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Role of Plant Diversity to Existence of Butterfly in Botanical Garden UPI Bandung Indonesia

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Abstract

Indonesia is a country with a rich diversity of flora and fauna. UPI Botanical Garden is one area that is used as a natural laboratory for students majoring in Biology Education FPMIPA UPI. UPI Botanical Garden are also composed of many plants that can support the life of various of Lepidoptera. This study aims to determine the diurnal butterfly diversity and its relationship with the presence of the host plant. The data of this study are also expected to support and provide information necessary for the formulation of a management plan recommendations butterfly conservation not only in the Botanical Garden UPI but also in other places. Diversity adult butterfly larvae sampled using standard Cruising methods. The results showed that there were 40 species of butterflies and 13 species of adult butterfly larvae with *Delias belisama* with the greatest abundance value (0.158 ± 0.063). While the lowest butterfly species adult's abundance were *Melanitis leda* (0.001 ± 0.003), *Elymnias hypermnestra* (0.003 ± 0.006), *Euthalia Monina* (0.003 ± 0.006), *Athyma nefte* (0.003 ± 0.006) and *Amathusia phidippus* (0.002 ± 0.003). In the research, also found endemic butterflies *Cyrestis lutea* which is only exist in Java and Bali Island, Indonesia. As for the number of host plant species of butterflies found in the Botanic Gardens UPI are 34 species. So the vegetation composition Botanical UPI supports the existence and diversity of butterflies.

Keywords: Botanical Garden UPI, Diversity and Abundance, Butterflies, Host Plants

1. Introduction

Butterfly is one of important role in plant pollination which is to maintain the ecosystem including composition of plant vegetation host. Lepidopteran's diversity not only determined by area geographic, migration but also by plant structure, distribution, abundance and composition^[6, 4]. Most of butterfly are nectar eater, only a small number is dirt eater such as *Junonia iphita*^[16]. In butterfly a reproduction phase is a key element in their life.

Host plant play one of critical point which are as shelter and larval host plants^[2]. Furthermore the Interaction of insect herbivores plants is related to plant diversity. Larval host plant is the main in Lepidoptera^[19]. There are some factors that influence the selection of host plants such as external stimuli, environment and internal responses as well as a series of environmental barriers^[11]. In general it can be assumed that the process of selection of host plants on insect is affected by volatile chemical signals the plant, after which the visual stimulus and then by non-volatile chemical signals^[7].

Diversity Lepidoptera was influenced by environmental conditions. Environmental factors that affect the altitude, temperature, humidity, intensity of light, weather and seasons^[14]. Thus the Lepidoptera are used as bio-indicators that one can be used to measure the effect of climate change on biodiversity^[13]. The impact of human activities and forest conversion on a large scale is the cause of significant mass extinction in the geologic time scale as the dissemination of the distribution of organisms^[17]. Among all insects, butterflies occupy a vital position in the ecosystem as well as the existence and diversity is an indicator of the terrestrial environment is still awake^[1]. Lepidoptera existence threatened due to color, pattern and shape of the wing is varied, so that the Lepidoptera are used as the object of research, collection and trade of commodities^[17]. UPI Botanical Garden is one area that is used as a natural laboratory for students majoring in Biology Education FPMIPA UPI.

UPI Botanical Gardens are also covered by many plants that can support the diversity of Lepidoptera. Total area of UPI botanical gardens is ± 20.000 m² square with many amenities such as a greenhouse, laboratory and animal house. With the composition of herbaceous and shrub vegetation in the Botanic Gardens can be a place to live UPI Lepidoptera and support life cycle.

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Material and Method

This study was conducted in February - July 2012 at the Botanic Gardens UPI.

The method which was using a cruising method due to its high mobility. Climatic factor such as light intensity, moisture, temperature also recorded. Observations were made from 08.00-12.00 am ^[3,12].

Data analysis

Samples of adult butterflies were identified with the available literature ^[9], ^[10]. Data were analysed by abundances, diversity, and evenness indices.

