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Analysis of mosquito population dynamics and diversity in Nanded city, Maharashtra, India

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Abstract

Mosquito-borne diseases continue to be a major public health concern in tropical regions. This study looked at the distribution and diversity of mosquito populations in five locations of Nanded City, Maharashtra, India, from 2024 to 2025. The number of mosquitoes recorded in 2024 was 2,569, and in 2025, it increased to 2,719, indicating an upward trend. To assess species diversity, we used diversity indexes such as Shannon-Wiener (H') and Simpson's index (D). The Shannon index values ($H' = 1.19$ in 2024; $H' = 1.21$ in 2025) showed moderate diversity, whereas Simpson's index values ($D \approx 0.67-0.68$) indicated high diversity with low dominance. Anand Nagar and Vazirabad had higher abundances, with peak populations occurring during the monsoon season. This study underlines the importance of combining diversity indices with spatial data to develop effective vector-management strategies.

Keywords: Mosquito diversity, Shannon index, Simpson index, spatial distribution, Nanded, vector ecology

Introduction

Mosquito populations are important not just for their size but also for their diversity, as different genera play diverse roles in disease transmission (Panda *et al.*, 2024) ^[1]. Ecological indices, such as the Shannon-Wiener and Simpson's indices, are frequently used to evaluate biodiversity and dominance patterns (Onwuegbuzie, 2024) ^[2].

Understanding ecological stability and potential disease threats requires a thorough study of both population density and diversity. As a result, this study covered both diversity indices and the location-wise distribution of mosquitos.

Materials and Methods

Study Area

This study focused on five separate areas of Nanded:

Anand Nagar, Shri Nagar, Taroda, Vazirabad, Degloor Naka.

Data Collection

Data on mosquito populations were regularly collected each month from January to December for two consecutive years, 2024 and 2025. To ensure that the observations were consistent and comparable, sampling was carried out at all five designated sites—Anand Nagar, Shri Nagar, Vazirabad, Taroda, and Degloor Naka. A regular sampling schedule was followed throughout the investigation to eliminate temporal bias and assure the trustworthiness of the gathered data. Mosquitoes were captured using a variety of common entomological techniques. Light traps were set up in the evening to attract and catch adult mosquitos, particularly those that are active at night. In addition, hand nets and aspirators were used to catch mosquitos resting on walls, vegetation, and other surfaces in the early morning and evening. These methods ensured a thorough sampling of the mosquito population across various microhabitats within each study site.

In addition to collecting adult mosquitos, we did further observations to identify probable nesting sites. Regular inspections were conducted in sites such as stagnant water bodies, drainage channels, residential water storage containers, and roadside puddles to identify potential larval habitats. While the study primarily focused on the quantity of adult mosquitos, these findings provided vital information about breeding conditions and

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environmental factors. Each month, all collected specimens were thoroughly numbered and documented at each location. A total of 2,569 mosquitoes were recorded in 2024, and 2,719 in 2025, reflecting a gradual rise in the mosquito population over the study period. To ensure data reliability, consistent sampling efforts and standardized procedures were maintained throughout both years. Observations were recorded using uniform formats, and data entries were cross-checked to minimize errors. This systematic and structured approach facilitated effective analysis of the spatial distribution, seasonal trends, and overall population dynamics of mosquitoes in the study area.

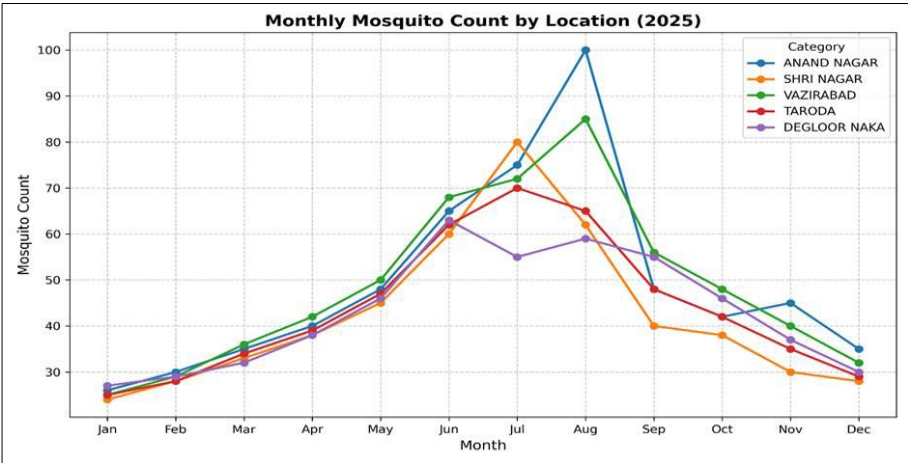
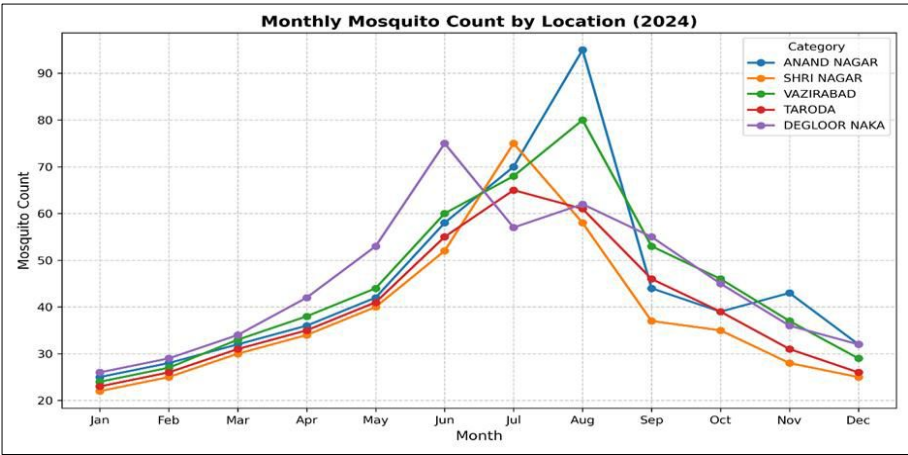
Location-wise Distribution

