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Cover: Dorsal view of Mantis Shrimp *Cloridina ichneumon* (Fabricius, 1798) & *Gonodactylellus demanii* (Henderson, 1893). © Fisheries Research Station, Junagadh Agricultural University, Sikka.

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COMMUNICATION

Bionomics study of *Mansonia* (Diptera: Culicidae) in a filariasis-endemic area of Sedang Village, Banyuasin Regency, South Sumatra, Indonesia

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Abstract: An investigation of bionomic study of *Mansonia* species was successfully conducted in Sedang village which is one of the filariasis-endemic areas in Indonesia. The study was carried out for 14 months from April 2017 to May 2018. In order to trap the local mosquitoes in the study area, indoor and outdoor human landing collection method was adopted. During the study, 7,908 mosquitoes were collected which consisted of 13 genera and 40 species of mosquitoes. Moreover, *Mansonia uniformis, M. annulifera*, and *M. indiana* were found to be the most abundant, dominant, and high frequency mosquitoes. The filariasis vector analysis through polymerase chain reaction test confirmed that only *Mansonia annulifera* positively detected as the filariasis vector. Furthermore, the longevity calculation showed that 81% of all the collected *Mansonia* spp. had already oviposited their eggs which indicates that the studied area possesses high possibilities of filariasis transmission.

Keywords: Filariasis diseases, filariasis vector analysis, *Mansonia* spp., mosquitoes, tropical diseases, vector transimission.

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Author contributions: RP—conceptualization, research design, field supervisor, writing. CA—research supervisor, evaluation, data interpretation. AG—data interpretation, data analysis. AH—writing, data visualization, writing, data analysis.

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INTRODUCTION

Filariasis is a zoonotic disease caused by the infestation with microfilaria, which is found in tropical areas, such as Indonesia. This disease has caught the attention of world researchers and policy-makers alike, especially in tropical and subtropical countries because it has infected more than 120 million people in 72 countries and more than 90% of filarial infections are infected by *Wuchereria bancrofti* and *Brugia malayi* which are transmitted by *Culex* and *Mansonia* mosquitoes (cdc.gov). Several studies have reported that *Brugia malayi* has dominantly caused the transmission of filarial infection in many Asian countries like China, South Korea, Japan, India, Myanmar, Indonesia, Malaysia, the Philippines, Thailand, and Bonaire Islands (Kanjanavas et al. 2009; Tan et al. 2011; Saeed et al. 2015).

To be more specific in Indonesia, Banyuasin is a regency in the South Sumatra province of Indonesia, which has been designated as an area where filariasis is endemic (Ministry Health of Republic of Indonesia 2016). In 2014, there were 142 cases of 173 provincial cases of chronic filariasis in Indonesia, in which Banyuasin has a high rate of endemicity, with an average microfilarial rate of 2.02%. Geographically, Banyuasin is a lowland filled with swamps, coastlines, rice paddies, and plantation fields, which makes it an ideal mosquito breeding ground. However, based on our knowledge, there is no record of comprehensive bionomics study in Banyuasin. Thus, this study will contribute to eradicating filariasis, mainly by vector control and case management (Saeed et al. 2015).

Herein, the present study aims to determine the bionomic study of *Mansonia* species in Banyuasin including their diversity, abundance, dominance, and preference. The main reason for choosing this area was based on the high filariasis cases reported in provincial case of filariasis in Indonesia. It is supported by the fact that the studied area still has high microfilaria rate which is 0.93% after conducting Mass Drug Administration (MDA) programmes by the Ministry of Health, Republic of Indonesia for the last three year (2013–2016) to eliminate the filariasis in this area. Therefore, the results are expected to provide evidence base and references to strategize a further prevention action to reduce the number of filariasis cases in Banyuasin regency, South Sumatera, Indonesia. The results could also become the reference and information baseline about the diversity and behavior of *Mansonia* spp. in Indonesia which enhance knowledge in Entomology.

MATERIALS AND METHODS

Study Area

The research was focused in Sedang Village which is located in Suak Tapeh District in Banyuasin Regency, South Sumatera-Indonesia. The research area had the coordinate of 2.853S and 104.579E with the altitude of 10 m. The studied area has a tropical weather with an average temperature of 26–28 °C and humidity ranging 89–92 %. The study area is dominated by high water bodies such as swamplands, ponds which has water plantations (Department Health of Banyuasin District, 2016). Image 1 presents the landscape of studied area taken using a drone.

Mosquito collection

All the obtained mosquitoes in this study were collected once a month for 14 months started from April 2017 to May 2018. Human landing collection (HLC) method was followed for both indoor and outdoor for 24 hours from 18.00 until 17.00 in the next day by six teams which consist of 12 volunteers. The six teams were divided into two teams (three team each condition) to collect the biting mosquitoes indoor and outdoor condition. The mosquitoes attached and rested to humans or wall shelters (rested only) were collected using aspirator for 40 minutes/hour and 10 minutes/hour, respectively. For consideration, all the research activities had been approved by the ethics team of Sriwijaya University (Ethical Access Certificate No. 522 / kepkrsmhfkunsri / 2016).

Image 1. The studied area in Sedang village. The light green ground was dominated by swamps and rice field, and the dark green refers to plantation. © Author.

