# Diversity and Relative Abundance of Mosquito (Order: Diptera) within human habitat in the district of Thane (Maharashtra).


## Abstract

Mosquito's form an integral part of our ecosystem. They act as vectors in transmitting diseases and weakening the human immune system. A large amount of the country's economy is expended in controlling the growth and spread of mosquitoes and the associated diseases. In the current study dead mosquitoes from different areas of Mira Bhayander Thane district were collected and identified using standard identification methods. The study was focused on the three genera *Aedes*, *Anopheles* and *Culex* as they are most commonly found in Mumbai and Thane region and are responsible for diseases like dengue, malaria, filariasis, etc which are currently on the rise. A total of 1123 dead mosquitoes were collected and it was observed that the concentration of *Culex* was higher and *Anopheles* was the least. Relative abundance of species was also calculated which concluded that the *Aedes* and *Culex* mosquitoes were the dominant species whereas the *Anopheles* was the subdominant species. The present study will aid in limiting the spread of diseases by controlling the growth of *Culex* and other mosquitoes.



## Keywords

*Anopheles*, *Culex*, *Aedes*, Mira Bhayander


## 1. Introduction

Mosquitoes have bedeviled humans for centuries, spreading diseases and death to millions. Mosquitoes are chief vectors that are accountable for causing diseases moreover their diversity and distribution determine the potency of disease transmission and also the ecological status of surrounding environment [1]. They act as vectors to disease causing pathogens in humans and livestock similarly. However, mosquitoes also have an importance ecologically, not only are they efficient pollinators but the larva of mosquitoes serves as a source of food for variety of fishes and birds that feed on very small aquatic animals [2]. There are 112 genera of mosquitoes worldwide out of which only few bite and play a role in causing diseases in humans [3]. According to WHO, vector borne diseases are 17% of all the infectious diseases that are caused globally out of which approximately 7,00,000 every year results in death [30]. *Aedes*, *Anopheles* and *Culex* genera are the most common and potential vectors for parasites that can cause various diseases like dengue, malaria, encephalitis, lymphatic filariasis and West Nile

virus [4] [5]. Mosquitoes not only play a role in transmitting various pathogens but also aid in suppressing the human immune system. As soon as the mosquitoes saliva enters into the human blood, it suppresses the production of cytokines in human peripheral blood mononuclear cells, thus helping the pathogen make us infected [6]. It also reduces IP10 which attracts macrophages, monocytes and dendritic cells [7]. Within the period of 7 days it also reduces neutrophils and myeloid cells that could suppress the growth of pathogens in the blood. Thus, adversely affecting the human immune system [8] [9]. During Covid 19, people were strengthening their immune system in order to not get infected by the virus [10]. This could be the reason that the cases of mosquito borne diseases reduced during the late 2020's. There are several records of studies done to understand the diversity and abundance of mosquitoes and mosquito borne diseases worldwide as well as in India, but there are barely any study that represents the diversity and abundance of mosquitoes in Maharashtra. The present work was an attempt to study the prevalance of three commonly found genus *Aedes*, *Culex* and *Anopheles* and the diseases concerned with them. According to 2011 census, Mira Bhayander has a population of approximately 8,00,000 people [31]. As per the severity of this disease, the cases were expected to be quite high comparatively, with 877 cases of filariasis within a span of 6 months i.e. January to June 2020 [32]. According to WHO, at least 36 million people live with the manifestation of this disease [30]. Hydrocele and lymphodema are symptoms of filariasis [4] however, due to lack of awareness, the people are not aware of the gravity of disease and detailed symptoms or causes. The disease is not deadly but causes unnecessary expense to treat the symptoms that are increased because of negligence. The present study will help to understand the intensity of infection in areas of Mira Bhayander and to adapt methods for the spread of disease.

## 2.Materials and Methods

### 2.1. Sampling site

The study was conducted in Mira Bhayander which is located in Thane district, Maharashtra, India. It can be located using GPS co-ordinates 19° 17' 42.8388'' N and 72°51' 15.8148'' E. The study was carried out in four different locations i.e. Rai, Navgarh Road, MBMC Dumping site and Uttan of Mira Bhayander for collection of samples that were close to human habitat and also to places that could be the possible breeding sites.

