



## Studies on the mosquito populations from Coimbatore, Tamil Nadu, India

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**Abstract:** Mosquito prevalence was studied in three areas of Coimbatore City, Tamil Nadu viz., North Coimbatore, Gandhipuram and Kavundampalayam. *Culex quinquefasciatus*, *C. pseudovishnu*, *C. gelidus* and *Armigeres subalbatus* are prevalent in the study area. Results indicated that *C. quinquefasciatus* was the predominant species in North Coimbatore followed by *C. pseudovishnu*, whereas *A. subalbatus* was the predominant species both in Gandhipuram and Kavundampalayam areas.

**Keywords:** *Armigeres subalbatus*, *Culex pseudovishnu*, *Culex quinquefasciatus*, Coimbatore City, Diptera, Gandhipuram, meteorological parameters, population dynamics.

### INTRODUCTION

Diptera represents one of the largest orders of insects with more than 85,000 species including a large number of disease vectors. Prominent among these are mosquitoes, which are placed under the suborder Nematocera and family Culicidae. More than 3100 species of mosquitoes belonging to 34 genera have been recorded under three subfamilies, namely, Anophelinae, Culicinae and Toxorhynchitinae (Knight & Stone 1977). Among insect pests mosquitoes are considered "Public Enemy Number One" for humans owing to their biting and blood feeding habits and their role as vectors of diseases including filariasis, malaria, yellow fever, dengue fever and Japanese encephalitis (WHO 1996).

The most important disease transmitting and nuisance causing mosquitoes belong to the genera *Anopheles*, *Culex*, *Aedes*, *Mansonia*, *Haemogogus*, *Sabithes* and *Psorophora*. In India, the various species of *Anopheles*, *Culex*, *Aedes* and *Mansonia* are important as carriers of diseases. Malaria, Filariasis, Japanese Encephalitis (JE), Dengue fever and Dengue Haemorrhagic Fever (DHF) are the major mosquito borne diseases in India (William 2000).

*Culex* spp. occur in all climatic zones ranging from forest to semi desert zones. Altitude does not seem to limit distribution, since they are observed at elevations of 2770 to 5500 m in India and also in mines at depths of 1,250m below the sea level (Bhat 1975; Renapurkar et al. 2001). At lower elevations, *C. quinquefasciatus* populations occur in high numbers with relatively little seasonal variation, although high numbers are found during the third quarter of the year. In contrast at middle ( $\approx$  600-1000 m) and high elevations ( $\approx$  1300-1500m) mosquito densities are much lower with well pronounced seasonal variations (Lapointe 2000).

Urbanization is a continuous process in developing countries like India and this has naturally led to aggregation of population. Further, due to rapid industrialization, large numbers of labourers migrate from rural to urban areas in search of job opportunities. This has resulted in the development of many slums with no proper sanitary and waste water disposal arrangements. Due to unplanned town expansions, the peripheral areas of towns bordering villages have become semi-urbanized and this process continues unchecked. The results are environmental changes including the creation of water bodies highly conducive for the breeding of mosquitoes. The increasing breeding potential



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of these ubiquitous mosquitoes can thus be attributed to the development process (Rajagopalan & Das 1988).

## MATERIALS AND METHODS

Coimbatore is located at the foothills of the Western Ghats a mega biodiversity hotspot. It is the third largest city in Tamil Nadu located at 10°50'-11°02'N & 76°56'-77°01'E. The city has an average elevation of 442m above the mean sea level. The total area of Coimbatore City is 1287km<sup>2</sup> with a population of 9,40,000 (Census of India 2001).

The Sanganoor Canal originates in the Western Ghats, (Kuridimalai Hills) and flows from west to east entering Coimbatore at the Coimbatore-Mettupalayam Road and flows for about 10km within the city. It is a major open drainage system which has intricate linkage with the storm water supply, domestic sewage and industrial effluent disposal.

Gandhipuram is a commercial neighbourhood located at the heart of the city, while Kavundampalayam and North Coimbatore are located on the Mettupalayam Road. These highly populated residential areas with open drainage were selected for the study.

Fortnightly collections of adult mosquitoes were made from November 1999 to October 2001 using mosquito sweep nets. Collected mosquitoes were anaesthetized using chloroform, examined under stereo binocular microscope (Carl Zeiss stemi dv4) and sorted. Identification is based on Christophers (1933) and Barraud (1934).

During the study period meteorological parameters such as temperature, relative humidity and rainfall were also recorded. Daily meteorological data were collected from the Meteorological Department, Tamil Nadu Agriculture University, Coimbatore.

### Statistical analysis

Meteorological factors and mosquito population estimates were subjected to correlation and multiple regression analyses. Data were also subjected to Canonical Correspondence Analysis (CCA) to study the pattern of variation in the populations and summarize multivariate data in scatter diagram. A canonical ordination technique was used to explain the patterns of variation in mosquito species with the environmental variables by combining regular ordination with aspects of regression (Jongman et al. 1987). In the present study population data for mosquito species was assessed along with environmental variables such as maximum and minimum temperature (°C), relative humidity (%) at 0722hr and at 1422hr, and rainfall (mm). CCA was carried out using the software PAST (Palaeontological Statistics Software package for education and data analysis, a free ware).

