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Composition of butterflies, food plants, and host plants in the Bodogol Nature Conservation Education Center, Mount Gede Pangrango Area

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Abstract

Butterflies act as bioindicators of habitat change and plant pollinators. The aim of this research is to determine the composition and inventory of butterfly feed and host plants in the Bodogol Nature Conservation Education Center Area, Mount Gede Pangrango. The research was conducted from March to June 2022 in two habitats, namely heterogeneous forests and homogeneous forests. Observations of butterflies and plants were carried out using a 700 m transect method with observations of 10 m left and right. Observations were carried out at 08.00 - 12.00 WIB. In each habitat, observations were made on three routes, 2 times. Total observation 12 days. 419 individuals and 93 species of butterflies were found in both habitats, while for plants 42 species were found in 22 families, namely: *Asteraceae, Apocynaceae, Palmaceae, Balsaminaceae, Euphorbiaceae, Fabaceae, Iridaceae, Lamiaceae, Malvaceae, Melastomaceae, Moraceae, Phyllanthaceae, Pinaceae , Poaceae, Rubiaceae, Sapindaceae, Solanaceae, Theaceae, Verbenaceae, Acanthaceae, Lamiaceae are known to interact with butterfly species as host plants and food plants. Plant species from the <i>Asteraceae* family are found in abundance compared to other families.

Keywords: Bodogol, nurse plant, record, plant, food

Introduction

The presence of butterflies in a habitat is closely linked to the availability of flowering plants that serve as food sources for butterflies. The mutualistic relationship between butterflies and plants provides valuable information regarding the stability of composition, structure, and the benefits of the interaction between plants and butterflies (Adriano et al., 2018) [1]. In the interaction between butterflies and flowering plants, both parties benefit. Butterflies obtain pollen and nectar, which are essential food sources for butterfly imagos (He et al., 2022), while plants benefit from the pollination process facilitated by butterflies. Butterfly-assisted pollination can influence the quality and quantity of agricultural yields (FAO, 2018)^[15]. The availability of host plants for larvae is also a crucial factor for the sustainability of the next generation of butterflies. Rivai et al. (2021) [24] stated that the absence of larval host plants could lead to a decline in butterfly diversity in a region. Habitat changes are among the main factors causing changes in vegetation, which indirectly affect the abundance and diversity of butterflies (Galicia et al., 2023)^[7]. Compared to climate change, habitat alteration is known to have a more significant effect on butterfly populations (Kwon et al., 2020)^[12].

The Bodogol Nature Conservation Education Center (PPKA) is a tropical rainforest consisting of various habitat types. Some areas have homogeneous habitats with limited vegetation types, while others have heterogeneous habitats with more diverse vegetation. Studies on the inventory of host plants and flowering plants interacting with butterflies remain limited. Knowledge of the plants visited by butterflies can provide insights into host specificity and butterfly preferences for the morphology of flowering plants at PPKA Bodogol. This information complements previous publications on butterfly diversity at the same observation site, as reported by Ruslan *et al.* (2023) ^[25]. Research on the composition of butterflies and their host and food plants in the PPKA area is still scarce, necessitating this study.

Materials and Methods

This study was conducted from March 2022 to June 2022 in two locations within the PPKA Bodogol area, Sukabumi, West Java: a heterogeneous forest and a homogeneous forest. Butterfly observations were carried out using the transect method over a 700-meter path, with observations extending 10 meters to the left and right of the transect (Lang *et al.*, 2016)^[13]. Data collection employed cameras and sweeping nets along pathways in both locations. Observations in the heterogeneous forest were conducted along the Rasamala, Canopy, and Aprika trails. In the homogeneous forest, observations were made along the Cipadaranten, Cikaweni, and Gombongkoneng trails.

