American Journal of Zoological Research, 2017, Vol. 5, No. 1, 1-4
Available online at http://pubs.sciepub.com/ajzr/5/1/1

DOI:10.12691/ajzr-5-1-1

Relationship between Climate Factor and Diptera Larvae on Phytotelmata in Dengue Fever's Endemic Areas in West Sumatera, Indonesia

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Abstract One of many factors that can influence insect population is climate, because direct and indirectly climate can influence insect development, included Diptera larvae which is one of insect order. The aim of this research is to know the relationship between climate factors with the numbers of individual Diptera larvae inhabit Phytotelmata. The sample was found in dengue endemic area's at three locations in West Sumatera. The result of this research shows that there is a relationship between climate factors (humidity, rainfall, and temperature) and the numbers of individual dipteral larvae inhabit in Phytotelmata. Humidity and rainfall factors have positive correlation with the number of individual Diptera larvae inhabit in Phytotelmata with value ($r = 0,534$; $p<0,01$) and ($r= 0,0418$; $p<0,01$), whereas temperature gives negative correlation with value ($r= 0,407$; $p<0,01$).

Keywords: *climate, Diptera, Phytotelmata*

Cite This Article: Emantis Rosa, "Relationship between Climate Factor and Diptera Larvae on Phytotelmata in Dengue Fever's Endemic Areas in West Sumatera, Indonesia." *American Journal of Zoological Research*, vol. 5, no. 1 (2017): 1-4. doi: 10.12691/ajzr-5-1-1.

1. Introduction

Climate is one of many factors that can influence insect population. Climate also changes from time to time. The changes of Climate and disturbance to habitats either directly or indirectly will affect insect populations that inhabit because the climate can affect the growth, reproduction and abundance of insects [3,12]. One of the elements of the climate in tropical countries is the main rainfall followed by other climatic factors such as temperature and humidity [7,11,13].

These factors may affect the development and growth of insects, among others, the failure of the eggs hatch into larvae, the larvae become pupae and pupae become and imago, because of temperature and precipitation associated with evaporation and temperature micro in breeding sites [4].

Diptera is insect order which is quite important in human life, besides having considerable number of members that most of its members act as vectors of diseases, such as DHF (Dengue Hemorrhagic Fever), chikungunya, malaria, filariasis and other diseases. Diptera breeding place divided in two kinds, natural and artificial. The example of natural diptera breeding place of the phytotelmata scattered in various environments, such as residential areas, forests, gardens, yards, etc.

Phytotelmata is one of natural breeding places which usually found on environment. Words Phytotelmata is defined by Derraik [6] as a puddle of water contained in the plant or section. According to Fish [8] there are 1500 plants belonging to the category phytotelmata and inhabited by many different types of insects.

West Sumatra is one of the tropical regions in Indonesia, which is endemic dengue, dengue cases always occur annually. The presence of dengue cases would not be separated from the presence of the vector and the breeding place in an area, one of the natural breeding places that are found are phytotelmata which will indirectly increase insect populations that inhabit it.

Research about the insects that inhabit phytotelmata related to climate factors have been reported by other researchers: Rosa et.al., [17]; Fluctuations Diptera larvae and its relation to climate factors; Influence of season on the stage of pre - adult *Aedes africanus* that inhabit tree holes [18]; comparison of Insects communities inhabiting *Heliamphora nutans* in the summer and the rainy season [4]; the effect of climatic factors on the distribution and density of mosquitoes in phytotelmata [1]. However, information about climate influence towards insect inhabiting phytotelmata is still limited. Therefore, this research arise to reveal the relationship between climate factors with the numbers of Diptera larvae inhabiting Phytotelmata in Dengue Endemic Areas around West Sumatera.

2. Materials and Method

This research was conducted at three locations in West Sumatera (Padang, Bukittingi, and Payakumbuh) from January to December 2012. The sampling technique follows Derraik [6] using pipette/straw. Volume of water

that has been inhale from plants was measured, and then inserted into a plastic bag/bottle. Larvae which lives in water's sample, separated from the rubbish or dirt that might be carried out at the time of retrieval. Larvae which are already died were put in the bottle containing 70% alcohol for further identification while surviving larvae reared to adulthood to ensure the identification. Larvae were identified which refers to the identification books [5,16]. All larvae that have been identified numbered. Sampling of larvae had been doing in every two weeks for one year at 2014. Climatic factors measured include humid, precipitation and temperature monitoring results obtained from the Meteorology and Geophysics Agency (BMKG) Minangkabau International Airport and Sicincin Climatological Station [2]. Analysis of data relationships between Diptera larvae number of individuals and some climate factors, statistically analyzed with linear regression models using the Ordinary Least Square computing program paleontological Statistics (Past) 2:10 version [9]. And to see the trend of the number of individuals larvae Diptera relationships with climate factors presented through diagrams Scatter Plot using computational program Excel.

