

Abundance and Diversity of Mosquito (*Anopheles sp*) in Malaria Endemic Areas of Ternate Island North Maluku

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Abstract: Research on the abundance and diversity of *Anopheles sp* on four different types of ecosystems is a settlement; plantation, scrub and forest have been implemented on Ternate Island which is endemic in Ternate. This study was conducted over 12 months from June 2015 to May 2016. The aims to study of abundance and diversity aspect of *Anopheles sp* in Ternate Island North Maluku province, on each type of ecosystem. Catching mosquitoes were conducted using a human landing collection from 18:00 to 06:00 o'clock, four times each month. Result of proportion analysis of mosquitoes *Anopheles sp* highest in central district of Ternate (31.05%), followed by Ternate Island district (25.78%), North Ternate district (21.88%), and South Ternate district (21.29%). While based on the ecosystem, the highest proportion contained in the settlement (24.48%), followed by shrub (24.98%), gardens (18.62), marshes (16.24%), city park (9.83%) and the lowest in the lake (6, 51%).

Keywords: *Anopheles sp*, malaria endemic area, abundance, diversity, Ternate Island

1. Introduction

Malaria is a disease caused by the obligate intracellular protozoan of the genus *Plasmodium*. Cases of malaria have extensive deployment increasing with the passage of time and become a public health problem. There are four identified species of these parasites cause malaria in humans, namely *Plasmodium vivax*, *P. falciparum*, *P. oval*, *P. malaria*. In Indonesia there are about 80 species, 24 of which proved to transmit malaria. The nature of each species varies depending on factors such as climate, geography, and growth. *Anopheles* mosquitoes live in accordance with the local environmental conditions, such as brackish water (*Anopheles sundaicus* and *Anopheles subpictus*), paddy fields (*Anopheles aconitus*) and clean water mountains (*Anopheles maculatus*) [1].

Vectors in North Maluku province is a mixture of several species of western and oriental Australasia group who migrated to the island of Halmahera, covering *farauti* *Anopheles species*, *An. punctulatus*, *An. koliensis*, *An. longirostris*, and *An. Bancrofti*. *Anopheles* mosquito. which has been found in 15 species breeding habitat on Halmahera Island in total of 11 species, namely *An. kochi*, *An. subpictus*, *An. vagus*, *An. tessellatus*, *An. farauti*, *An. barbumbrosus*, *An. punctulatus*, *An. hackeri*, *An. minimus* and *An. umbrosus*. Based on ELISA test results were positive for parasites (*Plasmodium vivax*) is *An. indefinitus*, *An. kochi* and *An. Vagus* [2]. Meanwhile, that was found five species of *Anopheles* in the village of Doro Halmahera, namely *An. kochi*, *An. vagus*, *An. farauti*, *An. punctulatus*, and *An. Minimus* [3]. In South Minahasa regency, North Sulawesi also get 12 potential vector species, namely: *An. anandalei*, *An. separtus*, *An. hunter*, *An. umbrosus*, *An. An. vagus*, *An.*

kochi, *An. kompestris*, *An. minimus*, *An. ramsayi*, *An. balabacensis*, *An. barbumbrosis*, *An. maculatus*, and *An. Supictus* [4].

Mobility malaria in an area determined by the Annual Parasite Incidence (API) per year, API is the number of positive cases of malaria per 1000 population in one year. Recently in Indonesia, malaria remains a public health problem, although the API numbers in 2011-2015 tended to decrease, namely from 1.75 per 1,000 population at risk, being 0.85 per 1,000 population at risk in 2015. Nationally, there are five provinces with the highest API per 1,000 inhabitants of Papua (31.93), West Papua (31.29), East Nusa Tenggara (7.04), Maluku (5.81), and North Maluku (2.77). The provinces with the lowest API (0,00) namely West Java, Banten, Jakarta, Bali and East Java. The API numbers that occurred in North Maluku province since 2012 experienced a decline of 5.08 becomes 2.77, in the year 2015 to 2.0 per 1000 population, which in 2015 indicated positive in 25.349 people and 3.220 people. The high rate of malaria incidence is closely related to the presence of several types of vectors in different types of ecosystems and the availability of various types of breeding habitats.

Ternate island is an area that is still found cases of malaria with the number of API 2.00 per 1000 in 2016, while the number of API in Ternate City of 0.77. Therefore, provide the highest contribution to morbidity. The high incidence of malaria in Ternate Island is caused by several factors including environmental factors such as their breeding places for mosquito breeding are: lakes, marshes, ponds, lakes, tread animals, trenches, tread animals and pools of abandoned, while the behavior of society less concerned for the care and attention to environmental hygiene in the prevention and control of malaria transmission is also very less.

