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Diversity of Butterflies in Different Habitus Plant at Universitas Siliwangi Tasikmalaya

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ABSTRACT

This research is about the diversity of butterflies on campus I, Universitas Siliwangi Tasikmalaya, which was conducted from September to December 2021. This study aims to determine the number and species of the families found, using the VisualEncounter Survey (VES) method, and there were 33 types of butterflies or 370 individuals per total butterfly found on campus I, Siliwangi University. The location of this research has four habitus, namely bush, shrub, trees and mixed habitus. The diversity of the four habitus shows that two habitus have a moderate diversity index in the bush and tree habitus, one mixed habitus has the highest diversity and one habitus shows the lowest diversity index value in shrub habitus. The abundant butterfly family was found in Nymphalidae as many as 44% or 171 species for the total number of species in the four habitus. While the largest population is in Letopsianina as many as 43 individuals from the Pierridae family and there were 8 types of butterflies that had similarities and were easily found in each habitus.

Keywords: Diversity, Butterfly, Biology Learning Resources

INTRODUCTION

The reality of the diversity of insect classes has a dominant population compared to other classes(Taradipha.,et al, 2019)because of the speed of insects in responding to environmental changes and the speed of reproductive mechanisms. The group of insects that are easily found at various heights are butterflies(Mogan et,al 2018) although their reproductive ability is high, this does not guarantee the survival of these animals in various types of habitats. Based on data from LIPI, there has been a decline in the population of butterfly diversity due to reduced open area in Indonesia (LIPI, 2007).

Based on preliminary studies on 11 December 2020 and 7 July 2021, it is often seen that several species of butterflies fly in the campus area of Siliwangi University, such as the species of the priest butterfly (*Papilo memnon*). In addition, the ecosystem at Siliwangi University has a suitable habitus for Lepidoptera life such as the presence of ponds, gardens,

and plant vegetation or open fields with quite diverse hostplants, and this will certainly support the existence of species from the Lepidoptera order. Vegetation is also defined as a place for activity and has a function as a source of food, and a place for breeding(Fauzia, et,al 2020).

Another problem found in the location on the Siliwangi University campus is that every year the green open land has decreased due to the conversion of land functions into lecture buildings and road facilities. So that gradually it can result in the loss of the potential for pollinating animals without knowing the exact data beforehand. According to (Imran, 2019)the presence of butterflies has an important role in maintaining the balance of the ecosystem, pollinating animals are part of the biodiversity that must be preserved (Aryf et,al 2018)

The nature of butterflies that are sensitive to changes in the environment, butterflies are vulnerable to existence, this is due to the large number of forest conversions (Suharno Zen, 2015). Therefore, there is a need for sustainable conservation efforts. This research is important to know that butterflies are also used as role models as environmental bioindicators(Arisandi & Syamsi, 2018). So that the diversity index can assess how the environmental conditions at Siliwangi University are because, the butterfly host plant is specific apart from the families *Nymphalidae* and *Pieriidae.*

RESEARCH METHODS

This study uses a quantitative approach assisted by survey techniques. The method used for data collection is a Visual Encounter Survey (VES) where the search for butterflies can be conducted actively to see and count the number and type of each species. In line with (Syaputra, 2015) this method, the modification of the line transect so that the transect has no limits, but the observations refer to a time-limited search.

Then the sample that was captured and collected was only one species in order to minimize the chance of decreasing the excess butterfly population (Lestari, 2015). Butterflies are caught using insect netsthen the sample is preserved for identification purposes in the labolatory(Rahayu & Basukriadi, 2012). The identification of butterflies based on identification books by Ruslan, Rohman and Peggie (2011,2014). Other reference journal and web for example GBIf, the last iNaturalist application used comparison picture.The use of the iNaturalist application is very helpful in identification, because it can communicate directly with various researchers, academics and citizen science directly to identify together. (The use of iNaturalist on learning courses of zoology vertebrates for prospective biology teachers D Hernawati1 , D M Chaidir1 and V Meylani1)

Study Area

Siliwangi University is located in Tasikmalaya city, Kahuripan Tawang Districts Tasikmalaya City, West Java whis has an area ±6.9 ha. The site position is at strategic coordinates108° 08′ 38″ – 108° 24′ 02″ E dan 7° 10′ – 7° 26′ 32″ LS.