## RESULTS

### Population Studies

During the study period 13 species were recorded in the three localities of North Coimbatore, Gandhipuram and Kavundampalayam. Of these four species *Culex quinquefasciatus*, *C. pseudovishnu*, *C. gelidus* and *Armigeres subalbatus* were recorded throughout the period of two years while nine species *C. vishnu*, *C. tritaeniorhynchus*, *C. bitaeniorhynchus*, *A. albopictus*, *A. vittatus*, *A. aegypti*, *A. vexans*, *A. subpictus* and *A. vagus* were recorded less frequently and only during certain periods.

*Culex quinquefasciatus* was the predominant species in North Coimbatore and showed a trend of increase in February 2000 (34) with a peak in October 2001 (42). Maximum number of *C. pseudovishnu* were recorded in November 1999 and January 2000 (30). Population of *A. subalbatus* peaked in July 2001 (20). Compared to North Coimbatore the population of *C. quinquefasciatus* was less in Gandhipuram (Figs. 1-10). Population of *A. subalbatus* peaked in January 2000 (42) and moderate numbers were recorded during March 2000 (26), February 2000 (19), October 2000 and September 2001 (18).

Observations made in Kavundampalayam area showed that maximum number of *C. quinquefasciatus* was in May 2000 (18) and the minimum in August 2000 (4), February and April 2001 (4). However, *A. subalbatus* registered high densities in March 2000 (47) and in February 2001 (39). A comparative analysis of the four species in the three localities of North Coimbatore, Gandhipuram and Kavundampalayam indicated that *C. quinquefasciatus* was the predominant species in North Coimbatore followed by *C. pseudovishnu*, whereas *A. subalbatus* was the predominant species in both Gandhipuram and Kavundampalayam areas.

### Statistical Analysis

Correlation and regression analysis showed no relationship between mosquito populations and meteorological parameters when data were subjected to area-wise correlation analysis (Table 1). Population of *C. quinquefasciatus* from Gandhipuram were found to decrease with increasing maximum temperature (31.89°C). *C. pseudovishnu* in Gandhipuram showed a similar trend, with a decrease in population density with an increase in maximum temperature. The relationship between the mosquito population of *A. subalbatus* from North Coimbatore and maximum temperature was more pronounced. Among the four species of mosquitoes, *C. pseudovishnu* in North Coimbatore and *A. subalbatus* in Gandhipuram showed an increase in population density with a decrease in minimum temperature (21.75°C) and a significant negative correlation was observed between these two parameters. Study of mosquito population in relation to humidity (0722hr) indicated that numbers

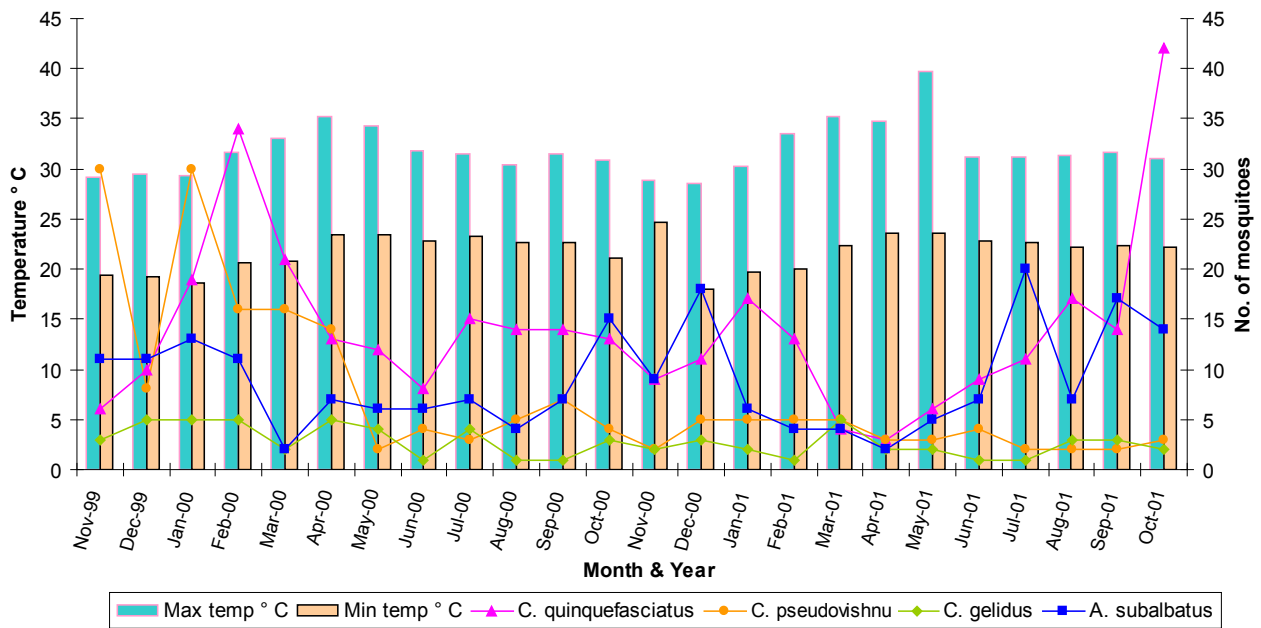


Figure 1. Population dynamics of mosquito species in relation to temperature (maximum and minimum) in North Coimbatore

