relative humidity and rainfall were also simultaneously recorded during the study.

RESULTS

A total of 1,429 female *Cx. quinquefasciatus* were collected indoor in 24 nights. The biting density (number of biting female per man per hour) ranged from 1.6/man/hour in December to 9.2/man/hour in March (Fig 1). The average biting density throughout the year was 5.0/man/hour. The biting density in winter (November-February) was lower than the overall average of biting density (5.0/man/hour) while in summer and rainy season (March-October) the biting densities were higher. Statistical significant associations were found ($p < 0.05$) between biting density and temperature while relative humidity and rainfall were not significantly associated ($p > 0.05$) with biting density (Fig 2).

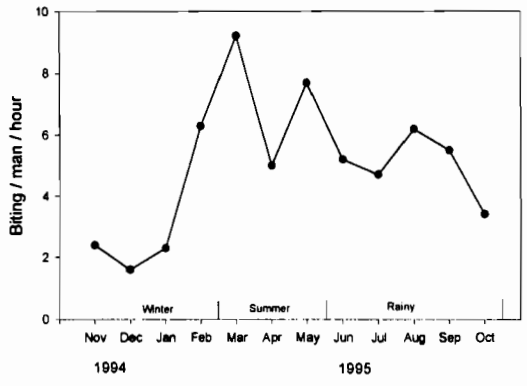

Fig 1–Monthly variation in biting density of *Cx. quinquefasciatus* in Khon Kaen.

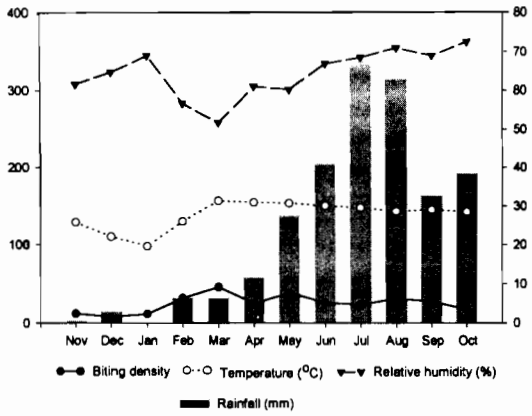

Fig 2–The relationship between biting density of *Cx. quinquefasciatus* and environmental conditions.

Biting cycle of total *Cx. quinquefasciatus* sample is shown in Fig 3. The biting activity commenced after the sunset (18.00 hours) and there was a steady increase in activity from 18.00 hours, reaching the peak at 22.00-23.00 hours. The peak lasted for 1 hour after which it gradually declined until 06.00 hours. About 58.1% of the total mosquito population have biting activity between 18.00-24.00 hours.

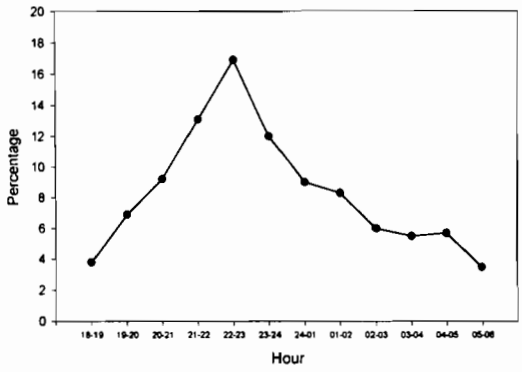

Fig 3–Biting cycle of *Cx. quinquefasciatus*.

Out of 1,429 females of *Cx.quinquefasciatus* 1,386 (96.9%) were dissected to determine their parities. There were 655 (47.3%) parous and 731

(52.7%) nulliparous mosquitos. The parous rates obtained in each month and during each hour were shown in Figs 4 and 5 respectively. The parous rates ranged from 33.3% in February to 71.9% in November. The number of biting by parous mosquito was high during the early hours of the night and gradually decreased until 06.00 hours, where as that of the nulliparous mosquito was low during the early hours of the night and gradually increased until 06.00 hours.

