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ENTOMOLOGICAL SURVEY OF MALARIA VECTORS IN GUNUNG MEGANG SUBDISTRICT, MUARA ENIM DISTRICT

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ABSTRACT

Malaria is one of the diseases that is a world problem due to its potential vectors. caused by plasmodium parasites living and breeding in human erythrocytes transmitted through the bite of infective female Anopheles mosquitoes. In 2019 malaria cases in Muara Enim Regency reached 112 cases ranked 2nd after South Ogan Komering Ulu. In 2018, malaria cases decreased compared to 2019, but the risk factors for malaria transmission if not controlled then malaria can reappear. The purpose of this study was to determine the entymology of malaria vectors in Gunung Megang District, Muara Enim Regency. The method used was descriptive method with cross sectional approach, namely observation. The population of this study were all captured mosquitoes in Gunung Megang sub-district, Muara Enim Regency. While the samples in this study were Anopheles mosquitoes and larvae obtained from the capture in Gunung Megang sub-district, Muara Enim Regency. Data analysis using univariate analysis. The results of univariate analysis obtained Anopheles mosquitoes are 4 species namely An. nigerimus, An. umbrosus, An. barbirostris and An. sinensis. An. barbirostris was found to be the most abundant with a total of 4 individuals. While An. umbrosus, An. nigerimus and An. sinensis were found only 1 Anopheles species each. Larvae obtained 3 species of Anopheles spp larvae, the most is An.barbirostris, and few are An.sinensis and An. Umbrosus. The larval density in the lake (53.8%) was 14 larvae, with a larval density of 1.4 larvae/invertebrate. In ponds it was 1.4 larvae/invertebrate. In swamp habitat (11.5) with a total of 3 larvae, having a larval density of 0.3% larvae/intrusion. while in culverts (7.7%) with a total of 2 larvae, having a larval density of 0.2 larvae/intrusion is the least Anopheles spp larval breeding habitat.

Keywords: Malaria, Entomology, Anopheles sp

Introduction

Malaria has become one of the world's health problems due to its potential vectors that can transmit and spread, resulting in a wide impact and international attention. Malaria is caused by plasmodium parasites that live and multiply in human erythrocytes. Human malaria is caused by infection with one or more species of Plasmodium sp, transmitted through the bite of an infective female Anopheles mosquito. The chronic nature that can occur in patients is because this parasite can hide in the body of the host and cause clinical manifestations at any time if the immune system is weak. Indonesia consists of 34 provinces, almost all of which have positive malaria cases. Therefore, Subscribe to DeepL Pro to edit this document. Visit www.DeepL.com/pro for more information. vigilance control must always be enforced because it is not impossible for a low endemic area to turn into a high endemic area. South Sumatra Province is a malaria endemic area. South Sumatra Province has 36,201 clinical malaria cases. Of these clinical cases, 28,491 cases

were laboratory confirmed and the number of positive malaria cases was 2,055 cases with an API value in 2015 of 0.3 per 1000 population. This value is included in the low case incidence category. Muara Enim Regency is one of the malaria endemic areas in South Sumatra, where most of the population has livelihoods in agriculture/plantations and mining so that the possibility of contact with vectors is greater[1]. Based on data from the central statistics agency in the number of cases of disease by type of disease (cases), 2019-2021 Malaria in the South Sumatra region, in 2019 there were 607 cases, in 2020 there were 66 cases and in 2021 there were 25 cases[2]. Based on data from the central statistics agency in the incidence of malaria in the South Sumatra region in 2018 had a malaria incidence of 0.080 per 1000 people, in 2019 it had a malaria incidence of 0.070 per 1000 people[2].

Based on data from the central statistics agency in the Number of Cases of Disease (Cases), 2019-2021 in Malaria in Muara Enim Regency in 2019 had 96 cases of malaria with a malaria morbidity rate of 0.15 per 1000 population, then in 2020 there were 24 cases with a malaria morbidity rate of 0.04 per 1000 population and in 2021 there was 1 case with a malaria morbidity rate of 0.00 per 1000 population[3].