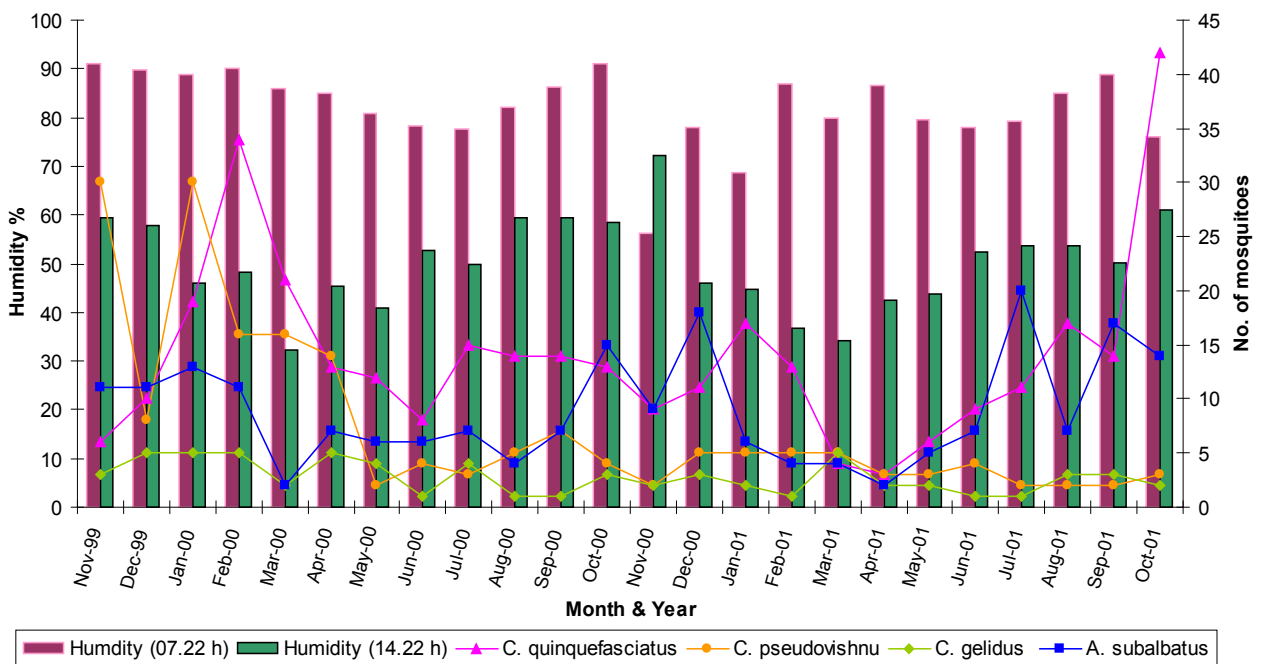


Figure 2. Population dynamics of mosquito species in relation to humidity (0722 & 1422 hr) in North Coimbatore

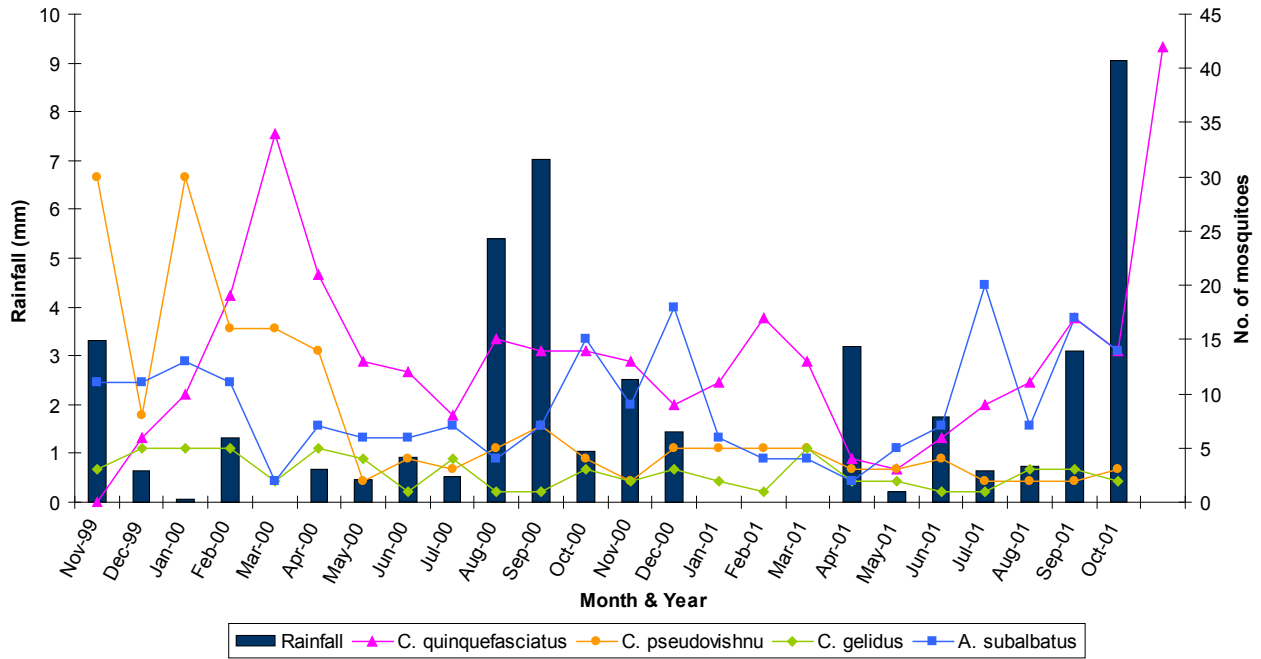


Figure 3. Population dynamics of mosquito species in relation to rainfall in North Coimbatore

