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Research

Distribution and The Habitat Characteristics of *Anopheles vagus* (Diptera: Culicidae) Larvae at Paddy Fields in The Vicinity of Dramaga IPB University Campus Dramaga Bogor West Java

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ABSTRACT

Dramaga sub-district is an area that has rice fields close to buffalo stalls and a population of wild Macaca fascicularis as natural hosts for several species of *Plasmodium*. This causes the Dramaga sub-district to become a potential vector habitat for malaria, including *Anopheles vagus*. This study aims to analyze distribution of *An. vagus* larval stage in 4 villages (Cikarawang, Babakan, Margajaya, and Ciherang) in Dramaga subdistrict which have paddy field areas. Larvae were collected using a dipper, and each collection sites of the larvae habitat were marked using Global Positioning System. The physical characteristics of the water habitat measured were temperature, pH, total dissolved solids and the electrical conductivity of the water. Pearson's correlation test was used to analyze the relationship between the number of larvae *An. vagus* with each of the parameters water physical characteristics. The results of this study obtained 309 *An. vagus* larvae from the 27 collection points. Larvae of *An. vagus* was found in 3 villages (i.e. Cikarawang, Babakan and Ciherang), but was not found in Margajaya village. The habitat characteristics of *An. vagus* in paddy fields showed a water temperature of 26.6-31.7°C, pH 6.40-8.10, the total dissolved solid 36-285 ppm, and the electrical conductivity 72-262 µm/cm. The Pearsons correlation test results did not show a significant difference between the number of *An. vagus* larvae and each parameter (r= -0.26, 0.13, -0.15 and -0.16, respectively). The presence of *An. vagus* in this area could be considered in malaria vector control programs.

Keywords: mosquito, *Anopheles vagus*, IPB University

ABSTRAK

Kecamatan Dramaga merupakan wilayah yang memiliki area persawahan yang dekat dengan kandang kerbau dan populasi *Macaca fascicularis* liar sebagai inang alami dari beberapa jenis *Plasmodium*. Hal tersebut menyebabkan kecamatan Dramaga potensial menjadi habitat vektor Malaria, termasuk *Anopheles vagus*. Penelitian ini bertujuan untuk menganalisis distribusi *An. vagus* stadium larva di area persawahan pada 4 desa (Cikarawang, Babakan, Margajaya, dan Ciherang) di Kecamatan Dramaga. Larva dikumpulkan dengan menggunakan *mosquto dipper*, dan setiap lokasi pengumpulan habitat larva ditandai dengan *Global Positioning System*. Karakteristik fisik dari habitat perairan yang diukur adalah suhu, pH, total padatan terlarut dan daya hantar listrik air. Uji korelasi Pearson digunakan untuk menganalisis hubungan antara jumlah larva *An. vagus* dengan masing-masing parameter karakteristik fisik air. Berdasarkan penelitian diperoleh hasil sejumlah 309 larva *An. vagus* dari 27 titik pengumpulan. Larva dari *An. vagus* ditemukan di 3 desa, yaitu Cikarawang, Babakan dan Ciherang. Akan tetapi, tidak ditemukan di Desa Margajaya. Karakteristik habitat *An. vagus*, yaitu sawah yang menunjukkan suhu air 26,6-31,7°C, pH 6,40-8,10, total padatan terlarut 36-285 ppm, dan daya hantar listrik 72-262 µm/cm. Hasil uji korelasi Pearsons tidak menunjukkan hubungan yang signifikan antara jumlah larva *An. vagus* dan setiap parameter (r = -0.26, 0.13, -0.15 dan -0.16, berturut-turut). Kehadiran nyamuk *An. vagus* di lokasi ini harus dipertimbangkan dalam program pengendalian vektor malaria.

