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Diversity of Mosquito Species (*Diptera*: *Culicidae*) as An Effort to Control Disease Vectors in Cattle in Amun Kay Village, Tanah Miring District, Merauke

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Abstract

Amun Kay Village is one of the villages in Tanah Miring District developed into an agricultural center with a background of transmigrant people working as farmers and cattle breeders. This village is located in a lowland area dominated by open shrub areas, rice fields, and swamps. Swamp areas, agricultural fields, and cattle areas become breeding sites for various types of mosquitoes. This study aims to find out about the different kinds of mosquitoes that live in Amun Kay village, Tanah Miring District, so that programs that take care of and maintain animals, like cattle, can better control the mosquitoes that spread disease to cattle. We adjusted the cattle collection method to the specific conditions of the research location. Based on the results of mosquito collection in 3 cattle cages in Amun Kay village, 32 mosquito species with 9 genera were found. The diversity of mosquito species in this study was moderate, and the evenness index of mosquito species was high. The low mosquito dominance index indicates that few mosquitoes dominate an area around the cattle barns in Amun Kay Village, Tanah Miring District, Merauke.

Keywords: *Diversity Index; Dominance Index; Evenness Index; Diversity Mosquitoes; Amun Kay Village*

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INTRODUCTION

We recognize the Eastern Indonesia region, particularly Papua, as an endemic area with a high concentration of parasites. This elevated concentration is the result of

mosquitoes, which function as infectious agents. Environmental conditions conducive to mosquito breeding substantiate this (Cano et al., 2014). In this region, the mosquitoes *Anopheles bancrofti*, *A. koliensis*, *A. farauti*, *A. sundaicus*, *A. subpictus*, and *A. barbirostris* are widely recognized as malaria vectors (Munif, 2009).

According to Shinta & Marjana (2016),Tanah Miring District was reported to have a higher distribution of Anopheles mosquitoes than other districts, including Sota and Kurik Districts. *Anopheles bancroftii*, *A. hilli*, *A. meraukensis*, and *A. peditaeniatus* were the Anopheles mosquito species discovered in 2014. We captured the most mosquitoes per night using cow bait, with *A. peditaeniatus* being the most prevalent species. This indicates that malaria remains a threat in this region.

Amun Kay Village is a village located in Tanah Miring District, Merauke Regency (BPS Merauke, 2023). This village is one of the target areas for the agricultural land extensification program in Merauke Regency. Transmigration communities, including farmers and ranchers, are responsible for managing the development of agricultural businesses (Nahumury, 2012). The Amun Kay Village area in Tanah Miring District is characterized by swamps, rice fields, ditches, gutters, and open green gardens. These features have the potential to be utilized by cattle breeders who opt for a semi-intensive system, in which cattle are grazed during the day and confined to pens in the afternoon. Furthermore, certain breeders opt to situate the cattle pens in proximity to swamps and open bushes. This environmental condition is a supporting factor for mosquito breeding, and cattle have an attractive power to mosquitoes (Khairiyati et al., 2021).

There is very little data on the diversity of mosquito species found in cattle farms. Mosquitoes can disturb the comfort of humans and livestock. In addition, the presence of mosquitoes can be a vector of disease for humans or livestock. This can have an impact on decreasing cattle production and causing losses to cattle farmers. According to Hadi et al. (2012), data on the diversity of mosquito species in cattle farms is an important thing in the livestock system that must be applied in making a disease vector control planning program in livestock.

There have been no reports of mosquitoes around the cow shed in Amun Kay Village, Tanah Miring District, Merauke. Therefore, the purpose of this paper is to report the diversity of species, the diversity index of mosquito species, the evenness index, and the dominance index of mosquitoes around the cow shed in Amun Kay Village, Tanah Miring District, Merauke. This study is expected to be a consideration Putri (2016) in carrying out prevention and control of mosquito vectors as a medium for the spread of blood parasitic diseases between livestock and humans (farmers).

METHOD

Research Design

The study was conducted in June-October 2024. Sampling of adult female mosquitoes around the cattle pens in Amun Kay Village as many as 3 pens was able to represent farmers who had experienced the incident of dead cattle in Merauke (shown in Figure 1) (Ardhana, 2024).

