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Research Report

## DIVERSITY, DOMINANCY, AND PERIODICITY OF MOSQUITOES IN FILARIASIS ENDEMIC AREAS IN SAMBOREJO VILLAGE TIRTO DISTRICT PEKALONGAN REGENCY

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### ABSTRACT

Vector-borne mosquito diseases are still as a public health problem in the world, including in Indonesia. Many of mosquitoes species are significantly as vectors of patogen, such as virus, bacteria, protozoan, and helminths due to human health. Samborejo Village is one of filariasis endemic areas and it is still in a high microfilaria rate. Each of mosquito species has a differential of distribution, bioactivities pattern, and type of habitat of their breeding sites with others. The objective of this study was to determine the diversity, dominancy, and periodicity pattern of mosquitoes during night time in Samborejo Village Tirto District Pekalongan Regency. Mosquitoes collections were done by landing method, from 6 pm - 6 am of in an hour period of collection, for biting and resting activities and also for indoor and outdoor collection respectively. Mosquitoes were then identified and the diversity was analyzed by Shannon-Wiener Index. The total number of each species was served in percent. Totally there were 339 collected mosquitoes, consisting of 165 (48.67%) females and 174 (51.33%) males. Of all, there were 4 species identified which were *Culex quinquefasciatus* (92.1%), *Culex tritaeniorhynchus* (0.6%), *Culex vishnui* (1.8%), and *Aedes aegypti* (5.5%). Samborejo Village showed in low diversity with the index of 0.338, and *Cx. quinquefasciatus* to be the dominant species in this area. *Culex quinquefasciatus* also became the frequent species in each period of collection for indoor and outdoor, and it showed the indoor active biting at 9 pm, 01 am, and 03 am; furthermore, the outdoor active biting was at midnight (00) and at 03 am. However, *Aedes* mosquito was showed active biting in earlier, it was at 6 pm, 7 pm, and at 02 am.

**Keywords:** diversity, dominancy, mosquito, periodicity, Samborejo Village.

### ABSTRAK

Penyakit tular vektor oleh nyamuk masih menjadi masalah kesehatan masyarakat di dunia termasuk di Indonesia. Berbagai jenis nyamuk memiliki peran sebagai inang perantara (vektor) dalam penularan agen penyakit baik dari jenis virus, bakteri, protozoa, hingga cacing, dan Kalurahan Samborejo adalah salah satu daerah endemik filariasis di Kabupaten Pekalongan dengan tingkat mikrofilaria yang masih cukup tinggi. Pola distribusi, keragaman, perilaku setiap nyamuk beserta lingkungannya merupakan kajian yang masih sangat terbatas informasinya. Tujuan penelitian ini adalah menjelaskan keragaman, dominansi, dan pola aktivitas nyamuk pada malam hari di Kalurahan Samborejo Kecamatan Tirto Kabupaten Pekalongan. Koleksi nyamuk dilakukan dari pukul 18.00 - 06.00 WIB pada periode setiap satu jam, dengan metoda landing biting, dan nyamuk dikoleksi pada saat biting dan resting baik indoor maupun outdoor. Nyamuk hasil koleksi diidentifikasi dan data keragaman dianalisis dengan Shannon-Wiener Index, data jenis dan jumlah nyamuk ditampilkan dalam persen. Sejumlah 339 ekor nyamuk dikoleksi terdiri atas 165 ekor (48.67%) adalah nyamuk betina dan 174 ekor (51.33%) adalah nyamuk jantan, dengan jenis *Culex quinquefasciatus* (92.1%), *Culex tritaeniorhynchus* (0.6%), *Culex vishnui* (1.8%), dan *Aedes aegypti* (5.5%). Kelurahan Samborejo menunjukkan keragaman nyamuk yang rendah, dengan nilai index 0,338, dan nyamuk

*Cx. quinquefasciatus* menunjukkan dominansi dan dapat ditemukan pada setiap periode koleksi baik indoor maupun outdoor. Pada periode waktu pukul 21.00, 01.00 dan 03.00 WIB nyamuk *Cx. quinquefasciatus* menunjukkan puncak periode aktif indoor, sedangkan puncak aktivitas outdoor adalah pada pukul 24.00 dan 03.00 WIB. Untuk nyamuk *Ae. aegypti* dapat ditemukan pada periode lebih awal yaitu pukul 18.00, 19.00, dan pukul 02.00 WIB.