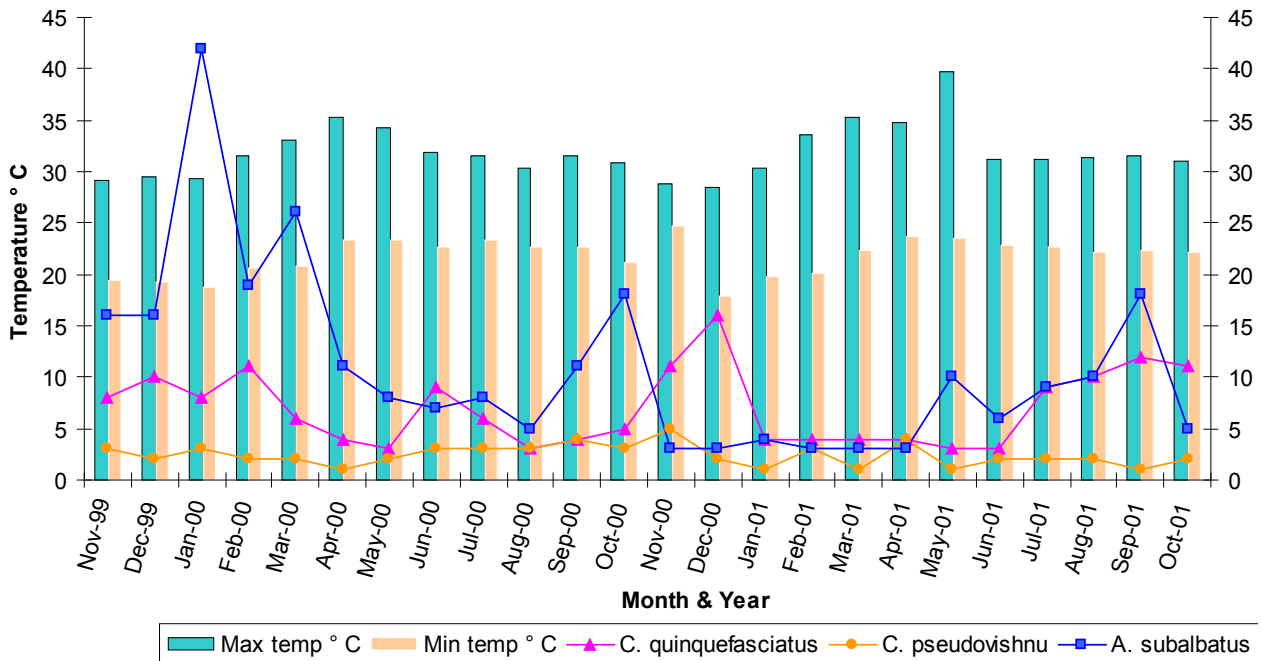


Figure 4. Population dynamics of mosquito species in relation to temperature (maximum and minimum) in Gandhipuram