South Sumatra Province has the second highest positive malaria cases in Muara Enim Regency with an API value in 2019 of 0.18 per 1,000 population[1]. Muara Enim Regency is divided into 22 sub-districts covering 10 villages and 245 villages, with a total population of 616,037 people. In 2019 malaria cases in Muara Enim Regency reached 112 cases ranked 2nd after South Ogan Komering Ulu, data from the Provincial Health Office in 2019. In terms of age, positive cases of malaria in Muara Enim district vary, the results of microscope examination are 42 people and Rapid Diagnostic Test (RDT) 70 people and the highest occurs at the age of 15-64 years[1]. Geographical characteristics of Muara Enim Regency is an agricultural area with an area of 7,483.06 km^2 . The tofographic conditions are diverse, the highland area in the southwest, is part of the Bukit Barisan mountain range, covering the Central Semende Darat sub-district and Tanjung Agung sub-district. The central plain area, located in the central part (Muara Enim, Ujan Mas, Benakat, Gunung Megang, Rambang Dangku, Rambang, Lubai) continues to the north-northeast, there is a swamp area directly opposite the Musi river basin, covering Gelumbang, Sungai Rotan and Muara Belida sub-districts[3].

Sunarsih's research in 2020, the results of spatial research obtained in 2019, malaria cases have decreased compared to previous years, but if risk factors for malaria transmission, such as human behavior and environmental factors as well as the presence of vectors and plasmodium are not controlled, malaria can reappear[4]. When patients are not found, because surveillance of malaria cases is not running and various other factors, the possibility of malaria does not disappear, but still exists in the Gunung Megang sub-district area with minimal patients[5]. In addition, Plasmodium spp can also hide in the human body, but not cause symptoms (carrier). If there are environmental

changes that support the development of Anopheles spp, contact will begin to occur and malaria can reappear. In Gunung Megang Sub-district in 2019, when malaria cases increased, malaria prevention has been carried out such as spraying in residents' homes and in habitats that are potential breeding grounds for larvae, but the implementation has not been based on sufficient entomological data. so that entomological surveys of malaria vectors need to be carried out in Gunung Megang Sub-district, especially in villages that have many malaria cases. This entomological survey is expected to provide an overview of malaria vectors of Anopheles species that are suspected to be vectors of malaria[6].

Previous research from Ndiki obtained the results, there were 4 Anopheles larvae breeding sites, namely rice fields with an average density of 12 individuals/cid, river mouths with a density of 5 individuals/cid, puddles with a density of 3 individuals/cid and lagoons with a larval density of 5 individuals/cid, and permanent breeding habitats are river mouths and temporary breeding sites, such as rice fields, puddles and lagoons[7].

Results from research Lestari et al., found there were five species found in the form of *An.aconitus, An.barbirostris, An.kochi, An.subpictus* and *An.sundaicus* and there were 7 *Anopheles* larval breeding habitats in the form of lagoons, former fish cages, swamps, ponds, water buffalo pits, rivers and rice fields. Larval densities of the five species from highest to lowest were *Anopheles subpictus, Anopheles sundaicus, Anopheles aconitus, Anopheles kochi and Anopheles barbirostris*. while larval densities based on breeding habitats from highest to lowest were fish ponds, lagoons, swamps, water buffalo puddles, ponds, rice fields and rivers[8].

Methods

This research is a descriptive study by conducting surveys and identifying Malaria vectors in Gunung Megang District, Muara Enim Regency. While the approach used was cross sectional, namely observation and data collection carried out at the same time. For mosquito capture research was conducted in 2 villages, namely Penanggiran and Tanjung Muning villages and for larval capture was carried out in 3 villages, namely Penanggiran Village, Tanjung Terang Village and Lubuk Mumpo village. The population of this study was all adult mosquitoes obtained from the capture and puddles that have the potential for larvae in Gunung Megang District, Muara Enim Regency. While the samples in this study were Anopheles sp mosquitoes and Anopheles larvae obtained from the capture results in Gunung Megang District, Muara Enim Regency. Mosquito capture using the Human Landing Collection method, namely capture by baiting people. Two methods were used to capture mosquitoes, namely the inside bait method and the outside bait method. The catching process was conducted from 18.00-06.00. Mosquito catchers captured mosquitoes when they landed on the body of the bait person and then sucked using the Aspirator tool for 40 minutes at each hour. The captured mosquitoes were then put into paper cups and

labeled according to the time of capture, method and location. To determine the type of Anopheles species, it was carried out by experts at LitbangKes Baturaja to be identified so that Anopheles species can be known. In this study, measuring larval density with the formula number of larvae obtained/number of punctures, this study used an observation sheet to record the habitat or location where larvae were found and record the location and time of capture of Anopheles mosquitoes. Data analysis used univariate analysis.

