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Diversity of Mosquito Species (Diptera: Culicidae) Around Cowsheds in Tanah Miring District, Merauke

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ABSTRACT

Tanah Miring District is one of the areas in Merauke Regency with a high cattle population. The landscape of Tanah Miring District is characterized by lowlands with slopes of 0-3%, dominated by swampy areas and grazing fields for livestock, such as cattle. One factor affecting cattle productivity is the presence of disease vectors such as mosquitoes. This study aims to provide information on the diversity of mosquito species found around cattle pens as preliminary data to support cattle productivity, maintenance, and care programs in controlling cattle disease vectors. The research method employed was the around-cattle collection method, conducted around cattle pens in three villages within the Tanah Miring District. The mosquitoes captured were then identified using a stereo microscope and a key for identifying mosquito genera and species at Laboratory 1 of the Faculty of Agriculture, Musamus University. Data on mosquito species and numbers of female mosquitoes were obtained for further analysis of diversity, evenness, and dominance indices. Based on mosquito collection results in cattle pens in Tanah Miring District, 41 species and 10 genera of mosquitoes were found. The species *Coquellittida nigrochracea* and *Coq. ochracea* were the most commonly found species around cattle pens in Tanah Miring District. The mosquito species diversity index fell within the moderate category, with an even distribution of mosquito species, and the dominant mosquito species ranged from 0.1 to 0.3. This indicates that mosquito species are very less prevalent around the cattle shed in the Tanah Miring District, Merauke. The presence of mosquitoes is commonly found on the roots of aquatic plants, namely *Coq. nigrochracea* and *Coq. ochracea*, which are also found around the cattle shed, indicates the need for mosquito vector control efforts by maintaining cleanliness around the cattle shed, such as clearing the grass and aquatic plants.

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ABSTRAK

Distrik Tanah Miring merupakan salah satu wilayah di Kabupaten Merauke memiliki jumlah populasi sapi yang tinggi. Kondisi wilayah Distrik Tanah Miring adalah dataran rendah dengan tingkat kemiringan 0-3% yang didominasi area rawa dan padang penggembalaan ternak seperti sapi. Salah satu faktor yang mempengaruhi produktivitas sapi adalah keberadaan vektor penyebar penyakit seperti nyamuk. Penelitian ini bertujuan untuk memberikan informasi mengenai keanekaragaman jenis nyamuk yang berada di sekitar kandang sapi sebagai data awal untuk mendukung program produktivitas, pemeliharaan dan perawatan ternak dalam mengendalikan vektor penyakit sapi. Metode penelitian yang digunakan adalah around cattle collection methode sekitar kandang sapi di 3 kampung wilayah Distrik Tanah Miring. Nyamuk yang ditangkap selanjutnya diidentifikasi menggunakan mikroskop stereo dan kunci identifikasi genus dan spesies nyamuk di Laboratorium 1 Peternakan Fakultas Pertanian Universitas Musamus. Data jenis spesies dan jumlah nyamuk betina diperoleh untuk selanjutnya dianalisa indeks keanekaragaman, indeks kemerataan, dan indeks dominansi. Berdasarkan hasil koleksi nyamuk di kandang sapi Distrik Tanah Miring ditemukan 41 spesies dan 10 genus nyamuk. Spesies Coquellittida nigrochracea dan Coq. ochracea merupakan spesies yang paling banyak ditemukan di sekitar kandang sapi di Distrik Tanah Miring. Indeks keanekaragaman jenis nyamuk adalah kategori sedang dengan tingkat penyebaran jenis nyamuk merata, dan spesies nyamuk yang mendominasi di rentang 0,1-0,3. Hal ini menunjukkan spesies nyamuk mendominansi sangat kecil di sekitaran kandang sapi Distrik Tanah Miring, Merauke. Keberadaan nyamuk yang sering ditemukan pada akar tanaman air yakni Coq. nigrochracea dan Coq. ochracea juga ditemukan di sekitar kandang sapi menunjukkan perlunya upaya pengendalian vektor nyamuk dengan cara menjaga kebersihan sekitar kandang sapi seperti membersihkan semak dan tanaman air.

INTRODUCTION

Tanah miring district is one of the districts in Merauke Regency, South Papua Province, which has 14 villages (BPS, 2021). Tanah Miring District is a lowland with a slope level of 0-3% and this area is dominated by marshlands near community settlements. Marshlands and waterlogged areas in Tanah Miring District generally have a type of clay soil with a moisture content of 3.415% which indicates a high-water holding capacity (Darwanta *et al*., 2019).

