ORIGINAL ARTICLE

Culex Mosquitoes Fauna In Salamwates Village, Trenggalek City, East Java

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ABSTRACT

Introduction: Mosquito-borne diseases are still a burden worldwide, including in Indonesia. Some of those diseases, such as filariasis and Japanese encephalitis, are transmitted by some species of *Culex* mosquitoes. We aimed to describe the fauna of *Culex* mosquitoes in Salamwates village, Dongko subdistrict, Trenggalek district.
Methods: Female *Culex* mosquitoes were collected in Salamwates village at night using the methods of indoor human-baited double bed-net trap and outdoor cow-baited double bed-net trap. The spesies of collected *Culex* mosquitoes were identified based on identification guide published by Ministry of Health of Republic Indonesia.
Results: There were 67 identifiable female mosquitoes collected using cow-baited methods and no female mosquitoes collected using human-baited methods. Those mosquitoes consisted of nine species. *Culex tritaeniorhynchus* (29.85%), *C. gelidus* (23.88%), *C. vishnui* (13.43%), *C. pseudovishnui* (11.94%) were the dominant species. The peaks of biting activities were at 18.45-19.00 and 23.45-24.00.
Conclusion: Nine species of *Culex* mosquitoes collected using cow-baited methods. *C. tritaeniorhynchus* was the dominant species. Those mosquitoes were zoophilic and exophagic. The peaks of biting activities of the *Culex* mosquitoes were at dusk and midnight.

Introduction

Vector-borne disease reached more than 17% of all infectious diseases in the world, with mosquitoes as the most common vector.[1] Mosquito-borne diseases are still a burden worldwide. Hundred species of mosquitoes have been known as disease carriers.[2] Those diseases have high morbidity and mortality rate and may cause an outbreak in Indonesia, including filariasis and Japanese encephalitis (JE) which are mainly transmitted by *Culex* mosquitoes that bite at night.[3,4,5] *C. fuscocephala, C. tritaeniorhynchus, C. gelidus* and *C. vishnui* transmit the Japanese encephalitis virus in the Oriental region.[4,5,6] *C. quinquefasciatus* is known as an important vector of bancroftian filariasis and found widespread across continents.[7,8] Most of these species mainly bite cattle and pigs and humans and their breeding places include rice paddies, swamps and water with high levels of organic material.[7,9]

JE transmission in Indonesia was said to be likely increase because of large agricultural areas, population growth, pig rearing, and lack of surveillance and vaccination program.[10] Tansmission of JE in the tropics occurs year-round and increases in the rainy season.[11] The incidence of JE is 1.8 per 100,000 and about 20-30% cases are fatal and 30-50% of patients have significant neurological sequelae.[9] Indonesia is also an area with a high risk of filariasis transmission. There were 31 provinces and 337 districts/cities endemic for filariasis with a total of 11,914 chronic cases until 2009. Filariasis can cause disability and psychosocial stigma that has impact on the reducing patient productivity, family burdens and huge economic losses for the country if not handled properly.[12] Trenggalek is one of the districs that was still burdened by diseases transmitted by mosquitoes. There are still new cases of filariasis in Trenggalek district in the last decade, with increasing number of cases year by year.[13,14,15]

Problems of vector control encountered in Indonesia are inadequate data of vector species and mapping of the vectors distribution in endemic areas, the increase

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of resistant population of multiple vectors to specific pesticides, and the limited resources of both personnel, logistical and operational costs. Mosquitoes have different characteristics of biting activity. Mosquitoes can bite during the day (diurnal) or at night (nocturnal). Mosquitoes are called endophagic if they bite indoor and called exophagic if they bite outdoor. Anthropophilic refers to the mosquito that prefers human blood while zoophilic refers to mosquito that prefers to bite of animals.[16]

There are still no sufficient data about *Culex* mosquitoes in Trenggalek district that are vectors potential of diseases such as filariasis and JE. Therefore, this study is aimed to describe the fauna of *Culex* mosquitoes in Salamwates village Trenggalek district, including the species and the biting behavior.

Methods

This study is a descriptive study by the identification of the collected sample. *Culex* mosquito samples were collected in Krajan, Salamwates Village, Dongko Subdistrict, Trenggalek. *Culex* mosquitoes were collected at night using the method of indoor human-baited double bed-net trap and outdoor cow-baited double bed-net trap between 18.00 - 24.00.

Mosquito collection were done in six periods by using double bed-net,[17,18] called inner net and outer net with a 75cm gap. Human-baited methods were using 2m x 2m x 2m nets and done every hour within a period of 45 minutes. Cow-baited methods were using 6m x 6m x 2m nets and done every hour within a period of 15 minutes each after human-baited method. The mosquitoes trapped between the two nets were collected using an aspirator and a flashlight.

Collected mosquitoes were put in a plastic cup sealed with gauze based on collection periods and methods. The cup were labeled with date, time, location, indoors or outdoors, and method of collection. All collected mosquitoes were then stored by cold preservation using refrigerator[19] and to be identified later. *Culex* spp. mosquitoes were identified in the Laboratory of Parasitology, Faculty of Medicine, Universitas Airlangga based on identification guide published by Ministry of Health of Republic Indonesia.[20] Female *Culex* mosquitoes accorded with the identification guide published were included while mosquitoes with some parts of the body were incomplete and could not be identified were excluded.

