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Diversity of Butterflies (Lepidoptera) Caught by Using Fruit Traps in Bukit Duabelas and Harapan Forest Landscape, Jambi

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Abstract. The presence of butterflies within an ecosystem is influenced by the availability of host plants and food. Butterflies have specific host plants to lay eggs and to get food for the larvae. One of the methods to collect butterfly by using fruit traps. The purpose of this research was to know the diversity of butterflies by using fruit trap in Bukit Duabelas and Harapan Forest landscape Jambi. Butterfly sampling was conducted on seven different land types: forest, forest riparian, jungle rubber, rubber plantation, riparian rubber plantation, oil palm plantation, and riparian oil palm plantation. Traps in pairs of 4 pieces using banana (2 traps) and pineapple fruit (2 traps). Trapping started from 08.00 am to 5.00 pm. The number of butterflies caught with banana traps was 52 species and 417 individuals. The highest number of butterflies caught is in the forest than to other land types. *Mycalesis mineus* (24 individuals) and *Elymnias congruent* (50 individuals) from the subfamily Satyrinae are the dominant species caught in traps. The traps with pineapple bait (44 species and 227 individuals) attracted more butterflies than the traps with banana (37 species and 190 individuals) as bait. The results of this study implied that the transformation of land use influenced the diversity of butterflies.

INTRODUCTION

The loss and degradation of natural habitats will pose a major threat to changes in the composition of ecosystem structures [1]. This is caused by changes in biodiversity and environmental factors in the ecosystem. Factors causing increased habitat degradation include agriculture, logging, forest fires, and increasing demands for clothing and food [1]. One of the many landscapes that have undergone significant changes is the landscape of Bukit Duabelas. The adverse effects of long-term deforestation include the loss of biodiversity and endemic species in the landscape [2]. Natural habitat recovery (succession) to natural conditions is not easy. One method to restore habitat is by doing reforestation [3]. They found an increase in wealth, abundance, and diversity of butterfly species along the gradient of the restoration [3]. The community of fruit-eating butterflies can recover within 40 years after restoration efforts, provided the primary forest is nearby. Different stages of restoration are characterized by different specialist species, with large numbers devoted to primary forest. Restoration efforts allow the rapid recovery of insect communities in tropical regions that have experienced deforestation [3]. One of the forests that have been restored is the Harapan Forest in Jambi. Butterfly research has never been conducted in Harapan forests and Bukit Duabelas landscapes.

The method of butterfly research can be done in an active or passive manner. The active method is done to make capturing butterflies directly using insect nets [4]. The passive method is carried out, setting up fruit bait. One research method is by using fruit bait traps and lamp traps (especially for moths) in combination [4]. The fruit bait trap is made

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by installing a cage on the lower wall of the slit (as a butterfly entrance) and placing bait in the form of banana or ripe pineapple (which has been fermented for 2 days) on the base of the cage. Butterflies that are attracted to the bait will enter confinement through the gap and trapped inside the cage. The trap any butterfly that is attracted to the smell of fruits [5].

The fruit trap method is a standard method and has been carried out to study the diversity of butterfly species. The advantage of the trap method is that it can be done easily with limited time and funds. Another advantage of using bait is that high and fast flying butterflies will also be caught [4]. Another practical advantage is the possibility of easily taking butterfly samples along vertical slopes in high forests, including sampling butterflies perched on a canopy or sub-canopy [6]. Most fruit-eating butterflies can be identified to a certain extent in the field survey using fruit traps. Most of the individuals captured can be marked and released unharmed, so that re-capture can be evaluated with minimum handling. The butterflies that are attracted by fruit bait come from the subfamilies of Biblidinae, Charaxinae, Nymphalinae, and Satyrinae (Nymphalidae) [4]. The trap method is also used in Sulawesi forests to assess the level of butterfly species diversity [7].

Information on the diversity of butterflies in the Harapan forest and Bukit Duabelas landscape is still limited. The Harapan forest and Bukit Duabelas landscapes have experienced changes in land function from forests to oil palm plantations and rubber plantations. Differences in land functions result in differences in flora and fauna of the ecosystem structure [7]. Thus, research needs to be done on each different land use. The purpose of this study was to examine the diversity of butterfly species in seven types of land in the Harapan forest and Bukit Duabelas landscape in Jambi Sumatera.