Results

Univariate Analysis

a. Capture of adult mosquito larvae in Gunung Megang Sub-district, Muara Enim Regency

Tabel 4. 1 Distribution of *Anopheles sp* species caught in Penanggiran Village and Tanjung Muning Village

Mosquito Species	Location		Total
	Tanjung Muning Village	Penanggiran Village	
An. umbrosus	1	0	1
An. sinensis	1	0	1
An. nigerimus	0	1	1
An. barbirostris	0	4	4
Total	2	5	7
%	28,6	71,4	100

Based on table 4.1, it was found that the most adult mosquitoes of Anopheles sp species found were An. barbirostris species with a total of 4 while for An. umbrosus, An. nigerimus and An. sinensis species only found 1 tail. Muning Village only found 2 (28.6%) while Penanggiran Village found 4 (71.4%). The total number of mosquitoes captured in both villages was 7 Anopheles sp. Mosquito captures based on insider bait and outsider bait at each hour in Penanggiran Village are presented in the following table:

Table 4.2 Distribution of capture results of Anopheles UOD-UOL mosquitoes in Penanggiran Village

Capture by baiting people inside and outside the house in Penanggiran Village			
Hours	**All mosquitoes captured with UOD**	**All mosquitoes captured with UOL**	***Anopheles sp* species found**
18:00-19:00	19	24	An. barbirostris (1 tail-UOL)
19:00-20:00	20	12	An. barbirostris (1 tail-UOL)
20:00-21:00	6	22	An. barbirostris (1 UOL), An. nigerimus (1 UOL)
21:00-22:00	11	25	An. barbirostris (1 tail-UOL)
22:00-23:00	20	21	
23:00-24:00	18	18	
24:00-01:00	6	18	
01:00-02:00	15	24	
02:00-03:00	4	17	
03:00-04:00	0	11	
04:00-05:00	0	4	
05:00-06:00	0	5	
Total	199	201	5

Description: UOD= Insider Feed, UOL= Outsider Feed.

Table 4.3 Distribution of capture results of Anopheles UOD-UOL mosquitoes in Tanjung Muning Village

Baited arrests of people inside and outside the house in Tanjung Muning Village			
Hours	**All mosquitoes captured with UOD**	**All mosquitoes captured with UOL**	***Anopheles sp* species found**
18:00-19:00	20	23	
19:00-20:00	15	20	
20:00-21:00	5	13	
21:00-22:00	8	21	
22:00-23:00	6	21	
23:00-24:00	4	20	An. sinensis (1 tail-UOD)
24:00-01:00	4	14	
01:00-02:00	2	12	An. umbrosus (1 tail-UOL)
02:00-03:00	0	11	
03:00-04:00	0	3	
04:00-05:00	0	0	
05:00-06:00	0	0	
Total	64	158	2

Description: UOD= Insider Feed, UOL= Outsider Feed.

Based on the results of mosquito catches in Tanjung Muning village, Gunung Megang sub-district, 1 An. sinensis species was found using the insider bait method with peak biting occurring at 123:00-24:00. In addition, An. umbrosus species was also found using the external bait method, which was found at 01:00-02:00.

b. Larval species found in breeding habitats in Gunung Megang District, Muara Enim Regency.

The results of this study found that there are 3 species of *Anopheles spp* larvae in Gunung Megang Sub-district, Muara Enim Regency which are spread across 3 villages, namely Penanggiran Village, Tanjung Terang Village and Lubuk Mumpo Village. The following is a table of *Anopheles spp* larval species . found in breeding habitats:

Table 4.4 Species of Anopheles Larvae found in Breeding Habitats at Gunung Megang Sub-district, Muara Enim Regency

	Anopheles sp larvae species			
Lrva Anopheles sp habitat	**An. Barbirostris**	**An. Umbrosus**	**An. Sinensis**	**Total**
Culverts	0	0	0	0
Swamp	1	1	0	2
Lake	5	0	2	7
Pond	0	0	1	1
Total	6	1	3	10
%	60	10	30	100