Result and Discussion

Lepidopteran Diversity and abundance in Botanical Garden

UPI botanical garden that composed of 150 species of plant which has implication of microclimate. Those consequences can be factors to support live of creature especially butterfly.

Thus the existence botanical garden as a learning media but also it can be used as conservation area ^[3,17]. stated that in the wild life the existence of butterfly was threaten since damaging of its habitat. Thus, botanical garden can support in lepidoptera biodiversity.

The characteristic of ecosystem in UPI botanical garden was planted with flower and tree, on the other hand some part is open field, those can be place to accomplish their life cycle. Environment characteristics is supporting the existence of butterfly, with light intensity 66912.66 lux and air temperature 21.66 %.

The result showed that in Botanical garden UPI were founded 40 species composed of 9 Familia i.e.:7 species Papilionidae, 6 species Pieridae, 2 species Danaidae, 5 species Satyridae, 13 species Nymphalidae, 1 species Amathusiidae, 3 species Lycaenidae, 2 species Hesperidae and 1 species Arctiidae (Table 1).

Table 1: Lepidopteran abundance indices in Botanical Garden UPI

No.	Familia	Species	Pi					Average ± SD
			1	2	3	4	5	
1.	Papilionidae	<i>Papilio memnon</i>	0.02	0.01	0.03	0.02	0.03	0.02 ± 0.006
2.		<i>Papilio demoleus</i>	0.01	0.01	0.01	0.01	0.01	0.01 ± 0.003
3.		<i>Papilio demolion</i>	0.01	0.03	0.01	0.01	0.02	0.01 ± 0.009
4.		<i>Papilio helenus</i>	-	0.01	-	0.01	0.01	0.006 ± 0.006
5.		<i>Graphium Agamemnon</i>	0.02	0.03	0.03	0.02	0.03	0.02 ± 0.01
6.		<i>Graphium doson</i>	0.02	0.04	0.01	0.02	0.02	0.02 ± 0.01
7.		<i>Graphium sarpedon</i>	0.02	-	0.03	0.01	0.01	0.01 ± 0.01
8.	Pieridae	<i>Delias belisama</i>	0.19	0.16	0.25	0.10	0.10	0.157 ± 0.06
9.		<i>Delias periboaea</i>	0.06	0.08	0.05	0.02	0.06	0.05 ± 0.02
10.		<i>Appias libythea</i>	0.06	0.06	0.05	0.05	0.04	0.05 ± 0.01
11.		<i>Letopsia nina</i>	0.12	0.11	0.13	0.24	0.15	0.147 ± 0.05
12.		<i>Eurema hecabe</i>	0.07	0.07	0.08	0.13	0.08	0.08 ± 0.02
13.		<i>Eurema sari</i>	0.03	0.03	0.03	0.02	0.02	0.03 ± 0.005
14.	Danaidae	<i>Euploea gloriosa</i>	0.04	0.02	0.03	0.02	0.04	0.03 ± 0.01
15.		<i>Euploea phaenareta</i>	0.06	0.01	0.02	0.02	0.09	0.04 ± 0.03
16.	Satyridae	<i>Mycalasis janardana</i>	0.01	0.01	0.01	0.02	0.01	0.01 ± 0.004
17.		<i>Melanitis leda</i>	0.01	-	-	-	-	0.001 ± 0.002
18.		<i>Yptima Philomela</i>	0.02	0.01	0.01	0.02	0.02	0.02 ± 0.005
19.		<i>Yptima baldus</i>	0.03	0.02	0.01	0.02	0.02	0.02 ± 0.01
20.		<i>Elymnias hypermnestra</i>	-	-	0.01	-	-	0.003 ± 0.006
21.	Nymphalidae	<i>Cupha erymanthis</i>	0.01	0.01	-	0.01	0.02	0.01 ± 0.01
22.		<i>Phalanta alcippe</i>	0.01	0.01	-	0.02	-	0.01 ± 0.01
23.		<i>Doleschallia bisaltide</i>	-	0.01	-	0.01	-	0.004 ± 0.006
24.		<i>Neptis hylas</i>	0.03	0.08	0.07	0.05	0.08	0.06 ± 0.02
25.		<i>Euthalia monina</i>	-	0.01	-	-	-	0.002 ± 0.006
26.		<i>Athyma nefte</i>	-	0.01	-	-	-	0.003 ± 0.006
27.		<i>Junonia iphita</i>	0.04	0.04	0.03	0.02	0.02	0.026 ± 0.01
28.		<i>Junonia orithya</i>	0.02	0.01	0.01	0.02	0.01	0.012 ± 0.006
29.		<i>Hypolimnas bolina</i>	-	-	0.01	0.01	-	0.004 ± 0.006
30.		<i>Polyura moori</i>	-	-	0.01	-	0.01	0.004 ± 0.005
31.		<i>Cyrestis lutea</i>	-	-	-	0.01	-	0.001 ± 0.003
32.		<i>Ariadne ariadne</i>	0.04	0.03	0.03	0.05	0.03	0.04 ± 0.01
33.		<i>Acraea issora</i>	-	0.01	-	-	-	0.001 ± 0.003
34.	Amathusiidae	<i>Amathusia phidippus</i>	-	-	0.01	-	0.01	0.002 ± 0.003
35.	Lycaenidae	<i>Zizina otis</i>	0.02	0.02	0.01	0.02	0.01	0.01 ± 0.01
36.		<i>Jamides caeruleus</i>	0.02	0.03	0.01	0.04	0.02	0.02 ± 0.01
37.		<i>Jamides pura</i>	0.04	0.01	0.03	0.06	0.03	0.03 ± 0.02
38.	Hesperidae	<i>Erionota thrax</i>	0.01	-	-	-	0.01	0.002 ± 0.003
39.		<i>Pelopidas conjunctus</i>	0.01	0.01	0.01	-	0.01	0.01 ± 0.003
40.	Arctiidae	<i>Nyctemera baulus</i>	0.01	-	-	-	-	0.001 ± 0.003
	9 Familia	40 Species	1	1	1	1	1	