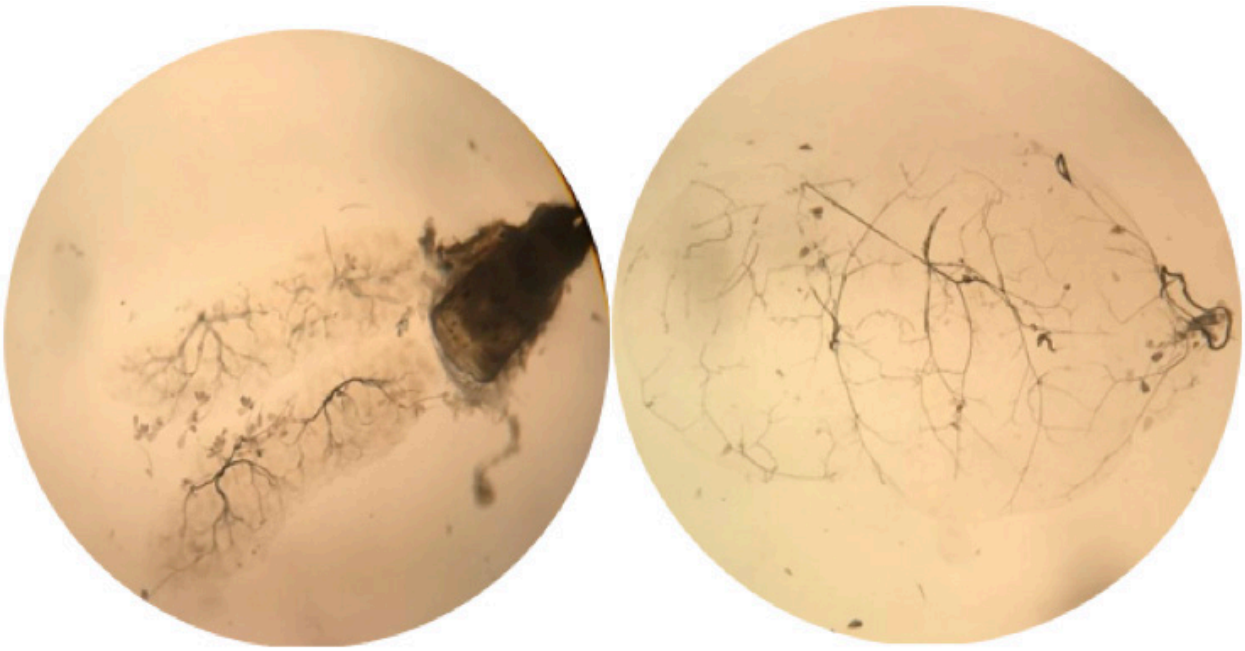

Image 2. Dilatation uterus.

Mosquito identification

All the collected-mosquitoes were further identified using the Rampa & Wharton identification book and carefully counted (Wharton 1978; Rattanarithikul 2005). In this study, only female mosquitoes were collected as biting mosquitoes since the male mosquitoes did not bite the volunteers in human landing method (Shirai et al. 2002). The females of *Mansonia* were then dissected to determine parity using dilatation methods and identify the ovarian as parous or nulliparous (Image 2).

Data analysis

All the collected mosquitoes in biting and resting positions were summarized and divided into several categories including diversity, abundance, frequency, dominance, man-hours density, man-biting rate, and resting rate. The detailed calculation to determine each category was shown in several formulas below.

Abundance= (Total number of collected mosquitoes per species / Total number of collected mosquitoes) x 100 % (1)

Frequency= Total number of collected mosquitoes per species / Total collecting hours (2)

Dominance= Frequency x Abundance (3)

Man-hours density= Total number of collected mosquitoes per species / Total collection hours per day x number of day x number of collector x duration of collection (minutes) (4)

Man-biting rate= Total number of collected biting mosquitoes / Total number of collector x number of collection hours (5)

Resting rate= (Total number of collected resting mosquitoes per species / Total number of collected resting mosquitoes) x 100% (6)

Longevity (P)= ^{A}VB

where A= Physiological age of collected mosquitoes (gonotrophic cycle); B= Proportion of porous from several dissected mosquitoes; P= Daily life opportunities. Estimated age of mosquito population= 1 / -log e^{P} (7)

Biomolecular examination

The molecular examination was carried out to determine the filariasis vector through DNA isolation from the heads of the *Mansonia* spp. Twenty-five mg sample kept in 1.5 ml microtube was smashed with pastel and added with 180 µl buffer ATL and 20 µl proteinase K. After vortex, the sample was incubated at 56 °C until lysed. Then 200 µl buffer AL and 200 µl ethanol (96–100 %) was added and vortexed, respectively, followed by the spinning period with Dneasy Mini Spin (Blood & Kit 2006). *Brugia malayi* specific primers were forward (5'-GCGCATAAATTCATCAGC-3') and reverse (5'-GCGCAAAACTTAATTACAAAAGC-3') amplified using thermal PCR (Haryuningtyas & Subekti 2008). The PCR temperature and the master mixes were according to Goodman et al. (2003). The amplicon was later electrophoresed at 80 volts for 40 minutes. The gel was 2% agarose TAE with ethidium bromide and read after

Table 1. The diversity of mosquitoes in Sedang Village, Banyuasin Regency, South Sumatera-Indonesia collected in the period of April 2017 to May 2018.