3. Result

1. The effect of humidity towards the number of Diptera larvae that inhabit Phytotelmata

Correlation analysis between the numbers of Diptera larvae that inhabit phytotelmata with the humidity during the research period can be seen in Figure 1.

From Figure 1. It is seen that the number of individuals on the phytotelmata Diptera larvae with humidity were positively correlated ($r = 0.534$; $p < 0.01$). These results indicate that the increase in humidity followed by an increase in the number of individual larvae Diptera. This is due to the increased humidity conditions in the environmental suitability of the humidity needed by the larvae that inhabit phytotelmata. Based on registration data from (IAMCG, 2012) in Padang city humidity ranged from 80.4 to 86.5%, in Bukittinggi from 81.81 to 88.11% and in Payakumbuh 80.27 - 88.35%.

Range of humidity at the research locations are still accordance to humidity that needed by diptera larvae development, 81.5-89.5% [21] incompatibility of environmental conditions such as humidity will affect the increase in the number of individual larvae, because the humidity conditions are appropriate, then the faster the metabolism process and during growth and development is getting short, The shorter duration of the development, the more generation of larvae will be appear. When viewed pattern of regression equation of this relationship ($Y = 0{,}7457X - 49.271$) with a slope value of 0.7457 indicates any increase in the percentage of humidity will be followed by an increase in the number of individual larvae of 0.7457. The value of coefficient of determination ($R2) = 0, 2797$ which indicates that in there was the influence of humidity 27.97% against an increase in the number of individuals Diptera larvae, and there are other factors beyond the influence of humidity factor of 72.03% against an increase in the number of individuals on the Diptera larva phytotelmata.

2. The relationship of rainfall to the number of Diptera larvae that Inhabit Phytotelmata

The results of the analysis of the correlation between the number of individuals with rainfall Diptera larvae showed a positive correlation ($r = 0.418$; $p < 0.01$. (Figure 2) These results suggest that increased rainfall, followed by an increase in the number of individuals on phytotelmata Diptera larvae.

High or low rainfall will affect the volume of water contained in phytotelmata. Puddles of water being stored will be able to affect the lives of organisms that inhabit it. However, rainfall is not always able to increase the number of individuals of larvae that inhabit phytotelmata because at the time the rainfall is too high will result in an abundance of water that are within or part of plants phytotelmata, especially on Phytotelmata types sepals, because sepal structure is smaller and not strong to accommodate the puddle water which is bigger than it. So that, the water in sepals abundants by rain and number of larvae inhabit in sepals becomes lower.

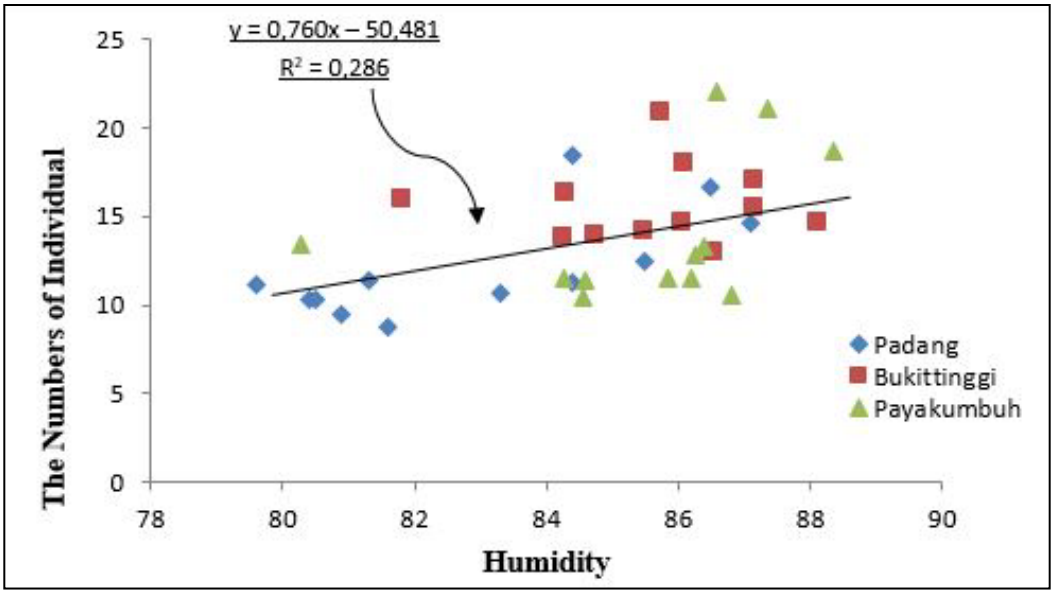

Figure 1. Scatter plot Diagram of Relationship between the number of Diptera Larvae individu and humidity at three locations