Kata kunci: nyamuk, *Anopheles vagus,* IPB University

INTRODUCTION

Malaria is a vector-borne disease caused by parasites from the genus *Plasmodium* that can infect a wide variety of animals including humans. The transmission of malaria is mediated by the Anopheles mosquito as a vector. The variety of Anopheles species in Indonesia is quite high, namely around 81 species and 25 of them have been proven to be malaria vectors (Ministry of Health 2015). This vector is distributed throughout the region in Indonesia and each region has different species, bioecology, habitat, distribution and density. The existence and survival of Anopheles larvae are strongly influenced by the conditions of their breeding sites such as the physical characteristics of water.

The villages around the Dramaga IPB campus are residence for students, teaching staffs, education personnel and other academicians as well as the natives of Dramaga District. IPB students are very unique because they come from various regions in Indonesia, including from malaria endemic areas. Barodji (1980) and Andiyatu (2005) conducted research on the species diversity of mosquitoes in the villages surrounding the Dramaga IPB campus including rice fields. Both of them reported several genus of *Anopheles* mosquitoes including *Anopheles vagus*. The rice fields around the Dramaga IPB campus are also close to animal sheds such as buffalo, cow, goat, and also wild *Macaca fascicularis* habitats as natural hosts for various species of *Plasmodium*.

The existence of *An. vagus* needs serious attention as a potential vector of malaria. Wigati *et al.* (2006) reported *An. vagus* originating from Hargorejo Village, Kokap District, Kulon Progo Regency has been confirmed by ELISA containing circum sporozoite protein of *Plasmodium falciparum*. *An. vagus* and *An. sinensis* in Muara Enim, South Sumatra was also confirmed by ELISA containing *P. falciparum* and *P. vivax* (Budiyanto *et al.,* 2017). In addition, Munif *et al.,* (2019) reported *An. vagus* was also a companion vector during the outbreak of malaria in Sukabumi because it contained *P. falcifarum* with a sporozoite index of 0.12% and an inoculation rate of 0.213.

Based on those informations, a study on the distribution and habitat characteristics of *An. vagus* larvae in the rice fields around the Dramaga IPB campus is important to study.

MATERIAL AND METHODS

The method used in this research was purposive sampling method. *Anopheles* larvae were collected using a dipper on watery rice fields in four villages around the Dramaga campus (Cikarawang, Babakan, Ciherang and Margajaya). The mosquitoes that were successfully collected were put into a small container to be identified up to the species level using the key morphology of the larvae according to O'Connor and Soepanto (1989). Each collection point was marked using the Global Positioning System and presented in a distribution map of *An. vagus*. in rice fields in the village around the Dramaga campus. The physical characteristics of water that were measured include temperature, pH, total dissolved solids, and electrical conductivity. The number of larvae that were collected was then performed the Pearson correlation test with each of the physical characteristics of the water.

RESULTS AND DISCUSSION

The results of this study obtained 309 *Anopheles vagus* larvae in 27 points of rice fields in Cikarawang Village, Babakan Village, and Ciherang Village, while in Margajaya Village they were not found ((Table 1 dan Fig. 1). The presence of *An. vagus* in the village rice fields around the campus was not evenly distributed. Rice fields in Cikarawang Village are the most points where *An. vagus* larvae can be found. The rice fields in Cikarawang Village are located close to residential areas that have buffalo and other livestock, while in Babakan, Ciherang, and Margajaya Villages, there are no buffalo stalls found around the rice fields. *An. vagus* was reported to have a preference for sucking animal blood (zoophilic) in Pesawaran and Muara Enim Districts (Hanafy 2015; Budiyanto *et al.* 2017).

The results of the measurement of the physical characteristics of water including pH, temperature, total dissolved solid and electrical conductivity varied between points where *An. vagus* larva was found, however did not show a significant correlation between each measurement and the number of larvae found (Fig 2). The pH value of rice field water where *An. vagus* found was 6.40-8.10 (mean 7.37). In Ogan Komering Ulu Regency, Maretasari *et al.* (2019) reported the pH value in the rice fields of *An. vagus* habitat was in acidic pH (5-6). Another study repoted that *An. gambiae* larvae lived in water with a pH of 4 -7.8 if there was sufficient food for consumption (Oyewole *et al.* 2009).