Obtained data consisted of species composition, time distribution, and biting behavior of *Culex* mosquitoes. The data were presented in tables and graphs and analyzed. Descriptive data analysis included counting the number and proportion.

Results

Two male mosquitoes and no female mosquitoes were collected using human-baited methods. 87 mosquitoes, consisting of 67 identifiable female mosquitoes, 18 male mosquitoes, and two unidentifiable female mosquitoes, were collected using cow-baited methods.

Table 1 shows that mosquitoes collected by cow-baited methods consisted of nine species. *C. tritaeniorhynchus* was the dominant species (29.85%), followed by *C. gelidus* (23.88%), *C. vishnui* (13.43%), *C. pseudovishnui* (11.94%), *C. fuscocephalus* (7.46%), *C. sitiens* (5.97%), *C. quinquefasciatus* (4.48%), *C. sinensis* (1.49%), and *C. pseudosinensis* (1.49%). The peaks of biting activities were at 18.45-19.00 and 23.45-24.00. The biting activities of each species of *Culex* were different. *C. tritaeniorhynchus*, *C. vishnui*, *C. pseudovishnui*, and *C. quinquefasciatu*s had higher activities at dusk and midnight. The peaks of *C. tritaeniorhynchus'* biting activities were at 18.45-19.00 and 23.45-24.00, 7 and 9 mosquitoes consecutively. *C. gelidus* had its highest biting activities at 19.45-20.00.

Table 1. Number of female *Culex* mosquitoes collected by cow-baited methods.

Species	Period of mosquito collection						Total	Percentage (%)
	1 18.45- 19.00	2 19.45-20.00	3 20.45-21.00	4 21.45-22.00	5 22.45-23.00	6 23.45-24.00		
C. tritaeniorhynchus	7	1	0	1	2	9	20	29.85
C. gelidus	0	9	6	1	0	0	16	23.88
C. vishnui	3	0	0	2	4	0	9	13.43
C. pseudovishnui	3	0	0	0	1	4	8	11.94
C. fuscocephalus	0	0	1	1	1	2	5	7.46
C. sitiens	2	0	0	1	0	1	4	5.97
C. quinquefasciatus	1	0	0	0	1	1	3	4.48
C. sinensis	1	0	0	0	0	0	1	1.49
C. pseudosinensis	0	0	1	0	0	0	1	1.49
Total	17	10	8	6	9	17	67	100