Based on table 4.4 above, it was found that *Anopheles spp*. larvae species that were found in 4 Anopheles spp. larval breeding habitats in Gunung Megang Subdistrict were An. *barbirostis* (60%), *An. sinensis* (30%) and the least was An. *umrosus* (10%). *An. barbirostris was* found in swamp and lake habitats, An. *sinensis was* found in lake and pond habitats while An. *umbrosus was* found in swamp habitats.

c. Density of Anopheles Larvae in Breeding Habitats in Gunung Megang District, Muara Enim Regency

Table 4.5 Density of Anopheles Larvae in Villages where Breeding Habitats were found inGunung Megang Sub-district

Village where it was found	**Swamp**	**Gorong-Gorong**	**Lake**	**Pond**	**Total Larvae**
Larval breeding habitat of *Anopheles spp.*					
Penanggiran	0	2	0	0	2
Tanjung Terang	3	0	0	0	3
Lubuk Mumpo	0	0	14	7	21
Total	3	2	14	7	26
%	11,53	7,69	53,84	26,92	100
Number of Hiccups	10	10	10	10	40
Larval Density	0,3	0,2	1,4	0,7	0,65

Based on table 4.5 above, getting the density of *Anopheles spp. larvae* found in each *Anopheles spp. larval* breeding habitat, showing that the breeding habitat of Anopheles spp. *larvae* is most in the Lake (53.8%) is 14 larvae, having a larval density of 1.4 larvae / injection. Ponds (26.9%) were 7 larvae, with a larval density of 0.7 larvae/invertebrate. In the Swamp Habitat (11.5%) with 3 larvae, the larval density was 0.3 larvae/inch. While the culvert (7.7%) with 2 larvae, having a larval density of 0.2 larvae/inch was the least *Anopheles spp larval* breeding habitat. The density of *Anopheles spp*. larvae in their breeding habitat is shown in detail:

Table 4.6 Density of Anopheles Larvae in Breeding Habitats in Gunung Megang Sub-district

Village where it was found Larval breeding habitat of *Anopheles spp.*	Swamp	Gorong-Gorong	Lake	Pond	Total Larvae
Penanggiran	0	2	0	0	2
Tanjung Terang	3	0	0	0	3
Lubuk Mumpo	0	0	14	7	21
Total	3	2	14	7	26
%	11,53	7,69	53,84	26,92	100
Number of Hiccups	10	10	10	10	40
Larval Density	0,3	0,2	1,4	0,7	0,65

From table 4.6 above, getting the density of *Anopheles spp. larvae* found in each habitat of *Anopheles spp*. larvae breeding, showing in Lake habitat (53.8%) which amounted to 14 larvae, having a larval density of 1.4 larvae / wound is the most habitat for the presence of *Anopheles spp.* Then the Pond habitat (26.9%) with 7 larvae, having a larval density of 0.7 larvae / wound. Then (11.5%) Swamp habitat with 3 larvae, having a larval density of 0.3 larvae/inch. While the breeding habitat of *Anopheles spp* larvae in the Culvert habitat (7.7%) with 2 larvae, the density of 0.2 larvae/inch was the least

a. Culverts

The results of the search for larvae in the Penanggiran Village culvert, obtained *Anopheles spp.* larvae as many as 2 larvae / 10 paws. After the larvae became mosquitoes and were identified, they turned out to be male *Anopheles spp.* mosquitoes, the identification key used by Litbangkes Baturaja was specifically for female *Anopheles spp.* mosquitoes, so the mosquitoes could not be identified.

b. Swamp

Searching for larvae in the swamp of Tanjung Terang Village, we found 3 *Anopheles spp.* larvae/10 paws. After the larvae became mosquitoes, during identification, 2 species of *Anopheles spp*. larvae were found, namely *An. barbirostis* and *An. umbrosus*. 1 larva died before becoming a mosquito for identification.

c. Lake

The results of the search for larvae in Lubuk Mumpo Village Lake, obtained *Anopheles spp. larvae* as many as 14 larvae / 10 paws. After the larvae became mosquitoes, identification of 2 species of *Anopheles spp*. *An. barbirostis* as many as 5 larvae and *An. sinensis* 2 larvae and 5 larvae including male mosquitoes that could not be identified.

d. Pond

The results of the search for larvae in the Lubuk Mumpo Village Pond, getting *Anophelesspp. larvae* as many as 7 larvae / 10 paws. After rearing only 2 larvae that became mosquitoes, after identification, 1 species of *Anopheles spp*. larvae was found, namely *An. Sinensis.* And 1 other mosquito is a male mosquito that cannot be identified.