According to Clark *et al.* (2004) pH of water affects the successful breeding of mosquito larvae where mosquito larvae will die at pH <3 and >12. Akhiriyanti and Nugroho (2019) reported neutral pH levels (6.8-7.2) have a higher potential (86.4%) for breeding place of *Aedes aegypti* larvae. Neutral pH water conditions supported the plankton growth and its presence became a source of food

Table 1 Results of Measurement Number of Larvae *An. vagus*, pH, temperature, the amount of dissolved solids, and the electrical conductivity of water in the Rice Fields Around IPB University

Collection Site	Number of Larvae	pH	Temperature	TDS	EC
1	43	7,4	29,5	75	150
2	48	7,6	27,7	55	110
3	27	7,5	29,8	60	121
4	31	7,5	28,2	45	90
5	25	7,6	27,9	52	104
6	14	7,3	27,5	85	165
7	10	7,4	27,6	45	144
8	3	7,3	27,5	66	122
9	15	7,2	27,2	61	175
10	1	7,3	29	87	220
11	6	7,6	29,5	285	142
12	3	7,9	30,4	130	173
13	15	7,6	29,6	132	262
14	4	7,8	28,7	98	199
15	2	7,8	28,7	92	206
16	14	7,7	28,6	123	247
17	1	7	29,2	80	161
18	1	7,1	29,2	74	158
19	17	7	27,4	82	116
20	7	7,1	26,6	85	170
21	8	6,4	26,9	78	154
22	3	6,9	29,2	77	136
23	3	7	30,2	72	145
24	4	7,6	29,3	78	157
25	1	7,1	29,7	36	72
26	1	8,1	30,2	39	79
27	2	7,4	31,7	41	77

for mosquito larvae (Sunarti *et al.* 2018).

The temperature of the rice fields where *An. vagus* larvae found was between 26.6-31.7 °C (mean 28.78 °C). This temperature is still in line with the research of Kenglueca *et al.* (2005) who stated that larva *An. vagus* in Northwestern Thailand can be found in water temperatures of 25.4-32 °C. Rice fields are areas without shade so that sunlight can penetrate the water and provide a higher temperature value than areas shaded by trees. Warm water in sunlit habitats may be an important factor for larval development because warm water speeds up their development. In addition, warm temperatures allow more microbes to develop microorganisms that provide a food source for mosquito larvae (Minakawa *et al.* 1999).

Total dissolved solid value and water electrical conductivity in paddy-field where *An. vagus* was found hold a range of value of TDS (36– 285) ppm

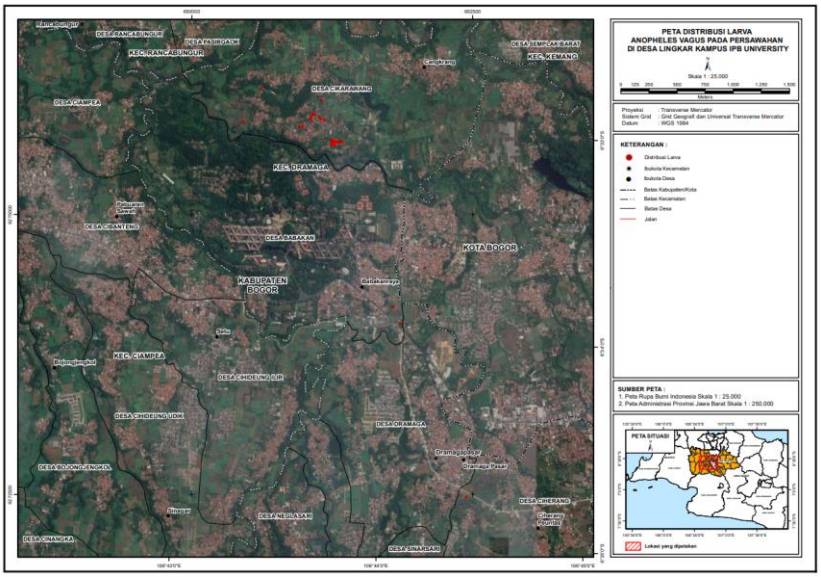

Figure 1 Distribution of *An. vagus* larvae in paddy-field in in the villages around the Dramaga IPB campus, Bogor