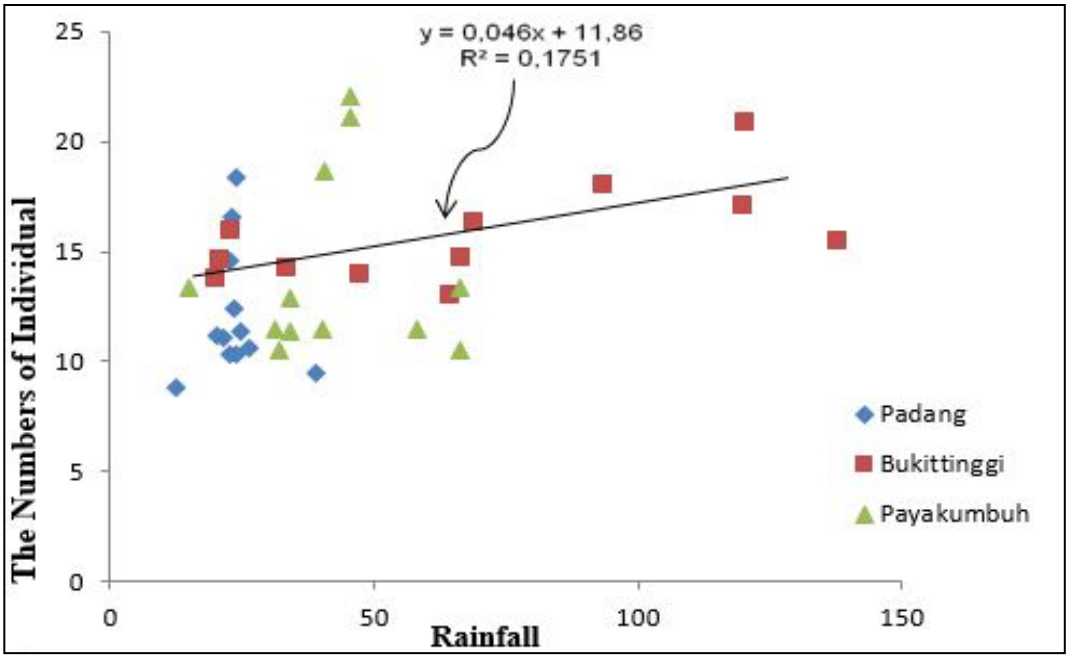

Figure 2. Scatter plot Diagram relationship between the number of Diptera larvae individual and rainfall at three locations

On the other hand, the high rainfall can also increase the availability of breeding sites, because many parts of the plant that can collect rain water. As a result, a lot of choices to Diptera larvae such as mosquitoes to lay eggs, and certainly will affect the number of larvae on phytotelmata predetermined.

Silva Toreias *et al.* [19] from Brazil has reported conflicting results where the abundance of *Culicidae* family that inhabits *Bromeliad Gusmania brasiliensis* leaves tank is higher in the dry season than during the rainy season. Similar results were also reported by Liria [15] that the number of families *Culicidae* who inhabit bromeliad *Aechmea fendleri* and *Hohenbergia stella* higher during the dry season in Venezuela. Rainfall also affects the ability of hatching eggs - eggs and decreased survival time in the adult stage *Epilachna* population *vigintiooctopunctata* [10].

If viewed from pattern of regression equation correlation with the number of individuals of rainfall (Y = 0,046X + 11.86; R2 = 0.1751). These data indicate that the influence rainfall on a very small number of individuals amounted to only 17.51%. Although a positive correlation between rainfalls with the number of individuals giving very little influence and the relationship is weak. This may imply that the size of the number of individual larvae are not only caused by rainfall but can also be caused by other factors such as the type and phytotelmata as larval breeding sites, as they relate to its ability to accommodate a puddle.