	Species	Number of collected mosquitoes	%
1	*Mansonia uniformis*	1,835	23.20
2	*Mansonia annulifera*	1,585	20.06
3	*Mansonia indiana*	985	12.50
4	*Mansonia bonneae*	30	0.40
5	*Mansonia annulata*	9	0.11
6	*Mansonia dives*	4	0.05
7	*Culex gelidus*	795	10.06
8	*Culex quinquifasciatus*	629	7.96
9	*Culex tritaeniorhynchus*	211	2.67
10	*Culex vishnui*	124	1.56
11	*Culex sitiens*	46	0.58
12	*Culex fuscocephalus*	23	0.29
13	*Culex hutchinsoni*	10	0.12
14	*Culex bitaeniorhyncus*	1	0.01
15	*Culex pseudosinensi*	1	0.01
16	*Culex nigropunctatus*	1	0.01
17	*Culex infula*	1	0.01
18	*Culex sinensis*	1	0.01
19	*Aedes aegypti*	339	4.29
20	*Aedes albopictus*	55	0.70
21	*Aedes butleri*	30	0.40
22	*Aedes pulchriventer*	11	0.14
23	*Aedes albolineatus*	6	0.07
24	*Aedes* sp.	5	0.06
25	*Aedes lineatopennis*	3	0.04
26	*Aedes anandelei*	1	0.01
27	*Aedes poicilius*	1	0.01
28	*Anopheles nigerrimus*	12	0.15
29	*Anopheles separatus*	7	0.09
30	*Anopheles barbirostris*	1	0.01
31	*Coquillettidia crassipes*	5	0.06
32	*Coquilettidia nigrosignata*	3	0.03
33	*Topomyia* sp.	542	6.90
34	*Armigeres subalbatus*	340	4.30
35	*Tripteroides* sp.	235	2.97
36	*Mimomyia* sp.	5	0.06
37	*Malaya jacobsoni*	5	0.06
38	*Uranataenia* sp.	2	0.02
39	*Hodgesia* sp.	1	0.01
40	*Uratonia longinistis*	1	
	Total	**7,901**	**100.00**

the DNA ladder addition under ultraviolet light using Gel doc. The PCR results positively result in a band at 326 bp as *Brugia malayi*.

RESULT AND DISCUSSION

Mosquito collections

Table 1 showed the diversity and total number of collected mosquitoes. During the research period, there were 7,908 mosquitoes collected which consisted of 13 genera including *Mansonia, Culex, Aedes, Anopheles, Coquilettidia, Topomyia, Armigeres, Triptoides, Miomyia, Malaya, Uranataenia, Hodgesia*, and *Urotonia*. From the 13 genera, all the obtained mosquitoes were analyzed and divided into 40 species. The most dominant diversity was from the genera *Culex* which has 12 species, followed by *Aedes* (9 species), *Mansonia* (6 species), *Anopheles* (3 species), *Coquilettidia* (2 species), and 1 species from *Armigeres, Triptoides, Malaya, Urotonia, Uranataenia, Topomyia, Coquilettidia, Hodgesia, Topomyia*, & *Miomyia*. In case of number, *Mansonia* spp. was found as the highest collected mosquitoes where 4,448 *Mansonia* spp. (56.30%) had successfully collected and identified during the research period. On the other hand, *Culex* spp. had the highest species diversity and was the second most abundant of collected mosquitoes which consists of 1,843 mosquitoes (23.33%).

The result was similar with the work conducted by Rohani (2013) who had reported the bionomic study in Malaysia and reported six genera of mosquitoes collected which were *Aedes, Anopheles, Armigeres, Culex, Coquilettidia*, and *Mansonia* which consist of only 27 species. However, the study reported that *Culex* spp. was the highest collected mosquito followed by *Anopheles, Armigeres*, *Mansonia*, *Aedes*, and *Coquilettidia*. As comparison in Indonesia, Sugiarto (2017) also reported the bionomic study in North Borneo Island, and found that *Anopheles* mosquitoes as the most collected mosquitoes during the research period. We can infer that there is a difference in the diversity and abundance of mosquito species in each studied area due to variations in geographical characteristics, climate, and the availability of breeding grounds and resting places (Rohani et al. 2013; Sugiarto et al. 2017). Moreover, this finding can contribute as the information about a fingerprint of specific species located in Sedang village of Banyuasin district, South Sumatera-Indonesia.

In order to see the potential of filariasis transmission vector, the further study was focused on *Mansonia* spp. as the most collected mosquitoes during the present

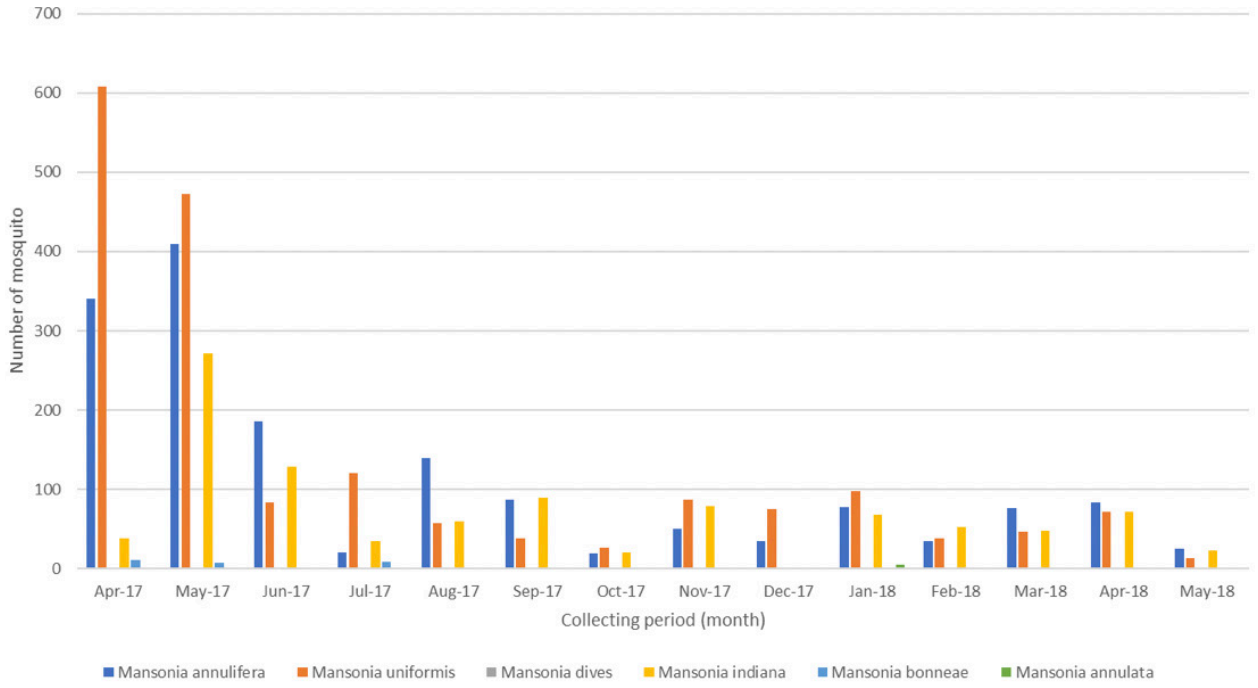

Figure 1. Seasonal distribution of *Mansonia* species.

study. It was because of the report of *Mansonia* spp. as the vector of filariasis compared to the other genera (Kumar et al. 1992).