Butterfly observations were conducted twice, with a 15-day interval, resulting in a total of 12 observation days across both locations. Observations were made from 8:00 AM to 12:00 PM. Butterflies were documented using digital cameras and insect nets. Identified butterflies were recorded directly with their respective numbers. Unidentified butterflies were photographed or captured using sweeping nets for subsequent identification using butterfly identification guides (Peggie and Amir, 2006; Weei and Mun, 2008; Kirton, 2014)^[10, 22, 29].

Host and food plant observations were conducted along the same pathways. Each flowering plant encountered was recorded, and unidentified plants were identified using plant identification guides (Yudhoyono and Sukarya, 2013; Engel and Phummai, 2008, 2002) ^[3, 4]. Non-flowering plants were also documented. The collected data were analyzed to determine butterfly species composition and diversity index (Shannon-Wiener Index) (Magurran, 1988) ^[15].



Fig 1: Research location

Results

a. Abundance and Diversity of Butterflies

The observations in this study recorded a total of 419 individuals representing 93 species. In the heterogeneous forest area, 78 species comprising 261 individuals were identified, while in the homogeneous forest habitat, 39 species comprising 158 individuals were found. These species belonged to five families: *Lycaenidae*, *Nymphalidae*, *Papilionidae*, *Riodinidae*, and *Pieridae*. The

diversity index for the two habitats, shown in Table Appendix 1, indicates that the species diversity index of butterflies in the heterogeneous forest (H' = 3.9) is higher than in the homogeneous forest (H' = 3.2).

b. Butterfly Host and Food Plants

The study identified several plants interacting with butterflies, as detailed in Table 1.

Table 1: Plant Species Found in Bodo	gol, Common Names, and Butterf	ly Species Interactions based on	previous study and current study
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N0.	Plant Family	Species	Species	Interacting Butterfly	Role	Reference
1	Asteraceae	Synedrella nodiflora	Jotang Kuda	Mycalesis mineus, Hypolimnas bolina	Imago's food plant	Keraf <i>et al.</i> , (2023)
2	Asteraceae	Ageratum conyzoides	Bandotan/Wedu san	Mycelesis mineus, Euploea eunice	Imago's food plant	Keraf <i>et al.</i> , (2023), Nursia <i>et al.</i> , (2022) ^[19]
3	Asteraceae	Vernonia sp.	Vernonia	Hypolimnas anomala	Imago's food plant	Rivai, et al., 2021 [24]
4	Apocynaceae	Bidens pilosa	Ketul/Ajeran	Appias olferna	Imago's food plant	Mape, et al., 2022 [16]
5	Palmaceae	Elaeis guineensis	Kelapa Sawit	Elymnias hypermnestra	Larva's food plant	CABI Compendium (2023)
6	Balsaminaceae	Impatiens sp.	Impatiens	Parantica menadensis, Dacalana anysis	Imago's food plant	Rivai, et al., 2021 [24]
7	Euphorbiaceae	Jatropha integerrima	Batavia	Catopsilia scylla, , Ideopsis juventa	Imago's food plant	Mape, et al., 2022 [16]
8	Fabaceae	Calliandra calothyssus	Kaliandra merah	Papilio memnon	Imago's food plant	Koneri, <i>et al.</i> , 2020 ^[11]
9	Fabaceae	Paraserianthe s falcataria	Sengon	Eurema blanda, Eurema hecabe	Larva's food plant	Setiawan et al. (2019)
10	Iridaceae	Iris pseudacorus	Bungairis kuning	Euthalia sp.	Imago's food plant	Keraf et al., (2023)
11	Lamiaceae	Tectona grandis	Jati	Eurema sari, Eurema hecabe	Larva's food plant	Qodri et al., (2023) ^[23]
12	Lamiaceae	Clerodendron japonicum	Pagoda	Catopsilia scylla, Catopsilia pomona, Papilio demolion, Papilio demoleus, Troides helena, Troides haliphron, Graphium agamemnon	Imago's food plant	Ngatimin, <i>et al.</i> , (2019) [17]
13	Malvaceae	Hibiscus rosa	Kembang Sepatu	Papilio demolion, papilio demoleus, Troides helena, Graphium agamemnon	Imago's food plant	Ngatimin <i>et al.</i> , (2019) [17]
14	Malvaceae	Sida acuta	Galunggang	Eurema alitha	Imago's food plant	Rivai, et al., 2021 [24]
15	Melastomaceae	Clidemia hirta	Senduduk bulu	Euthalia monina	Larva's food plant	Qodri et al., 2023 [23]