Volume 6 Issue 4, April 2017

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Environmental factors that determine the spread of the mosquito *Anopheles sp* including the physical environment consisting of elevation, land use, weather and micro environment in the form of puddles as breeding habitat. The habitat required by the mosquito for laying eggs, then hatch into larvae develop into pupae until *eklosi* into adult mosquitoes early [5]. This study aims to determine the abundance, diversity, and preferences of *Anopheles sp* against several types of different ecosystems in Ternate Island of North Maluku.

2. Methodology of Research

This study was conducted over 12 months from May 2015 until June 2016 in four districts of Ternate Island of North Maluku Province which is the district with the category of higher malaria transmission. Ternate Island is an area that is surrounded by beaches and most of its territory is residential land, gardens, shrubs and forest. Catching mosquitoes carried out on six different types of ecosystems, namely settlements, gardens, shrubs, marshes, lakes and the city park. Arrest made each hour starting sunset until sunrise (18:00 until 06:00) four times in a month with human landing collection method (HLC) conducted by 5 trained catchers.

The mosquitoes were caught incorporated into paper cup and taken to a laboratory to be identified under a stereo microscope with display key books adult *Anopheles* mosquitoes Maluku and Papua⁶. Data collected in the form of the number of mosquitoes per species of every ecosystem type analyzed descriptively and presented in distribution tables and graphs of abundance. The number of *Anopheles* analyzed using several parameters are: relative abundance is calculated based on the proportion of certain *Anopheles* mosquito species to the total number of *Anopheles* were caught and multiplied by 100%. Species diversity index is calculated using the Shannon-Wiener method.

3. Results and Discussion

The number of *Anopheles* mosquitoes were caught in the six different types of ecosystems, namely settlements, gardens, swamps, bushes, lakes and city parks amounted to 1536 people *Anopheles* mosquitoes caught consists of six species, namely, *An. farauti*, *An. indefinitus*, *An. kochi*, *An. maculatus*, *An. subpictus*, and *An. vagus*. The thirteen species of *Anopheles* in Datar Luas village of Aceh Jaya, namely *An. kochi*, *An. barbirostris*, *An. maculatus*, *An. letifer*, *An. tessellatus*, *An. sinensis*, *An. vagus*, *An. separatus*, *An. sundaicus*, *An. minimus*, *An. subpictus*, *An. aconitus* and *An. Barumbrosus*⁷. In the village of South Halmahera Saketa was found of 10 species, namely, *An. barbumbrosus*, *An. farauti*, *An. hackeri*, *An. indefinitus*, *An. kochi*, *An. koliensis*, *An. punctulatus*, *An. subpictus*, *An. tessellatus*, and *An. Vagus* [8]. Results obtained in which (*An. Kochi*, *An. Maculatus*, *An. vagus* and *subpictus An*, *An indefinitus*) are the same species as those found on Ternate Island. The same thing was also found in South Minahasa regency, North Sulawesi also get 12 potential vector species, namely: *An. anandalei*, *An. separtus*, *An. hunter*, *An. umbrosus*, *An. vagus*, *An. kochi*, *An. kompestris*, *An. minimus*, *An. ramsayi*, *An. balabacensis*, *An.*

barbumbrosus, *An. maculatus*, and *An. Subpictus*³. There are 4 of the same species (*An. Vagus*, *An. Kochi maculatus*, and *An. Subpictus*) was found in Ternate Island.

Analysis of the proportion of mosquitoes *Anopheles sp* highest in the District of Central Ternate 31.05%, followed by the District of Ternate Island, 25.78%, 21.88% District of North Ternate and the District of South Ternate 21.29%, while based on the ecosystem, the highest proportion contained in the settlement ecosystems (24.48%), followed by shrub ecosystems (24.28%), shrubs (24.98%), gardens (18.62), marshes (16.24%), Park City (9.83%) and the lowest in the lake (6.51%).