The species identification showed six species of *Mansonia* collected in this study including *M. uniformis, M. annulifera, M. indiana, M. bonneae, M. annulata,* and *M. dives*. *M. uniformis* was found as the most abundant species (41.25%) followed by *M. annulifera* (35.63%), and *M. indiana* (22.14%). The detailed number and percentage of collected *Mansonia* spp. as a function of its species can be seen in Table 2.

To be more specific in seasonal distribution during the study period, *M. uniformis,* and *M. annulifera* were found as the most predominant mosquito species as they were present in almost all months, while *M. indiana* as the third highest number collected mosquito was not present in December 2017. The other *Mansonia* species have relatively low dominance by occurring only in the specific months. For example, *M. bonneae* was collected only in April 2017, May 2017, July 2017, January 2018, and March 2018; *M. annulata* in May 2017, September 2017, October 2017, January 2018, and February 2018; and *M. dives* was only detected in June 2017 and December 2017. Moreover, the period between April 2017 and June 2017 were found as the highest occurrence period of *Mansonia* species. It is because the air temperature and relative humidity were 27–28 °C and 90%, respectively which is the most suitable period for mosquitoes to breed than other seasons.

Table 2. The diversity of Mansonia spp in Sedang Village, Banyuasin Regency, South Sumatera, Indonesia.

Species	Number of collected mosquitoes	Percentage (%)
M. uniformis	1,835	41.25
M. annulifera	1,585	35.63
M. indiana	985	22.14
M. bonneae	30	0.7
M. annulata	9	0.2
M. dives	4	0.08
Totally	4448	100

Frequency, abundance, and dominance of *Mansonia* mosquito

The analysis result for the frequency, abundance, and dominance of mosquitoes biting outdoor and biting indoor is presented in Table 3. *M. uniformis, M. Annulifera*, and *M. indiana* become the top number of abundance and dominance compared to other species. Correlating with the number of collected mosquitoes, *M. uniformis* has the highest frequency both indoor and outdoor, abundance in indoor, and dominance in both condition. It was followed by *M. annulifera* and *M. indiana* which become the second and third species

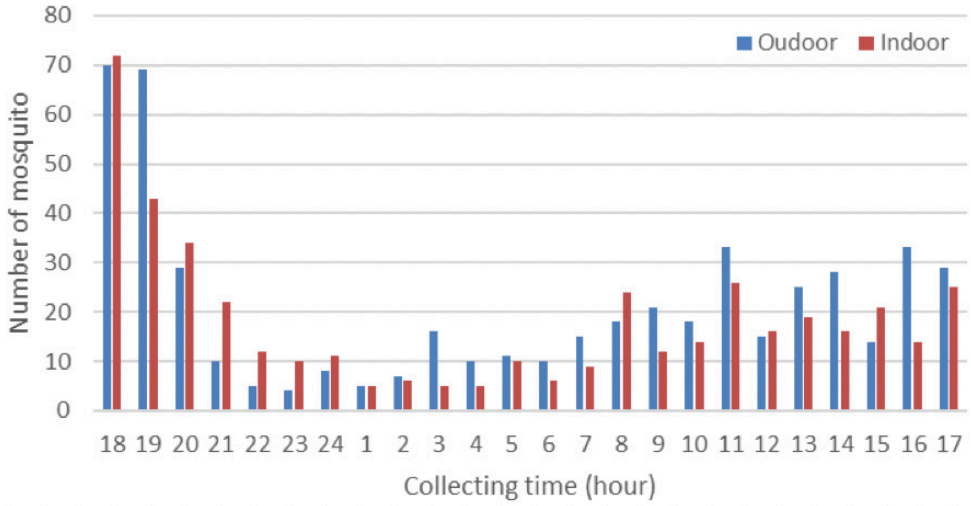

Figure 2. The biting activity of *Mansonia uniformis*.

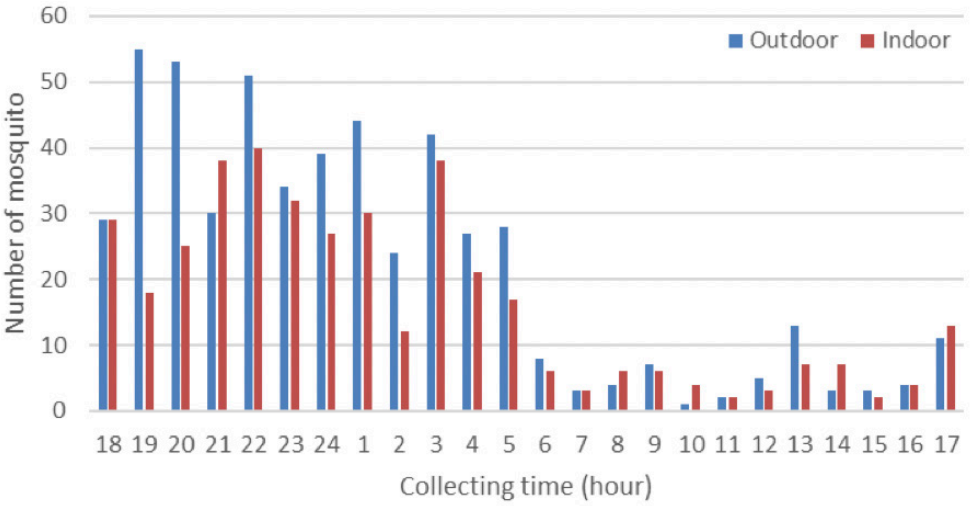

Figure 3. The biting activity of *Mansonia annulifera*.

