SPECIES DIVERSITY AND ABUNDANCE OF *Anopheles* MOSQUITOES IN IRANAMADU, KARACHCHI MOH AREA, SRI LANKA

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Malaria is one of the major vectors borne disease in the world and the pathogen is transmitted by *Anopheles* sp. mosquitoes. Even though, WHO declared, Sri Lanka is a malaria free country since 2013, there are many imported cases reported recently from the travellers and pilgrims. As there has been interruptions of continuous malaria control programs and the emergence of many breeding habitats for mosquitoes as well as the lack of sufficient vector surveillance studies, this study was done to investigate the *Anopheles* sp. mosquito diversity and abundance in the Karachchi MOH area (GPS coordinates x - 9.49438, y - 80.442778), a region at risk for malaria re-emergence. This study focuses on the diversity and abundance of *Anopheles* sp. mosquitoes in the Karachchi MOH area in Kilinochchi district, Sri Lanka. Cattle baited traps (CBTC) and cattle-baited huts (CBHC) were used over the course of two months, we used two traps every week to collect mosquitoes. Mosquitoes were collected early morning, ensuring minimal escape. Captured mosquitoes were anaesthetized by placing them at 4°C and they were identified using standard taxonomic keys. Shannon's and Simpson's Diversity Indices were calculated to assess species richness. During this period 368 *Anopheles* mosquitoes from 10 vector species that were collected (*Anopheles annularis (0.67%), Anopheles tessellatus (2.7%), Anopheles culicifacies (3%), Anopheles vagus (6.76%), Anopheles peditennatus (7.77%), Anopheles varuna (8.11%), Anopheles barbirostris (9.46%), Anopheles nigerrimus (17.23%), Anopheles subpictus (21.96%), and Anopheles jamsai (22.29%*). where *Anopheles jamsai (22.29%*) being the highest and *Anopheles annularis (0.67%)* the lowest recorded species. This study compared the effectiveness of CBTC and CBHC methods in capturing *Anopheles* mosquitoes. An independent t-test revealed a significant difference in capture counts ($t_{(18)} = 2.72$, $p = 0.014$). The CBTC method demonstrated superior efficacy, capturing 80% of the total mosquitoes, including all species. In contrast, the CBHC method was particularly successful for *Anopheles culicifacies*.

Key Words: *Anopheles* mosquitoes, species diversity, species abundance, Kilinochchi district, Cattle Baited Traps, Cattle Baited Huts.

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INTRODUCTION

Mosquito-borne diseases contribute significantly to global morbidity and mortality, with mosquitoes serving as efficient vectors for a variety of pathogens (Brenda et al., 2000; Dahmana & Mediannikov, 2020). These vectors are responsible for the transmission of diseases such as dengue, malaria, filariasis, chikungunya, Japanese encephalitis, and Zika, posing a substantial public health challenge. Urbanization, environmental changes, demographic shifts, and socioeconomic disparities all contribute to the spread of these diseases by facilitating mosquito proliferation (Chala & Hamde., 2021).

Despite significant efforts to reduce its incidence and eliminate indigenous cases since 2013, malaria remains a major concern in Sri Lanka (Gunathilaka et al., 2016) due to the risk of re-emergence. The introduction of new vector species like *Anopheles stephensi*, which is the major vector for malaria transmission in India is another important concern (Shretta et al., 2017). Recent malaria cases have resulted in fatalities. Additionally, rapid urbanization, construction, and agricultural activities are the primary causes of dengue fever, making it a critical public health issue in the Northern region. **(**Surendran et al., 2019)

The study site, Iranaimadu Tank in Kilinochchi, Sri Lanka, is characterized by its varied elevation, which affects water retention and creates potential breeding sites for mosquitoes. Low stream flow in the area supports oviposition and larval development. From October to January, continuous rainfall causes the Iranaimadu Tank to overflow, leading to flooding and the emergence of new breeding sites. This region's high receptivity to mosquito-borne diseases poses a significant risk for regional epidemiology. Although the WHO certified Sri Lanka as malaria and filariasis-free in 2016, the country remains vulnerable to the re-emergence of these diseases due to the creation of new breeding sites.