16	Melastomaceae	Melastoma candidum	Harendong	Euproctis sp.	Imago's food plant	Huang <i>et al.</i> , 2021
17	Moraceae	Ficus variegate	Buah Kondang	Euthalia sp. Papilio memnon	Imago's food plant	Keraf <i>et al.</i> , (2023)
18	Moraceae	Arthocarpus heteropilus	Nangka	Neptis hylas	Imago's food plant	Keraf <i>et al.</i> , (2023)
19	Phyllanthaceae	Baccaurea dulcis	Menteng besar	Mycalesis mineus	Imago's food plant	Keraf <i>et al.</i> , (2023)
20	Pinaceae	Pinus merkusii	Pinus	Papilio sp.	Larva's food plant	Latumahina (2020) [14]
21	Poaceae	Paspalum conjugatum	Rumput Paitan	Nymphalidae	Imago's food plant	Ginoga <i>et al.</i> , 2019 ^[8]
22	Rubiaceae	Neolamackia cadamba	Jabon	Euthalia sp.	Imago's food plant	Keraf <i>et al.</i> , (2023)
23	Rubiaceae	Ixora coccinea	Bunga Soka	Papilio demoleus, Papilio polytes, Troides helena	Imago's and larva's food plant	Qodri et al., (2023) ^[23]
24	Rubiaceae	Ixora paludosa	Asoka	Catopsilia scylla, Catopsilia pomona, Papilio demolion, Papilio demoleus, Troides helena,	Imago's food plant	Ngatimin, <i>et al.</i> , (2019) [17]
25	Sapindaceae	Nephelium lappaceum	Rambutan	Delias hyparete,	Imago's food plant	Qodri et al., (2023) ^[23]
26	Selaginellaceae	Sellagimella sp.	Bambu rambat/paku rane	Euptychia mollina	Larva's food plant	Freitas et al., (2019) ^[6]
27	Solanaceae	Solanum torvum	Takokak	Jamides celeno	Imago's food plant	Ramandei, et al., 2022
28	Theaceae	Schima wallichii	Puspa	Sinthusa nasaka	Imago's food plant	Qodri et al., 2023 [23]
29	Verbenaceae	Lantana camara	Cente	Idea blanchardii, Ideopsis vitrea	Imago's food plant	Rivai <i>et al.</i> , (2021) ^[24] , Ramandei <i>et al.</i> , (2022)
30	Verbenaceae	Clerodendrum thomsoniae	Nona Makan Sirih	Papilio demoleus, Menelaides polytes	Imago's food plant	Mape, et al., 2022 [16]
31	Acanthaceae	Asystasia gangetica.	Bayaman, Rumput Israel	Papilio polytes, Appias olferna, Delias hyparete, Leptosia nina Eurema hecabe Danaus genutia,	Imago's food plant	Ruslan &Andayaning sih (2021) ^[26]
32	Commelinaceae.	Commelina virginica	Aur-aur	Zizina otis	Imago's food plant	Ruslan, et al., 2021 [26]
33	Fabaceae	Mimosa pudica	Putri malu	Eurema hecabe	Larva's food plant	
34	Asteraseae	Wedelia triloba	Kémanten	Eurema hecabe Ypthima philomela	Imago's food plant	
35	Asteraceae.	mikania cordata	Akar Bulou	Ypthima pandocus	Imago's food plant	
36	Verbenaceae	Stachytarpheta indica	Pecut kuda	Ypthima pandocus Parantica aspasia	Imago's food plant	
37	Acanthaceae	Asystasia gangetica	Bayaman, Rumput Israel	Eurema hecabe Ypthima philomela	Imago's food plant	
38	Lamiaceae	Orthosiphon aristatus	kumis kucing	Mycalesis mineus	Imago's food plant	