**Kata kunci:** Diversitas, dominansi, periodisitas, nyamuk, Kalurahan Samborejo.

## INTRODUCTION

Mosquitoes have been known as one of haematophagus insects and some of them can serve as vector for transmitting the protozoan, worms, or virus, agent of human diseases in many parts of the world, including in Indonesia.<sup>1,2</sup> Lymphatic filariasis (LF) is one of public health problems, caused by one of 3 species of filarial nematodes, namely, *Wuchereria bancrofti*, *Brugia malayi*, and *Brugia timori*. The microfilariae are found in the human blood only around midnight.<sup>3-4</sup> It is transmitted by mosquitoes and globally about 120 million people in 73 countries have been affected.<sup>1,2,4,5</sup> In Indonesia, there is an increasing number of lymphatic filariasis endemic areas in which filariasis cases are increased significantly. It was about 8,000 cases in the year 2004 and to more than 14,900 cases in 2016.<sup>6-8</sup> Study by Febrianto<sup>9</sup> found that there was 7.6% from 76 of respondents showed the positive microfilaremia in Samborejo Village.

Some mosquitoes are cosmopolitan and live nearby human habitations.<sup>10</sup> In Indonesia, 20 mosquitoes species have been known as filariasis vectors, 8 species of *Anopheles* spp., 3 species of *Culex* spp., 6 species of *Mansonia* spp., one species of *Aedes*, *Armigeres*, and *Coquilletidea*,<sup>1</sup> and some of them have biting behaviour in the night time.<sup>11</sup> The nocturnal active biting of vector could be considered as an intermediary for filariasis transmission. Studies on the distribution, behavior, and ecology of mosquitoes in filariasis endemic areas are significant studies in studying parasitic-vector interactions and are studies of novelty that are still very limited in information.<sup>12</sup>

Samborejo Village is located in Pekalongan Regency Central Java and the ecotype is a semiurban areas. This village was an endemic area for urban filariasis caused by *Wuchereria bancrofti*.<sup>9</sup> However, there is unwell known in the distribution, species variation, dominancy and periodicity of mosquito population in Samborejo Village Pekalongan Regency. The purpose of this study was to examine the diversity, dominancy, and active period of mosquitoes during night time in Samborejo Village.

## MATERIAL AND METHOD

### Materials

Mosquitoes were the subjects of this study. The materials for mosquitoes collection were aspirator, hand net, paper cup/coffee cup with gauze covered, and cotton

with sugar solution. Microscope, cover glass petridish, and small brush were provided for mosquitoes identification.

### Methods

The study was under consideration with the Ethical Commission of Faculty Medicine Gadjah Mada University, number REF: KE/FK/0612/EC/2017. *Study area.* Samborejo Village in Tirto District Pekalongan Regency was selected as the study area. It was semiurban types for the settlement.

*Mosquitoes Collection.* Mosquitoes collections were done every hour from 6 pm - 6 am by Landing Bite method and mosquito's net in the selected house of the area. Mosquitoes were put in paper cup covered by gauze. Then, mosquitoes were identified by using identification key book, Mosquito Pictorial Key of Indonesia.<sup>13</sup> Data were tabulated and analyzed. The environmental parameter, air temperature (°C) and humidity (%), of selected location of settlement were measured.

*Data analysis.* The number of mosquitoes from the study area was performed in percent. The diversity of mosquito species was analyzed by Shannon Wiener Diversity Index.<sup>14</sup> Correlation analysis of ecological parameters with the active period of the mosquitoes was done by Correlation Test (SPSS 20. version).

## RESULT AND DISCUSSION

### Diversity

From Samborejo Village, totally there have been 340 collected mosquitoes that consisted of 175 males and 165 females (Table 1).

Based on the Shannon-Wiener Index Samborejo Village was low in diversity (0,338). It was understood that there were only 2 genera, *Culex* and *Aedes* has collected. This finding was similar to our previous study in other the endemic areas, in Pasirsari Villages (Pekalongan City) and Simbangkulon Villages (Buaran Distric Pekalongan Regency). In the both areas the total number of 323 adult female mosquitoes had been collected and consisted of 8 species of the genus *Culex* and 1 species of *Aedes aegypti*.<sup>15</sup> However, in Jenggot Village (Pekalongan City) it is showed moderate diversity and more various the mosquitoes genus, which were 5 of mosquito genera, which were genera of *Culex*, *Aedes*, *Armigeres*, *Anopheles*, and the genus of *Lutzia*. This finding is different from the results of the research conducted by Arimurti (2008) which concluded that the *Cx. quinquefasciatus* mosquito from Pekalongan

