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# Comparative study of species composition, diversity of mosquitoes [Diptera: Culicoidea (Meigen, 1818)] in the Eastern and Western regions of India

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**Abstract**
Mosquitoes are important insects throughout the world because they are vectors of various diseases in the human population. Out of the 3700 mosquito species known to exist worldwide, 393 are found in India. After Brazil, Indonesia, Malaysia, and Thailand, India is the fifth most mosquito-diverse country. Mosquito diversity was discovered to be highly dependent on environmental factors such as temperature, relative humidity, and altitude, resulting in varying species composition and diversity across the Indian subcontinent. The diversity and species composition of mosquitoes in India's eastern and western regions were compared, and there was a significant difference in diversity. A total of 22 mosquito species belonging to *Aedes*, *Culex*, *Anopheles*, *Culiseta*, *Toxorhynchites*, and *Armigeres* were observed in the eastern region of India. In the western region of India, a total of 26 mosquito species belonging to the *Aedes*, *Culex*, and *Anopheles* families were observed. The calculated value of Sorenson's Coefficient was 0.1666, indicating that community similarity did not show much overlap and that *Anopheles* was the dominant genus in the studied region. The Bray-Curtis dissimilarity index was estimated at 0.7143 showed much dissimilarity between investigated two regions which showed much dissimilarity in the species composition of mosquitoes between the studied areas. This work is significant for the study of the adverse effect of mosquitoes on the human population.

**Keywords:** *Anopheles*, bray-curtis dissimilarity index, diversity, sorenson's coefficient

## Introduction
The diversity of life forms ranging from prokaryotes to higher eukaryotes is referred to as biodiversity. The term "diversity" refers to the range of variations that exist from the gene to the ecosystem level. Biodiversity is extremely important in our lives since it is essential for the creation of many items such as food, water, and other resources. Biodiversity is extremely significant both ecologically and economically, and it also plays a vital role in our daily lives because it can be applied to a variety of disciplines for greater development in the modern world. Because of differences in geographical and climatic parameters, diversity is unevenly distributed around the world, which must be understood.

Mosquitoes are a large group of insects in the Diptera order that belong to the Culicidae family. Diptera is the largest order of insects, consisting of two-winged flies. Mosquitoes were abundant in the tropical and temperate regions of the world, but they were also found in the Arctic Circle, the Oriental, and the Neotropical regions [1]. Aside from the Neotropical region, India is considered to have the richest biogeographically regions for mosquitoes in the world [2]. After Brazil, Indonesia, Malaysia, and Thailand, India is the fifth most mosquito-diverse country [3].

Worldwide, 3700 mosquito species from two families and 112 genera have been reported [4]. The diversity and species composition of mosquitoes have been reported to be important for the management and control of the mosquito-borne disease. Mosquitoes serve as vectors for a variety of diseases in the human population. It is estimated that approximately 700 million people are infected by various diseases transmitted by mosquitoes each year [5].

*Culex* species serve as vectors for a variety of diseases, including avian malaria, Nile virus, Lymphatic filariasis, and Japanese encephalitis, making them medically significant [6].
Diversity and species composition of mosquito vector was found directly associated with environmental factors like temperature, relative humidity [7].
Due to different climatic conditions across the country, species composition of mosquitoes shows variations. Important lakes and rivers have receded dramatically as a result of climate change, creating ideal mosquito breeding habitats. As a result, the number of mosquito-borne diseases has grown. Climate change has resulted in disease outbreaks, particularly in locations where such diseases were previously uncommon, as well as the reemergence of disease-transmitting pathogens including microfilaria, arboviruses, and Chickengunya. This is the main cause of this research work.

## Materials and Methods

The information on the species composition of India's Eastern and Western regions was collected from two online resource databases and published material [8, 9] Species composition was compared by calculating the Sorensen's coefficient and Bray-Curtis dissimilarity index.

