

Species Diversity of Mosquito Vectors in Khok Ket Village, Samut Songkhram Province, Thailand

Sedthapong Laojun^{1,*} and Tanawat Chaiphongpachara²

¹ Department of Public Health and Health Promotion, College of Allied Health Sciences, Suan Sunandha Rajabhat University, Samut Songkhram, 75000, Thailand, E-mail: sedthapong.la@ssru.ac.th

² Department of Public Health and Health Promotion, College of Allied Health Sciences, Suan Sunandha Rajabhat University, Samut Songkhram, 75000, Thailand, E-mail: tanawat.ch@ssru.ac.th

*Corresponding author

Abstract

Mosquitoes are important vectors of several human diseases, including malaria, filariasis, dengue fever, chikungunya, and Japanese encephalitis. Understanding the species diversity and distribution of mosquito vectors is crucial for effective surveillance and control. This study investigated the species diversity of mosquito vectors in Khok Ket Village, Plai Phongphang Subdistrict, Amphawa District, Samut Songkhram Province, Thailand. Mosquitoes were collected using BG light traps baited with dry ice from April to May 2023 and identified morphologically under a stereomicroscope using standard taxonomic keys. A total of 221 mosquitoes were collected and classified into 11 species. The most abundant species were *Anopheles tessellatus* (31.67%), a suspected secondary vector of malaria and filariasis; *Anopheles hyrcanus* group (*An. paraliae* / *An. pursati*) (17.19%), a potential malaria vector; and *Culex gelidus* (14.93%), a vector of Japanese encephalitis. Species diversity indices revealed a Dominance Index (D) of 0.18, a Simpson Index of 0.82, a Shannon Index of 1.95, a Margalef Richness of 1.85, and an Evenness of 0.64, indicating moderate species diversity and richness in the study area. These findings highlight the potential risk of mosquito-borne disease transmission in Samut Songkhram Province and provide essential baseline data to support public health authorities in developing effective vector surveillance and control strategies.

Keywords: mosquito vectors, species diversity, Samut Songkhram, disease surveillance

1. Introduction

Mosquitoes are small insects distributed worldwide, with the greatest abundance in tropical and temperate regions (Osório et al., 2014; Promprao et al., 2025). Globally, approximately 3,718 mosquito species have been identified, several of which act as vectors transmitting pathogens responsible for serious human diseases. Each year, mosquito-borne infections affect millions of people and cause hundreds of thousands of deaths (Raksakoon and Potiwat, 2021). Among the medically important species, *Aedes aegypti* and *Aedes albopictus* transmit dengue hemorrhagic fever and chikungunya, *Culex* mosquitoes serve as vectors of Japanese encephalitis, *Mansonia* mosquitoes transmit filariasis, and *Anopheles* mosquitoes are responsible for malaria transmission. The biology and ecology of mosquito species vary widely, including their breeding habitats, resting sites, blood-feeding preferences, host-seeking behavior, life cycles, and environmental adaptations (Norbert, 2010). Therefore, understanding the species diversity,

habitat distribution, and population abundance of mosquito vectors is essential for effective surveillance and control of mosquito-borne diseases (Osório et al., 2014).

In Thailand, mosquito borne diseases continue to pose a significant public health challenge (Damapong et al., 2016). Samut Songkhram, the smallest province in central Thailand, covers an area of approximately 416.7 square kilometers. It is bordered by Samut Sakhon Province to the north and east, Phetchaburi Province to the south and west, and Ratchaburi Province to the west. The province is characterized by low-lying plains adjoining the Gulf of Thailand, featuring fertile mangrove forests and a tropical, humid climate. Administratively, Samut Songkhram is divided into three districts, including Mueang Samut Songkhram, Amphawa, and Bang Khonthi, with a total population of around 200,000 people. Most residents engage in orchard farming, agriculture, and coastal fisheries due to the province's flat terrain and coastal environment. Epidemiological data from the past three years indicate that dengue fever is the most prevalent mosquito-borne disease in Samut Songkhram Province. In 2021, 11 cases were reported; in 2022, 93 cases; and in 2023, 667 cases. Malaria ranked second, with no reported cases in 2021, two cases in 2022, and two cases in 2023. Chikungunya ranked third, with no reported cases in 2021 and 2022, and one case in 2023. This upward trend in mosquito-borne infections underscores the persistent challenges in vector control and disease prevention within the province.

Comprehensive disease surveillance, vector control, and the elimination of mosquito breeding sites are essential measures for reducing mosquito populations (Srisuka et al., 2022). Therefore, this study investigated the species diversity of mosquito vectors in Khok Ket Village, Samut Songkhram Province, Thailand. The findings of this study will provide important information to support future disease control efforts in Samut Songkhram Province.

2. Research Objective

This study aimed to investigate the species diversity of mosquito vectors in Khok Ket Village, Samut Songkhram Province, Thailand.