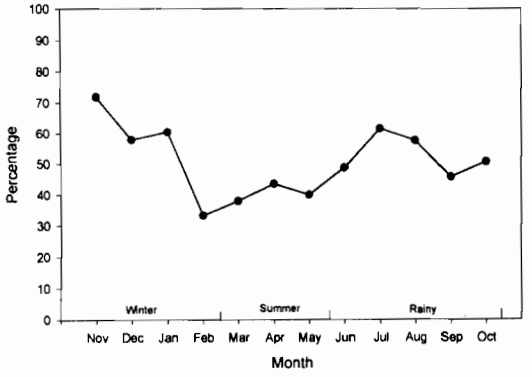

Fig 4–Monthly variation of parous rate of *Cx. quinquefasciatus.*

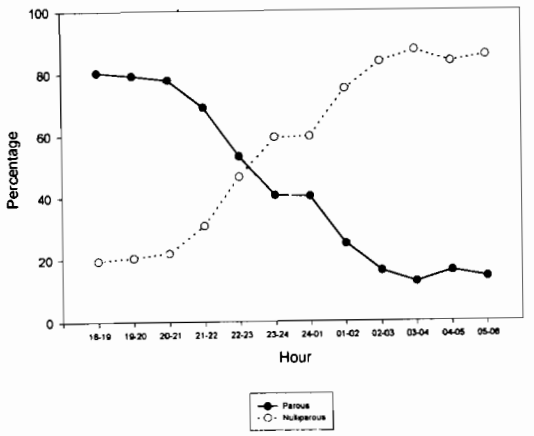

Fig 5–Proportion of parous and nulliparous *Cx. quinquefasciatus* biting at night.

The biting cycles of parous and nulliparous mosquitos are shown in Fig 6. Each group of mosquitos had a single peak biting profile, the peak lasted 1 hour after which there was a steady decline in activity of nulliparous mosquito and gradually decline in activity of parous mosquito. The nulliparous group reached the peak at 22.00-23.00 hours. The peak for parous group was observed at 21.00-22.00 hours. About 81% of parous mosquitos were found before midnight while 56.5% of nulliparous were found after midnight.

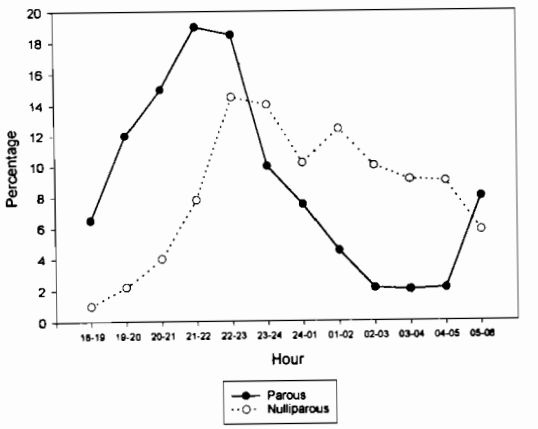

Fig 6–The biting cycles of parous and nulliparous *Cx. quinquefasciatus.*

DISCUSSION

The biting density of *Cx.quinquefasciatus* varied from place to place with the influence of climatory factors and human habits. The seasonal changes observed in our studies on the biting density are similar to those reported in India (Rajagopalan *et al,* 1977; Gowda and Vijayan, 1992. The result of the present study revealed that *Cx. quinquefasciatus* population started building up from February, and attained a peak density (9.2/man/hours) in March and remained relatively high level throughout summer and rainy seasons. It seemed that the mosquito population started declining in winter with the lowest density of 1.6/man/hours in December. This is probably because many breeding places are drying up and the adverse effect of low temperature on the activity and survival of adult mosquito. Thus a campaign for control or eradication of *Cx.*

quinquefasciatus in Khon Kaen City should be done on February before the mosquito population started building up.