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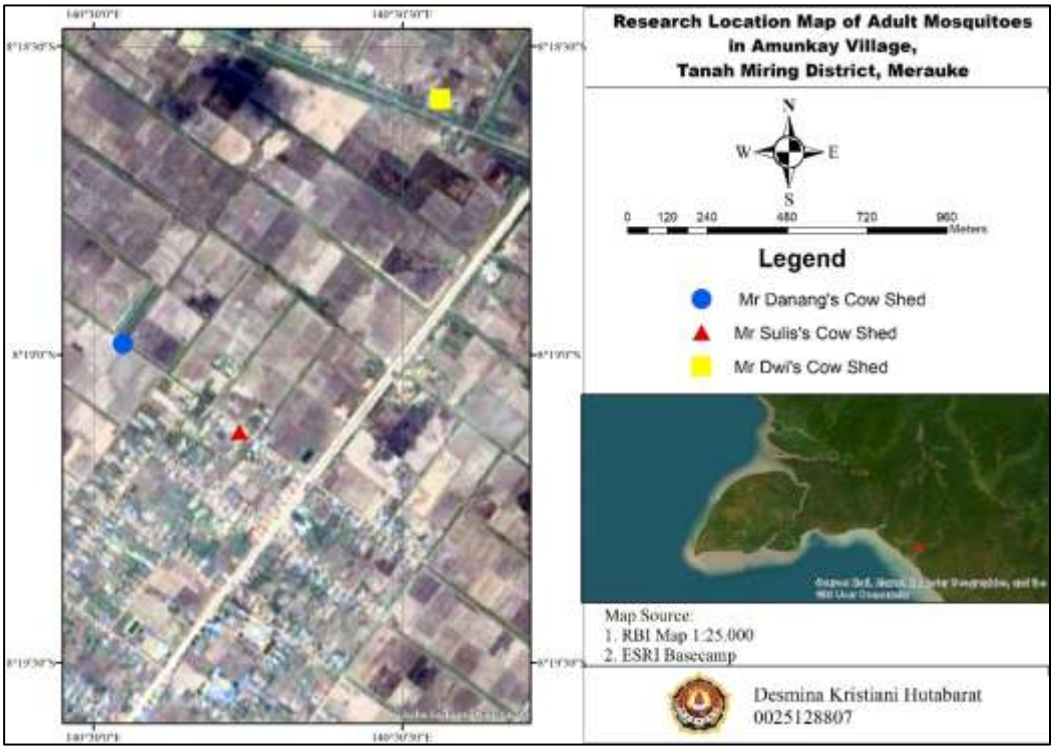


Figure 1. Research Location Map

Mosquito capture using the around cattle collection method, namely, mosquitoes were captured that were biting around the cows at 18.00-19.00 P.M. The captured mosquitoes were put in sample bottles filled with 70 % alcohol. Each 1.8 ml sample bottle was given a sample description. Mosquitoes were identified using a stereo microscope and a DinoCapture 2.0 microscope camera at Laboratory 1 of Animal Husbandry, Faculty of Agriculture, Musamus University. Identification using the mosquito genus determination key in Indonesia (Nugroho & Mujiyono, 2021b), *Tripteroides* determination key (Nugroho & Mujiyono, 2021a), *Coquillettidia* determination key (Nugroho et al., 2020), *Mansonia* determination key (Nugroho et al., 2021), *Ficalbiini* Tribe determination key (Nugroho, 2021), *Anopheles* determination key (O'Connor, 1999), *Culex* and *Lutzia* determination key (Rattanarithikul et al., 2005), *Aedes* determination key (Huang, 2002).