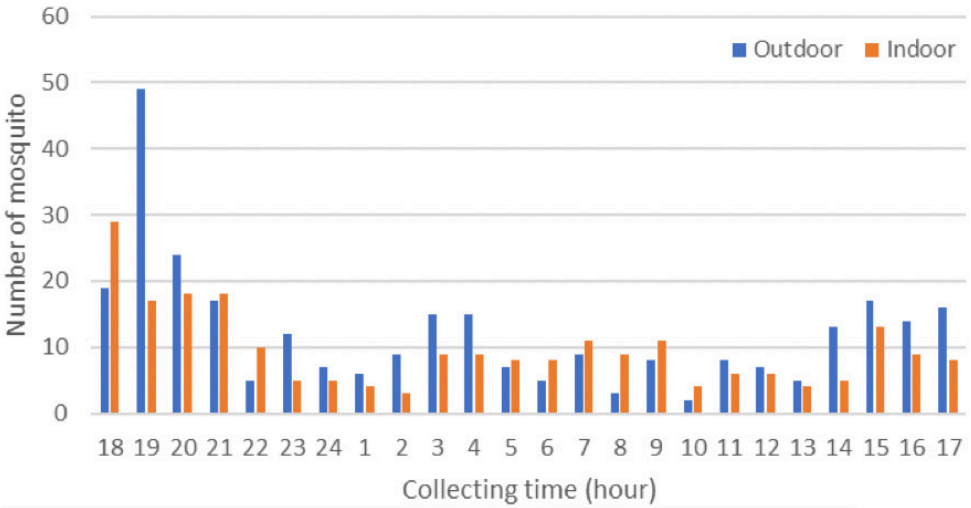

Figure 4. Biting activity of *Mansonia indiana*.

Table 3. Frequency, abundance, and dominance of Mansonia spp. biting activity in outdoor and indoor in Sedang Village.

Species	Outdoor Frequency	Indoor Frequency	Outdoor Abundance	Indoor abundance	Outdoor dominance	Indoor dominance
M. uniformis	0.50	0.42	37.90	41.15	19.06	17.51
M. annulifera	0.44	0.42	39.18	36.72	17.40	15.63
M. indiana	0.38	0.38	22.00	21.56	8.32	8.15
M. bonneae	0.03	0.009	0.68	0.38	0.02	0.003
M. annulata	0.003	0.003	0.15	0.09	0.0004	0.0003
M. dives	0.50	0.42	0.07	0.09	0.04	0.04

Table 4. Frequency, abundance, the dominance of Mansonia resting indoor and outdoor in Sedang village.

Species	Outdoor Frequency	Indoor Frequency	Outdoor abundance	Indoor abundance	Outdoor dominance	Indoor dominance
M. uniformis	0.41	0.46	39.96	46.88	16.41	21.49
M. annulifera	0.42	0.44	35.24	30.40	14.68	13.30
M. indiana	0.34	0.36	23.52	21.57	7.98	7.83
M. bonneae	0.02	0.03	0.79	0.86	0.02	0.03
M. annulata	0.009	0.009	0.003	0.3	0.027	0.002
M. dives	0.006	0.0	0.2	0.0	0.001	0.0

having the highest abundance and dominance under *M. uniformis*. But, *M. annulifera* was found as the highest outdoor abundance compared to all *Mansonia* spp. including *M. uniformis* as the highest collected mosquito.

In term of resting activities, there was a correlation between the biting activity and resting activity. Table 4 showed that *M. uniformis*, *M. annulifera* and *M. indiana* were the species that also had the highest outdoor and indoor resting frequency, abundance, and dominance compared with other species. In general, we can say that the high biting activity was positively followed by t high resting activity. However, *M. annulifera* showed a difference where it had high biting behavior and less resting activity.

The hourly biting behavior of most collected *Mansonia* spp.

The study was aimed to investigate the detailed biting time of *M. uniformis, M. annulifera,* and *M. indiana* as the highest species collected and active during the research period. Figure 2 showed that *M. uniformis* as the most collected species had the highest activity in the evening in both conditions (indoor and outdoor). It began at 1800 h and slightly decreased after 1900 h. However, the biting activity fluctuated and relatively increased in the early morning (after 0600 h) and continuously increased until the highest peak at 1800 h and 1900 h for indoor and outdoor activities, respectively. Moreover, the biting behavior patterns in outdoor and indoor was quite similar, instead the number of mosquitoes caught are different. The outdoor biting activity was higher than the indoor biting activity, indicating the *M. uniformis* was categorized as the exophage species.

Figure 3 showed the biting activity as a function of time of *M. annulifera* for 24 hours of collecting period. The outdoor biting activity began at 1800 h with the highest biting activity at 1900 h. The biting activity slowly decreased till midnight and then again slightly decreased after 0400 h. During noon, most of *M. annulifera* had low biting activity until 1600 h and started to increase after 1700 h. The biting activity was different with the indoor biting behavior of *M. annulifera* which began the biting activities at 0600 hoand had the highest peak of biting activity at 0300 h. The indoor biting activity started to drop at 0400 h to 1100 h and fluctuated between 1200 h and 1700 h. The biting behavior pattern of *M. annulifera* was different in the highest biting activity in outdoor and indoor condition, but had similar behavior in the low biting activity. Based on the number of collected species, *M. annulifera* identified as exophage species which had a higher number of collected mosquitoes in outdoor compared to the number of catch mosquito in indoor condition.

