# The Diversity and Abundance of Mosquitoes in Endemic and Non-endemic Areas of Denguefever in The Palembang Region

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**Abstract.** Mosquitoes are cosmopolitan and are found in all types of habitats such as wastewater, stagnant water and fresh water. Many mosquito species can adapt to their specific habitats such as the Aedes species which adapt to colder areas where eggs are dominant compared to warmer areas. The purpose of this study was to evaluate the diversity, distribution and relative abundance of mosquito fauna in the Palembang City area. This research was carried out in 2 sub-districts in the city of Palembang, namely Gandus sub-district and IlirTimur 1 sub-district. Eight villages were selected for each sub-district so that the total observation sites were 16 villages and the Joint Laboratory of the Sriwijaya University Postgraduate Program. The research was carried out using the active collection method, namely finding and catching mosquitoes in their habitat using insect nets and the passive method with ovitrap installation in both indoor and outdoor research areas. Species diversity was calculated using the Shannon-Wienner Diversity Index. The results showed that Gandus District has low diversity and there are species that dominate compared to IlirTimur I District which has moderate diversity and no species dominates.

**Keywords:** The Diversity and Abundance, Mosquitoes, Endemic and Non-endemic Areas, Denguefever, Palembang Region

## 1. Introduction

Mosquito-borne diseases is a major public health problem worldwide. [1] Climate change and human activity affect the geographical and annual distribution and population abundance of mosquitoes [2] Mosquito serves as a vector of various dead-ly diseases including Malaria, Dengue fever. [3] Mosquitoes are cosmopolitan and are found in all types of habitats such as wastewater, stagnant water and fresh water. Many mosquito species can adapt to their specific habitats such as the Aedes species which adapt to colder areas where their eggs are more dominant than warmer areas. [4] Mosquitoes are harmful because they can be vectors of many pathogens for humans. [5] Many pathogens that can be spread by mosquitoes include pathogens that cause dengue fever, malaria, brain inflammation hencephalitis, elephantiasis and chikungunya. [6] The types of mosquitoes that can be vectors for the disease are Anopheles, culex, Aedes and Mansonia. Mosquitoes are blood-sucking insects that have the potential as vectors for many diseases. [7]

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Indonesia, which is a tropical country, is very suitable for the development of mosquitoes. Transmission of disease through mosquitoes can easily develop, so it can be a source of disease that is dangerous for the population. [8] Mosquitoes are insects that have a high diversity of species. Around 3,490 mosquito species have been officially recorded [9] of which 457 species are in Indonesia, namely 8 Mansonia species, 80 Anopheles species, 82 Culex species, and 125 mosquito species. The remaining species are insignificant members in infectious disease. [10] Mosquito activity varies from species to species. [11] Some species are diurnal and others nocturnal while many others are crepuscular. Mosquito feeding behavior and breeding grounds depend on temperature. Some mosquitoes are attracted to hosts by their own choice, such as skin odor, temperature, humidity or visual cues. Mosquitoes bite almost any animal enough to feed them a blood meal. Some species are host specific. Host specificity for blood sucking by mosquitoes plays an important role in disease transmission. A large diversity of mosquitoes (31%) is found in the neotropics. [12]

The study of mosquito diversity, distribution, relative abundance and surveys is important because of the loss of natural mosquito habitats [13] and the worldwide spread of invasive mosquitoes. [14] To address the challenges of future vector-borne diseases, it is necessary to evaluate the current status of the mosquito fauna in different habitats in different geographic locations. [15] The purpose of this study was to evaluate the diversity, distribution and relative abundance of mosquito fauna in the Palembang City area, to continue previous studies that looked at the diversity of mosquito populations based on climatic factors.

