EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 5
Issue: 6
447-452
Year: 2018

SPECIES COMPOSITION AND SEASONAL DYNAMICS OF MOSQUITOES IN COIMBATORE, TAMIL NADU, INDIA.

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Article Received on 13/04/2018 **Article Revised on 03/05/2018** **Article Accepted on 23/05/2018**

ABSTRACT
Mosquitoes are causative agents for many diseases and affect millions of people worldwide. They produce humming shadows near our ears is irritating, after that they bite like pricking with a needle causes swelling and itching. A detailed investigation was undertaken to study the population dynamics of mosquito species namely, *Culex quinquefasciatus, Culex vishnui, Culex pseudovishnu, Culex gelidus, Aedes aegypti* and *Armigeres subalbatus* which were prevalent in the two selected areas namely Race course and Kavundampalayam of Coimbatore district, Tamil Nadu, India. During the study period meteorological parameter were also recorded to assess the influence of these factors on the mosquito population. Canonical Correspondence Analysis (CCA) was employed to study the pattern of variation in the population of mosquito species over a period of 12 months. Multiple linear correlation and regression analysis showed negative relationship between mosquito populations and maximum temperature and there is no relationship between other meteorological parameters such as minimum temperature, humidity and rainfall in selected areas. Canonical Correspondence Analysis showed population of *C.gelidus* with humidity (14.22h), C.*vishnui*, *A.aegypti* and *A.subalbatus* with humidity (07.22h) and *C.quinquefasciatus* with maximum temperature showed positive relationship in Race course.

KEYWORDS: *Culex quiquefaciatus*, Mosquito population, Meteorological parameters.

INTRODUCTION
Diptera is one of the largest order of insects consisting of more than 85,000 species and it includes a large number of vectors. The predominant groups are placed under the suborder Nematocera and family Culicidae. More than 3100 species of mosquitoes belonging to 34 genera have been recorded and arranged under three sub families namely, Anophelinae, Culicinae and Toxorhynchitinae.[15] The genus *Culex* was first named and described by Linnaeus in 1735. Following this Meigen in 1818 described two more genera, *Aedes* and *Anopheles*.

Mosquitoes can transmit more diseases and affect millions of people throughout the world. WHO has declared the mosquito as "Public enemy number one". Mosquito borne diseases are prevalent in more than 100 countries across the world, infecting over 700 million people every year globally and 40 millions of the Indian population. They act as a host and transmit most of the diseases, in many other part of the world. In 2008, there were 243 million cases, and an estimated 8, 63,000 deaths attributed to malaria.[25]

The vector abundance reveals diseases outbreak, the management and adequate knowledge about species diversity, distribution pattern and preferential habitat selection of vector species will help to evolve a suitable strategy to control mosquito populations, thereby preventing outbreak of diseases.[5]

MATERIALS AND METHODS
Collection of adult mosquitoes for population studies
Two different areas, viz., Race course, and Kavundampalayam of Coimbatore city, (Plate 1) Tamil Nadu, India were selected to study the population dynamics of mosquito species. Fortnightly collections of adult mosquitoes were made from July 2010 to June 2011 using mosquito sweep nets during 5.30 p.m. to 6.30 p.m. The collected mosquitoes were anaesthetized using chloroform, examined under stereo binocular microscope (Carl Zeiss Stemi DV4), sorted out species-wise and counted.

During the study period meteorological parameters such as temperature, relative humidity and rainfall were also recorded to assess the influence of these factors on the mosquito population. Daily meteorological data were

collected from the Meteorological Department, Tamil Nadu Agricultural University, Coimbatore city.

Identification of mosquitoes

The different species of mosquitoes were identified using the keys of Christophers (1933) and Barraud (1934).

Canonical Correspondence Analysis (CCA)

In order to study the impact of meteorological factors on mosquito population, simple correlation and multiple regression analysis were carried out. Further, the data were subjected to Canonical Correspondence Analysis (CCA). Canonical Correspondence Analysis (CCA) was employed to study the pattern of variation in the population of mosquito species over a period of 24 months from July, 2010 to June 2011.