Throughout this two-month study, mosquito diversity and abundance in the Karachchi MOH area of Kilinochchi district, Sri Lanka was investigated. Utilizing methods such as cattle-baited traps and cattle-baited huts, the research focuses on analyzing the Anopheles species mosquito population and calculating diversity indices. The aim is to inform disease prevention strategies and enhance public health efforts in this region, which is particularly susceptible to mosquito-borne diseases

OBJECTIVES

The aim of this study was to investigate the diversity and the abundance of *Anopheles* mosquitoes in the Karachchi MOH area of Kilinochchi district, Sri Lanka.

METHODOLOGY

Because of its conducive environment, Iranamadu Karachchi MOH area in Kilinochchi District in northern Sri Lanka was selected for the study (Figure 1). Normal cattle bait traps for *Anopheles* mosquitoes were deployed, using a live cow as bait to mimic natural conditions and maximize mosquito capture. The traps were strategically placed and operated overnight to align with mosquito feeding habits.

Mosquitoes were collected early morning, ensuring minimal escape. Captured mosquitoes were anaesthetized and placed at 4°C and identified using standard Amarasinghe's taxonomic keys and WHO pictorial identification of vectors South-East Asia Region (2020) ensuring accuracy and consistency. The study employed Shannon's and Simpson's Diversity Indices to assess species richness and evenness, revealing insights into mosquito diversity and population structure. The study conducted a two-sample t-test to compare the differences between CBHC and CBTC.

Figure 1: A) Sample Collecting Site at Iranamadu, Karachchi MOH area, Kilinochchi District.

RESULTS AND DISCUSSION

For this study, cattle-baited traps (CBT) and cattle-baited huts (CBH) were used to collect the mosquitoes. These two methods and traps are highly effective in sampling a variety of *Anopheles* malaria vectors because *Anopheles* sp. are zoophilic, hematophagous, and nocturnal dipterans. These sampling methods captured high numbers of anophelines with limited sampling effort and greatly reduced human exposure to mosquito bites compared to the standard human landing collection (HLC) and human-bait tents (HBT) (Brandyce, 2016).

Total of 368 *Anopheles* mosquitoes representing 10 distinct species were collected. The CBHC method targeted specific species, and collected 72 mosquitoes, while the CBTC method captured total of 296 mosquitoes representing all 10 species, (80% of the total).

Anopheles culicifacies was the predominant species, especially in the CBHC method. The Shannon Diversity Index (H = 2.02) indicated moderate to high species diversity, and the Simpson Diversity Index (D = 0.848) suggested a high probability of diversity among the species.