Mosquito Data (January-December 2024)

Sr. No	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	ANAND NAGAR	25	28	32	36	42	58	70	95	44	39	43	32	544
2	SHRI NAGAR	22	25	30	34	40	52	75	58	37	35	28	25	461
3	VAZIRABAD	24	27	33	38	44	60	68	80	53	46	37	29	539
4	TARODA	23	26	31	35	41	55	65	61	46	39	31	26	479
5	DEGLOOR NAKA	26	29	34	42	53	75	57	62	55	45	36	32	546
Total														2569

Mosquito Data (January-December 2025)

Sr. No.	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	ANAND NAGAR	26	30	35	40	48	65	75	100	48	42	45	35	589
2	SHRI NAGAR	24	28	33	38	45	60	80	62	40	38	30	28	506
3	VAZIRABAD	25	29	36	42	50	68	72	85	56	48	40	32	583
4	TARODA	25	28	34	39	47	62	70	65	48	42	35	29	524
5	DEGLOOR NAKA	27	29	32	38	46	63	55	59	55	46	37	30	517
Total														2719





Diversity Indices

- Diversity Metrics for 2024
- Shannon Index (H') = 1.19
- Simpson's Index (D) = 0.67
- Diversity Metrics for 2025
- Shannon Index (H') = 1.21
- Simpson's Index (D) = 0.68

Interpretation of Diversity

The Shannon-Wiener index values ($H' = 1.2$) indicate a modest diversity level among mosquitoes in the research area, indicating that the mosquito population is dispersed across numerous genera and no single group is overwhelmingly dominant. This pattern suggests a balanced ecological structure where different genera coexist under similar environmental conditions. Likewise, the Simpson's diversity index values ($D \approx 0.68$) suggest high diversity with minimal dominance, meaning there is a relatively high chance of encountering individuals from different genera. This observation further confirms that the mosquito community is not heavily skewed toward one dominant genus but instead shows a stable and varied composition. The minor increase in diversity indices from 2024 to 2025 suggests a marginal improvement in ecological balance, probably due to environmental variables such as improved breeding habitat availability under favorable meteorological

circumstances, which promote the cohabitation of numerous mosquito taxa.

Seasonal Trends

The analysis of monthly mosquito data revealed a clear and consistent seasonal trend across all research sites. During the winter and early summer months (January-March), the mosquito population remained relatively low, likely due to unfavorable environmental conditions such as decreased humidity and fewer breeding sites. Mosquito populations gradually increased beginning in April and peaked during the monsoon season (June-August). This rise can be due to increased rainfall, which causes stagnant water bodies that provide ideal circumstances for mosquito reproduction and growth. From September to December, mosquito population gradually decreased following the monsoon peak. This decline is most likely due to less rainfall, drying of breeding grounds, and less favorable climatic conditions. Importantly, all five study locations displayed comparable seasonal trends, implying that climatic factors dominate mosquito population dynamics across the region, regardless of local environmental changes.

Discussion

Integrating diversity indices with location-specific data provides richer ecological insights.

Diversity Patterns

Mosquito populations were somewhat diverse, with Shannon index values ranging from 1.19 to 1.21, indicating no severe dominance (Visa Shalini *et al.*, 2022) [4]. Simpson's index (~0.67-0.68) showed low dominance and stable diversity, indicating no single genus dominated the environment (Lei *et al.*, 2025) [5].

Spatial Variation

Anand Nagar and Vazirabad have high levels of diversity and abundance, but Shri Nagar has lower diversity. Environmental fluctuation, the abundance of breeding sites, and human activities may all contribute to these variances.

Seasonal Influence

The monsoon season increases population size and diversity by providing additional breeding locations and optimal humidity and temperature conditions (Shah Habibullah *et al.*, 2019) [6].

Ecological and Public Health Implications

Moderate diversity suggests the existence of several vector genera, such as Anopheles (responsible for malaria), Aedes (related with dengue), and Culex (connected to filariasis). This scenario raises the probability of contracting a variety of vector-borne illnesses.

Conclusion

According to the findings, mosquito populations in Nanded are on the rise, with moderate but consistent diversity and a noticeable seasonal influence. The use of diversity indices indicates ecological stability while also indicating potential dangers of transmitting numerous diseases.

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