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Fluctuation of Diptera Larvae in Phytotelmata and Relation with Climate Variation in West Suinatra Indonesia

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Abstract: Research of fluctuations in Diptera's larvae in Phytotelmata had been conducted at three locations in West Sumatra, Indonesia; Padang, Bukittinggi and Payakumbuh, which aimed to determine the number and fluctuations Diptera larvae in Phytotelmata. The results obtained; the highest number of individual larvae Diptera in Phytotelmata was 7109 *Aedes albopictus* larvae (49.56%), followed by larvae of *Culex tritaeniorhynchus* with 2409 individuals (16.80%). Larvae fluctuated every month and tent to increase in November and December. There was no difference in the number of Diptera larvae individuals inhabitm g pandan, taro, and pineapple, but there were significant differences between the three types of Phytotelmata (pandanus, taro and pineapple) with bamboo ($p<0.05$). Number of individual larvae in Phytotelmata negatively correlated with temperature and ram fall, but positively correlated with humidity ($r = 0.44$: $p<0.05$).

Key words: Phytotelmata, diptera, fluctuation, West Sumatra

INTRODUCTION

Phytotelmata, aquatic habitat in or on plants, include treeholes, pitcher plants, bamboo shoots, and bromeliad bracts (Paradise, 2004). Phytotelmata are inhabited by aquatic insects, mam ly Diptera and Coleoptera, and most phytotelmata contain at least one species of mosquito (Culicidae) whose immature stage are usually numerically dominant (Fish, 1983). The most recent summmary of phytotelmata in habitanss included over 20 families of insects (Greeney, 2001).

Insects includm g Diptera life is largely determm ed by factors both biotic and abiotic environments. An abiotic factor such as chm ate is one of the most important factors in the life of insects, because the chm ate can affect growth, reproduction and abundance of insects (Cammell and Knight, 1992). Besides, climate can also affect mortality directly or indirectly which will lead to changes in the number of insects (Kahono and Amir, 2003). Chm ate consists of several elements such as temperature, ram fall and humidity that each element has different effects on different regions. Temperature is the most dominant element in the countly with temperate climates, while rainfall is a major element of the climate in tropical countries, other elements of the chm ate in the tropics is the temperature, humidity (Ewusie, 1990; Kahono and Nardjito, 2001). Chm ate may change from tim e to time; climate change and disturbance of habitat will affect the insect population that is constantly fluctuatm g all the tim e.

Several studies related to insect fluctuation has been done by several researchers, among others: The fauna of tree holes in relation to envfronmental factors (Kitchm g, 1969); seasonal population dynamics of the immature stages of *Aedes africanus* (Theobald) (Diptera; Culicidae) in Zika Forest (Sempala,1983); species richness and altitudm al variation in theaquatic metazoan commumiy in bamboo Phytotelmata from North Sulawesi (Sota and Mogi,1996); distribution of larval mosquitoes among bamboo-stump pools which vary inpersistence and resource input (Sunahara and Mogi, 1997); searchm g cluster of community composition along multiple: a case study on aquatic invertebrate communities in bamboo stump in West Timor (Sunahara and Mogi, 2004); bromeliad-inhibiting mosquitoes in an urban botanical garden of dengue endemic Rio de Janeiro- are bromeliad productive habitats for the invasive vectors *Aedes aegypti* and *Aedes albopictus* (Mocellin *et al.*, 2009). But then, how fluctuations of Diptera larvae in Phytotelmata associated with the changes of envhonmental factors (temperature, rainfall and humidity) in settlements of West Sumatra, so far there has been no information. This study aimed to determm e the change in climate factor to fluctuations of Diptera larvae in Phytotelmata in residential areas of West Sumatra, Indone s ia.