Figure 4 showed the biting activities of *M. indiana*

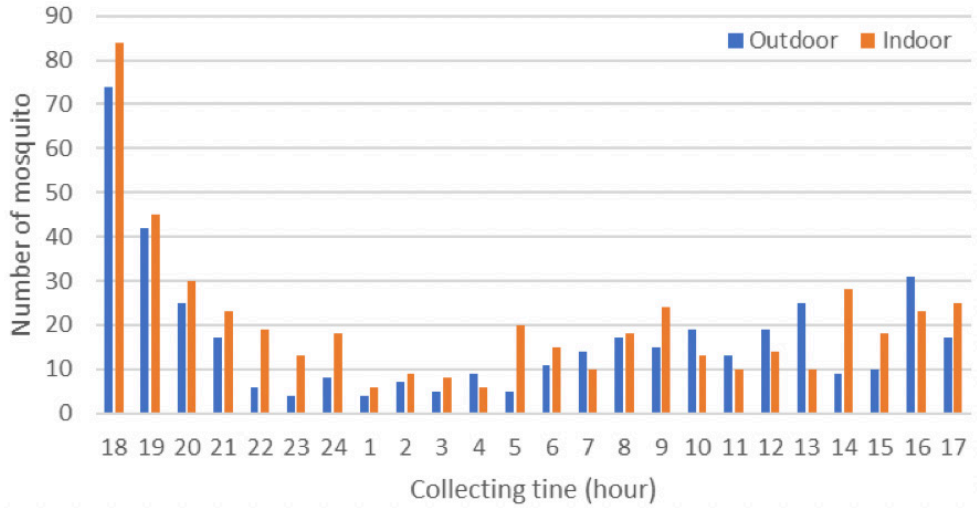

Figure 5. Resting activity of *Mansonia uniformis*.

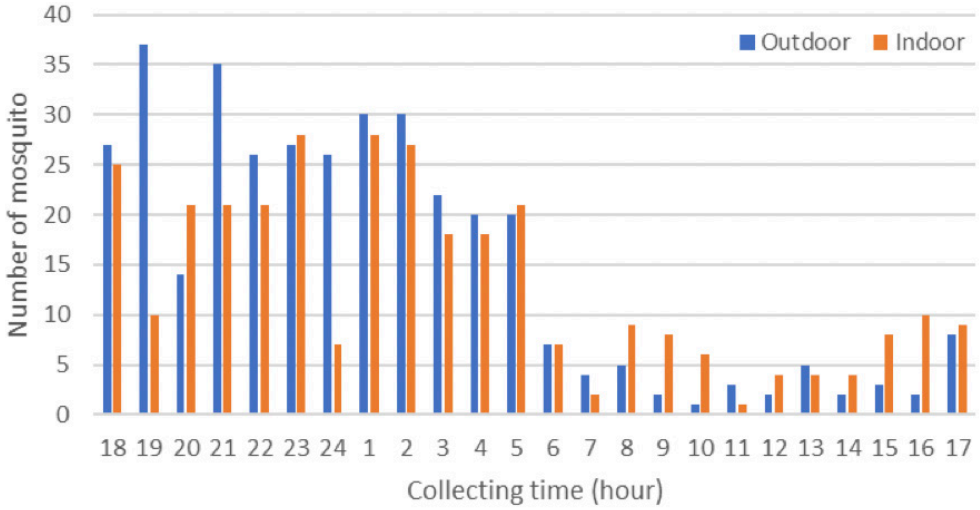

Figure 6. Resting rythme of *Mansonia annulifera*.

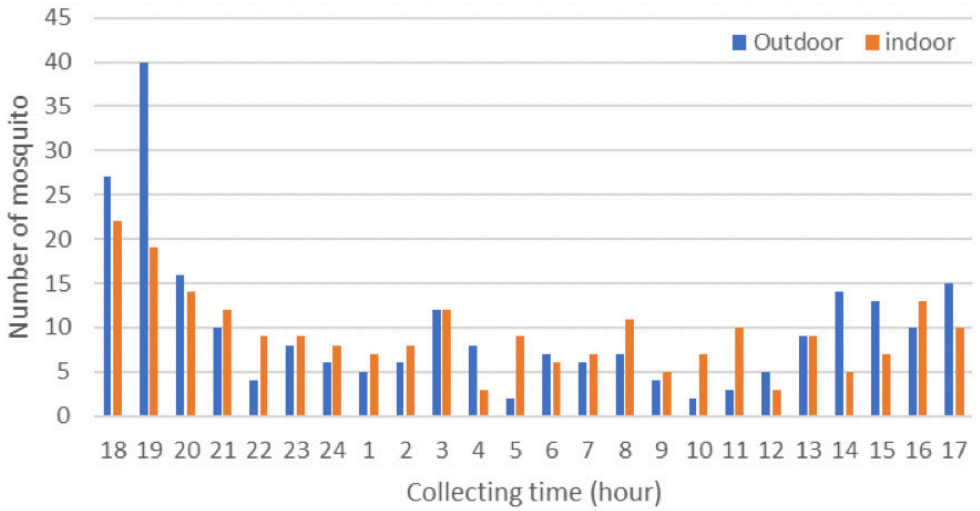

Figure 7. Resting rythme of *Mansonia indiana*.

as the third most collected mosquitoes in this present study. The highest peak of biting activity of *M. indiana* conducted at 1800 h and 1900 h for indoor condition and outdoor condition, respectively. However, there were an extremely decreased after the highest biting activity for outdoor condition, while the indoor condition showed a slightly decrease after the highest peak activity. The biting behavior of *M. indiana* was relatively different in outdoor and indoor condition at the highest biting activity was at 1800 h to 2300 h, but having the similar activity after the highest peak period. Based on the number of biting activity, *M. indiana* was the exophage species which had higher outdoor biting activity than indoor biting activity.