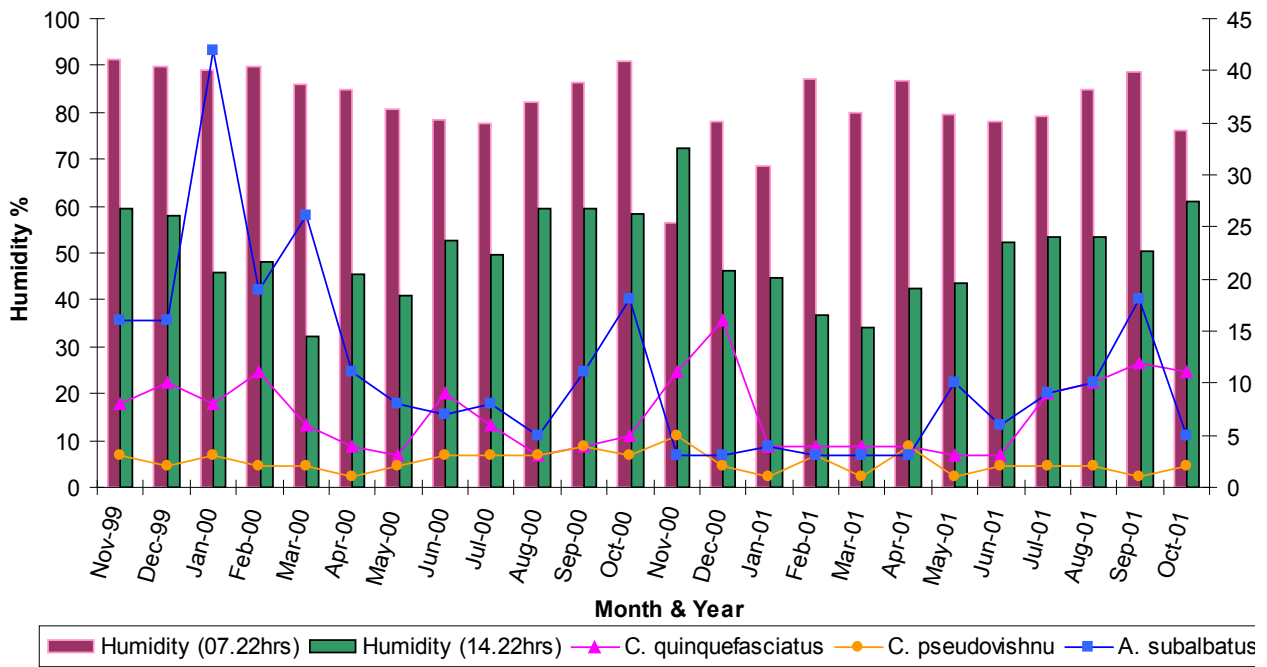


Figure 5. Population dynamics of mosquito species in relation to humidity (0722 & 1422 hr) in Gandhipuram

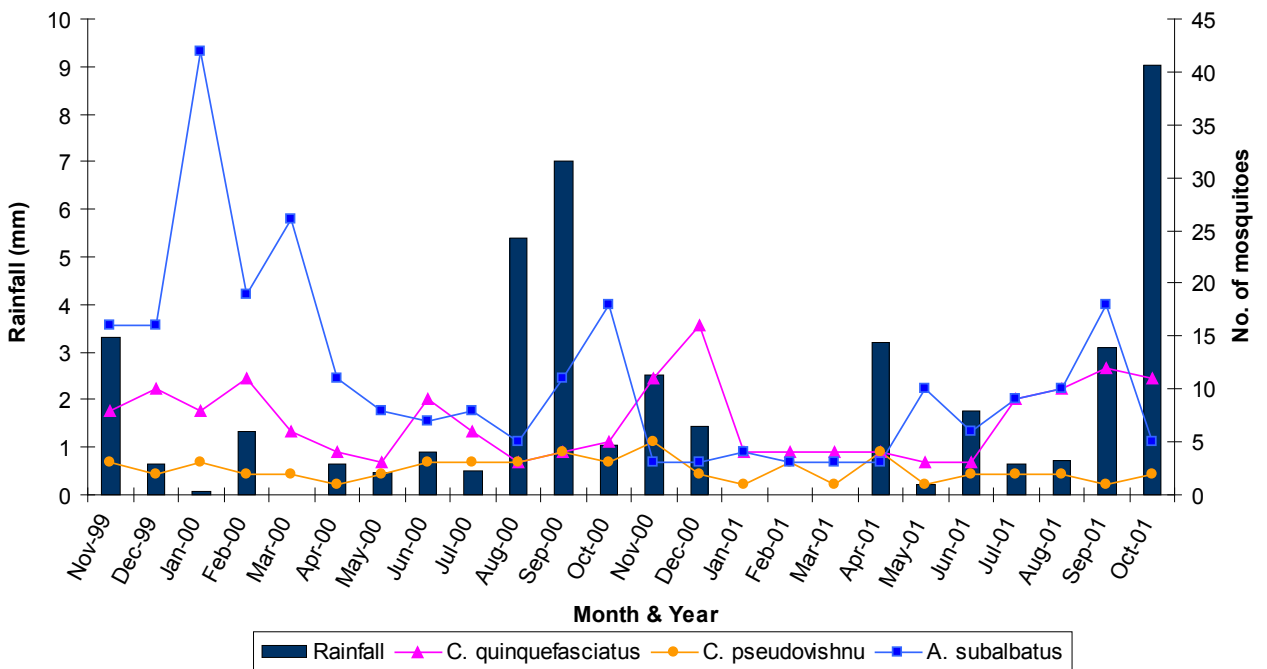


Figure 6. Population dynamics of mosquito species in relation to rainfall in Gandhipuram