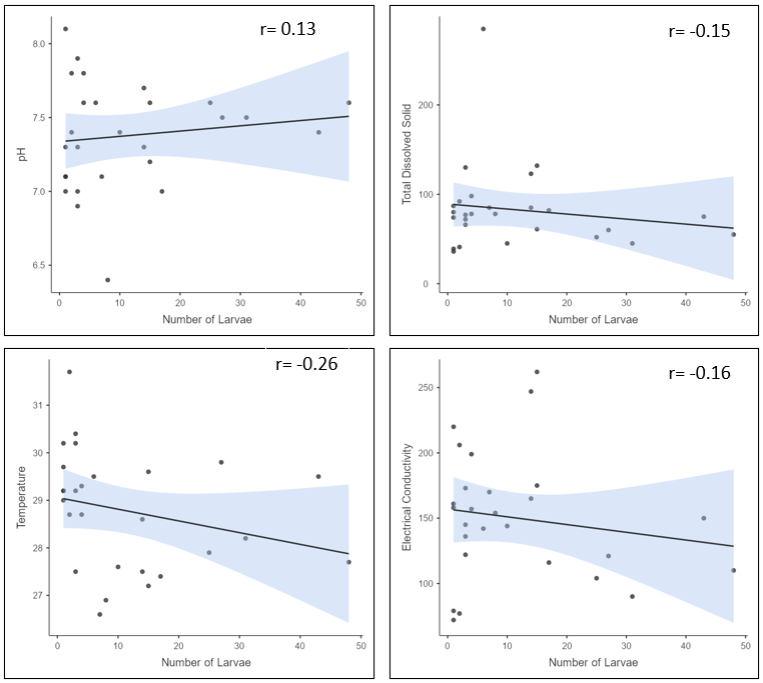

Figure 2 Scattered Plot on *An. vagus* Larvae numbers with pH, temperature, total dissolved solid and electrical conductivity on paddy-field

while EC (71– 262) µm/cm. In accordance to Astuti (2014), a larger value on TDS in a liquid imposes a probability of higher numbers of ion in the liquid, which makes the electricity conductivity in a larger value. Water EC value hold a negative correlation to *An. Arabiensis* larvae density. *Anopheles gambiense* larvae and *An. arabiensis* were detected in an environment where water conductivity is low and water electricity conductivity is above 2000 µm/cm which impose significant larvae decrease (Fillinger *et al.*, 2009). High electricity conductivity caused by salinity and dissolved ion may trigger a negative impact on mosquito larvae growth (Closs *et al.*, 2003).

The TDS (total dissolved solid) and EC (electrical conductivity) values of water in rice fields where *An. vagus* found were 36–285 ppm and 71– 262 µm/cm, respectively. According to Astuti (2014) the greater value of total dissolved solids (TDS) in the solution,

the greater the possibility of the number of ions in the solution, so that the electrical conductivity (EC) value is greater. Fillinger *et al.* (2009) reported the value of the electrical conductivity of water has a negative correlation with the density of larvae *An. arabiensis*. *An. gambiense* and *An. arabiensis* larvae were found in the habitat where the water conductivity was low and the water electrical conductivity was above 2000 µm/cm and caused a significant decrease in larvae. High electrical conductivity due to salinity and dissolved ions can have a negative impact on the growth of mosquito larvae (Closs *et al.* 2003).

"All authors declare that there are no conflicts of interest".

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