The Tanah Miring District environment also features large areas of grasslands, characterized by a variety of dominant grass species and leguminous/herbaceous compositions. This condition causes livestock such as cattle to be generally reared extensively. However, some farmers have begun to adopt a semi-extensive rearing system, where cattle return to the cowshed at night. Thus, the Tanah Miring district is an area that has the potential for cattle productivity in Merauke Regency (Tiro *et al*., 2020).

The productivity of cattle will be achieved if farmers also consider the presence of parasites around livestock. The impact of the presence of parasites on livestock such as decreased milk production, weight loss, decreased meat quality, and even death of livestock. Parasites such as blood parasites that are often found can be spread through insects such as mosquitoes, ticks, and blood-sucking flies as vectors (Narladkar, 2018).

Tanah Miring District has the highest distribution of Anopheles mosquitoes than Sota and Kurik Districts. The mosquito species found during 2014 in Tanah Miring District

were *Anopheles bancroftii*, *An. hilli*, *An. meraukensis*, and *An. peditaeniatus*. The greatest number of mosquitoes caught per night was using cattle bait, with the most mosquito species found being *An. peditaeniatus*. This suggests the district is still at risk of malaria (Shinta & Marjana, 2016).

Mosquito species besides the Anopheles genus that have been identified in Papua are found in the Jayapura, Wamena, and Manokwari regions. Mosquitoes *Aedes aegypti, Ae. albolineastu, Ae. albopictus, Ae. kochi, Ae. notoscriptus, Ae. scutellaris, Ae. vexans, Ae. vigilax, Cullex annulirostris, Cx. bitaeniorhynchus, Cx. gelidus, Cx. quinquefasciatus, Cx. tritaeniorhynchus*, and *Mansonia uniformis* are distributed around the southern island of Papua (Russell & Burkot, 2023). Data on mosquitoes in the Southern Papua region is minimal (Maffi *et al*., 1979).

Research on mosquito species around cowsheds was previously conducted in Amun Kay village, Merauke. The identified mosquito species comprised 32 species from 9 mosquito genera. Based on the dominance index, there was no dominant species, but *Coquillettidia nigrochracea* was most frequently found at the sampling location (Hutabarat *et al*., 2025). Reports of the death of approximately 210 cattle in Merauke Regency and Tanah Miring District were among the extraordinary events that occurred in early March 2024. The incident was caused by parasites found in blood samples taken from livestock suspected of having been bitten by mosquitoes (Marbun *et al*., 2024). Thus, the purpose of this study aimed to obtain the diversity of mosquito species that are potential vectors of disease around cowsheds in the Tanah Miring District.

MATERIALS AND METHODS

The study was conducted from June to October 2024 after the incident of dead cattle (Ardhana, 2024). Sampling of mosquitoes around cowsheds in the Tanah Miring District. Mosquito collection in Tanah Miring District was conducted in 3 villages, namely Yasamulya Village, Sumber Harapan Village, and Amun Kay Village (Figure 1). Generally, Tanah Miring District is located at an altitude of ± 6-25 m above sea level (BPS Merauke, 2023). These three villages have more cattle farms than other villages and represent the upper, middle, and lower areas of the Tanah Miring District (Hutabarat *et al*., 2025).