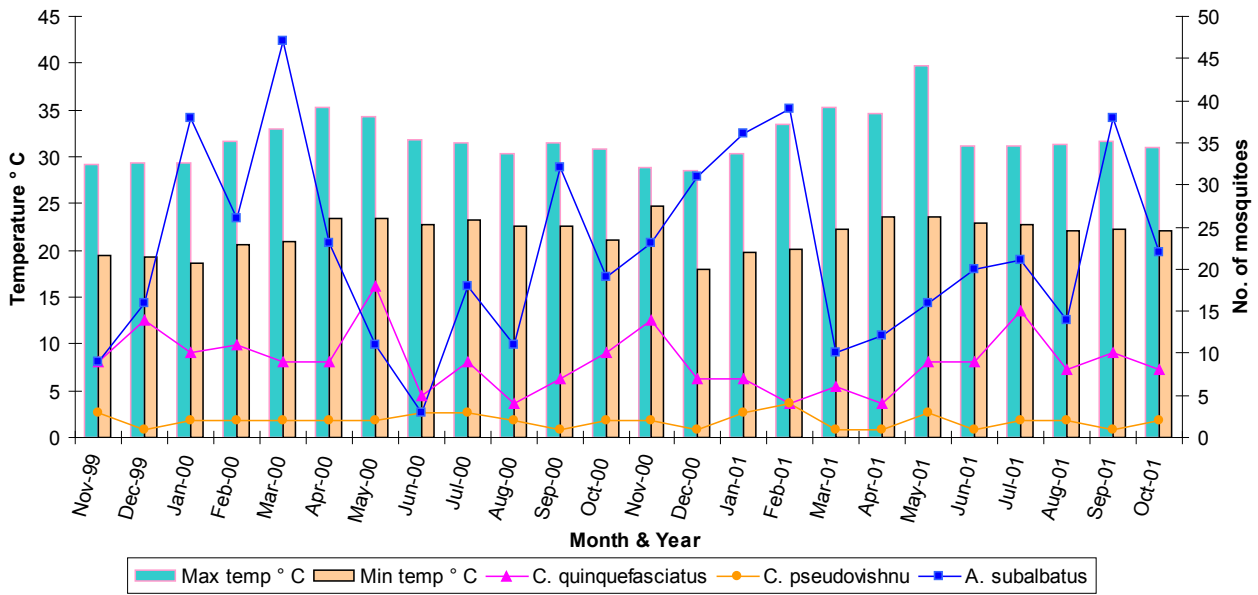


Figure 7. Population dynamics of mosquito species in relation to temperature (maximum and minimum) in Kavundampalayam

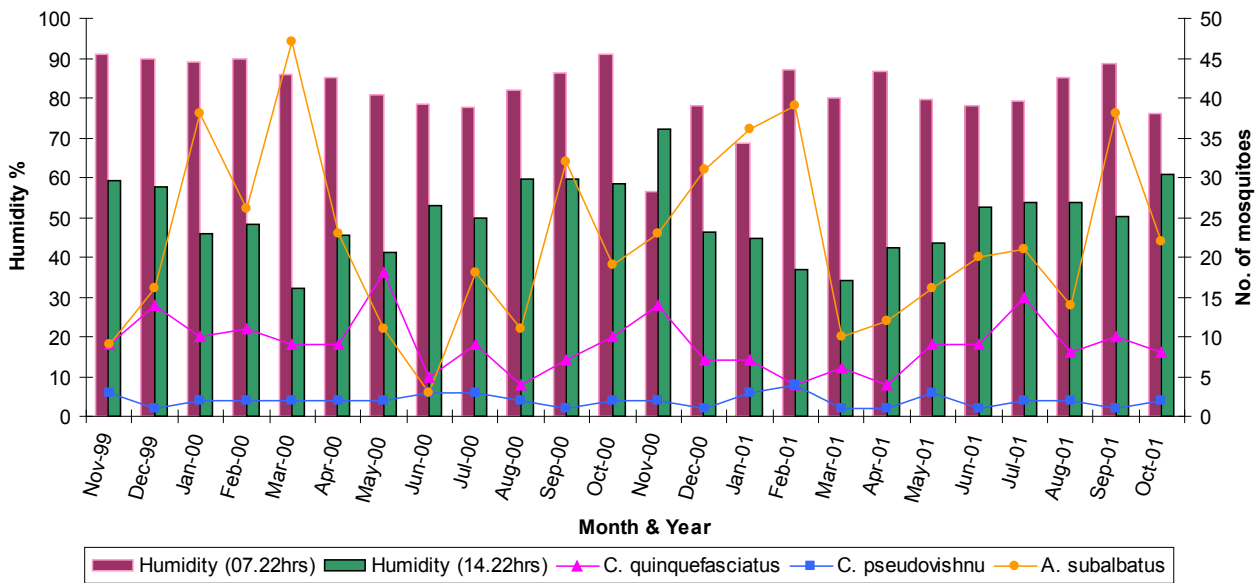


Figure 8. Population dynamics of mosquito species in relation to humidity (0722 & 1422 hr) in Kavundampalayam