Data Analysis

This formula was used to find the mosquito species diversity index (H'), the uniformity index (E), and the dominance index (D) based on the type and number of adult female mosquitoes that were collected:

Diversity Index (H')

The Diversity Index (H') is calculated using the Shannon-Wiener diversity index (Odum, 1959) as follows:

$$H' = -\sum_{i=1}^{s} pi \ln pi \quad \text{..} \quad (1)$$

Information:
H': Shannon-Wienner Diversity Index
S : Number of species:
Pi : proportion of the number of individuals of type 1 to the total number of individuals

The Shannon-Wiener diversity index calculates the level of species diversity in each cattle pen in Amun Kay Village. If the value of H ≤ 1, then it is low diversity; if the value of 1 ≤ H' ≤ 3, then the diversity is moderate; and if H ≥ 3, then the diversity is high (Odum, 1959).

Evenness Index

The formula yields the evenness index (Ludwig & Reynolds, 1988):

$$E = \frac{H'}{lnN} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Information:
H'= The Shannon-Wiener diversity index
N= Number of mosquito species

If the E value is found to be small, then the distribution of mosquito species is narrow and vice versa. The criteria for the evenness index are if E<0.3, it indicates low evenness of mosquito species; if E is between 0.3-0.6, it indicates medium species evenness; and if E>0.6, it indicates high species evenness (Ludwig & Reynolds, 1988).

Dominance Index (D)

Dominance Index (D) is calculated using Simpson's formula (Odum, 1959):

$$D = \sum \left(\frac{ni}{N}\right)^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Information:
D= Simpson Dominance Index
Ni= Number of individuals per species
N= Number of individuals of all species

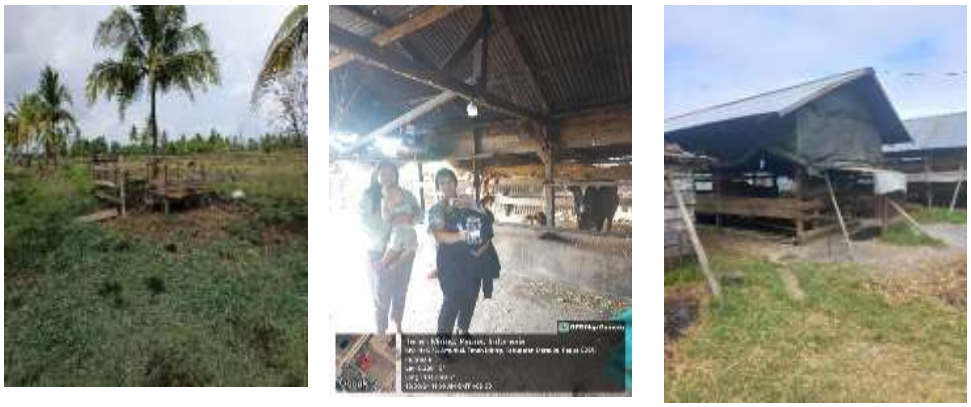
The dominance index ranges from 0 to 1, where the smaller the dominance index value indicates that there is no dominant species and vice versa, the larger the dominance index value indicates that there is a certain species that dominates in a community (Odum, 1959).

RESULTS AND DISCUSSION

Location and composition of mosquito species around cow sheds in Amun Kay Village, Tanah Miring District

Mosquito collection in Amun Kay Village was carried out in Mr. Danang's Cow Shed, Mr. Dwi's Cow Shed, and Mr. Sulis' Cow Shed. Figure 2 illustrates the

condition of the cow shed. The condition of Mr. Danang's cow shed is very close to the open garden and near the bushes; Mr. Dwi's cow shed is next to the farmer's house, which is somewhat closed; and Mr. Sulis' cow shed is near the farmer's house, but the open area is close to empty land. All conditions of the cow shed support the survival of mosquitoes in Amun Kay Village.



A B C

Figure 2. Sampling Locations of Adult Female Mosquitoes. A) Mr. Danang's Cow Shed; B) Mr. Dwi's Cow Shed; C) Mr. Sulis' Cow Shed.