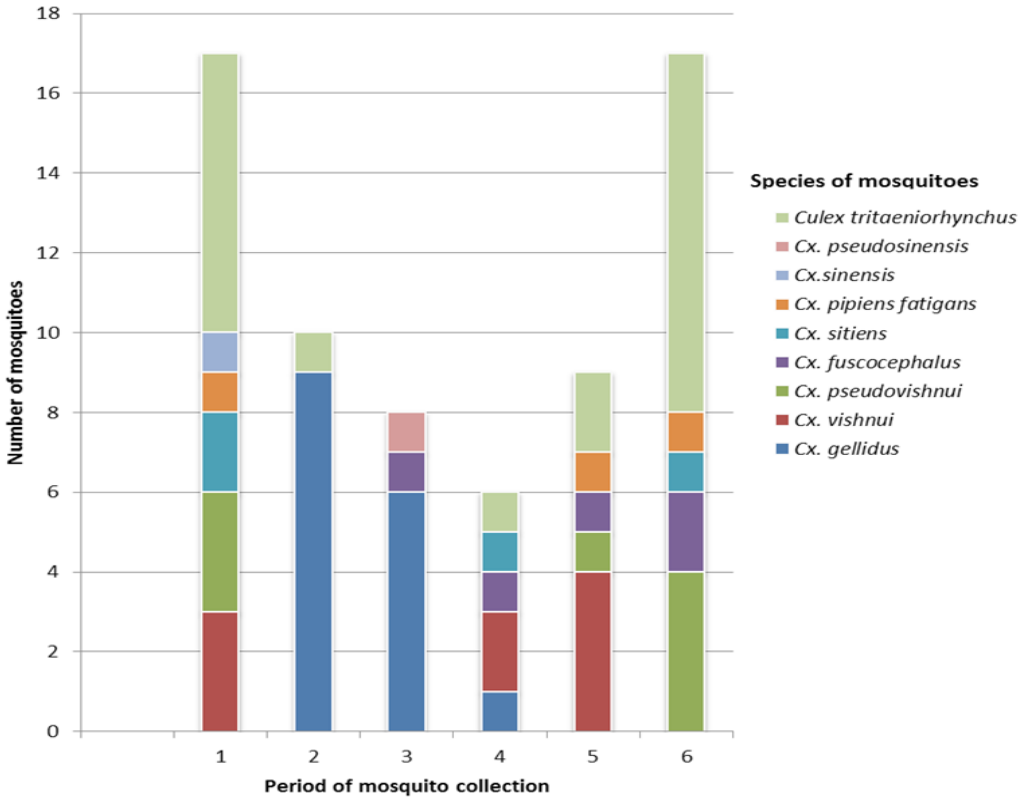

Figure 1. Biting activities period of each Culex species

Discussion

C. tritaeniorhynchus alongside with *C. quinquefasciatus* were the dominant species collected in this study. There were many breeding places of those mosquitoes found in Salamwates, where the mosquitoes were collected, including rice paddies, ponds, and sewerage. Agriculture and cattle farming were the main livelihoods in the area. *C. tritaeniorhynchus* is the primary vector of JE in the oriental region and mainly bite cattle and pigs.[21,22] *C. tritaeniorhynchus* mainly bite outdoors and will bite human when cattle and pigs were unpresent.[5,21] Das et al. (2004),[23] found that *C. tritaeniorhynchus* was also the predominant species collected outdoor. *C. gelidus* is zoophilic species which particularly bite animals and can bite humans.[24] *C. quinquefasciatus* was only 4.48% of the mosquitoes collected in this study. This species rarely bite humans inside the house and show zoophilic behavior both to mammals and birds.[7] *C. quinquefasciatus* in the research by Wilson and Sevarkodiyone in India show the same preference to bite both humans and animals. Female mosquitoes were only collected in cow-baited methods in this study, therefore the human biting behavior of Culex mosquitoes could not be described.[25]

This research does not investigate the presence of viruses or nematodes in the body of the mosquito but some of the species collected in this study have been known as vectors of JE and filariasis. WHO reported that filariasis vectors in Asia region included *C. quinquefasciatus* and *C. sitiens*.[7] *C. quinquefasciatus* is stated as an important vector of Wuchereria bancrofti in the many countries,[8] while *C. sitiens* contributes in Brugia malayi transmission.[26] *C. tritaeniorhynchus*, *C. gelidus*, *C. fuscocephalus*, *C. vishnui*, *C. sitiens*, and *C. pseudovishnui* are vectors of JE. *C. fuscocephala*, *C. gelidus*, and *C. tritaeniorhynchus* were also found as the major species of mosquitoes in Bali,[27,28] in which annual incident rate of JE is 7,1 per 100,000 children under 10 year old.[29] The disease is predominantly found in area where humans live in closer proximity to pigs as the hosts.[30] *C. quinquefasciatus* was dominant species alongside with *C. tritaeniorhynchus* and *C. pseudovishnui*.[31] Surabaya had filariasis cases from Health Office of East Java Province and those species mosquitoes are infectious disease vectors.[13]

Mosquito biting periods affect the rhythm of disease transmission.[32] This study showed that the number of mosquitoes most obtained in the initial period of collection in the evening then declined until the mid-period of collection and increased again as midnight approached. Rogozi et al. (2012),[33] in their research with human bait concluded that *Culex* had three peaks of activity at night that is in the early evening, in the middle of the night and in the early morning. The mosquitoes caught in this study had diverse distribution based on collection periods. *C. tritaeniorhynchus* had the peak activity in the early evening and mid-night. These results are similar to studies in Malaysia,[34] but contrast to the results of research in South India,[22] which obtained that the peak of *C. tritaeniorhynchus* activity occurred at 21.00. *C. pseudovishnui*, *C. vishnui*, and *C. quinquefasciatus* had the same pattern of activity as *C. tritaeniorhynchus*. These results agreed with the results of other studies in Philippines,[35] in Kuala Lumpur,[5] and in South India.[22] The biting activity and frequency of mosquitoes depend on the mosquito species, environment conditions, ecological conditions and requirements from the gonotrophic cycle of

mosquitoes.[33] The biting rythm of mosquitos can also be influenced by co-existence and sharing of hosts available in rural areas to avoid competitions between themselves.[22]

This study has some limitations. Mosquitos were only collected indoor with human-bite collection. We also only collected the data from 18.45 to 24.00. We could not present the data of outdoor mosquito activities in biting human and the mosquito activities from midnight to dawn. Human outdoor activities at night increases the chances of contact with mosquitoes, especially during the peak of mosquito activity.[11] There are many factors that affect the risk of mosquito-borne disease transmission, such as the age of mosquitoes, mosquito density and its contact with humans, resistance to parasites, and the source of infection. Health education and entomological surveillance are required and should be followed up with a program to control the spread of disease vectors and with an evaluation to assess the effectiveness of the vector-controlling program.

Conclusion

Culex mosquitoes collected using cow-baited methods consisted of nine species, namely *C. tritaeniorhynchus*, *C. gelidus*, *C. vishnui*, *C. pseudovishnui*, *C. fuscocephalus*, *C. sitiens*, *C. quinquefasciatus*, *C. sinensis*, and *C. pseudosinensis*. *C. tritaeniorhynchus* was the dominant species. Those mosquitoes were zoophilic and exophagic. The peaks of biting activities were at 18.45-19.00 and 23.45-24.00.

Further research about *Culex* mosquitoes should cover wider range of samples, include mosquitoes collection in day and night time with longer duration in several seasons.

Conflict of Interest

The author stated there is no conflict of interest

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