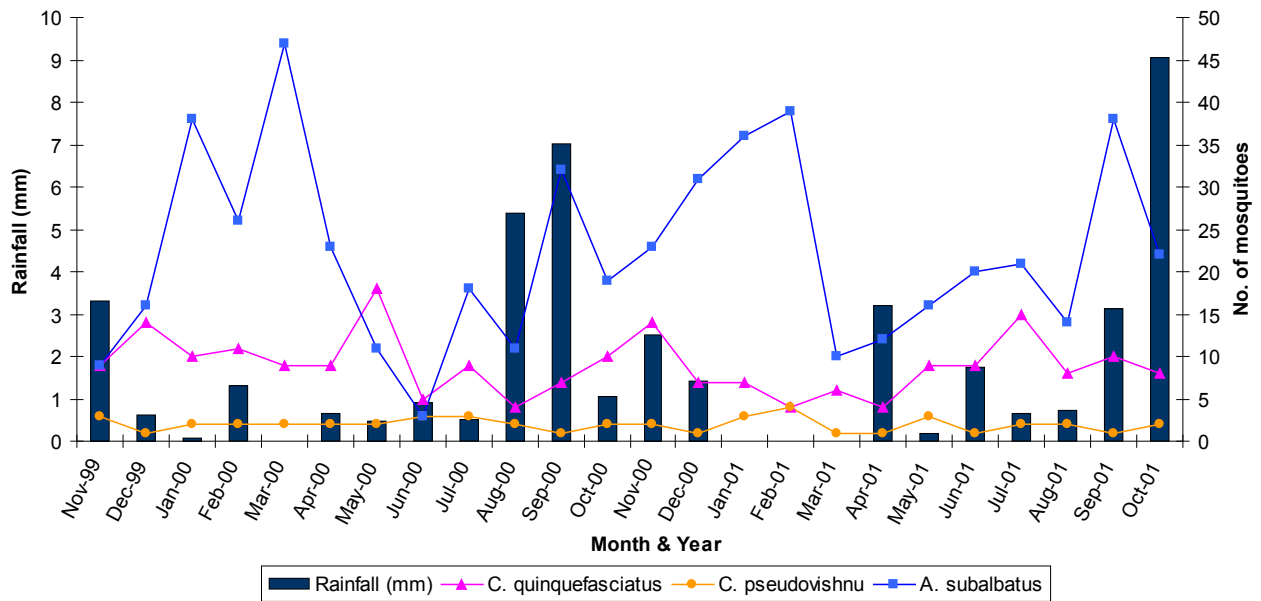
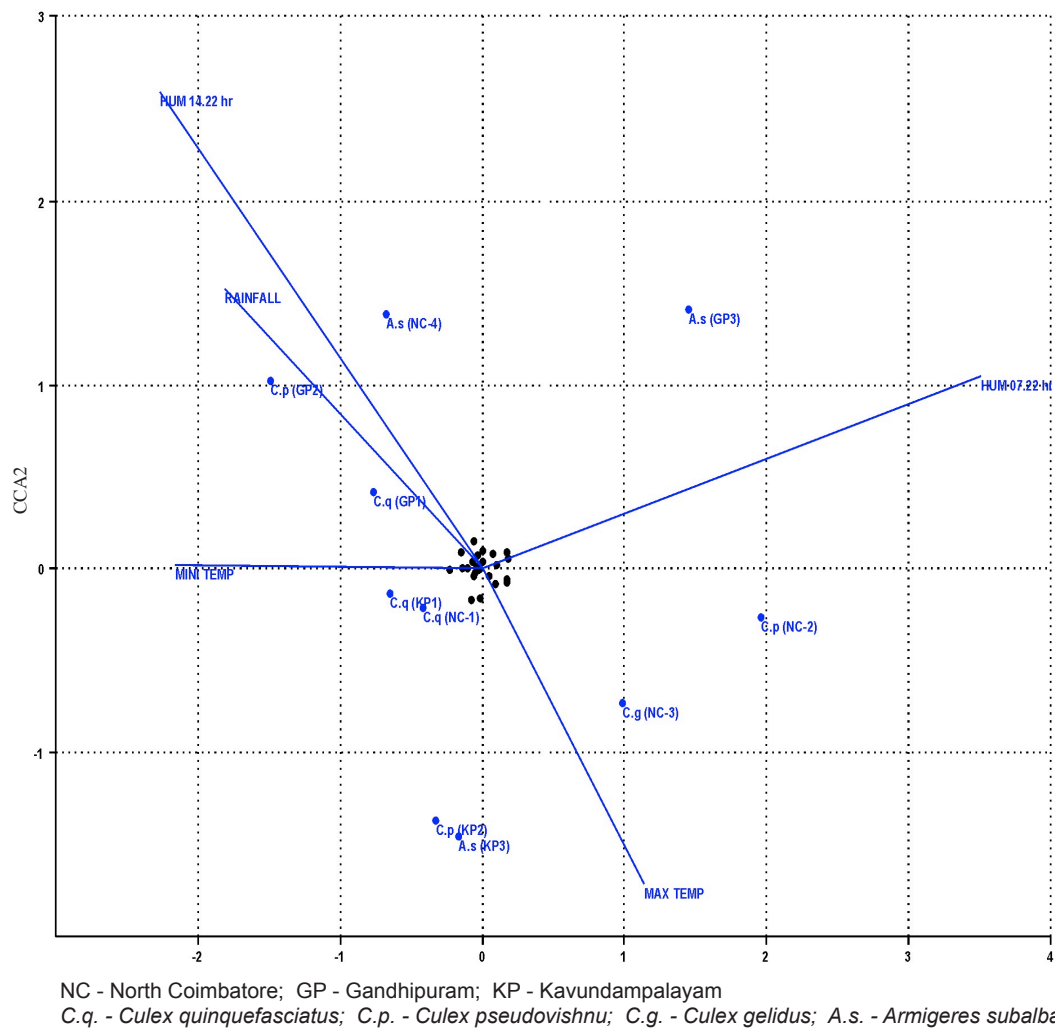


Figure 9. Population dynamics of mosquito species in relation to rainfall in Kavundampalayam



NC - North Coimbatore; GP - Gandhipuram; KP - Kavundampalayam  
 C.q. - *Culex quinquefasciatus*; C.p. - *Culex pseudovishnu*; C.g. - *Culex gelidus*; A.s. - *Armigeres subalbatus*

Figure 10. Cano plot showing the distribution of mosquito populations from three areas of Coimbatore from November 1999 – October 2001