The composition of mosquito species found around the cattle pens in Amun Kay Village can be seen in Figure 3. In this study, 32 types of mosquito species were found, with 9 genera consisting of *Tripteroides*, *Coquillettidia*, *Culex*, *Aedes*, *Lutzia*, *Mymomia*, *Mansonia*, *Ficalbia*, and *Anopheles*. The types of mosquitoes found in all cattle pens in Amun Kay Village, Tanah Miring District, were *Mimomyia elegans* and *Coquillettidia fuscopteron*. *Mimomyia elegans* is a dominant mosquito species in Australia, including Papua (Steffan, 1966; Gould & Valdez, 2024). The same thing also applies to *Coq. fuscopteron*, which is one of the types of mosquitoes from the genus *Coquillettidia* that is most commonly found in Papua, Indonesia (Nugroho et al., 2020).

The *Coquillettidia nigrochracea* mosquito has the largest number of other mosquito species, but its distribution was not found in Mr. Dwi's cow shed. This indicates the possibility of an environment with lots of plants and grass roots causing the *Coq. nigrochracea* species to be found in abundance in Mr. Danang's and Mr. Sulis's cow sheds. Around swamps and ponds, the roots of plants often host larvae and adult *Coquillettidia* mosquitoes (Laojun et al., 2023).

Figure 2 shows that the type of *Anopheles* mosquito found was *Anopheles bancroftii* and was only found in Mr. Dwi's cow shed. In 2014, it was reported that 4 *Anopheles* species were found in Tanah Miring District, namely *An. Bancroftii*, *An. Hilli*, *An. Meraukensis*, and *An. peditaeniatus* (Shinta & Marjana, 2016). It shows that the *An. bancroftii* population exists in Amun Kay Village, Miring District, although the number found was small in 1 cow shed. The small number of *Anopheles* in this study may have been influenced by factors such as changes in the rainy and dry seasons, which affected changes in behavior, including vector density. Therefore, we recommend conducting periodic research on climatic factors (Yahya et al., 2018; Kawulur et al., 2019).

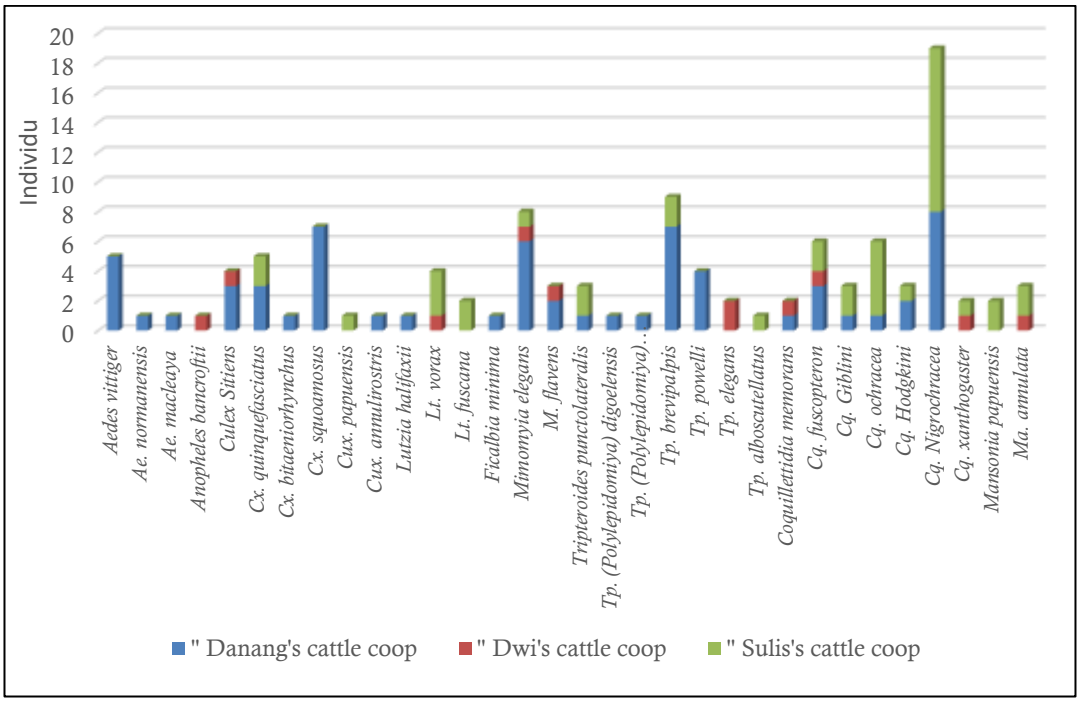


Figure 3. Composition of Mosquito Species Found in Cow Sheds in Amun Kay Village, Tanah Miring District