3. Methodology

Mosquito Collection

Mosquitoes were collected in Khok Ket Village, Plai Phongphang Subdistrict, Amphawa District, Samut Songkhram Province (13°23'19.5"N, 99°55'36.3"E) using BG light traps baited with dry ice from April to May 2023. The traps operated nightly from 18:00 to 07:00 (13 hours per night). Each morning at 07:00, the collection bags were retrieved and placed at 20 °C for 20 minutes to euthanize any remaining live specimens. Collection details, including the date, month, and year, were recorded on each bag. The preserved specimens were then transported to the College of Allied Health Sciences, Suan Sunandha Rajabhat University, for species identification.

Morphological Identification of Mosquitoes

Upon arrival at the Biology Laboratory, College of Allied Health Sciences, Suan Sunandha Rajabhat University, mosquito specimens were immediately processed using standard morphological identification methods. Identification began with sex separation, using only female mosquitoes for analysis, as males are not considered disease vectors. Each specimen was then carefully identified to the species level based on morphological characteristics and diagnostic features under a stereomicroscope, following standard taxonomic keys for Thai mosquitoes (Rattanaarithikul et al., 2005).

Statistical Analysis

The diversity indices used in this study were as follows:

1) Dominance Index (D): This index indicates whether certain mosquito species are dominant within the study area. Its value ranges from 0 to 1, with values closer to 1 suggesting that a few species dominate the population (i.e., the presence of highly abundant species).

2) Simpson Diversity Index (Simpson_1-D): This index estimates the probability that two mosquitoes randomly selected from a sample belong to the same species. The index ranges from 0 to 1, with higher values indicating greater species diversity.

3) Shannon Species Diversity Index (H): This index represents the overall diversity of mosquito species in the study area, where higher values correspond to greater diversity.

4) Margalef Richness Index (S): This index reflects the species richness of mosquitoes in the study area. A higher value indicates a greater number of mosquito species.

5) Evenness Index (J): This index measures the uniformity of mosquito species distribution within the study area. It ranges from 0 to 1, with values closer to 1 indicating a more even distribution among species.

4. Results

Mosquito Species Found in Khok Ket Village

Mosquito species collected from Khok Ket Village, Plai Phongphang Subdistrict, Amphawa District, Samut Songkhram Province are presented in Table 1. A total of 221 mosquitoes were collected and identified, representing 11 species. The most abundant species was *Anopheles tessellatus*, a suspected secondary vector of malaria and filariasis, with 70 individuals accounting for 31.67% of the total collection. The second most common species was *Anopheles hyrcanus* group (*An. paraliae* / *An. porsati*), vectors of malaria, with 38 individuals (17.19%), followed by *Culex gelidus*, a vector of Japanese encephalitis, with 33 individuals (14.93%).

Table 1. Mosquito Species Collected from Khok Ket Village, Plai Phongphang Subdistrict, Amphawa District, Samut Songkhram Province.

Mosquito species	<i>n</i>	Percentage (%)	Disease transmitted
<i>Aedes aegypti</i>	1	0.45	Dengue fever, Chikungunya
<i>Aedes albopictus</i>	13	5.88	Dengue fever, Chikungunya
<i>Aedes amesii</i>	8	3.62	-
<i>Anopheles hyrcanus</i> group (<i>An. paraliae</i> / <i>An. pursati</i>)	38	17.19	Malaria
<i>Anopheles tessellatus</i>	70	31.67	Malaria, Filariasis
<i>Anopheles umbrosus</i> group	14	6.33	Filariasis
<i>Armigeres subalbatus</i>	28	12.67	Filariasis
<i>Culex gelidus</i>	33	14.93	Japanese encephalitis
<i>Mansonia annulifera</i>	6	2.71	Filariasis
<i>Mansonia indiana</i>	8	4.07	Filariasis
<i>Mansonia uniformis</i>	1	0.45	Filariasis
Total	221	100	

Species Diversity of Mosquitoes in Khok Ket Village

The species diversity indices of mosquitoes collected from Khok Ket Village, Plai Phongphang Subdistrict, Amphawa District, Samut Songkhram Province are presented in Table 2. The analysis revealed that a total of 11 mosquito species were recorded in the study area. The Dominance Index (D) was 0.18, a value closer to 0 than to 1, indicating that no single mosquito species was overwhelmingly dominant in the sampled population. The Simpson Index was 0.82, a value closer to 1 than to 0, suggesting a low probability of randomly selecting two individuals of the same species, which reflects a high level of species diversity. The Shannon Species Diversity Index (H) was 1.95, indicating a moderate overall level of species diversity among the mosquito population in the study area. The Margalef Richness Index (S) was 1.85, demonstrating moderate species richness. Lastly, the Evenness value was 0.64, ranging from 0 to 1, suggesting a moderate degree of uniformity in species distribution within the mosquito community.