Discussion

Based on the catches made in Penanggiran village and Tanjung Muning village, 4 species were found, namely *An. nigerimus*, An. *umbrosus*, *An. barbirostris* and *An. sinensis.* An. barbirostris was found to be the most abundant with 4 individuals. While An. *umbrosus*, *An. nigerimus* and *An. sinensis were found to be* only 1 each.

The theory of Mahdalena and Wuriastuti, the preferred breeding places for*An. umbrosus* are swamps where there are many plants and trees that are dense and not exposed to direct sunlight. After sucking blood, *An. umbrosus* mosquitoes often rest inside and outside the house, but are usually found outside the house, especially near livestock pens. The peak blood sucking density of *An. umbrosus* mosquitoes occurred at 20:00 - 21:00 WIB inside the house and 24:00 - 23:00 to 22:00 - 03:00 WIB for outside the house[9].

Based on the theory of Natadisastra, it states that *An. barbirostris* is an *Anopheles* species that likes breeding sites in rice fields, springs, puddles, fish ponds, and former excavations. This species likes to rest outdoors around plants. *An. barbirostris* density occurs at night at 20.00 to 24.00 WIB. *An. barbirostris* is anthropophilic and also zoophilic. While *An. nigerimus* is a species that prefers breeding places in ponds, rice fields and swamps where there are water plants on the edges. After sucking blood, *An. nigerimus prefers* to rest outdoors or around livestock pens. This mosquito species is not only zoophilic, but also anthropophilic[10].

The theory of Asmara et al, mentioned *An. sinensis* is one of the secondary vectors in Sumatra. Mosquitoes of this species like to breed in residential neighborhoods that are located close to rice fields, swamps, wells and ponds. The preferred habitat of An. sinensis is usually grass or water plants and prefers directsunlight exposure[11]. According to the theory of Budiyanto states that *An. sinensis* blood-seeking behavior or peak biting density occurs at 21.00 to 24.00 WIB. An. sinensi is zoophilic and anthropophilic[12].

Based on the results of the study, 4 species of *Anopheles sp were* obtained, most of which are also anthopophilic where this species of mosquito not only likes animal blood but also looks for targets in humans to suck blood. Therefore, it is recommended that residents take preventive measures such as the use of lotions and mosquito repellents to avoid *Anopheles sp mosquito* bites.

Based on the research conducted, it was found that *Anopheles spp.* larvae species that were found in 4 Anopheles spp. larval breeding habitats in Gunung Megang Subdistrict were *An.barbirostis with* 6 larvae, *An.sinensis with* 3 larvae and An.*umrosus with* 1 larvae. *An. barbirostris was* found in swamp and lake habitats, An. *sinensis was* found in lake and pond habitats while An. *umbrosus was* found in swamp habitats.

According to the theory of Budiyanto, the results of the identification of *Anopheles spp. larvae* in this study there were 3 species of *Anopheles spp* larvae obtained. In the South Sumatra area itself there are already several mosquitoes confirmed as malaria vectors, including those in this study, namely *An.sinensis* and *An.barbirostris*. Currently in South Sumatra there are six species of *Anopheles spp.* that have been confirmed as malaria vectors, namely An.*sinensis* and *An.barbirostris An.nigerrimus, An.maculatus, An.vagus, An.letife.* In Muara Enim district, there are two species of *Anopheles spp*. that have been confirmed as malaria vectors, namely An.*vagus and An.sinensis*[12].

The results of research from Yahya, stated that there were 8 species of *Anopheles spp*. larvae that succeeded in becoming mosquitoes and identified, namely the most dominant *Anopheles spp.* from the *Cellia* subgenus, there are 5 species including An.*kochi, An.maculatus, An.subpictus, An.vagus* and *An.tesselatus. The* other 3 species belong to the subgenus *Anopheles spp.* namely An.*umbrosus, An.barbirostris* and *An.nigerrimus. The* types of breeding habitat for *Anopheles spp.* larvae are ditches, streams on the edge of rice fields, rice fields, buffalo pits, kobakans, fish ponds, swamps and lakes[13].