Environmental Measurement Method

Several tools are used such as lux meters to measure light intensity in the field, hygrometers to measure temperatre, weather and high humidity. Measurement of climatic data is done repeatedly to find out whether there is a relationship between environmental conditions with abundance of butterfly.

Data Analysis

The index was calculate using excel, the species divesity indes (H) was determined by using the Shannon-Weiner, the calculation of species evennes used the Shannon Evennes and the dominance using Simpson with the formula as follows :

a. Index Diversity Shannon-Weiner (H')Magurran (1998)

   $H' = -\Sigma Pi \ln Pi$

   Pi = Propotion of each species

   In = Natural logarithm (natural number)

b. Index Uniformity Evennes (E) Magurran(1998)

   $E = H/ \ln (S)$

   S = Number of Spescies

c. Index Dominance (C)Magurran (1998)

   $C= \Sigma pi^2$

   Pi = ni/N

   ni : total of type species i

   N : total all of species

Sampling Procedure

Data collection was carried out from September 2021 to December 2021, searching and catching butterflies began at 08.00 to 11.30 WIB and 12.30 to 15.00 WIB by looking at butterfly active time (Erniwati, 2009). Observation of this butterfly is done by looking at the characteristics of the vegetation which is divided into bush, shrub, tree and mixed habitus. The following is a butterfly research location on campus I, Siliwangi University, Tasikmalaya.

Figure 1 Research Location
Source : Google Earth

RESULTS AND DISCUSSION

Siliwangi University is in the lowlands because its altitude is <350 masl which is included in the category of areas that are easy to find butterflies with stable abiotic conditions. Some charming and easy-to-find butterflies are often found in the *Papilionoidea* family, along with samples of specimens found in the field (Figure 2) and (Figure 3).

Figure 2 Captured *Papiliopolytes* Butterfly

The capture method is taken by following the flying butterfly and taking a picture of it. Then if possible, butterflies are sampled for identification and documentation at the Zoological laboratory of Siliwangi University. The photo was taken using a Canon EOS 700D camera with lens 18-35mm, the camera's built-in flash assistance is also a mini studio. Examples of

settings used in figure 2 are ISO -160, f/5.6 , Exposure Time 1/80 sec and lens focal length 55mm Source: Observation Results

When observed, there are differences in butterflies (a, b) for the male and (c) female species, where the female has a red motif on the edge of the hind wing. The identification characteristics of *Papiliopolytes* refer to the characteristic presence of a tail on the back of the wings that both of them have(Ruslan & Prakosa, 2020). However, there is no visible tail in (Figure 2) due to the active reaction of the butterfly at the anesthetic stage.

Figure 3 Captured *Graphiumagamemnon* Butterfly Samples

The capture method is taken by following the flying butterfly and taking a picture of it. Then if possible, butterflies are sampled for identification and documentation at the Zoological laboratory of Siliwangi University. The photo was taken using a Canon EOS 700D camera with lens 18-35mm, the camera's built-in flash assistance is also a mini studio. Examples of settings used in figure 3 are ISO -250, f/2.6 , Exposure Time 1/125 sec and lens focal length 100mm (Source: Observation Results)

The identification characteristic of this butterfly is seen from the swallowtail, where the hind wings are elongated like a kite, has a striking color with a polka dot motif, on the back of the wings like dry brown leaves. The *Graphiumagamemnon* species is seen using *Polyalthialongifolia*Sonn, one of which is often used as a shade plant as well as a *Polyalthialongifolia* (glodokan) host plant that is easy to live and is found in various types of habitus(Fitriana, et,al, 2016).