In this study, *Mansonia* spp. had a higher outdoor biting activity than indoor biting activity. It was in accordance with the study reported by Supranelfy et al. (2012) where *Mansonia* spp. bites more frequently outdoor than indoor condition. However, as the fraction of indoor biting behaviour remained high, we would still have to take them into account. The availability of the main indoor host (humans), or reservoir hosts (i.e., pets), attracted the adult mosquitoes to do more activities indoors. Besides, the environmental factors including climate, geography, and geology, the socio-economic-cultural environment (the environment produced by interpersonal interactions) potentially modify the outdoor/indoor ratio of biting activity of *Mansonia*.

Study the resting behavior of most collected *Mansonia* spp.

The bionomic study was continued by investigating the resting behavior of *Mansonia* species. In Figure 5, the resting activity of *M. uniformis* was quite similar with the biting activity (Figure 2). The highest peak of highest resting peak was conducted in the similar time of highest peak of biting activity. The result indicated that most of *M. uniformis* did resting activity when doing biting activity. The high number of resting activity also indicated that there was a high number of mosquito population in those range of time (1800–1900 h). Moreover, the resting mosquitoes was slightly down in number after the highest peak of resting activity until 2300 h and become fluctuating after 2300 h until 1700 h the next day. The resting paths for indoor and outdoor condition were relatively similar, indicating the condition (indoor or outdoor) did not affect resting behavior. In terms of number, the number of resting activities was found higher in indoor condition than outdoor condition. However, it could not be said that *M. uniformis* was categorized as endophage species since it was an exophage species based on biting behavior. The most possibility reason why there were high number of *M. uniformis* found in indoor condition was because of the presences of suitable place for resting.

Table 5. The density of collected *Mansonia* spp.

Species	Outdoor biting	Man hour density (MHD)	Indoor biting	Man hour density (MHD)
M. uniformis	503	10.43	437	9.06
M. annulifera	520	10.78	390	8.08
M. indiana	292	6.05	229	4.75
M. bonneae	9	0.19	4	0.08
M. annulata	2	0.04	1	0.04
M. dives	1	0.02	1	0.04

Table 6. Man biting rate data.

Species	Outdoor Biting	Indoor Biting	Total	MBR
M. uniformis	503	437	940	156.67
M. annulifera	520	390	910	151.67
M. indiana	292	229	521	86.83
M. bonneae	9	4	13	2.17
M. annulata	2	1	3	0.50
M. dives	1	1	2	0.33

The resting behavior of *M. annulifera* was found similar with the resting behavior of *M. uniformis* where the pathway was correlated with the biting activity. To be more specific, the outdoor resting activity began at 1800 h and had the highest peak at 1900 h. The outdoor resting behavior fluctuated between 2000 h and 0500 h the next day. However, the indoor resting behavior was completely different with the outdoor resting behavior where *M. annulifera* had the highest peak of resting activity at 2300 h. The resting behavior was similar with its biting activity, indicating *M. annulifera* relatively did the resting after biting activity in both condition (outdoor and indoor). In case of number, the resting activity in outdoor condition was higher than the number of indoor resting behavior, meaning *M. annulifera* was categorized as the exophage species. However, the result was different with the study reported by Kumar (1992) who reported *M. annulifera* as the endophage species.

Figure 7 shows the resting forms of *M. indiana* for 24 hours of collecting time. The result showed that the outdoor resting activity started at 1800 h with the highest peak at 1900 h. After the highest resting activity, the number of resting mosquitoes decreased

Table 7. Parity rate and longevity.

Species	Number of dissection	Parous	Nulliparous	Parity rate	Longevity (days)
M. uniformis	636	508	128	0.79	13.35
M. annulifera	680	491	189	0.72	9.21
M. indiana	544	443	101	0.81	14.61
M. bonneae	9	3	6	0.33	2.7
M. annulata	5	2	3	0.4	3.3
M. dives	4	4	0	1	-

and relatively fluctuated until the next day. In indoor condition, the resting time started 1800 h, which also become the highest peak of resting time. The resting activity dropped after the high peak and continuously fluctuated until the next day. The outdoor and indoor resting activity was quite similar but having the different in quantity. The number of resting *M. indiana* in outdoor condition was found higher than the number of resting *M. indiana* in indoor resting activity, indicating *M. indiana* as the exophage species.

From the study of resting behavior of most collected *Mansonia* spp., most of mosquitoes had the similar rhythm with the biting activity, indicating the biting activity was always followed by the resting activity before continuing doing their activity. However, it was only a hypothetic theory based on the rhythm of biting and resting activity.

Mosquitos density

Table 5 reveals that in Sedang village, the outdoor man hour density of *M. uniformis* was 10.43 mosquitos per person-hour in which *M. annulifera* and *M. indiana* were 10.78 and 6.05 mosquito per person-hour, respectively. On the other hand, the indoor man hour density of *M. uniformis*, *M. annulifera, M. indiana* were 9.06, 8.08, and 4.75 mosquitos per person-hours, respectively. It should be a concern because the potential for filariasis transmission is very high. The result was different with the one reported by Sabesan et al. (1991) where the average of man hour density for *M. annulifera, M. uniformis*, and *M. indiana* indoor were 3.29, 0.25, and 0.01, respectively.

Santoso et al. (2016) conducted a study of Mansonia species in Jambi Province, Indonesia and reported that the man hour density was below five (Santoso et al. 2016). In this study, we found that outdoor and indoor MHD of *Mansonia* spp. have more than five which meant that the potential for filariasis transmission was very high. It was supported by the regulation of the Minister of Health of the Republic of Indonesia No. 50 of 2017 where the value of man hour density should be under five. In addition, the high the man density was supported by the data of man biting rate (Table 6). The result showed that the highest man-biting rate was *M. uniformis* (156.67) followed by *M. annulifera* (151.67), and *M. indiana* (86.83), which correlated with the biting activities of *Mansonia* spp.