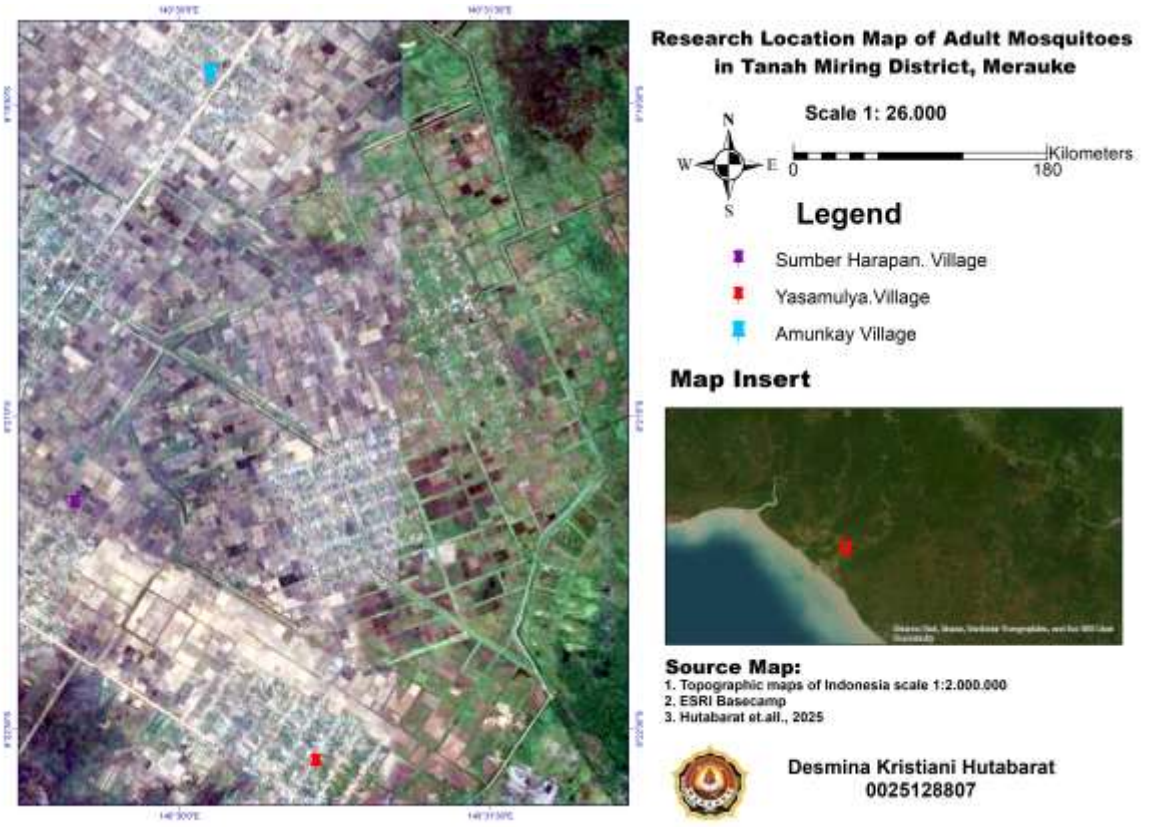

Figure 1. Location of mosquito sample collection in Tanah Miring District

All of mosquitoes were captured using the around cattle collection method at 18.00-19.00 WIT. Captured mosquitoes were placed in sample bottles containing 70% alcohol. Each sample bottle was labelled with sample information.

The mosquitoes identified were adult female mosquitoes because of their performance of blood-sucking (Kim *et al*., 2011). Mosquitoes were identified at Laboratory 1 of the Faculty of Agriculture, Musamus University. Morphological observations were made using a stereo microscope and camera optics lab. The identification used the key to determine the mosquito genus in Indonesia (Nugroho & Mujiyono, 2021b). The key to determining the species of Tripteroides mosquitoes (Nugroho & Mujiyono, 2021a). The key to determining the species of Coquillettidia mosquitoes (Nugroho *et al*., 2020). The key to determining the species of Mansonia mosquitoes (Nugroho *et al*., 2021). The key to determining the species of Ficalbiini mosquitoes (Nugroho, 2021). The key to determining the species of Anopheles mosquitoes (O'Connor, 1999). The key to determining the species of Culex and Lutzia (Rattanarithikul *et al*., 2005). The key to determining the species of Aedes mosquitoes (Min Huang, 2002).

The species and number of adult female mosquitoes obtained were used as the basis to determine the mosquito species diversity index (H'), uniformity index (E), and Dominance Index (D) with the following formula.

Species diversity indices (H') diversity index equation of Shannon-Wienner (Odum, 1959) shown below:

$$H' = -\sum_{i=1}^{S} pi \ln pi$$

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

From the calculation of the Shannon-Wiener diversity index, it can be seen that the level of species diversity in each cowshed in the Tanah Miring District. If the value of H'≤1, then including low diversity, if the score of 1 ≤ H' ≤ 3, then moderate diversity, and if H'≥ 3, then high diversity (Odum, 1959).

Evenness index obtained with the formula (Ludwig & Reynolds, 1988):

$$E = \frac{H'}{lnN}$$

Information:

H'= The Shannon-Wienner 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) calculated by the formula of Simpson (Odum, 1959):

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

Information:

D= Simpson Dominance Index

Ni= Number of Individuals per Species

N= Number of Individuals of all species.

