International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 07-08-2024, Accepted: 06-09-2024, Published: 21-09-2024
Volume 9, Issue 9, 2024, Page No. 98-100

The study of mosquito fauna diversity through biomonitoring in designated locations within the Madurai district, Tamil Nadu

P Yuvarani[1], R Umamaheshwari[2], S Krishnamoorthy[3*]
[1] Department of Zoology, Sri Meenakshi Govt. Arts College for Women, Madurai, Tamil Nadu, India
[2] Department of Zoology, A.P.A College for Women, Palani, Dindigul, Tamil Nadu, India
[3] Department of Zoology, Vivekananda College, Tiruvedakam West, Madurai, Tamil Nadu, India

Abstract
This study conducted a survey of mosquito density across three selected locations in the Madurai district, specifically Nagamalai, Kochadai, and Viratippathu. The findings reveal the existence of ten mosquito species categorized into four genera: *Aedes, Anopheles, Armigeres, and Culex.* The overall collection of mosquitoes was relatively low, with the exception of *Culex quinquefasciatus*, which was more prevalent. Diversity indices, specifically Shannon's and Simpson's, exhibited minor variations among the three sites. Kochadai recorded a slightly elevated Shannon's index of 1.883, in contrast to Nagamalai and Viratippathu, both of which had indices of 1.804. Similarly, Kochadai's Simpson's index was marginally higher at 0.7994 compared to Nagamalai and Viratippathu, which had indices of 0.7677 and 0.7579, respectively. The study identified that the peak mosquito population density occurred in July and October, while the lowest density was observed in September.

Keywords: Mosquito fauna, biomonitoring, Tamil Nadu

Introduction
Mosquitoes represent the most significant family of insects impacting human health globally. Despite numerous efforts to manage their populations, these highly adaptable mosquitoes continue to thrive alongside humans, feeding on both people and their domesticated animals (Pandian, 1998) [7]. In addition to causing blood loss, they are vectors for various diseases, including filariasis, malaria, yellow fever, Japanese encephalitis, and dengue (Dutta *et al*., 2003; Service, 1983) [5]. Their aggressive feeding behavior, high reproductive rates, ability to disperse, and effective environmental adaptation contribute to the widespread proliferation of mosquitoes around the world (Pandian, 1990).
Mosquitoes inhabit a wide range of environments linked to water sources, including sewage, stagnant water, and septic tanks. It is imperative to address the increase in both vector and non-vector mosquito populations to mitigate the spread of vector-borne diseases and alleviate their associated nuisances through effective control measures. The breeding habitat plays a vital role in the dynamics of mosquito populations, as it serves as the site for several critical life cycle processes. These processes encompass larval development, adult emergence, resting, swarming, and mating behaviors of adults (Reuben, 1978).
With the continuous increase in the density of both vector and non-vector species, it is crucial to employ all relevant technological and management strategies to achieve an effective level of control in a cost-efficient manner (Kumar *et al*., 2002) [6]. Effective mosquito management necessitates the gathering of comprehensive knowledge regarding species diversity and distribution patterns within a specific area. This understanding is vital for developing and implementing appropriate strategies aimed at meaningful population control, ultimately reducing the threat and incidence of related diseases (Rajavel *et al*., 2001) [8].
Despite numerous studies being carried out in different regions globally, especially in India and certain locations within Tamil Nadu, there remains a necessity to investigate the bionomics of mosquitoes across all areas. Therefore, a survey of the mosquito fauna has been conducted in three chosen sites: Nagamalai, Kochadai, and Viratippathu, located in the Madurai district of Tamil Nadu.

Materials and Methods
Sampling strategy
Mosquito sampling was systematically conducted at three designated locations within the Madurai district of Tamil Nadu, specifically at Nagamalai, Kochadai, and Viratippathu. This sampling initiative spanned a period of six months, from July 2017 to December 2017, with collections occurring on a monthly basis. The sampling sessions were strategically scheduled to take place during the hours of 7:00 PM to 9:00 PM, a timeframe that aligns with the peak activity periods of many mosquito species.

Collection of adult female mosquitoes
The biting rhythm patterns of mosquitoes were examined at two distinct locations within the chosen village by continuously capturing biting mosquitoes throughout the night using human subjects as bait. In this study, humans served as the bait. Transparent vials (4.5 x 2.5 cm) with lids were employed to collect the mosquitoes. The vials were swiftly positioned over the mosquitoes while they were feeding. The captured mosquitoes were subsequently anesthetized and euthanized using ether, and then stored in separate vials labelled with the time and location of collection. The identification of the collected adult female mosquitoes was conducted by specialists at the Centre for Research in Medical Entomology (CRME) in Madurai.