Results of Observation of Climatic Data in the Field

The existence Butterfly responding to environmental changes, following are the result of measurement of climatic data.

Table 1 Average Value of Climatic Data in the Field

No	Climatic Data	Sampling			
		Habitus I (HS)	**Habitus II (HPD)**	**Habitus III (HPH)**	**Habitus IV (HC)**
1.	Light intensity (lx)	800	500	700	800
2.	Humidity ($g/m^{3)}$	70	79	72	70
3.	Temperature (^{0}C)	30	27	30	32
4.	Weather	Sunny	Cloudy	Sunny Cloudy	Sunny

Source: Observation Results

Information: HS : Bush habit, HPD : Shrub habit; HPH : Trees and HC Mixed Habitus

This climatic data was measured with two repetitions for each habitus, each showing different weather conditions in the field that affected the data on the frequency of the appearance of butterflies. There are some plants that are only found in certain habitus, for example the presence of banana trees (*Musa* sp.) in habitus 4 (mixed) was found by *Erionatrax*. So that it can be known that the habitat is not only a place to live and shelter, but must have sufficient food sources (Yudisthira in Rahayuningsih et al., 2012)

Composition of Butterflies Found in the Field

The composition of the most butterflies is found in the *Nymphalidae* family, this is related because *Nymphalidae*can adapt to various types of habitus. In line with Ellya (2014) the abundance of distribution of *Nymphalidae* which is easily spread in various areas is supported because it is polyphagous so that it is still possible to survive even though the main host plant is not available in its habitus(Lestari, 2015). Several types of plants that are usually used by *Nymphalidae*are also found in various habitus, the presence of food sources such as Annonaceae, Asteraceae, Verbenaceae, Moraceae, Rubiaceae danAnacardiaceae(Lamatoa,et,al 2013).

In the following, more details about the composition of each butterfly family found in each habitus can be seen in (Figure 4).

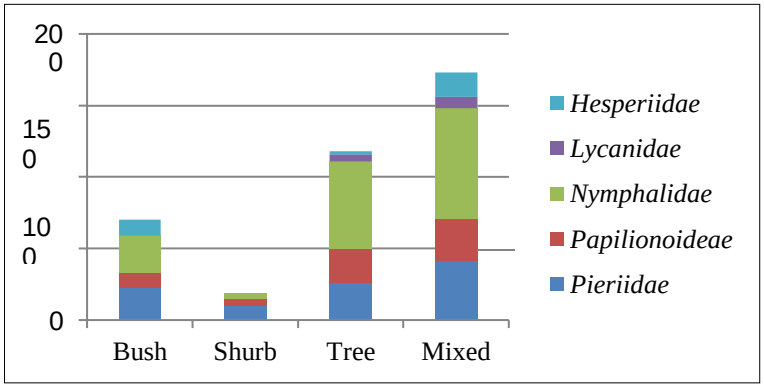

Figure 4 Composition of the Number of Butterflies in each Habitus

Source: Observation Results

The most families were found in *Nyhmphalidae* as much as 44% with fourteen types of butterflies with a total of 171 species in total. Then the second largest family were six types of butterflies of the *Papilionidae*family, which is 19% with a total of sixty-seven species. Each had 5 species, but the number of families *Pieriidae* is more than the others, namely 16% with a total of 100 individuals found. Followed by 15% of the Hesperiidae family with a total of thirty individuals, and only 6% of the *Lychanidae* family were found with two butterfly species for a total of thirteen species. Meanwhile, some of the distribution of butterflies that are only found in certain habitus can be seen more clearly through (Figure 5).