**Table 1.** Diversity and total number of female mosquitoes in Samborejo Village Tirto District Pekalongan Regency.

Species	Number of Mosquitoes				Total	%
	Indoor Biting	Outdoor Biting	Indoor Resting	Outdoor Resting		
<i>Culex quinquefasciatus</i>	61	49	7	35	152	92.12 %
<i>Culex tritaeniorhynchus</i>	0	1	0	0	1	0,60 %
<i>Culex vishnui</i>	1	1	0	1	3	1,83 %
<i>Aedes aegypti</i>	8	0	0	1	9	5,45 %
Total Number of Mosquito					165	100 %

city and Regency showed a high level of diversity with polymorphism reaching 100% based on the RAPD-PCR method.<sup>16</sup>

The *Culex* and *Aedes* are *culicinae* mosquito, they were belong to *Culicidae* family and the order of Diptera. Morphologically the adult female mosquito in the genera of *Culex* and *Aedes* may distinguished mostly by the head and thorax character. In both genera, at the head the *palpus* were shorter than the proboscis, however in the *scutum* of thorax's *Culex* mosquito covered pale brown scales and in *Aedes* the scales usually dark and sometimes with contrast white scales.<sup>13</sup> The adult female *Cx. quinquefasciatus* may be recognized easily with other *Culex* species (*Cx. tritaeniorhynchus* or *Cx. vishnui*) by the dark brown without pale band of the proboscis and the terga of abdomen was dark with broad white basal bands.<sup>13</sup>

Geographically, mosquito is cosmopolite insect, and it widespreads in the tropic and subtropic region,<sup>10</sup> and the changing of the environment will affect the insect activity in which will have an impact on diversity and distribution.<sup>1,4,10</sup>

### Dominancy and Periodicity

*Culex quinquefasciatus* to be the dominant in the area of study (92.12%). The dominancy this mosquito also is showed in the different endemic areas in Pekalongan, such as 66.67% in Pekalongan Selatan District<sup>17</sup>, 97.3% in Buaran District<sup>18</sup>, and in Samborejo the density was 5.25 mosquito/human/hour.<sup>9</sup> As in Table 1, *Cx. quinquefasciatus* was abundant and it was the most frequent active in each of period of collection for indoor and outdoor collection. Every mosquito species has its own distribution, behaviour pattern and character of its habitat different from others. The daily behaviour pattern of mosquito activities will occur at day or night time depending on the species.<sup>19</sup> There was limited information in the periodicity of biting and resting behaviour of *Cx. quinquefasciatus*, especially in filariasis endemic areas. This study will improved the collecting data of its bionomic.

In this study, the period of collection from 6 pm-6 am showed that only *Cx. quinquefasciatus* was the most frequent active, and the indoor activities was rather higher than the outdoor ones (Figure 1). Resting activities was showed the earlier period of collection, it was around 9 pm for indoor and 7 pm for outdoor (Figure 2). This

phenomenon may be due to the moving of this mosquitoes from the breeding sites to the houses before they get for the source of blood.

This mosquito was mostly active in outdoor biting and the period of active was at 01 and 4 am<sup>18</sup>, while in Pasir Sari Village Pekalongan Selatan District the peak of active biting period was at midnight and around 02 pm.<sup>15</sup> This peak timing of the mosquito periodicity may synchronous with the abundant of mf in the peripheral blood.

As Sack<sup>20</sup> has said that the secretion of overnight host melatonin may introduce the release of *W. bancrofti* mf in the blood circulation. The host's melatonin profile study is revealed that there was significantly increased and the peak of the concentration was at 0 - 4 am. Besides that, the total mf also significantly increased from about 82% at 22 pm and reached out 100 % at 1 am. At the next period the total number of mf was still high, it was around 98% and 80% at 2 am and 3 am respectively, then it was drastically reduced, from 62% at 4 am to 2% at 10 am.<sup>20</sup>

The study in the some filariasis endemic areas in Pekalongan is showed that *Cx. quinquefasciatus* caught more frequently during the time of collection rather than other species. As in Pasirsari Village, in Pekalongan Selatan District Pekalongan City and in Paweden Village Pekalongan Regency is showed that 76%, 57.7% and 98.9% respectively were *Cx. quinquefasciatus*.<sup>15,18,19</sup>

The mosquito existence was important for transmitting the parasite. Some studies was reported that the environment around settlement and human activities in the night time had significant effect for increasing the risk factor of people to get the infection.<sup>9,19</sup> Windiastuti *et al.*<sup>17</sup> has said that the existence of breeding places, resting places around houses will increased the risk of infection 8.7 times and 2.17 times respectively, even it would be 9.03 times to get infection for people who has active in the night time. This study is revealed that on the period of midnight to 4 am was the active peak of *Cx. quinquefasciatus* (Figure 1B).