## 2. Material and Method

This research was carried out in 2 sub-districts in the city of Palembang, namely Gandus sub-istrict and IlirTimur 1 sub-district. Eight villages were selected for each sub-district so that the total observation sites were 16 villages and the Joint Laboratory of the Sriwijaya University Postgraduate Program. The research was carried out using the active collection method, namely finding and catching mosquitoes in their habitat using insect nets and the passive method with ovitrap installation in both indoor and outdoor research areas. Catching mosquitoes with insect nets is done by swinging the net to form a figure of eight. [16] The caught mosquitoes were put into bottles containing 3 ml of cotton that had been given 10% chloroform and covered with gauze. [17]

Sampling with the installation of ovitrap which includes endemic areas of DHF and non-endemic areas of DHF. In one sub-district, 20 ovitraps were installed with a sample of 16 sub-districts, which were divided into 8 DHF Endemic Regional Villages and 8 Non-DHF Endemic Regional Villages. The locations for laying ovitrap are 3 inside the house and 2 outside the house, 10 public places such as schools, and 5 gardens/moorlands. A total of 320 ovitraps have been installed.

Collecting data in this study by observing the ovitrap once a week, checking the condition of the ovitrap, and changing the water and filter paper on the ovitrap. list of hatching eggs trapped in the ovitrap and calculate the percentage of the number of Aedes spp. larvae. which successfully hatched from the collection of eggs with ovitrap. Installation of ovitrap is placed in several places such as inside and outside (yard) of the house, in elementary schools, and in the bushes or gardens.

Species diversity was calculated using the Shannon-Wienner Diversity Index. [16] According to [18], the diversity index is formulated as follows:

$$H' = \sum p\text{iLnpi}$$

where:
H' = Shannon-Wienner diversity index.
Pi = the proportion of the ith species in the total sample.

With the Diversity index as follows: a < 1 means low diversity, 1-3 means moderate diversity and > 3 means high diversity.The dominance index is used to determine the species that dominates a community. The dominance index is calculated according to Simpson with the following equation. [19]

$$c = \sum_{i=1}^{s} \binom{ni}{N}$$

Where :
C = Simpson dominance index
ni = Number of individuals of type i
N = Total number of individuals
S = Number of Genera

The value of the Simpson dominance index (D) is used as a comparison against the Shannon - Wienner diversity index value (H'). A community with a high dominance index will show a low diversity index value. Then the Dominance Index is as follows: 0-0.5 there is no dominating species, 0.5-1 there is a dominating species. Data analysis was carried out using descriptive analysis. Calculation of the ovitrap index using .the following formula:

IO = total of positive ovitrap x 100 %

**Table 1.** Criteria index of ovitrap (According to FEDH Hongkong 2006 (Hidayati, Hadi, & Soviana, 2017).

| Ovitrap Index | Score | Criteria |
|---|---|---|
| Level 1 : IO < 5 % | 1 | Very low |
| Level 2 : 5% ≤ IO < 20 % | 2 | Low |
| Level 3 : 20% ≤ IO < 40 % | 3 | Medium |
| Level 4 :IO ≥ 40 % | 4 | High |

Index of ovitrap value (IO) can be known from number of positive ovitrap in each locality.

## 3. Resultand Discussion

Results of the identification of the types of mosquitoes caught in Gandus sub-district obtained 3 mosquito genera, namely Aedesspp, Anopheles spp and Mansonia spp. While in Ilir Timur 1 sub-district there are 5 mosquito species, namely Aedesspp, Anopheles spp, Mansoniaspp, Culex and Armigerres spp. The number of each mosquitoes is shown in Tables 2 and 3.

**Table 2.** Diversity and population of mosquito species in Gandus sub-district, Palembang city

| Type of mosquitoes | Number of caught mosquitoes at observation to | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| Aedesspp | 14 | 13 | 17 | 18 | 15 | 16 | 19 | 20 | 132 |
| Anopheles spp | 10 | 11 | 9 | 5 | 8 | 12 | 11 | 13 | 79 |
| Mansoniaspp | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |

**Table 3.** Diversity and population of mosquito species in Ilir Timur 1 sub-district Palembang City

| Type of mosquitoes | Number of caught mosquitoes at observation to | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| Aedesspp | 11 | 12 | 10 | 13 | 11 | 12 | 11 | 10 | 90 |
| Anopheles spp | 8 | 9 | 7 | 5 | 4 | 8 | 6 | 5 | 52 |
| Mansoniaspp | 4 | 5 | 3 | 4 | 2 | 3 | 4 | 3 | 28 |
| Culexspp | 2 | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 18 |
| Armigeresspp | 1 | 2 | 0 | 0 | 3 | 2 | 1 | 1 | 10 |

The value of the Diversity Index of mosquitoes in Gandus sub-district as a whole is 0.68, which means the diversity index is low and the Dominance Index value is 0.510, which means that there are types of mosquito species that dominate while in IlirTimur District 1 the overall Diversity Index is 1.35, which means the diversity index moderate and the value of the Dominance Index is 0.28, which means that there is no dominant type of mosquito species (Table 4).

