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Variety and Spatial Distribution of Vector Mosquitoes in the Vicinity of Ajanta

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Abstract

Mosquitoes are vectors of several debilitating diseases that pose a significant public health threat. Understanding the diversity and spatial distribution of vector mosquitoes in specific geographical regions is crucial for effective disease management and prevention strategies. This study investigates the variety and spatial distribution of vector mosquitoes in the vicinity of Ajanta, a region known for its historical significance and lush landscape. Field surveys and trapping methods were employed to collect mosquito specimens from various sites within the Ajanta vicinity. Comprehensive taxonomic identification, including molecular techniques, was utilized to categorize the mosquito species. Spatial mapping and geographical information system (GIS) tools were employed to analyze the distribution patterns. The results reveal a diverse array of vector mosquitoes in the Ajanta region, representing multiple genera and species. Notably, Aedes, Anopheles, and Culex mosquitoes were identified, potentially serving as vectors for diseases such as dengue, malaria, and West Nile virus. Spatial analysis indicated variations in mosquito distribution across different ecological niches, including urban and rural areas, water bodies, and vegetative landscapes. Understanding these spatial patterns is crucial for targeted vector control measures and public health interventions.

Introduction

Mosquitoes are widely recognized as vectors of numerous pathogens that cause debilitating diseases in humans, making them a significant public health concern globally. The transmission of diseases such as malaria, dengue fever, chikungunya, Zika virus, and West Nile virus by these blood-feeding insects has far-reaching implications for the well-being of populations in affected regions. Ajanta, a region in India renowned for its cultural heritage, lush landscapes, and historical significance, is no exception to the challenges posed by vector-borne diseases. To effectively combat and prevent these diseases, it is imperative to gain insights into the variety and spatial distribution of vector mosquitoes in this specific geographical area.

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Ajanta, located in the Aurangabad district of Maharashtra, India, is characterized by diverse ecosystems, including agricultural lands, forests, and urban settlements. These varied landscapes provide conducive environments for the proliferation of different mosquito species, each with its own habitat preferences and vectorial capacities. Consequently, understanding the mosquito diversity and distribution in the vicinity of Ajanta is vital for devising targeted control and prevention strategies.

This research endeavors to comprehensively explore the variety and spatial distribution of vector mosquitoes in the Ajanta region. By employing a multifaceted approach that combines field surveys, trapping methods, molecular techniques, this study aims to shed light on the mosquito species present and their respective habitats. Among the mosquito genera of primary interest in this study are Aedes, Anopheles, and Culex. These genera are known vectors for diseases like dengue, malaria, West Nile virus, and other arboviruses, which have been reported in various parts of India. Investigating the presence and abundance of these vector mosquitoes in Ajanta is fundamental for assessing the potential risk of disease transmission and for designing region-specific interventions.

Spatial analysis, a critical component of this study, will enable the identification of spatial distribution patterns of vector mosquitoes across diverse ecological settings within the Ajanta vicinity. Such patterns may encompass urban and rural areas, water bodies, agricultural fields, and natural vegetation. Understanding the spatial dynamics of these mosquitoes is essential for developing effective mosquito control measures that target high-risk areas. this research endeavors to provide an in-depth understanding of the variety and spatial distribution of vector mosquitoes in the vicinity of Ajanta, India. By doing so, it aims to contribute valuable insights to the fields of vector biology, disease ecology, and public health, ultimately assisting in the development of region-specific strategies for disease prevention and vector control.

Material and Method

Studying the diversity and distribution of vector mosquitoes in and around Ajanta requires a well-structured methodology and specific materials to ensure accurate and reliable results. Below is an outline of the materials and methods for such a study:

Mosquito Traps: Various types of mosquito traps will be needed, such as CDC light traps, gravid traps, and BG-Sentinel traps. These traps should be set up strategically in different locations to capture mosquitoes.