EXPERIMENTAL DETAILS

Butterfly sampling and biodiversity assessment were conducted in Jambi from August to October 2017 using fruit traps. Research used fruit trap methods to caught butterflies [8]. The number of traps used is 4 pieces. The fruits used as bait are banana and pineapple which has been fermented for 2 days before installation with the addition of yeast. Traps used consist of 2 banana bait traps and 2 pineapple bait traps. Fruit traps are installed in the plot from 08.00 am to 05.00 pm. Traps are hung on trees in plots with a height of 1 m above ground level and a distance of 25 m between traps. The number of observation plots is 44 plots consisting of 16 plots in the Bukit Duabelas landscape (4 forest plots, 4 jungle rubber plots, 4 Rubber plantation plots, and 4 palm plantation oil plots) and 28 plots in the Harapan Forest landscape (4 forest plots, 4 jungle rubber plots, 4 Rubber plantation plots, 4 palm plantation oil plots, 4 forest riparian plots, 4 riparian plots rubber, and 4 plots riparian oil palm plantation). The size of each observation plot is 50x50 m^2. Identification and preservation of specimens are done on the Insect Biosystematics Laboratory, Department of Plant Protection, IPB. Identification of butterfly specimens is based on guidebooks [9-11].

Data analysis was done by calculating the diversity index of Shannon Wienner (H ') species, Simpson index (1-D), Evenness index (E), and dominance index species (D) [12]. The similarity of butterfly species between ecosystems is based on the proximity of the distance between objects depicted in the non-metric multidimensional scaling (NMDS) graph. The closer the accuracy of the object to zero, the more precise the position of the object. The diversity index calculation and MDS analysis will be calculated using the R 3.0.2 vegan package software [13]. Analysis of the similarities and differences in butterflies species composition on different types of land venny diagrams 2.1 was processed on the website http: //bioinfogp.cnb. csic.es/tools/venny/.

RESULT AND DISCUSSION

The diversity of butterfly species in the Harapan forest and Bukit Duabelas landscape varies according to land use. The number of species found in the two landscapes was 52 species and 417 individuals (Table 1). Species diversity value based on the Shannon index is classified as high (H '= 3.12) in the Harapan forest and Bukit Duabelas landscape [12]. The diversity is higher in Bukit Duabelas landscape compare to Harapan forest (H '= 2.83). Species diversity if reviewed based on land use is higher in forests compared to other land uses. This proves that habitat heterogeneity supports the electability of butterflies in an ecosystem [6]. Oil palm plantation is a homogeneous habitat so that the diversity of species is also low. Homogeneous habitat is less supportive for the lives of various butterfly species due to limited availability of food plant and host plant [4]. The diversity of butterflies will be high in habitats in which feed is available for larvae (host plant) and imago (nectar) [2]. The similarity of butterfly species in each land use is classified as high based on the Simpson index value ranging from 0.61-0.93. This means that the composition of the land use constituent species is almost the same. The evenness index of species contained in land use shows different

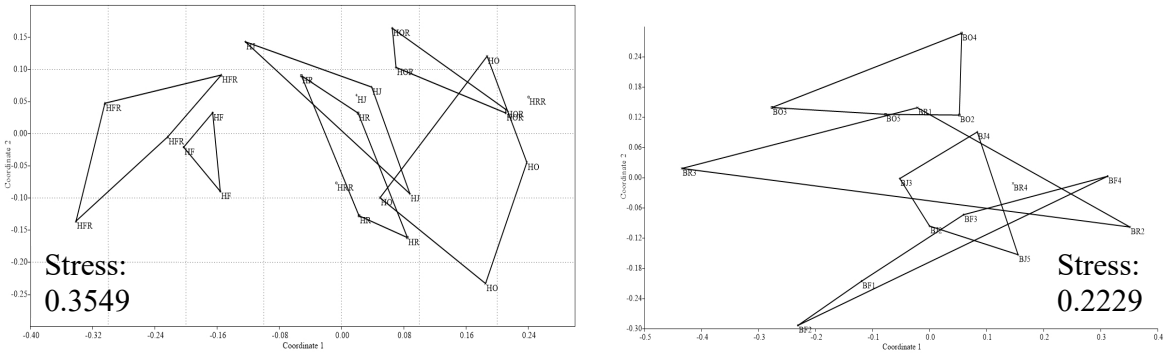
values. Species evenness index which is classified as high in forest land use (E = 0.9), that means the species diversity in the land use is stable.