Dissection was performed on the ovaries of mosquitos to find out whether the mosquitos had laid their eggs or not. In Sedang village, the dissection was carried out using 1,878 *Mansonia* spp. Table 7 explains that 1,878 *Mansonia* spp. mosquitos had a dissection in which 1,451 and 427 were parous and nulliparous, respectively. The longevity was performed to see how long the mosquito life expectancy. To obtain the longevity, the parity rates was calculated. The result showed that the paruty rate of *M. uniformis, M. annulifera,* and *M. indiana* were 0,79, 0,72, and 0,81, respectively, indicating there are 79%, 72%, and 81% of these mosquitos have oviposited their eggs.

Based on the parity rate, the population longevity of *M. uniformis*, *M. annulifera,* and *M. indiana* was found to be 13.35 days, 9,21 days and 14,61 days, respectively. The result found that *Mansonia* was ideal as the host of filariasis transmission where the growth period of microfilariae in the body of mosquitoes that become hosts ranges from 10–14 days. To be more specific, *Brugia* species need 8–10 days, the *Wuchereria* species takes 10–14 days (Ministy Heath of Republic of Indonesia 2016). According to Gilles & Warrel (1993), the cycle of mosquitoes and the age are obtained to support the development of the parasite cycle in the body of mosquitoes. The number of longevity determined how long the host could transmit the disease, when associated with the parasite life cycle. Observation of the age of life was one of the most important factors in determining the discrimination of vectors so that transmission can be detected somewhere (Mardiana 2009).

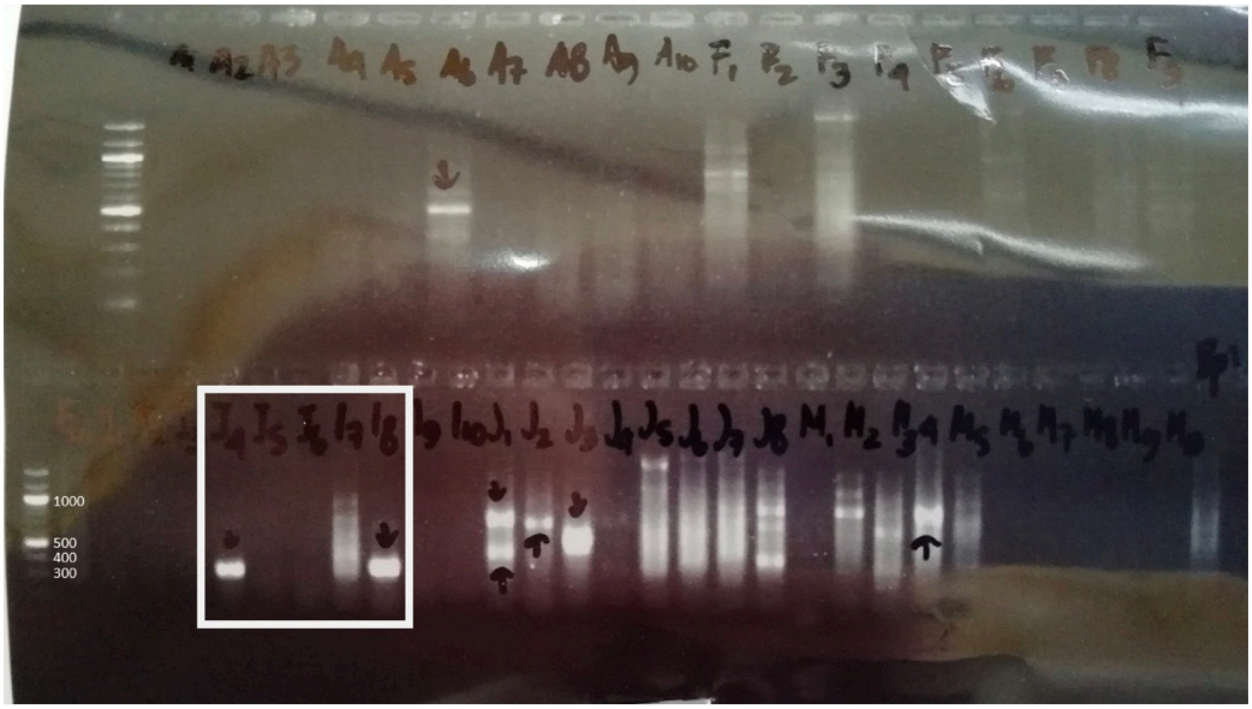

Image 3. Agarose gel with ethidium bromide electrophoresis UV visualization of sample's pools. Positive PCR amplicons wells of *Brugia malayi* were at 324 bp. Note: PCR process produces false-positive result, where the white band was in the wrong base pair size.

The PCR study was performed to support the longevity and the potential of filariasis transmission. In Figure 10, there was a correct band size of *Brugia malayi* which detected in I4 sample which come from *M. annulifera*. There was no positive band size of *Brugia malayi* detected in the other sample, indicating only *M. annulifera* potentially transmitted the filariasis. However, the result could not be a final conclusion since the other *Mansonia* species was potential as the host for filariasis transmission.

CONCLUSION

In conclusion, *M. uniformis, M. annulifera*, and *M. indiana* have the highest frequency, abundance, and dominance. The biting activity and resting rhythm are available in 24 hours and they also had a big parity rate and longevity. They eventually had the greatest number of MHD and MBR, which could be contributed to the high rate of filariasis transmission. *M. annulifera* was confirmed as the potential filariasis vector based on PCR examination.

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