**Table 1. Correlation between mosquito populations and meteorological parameters**

Mosquito Species	Area	Meteorological parameters	Estimated Parameter Humidity % (1422hr) $X_4$	F	R <sup>2</sup>
<i>C. quinquefasciatus</i>	Gandhipuram	Max. Temperature (°C) (33.05)	- 0.82*	10.75	0.33*
<i>A. subalbatus</i>	North Coimbatore	Max. Temperature (°C) (41.46)	-1.02*	7.97	0.27*
<i>C. pseudovishnu</i>	North Coimbatore	Min. Temperature (°C) (60.64)	- 2.44*	9.25	0.30*
<i>A. subalbatus</i>	Gandhipuram	Min. Temperature (°C) (57.51)	-2.14*	4.79	0.18*
<i>C. pseudovishnu</i>	North Coimbatore	Humidity (%) (07.22 (-30.39))	0.46*	5.63	0.20*
<i>A. subalbatus</i>	Gandhipuram	Humidity (%) (07.22 h) (-40.22)	0.62*	9.14	0.29*

\* - Statistically significant at 5% level

of *C. pseudovishnu* from North Coimbatore showed a positive relationship with humidity. A similar positive correlation with humidity was recorded for *A. subalbatus* in Gandhipuram and *C. pseudovishnu* and *A. subalbatus* from Gandhipuram. Of the four species observed, *C. quinquefasciatus* numbers in North Coimbatore showed a positive correlation with rainfall. For the other areas, rainfall had no significant effect on mosquito populations. Numbers of *C. gelidus* were not found to be significantly associated with environmental variables.

#### Canonical Correspondence Analysis

Distribution of mosquito species in relation to environmental variables like maximum temperature (°C) and minimum temperature (°C), relative humidity (%) at 0700hr and at 1400hr and rainfall (mm) were analyzed by ordination based on canonical correspondence analysis for two years (November 1999 to October 2001) in the three study areas, North Coimbatore, Gandhipuram and Kavundampalayam (Fig. 10). A positive relationship with humidity (0722hr) was observed in Gandhipuram for *A. subalbatus*, and with maximum temperature for *C. pseudovishnu* and *C. gelidus* in North Coimbatore. Most of the clusters are clumped together in the base, showing the low importance of seasons (Fig. 1). *A. subalbatus* showed a positive relationship with humidity (1422hr) in North Coimbatore and also a positive relationship with humidity (0722hr) in Gandhipuram. In Gandhipuram *C. pseudovishnu* had a positive relationship with rainfall. *C. quinquefasciatus* in Kavundampalayam and North Coimbatore area showed more inclination towards minimum temperature. Most of the clusters are clumped together in the base exhibiting the less importance of seasons (Fig. 10).

#### DISCUSSION

During the study period, 13 species were recorded

in the three test localities. Of these four species, *C. quinquefasciatus*, *C. pseudovishnu*, *C. gelidus* and *A. subalbatus* were recorded throughout the period of two years. However, nine species, viz., *C. vishnu*, *C. tritaeniorhynchus*, *C. bitaeniorhynchus*, *A. albopictus*, *A. vittatus*, *A. aegypti*, *A. vexans*, *A. subpictus* and *A. vagus* were recorded less frequently which agrees with the established fact of seasonal occurrence of mosquitoes (Bosgelmez et al. 1994, 1995).

In the present study *C. quinquefasciatus* was found to be the predominant species in North Coimbatore, whereas *A. subalbatus* was the predominant species in Gandhipuram and Kavundampalayam closely followed by *C. quinquefasciatus*. The high prevalence of *A. subalbatus* and *Culex* species in Gandhipuram and Kavundampalayam may be attributed to the presence of open sewage canals and closeness to Sanganoor channel into which sewage is discharged at various points in its course. These polluted waters offer an ideal breeding ground for mosquitoes. Similar observations have been made by Amerasinghe (1982) who found *A. subalbatus* breeding commonly in polluted ground water collections as well as in container habitats like tree holes and bamboo stumps.

Studies on population dynamics of mosquito species have been undertaken by several investigators (Alten et al. 2000; Gleiser, et al. 2000; Ahumada et al. 2004; Simsek 2003, 2004). According to Alten et al. (1997), the highest number of mosquitoes was found during summer and autumn and less number during winter and early spring. Similar observations were made by Bosgelmez et al. (1995) who recorded highest numbers of species during early summer especially in June, with the total number of adults collected increasing from June to September and decreasing in October. Contrary to this observation in the present investigation highest numbers were recorded invariably in January to March and October to December which might be due to the prevailing monsoonal pattern.

Rao et al. (1981), Dash et al. (1998) and Dixit et al.



(2002) observed a low density of *C. quinquefasciatus* in May and a high density in February in East Godavari District of Andhra Pradesh. Similar high density had been observed in North Coimbatore in the month of February in the present study. However, in the other two areas high density was recorded in November to December. Dhar et al. (1968) also recorded high densities in November to December.

Population studies on *A. subalbatus* are meagre. In the present study peak population was recorded invariably from January to March and population was comparatively low in May to August in both Gandhipuram and Kavundampalayam. *C. pseudovishnu* population was abundant in North Coimbatore area and highest density was recorded in November 1999 and January 2000. In Gandhipuram and Kavundampalayam low density was observed throughout the study period. According to Joshi & Bansal (1991), *C. pseudovishnu* prefers outdoor habitats where both temperature and relative humidity are high. In the present study *C. pseudovishnu* numbers were higher when the temperature was optimum in a range of 29.21 to 29.41 °C and humidity ranging from 89-91 %.

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