MATERIALS AND METHODS

Study area: Study was begun in January until December 2012, at three locations in the city of West Sumatra;

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Fig. 1: Study area

Padang, whichlies in the (00° 53' 666' - 00° 53' 786" SL and 100° 21' 999' and 100° 2' 968" LE), elevation was in 18 m above the sea level (asl.). Bukittinggi is located on the site (00° 18' 899"- 00° 17' 898" SL and 100° 23' 61"-100° 22' 62" LE), elevation was in 939 m above sea level. Payakumbuh lies in the (00° 12' 935"-00° 12' 935" LS and 100° 37' 901"-100° 37' 899" LE), elevation was in 534 m above sea level. Rainfall, temperature and humidity data were obtained from the Meteorology and Geophysics Agency (MBKG) MinangKabau Airport, 2012 and Sicincin Climatology Station, West Sumatra, 2012 (Fig. 1).

Sampling and method: Determination of plant Phytotelmata for larval samplm g referred to Kitchm g (1971) criteria. Sampling techniques followed to Derraik (2005) method carried out by using a pipette/straw with a size adapted to Phytotelmata. Water that had been taken from the plant, sorted from trashes and dirt, then larvae was separated. Obtam ed larvae were identified and referred to (Delfma do, 1966; Pennak,1978; Gek *etal.,* 2008, 2010). Diptera larvae found were calculated, dead larvae put in a bottle containing alcohol 70% for identification, live larvae was being kept alive until adulthood to ensure the identification result. Identification was performed in Research Laboratoiy, Animal Taxonomy, Department of Biology, Mathematics and Science Faculty, University of Andalas. Diptera larvae sampling was done once every two weeks, for one year.

Data analysis: Analysis of the data included the number of individual larvae, larvae fluctuations, differences in the number of individual larvae of Diptera in several Phytotelmata analyzed by one-way ANOVA and advanced Tukey's test usm g the program SPSS Statistics version 16. Relationship between the number of individual larvae with some chm atic factors (rainfall, temperature, and humidity) was analyzed with Spearman's correlation using the program SPSS 16 version.

RESULTS

Number of Diptera larvae on the four types of Phytotelmata is presented in Table 1.

The number of Diptera larvae in pandan ranged from 3-1607, with the total individual was 3488. In taro, larvae ranged from 44-1445, with total 3313. In bamboo, larvae ranges from 14-1697 (2366) and pineapple ranges from 5-2360 individuals (5176). Meanwhile, when we saw from the number of types of each larva, the highest number of individuals found in the larvae of *Aedes albopictus,* 7109 individuals (49.56%), followed by *Culex tritaeniorhynchus* larvae with 2409 individuals (16.80%), larvae of *Chironomus* sp. (15.01%). Individual differences in the number of Diptera larvae in all four types of Phyotelmata can be seen in Table 2.

The number of of Diptera larvae for four types of Phytotelmata is presented in Table 2. The average number of individuals of Diptera larvae in pandan was (442.58±112.04), in taro (477.50±131.82), in bamboo (477 .94±36.67), and pineapple (319. 92±147, 99). Statistical analysis of the results showed that the number of individual larvae Diptera in pandan no different than taro,but unlike in bamboo, while the number of individual larvae of Diptera in contrast to the panda, pineapple, taro and bamboo ($p<0.05$).