Value of Diversity Index, Evenness (E) and Dominance (D)

Table 1 displays the value of the mosquito species diversity index (H'), evenness, and dominance index. The value of the mosquito species diversity index at the three locations is 2.3 to 2.8. This value is in the range of 1<H'<3, so it can be concluded that the diversity of mosquito species in Amun Kay Village is in the moderate category. The species diversity index around the livestock pens found in the Palu area and around the pig pens in Tangerang Regency also shows a moderate category (Riandi et al., 2020; Maksud et al., 2018). This shows that environmental factors at the cattle farm location in Amun Kay Village support the life of these mosquito species.

Table 1. H', E and D Indexes Around the Cow Shed in Amun Kay Village, Tanah Miring District, Merauke

No	Cowshed	Index Value		
		Species Diversity (H')	Equity (E)	Dominance (D)
1	Danang's	2,8	0,9	0,07
2	Dwi's	2,3	1	0,11
3	Sulis's	2,5	0,9	0,12

The evenness index value (E) indicates the degree of evenness of the abundance of individuals in each species. If a species has the same number of individuals, the evenness index is high. If the evenness index value is small, it indicates that a community has dominant, sub-dominant and dominant species (Odum, 1959). In the study, the evenness value was included in the high evenness category with an E index

> 0.6. This shows that the distribution of mosquito species in Amun Kay Village is even so that each species has the same ecological role because there is no dominant mosquito species due to the almost equal abundance. According to Baderan et al., (2021), this even distribution also indicates the same quantity of mosquito individuals. The high evenness value is also due to a balanced ecosystem because there is no chemical control or administration (Habibi et al., 2022).

The dominance index value (D) of mosquito species around the cattle pen where the samples were taken ranged from 0.07 to 0.12, categorized as low dominance. The smaller the dominance value indicates that there are no mosquito species that dominate around the cattle pen in the Amun Kay Village area, Tanah Miring District, Merauke. The low dominance value of mosquito species in Amun Kay Village indicates that mosquitoes are unable to adapt to the breeding environment (Fahmi et al., 2016). This is also influenced by the habit of farmers to smoke by burning rice husks and straw all night around the pen to reduce the quantity of mosquitoes so that very few or almost no certain mosquito species are able to adapt and live around the pen. According to Nisrina et al. (2020), the behavior of burning straw around livestock pens all night long is 75.3 % effective in minimizing mosquito attacks, such as Anopheles, in Jatirejo Village, Purwerejo.

Associated with efforts to control disease vectors such as filariasis around the cattle pens that can be done by farmers in Amun Kay Village is maintaining the cleanliness of the pen location, which has a biological environment of mosquitoes, such as reducing the number of puddles and cleaning bushes and water plants as a place for mosquito growth. If the weather is not rainy, farmers can fumigate with rice husks at night to reduce the number of mosquitoes around the cattle pens. The presence of mosquito predator fish will also control the mosquito population, such as *tilapia*, climbing perch fish, and tinhead fish that eat mosquito larvae, such as *Anopheles spp* (Supranelfy et al., 2012).

CONCLUSION

The conclusion of this study is that 32 types of mosquito species were found with 9 genera consisting of *Tripteroides*, *Coquillettidia*, *Culex*, *Aedes*, *Lutzia*, *Mymomia*, *Mansonia*, *Ficalbia* and *Anopheles*. *Mimomyia elegans* and *Coquillettidia fuscopteron* are mosquito species that are distributed around the cow shed in Amun Kay Village, Tanah Miring District. However, based on the quantity of mosquitoes, the *Coq. nigrochracea* type is the most abundant of the other mosquito species. Based on the value of the mosquito diversity index found, it is included in the moderate category. Based on the evenness index, the distribution of mosquito species around the cow shed is even, but based on the dominance index, few or no dominant species were found.

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