Notes:

- ■ = highest lepidopteran indices
- ■ = lowest lepidopteran indice
- 1-5 = replication

Based on the data showed that most of butterfly existence in botanical garden exist on open area, grass area and herba area. However some of member Genus *Graphium*, *Delias* and *Papilio* live in tight canopy. Butterflies which lives in this area has ability to faster fly and reach the top of three.

On the other hand the highest abundance was on Pierids but the larvae was not found it because of limitation of host plant. Hence butterfly which live in open area are slow flyers which are the vegetation are grass and herb. Since butterfly poikilotherm characteristic that like of warm temperature [8].

The Highest Species Relativeness was on *Delias belisama* with score 0.16 ± 0.06 and *Letopsia nina* with score 0.15 ± 0.05 , while the lowest is on $0.001 - 0.003$, that they were ; *Papilio helenus*, *Acraea issora*, *Melanitis leda*, *Elymnias hypermnestra*, *Phalanta alcippe*, *Euthalia monina*, *Athyma nefte*, *Cyrestis lutea*, *Amathusia phidippus*, *Erionota thrax* and *Nyctemera baulus*. Shannon-Wiener index, diversity value and community of UPI botanical garden is at average state with $H' = 2.82 \pm 0.16$ and evenness indices (e) 0.83 ± 0.04 (Table 2).

Table 2: Lepidopteran Diversity and Evenness at Botanical garden UPI

Replication	H'	∑ species	Evenness
1	2.87	30	0.84
2	3.03	31	0.88
3	2.7c	29	0.83
4	2.82	30	0.83
5	2.59	30	0.76
Average± SD	2.82 ± 0.16	30	0.83 ± 0.04