### Sorensen's coefficient

The Sorensen name in this coefficient stands for Thorvald Sorensen [10].

$$SC = 2 \left| A \cap B \right| \div \left| A + B \right|$$

Here, A∩B = Common species in A & B regions
A = Total number of species in 'A' region
B = Total number of species in 'B' region

### Bray-Curtis dissimilarity index

The Bray-Curtis name in this index stands for Roger Bray and John Curtis [11].
It is a statistic that is used to quantify the compositional dissimilarity between two different regions using counts from each region.

$$BC_{ab} = 1 - 2\, C_{ab} / S_a + S_b$$

Here, $C_{ab}$ = Number of common species in both regions a & b
$S_a$ = Total number of species in the 'A' region
$S_b$ = Total number of species in 'B' region

## Results and Discussion

A total of 22 mosquito species were reported in the Eastern regions of India (Table 1). Mosquitoes were belonging to two different sub-families i.e. Culicinae and Anophelinae of the Culicidae family. Mosquitoes from the Culicinae sub-family were found most abundant in this region. Most of the mosquitoes were reported from the *Anopheles* genus followed by *Culex*, *Aedes*, *Armigeres*, *Culiseta* and *Toxorhynchites* (Fig. 1).

A total of 26 mosquito species were reported in the Western region of India (Table 2). Mosquitoes were belonging to two different sub-families i.e. Culicinae and Anophelinae of the Culicidae family. Mosquitoes from the Culicinae sub-family were found most abundant (14 species) in this region. Most of the mosquitoes were reported from the *Anopheles* genus (12) followed by *Aedes* (7) and *Culex* (7) (Fig. 2).
The Eastern and western regions of India showed some of the common mosquito species, so species composition was compared by calculating Sorensen's coefficient and Bray-Curtis dissimilarity index (Table 3). There were four common species were reported between these two regions i.e. *Aedes aegypti*, *Culex tritaeniorhynchus*, *Anopheles vagus* and *Anopheles barbirostris* as per different climatic conditions between these two regions. Sorensen's coefficient was estimated at 0.2857 for the Eastern and Western regions of India. The result showed that community similarity did not show much overlapping. The value of Sorensen's coefficient ranges from 0 to 1. If the calculated value is zero then there were no community overlapping, meaning there were no common species between two comparable regions. If the value of Sorensen's coefficient is one then complete community overlapping is found, meaning both the comparable region have the same species composition. In the present investigation, the value of Sorensen's coefficient was estimated at 0.2857 which is very near to zero and far from value one, so less species similarity was observed. The dissimilarity of species composition was estimated by calculating the Bray-Curtis index. The value of Bray-Curtis dissimilarity index was estimated at 0.7143 showed much dissimilarity between investigated two regions. The Bray-Curtis index ranges from zero to one. One value of this index indicates that there is no common species found between the two comparable regions and zero value indicated that there are all common species found. In the present investigation value, 0.7143 showed that significant dissimilarity was observed between the Eastern and Western regions of India. It was found that similarity or dissimilarity in species composition of two habitats depends on the climatic parameters and environmental condition of the studied region.
Two mosquitoes from the *Armigeres* genus were reported in the Eastern region of India and none of the species from the *Armigeres* genus was reported in the Western region of India. In a previous study, two different species of mosquitoes from the *Armigeres* genus were reported in the easternmost northeast region of Manipur [12]. *Armigeres* species was also reported in the Kpargaon tehsil along with *Culex*, *Aedes* in the Eastern region of India [13]. In a recent investigation carried out in the Jodhpur district of Rajasthan, *Armigeres* subalbatus mosquito was reported [14]. According to National Geographic, mosquitoes play an important part in many ecosystems. Male mosquitoes devour nectar and pollinate a variety of plants in the process. Many other animals, including bats, birds, reptiles, amphibians, and even other insects, rely on these insects for sustenance. This makes mosquitoes important for the study.