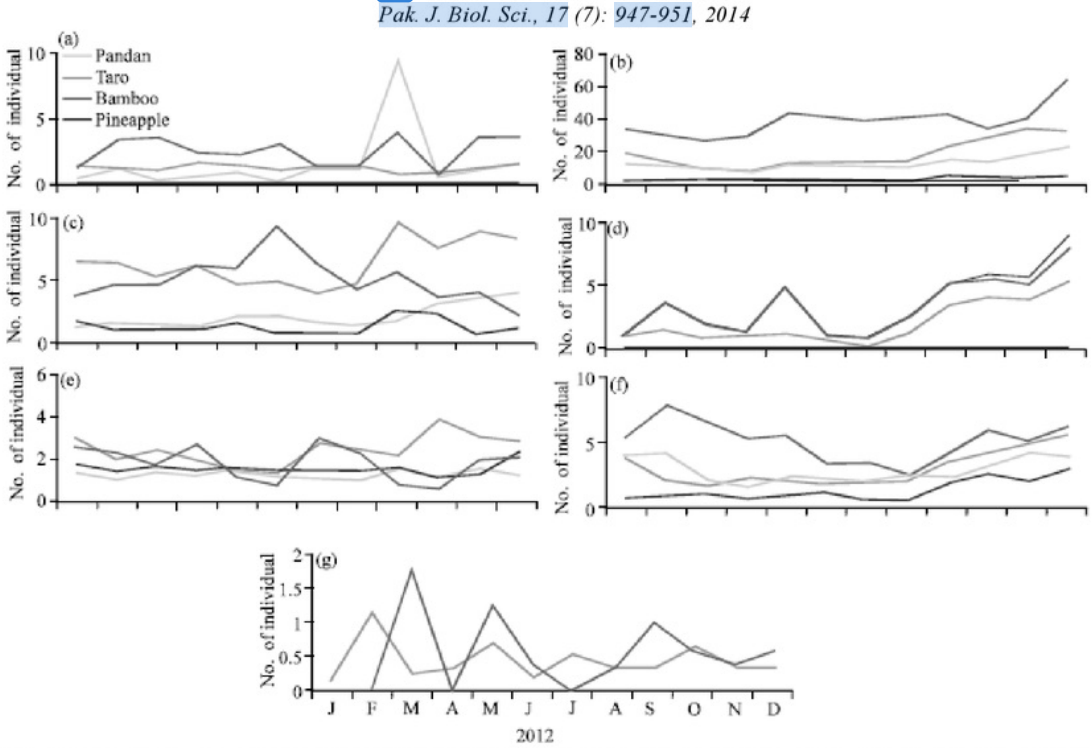

Fig. 2(a-g): Fluctuations for seven types of diptera larvae in phyototelmata every month, (a) *Ae. aegypti*, (b) *Ae. Albopictus, (c) Culex,* (d) *Armigers,* (e) *Tiptda* sp. (f) *Chironomus* sp. and (g) *Psychoda* sp.

Table 1: No.of individual diptera larvae in phytotelmata

Species	No. of individual diptera larva Pandan	Taro	Batnboo	Pineapple	Total	(%)
Chironomidae						
Chironoinus sp.	673	380	212	888	2153	15,01
Culicidae						
Ae. aegypti	142	222	102	0	466	3,25
Ae albopicivs	1607	1445	1697	23 60	7109	49,56
Ar. subalbatus	3	222	51	107	383	2,67
Cx. tritaentorhynchus	636	735	208	830	2409	16,8
Tipulidae						
TipLda sp.	427	262	82	986	1757	12,25
Psychodidae						
Psychoda sp.	0	47	14	5	66	0,46
Total	3488	3313	23 66	5176	14343	

Table 2: Total range in the No. of Diptera larvae in Phytotelmata

Kind ofphytotelmata	Range	Mean±SD
Pandan	287-642	442.58±112.04a
Taro	223-587	477.50±131.82a
Batnboo	164-285	477.94±36.67'
Pineapple	271-721	319. 92±147.99"

Description: Subscribe with different signs indicated a significant difference ($p<0.05$) and the same sign indicated no difference between of them

Fluctuations of Diptera larvae on each month phytotelmata was seen in Fig. 2. The highest number of of *Aedes aegypti* larvae in September was found in pandan and bamboo. In October the lowest numbers of individuals were found at pandan, taro and bamboo. *Ae. albopictus* larvae was highest in December on all types Phytotelmata and the lowest was in March and April. Larvae of *Culex tritaeniorhynchus* were highest in September in pandan and the lowest in August. *Annigeres subalbatus* was highest in December at all kinds of Phytotelmata and lowest was in the month of July. Larvae of *Tiptda* sp. were highest in January and December, and the lowest was in June. Number of larvae *Chironomus* sp. almost evenly throughout the year, but showed an increase and the highest in December, the lowest in August. *Psychoda* sp. larvae were highest in March and lowest in January.