Table 4: List Familia and butterfly host plant in botanical garden UPI

No.	Host	Host's species	Habitus	Butterfly	Butterfly species
1.	Annonaceae	<i>Annona muricata</i>	Tree	Papilionidae	<i>Graphium sarpedon</i>
		<i>A. squamosal</i>	Tree		<i>Graphium agamemnon</i> ,
		<i>A. reticulate</i>	Tree		
2.	Arecaceae	<i>Arenga pinnata</i>	Tree	Satyridae	<i>Elymnias hypermnestra</i>
		<i>Calamus rottan</i>	Tree	Hesperidae	<i>Erionota thrax</i>
				Satyridae	<i>Elymnias hypermnestra</i>
3.	Capparaceae	<i>Gynandropsis gynandra</i>	Herba	Pieridae	<i>Appias libythea</i>
					<i>Letopsia nina</i>
4.	Convolvulaceae	<i>Ipomoea cairica</i>	Liana	Nymphalidae	<i>Hypolimnas bolina</i>
					<i>Junonia orithya</i>
5.	Euphorbiaceae	<i>Euphorbia sp.</i>	Bush	Pieridae	<i>Appias libythea</i>
		<i>Phyllanthus sp.</i>	Herba	Nymphalidae	<i>Athyma nefte</i>
		<i>Ricinus communis</i>	Bush		<i>Ariadne ariadne</i>
6.	Fabaceae	<i>Erythrina lithosperma</i>	Tree	Pieridae	<i>Delias belisama</i>
				Nymphalidae	<i>Delias periboea</i>
7.	Lauraceae	<i>Persea Americana</i>	Tree	Papilionidae	<i>Graphium doson</i>
		<i>Litsea cubeba</i>	Liana	Papilionidae	<i>Graphium doson</i>
8.	Lorantaceae	<i>Dendrophthoe falcate</i>	Stem's Parasite	Pieridae	<i>Delias belisama</i>
					<i>Delias periboea</i>
9.	Magnoliaceae	<i>Michelia champaca</i>	Tree	Papilionidae	
10.	Malvaceae	<i>Durio zibethinus</i>	Tree	Papilionidae	<i>Graphium Agamemnon</i>
		<i>Hibiscus sp.</i>	Tree	Nymphalidae	<i>Hypolimnas bolina</i>
11.	Mimosaceae	<i>Acacia auriculariaformis</i>	Tree	Pieridae	<i>Eurema hecabe</i>
		<i>Mimosa pudica</i>	Herba	Nymphalidae	<i>Junonia orithya</i>
				Lycaenidae	<i>Zizina otis</i>
12.	Moraceae	<i>Leucaena leucocephala</i>	Bush	Pieridae	<i>Delias belisama</i>
		<i>Ficus religiosa</i>	Tree	Danaidae	<i>Delias periboea</i>
13.	Papilionaceae	<i>Artocarpus heterophyllus</i>	Tree	Nymphalidae	<i>Euploea gloriosa</i>
		<i>Crotalaria anagyroides</i>	Herba		Lycaenidae
					<i>Jamides caeruleus</i>

It was founded that larvae from Familia of Lymantriidae, Lasiocampidae, Pieridae, Arctiidae and Nymphalidae. Distribution of larvae was found in Familia Pieridae spesies 2 (1,67) in herbaceous plant and Familia Lymantriidae and Lasiocampidae with small score of spesies 1, 3 dan 9 (0,01). It's hasn't implication in index of diversity 1,68 (Table 3).

Table 3: Larvae of Butterfly indices in Botanical Garden UPI

Replication	H'	∑ species	Evenness
1	1,88	8	0,90
2	1,66	7	0,85
3	1,60	7	0,82
4	1,26	4	0,91
5	1,99	8	0,96
Average ± SD	1,68		0,89

Interaction host plant and Lepidopteran

Based on observation host plant of larvae in botanical garden there are 17 Familia and 34 host species which are 16 of three, 13 herba, 4 liana, 2 bush dan 1 stem of parasite. Host of Familia that found in botanical garden are Annonaceae (3), Arecaceae (2), Capparaceae (1), Convolvulaceae (1), Euphorbiaceae (3), Fabaceae (1), Lauraceae (2), Lorantaceae (1), Magnoliaceae (1), Malvaceae (2), Mimosaceae (3), Moraceae (2), Papilionaceae (1), Piperaceae (1), Poaceae (10), Rubiaceae (1) and Rutaceae (1). From 28 species, the most familia founded are Euphorbiaceae and Mimosaceae.