Table 1: The abundance and diversity of *Anopheles sp* type in North Ternate district

District	Species	Abundance nisbi (%)	Diversity index
North Ternate	<i>An. farauti</i>	17.66	0,85 (Low)
	<i>An. Indefinitus</i>	36.09	
	<i>An. kochi</i>	18.93	
	<i>An. maculatus</i>	8.94	
	<i>An. subpictus</i>	5.57	
Central Ternate	<i>An. farauti</i>	17.16	1,20 (Medium)
	<i>An. Indefinitus</i>	55.94	
	<i>An. kochi</i>	20.06	
	<i>An. maculatus</i>	0.38	
	<i>An. subpictus</i>	2.93	
South Ternate	<i>An. farauti</i>	13.19	0,91 (Low)
	<i>An. Indefinitus</i>	43.67	
	<i>An. kochi</i>	15.84	
	<i>An. maculatus</i>	8.2	
	<i>An. subpictus</i>	2.08	
Ternated Island	<i>An. farauti</i>	16.83	0,93 (Low)
	<i>An. Indefinitus</i>	7.65	
	<i>An. kochi</i>	36.71	
	<i>An. maculatus</i>	29.79	
	<i>An. subpictus</i>	5.52	
	<i>An. vagus</i>	9.92	
	<i>An. vagus</i>	5.67	

Analysis of the proportion of *Anopheles* species on Ternate Island, *An. indefinitus* and *An. kochi* have a higher proportion in all kinds of species compared to other species. The highest species was *An. indefinitus* (44.40%), followed by *An. kochi* (20.96%), *An. farauti* (15.40%), *An. vagus* (9.51%), *An. maculatus* (9.51%), and lowest *An. subpictus* (4.49%). The high proportion of *An. indentifitus* and *An kochi* show a higher ecological role when compared to other species. *An. subpictus*, although the proportion is quite low and ecological value, but because of its status as a vector presence would be an indicator of a threat to the transmission of malaria on Ternate Island [3], [7], [8].

The abundance and diversity of *Anopheles sp* in Ternate Island includes North Ternate district, Central Ternate district, South Ternate district, and Ternate Island district can be seen in the Tables 1.

Table 1, shows that in North Ternate district, the diversity level of 0.85 (low criteria). While in Central Ternate district, the diversity level of 1:20 (medium criteria). The diversity

level in South Ternate district of 0.91 (low criteria), and the diversity level in Ternate Island district of 0.93 (low criteria). The average abundance of *Anopheles sp* in Ternate Island area as shown in Table 2.

Table 2: Average abundance of *Anopheles sp* in Ternate Island

Species	North Ternate	Central Ternate	South Ternate	Ternate Island	Amount	Average Abundance
<i>An. Farauti</i>	17.66	17.16	13.19	7.65	55.66	13.92
<i>An. Indefinitus</i>	36.09	55.94	43.67	36.71	172.41	43.10
<i>An. Kochi</i>	18.93	20.06	15.84	29.79	84.62	21.16
<i>An. maculatus</i>	8.94	0.38	8.2	5.52	23.04	5.76
<i>An. subpictus</i>	5.57	2.93	2.08	9.92	20.5	5.13
<i>An. Vagus</i>	12.82	3.49	16.83	5.67	38.81	9.70

Based on table 2, the abundance of on Ternate Island in Indonesia and many countries that have problems with malaria, the mosquito does not act as vectors. But the results of the ELISA test against *An. indefinitus* were found in the Saketa Village indicate a positive sample containing *Plasmodium vivax*². *An. indefinitus* entry of Vietnam and Southeast Asia region to Guam and Spain via air transportation after World War II. These mosquitoes as vectors and potentially cause an outbreak of malaria in Guam in 1966 and 1969⁹, in Indonesia no potential mosquito vector but only cause disruption effect alone.

There are many types of adult mosquitoes obtained from the study site is influenced by environmental factors. The environmental factors are closely related to the distribution and activity of blood sucking each species, such as temperature and humidity. Low temperatures and high humidity affect the catches of mosquitoes were found. Mosquitoes suck most outside in the humidity of 84-88% and an average temperature of 25-27°C appropriate growth and proliferation of mosquitoes.

The density of *Anopheles sp* in Ternate Island as shown in Figure 1. The value Man Hour Density (MHD) is at its highest in Central Ternate district of 1,975 (tail / person / hour) people feed (PF), followed by the Ternate Island district of 1,796 (tail/person/hour) (PF), South Ternate district of 1,417 (tail/person/hour) (PF) and the lowest in North Ternate district of 1,103 (tail/person/hour) (PF). The value of MBR is highest in the Central Ternate district of 0.658 (tail/person/hour) (PF), followed by Ternate Island district of 0.599 (tail/person/hour) PF, South Ternate district of 0.47 (tail/person/hour) (PF), and the lowest in North Ternate district.