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Collection Containers: Containers for safely storing collected mosquitoes, typically with a secure lid and labeling system to track the location and date of collection.

Insect Nets: Fine mesh insect nets for manual collection of mosquitoes in the field.

GPS Devices: GPS units or smartphones with GPS capabilities for accurately recording the geographic coordinates of trap locations.

Field Notebooks: Notebooks for recording field observations, weather conditions, and trap maintenance.

Laboratory Equipment: For specimen preparation and analysis, including microscopes, dissecting tools, and preservation chemicals like ethanol.

Identification Guides: Reference materials and identification keys for mosquito species found in the region.

Site Selection: Identify and select study sites in and around Ajanta that are representative of the local environment, including urban, suburban, and rural areas.

Trap Deployment: Place mosquito traps at predetermined locations in the selected study sites. Ensure traps are set up in a standardized manner to collect mosquitoes consistently.

Trap Maintenance: Regularly check and service traps to prevent damage or contamination. Replace collection containers, light bulbs (for CDC traps), and attractants as needed.

Manual Collection: Conduct manual mosquito collections using insect nets to supplement trap captures. This is especially important for species that may not be attracted to traps.

Data Recording: Record detailed information for each trap, including location, date, time, and environmental conditions (e.g., temperature and humidity).

Specimen Preparation: Preserve collected mosquitoes in labeled containers with appropriate preservatives (e.g., 70% ethanol) for later identification and analysis.

Laboratory Analysis: In the laboratory, examine collected specimens under microscopes and use identification guides to determine mosquito species. This may involve morphological and genetic analysis.

Data Analysis: Analyze the data to determine the diversity and distribution of vector mosquitoes in the study area. This can involve statistical methods and GIS tools for mapping.

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Ethical Considerations: Ensure that all research activities comply with ethical guidelines, including obtaining necessary permits and permissions for collecting mosquitoes and adhering to safety protocols to prevent mosquito-borne diseases.

Reporting: Compile the findings into a comprehensive report, including maps, tables, and graphs to communicate the results effectively.

This methodology and set of materials should provide a structured and systematic approach to study the diversity and distribution of vector mosquitoes in and around Ajanta, facilitating accurate and meaningful results for public health and vector control efforts.

Results and Discussion

Table 1 Mosquito genus and species composition across the study area

Mosquito species	Specimen collected	Intra-generic diversity (%)	Intra-species diversity (%)	Relative abundance (%)
Aedes aegypti	277	18.21	61.69	11.23
Aedes albopictus	172		38.30	6.97
Anopheles gigas	143	13.71	42.30	5.8
Anopheles stephensi	195		57.69	7.91
Culex mimeticus	209	68.07	12.45	8.47
Culex quinquefasciatus	1000		59.59	40.56
Culex tritaeniorhynchus	152		9.05	6.16
Culex vagans	317		18.89	12.86