There was new finding that *Ae. aegypti* mosquito was active indoor in the early night, it was about at 6 pm and at 2 am in early morning (Figure 1A). Other species, *Cx. vishnui* and *Cx. tritaeniorhynchus* were known as Japanese Encephalitis (JE) virus.<sup>2,4</sup> In this area the occurrence proportion of the two species was low. This may because of they more like the animal rather than human as their source of blood, such as chicken and domestic birds.

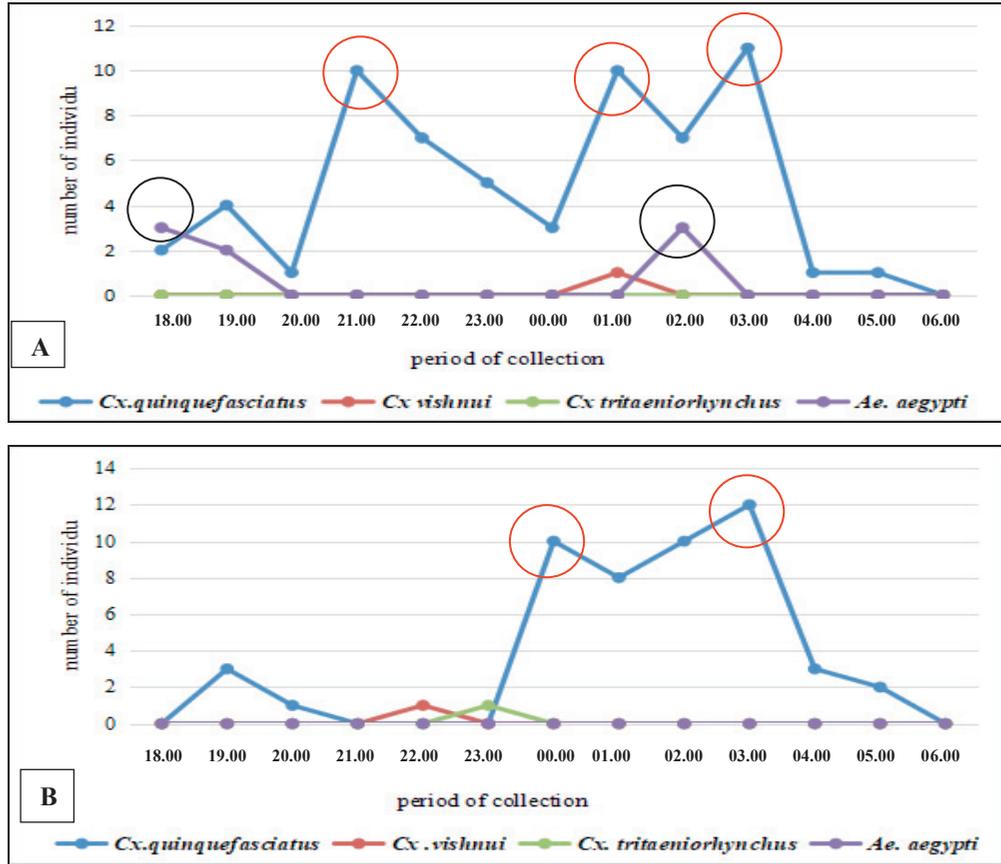


Figure 1. Mosquitoes diversity and periodicity of indoor (A) and outdoor (B) biting activities in Samborejo Village.