Based on the results of the study, the most *Anopheles spp.* larvae species in Gunung Megang District, Muara Enim Regency were found in the lake, namely 2 species of An.*barbirostris* and An.*sinensis* then in the swamp 2 species of An.*barbirostris* and *An.sinensis and the* least in the pond, namely 1 species of *An.sinensis.* The discovery of various species of *Anopheles spp. larvae* in a habitat can be influenced by the number of larval densities present, because the more larvae present in a habitat can potentially havea variety of species present.

Based on larval searches conducted in Gunung Megang sub-district, Muara Enim district, *Anopheles spp. larvae were* found in 4 breeding habitats, namely culverts, swamps, lakes and ponds. The larvae found were very different, the habitat where the most larvae were found was in the Lake habitat which had 14 larvae with a larval density (1.4 larvae/invasion). Then the Pond habitat had 7 larvae, larval density (0.7 larvae/inch).

The Swamp habitat had 3 larvae, larval density (0.3 larvae/inch). And the least larval habitat was the Culvert with 2 larvae, larval density (0.2 larvae/inch).

Theory from Tulak states that there are several factors that can affect the density of *Anopheles spp*. larvae is rainfall, fluctuations in the intensity of rainfall can have an impact on the amount of habitat and *volume of* standing water so that it can have a direct effect on the presence of preadult mosquitoes in aquatic habitats[14]. When it rains continuously and the intensity of rainfall is high, *Anophele spp*. larvae can be washed away, reducing the aquatic habitat containing *Anopheles spp. larvaeand the larval* density at that time. However, for the next few days, new stagnant water habitats will emerge that can potentially become mosquito breeding sites. However, if rainfall is sufficient, the larvae can complete the cycle to become adult mosquitoes successfully. Rainfall indirectly affects the population of adult *Anopheles spp*. mosquitoesas vectors of malaria. Then shallow habitats without vegetation, larvae take refuge at the bottom of the habitat before surfacing to breathe, while deep habitats, larvae are found more at the edge of the habitat and in habitats that have aquatic vegetation. The function of aquatic vegetation is to provide shelter for larvae and to inhibit the flow of water. *Anopheles spp*. larvae are often found in aquatic habitats that have clear water but sometimes they are found in turbid water up to a certain turbidity limit. Turbid water has a suspension that cannot be tolerated by the larvae, because it can interfere with the breathing of the larvae which can cause many mosquito larvae to die. Habitat water temperature is also a factor that affects larval density. Shallow water habitats have high water temperatures but deep water habitats tend to have lower water temperatures. Water temperature can affect the stage of the adult mosquito development cycle. To some extent, high water temperatures can accelerate the developmental stages of mosquitoes while low water temperatures can slow down the developmental stages of preadult mosquitoes. Another limitation to the presence of *Anopheles spp. mosquito* larvae is water pH, each larval species has a different tolerance to water pH values. Furthermore, aquatic plants in aquatic habitats can protect larvae from predators and are protected from direct sunlight, and aquatic plants also contain microfauna and macrofauna that can serve as food for larvae.

Conclusion

In the capture of mosquitoes in Gunung Megang Sub-district, Muara Enim Regency, 4 species of *Anopheles sp were* found, the most commonly found species was *An. barbirostris* with a total of 4 species while for An. *umbrosus*, *An. nigerimus* and *An. sinensis* species only found 1 species. In Tanjung Muning Village, only 2 (28.6%) were found while in Penanggiran Village, 4 (71.4%) were found. *The* totalnumber of mosquitoes captured in both villages was 7 *Anopheles sp.* 3 species of *Anopheles* larvae were found, namely An. *barbirostris*, *An. sinensis* and *An. umbrosus* and there were 4 locations of breeding habitat for *Anopheles* sp larvae in the form of the highest to

lowest habitat, namely lakes and ponds in Lubuk Mumpo Village, swamp habitat in Tanjung Terang Village and culvert habitat in PenanggiranVillage.

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