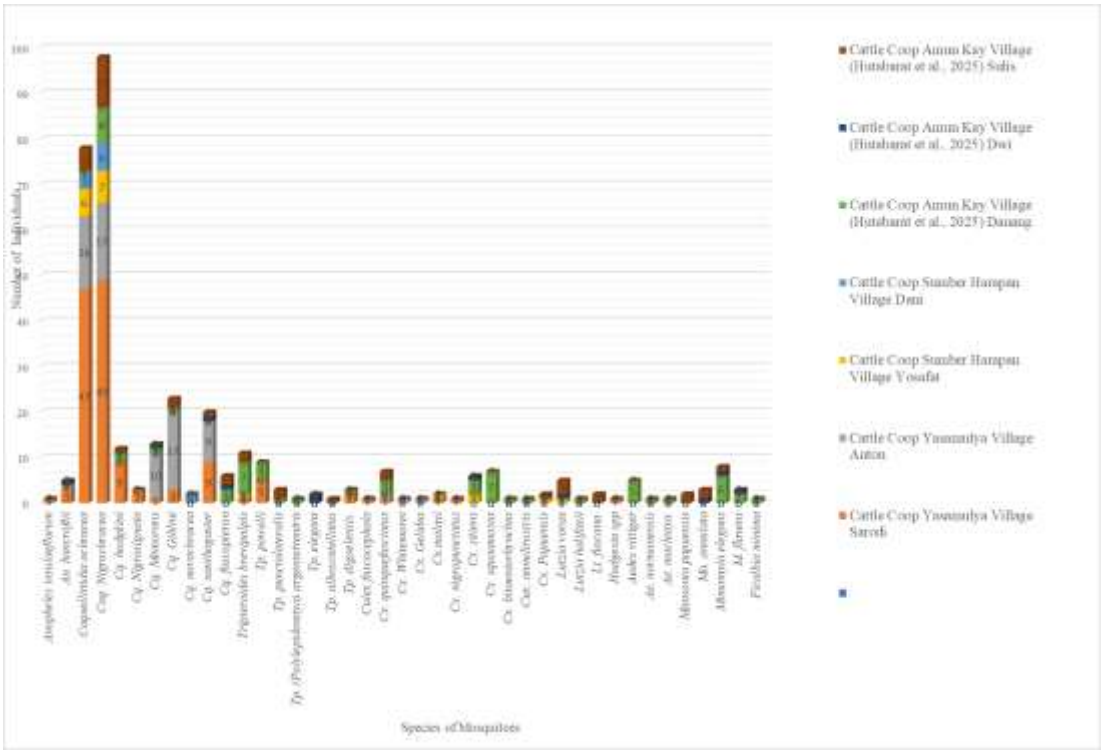

Figure 2. Composition of mosquito species found in cow shed in Tanah Miring

The dominance index ranges from 0 to 1, where the smaller the dominance index value indicates the more dominant the species and vice versa. The greater the dominance index value, the more dominant the presence of certain species that dominate in a community (Odum, 1959).

RESULT AND DISCUSSION

Composition of Mosquito Species

The composition of mosquito species found around cowsheds in the Tanah Miring District can be illustrated in Figure 2. In this study, 41 species of mosquito were found with 10 genera consisting of Tripteroides, Coquillettidia, Culex, Aedes, Lutzia, Mymomia, Mansonia, Hodgesia, Ficalbia, and Anopheles genus. The mosquito species found in all cattle farms in the Tanah Miring District were from the genus Coquillettidia, namely *Coq. nigrochracea* and *Coq. ochracea*. The Papua region has the 7 species Coquillettidia in Indonesia (Nugroho *et al*., 2020). *Coq. nigrochracea* mosquitoes had the highest number of other mosquito species and were distributed in almost all cowsheds in the Tanah Miring District. This indicates that the environment around the cowsheds has a lot of vegetation, and the grass roots are a suitable habitat for *Coq. nigrochracea* species. Larvae and adults of Coquillettidia mosquitoes were found in plant roots, attached to plant root tissues around swamps and ponds (Laojun *et al*., 2023). Coquillettidia mosquitoes are also anthropophilic insects capable of adapting to the environment by attaching themselves to plant roots as hosts to obtain oxygen (Sérandour *et al*., 2011). Coquillettidia mosquitoes are a potential vector of many human and animal disease pathogens (Laojun *et al*., 2023). Female *Coq. perturbans* (Walker) mosquitoes were found to be infected with eastern equine encephalomyelitis (EEE) virus after sucking chicken blood (Moncayo *et al*., 2000). Mosquitoes of the species *Coq. aurites, Coq. pseudoconopas,* and *Coq. metallica* were found to be vectors of avian malaria, with 33 % positively containing *Plasmodium spp*. (Njabo *et al*., 2009).