In table 1, plants from the family *Asteraceae* were the most frequently encountered compared to other families. According to Koneri *et al.* (2020) ^[11], species from the *Asteraceae* family, such as *Ageratum conyzoides* and *Synedrella nodiflora*, are commonly visited by butterflies due to their flower colors and shapes. Flowers with yellow and purple hues and tubular or capitulum-shaped blooms are particularly attractive to butterflies.

Discussion

In the Bodogol Bodogol Nature Conservation Education Center area, 78 butterfly species comprising 261 individuals were found in the heterogeneous forest, while 39 species comprising 158 individuals were recorded in the homogeneous forest. The species diversity index was higher in the heterogeneous forest (H' = 3.9) compared to the homogeneous forest (H' = 3.2). Variations in species count, individual count, and diversity index between the two habitats could be attributed to differences in biotic and abiotic factors within each habitat. Observation of habitat conditions revealed that the heterogeneous forest had more varied vegetation compared to the homogeneous forest. Butterflies are a highly diverse group of insects whose presence and diversity are influenced by environmental factors (Ruslan *et al.*, 2023)^[25]. According to Rahayu *et al.* (2013), diverse vegetation in a habitat provides a broader range of food sources, resulting in higher individual and species diversity in heterogeneous forests.

The study in PPKA Bodogol identified 38 plant species from 22 families interacting with specific butterfly species (Table 1). The *Asteraceae* family was the most frequently observed, acting as either a larval host plant or an imago food source. Host plants serve as sites for butterflies to lay eggs, which hatch into larvae that consume specific plant tissues before pupating and emerging as imagos (Qodri *et al.*, 2023) ^[23]. Strong interactions are often observed between butterflies and their host plants, as noted by Qodri *et al.* (2023) ^[23].

According to Nursia *et al.* (2022) ^[19], most plant families in Bodogol, such as *Melastomaceae*, *Sapindaceae*, *Malvaceae*,

Myrtaceae, *Leguminaceae*, *Rubiaceae*, *Euphorbiaceae*, *Moraceae*, *Verbenaceae*, and *Asteraceae*, play roles as both host plants and food plants.

Food plants for butterfly imagos were more frequently observed than larval host plants (Figure 1). This might be due to the ease of observing interactions between butterfly imagos and flowers compared to locating butterfly larvae on host plants. Nectar availability in food plants is a crucial factor attracting butterfly imagos (Sukma *et al.*, 2021) ^[28]. Additionally, morphological features of food plants, such as flower color, aroma, and shape, serve as attractants for butterfly imagos (Qodri *et al.*, 2023) ^[23].



Fig 2: Comparison of the number of plants serving as larval host plants and adult food plants

Butterflies exhibit diverse interactions with flowering plants. Some butterfly species may visit flowers of the same plant species, while others specialize in visiting specific plant species. This mutualistic symbiosis between butterflies and flowering plants results from long-term coevolution, a process that remains relatively underexplored (Kawahara *et al.*, 2022) ^[9]. Butterfly preferences for plants can be influenced by the compatibility between the shape and length of their proboscis and the flower's structure (Pertiwi *et al.*, 2020) ^[20].

Several butterflies observed in this study were actively feeding on nectar, including Parantica aspasia and Delias belisama feeding on *Stachytarpheta indica*, Mycalesis mineus feeding on *Orthosiphon aristatus*, Ypthima philomela and Eurema hecabe feeding on *Wedelia triloba*, Euploea mulciber feeding on *Ageratum conyzoides* and *Mikania cordata*, Ypthima pandocus feeding on *Mikania cordata*, Parantica aspasia also feeding on *Lantana camara*. Plant Characteristics and Butterfly Interactions observed in this study such as (1) *Stachytarpheta indica* (*Verbenaceae*)