Canonical ordination technique will explain the patterns of variation in the mosquito species with the environmental variables such as maximum and minimum temperature (^{o}C), relative humidity (%) at 07.22 h and at 14.22 h and rainfall (mm). Canonical correspondence analysis was carried out using the software PAST (Palaeontological Statistics Software package for Education and Data Analysis).

RESULTS AND DISCUSSION

Coimbatore located at the foot hill of Western Ghats, is one of the mega biodiversity areas. It is the third largest city in Tamil Nadu, India and is situated between 11.0183°N longitude and 76.9725°E latitude. The city has an average elevation of 411 m above the mean sea level. The total area of Coimbatore city is 246.8 km^2

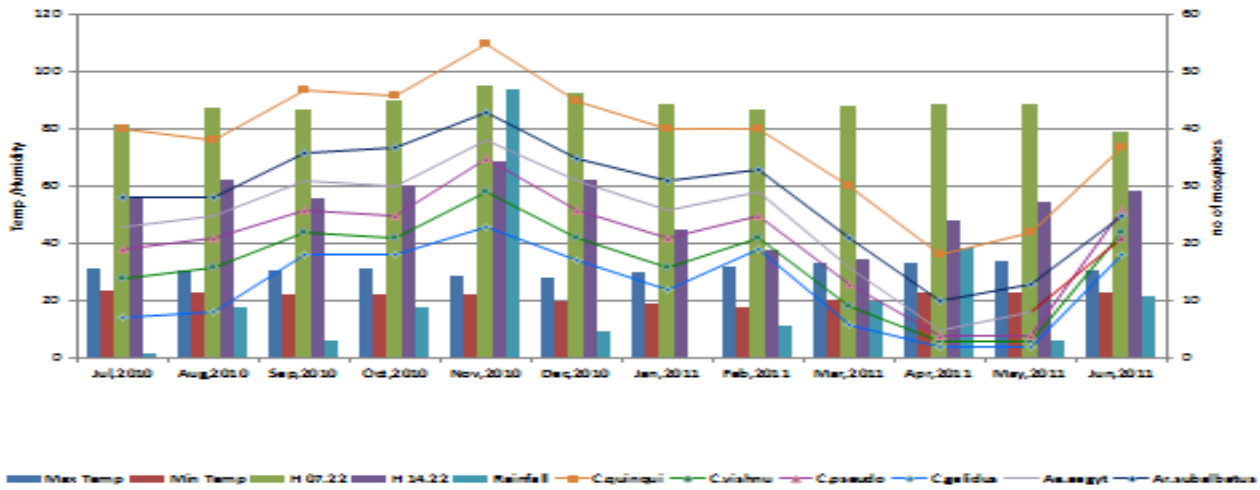
Urbanization is a continuous process in developing countries like India and this has naturally led to aggregation of population. Further, due to rapid industrialization, large numbers of labourers migrate from rural to urban areas in search of job opportunities. This has resulted in the development of many slums with no proper sanitary and waste water disposal arrangements.

Population Studies

Race course

Observations made in this area exhibited maximum population of entire species. *C.quinquefasciatus* was major species recorded in November 2010 and 2011 were given in figure1 and minimum populations were observed in August 2010 and April 2011. Maximum number of *C.vishnui* population was registered in November 2010 and 2011.

Ae.aegypti population was neutral when compared to all species in this area. High population was observed in November 2010 and 2011. Low population was noticed in July 2010 and April 2011. *Ar. subalbatus* was the second dominant species in this locality. Maximum number of mosquitoes observed in November 2010 and 2011. Minimum population was found in July and August 2010 and April 2011 were presented in figure1.