Results and Discussion

By the Jurassic period, approximately 210 million years ago, mosquitoes had already undergone significant evolutionary changes (Edwards, 1932). This era coincided with the onset of continental drift (Wilson, 1963), which resulted in the fragmentation of landmasses and geographic isolation, likely facilitating rapid speciation. Currently, over 3,200 mosquito species have been identified across 37 genera, categorized into three subfamilies: *Anophelinae*, *Culicinae*, and *Toxorhynchitinae*, comprising 3, 33, and 1 genus respectively (Ward, 1992). Notably, the genus Anopheles includes approximately 420 species, *Aedes* encompasses 950 species, *Culex* contains 800 species, and *Mansonia* has 25 species. Their rapid proliferation can be attributed to their aggressive feeding behavior, high reproductive rates, and effective environmental adaptation (Berlin, 1972). Furthermore, mosquitoes are distributed nearly worldwide, inhabiting regions from the equator to the poles and from sea level to altitudes of at least 7,000 feet. Certain species serve as significant vectors for diseases such as malaria, filariasis, yellow fever, dengue fever, and other arboviral infections (Malar *et al*., 2015, Prasad *et al*., 2021; Saravanabavan *et al*., 2021) [2, 3, 4]. In India, the primary vector mosquitoes belong to four genera: *Anopheles* (malaria), *Aedes* (dengue fever), *Culex* (filariasis and Japanese encephalitis), and *Mansonia* (filariasis).

The mosquito fauna of India comprises 255 species categorized into 16 genera. Of these, 58 species are classified under the genus Anopheles, 57 under Culex, 111 under Aedes, and 7 under Mansonia (Chaves *et al*., 2011) [1]. In Madurai, a total of 27 mosquito species have been identified across the genera Aedes, Anopheles, Armigeres, Culex, and Mansonia (Pandian, 1998) [7]. Among these genera, *Anopheles*, *Aedes*, and *Culex* are particularly significant due to their capacity to transmit serious diseases such as Malaria, Dengue, Filariasis, and Japanese encephalitis, respectively (Nalluchamy *et al*., 2024; Vinothini *et al*, 2024 and Reshma *et al*., 2020) [11, 12, 13].

The current research indicates that a survey conducted from July 2017 to December 2017 identified ten species across four genera*: Aedes*, *Armigeres*, *Anopheles*, and *Culex*, prevalent in the study area. Among these, *Armigeres* and *Anopheles* each comprise a single species. The genus *Aedes* includes four species: *Aedes (adenomorphus) vexans, Aedes aegypti, Aedes albopictus, and Aedes lineatophenetus*. Similarly, the genus *Culex* is represented by four species: *Culex gelidus*, *Culex infula*, *Culex quinquefasciatus*, and *Culex tritaneorhyncus.*

Table 1 presents the various diversity metrics of mosquito populations observed in Nagamalai from July 2010 to December 2010. The peak dominance of mosquitoes occurred in September. The highest value of Shannon's index was recorded in July at 1.804, while the lowest value of 1.267 was noted in September. Additionally, the maximum value of Simpson's index, 0.7677, was observed in July, with a minimum value of 0.5321 recorded in September.

Table 1: Diversity metrics of mosquito populations observed in Nagamalai

Diversity measures	Taxa S	Individuals	Dominance_D	Shannon_H	Simpson_1-D	Evenness_e^H/S
Jul 2017	10	209	0.2323	1.804	0.7677	0.6072
Aug 2017	9	227	0.3446	1.519	0.6554	0.5078
Sep 2017	10	516	0.4679	1.267	0.5321	0.3549
Oct 2017	10	450	0.2688	1.707	0.7312	0.5512
Nov 2017	9	579	0.2668	1.7	0.7332	0.608
Dec 2017	10	496	0.2617	1.764	0.7383	0.5837

Table 2 outlines the dominance and diversity indices of mosquito populations documented in Kochadai. The month of September also exhibited the highest mosquito dominance. The Shannon's index reached its peak at 1.883 in October, whereas it fell to a minimum of 1.488 in September. For Simpson's index, the highest value of 0.7994 was noted in July, while the lowest value of 0.6288 was recorded in September.

Table 2: Diversity metrics of mosquito populations observed in Kochadai

Diversity measures	Taxa S	Individuals	Dominance_D	Shannon_H	Simpson_1-D	Evenness_e^H/S
Jul 2017	10	181	0.2006	1.879	0.7944	0.6548
Aug 2017	9	224	0.2357	1.769	0.7643	0.6517
Sep 2017	10	417	0.3712	1.488	0.6288	0.4428
Oct 2017	10	478	0.2181	1.883	0.7819	0.6576
Nov 2017	10	457	0.2488	1.801	0.7512	0.6055
Dec 2017	10	517	0.2464	1.802	0.7536	0.6064

Table 3 presents the various diversity metrics of mosquito populations observed in Viratippathu from July 2010 to December 2010. The peak dominance of the mosquito population occurred in September. The highest values for Shannon's and Simpson's diversity indices were recorded in October, at 1.804 and 0.7579, respectively, while the lowest values were noted in September, at 1.295 and 0.5415. The diversity indices (Shannon's and Simpson's) exhibited minor variations across the three selected study sites. Specifically, the Shannon's index for Kochadai was marginally higher at 1.883 compared to Nagamalai and Viratippathu, both of which had values of 1.804. Similarly, the Simpson's index for Kochadai was slightly elevated at 0.7994 in contrast to Nagamalai and Viratippathu, which recorded indices of 0.7677 and 0.7579, respectively.