Figure 2 also shows that *Anopheles bancroftii* was found in Yasamulya and Amun Kai villages. In 2014, it was reported that *An. bancroftii* was also found in the Tanah Miring District (Shinta & Marjana, 2016). This showed that cattle sheds in the two villages were generally close to the breeder's house. *An. bancroftii* mosquitoes are known as vectors of malaria because adults usually live in swamps but can be inside the house to rest after sucking human blood (Salim *et al*., 2018). Although the number of Anopheles in this study is small, it may affect the factor of weather changes that affect behavioural changes, including vector density. Therefore, it is recommended to conduct periodic research related to climatic factors (Kawulur *et al*., 2019).

Value of diversity indices (H'), Evenness (E), and Dominance (D)

The values of the mosquito species diversity index (H'), evenness, and dominance index can be seen in Table 1. The values of the mosquito species diversity index in the three villages were 1.29 - 2.52. This value is in the range of 1<H'<3, so it can be concluded that

mosquito species diversity in Tanah Miring District is in the medium category. The species diversity index around livestock enclosures found in Palu and around pig cages in Tangerang District also showed a medium category (Maksud *et al*., 2018; Riandi *et al*., 2020). This suggests that environmental factors such as temperature at the cattle farm site are favourable for the mosquito species (Lysyk, 2010).

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

No	Village	Index Value		
		Species Diversity (H')	Evenness (E)	Dominance (D)
1	Amun Kay	2.52	0.93	0.1
2	Yasamulya	1.79	0.75	0.22
3	Sumber Harapan	1.29	1.16	0.33

In this study, the evenness value was included in the high evenness category with an E index >0.6. It indicates that the distribution of mosquito species in the sloping land district is evenly distributed so each species has the same role ecologically as there is absence of dominating mosquito species due to similar abundance. According to Baderan *et al.* (2021), the distribution of evenness is also indicated by the same number of individual mosquitoes. The high value of evenness is also due to a balanced ecosystem, due to the absence of chemical control or treatment (Habibi *et al*., 2022).

The dominance index (D) of mosquito species around the cowsheds where the samples were collected ranged from 0.1 -0.3 and was considered low dominance. The smaller the dominance value, the less dominant the mosquito species around the cowsheds in the Tanah Miring District of Merauke. The low dominance value of mosquito species indicates that the mosquito species are unable to adapt to the habitat of their breeding areas (Fahmi *et al*., 2016). This is also influenced by the farmer's habit of fumigating by burning husks and straw all night around the cage in order to reduce the quantity of mosquitoes; thus, very few or almost no specific mosquito species can adapt and stay around the cage. According to Nisrina *et al*., (2020), the behaviour of burning straw around livestock pens throughout the night was 75.3% effective in reducing mosquito attacks, such as Anopheles in Jatirejo Village, Purwerejo.

The study of mosquito diversity can be related to disease vector control efforts around the cattle sheds. This study shows that mosquito trapping around the cattle shed can reveal the types and numbers of mosquitoes as well as habitat characteristics, which can be used as guidelines for mosquito control around the cattle shed. In addition, it aims to reduce and prevent cattle deaths caused by mosquito bites (Marbun *et al*., 2024). Farmers can maintain the cleanliness of the shed location that has a mosquito bioenvironment, such as reducing the amount of stagnant water, cleaning shrubs and water plants as mosquito growth sites. Although this study did not discuss mosquito species that contain pathogen vectors, it did not address the risk of infectious diseases from mosquito vectors (Confalonieri & Costa Neto, 2012; Supranelfy *et al*., 2012).

CONCLUSION AND SUGGESTION

The conclusion of this study was the identification of 41 mosquito species, consisting of 10 genera: Tripteroides, Coquillettidia, Hodgesia, Culex, Aedes, Lutzia, Mymomia, Mansonia, Ficalbia, and Anopheles. Based on the number of mosquitoes, the genus Coquellittidia was the most abundant, and the species *Coq. nigrochracea* was the most abundant found in the area sampling locations. The vegetation around cowsheds in the Tanah Miring District supports the even distribution of mosquito species, and the diversity of these species falls into the medium category. Consequently, the mosquito species that dominate around the cowsheds are found to be only a few, with only a few dominant species. Based on the results obtained, it is recommended to conduct sampling at different times of the day, specifically morning and afternoon, to identify the activity patterns of mosquitoes around cowsheds in Tanah Miring District.

STATEMENT OF CONTRIBUTION

Desmina Kristiani Hutabarat was responsible for research, data analysis, and article writing. Apri Irianto and Nurcholis were tasked with data analysis, while Yolanda Gebse and Jefri Sembiring were tasked with writing the result and discussion.

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