### 2.2.Sampling method and identification

The collection of samples of mosquito started in the month of July 2022 and ended in December 2022, it included monsoon and winter seasons. Due to fluctuations in the temperature during the month of October, it was the most efficient time to study about the impact of temperature

on the diversity of mosquitoes. The mosquito samples were collected by human landing method and mostly by light trap method using UV LED mosquito trap machine between dawn and dusk i.e. between 8:00 pm to 7:00 am placed at restaurants and stalls. The trapped mosquitoes were collected in a vial and then taken to the laboratory of the Zoology department of Bhavan's College (Autonomous), Andheri west, Mumbai for identification. The samples were then stored in formalin until it was further identified and sorted. The identification was done with the help of compound microscope and dissecting microscope based on standard taxanomic keys- A catalogue of Indian Mosquitoes [8]. The mosquitoes were first identified as male and female and then on the basis of their genera. The current work did not involve any breeding or collection of live mosquitoes, only dead mosquitoes were collected for the study.

### 2.3.Data Analysis

The relative abundance (RA) of mosquitoes [11] was calculated by using the formula given by Weiher and Keddy, 1999.

$$\text{RA} = \frac{1}{L} \times 100$$

• Where l is equal to the number of specimens collected of particular species and L is equl to the total number of specimens collected. Based on the values of RA, the specimens are considered as satellite (RA< 1%); sub-dominant (RA< 5%) and dominant species (RA > 5%).

Shannon diversity index (H') and Simpson's diversity index (D) was calculated in order to find out diversity of mosquito in the district using Microsoft Excel Worksheet (Version 2016) [12].

Shannon diversity index (H);

$$H = -\sum_{i=1}^{s} pi \ln pi$$

Simpson diversity index (D);

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

## 3. Results

A total of 1123 mosquitoes were collected out of which 661 were identified as *Culex* (58.86%), 328 *Aedes* (29.2%), 23 *Anopheles* (2.05%) and 111 belong to other genus which were not considered for the study (9.88%). According to the theory of Weiher and Keddy, 1999, relative abundance was calculated as per which *Anopheles* was considered to be subdominant

species with RA= 2.04, *Culex* and *Aedes* were considered to be dominant species with RA equals 58.86 and 29.20 respectively. Thus within the duration of 6 months it was found that the genus *Culex* was the dominating species as compared to other disease causing mosquitoes.

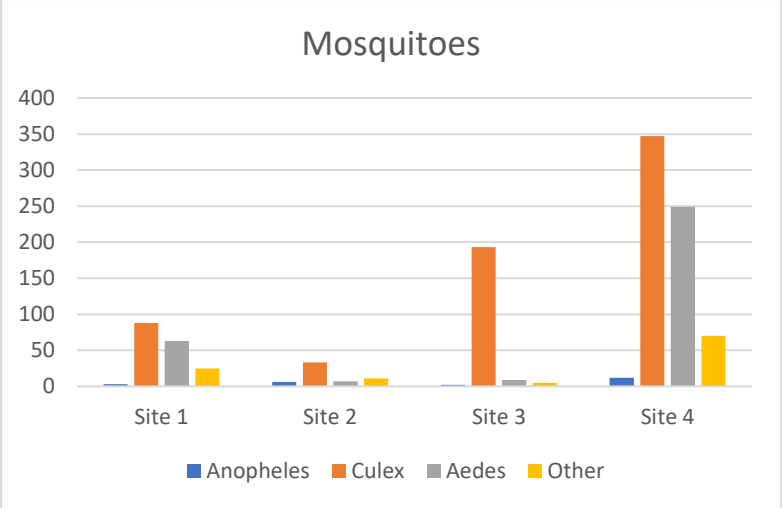
As per the Simpson's index and the Shannon- Wiener index; *Anopheles* was found to be moderately diverse whereas *Culex* and *Aedes* was found to be highly diverse. The correlation between the two index