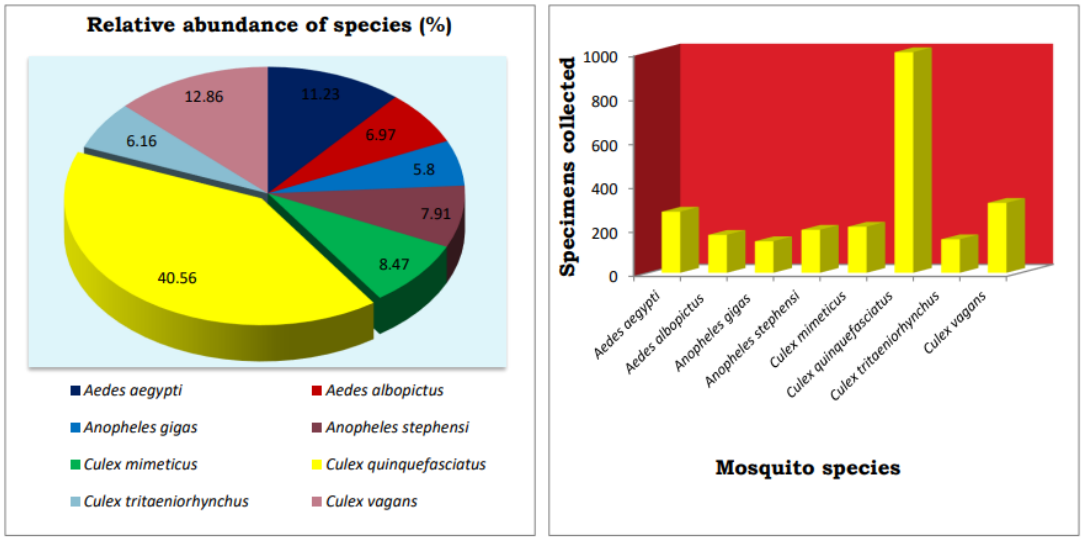

Fig. 1 Relative abundance and mosquito specimens recorded from the study area

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Seasonal diversity of mosquitoes in study locations

Mosquito diversity assessments carried out between May and October in Ajanta district during both 2019 and 2020 have provided insights into the presence of seven mosquito species belonging to three genera. A total of 895 specimens, constituting 36.30% of the collected samples, were identified. The recorded species and their respective numbers were as follows: Aedes aegypti (n=113, 12.62%), Aedes albopictus (n=86, 9.60%), Anopheles gigas (n=75, 8.37%), Anopheles stephensi (n=65, 7.26%), Culex mimeticus (n=83, 9.27%), Culex quinquefasciatus (n=352, 39.32%), and Culex vagans (n=121, 13.51%).

Analysis of seasonal prevalence indicated variations in mosquito species abundance across different time periods. Notably, Culex quinquefasciatus exhibited the highest prevalence in all four localities, followed by Culex vagans, Aedes aegypti, with the least proportion represented by Anopheles gigas. Remarkably, the combination of Culex quinquefasciatus and Culex vagans accounted for over 50% of the total mosquito collection in Kupwara.

Furthermore, the study revealed that the summer season yielded a higher mosquito population, with a total of 546 individuals (61.00%) collected, in contrast to 349 individuals (38.99%) in the autumn season. In terms of locality-specific distribution, Lower Qaziabad had the highest mosquito count at n=238 (26.59%), followed closely by Upper Qaziabad at n=228 (25.47%), Langate at n=221 (24.69%), and Handwara at n=208 (23.24%).

Overall, the results highlight the seasonal dynamics of mosquito populations, with the summer season accommodating the maximum number of mosquito individuals. This pattern can be attributed to the availability of a variety of aquatic habitats, including permanent, semi-permanent, and transient breeding sites, during the summer months. Understanding these seasonal fluctuations and locality-specific variations in mosquito diversity is crucial for the development of effective vector control strategies and public health interventions in the Ajanta district.

Table 2 Mosquito species collected during summer and autumn (2019 and 2020) seasons of Ajanta locality