**Table 4.** Index of mosquito diversity and dominance in the sub-districts of Gandus and IlirTimur 1 City Palembang

| Type of mosquitoes | Gandus sub-district | | | | | Ilir Timur 1 sub-district | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pi | LnPi | PiLnPi | H' | D | Pi | LnPi | PiLnPi | H' | D |
| Aedesspp | 0.62 | -0.47 | -0.29 | 0.29 | 0.38 | 0.45 | -0.79 | -0.35 | 0.35 | 0.20 |
| Anopheles spp | 0.37 | -0.99 | -0.36 | 0.36 | 0.13 | 0.26 | -1.34 | -0.35 | 0.35 | 0.06 |
| Mansoniaspp | 0.004 | -5.52 | -0.02 | 0.02 | 0.00001 | 0.14 | -1.96 | -0.27 | 0.27 | 0.01 |
| Culexspp | | | | | | 0.09 | -2.40 | -0.21 | 0.21 | 0.008 |
| Armigeresspp | | | | | | 0.05 | -2.99 | -0.14 | 0.14 | 0.002 |
| Total | | | | 0.68 | 0.510 | | | | 1.35 | 0.28 |

In this study, it appears that the population of dengue vector mosquitoes is high in both endemic and non-endemic areas compared to other mosquito species. The distribution of positive ovitrap density of Aedes aegypti vector DHF eggs at both study sites is presented in Table 5 and Table 6.

**Table 5.** Positive ovitrap, number of eggs and category level Ovitrap index in endemic areas DHF, Gandus sub-district, Palembang City.

| Village | Ovitrap amount | Positive Ovitrap | Amount of egg | Ovitrap Index (%) | Level | Category |
|---|---|---|---|---|---|---|
| Gandus I | 20 | 7 | 120 | 35 | Level 3 | Medium |
| Gandus II | 20 | 9 | 110 | 45 | Level 4 | High |
| Gandus III | 20 | 6 | 104 | 30 | Level 3 | Medium |
| Gandus IV | 20 | 8 | 122 | 40 | Level 4 | High |
| 36 Ilir | 20 | 5 | 106 | 25 | Level 3 | Medium |
| KarangAnyar | 20 | 6 | 117 | 30 | Level 3 | Medium |

| | | | | | | |
|---|---|---|---|---|---|---|
| Karang Jaya | 20 | 7 | 132 | 35 | Level 3 | Medium |
| PuloKerto | 20 | 8 | 126 | 40 | Level 4 | High |
| Total | 160 | 60 | 937 | | | |

Table 5 above shows that the Ovitrapeutic Index (IO) results are in the 20% category IO<40% (medium category) are found in 5 urban villages and the Ovitrapous Index (IO) category 40% (high category) is found in 3 urban villages.

**Table 6.** Positive ovitrap, number of eggs and category level Ovitrap index of non-endemic areas DHF IlirTimur 1 subdistrict, Palembang City.

| Village | Ovitrap amount | Positive Ovitrap | Amount of egg | Ovitrap Index (%) | Level | Category |
|---|---|---|---|---|---|---|
| 13 Ilir | 20 | 7 | 102 | 35 | Level 3 | Medium |
| 14 Ilir | 20 | 3 | 84 | 15 | Level 2 | Low |
| 15 Ilir | 20 | 4 | 72 | 20 | Level 3 | Medium |
| 16 Ilir | 20 | 4 | 96 | 20 | Level 3 | Medium |
| 17 Ilir | 20 | 5 | 92 | 25 | Level 3 | Medium |
| 18 Ilir | 20 | 6 | 105 | 24 | Level 3 | Medium |
| 20 Ilir DI | 20 | 7 | 110 | 35 | Level 3 | Medium |
| 20 Ilir DIII | 20 | 3 | 82 | 15 | Level 2 | Low |
| Total | 160 | 39 | 743 | | | |

Table 6 shows that the Ovitrap Index (IO) results are in the range of 5% category IO<20% (low category) are found in 2 urban villages and 20% Ovitrap Index category IO<40% (medium category) is found in 6 urban villages.