**Table 1. Diversity and Relative Abundance of Mosquitoes in Mira Bhayander of Thane District**

| | Site 1 | Site 2 | Site 3 | Site 4 | Total | RA (%) | Status |
|---|---|---|---|---|---|---|---|
| ***Anopheles*** | 3 | 6 | 2 | 12 | 23 | 2.04 | Sub dominant |
| ***Aedes*** | 88 | 33 | 193 | 347 | 661 | 58.8 | Dominant |
| ***Culex*** | 63 | 7 | 9 | 249 | 328 | 29.2 | Dominant |
| **Others** | 25 | 11 | 5 | 70 | 111 | 9.88 | Dominant |
| **Total** | | | | | **1123** | | |

Figure 1. Top- female *Culex*; Bottom – male *Culex*

Figure 2. Number of mosquitoes based on sites




## 4. Discussion

India is inhabitant to over 393 species and 49 genera of mosquitoes. The present study was conducted between the month of July to December 2022 where *Aedes*, *Anopheles* and *Culex* were considered to be most important because of their potential ability in transmission of disease [13].

The present study supports the work of Sule et al., that shows the presence of 393 species of *Culex* which is much higher than that of other genera in Maharashtra. The present work also supports the reported 877 cases of Filariasis from the month of January to June 2020 published in The Times of India [32]. Atullah, studied the diversity of species and relative abundance of *Anopheles*, *Aedes* and *Culex* species in Pakistan and found that *Culex* is dominating followed by *Aedes* over the others which supports the current research [12]. Haq and Singh studied the species diversity of mosquitoes in Uttarakhand and found *Culex*, *Aedes* and *Anopheles* to be dominating over other species [11] supported by the work of Kumar et al. who studied the same in Tamil Nadu and found similar results [14]. While studying the abundance of mosquitoes in Jalna [5], it was found that *Anopheles* genus to dominate [5] whereas in the present study where *Culex* was found to be dominating followed by *Anopheles* genus. It was studied that the diversity of mosquitoes from Coimbatore region of Tamil Nadu and found 4 genera of mosquitoes to be predominant, out of which *Culex* was the leading one [15] which further supports our current study. Our work is in sync with the research conducted at Nanded district of Maharashtra wherein *Culex* was found in abundance [2]. The breeding site of *Anopheles* mosquitoes is stagnant water in pond or lakes that are more than half inch in depth whereas the breeding sites of *Culex* and *Aedes* mosquitoes include small puddles or any places for water less than half inch deep [16]. The samples were collected from the places that were habitable by humans such as Rai (Site 1), Navgarh road (Site 2), MBMC Dumping ground (Site 3) and Uttan (Site 4). Thus these sites forms an appropriate breeding place for *Culex* and *Aedes*

mosquitoes. It was observed that that the number of mosquitoes were higher in the month of September in Nanded District of Maharshtra [4]. A similar study was conducted in United Kingdoms which stated the similar results about the population of mosquitoes being highest in the month of September when the temperature of UK was the highest [17] but for the present study it was found that the highest number of mosquitoes was found in the month of November and lowest in the month of July 2022. Mosquitoes are poikilotherms and their temperature is essentially the same as their surroundings, thus they are not capable of regulating their body heat. Mosquitoes are most active at 80°F, become lethargic at 60°F, and cannot function below 50°F [18]. In tropical areas, mosquitoes are active throughout the year. In temperate climates, adult mosquitoes of some species become inactive with the beginning of cool weather and enter hibernation to live through the winter states Central Mass Mosquito Control Project (CMMCP). The temperature in the district of Thane is been fluctuating throughout the year, thus the temperature range in the district was above 29°C in the month of November which is an ideal temperature for them to remain active and reproduce [2].

For the first time, extensive studies on diversity of mosquitoes in Mira Bhayander have been undertaken and it provides a raw data on the diversity of mosquitoes in this area.

## Conclusion

From the present study it can be concluded that there is an increase in the population of *Culex* followed by *Aedes* mosquitoes near human habitats. With the increasing cases of mosquito borne diseases, there is a need to control the growth of mosquitoes before Filariasis and Dengue become [18] endemic to the area and the city further on. There is also a need to reduce the breeding sites of mosquitoes and to increase the awareness regarding the disease and also about basic hygiene among the people. The government needs to take standard measures for the same and people need to be thoroughly educated on the matter.

The diversity of mosquitoes not only depends on the climate but also on the temperature that they thrive in. They require warm temperatures of approximately 29- 30 °C to flourish well.



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