The highest population of butterfly are in oil palm plantation (83 individuals) in the Bukit Duabelas landscape with a standard error (SE) value are 8.90. The lowest population of butterflies on land use in the rubber (20 individuals) in the Harapan Forest landscape with a value of SE: 0.41 (Tab. 1). The highest population of butterflies on riparian plots was found in oil palm riparian land with 62 individuals and standard error of 8.27, while the lowest population was found in riparian rubber with 8 individuals and standard error of 1.22.

TABLE 1. Diversity of butterflies in Bukit Duabelas and Harapan Forest Landscape: H ': Shannon index; 1-D: Simpson Index; E: Evenness index; D: Dominance index

Land Use	Sub family	Genus	Species	Individual	H '	1-D	E	D
Hutan Harapan								
Forest	4	10	17	37	2.7	0.93	0.87	0.08
Jungle Rubber	3	6	10	27	1.99	0.83	0.73	0.17
Oil Palm	4	6	10	20	2.1	0.85	0.82	0.15
Rubber	3	6	11	25	2.23	0.88	0.85	0.12
Riparian Forest	4	7	13	48	1.97	0.79	0.55	0.21
Riparian Rubber	2	5	7	8	1.91	0.84	0.96	0.17
Riparian Oil Palm	5	9	10	62	1.42	0.61	0.41	0.39
Subtotal	**5**	**19**	**41**	**227**	**2.18**	**0.73**	0.21	0.27
Bukit Duabelas								
Forest	4	9	12	21	2.38	0.9	0.9	0.1
Jungle Rubber	4	14	23	58	2.79	0.92	0.71	0.08
Oil Palm	4	7	17	83	1.99	0.74	0.43	0.26
Rubber	5	10	12	28	2.48	0.9	0.85	0.09
Subtotal	**5**	**19**	**36**	**190**	**2.83**	**0.88**	0.47	0.12
Total	**6**	**25**	**52**	**417**	**3.12**	**0.92**	0.44	0.08

The results of the NMDS analysis on the Harapan show that forests and riparian forest have different species composition than other land types (Fig. 1). While there is an overlap on Jungle rubber, rubber plantation, oil palm, and riparian oil palm, meaning that the species composition of those land types bears some similarities. The similarity of species composition in plantation land use is looked the same because all of those lands are a plantation, so the vegetation contained is also nearly the same. Similarities in species composition also occur in some land use types in the Bukit Duabelas landscape.



a **b**

FIGURE 1. NMDS analysis of butterfly species composition in Harapan Forest and Bukit Duabelas landscape: a. Landscape Harapan Forest: HF (Forest), HJ (jungle rubber), HO (oil palm plantation), HR (rubber), HFR (riparian forest), HOR (riparian oil palm) dan HRR (riparian rubber); b: Bukit Duabelas landscape: BF (forest), BJ (jungle rubber), BO (oil palm) dan BR (rubber).

Some butterfly species were found in all 7 land types while some species are only found in 1 type. There are 5 species found in all land (Fig. 2). Those species are *Amanthusia friderici*, *Elymnias panthera*, *Mycalesis felderi*, *Mycalesis mineus*, and *Taenacia palguna*. These butterflies are the most commonly found in all land types and also are common species in Sumatera [9]. There are 8 species found only in the forest, 7 species found only in jungle rubber, 1 species found only in a rubber plantation, and 4 species found only in oil palm. These species are not found in riparian land types, meaning that it has its unique species composition. There are 12 species found only in riparian forest, 4 species found only in riparian rubber, and 8 species found only in riparian oil palm.

This research uses fruit traps with banana and pineapple. Pineapple bait caught more butterflies compared to banana bait. The number of butterflies caught using pineapple bait is higher than banana bait in both Harapan Forest (33 species) and Bukit Duabelas (29 species) (Table 2). The scent of banana bait is sharper than the pineapple bait so it is more easily sensed by the butterflies.