Based on the results of the study that the diversity and dominance index in Gandus District, it was found that the Diversity Index of mosquitoes in Gandus District as a whole was 0.68 which means the diversity index is low and the Dominance Index value is 0.510 which means that there are types of mosquito species that dominate while in IlirTimur 1 sub-district. The overall Diversity Index is 1.35, which means the diversity index is moderate and the Dominance Index value is 0.28, which means that there are no dominant species of mosquito species.In this study, it appears that the vector mosquito population of dengue fever is high in both endemic and non-endemic areas compared to other mosquito species, but in dengue endemic areas there are mosquito species that dominate and in non-endemic areas there is no dominant species.

The existence of mosquito species that dominates in endemic areas here is caused because Gandus District is a sub-district that is located far from the center of Palembang City and has varied demographic characteristics of the community, where there are still some housing conditions whose sanitation conditions are not good. Poor housing sanitation conditions, such as used cans and water storage materials, can be a potential breeding ground for the Aedes aegypti mosquito vector of Dengue Hemorrhagic Fever (DHF).Research conducted by [20], found that the density and distribution of dengue hemorrhagic fever (DHF) vectors were higher in endemic areas than non-endemic areas of dengue and there was non-specific esterase enzyme activity in mosquitoes in endemic and non-endemic areas of dengue hemorrhagic fever (DHF) [21]. Likewise, the results of the measurement of the vector density of Dengue Hemorrhagic Fever (DHF) Aedes aegypti mosquitoes in dengue endemic areas, show that the Ovitrap Index (IO) results are in the 20% category range IO < 40% (medium category) are in 5 urban villages and categories Ovitrap Index (IO) 40% (high category) is found in 3 urban villages.

Then the results of the measurement of the vector density of Dengue Hemorrhagic Fever (DHF) Aedes aegypti mosquitoes in non-endemic areas of DHF showed that the Ovitrap Index (IO) was in the 5% category range IO < 20% (low category) was found in 2 urban villages and the index category was Ovitrap 20% IO<40% (moderate category) is found in 6 urban villages.

From the results of this study, it can be seen that for dengue endemic areas the Ovitrap Index (OI) value tends to be in a high range, this is in line with the measurement of mosquito population diversity that in dengue endemic areas there is a dominating population, namely the Aedes aegypti mosquito. This is because in Gandus Subdistrict there are several villages that have poor sanitation conditions, especially areas with a fairly dense population or simple housing areas because Gandus Village is an area that is currently growing rapidly with many simple housing. Materials such as used cans and other water-containing materials can be potential breeding sites for the vector of Dengue Hemorrhagic Fever (DHF) the Aedes aegypti mosquito.This study is in accordance with the research of [22] , who stated that the mosquito species Ae. aegypti is more adapted to the residential environment [23], prefers densely populated areas, dark areas, is anthropophilic and endophilic [24]. This is in accordance with the nature of the mosquito Ae. aegypti which prefers the presence of humans as its host, food source and also its breeding ground.

## 4. Conclusion

Based on the results of the study, it can be concluded that for endemic areas there were 212 mosquitoes that were collected consisting of 3 genera and in non-endemic areas there were 198 mosquitoes that were collected consisting of 5 genera. Aedes was found as the most dominant genus found in both Gandus District and Ilir Timur I sub-district.The assessment of species diversity showed that Gandus District had low diversity and there were species that dominated compared to Ilir Timur I sub-district which had moderate diversity and no dominant species. the dominance index of Aedes spp in the sub-district. The novelty of this study is the finding of the index of dominance and population density of mosquitoes between endemic and non-endemic areas of Dengue Hemorrhagic Fever (DHF).

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