3. The Relationship between temperature and the number of individual diptera larvae that inhabit Phytotelmata

Relationship between the number of individual diptera larvae and temperature has negative correlations with value r = - 0,4070; p<0,01(Figure 3). These results indicate that an increase in temperature decreases the amount of individual larvae in phytotelmata.

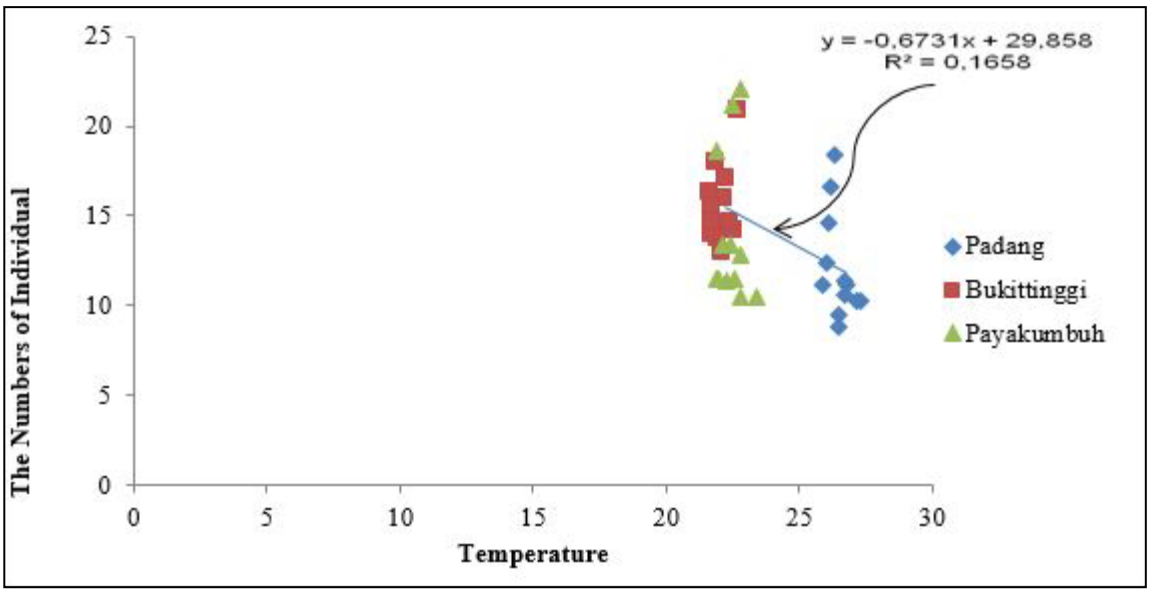

Figure 3. Scatter plot Diagram Relationship between the number of individual dipteral larvae and temperature's factor at three locations

Temperature is an important factor in the development of the life of insects, include to the order Diptera. Temperatures were flawed from BMKG data (2012) during this research for the city of Padang ranged from 25.0 to 28, 60°C, for the city of Bukittinggi ranging from 21.98 -22.89°C and for Payakumbuh ranging from 21.37 to 22, 83°C. While the averages of temperature optimum for the development of mosquito larvae is 30°C (Bieber *et al*., 2010). The range of temperature during the research is still within the limits required by the insect's development. Insects can still live a range of minimum and maximum temperature but its development will be maximized at the optimum temperature. The ambient temperature will have implications for the decrease in metabolic processes, so that the time required for the development of larvae will be longer, consequently the amount of generation that will grow fewer.

Because temperature is an important factor and affects the life of insects, among others on the activity and the breeding of insects and in general insects, especially living in tropical regions, are very sensitive to temperature and precipitation affect the density [13,20]. In tropical area, there is another climate factor that can influencing the dynamics of insect life beside rainfall factor itself [7].

From the pattern of the equation (Y = -0,6731X + 29.85; R2 = 0.1658) these data suggest that the effect of temperature on declines in the number of individual larvae of Diptera larvae amounted to only 16.58%. It means that in this research the increase in the number of individuals is not only influenced by climatic factors, there are still other factors that influence the number of individuals on phytotelmata Diptera larvae that have not been included in this research study.

4. Conclusion

From this study can be concluded that:

1. Climate factor covers humidity, rainfall, temperature and have correlation with the number of individual dipteral larvae inhabit Phytotelmata
2. Factors of humidity and rainfall have positive correlation with the number of individual diptera larvae with value (r = 0,534; p<0,01) and (r= 0,0418; p<0,01). Meanwhile, temperature factor have negative correlation with value (r= 0,407; p<0,01).

Acknowledgements

The Researcher would like to say thanks to everyone whom helped this research from the very start until the end.

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