Population dynamics of mosquito species in relation to meteorological parameters in Race course

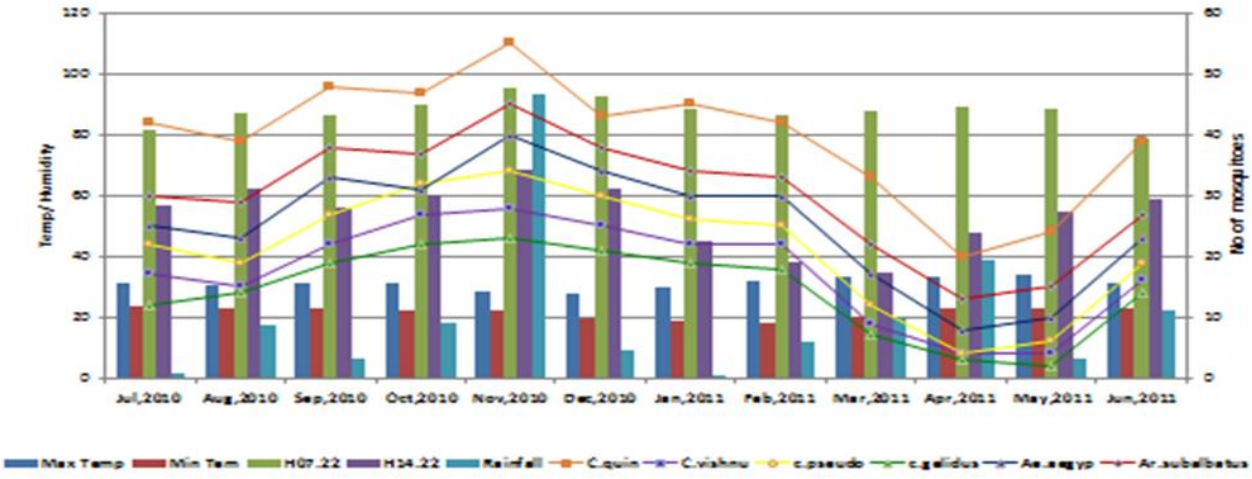
Kavundampalayam

In this area entire species of mosquitoes were rich because of sanganoor sewage. Adult population of *C.quinquefasciatus* was reached a high peak in November 2010 and 2011 were exhibited in figure 1. Minimum population was observed in August 2010 and April 2011. Maximum number of *C. vishnui* mosquito species was noticed in November 2010 and 2011.

Minimum population was recorded in August 2010 and April and May 2011.

Maximum number of *C. psudovishnui* population was observed in November 2010 and May 2011. Minimum population was recorded in August 2010 and April 2011.

C.gelidus was least species occurred in this area with low population compared to other species in this locality. Maximum number of this species found in November 2010 and 2011. Minimum populations observed in July 2010 and May 2011.



Population dynamics of mosquito species in relation to meteorological parameters in Kavundampalayam

Regression Analysis

Species II: *Culex vishnui*

Maximum temperature, minimum temperature, humidity (07.22h), humidity (14.22h) and rainfall was subjected to analysis. The maximum temperature was statistically significant at 1% level and it could be identified from the‘t’ value of maximum temperature in Race course (-4.18**) and Kavundampalayam (-4.04**) were found to be significant. Maximum temperature was negatively correlated with *C. visnui* population.

Species III: *Culex psudovishnui*

In two selected areas, meteorological factors such as maximum temperature, minimum temperature, humidity (07.22h), humidity (14.22h) and rainfall were presented in table 5. The maximum temperature was statistically significant at 1% level and it could be identified from the significant‘t’ value of maximum temperature in Race course (-4.69**) and Kavundampalayam (-4.28**) and was negatively correlated with *C. psudovisnui* population.

Species IV: *Culex gelidus*

In two selected areas, maximum temperature was statistically significant at 1% level and it could be identified from the significant‘t’ value of maximum temperature in Race course (-2.99**) and Kavundampalayam (-3.67**). Maximum temperature was negatively correlated with *C. gelidus* population were given in table 6.

Species V: *Aedes aegypti*

Correlation between population of *Ae. aegypti* and maximum temperature was statistically significant at 1% level. It could be identified from the significant‘t’ value of maximum temperature in Avinashilingam University campus Race course (-4.45**) and Kavundampalayam (-4.59**). Maximum temperature was negatively correlated with *Ae. aegypti* population were shown in table 7.