attracts butterflies from families such as Papilionidae, Pieridae, Nymphalidae, and Hesperidae (Chahar et al., 2021)^[2]. Delias belisama (*Pieridae*) and Parantica aspasia (Nymphalidae) feeding on this plant. (2) Orthosiphon aristatus (Lamiaceae) commonly known as "cat's whiskers," this plant has variable flower colors and a light fragrance, blooming for 2-3 weeks (Peniwidiyanti et al., 2020)^[21]. It was observed attracting Mycalesis mineus. (3) Wedelia triloba (Asteraceae): This plant served as a nectar source for Eurema hecabe (*Pieridae*), whose larval hosts are typically grasses (*Poaceae*) and shrubs (Nikmah *et al.*, 2021)^[18]. (4) Ageratum convzoides and Mikania cordata (Asteraceae): These plants were visited by Euploea mulciber and Ypthima pandocus (Nymphalidae), which are polyphagous butterflies. (5) Larvae were observed on plants such as Acroatichum sp., which are essential for butterfly development through their complete metamorphosis stages (egg-larva-pupa-adult). Host plant presence significantly influences butterfly habitat distribution (Handayani and Rahayuningsih, 2022).

 Table 2: Number of famili, species, individuals of butterflies found in Heterogeneous and Homogeneous Habitats in Bodogol Nature Conservation Education Center

Number of individual				
Famili	Spescies	Heterogenous	Homogeneous	
Lycaenidae	Allotinus sarrastes Fruhstorfer	2	-	
	Allotinus unicolor Fruhstorfer	1	7	
	Arhopala centaurus Fabricius	1	-	
	Catochrysops strabo Fabricius	1	-	
	Chilades pandava Horsfield	1	-	
	Eooxylides tharis Geyer	8	-	
	Loxura atymnus Stoll	1	-	
	Jamides alectoC Felder	5	6	
	Jamides celeno Cramer	16	17	
	Jamides pura Moore	3	3	
	Lampides boeticus Linnaeus	2	-	
	Neopithecops lucifer Rober	3	-	
	Petrelaea dana de Niceville	6	-	
	Pithecops dionisius Boisduval	1	1	
	Pithecops corvus Fruhstorfer	1	-	
	Prosotas dubiosa Semper	3	-	

	Zeltus amasa Hewitson	7	-
	Candalides xanthospilos Hubner	-	1
	Miletussp.	-	7
	Prosotas gracilis Rober	-	3
Riodinidae	Abisara savitri Savitri	-	2
Nymphalidae	Chersonesia rahria Moore	5	-
	Cethosia hypsea Doubleday	1	-
	Cupra erymaninis Diuly	1	-
	Dangus chrysinnus Linnaeus	2	-
	Discophora sondaica Boisduval	1	
	Doleschallia bisaltide Cramer	1	-
	Elymnias hypermnestra Linnaeus	3	1
	Erites argentina Butler	5	8
	Euploea camaralzeman Butler	2	-
	Euploea mulciber Cramer	6	-
	Euploea radamanthus Fabricius	1	-
	Euthalia aconthea Cramer	1	-
	Faunis canens Stichel	7	10
	Hypolimnas bolina Linnaeus	2	-
	Hypolimnas misippus Linnaeus	1	-
	Ideopsis juventa Cramer	1	-
	Lasippa monata weyenbergn	2	-
	Lethe confusa Aurivilius	0	3
	Lexids diffed Fabilities	5	-
	Melanitis phedima Cramer	1	-
	Mycalesis horsfieldi Moore	2	-
	Mycalesis janardana Moore	7	12
	Mycalesis mineus Linnaeus	9	3
	Mycalesis moorei Hubner	2	13
	Mycalesis sudra C & R Felder	1	-
	Neoring crhishng Westwood	4	4
	Nontig clinic Moore		
		2	-
	Neptis hylas Linnaeus	1	-
	Neptis miah Moore	1	-
	Neptis vikasi Horsefield	5	-
	Parantica aspasia Fabricius	5	-
	Pantoporia hordonia Stoll	2	1
	Symbrenthia, hypatia Wallace	1	-
	Tanggoig ignis Godart	6	
	Tanaecia taja sta Maara	1	-
	Tanaecia trigerta Moore	1	-
	Stibochiona coresia Hubner	1	-
	Ypthima baldus Fabricius	13	7
	Ypthima nigricans Snellen	5	-
	Ypthima pandocus Hubner	11	-
	<i>Ypthima philomela</i> Linnaeus	6	-
	Zeuvidia luverii Hubner	2	_
	Numphalidas	1	
	Nymphallade	1	-
	Euthalia monina Fabricius	-	2
	Lethe europa Fabricius	-	4
	Melanitis leda Linnaeus	-	2
	Tanaecia japis Moore	-	11
	Ypthima horsfieldi Moorei	-	2
	Zeuridia luvuri Hubber	<u> </u>	- 1
יזי יזי <u>מ</u>		-	1
Papilionidae	Papilio demolion Cramer	1	-
	Papilio memnon Linnaeus	3	2
	Papilio nephelus Boisduval	3	-
	Papilio polytes Linnaeus	2	-
	Troides helena Linnaeus	6	2
	Papilio sp.	-	1