Table 2. Species Diversity of Mosquitoes in Khok Ket Village, Plai Phongphang Subdistrict, Amphawa District, Samut Songkhram Province.

Diversity Index	Value
Number of species	11
Dominance (D)	0.18
Simpson Index (Simpson_1-D)	0.82
Shannon Species Diversity (H)	1.95
Margalef Richness (S)	1.85
Evenness ($e^{H/S}$)	0.64

5. Discussions

This study investigated the species diversity of mosquito vectors in Khok Ket Village, Plai Phongphang Subdistrict, Amphawa District, Samut Songkhram Province, using both human landing catches and BG light traps. A total of 221 mosquitoes were collected and identified, representing 11 species. The presence of multiple vector species suggests that the area is at risk of mosquito-borne diseases such as malaria, filariasis, dengue fever, chikungunya, and Japanese encephalitis. The species identified included *Ae. aegypti*, *Ae. albopictus*, *Ae. amesii*, *An. hyrcanus* group (*An. paraliae* / *An. pursati*), *An. tessellatus*, *An. umbrosus* group, *Ar. subalbatus*, *Cx. gelidus*, *Ma. annulifera*, *Ma. indiana*, and *Ma. uniformis*.

The three most abundant species were *An. tessellatus* (70 individuals, 31.67%), a suspected secondary vector of malaria and filariasis; *An. hyrcanus* group (38 individuals, 17.19%), a potential malaria vector; and *Cx. gelidus* (33 individuals, 14.93%), a vector of Japanese encephalitis (Chaiphongpachara and Sumruayphol, 2017; Zhong et al., 2022). The high abundance of these species may be associated with the favorable environmental conditions of Khok Ket Village, which provide suitable breeding and resting habitats for mosquitoes. *An. tessellatus* commonly inhabits natural environments such as forests and moist areas with moderate to dense vegetation. Its breeding sites include both shaded and sunlit groundwater pools, typically rich in organic matter and mud (Rattanaarithikul et al., 2006). *An. hyrcanus* group (*An. paraliae* / *An. pursati*) thrives in humid, vegetated habitats such as forests and cultivated plantations, with breeding sites in natural water bodies such as ponds, streams, and ditches intermittently exposed to sunlight. This group can also breed in brackish water (Rattanaarithikul et al., 2006). *Culex gelidus* breeds in water sources around animal shelters contaminated with organic waste, rice fields, and irrigation canals. Stagnant water in urban lawns after rainfall also serves as an ideal breeding habitat for this species.

Controlling *An. tessellatus* and the *An. hyrcanus* group (*An. paraliae* / *An. pursati*) larvae is challenging because their breeding sites are natural and widely distributed. However, adult mosquito populations can be effectively managed through the use of light traps, which help reduce reproduction. For optimal efficiency, traps should be deployed in sufficient numbers and strategically distributed throughout the area. In addition, personal protection measures, such as sleeping under mosquito nets, using mosquito coils, and applying repellents, remain essential in preventing mosquito bites. The control of *Cx. gelidus* is also difficult at the larval stage due to its breeding in rice paddies and irrigation canals, which are integral to the local ecosystem. Therefore, control measures should primarily target adult mosquitoes using light traps to suppress population growth. Preventive strategies, including personal protection and vaccination against Japanese encephalitis, are crucial for minimizing disease transmission.

The species diversity analysis in Khok Ket Village revealed a total of 11 mosquito species. The Dominance Index ($D=0.18$) indicated that no single species was overwhelmingly dominant, although *Anopheles tessellatus* was relatively more abundant due to the area's natural landscape of forests, orchards, and diverse water sources that favor its breeding. The Simpson Index (0.82) suggests a low probability of randomly selecting two individuals of the same species, reflecting

high species diversity. The Shannon Species Diversity Index ($H = 1.95$) indicates a moderate level of overall diversity, likely influenced by the moderate environmental heterogeneity of the study area.

6. Conclusion

The findings from this study on the species diversity of mosquito vectors provide valuable insights into the characteristics of each vector species, including habitats and ecology. Such information is essential for understanding disease transmission dynamics and serves as a foundation for planning mosquito-borne disease surveillance, control, and prevention in the study area. Relevant agencies, including government and private sectors, the Ministry of Public Health, the Department of Disease Control, and local administrative organizations, can utilize these findings as baseline data to assess disease risk and develop effective monitoring and control strategies. In Samut Songkhram Province, local health-promoting hospitals, public health officers, and village health volunteers can apply these data to evaluate the risk of mosquito-borne disease outbreaks and strengthen local surveillance and prevention efforts. Furthermore, the information can be used to develop public awareness campaigns that educate communities about the risks and severity of mosquito-borne diseases and promote appropriate vector control practices. This increased awareness and community participation will ultimately contribute to sustainable mosquito control and disease prevention in the area.

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