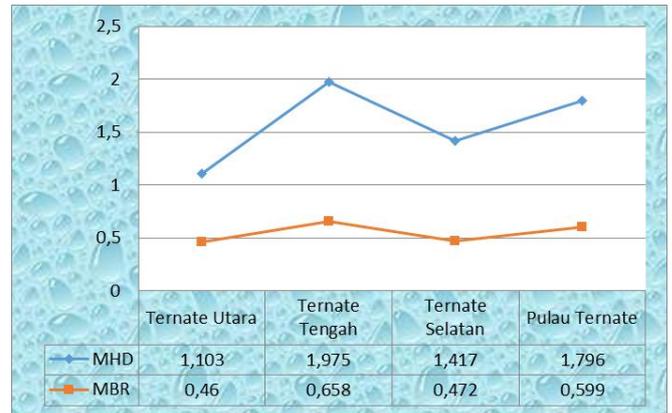


Figure 1: Average value of MHD and MBR in Ternate Island

The diversity index of *Anopheles* species obtained from all four districts in Ternate Island, North Ternate district of 0.85, Central Ternate district of 1.2, South Ternate district of 0.91 and Ternate Island district of 0.93. These results indicate that the diversity of species in Ternate Island included in the low category, as shown in Figure 2.

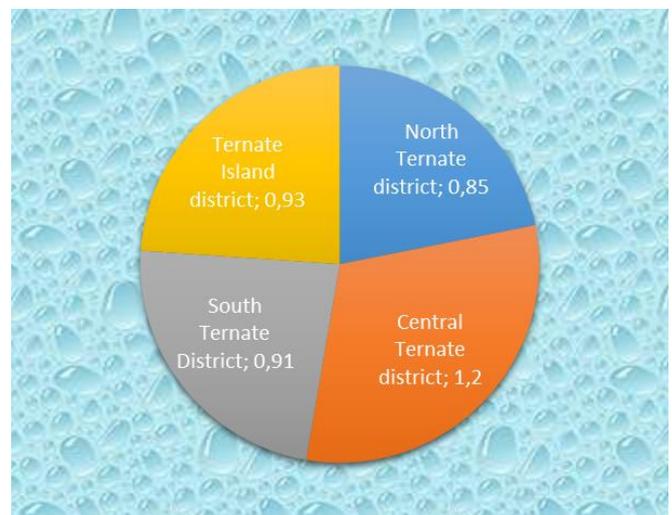


Figure 2: The diversity index of *Anopheles* in Ternate Island

The Low of diversity index of *Anopheles sp* was found, that effect of several factors, the first factor is weather condition. The study took place during the rainy season that affects the existence of adult mosquitoes (imago). According to Pratt (2015), the torrential rain water levels on larval breeding sites such as swamps, puddles also increased as well as the water flow more swift. Heavy water flow will eliminate larvae. The second factor is the cycle of the mosquito itself, respectively. Each species of mosquitoes have time hatching and development of different. The third factor is the diversity of adult mosquitoes in a category, this is caused of time sampling on good weather, no rain so many adult mosquitoes hatch. The arrest was made at night. When it is time for mosquitoes to seek eat / suck the blood, in both humans and animals that exist.

Based on the results, in addition to the dominant *Anopheles* species, other *Anopheles* species that need to be considered in relation to vector is a species listed in *punctulatus* group that *An. farauti*, *An.vagus* and *An. subpictus*. The third species is an vector in Papua who geografis closer to the island of

Ternate. The high mobility of the people of Ternate immigrants from Papua to allow a high chance of accumulation of parasites carried by Anopheles species in Papua in Ternate.

4. Conclusion

Anopheles in Ternate Island spread on six different types of ecosystems, namely residential, gardens, parks, bush, swamps and lakes. Mosquito *Anopheles spp* was found consists of six species, namely; *An. farauti*, *An. indefinitus*, *An. kochi*, *An. maculatus*, *An. subpictus*, and *An. vagus*. *An. indefinitus* is the most dominant species on the entire ecosystem. The highest proportion found in settlements (24.48%), followed by shrub (24.28%), gardens (18.62%), marshes (16.28%), city park (9.83%) and lake (6.51%). *Anopheles* species diversity index obtained from the fourth district in Ternate Island. The District of North Ternate (0.85), Central Ternate 1.2, South Ternate (0.91) and the Ternate Island (0.93). These results indicate that the diversity of species on the island of Ternate included in the low category.

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