In the present study, biting took place from 18.00 hours to 06.00 hours, only single peak activity was recorded in 22.00-23.00 hours. The pattern of biting cycle of the mosquito in Khon Kaen was similar to that in endemic area of *W.bancrofti* where there was a single peak of biting activity around midnight (Samarawickrema, 1967; DeMeillon and Sebastian, 1967). However the pattern of biting cycle was markedly different to that of *Cx. quinquefasciatus* in Bangkok. In Bangkok, the peak of biting was between 22.00 and 23.00 hours with two other peaks after midnight at 01.00 hours and the other at 04.00 hours (Sucharit *et al*, 1981). This discrepancy in the results of various reports might due to the differences in environmental conditions such as pollution and other unidentified factors. The biting cycle of *Cx. quinquefasciatus* in Khon Kaen has the peak biting period between 22.00-23.00 hours, coinciding with the peak of microfilaria density of urban and nocturnally periodic type *W.bancrofti* in the peripheral blood.

The parous rate on monthly basis have been used to estimate mortatity and daily survival rate of *Cx. quinquefasciatus* population (Samarawickrema, 1967). In our study the average parous rate was 47.3% in comparison to 47.0-60.4% in Colombo, Sri Lanka, the endemic area of *W.bancrofti* (Samarawickrema, 1967). The longer survival rate in *Cx. quinquefasciatus* indicated more chance of transmitting the disease to man.

In this study, the biting cycle of parous and nulliparous mosquitos closely follow that for total population, with a single peak before midnight. The parous mosquitos reach peak biting activity at 21.00-22.00 hours, 1 hour ahead of the peak for nulliparous group. Therefore, we can consider the peak of the total population of mosquito at 22.00-23.00 hours. The older mosquitos contribute more to the earliest hour and the nulliparous to the last hour of the peak. Sucharit *et al* (1981) reported that in Bangkok the parous mosquito bit man significantly more in the later half of the night. This is in contrast to the present study in which 81% of parous mosquitos bit man in the early half of the night. Therefore *Cx. quinquefasciatus* in Khon Kaen may have a greater chance to transmitt the disease to man than in Bangkok.

The results of the present study suggest that biting density and biting cycle of *Cx. quinquefasciatus* in Khon Kaen City is suitable for transmission of urban and nocturnal periodicity of *W.bancrofti*. The problem of filariasis being imported in future cannot be ruled out.

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REFERENCES

DeMeillon B, Sebastian A. The biting cycle of *Culex pipiens fatigans* on man in Rangoon, Burma, and the microfilarial periodicity. *Bull WHO* 1967; 36 : 174-6.

Detinova TS. Age-grouping methods in Diptera of medical importance. *WHO Mongr Ser* 1962; 47 : 216 pp.

Gowda NN, Vijayan VA. Biting density, behavior and age distribution of *Culex quinquefasciatus,* Say in Mysore City, India. *Southeast Asian J Trop Med Public Health* 1993; 24 : 152-6.

Rajagopalan PK, Brooks GD, Menon PKB, Mani TR. Observations on the biting activity and flight periodicity of *Culex pipiens fatigans* in an urban areas. *J Commun Dis* 1977; 9 : 22-31;

Rozeboom LE, Bhattacharya NC, Gilotra SK. Observation on the transmission of filariasis in urban Calcutta. *Am J Epidemiol* 1968; 87 : 616-32.

Samarawickrema WA. A study on age composition of natural population of *Culex pipiens fatigans* Wiedmann in relation to transmission of filariasis due to *Wuchereria bancrofti* (Cobbold) in Ceylon. *Bull WHO* 1967; 37 : 117-37.

Sasa M, Kurihara T, Harinasuta C. Studies on mosquitos and their natural enemies in Bangkok. Part-I. Observation on the bionomics of *Culex pipiens fatigans* Wiedmann. *Jpn J Exp Med* 1965; 35 : 23-49.

Sucharit S, Harinasuta C, Surathin K, Deesin T, Vutikes S, Rongsriyam Y. Some aspects of biting cycles of *Culex quinquefasciatus* in Bangkok, Thailand. *Southeast Asian J Trop Med Public Health* 1981; 12 : 75-8.

Divison of Epidemiology, Ministry of Public Health, Bangkok. *Weekly Epidemiol Rec* 1995; 26 : 321-31.

WHO. Manual on Practical Entomology in Malaria. Part II. Methods and techniques. Geneva 1975: 84-112.