Pieridae	Appias lyncida Cramer	2	1
	Appias olferna Swinhoe	2	1
	Catopsilia pomona Fabricius	2	4
	Catopsilia pyrantheLinnaeus	2	1
	Catopsilia scylla Linnaeus	1	-
	Cepora judith Fabricius	3	1
	Delias belisama Cramer	1	-
	Eurema alithaC & R Felder	1	-
	Eurema blandaBoisduval	1	5
	Eurema hecabe Linnaeus	18	2
	Eurema sari Horsefield	7	4
	Leptosia nina Fabricius	1	-
	Gandaca harina Horsefield	2	-
	Belenois java Fruhstorfer	-	1
	Delias hyparate Linnaeus	-	1
Number of famili		4	4
Number of species		78	39
Number of individuals		260	157
Diversity Index (H')		3,9	3,2

Conclusions and Recommendations Conclusions

bservations from this study recorded a total of 419 individuals representing 93 butterfly species. Additionally, 38 plant species were identified: Synedrella nodiflora, Ageratum conyzoides, Vernonia sp., Bidens pilosa, Elaeis guineensis, Impatiens sp., Jatropha integerrima, Calliandra calothyssus, Paraserianthes falcataria, Iris pseudacorus, Tectona grandis, Clerodendron japonicum, Hibiscus rosa, Sida acuta, Clidemia hirta, Melastoma candidum, Ficus variegate, Arthocarpus heterophyllus, Baccaurea dulcis, Pinus merkusii, Paspalum conjugatum, Neolamackia cadamba, Ixora coccinea, Ixora paludosa, Nephelium lappaceum, Sellaginella sp., Solanum torvum, Syzygium aquenum, Schima wallichii, Lantana camara. Clerodendrum thomsoniae, Asystasia gangetica, Commelina virginica, Mimosa pudica, Wedelia triloba, Mikania cordata, Stachytarpheta indica, and Orthosiphon aristatus. These plants belong to 22 families: Asteraceae, Apocynaceae, Palmaceae, Balsaminaceae, Euphorbiaceae, Fabaceae. Iridaceae. Lamiaceae, Malvaceae. Melastomaceae, Moraceae, Phyllanthaceae, Pinaceae, Poaceae, Rubiaceae, Sapindaceae, Selaginellaceae, Solanaceae, Theaceae, Verbenaceae, Acanthaceae, and Lamiaceae. They were found to interact with butterfly species as host plants and food plants. Plant species from the family Asteraceae were observed to be the most commonly found compared to other families.

Recommendations

Further research is needed to explore butterfly-plant interactions, focusing on plant preference based on butterfly visit frequency to specific plants.

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