Relationships of number of individual Diptera larvae with climate factors included rainfall, temperature, and humidity the study period can be seen in Table 3. Table 3

Table 3: Correlation between the numbers of individual larvae with climatic factors

No. of individual	Rainfalls	Temperature	Humidity
-	-0,051 (0,770) -	- 0,198 (0,24) -	0,440 (0,007)**
		0,571 (0,00)** -	0,401 (0,015)*
			0,465 (0,004)** -

Description: subscribe with different signs indicated a significant difference ($p<0.05$) and ($p<0.01$)

showed that the number of individuals of Diptera larvae was negatively correlated with rainfall and temperature, but positively correlated with the moisture with a correlation of 0.440 ($p<0.05$ <0.01).

DISCUSSION

Table 1 showed the number of individuals of Diptera larvae in Phytotelmata were dominated by *Aedes albopictus*, followed by *Culex tritaeniorhynchus* larvae. This might be due to incompatibility of breedm g places for the life of this type of larva, *Aedes albopictus* and *Culex* breedm g places were more like the outside of the house,cludm g the pool of water in plants (Delfm ado, 1966). Similar results were also reported by Yanoviak *et al.* (2006), the genus of *Culex* and *Aedes* were found together inhabited Phytotelmata bromeliads. Adebote *et al.* (2008) reported the dominance of the genus *Aedes* and *Culex* were in Phytotelmata tree hole. When we referred from the fluctuations of Diptera larvae in Phytotelmata every month for a year, there was a tendency that the number of Diptera larvae was found to increase in November and December, except for *Psychoda* sp. When we associated with ram fall in November and December, both months was quite high in November (241.3 mm) and in December (281.4 mm). Rainfall above 150 mm in one month and was followed two months later, it said to be the rainy season, but if it was below 150 mm in a month, it was said to be the dry season.

High ram fall will result in increased volumes of standing water being stored in phytotelmata. Sufficient amount of water volume in the breeding places will support breeding Diptera larvae that inhabit in Phytotelmata, we could see from the fluctuations on Diptera larvae in Phytotelmata increased in November and December. Similar results were reported by Paradise (2004) the density of *Culex guttipenis* larvae were higher in the tree hole with a higher volume of water, in contrast with the low water volume. Jabiol *et al.* (2009) revealed the number of individual insects in bromeliads Phytotelmata increased with the volume of water. The average of ram fall during the two months of November and December above 150 mm, including the rainy season, the condition was accompanied by an increasing trend in the individual number of Diptera larvae in Phytotelmata. The same facts also happened on the observation of insect communities in pitcher plants, which was increased in the wet season (ram y) and decreased in the dry season (Barrera *et al.*, 1989). *Toxorhynchites* population was much reduced during the dry season in Kenya (Lounibos, 1979). Other types of larvae vary in numbers, such as *Psychoda* sp., they increased in March and May.

Rainfall and temperature were negatively correlated with the number of Diptera larvae (Table 3). This result was supported by several researchers, among others, in West Java; Siva Torreias *et al.* (2010) in Brazil. Humidity factor was positively correlated with the number of individual larvae, it was presumably because of the humidity was still withm the range required by the larvae (50.5 to 89.92%) that had an impact on increasing the number of larvae. At the appropriate humidity conditions, the metabolic process was faster and the growth and development were shorter. In the tropical areas, ram fall was the primary factors, whereas the temperature and humidity factors also affected the dynamics of insect life (Ewus ie, 1990).

CONCLUSION

Composition of Diptera larvae that inhabited the four types of phytotelmata consist of four families, namely family *Chironomidae, Culicidae, Tipulidae* and fam ilie s *Psychodidae* and sev en spec ies of larvae; *Chironomus* sp., *Aedes aegypti, Aedes albopictus, Culex tritaeniorhynchus, Armigeres SUbalbatus, Tipula* sp and *Psychoda* sp. Number of individual larvae in phytotelmata were highest in Diptera larvae, found in *Aedes Albopictus*, followed by larvae of *Culex Tritaeniorhynchus*. Diptera larvae fluctuation tent to increase in November and December. There was no difference in the number of Diptera larvae inhabitm g pandanus and taro, and pm eapple, but there were significant differences between the three plants (pandan, taro and pm eapple) with bamboo ($p<0.05$). Number of individual larvae in Phytotelmata were negatively correlated with temperature and rainfall, but positively correlated with humidity of ($r = 0.4$: $p<0.05$).

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