**Table 1:** Species Composition of Mosquitoes in the Eastern regions of India

| S.N. | Name of Mosquitoes | Author | Family | Sub-family | Tribe |
|---|---|---|---|---|---|
| 1 | *Aedes aegypti* | Linnaeus (1762) | Culicidae | Culicinae | Aedini |
| 2 | *Aedes albopictus* | Skuse (1894) | Culicidae | Culicinae | Aedini |
| 3 | *Culex quinquefasciatus* | Say (1823) | Culicidae | Culicinae | Culicini |
| 4 | *Culex tarsalis* | Coquillett (1896) | Culicidae | Culicinae | Culicini |
| 5 | *Culex peus* | Speiser (1904) | Culicidae | Culicinae | Culicini |
| 6 | *Culex tritaeniorhynchus* | Giles (1901) | Culicidae | Culicinae | Culicini |
| 7 | *Culex mimeticus* | Noe (1899) | Culicidae | Culicinae | Culicini |
| 8 | *Culex bitaeniorhynchus* | Giles (1901) | Culicidae | Culicinae | Culicini |
| 9 | *Anopheles barbirostris* | Van Der Wulp (1984) | Culicidae | Anophelinae | Anophelini |
| 10 | *Anopheles nivipes* | Theobald (1903) | Culicidae | Anophelinae | Anophelini |
| 11 | *Anopheles vagus* | Doenitz (1902) | Culicidae | Anophelinae | Anophelini |
| 12 | *Anopheles dirus* | Peyton, Harrison (1979) | Culicidae | Anophelinae | Anophelini |
| 13 | *Anopheles willmori* | James (1903) | Culicidae | Anophelinae | Anophelini |
| 14 | *Anopheles jeyporiensis* | James (1902) | Culicidae | Anophelinae | Anophelini |
| 15 | *Anopheles philippinesis* | Ludlow (1902) | Culicidae | Anophelinae | Anophelini |
| 16 | *Anopheles jamesii* | Theobald (1901) | Culicidae | Anophelinae | Anophelini |
| 17 | *Anopheles mininus* | Theobald (1901) | Culicidae | Anophelinae | Anophelini |
| 18 | *Culiseta melanura* | Coquillett (1902) | Culicidae | Culicinae | Culicini |
| 19 | *Culiseta inornata* | Williston (1893) | Culicidae | Culicinae | Culicini |
| 20 | *Toxorhynchites splenden* | Wiedemann (1819) | Culicidae | Culicinae | Aedini |
| 21 | *Armigeres obturbans* | Walker (1859) | Culicidae | Culicinae | Aedini |
| 22 | *Armigeres aureolineatus* | Leicester (1908) | Culicidae | Culicinae | Aedini |

**Table 2:** Species Composition of Mosquitoes in the Western regions of India

| S.N. | Name of Mosquitoes | Author | Family | Sub-family | Tribe |
|---|---|---|---|---|---|
| 1 | *Aedes aegypti* | Linnaeus (1762) | Culicidae | Culicinae | Aedini |
| 2 | *Aedes culicinus* | Edward (1922) | Culicidae | Culicinae | Aedini |
| 3 | *Aedes sintoni* | Barraud (1924) | Culicidae | Culicinae | Aedini |
| 4 | *Aedes vittaus* | Bigot (1861) | Culicidae | Culicinae | Aedini |
| 5 | *Aedes w-albus* | Theobald (1905) | Culicidae | Culicinae | Aedini |
| 6 | *Aedes yusafi* | Barraud (1931) | Culicidae | Culicinae | Aedini |
| 7 | *Aedes taeniorhynchoides* | Christophers (1911) | Culicidae | Culicinae | Aedini |
| 8 | *Culex halifaxii* | Theobald (1903) | Culicidae | Culicinae | Culicini |
| 9 | *Culex barraudi* | Edward (1922) | Culicidae | Culicinae | Culicini |
| 10 | *Culex sitiens* | Wiedemann (1828) | Culicidae | Culicinae | Culicini |
| 11 | *Culex univittatus* | Theobald (1901) | Culicidae | Culicinae | Culicini |
| 12 | *Culex pseudovishnui* | Colless (1957) | Culicidae | Culicinae | Culicini |
| 13 | *Culex tritaeniorhynchus* | Giles (1901) | Culicidae | Culicinae | Culicini |
| 14 | *Culex malayi* | Leicester (1908) | Culicidae | Culicinae | Culicini |
| 15 | *Anopheles vagus* | Donitz (1902) | Culicidae | Anophelinae | Anophelini |
| 16 | *Anopheles tessellates* | Theobald (1901) | Culicidae | Anophelinae | Anophelini |
| 17 | *Anopheles pallidus* | Theobald (1901) | Culicidae | Anophelinae | Anophelini |
| 18 | *Anopheles pulcherrimus* | Theobald (1902) | Culicidae | Anophelinae | Anophelini |
| 19 | *Anopheles barbirostris* | Van Der Wulp (1884) | Culicidae | Anophelinae | Anophelini |
| 20 | *Anopheles annularis* | Van Der Wulp (1884) | Culicidae | Anophelinae | Anophelini |
| 21 | *Anopheles turkhudi* | Liston (1901) | Culicidae | Anophelinae | Anophelini |
| 22 | *Anopheles stephensi* | Liston (1901) | Culicidae | Anophelinae | Anophelini |
| 23 | *Anopheles subpictus* | Grassi (1899) | Culicidae | Anophelinae | Anophelini |
| 24 | *Anopheles splendidus* | Koidzumi (1920) | Culicidae | Anophelinae | Anophelini |
| 25 | *Anopheles fluviatilis* | James 1902 | Culicidae | Anophelinae | Anophelini |
| 26 | *Anopheles dthali* | Patton 1905 | Culicidae | Anophelinae | Anophelini |