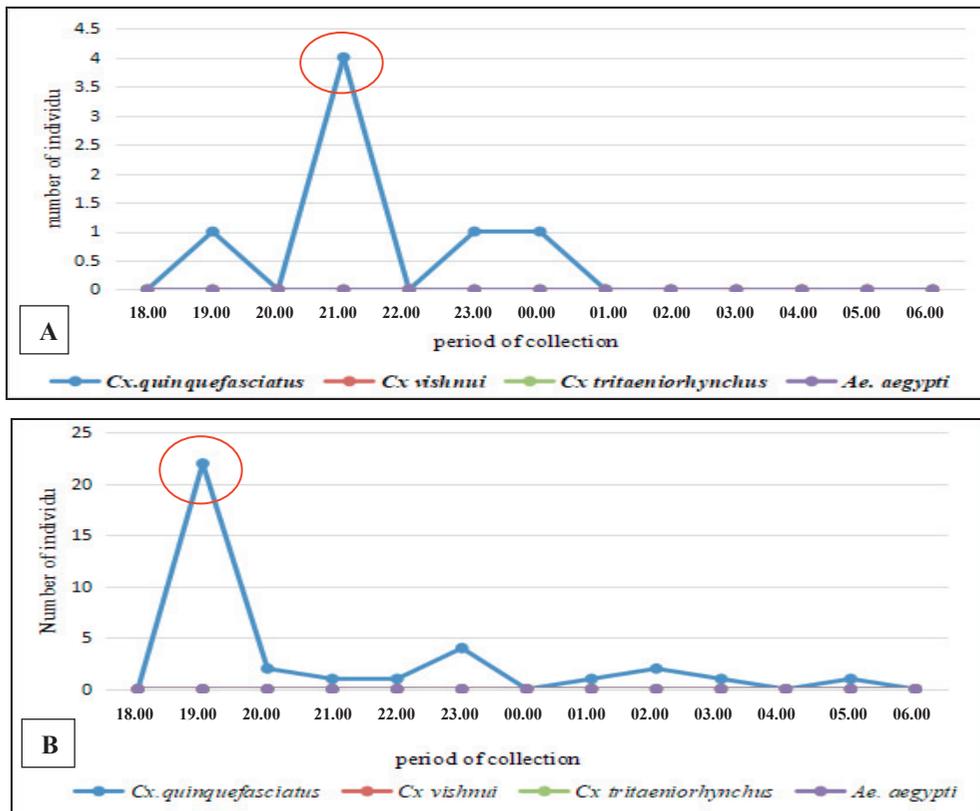


Figure 2. Mosquitoes diversity and periodicity of indoor (A) and outdoor (B) resting activities in Samborejo Village.

### Ecological Parameter

In this study the ecological parameter affected in various indoor and outdoor activities of mosquitoes, especially for *Cx. quinquefasciatus* both for the biting and for the resting activities (Table 2).

**Table 2.** Correlation of ecological parameter to the activities of mosquito in Samborejo Village Tirto District Pekalongan Regency.

Species	Level of coefisien Correlation			
	Indoor Biting	Outdoor Biting	Indoor Resting	Outdoor Resting
Temperature (°C)	0,0663	-0,484	0,414	0,384
Humidity (%)	-0,513	0,398	0,150	-0,437
Wind Velocity	-0,977*	-0,107	0,017	0,801

Each mosquito species needs specific ecological requirement for their survival, distribution, and abundance.<sup>4,21</sup> There was limited information of the effects of temperature and humidity to the mosquito activities in such filariasis endemic areas. Moise *et al.*<sup>21</sup> has stated that *Cx. quinquefasciatus* abundance increased significantly in May and June annually as their observed in 2006 to 2010, and temperature was positively affected for the mosquito abundance.

As shown in Table 2, there was no correlation among the temperature to the indoor biting, humidity to the indoor resting, and wind velocity to outdoor biting and indoor resting. Low correlation in positive and negative was showed by the temperature, humidity to the indoor or outdoor, and to biting and resting activities. However, there was a strongly negative correlation of wind velocity to the indoor biting activities and strong positive correlation to the resting activities. It is said that by increasing the wind velocity will significantly reduce the indoor biting activities. However, it significantly will increase the number of mosquitoes to rest.

For comparison, the study in Paweden Village Pekalongan Regency is showed that there was moderate negative correlation (-0.50 and -0.64) between temperature and the *Cx. quinquefasciatus* mosquito for indoor and outdoor biting activities. It was mean that as increasing temperature will reduce the indoor and outdoor biting activities, however the humidity has strong positive correlation (0.75) to the activities.<sup>18</sup>

Based on the results, the abundance and periodicity were likely match with the microfilaria in the blood of patient. This condition will maintain the high risk of filariasis transmission. For that purpose, vector surveillance should be considered to gain the filariasis elimination program together with Mass Drug Administration (MDA).

### CONCLUSION

This study is revealed that Samborejo Village showed low diversity (0,338) of mosquitoes fauna, and *Culex quinquefasciatus* to be the dominant species in this area. The indoor biting activities of *Cx. quinquefasciatus* were at 9 pm, 01 am, and 03 am; furthermore, the outdoor biting activities were at midnight (00) and at 03 am. However, *Aedes* mosquito was showed active biting in earlier periods, which were at 6 pm, 7 pm, and at 02 am.

### CONFLICT OF INTEREST

There was no conflict of interest for this paper.

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