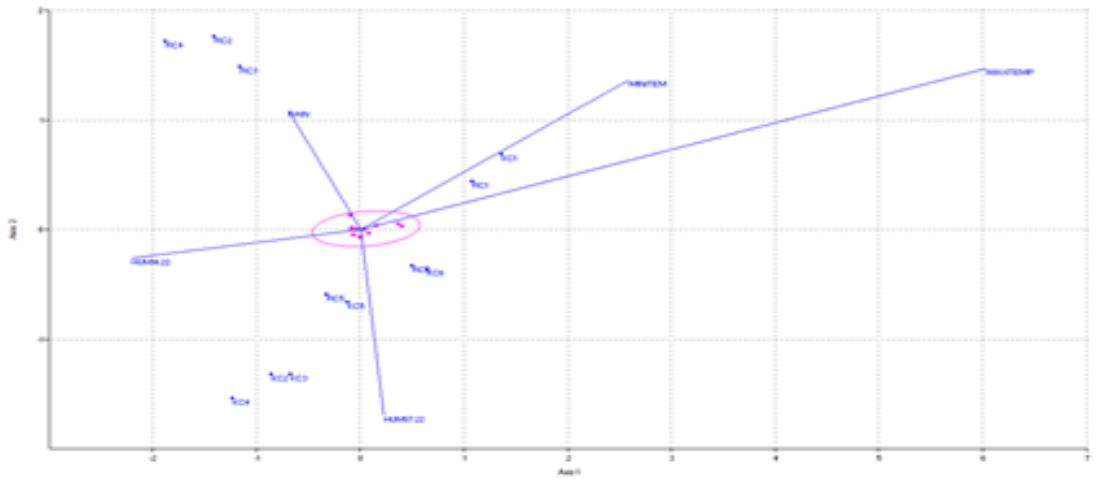
Species VI: *Armigerus subalbatus*

Maximum temperature in selected areas was statistically significant at 1% level and it could be identified from the significant‘t’ value of maximum temperature in Race course (-4.21**) and Kavundampalayam (-4.75**). Maximum temperature was negatively correlated with *Ar. subalbatus* population were presented in table 8.

Canonical Correspondence Analysis

Canonical Correspondence ordination diagram is widely used as a technique for relating the mosquito population to the environmental variables as the impact of these was applied in ordination technique. The aim of canonical ordination was to detect the insignificant or unrecognizable relationship between the species and the observed environment.

Canoplot showing the distribution of mosquito populations areas of Coimbatore from July2010 to June 2011.

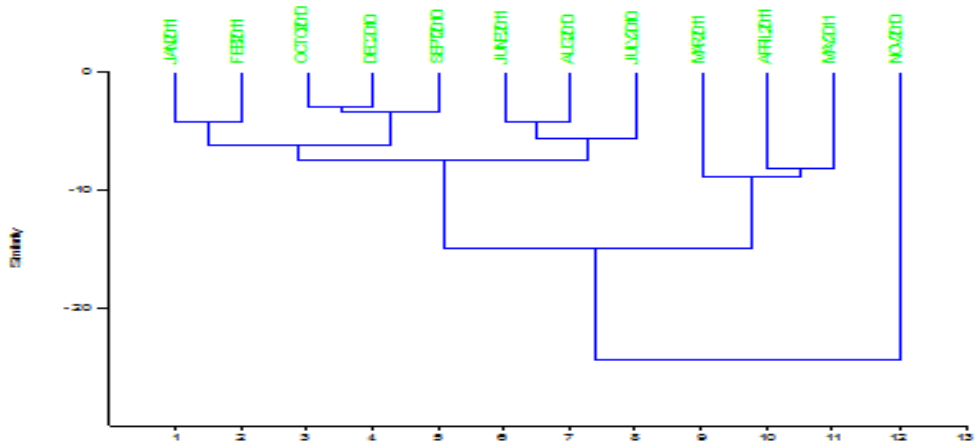


R-Race course : K-Kavundampalayam G1- *Culex quinquefasciatus*; G2- *Culex vishnu*; G3- *Culex pseudovishnu* G4- *Culex gelidus* ; G5-*Aedes aegypti* ; G6-*Armigeres subalbatus*