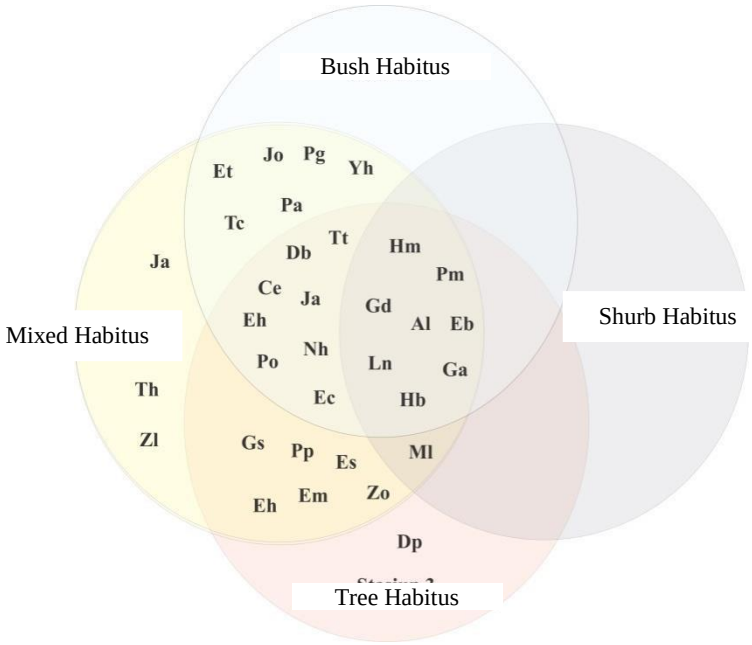

Figure 5 Venn Diagram of Butterfly Distribution per Habitus

Source: Observation Results

Based on the picture above, it is shown that there are 3 species that are only found in habitus 4, namely *Troideshelena, Jononiaalmana,* and *Zizinalabradus*. In addition, we only found *Deliaspasithoe* in habitus 3 with a small number and the same host, while for bush and shrubs, there were absolutely no species that were usually only found in bush and shrubs.

Among the four habitus, it is clear that the shrub habitus has the least number of species with 8 kinds of butterfly species found in each habitus, namely *Appiassp, Euremablanda, Letopsianina, Papilomemnon, Graphiumagamemnon, Graphiumdoson, Hypolimnas Bolina, HypolimnasMisippus*. There are many species similarities between habitus 1, 3 and 4, as many as 8 species including *Euremahecabe, Doleschalliabisaltide, Neptishylas, Euploeacaramalzeman, Jononiaatlites, Cuphaerymanthis, Tanaeciatrigerta, Pothantusomaha.* The number of species found in 1 and 4 were 7 kinds of butterfly species including *Junoniaorithya, Ypthimahorsfieldi, Eritoniathrax, Pothantusomaha, Parnara ganga, Pelopidas agna, Telicota colon.*

Whereas in the Ly hanidae family only *Zizinaotis* is also found only in the Tree and Mixed habitus, the cause of the species from this family being found only a few because of the small body size factor and perching on small leaves that are rarely observed making it difficult to observe(Hengkengbala,et,al 2020).

Ecological Index Calculation Results in the Field

The results were obtained to assess the observed environmental conditions using climatic data, this is because ideally the abundance of butterflies is closely related to environmental factors in nature.

Table 2. Calculation Value of Ecological Index

Habitus	Diversity (H')	Evenness (E)	Dominance (C)
Habitus I (Bush)	2.95	0.84	0.05
Habitus 2 (Shurb)	1.29	0.37	0.20
Habitus 3 (Tree)	2.84	0.80	0.05
Habitus 4 (Mixed)	3.11	0.89	0.05

Source: Observation Results

The Diversity Value (H') is said to be high if it is more than 3. The high or low diversity value is influenced by species factors found in different genera or species. The diversity index value obtained falls into three categories, habitus 2 (shrubs) has an index value of 1.29 in the low category. This is because the habitus of shrubs is not found in many types of flowering plants, besides the limited garden area in the Siliwangi University environment has

also turned into lecture buildings. Limited land, such as the absence of special green garden or community facilities, causes a limited variety of shrubs.