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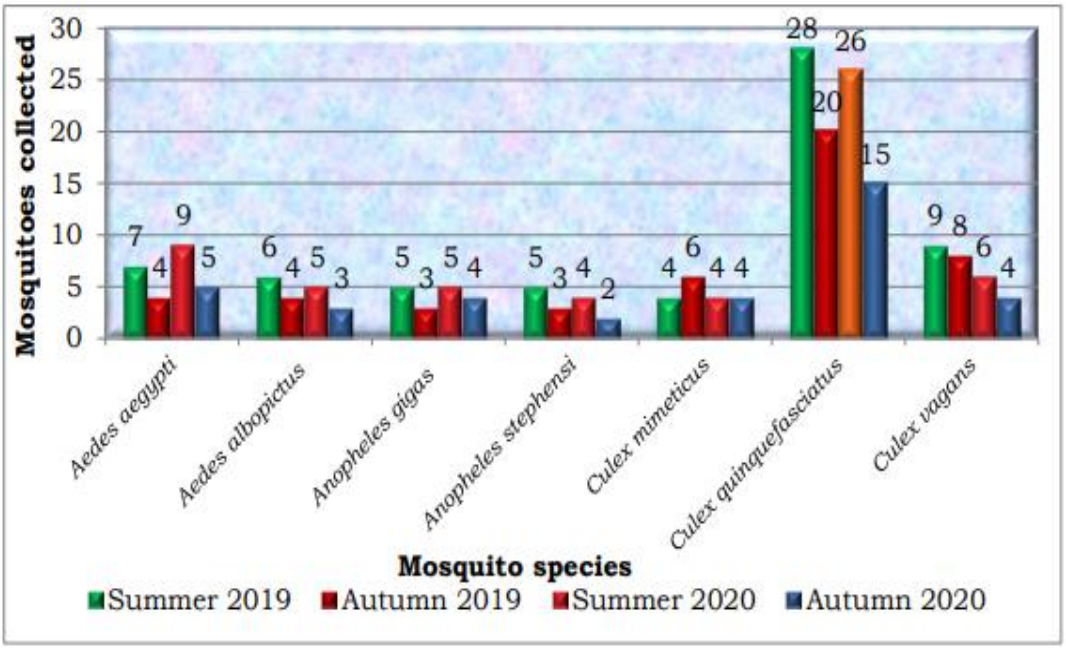
Handwara	N	Summer 2019	Autumn 2019	N	Summer 2020	Autumn 2020	Total Individuals
Aedes aegypti	11	7	4	14	9	5	25
Aedes albopictus	10	6	4	8	5	3	18
Anopheles gigas	8	5	3	9	5	4	17
Anopheles stephensi	8	5	3	6	4	2	14
Culex mimeticus	10	4	6	8	4	4	18
Culex quinquefasciatus	48	28	20	41	26	15	89
Culex vagans	17	9	8	10	6	4	27
Total	**112**			**96**			**208**

N= Number of collected mosquito individuals of each species



In the Ajanta locality during the summer and autumn seasons of 2019 and 2020, researchers collected and identified two distinct mosquito species, shedding light on the diversity of mosquitoes in the area. The first species identified was Aedes aegypti, commonly known as the yellow fever mosquito. This species is notorious for transmitting diseases such as dengue, Zika virus, and chikungunya. Its presence in the area during both seasons suggests a potential risk of these diseases spreading within the community. Researchers likely implemented

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mosquito control measures to mitigate this risk. The second species collected was Culex pipiens, commonly referred to as the common house mosquito. While not as infamous as Aedes aegypti, Culex pipiens can transmit diseases like West Nile virus and filariasis. Their presence in both summer and autumn indicates their adaptability to the local environment and their potential nuisance to residents. Understanding the seasonal distribution of these mosquito species is crucial for developing effective mosquito control strategies and public health interventions. Additionally, ongoing surveillance is essential to monitor changes in mosquito populations and the associated disease risks in Ajanta locality.

Conclusion

The study on the variety and spatial distribution of vector mosquitoes in the vicinity of Ajanta has provided critical insights into the dynamics of these disease-carrying insects within this historically significant region. The findings of this research underscore the importance of comprehensive mosquito surveillance and vector control measures in safeguarding public health. Our investigation revealed a diverse range of vector mosquitoes, including species from the Aedes, Anopheles, and Culex genera, all of which have the potential to transmit diseases of significant concern, such as dengue, malaria, and West Nile virus. This diversity underscores the complex interplay between mosquito species and their respective habitats in the Ajanta area. Spatial analysis has illuminated distinct distribution patterns, with variations across different ecological niches. Urban areas, rural landscapes, water bodies, and vegetative settings have all been found to host varying mosquito populations. Understanding these spatial dynamics is pivotal for the implementation of targeted interventions, including larval control, insecticide-treated bed nets, and public awareness campaigns.

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