**Table 3:** Comparative study of species composition of mosquitoes by Sorensen's coefficient and Bray-Curtis dissimilarity index

| | Number of Mosquito Species | |
|---|---|---|
| **Genus** | **Eastern region of India** | **The western region of India** |
| *Aedes* | 2 | 7 |
| *Culex* | 6 | 7 |
| *Anopheles* | 9 | 12 |
| *Culiseta* | 2 | 0 |
| *Toxorhynchites* | 1 | 0 |
| *Armigeres* | 2 | 0 |
| Total of Species | $S_a$= 22 | $S_b$=26 |

| | |
|---|---|
| Common species | $C_{ab}$=4 |
| | |
| Sorensen's Coefficient | $2C_{ab} / S_a + S_b$ |
| Sorensen's Coefficient | 2×4/ 22+ 26 = 0.2857 |
| Result | Community similarity did not show much overlapping |
| Dominant Genus | *Anopheles* |
| Bray-Curtis dissimilarity | $1- 2C_{ab}/ S_a + S_b$ = 1-2×4 / 22+26 = 0.7143 |
| | The community showed significant dissimilarity between the two ecosystems |

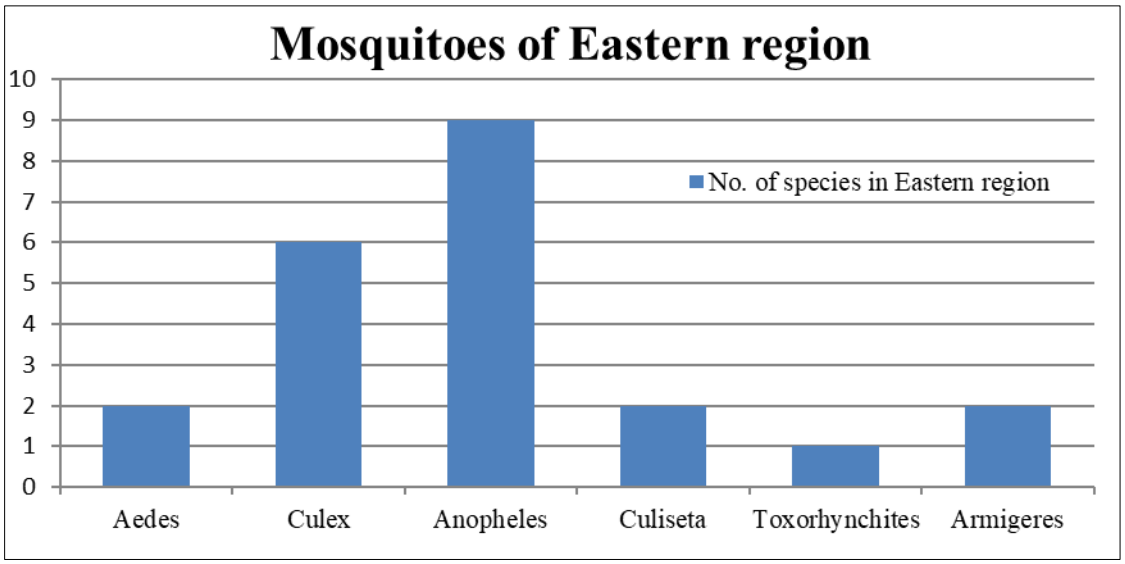


**Fig 1:** Genus diversity of mosquitoes in the Eastern region of India

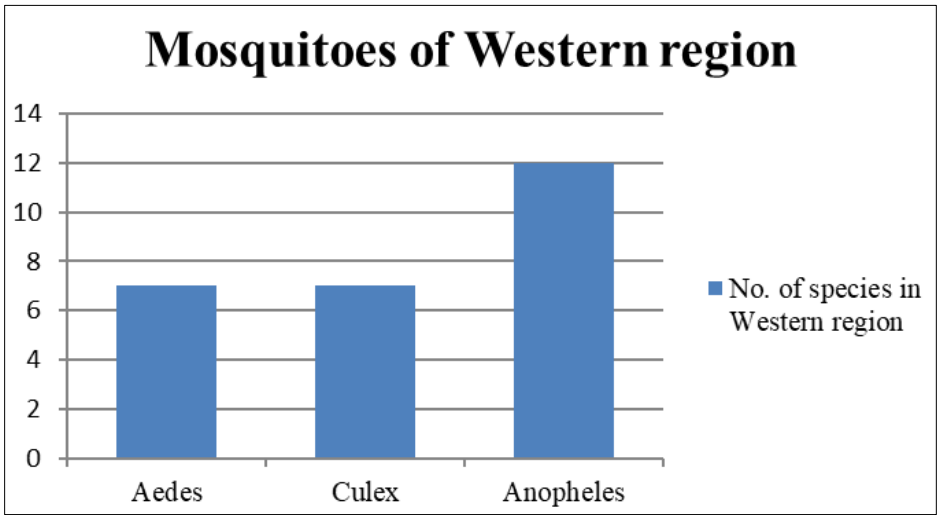


**Fig 2:** Genus diversity of mosquitoes in the Western region of India

## Conclusion

The present investigation showed a comparative study of two different regions of India. There was great dissimilarity in species composition of mosquitoes between two distinct habitats based on environmental parameters and geographical variations. Only four common mosquito species were reported between these two regions. This comparative study was needed for a better understanding of distribution patterns in vector-borne disease. Mosquitoes from the *Anopheles* genus were abundant in both the studied regions.

## References:

1. Harbach RE. The Culicidae (Diptera): a review of taxonomy, classification and phylogeny. Zootaxa. 2007;1668:591-638.
2. Gaston KJ, Hudson E. Regional patterns of diversity and estimates of global insect species richness. Biodiversity and Conservation. 1994;3:493-500.
3. Foley DH, Rueda LM, Wilkerson RC. Insight into mosquito biogeography from country species records. Journal of Medical Entomology. 2007;44:554-567.