Population of *Ae. aegypti* with humidity (07.22h), *C. vishnui* and *C. pseudovishnu* with rainfall, *C. quinquefasciatus* with minimum temperature with minimum temperature were exhibited positive relationship and *Ar. subalbatus* is negatively correlated with maximum temperature. Canonical correspondence analysis also showed *C.quinquefasciatus* was found to be predominant species followed by *Ar.subalbatus* and *Ae. aegypti.*

Cluster Analysis

Distributions of mosquito population in relation to seasons were used by Neighbour joining clustering, which is an alternative method for hierarchical cluster analysis for two years from July 2010 to June 2011 in two areas namely Racecourse and Kavundampalayam of Coimbatore. Mosquito population gradually increases and attains maximum population level in November 2010 and 2011 in all areas. Decreased mosquito population was recorded gradually and minimum population was observed in April 2011. This proves that mosquito population had a negative relationship with maximum temperature.



Cluster Analysis showing the distribution of mosquito populations areas of Coimbatore from July2010 to June 2011

DISCUSSION

During the study period, 6 species were recorded in the two areas viz., Race course, and Kavundampalayam. Of these four species, *C. quinquefasciatus, C. pseudovishnu, C. gelidus* and *Ar. subalbatus* were recorded throughout the period of two years. However, two species *C.vishnu and C. gelidus,* were recorded less frequently and absent during certain period of study. This falls in line with the observation of[7,8] who reported the occurrence of some species of mosquitoes throughout the year and others with restricted seasonal occurrence. Studies on population dynamics of mosquito species has been undertaken by several investigators.[2,13,1,23,24] It is evident from above work, in the present study also, there is a relationship only between maximum temperature and no significant relationship between other meteorological factors.

Canonical correspondence analysis in the present investigation showed a positive relationship of *Ar.subalbatus* and *Ae. aegypti* with humidity. But humidity had positive relationship with *Ae. aegypti* from Race course. International studies showed the temperature is a major driving force behind mosquito population density.[1,12,4,17,19] High temperature leads to evaporation of temporary water recourses like ponds and pools, tree holes, coconut shells, waste vessels, plastics etc, this factor may be possible reason for the present study.[20] surveyed during the yearlong study from July 2006 to June 2007 and recorded 16 mosquito species from the human habitations. A total of 3005 mosquitoes were captured in three seasons of which, the number in rainy season was significantly higher than those of winter and summer these observations were in line with the findings of[22] Climate change plays an important role in determining the mosquito population.[12] found a temperature effect for *C. tarsalis* and *Ae. vexans* and described a positive influence of temperature at the week of the capture and a lesser negative effect of temperature with a two week lag. Thus it seems that female *C. pipiens* are strongly influenced by temperature changes Similarly in the present study also temperature also influences in mosquito populations were registered using Neighbour joining clustering analysis in November 2010 and 2011 during rainy months and maximum temperature recorded was less in these months.

End of the rainy season abundant population of *Ae. aegypti* and the proliferation of other species of Aedes was observed by.[16] Similar observations were recorded in the present study that Canonical Correspondence Analysis (CCA) showed a positive relationship of mosquito species namely *C.vishnui* and *C. pseudovishnu* with rain fall in Race course area.

CONCLUSION

The findings of this study help to assess appropriate and possible strategies to control different mosquito species. Mosquito borne diseases gained dominant position through life threatening hazards by population explosion, urbanisation leads to temporary water sources like plastic containers, tiers and tender coconut shells, ditches, dirty pools, and stagnant water. Human population are altering and polluting the environment and encouraging vectors which subsequently causes diseases. Further research will be needed on gene sequencing for vectors and vector borne pathogens and to motivate the community to remove and dispose of any water holding containers.

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