					<i>Jamides pura</i>
14.	Piperaceae	<i>Piper betle</i>	Liana	Papilionidae	<i>Graphium Agamemnon</i>
15.	Poaceae	<i>Eleusine indica</i>	Herba	Satyridae	
		<i>Cynodon dactylon</i>			
		<i>Melinis minutiflora</i>			
		<i>Axonopus compressus</i>			
		Spesies 5			
		Spesies 6			
		Spesies 7			
		<i>Bambusa sp.</i>	Tree	Satyridae	<i>Melanitis leda</i>
				Hesperidae	<i>Pelopidas conjunctus</i>
16.	Rubiaceae	<i>Ixora japonica</i>	Bush	Nymphalidae	<i>Phalanta alcippe</i>
17.	Rutaceae	<i>Citrus grandifolia</i>	Tree	Papilionidae	
	17 Familia	34 species			

In Botanical garden there are 17 Familia dan 34 species of larvae host i.e: Annonaceae (3), Arecaceae (2), Capparaceae (1), Convolvulaceae (1), Euphorbiaceae (3), Fabaceae (1), Lauraceae (2), Lorantaceae (1), Magnoliaceae (1), Malvaceae (2), Mimosaceae (3), Moraceae (2), Papilionaceae (1), Piperaceae (1), Poaceae (8), Rubiaceae (1) and Rutaceae (1). From 28 species Lepidoptera host plant there are 2 familia with the most used :Euphorbiaceae dan Mimosaceae. Based on observation, Familia Euphorbiaceae are host plant for familia Pieridae dan Nymphalidae. *Appias libythea* with host plant of *Euphorbia sp.* as host plant. Also *Athyma nefte* with host plant *Phyllanthus sp.* As its host plant. *Ariadne ariadne* which its host plant *Ricinus communis* ^[19].

Familia of Mimosaceae, *Mimosa pudica* was used by two butterfly species *Zizina otis* and *Junonia orithya*. Still in the same Familia *Acacia auriculariaformis* used by *Eurema hecabe* and *E. sari*. Butterfly of Genus *Delias* fly around *Leucaena leucocephala* used its nectar for source of food ^[19].

The result show that, Anonnaceae as host plant for genus *Graphium*. It is found also at *Citrus grandifolia* as specific host for genus *Papilio* ^[15].

Some species from were catch was member of Genus *Euploea*, yaitu *E. sp.*, *E. eunice* dan *E. mulciber*. They are stay at *Ficus religiosa* and the adult fly around *Glyricida sephium* because of its yellow flower.

With the characteristic fair productivity, community stability, balance ecosystem fair ecosystem pressure its support diversity of Lepidoptera ^[14,16]. As shown *Delias belisama* dan *Delias periboea* has a high abundance cause of spread to botanical garden to find source of food ^[18].

It was found also *C.lutea* that endemic species. Wings of *C. Lutea* was broken, it can be assumed that *C. Lutea* had been journey from long distance. Due to it's endemic state it should be more being aware. It was only found in Java and Bali Island with 1400 m of height. It has a brown pale with a streamline with 'tail like' on hind wing.

Based on the research that has been done, 40 species of butterflies and 13 species of adult butterfly larvae are found. These results prove that the Botanic Gardens UPI has the ability as a butterfly conservation. Butterfly species found that most adults *Delias belisama* and *Letopsia nina* due to the availability of host plants are abundant in the Botanic Gardens UPI. However, familia butterfly larvae found that most larvae Pieridae not Danaidae familia because ability of adult butterflies in selecting a host plant. There is a species endemic to the island of Java, *Cyrestis lutea* were obliged to be noticed and held host plants for the preservation of endemic species. There are 17 Familia and 34 species of larval host plants and adult butterflies in the Botanic Gardens UPI.

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