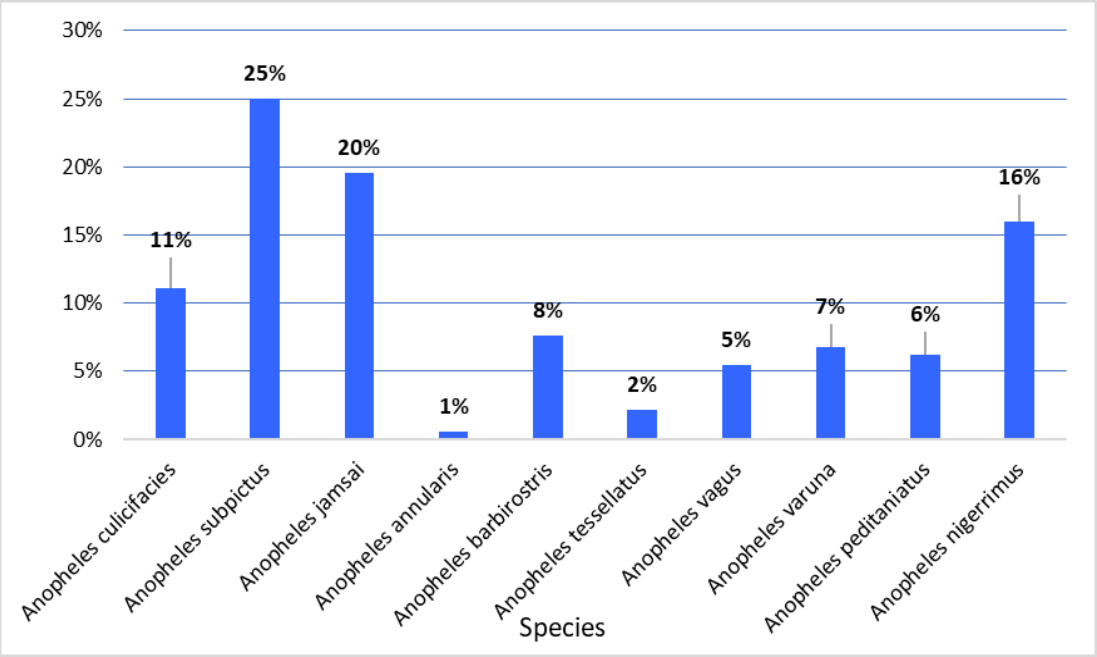

Figure 2: Percentage of *Anopheles* species collected using Cattle Baited Trap (CBT) and Cattle Baited Hut (CBH).

This study compared two mosquito collection methods, Cattle Baited Trap (CBT) and Cattle Baited Hut (CBH), to capture *Anopheles* malaria vectors, exploiting their nocturnal and zoophilic behaviours. The p-value was 0.014 for the two-sample t test conducted for CBHC and CBTC, which is lower than 0.05. There is a significant difference between the means of the samples collected by the two traps at the 5% significance level. The CBT method, being portable, proved more effective overall, capturing a greater variety of species by allowing strategic placement near breeding sites. In contrast, the stationary CBH method was less effective but excelled in collecting *Anopheles culicifacies*, which preferred the hut's dark, cool environment. The study highlights the importance of selecting collection methods based on target species behaviours and site characteristics, enhancing the effectiveness of mosquito surveillance and control strategies.

CONCLUSIONS/RECOMMENDATIONS

In conclusion, this study reveals a diverse community of anopheline mosquitoes in the region, as indicated by the Shannon Diversity Index (2.02) and Simpson's Diversity Index (0.848). The relatively high diversity values suggest a significant potential for malaria transmission, emphasizing the need for vigilant public health measures. The findings are crucial for local health authorities to develop targeted and effective vector control strategies, aiding in the proactive prevention of malaria resurgences. This research provides valuable insights for ongoing malaria control efforts and highlights the importance of adaptive strategies to manage vector-borne diseases.

REFERENCES

Gayan Dharmasiri, A. G., Perera, A. Y., Harishchandra, J., Herath, H., Aravindan, K.,

Jayasooriya, H. T. R., ... & Hewavitharane, M. (2017). First record of Anopheles stephensi in Sri Lanka: a potential challenge for prevention of malaria reintroduction. *Malaria Journal*, *16*, 1-9.

Dharmawardena, P., Premaratne, R., Wickremasinghe, R., Mendis, K., & Fernando, D. (2022). Epidemiological profile of imported malaria cases in the prevention of reestablishment phase in Sri Lanka. *Pathogens and global health*, *116*(1), 38-46.

Romeo-Aznar, V., Paul, R., Telle, O., & Pascual, M. (2018). Mosquito-borne transmission in urban landscapes: the missing link between vector abundance and human density. *Proceedings of the Royal Society B*, *285*(1884), 20180826.

Srisuka, W., Sulin, C., Sommitr, W., Rattanarithikul, R., Aupalee, K., Saeung, A., & Harbach, R. E. (2022). Mosquito (Diptera: Culicidae) diversity and community structure in Doi Inthanon National Park, Northern Thailand. *Insects*, *13*(9), 814.

St. Laurent, B., Oy, K., Miller, B., Gasteiger, E. B., Lee, E., Sovannaroth, S., & Fairhurst, R. M. (2016). Cow-baited tents are highly effective in sampling diverse Anopheles malaria vectors in Cambodia. *Malaria journal*, *15*, 1-11.

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