Table 3: Diversity metrics of mosquito populations observed in Viratippathu

Diversity measures	Taxa S	Individuals	Dominance_D	Shannon_H	Simpson_1-D	Evenness_e^H/S
Jul 2017	10	250	0.2587	1.785	0.7413	0.596
Aug 2017	10	326	0.2509	1.766	0.7491	0.5848
Sep 2017	9	574	0.4585	1.295	0.5415	0.4056
Oct 2017	10	539	0.2421	1.804	0.7579	0.6074
Nov 2017	10	613	0.2779	1.715	0.7221	0.5555
Dec 2017	10	598	0.256	1752	0.744	0.5768

It is widely recognized that certain mosquito species, which were initially zoophilic and sylvatic, have transitioned to feeding on humans, becoming peridomestic and even periurban as a result of deforestation. The extent to which humans participate in specific host-parasite cycles is influenced by their activities on the breeding habitats of vectors, the vectors' ability to adapt to new ecological conditions, the availability of animal reservoirs, and patterns of human behavior. In India, *Aedes albopictus*, a vector for dengue hemorrhagic fever, was identified as a sylvatic species in the current survey. *Culex quinquefasciatus* serves as the primary vector for urban filariasis, which is caused by the periodic presence of *Wuchereria bancrofti*. During the study period, the highest density of the mosquito population was recorded in July and October, while the lowest density was observed in September.

The conservation of biodiversity requires comprehensive baseline data on all species of fauna and flora, including those that are less well-known, as each group contributes uniquely as producers, consumers, pollinators, and decomposers. The varied micro and macro climatic conditions support a wide range of invertebrate fauna, including mosquitoes, which are crucial for the conservation and maintenance of biodiversity within the study area.

References

1. Chaves LF, Hamer GL, Walker ED, Brown WM, Ruiz MO, Kitron UD. Climatic variability and landscape heterogeneity impact urban mosquito diversity and vector abundance and infection. Ecosphere,2011:2(6):1-21.
2. Malar KS, Gopal R, Pandian RS. Influential inflicts of monsoon and agricultural practices among the population density of mosquitoes in the agro-rural villages of Madurai. Int J Mosquito Res,2015:2(1):42-6.
3. Prasad KI, Govindarajan R, Sreepada KS. Seasonal diversity of mosquito species in Dakshina Kannada district, Karnataka, India. J Vector Borne Dis,2021:58(2):119-25.
4. Saravanabavan V, Balaji D, Reshma CU, Sheheersha SK, Sudharsan R, Vimala Vinnarasi J, *et al*. Urban disease ecology and its spatial variation of Chikungunya in Madurai City, Tamilnadu, India: a geo-medical study. GeoJournal,2021:86:2335-50.
5. Dutta PS, Khan SA, Khan AM, Sharma CK, Hazirika NC, Mahanta J. Survey of medically important mosquito fauna in Mizoram. Entomon,2003:28(3):237-40.
6. Kumar SR, Pandian RS, Ismail M. Biting and breeding behaviour of mosquitoes in Devakottai, Tamilnadu, South India. Env Pol Tech,2002:1(2):87-92.
7. Pandian RS. Biodiversity of mosquito fauna and efficacy of biopesticides against mosquitoes in an urban area in Tamilnadu. Indian J Environ Sci,1998;2(1):7-16.
8. Rajavel AR, Munirathinam A, Natarajan R, Vaidyanathan K. Species diversity of mosquitoes (Diptera: Culicidae) in mangrove ecosystem in South India. Entomon,2001:16(3&4):271-7.
9. Reuban R. A report on mosquitoes collected in the Krishna Godavari delta, Andhra Pradesh. Indian J Med Res,1978:68:603-9.
10. Southwood TRE. Ecological methods. London: Chapman and Hall, 1978, 524.
11. Nalluchamy KD, Soorangkattan S, Rajasekaran MR, Pitchai M, Muthuramalingam JB, Sivagnanam C. Studies on the influence of water quality on community assemblage of immature mosquitoes in different ecosystems along the Vaigai river, Tamil Nadu, South India. J Basic Appl Zool,2024:85(1):1-16.
12. Vinothini C, Saravanabavan V, Rose RS. Travel patterns of adult patients to primary health centers in Madurai district: a public health perspective, 2024.
13. Reshma VSDBC, Sheheersha SK, Balasubramani SEK. Urban disease ecology and its spatial variation of Chikungunya in Madurai City, Tamilnadu, India: a geo-medical study, 2024.