4. Harbach RE. Mosquito Taxonomy inventory. Accessible at (http://mosquito-taxonomic-inventory.info). Captured on 17 October 2014.
5. Sule SR, Chavan RJ, Shinde LV, Khaire BS. Climate change, Mosquito diversity and epidemics of mosquito-borne diseases in India. 2021;x0:8389-8403.
6. Bansal SK, Karam V, Kumar S. Larvicidal activity of the extracts from different parts of the plant *Solanum xanthocarpum* against important mosquito vectors in the

arid region. Journal of Environmental Biology. 2009;30:221-226.
7. Shinde LV, Thete KD, Chavan RJ, Birajdar SG. Vector mosquito diversity in association with environmental factors. The Eco scan: special issue. An international quarterly journal of environmental sciences. 2011;1:191-194.
8. Mitra B, Sharma RM, Parui P. Inventory of the true flies (Diptera) of the Thar Desert. Records of Zoological Survey of India. 2005;104:147-155.
9. Vanlalruia K, Senthil KN, Gurushubramanian G. Diversity and abundance of mosquito about their larval habitats in Mizoram, North-eastern Himalayan region. Acta Tropica. 2014;137:1-18.
10. Sorensen T. A method of establishing groups of equal amplitude in plant sociology based on similarity of species and its application to analyses of the vegetation on Danish commons. 1948;5:1-34.
11. Bray JR, Curtis JT. An ordination of upland forest communities of southern Wisconsin. Ecological Monographs. 1957;27:325-349.
12. Bhuvneshwari DM, Dhananjoy CS. Two *Armigeres* species of Manipur, easternmost northeast India. International Journal of mosquito research. 2018;5:39-43.
13. Ramdas GP, Kisan DT, Laximkant VS. Distribution and diversity of mosquito larvae from Kpargaon Tehsil, District, Ahmednagar, India. International journal Life Science Scientific Research. 2017;3:1305-1310.
14. Sharma G, Chittora S, Ojha R. Study on mosquito (Diptera: Culicidae) diversity in Jodhpur district of the Rajasthan state. International Journal of Mosquito Research. 2021;8:16-19.