There are 3 habitus that have a uniformity index with a value above 0.75, namely in habitus 1 (bush), habitus 3 (trees) and habitus 4 (mixed), which means that the environmental conditions in the three habitus show the distribution of individuals in the ecosystem evenly or relatively the same while habitus 2 (shrub) is in the depressed category. Then the lowest dominance index is in habitus 4 which is 0.05, and the largest is in habitus 2 which is 0.15. This indicates that the four habitus are not found with butterflies that live to dominate.

Factors Affecting Butterfly Abundance

Many components can support butterfly abundance, in addition to the variety of host plants. The relationship between the existence of butterflies is influenced by environmental conditions. So that butterflies can be used as environmental bioindicators. Damage to the environment is characterized by the lack of interaction between biotic and abiotic components. There are several abiotic components that can affect butterfly diversity including temperature, humidity, light intensity, weather, and nectar on host plants (Lamatoa et al., 2013).

1. Light Intensity

   In some butterfly families, especially *Papilionoidea*, they have a high light requirement for drying their wings. In addition, light exposure is needed for butterflies to obtain energy and speed up their metabolism. However, the facts in the research field show that during the rainy season, the mobility frequency of *Papilionoidea* butterflies which tend to like light also increases. Even some families Hesperiidae (skipper famili) which are generally active in the morning and evening also show their activity towards noon.

   This happens due to extreme weather changes in the rainy season, so the butterfly needs to take advantage of the available light intensity opportunities without being affected by their biological clock. As found *Zizinaotis* sunbathing on cloudy weather. When the internal heat temperature increases and exceeds its needs, the response of the butterfly will be to seek shade for protection. Butterfly wings play a role in controlling body heat. When the light intensity is minimal, the frequency of sunbathing will be increased to collect internal heat. This is in accordance with the findings in the field on *Junoniaatlites* and *N. hylas* species which are commonly found when the weather is cloudy.

2. Humidity

   Generally, butterflies can grow well in high humidity, namely in the humidity range of 64 to d. 94% (Ilhamdi, et,al 2018). The data in table 1 shows that the four habitus have optimum humidity values that are suitable for the development of Lepidoptera larvae and imago.

There are three possibilities that occur if the humidity is high, first fungi and pathogens can appear and multiply, and then attack butterfly larvae. Second, some butterfly larvae fail to reproduce because of the difficulty of surviving, especially if it rains continuously. Third, if the humidity is within the normal range, the imago phase of a butterfly that is tolerant of high humidity can make certain butterflies the dominant species(Ilhamdi, et,al 2018).

3. Temperature

Butterflies are animals whose body temperature is influenced by the environment, so the presence of the intensity of sunlight will help them obtain energy. According to Ilhamdi (2019) generally butterflies can maintain their body temperature at a temperature of 30^{o} – 35^{o}C. Two butterfly sunbathing positions with closed wings or lateral sunbathing conditions were found, for example in *E. hypermnestra* and *Appiaslibythea*. Furthermore, this butterfly then tilts its wings until it is perpendicular to the sunlight. According to Rohman, et,al (2019) this position can receive sunlight optimally and efficiently. Meanwhile, the position of sunbathing with open wings was found in *Neptishylas, Tanaeciatrigerta, Junoniaatlites* so that the light exposure received was effective in warming and raising their body temperature.

4. Weather

Apart from the three abiotic factors that can affect the existence of butterflies, this can actually be seen and concluded in the weather indicators. If it is cloudy, it is certain that the light intensity will not be maximum, this is also directly proportional to the low daily temperature and high humidity.

CONCLUSION

The diversity of butterflies in each habitus shows variations in different categories. The limited land and the number of butterfly host plants causes the shrub habitus condition to have the lowest index value of 1.29, while the highest index value of 3.11 is found in mixed habitus with a total number of species as many as 173. The existence of life from the *Troideshelena* species which is only found in mixed habitus is also supported by the interaction of several abiotic and biotic components. The distribution of Lepidoptera can decrease if the variety of hostplant and foodplant for this butterfly decreases, this is in line with the decrease in green areas every year.

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