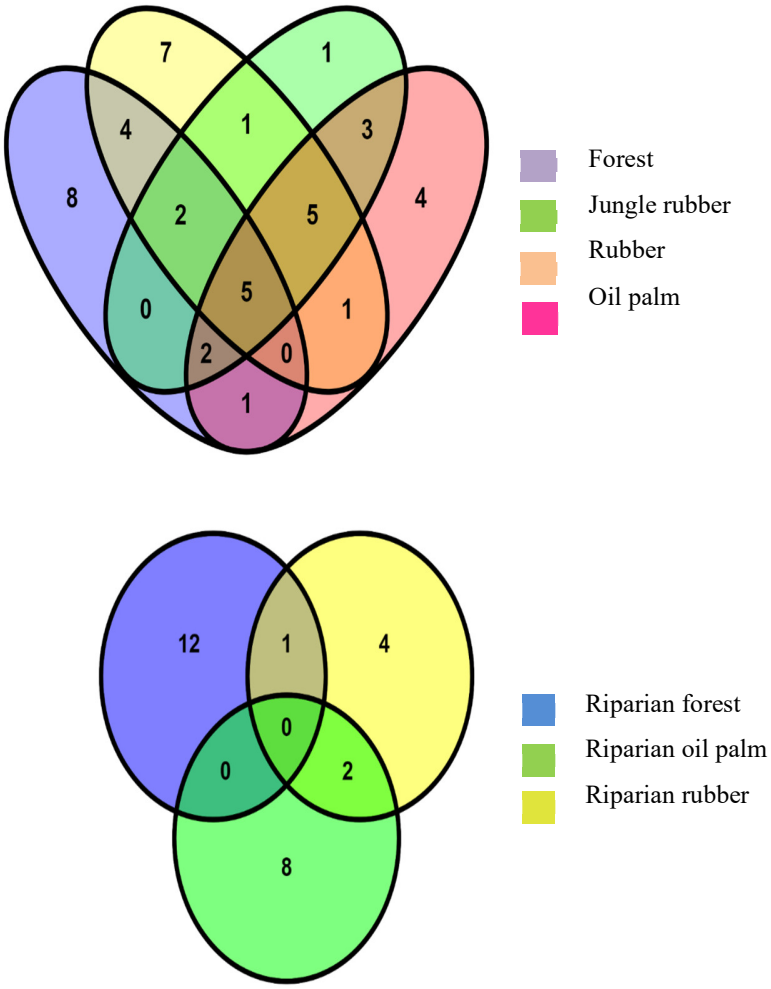


FIGURE 2. Number of butterfly species in seven types of land in Jambi

TABLE 2. The population of butterflies caught by fruit traps in the landscape of Harapan Forest and Bukit Duabelas Jambi.

No	Species	Harapan Forest			Bukit Duabelas			Grand
		B	P	Total	B	P	Total	Total
1	*Agatasa calydonia*	0	1	1	1	1	2	3
2	*Amanthusia binghamii*	3	2	5	1	4	5	10
3	*Amanthusia friderici*	0	0	0	5	2	7	7
4	*Amanthusia schoenbergi*	0	1	1	0	0	0	1
5	*Amathuxidia masina*	0	0	0	0	1	1	1
6	*Bassarona dunya*	2	2	4	0	0	0	4
7	*Bassarona teuta*	11	13	24	0	0	0	24
8	*Charaxes durnfordi*	1	1	2	1	0	1	3
9	*Charaxes fervens*	1	0	1	8	5	13	14
10	*Charaxes solon*	1	0	1	0	0	0	1
11	*Coelites euptychioides*	0	0	0	0	2	2	2
12	*Discophora timora*	0	1	1	0	1	1	2
13	*Dophla evelina*	1	2	3	7	6	13	16
14	*Elymnias congruens*	13	37	50	6	5	11	61
15	*Elymnias hicetas*	0	0	0	0	1	1	1
16	*Elymnias nesaea*	5	5	10	5	4	9	19
17	*Elymnias panthera*	1	1	2	6	2	8	10
18	*Eulaceara osteria*	0	0	0	0	1	1	1
19	*Euthalia adonia*	1	0	1	0	0	0	1
20	*Euthalia agnis*	1	1	2	0	0	0	2
21	*Euthalia alpeda*	3	4	7	3	0	3	10
22	*Euthalia mehadeva*	1	3	4	1	0	1	5
23	*Euthalia mertha*	0	0	0	1	0	1	1
24	*Euthalia monina*	0	1	1	1	6	7	8
25	*Euthalia whiteheadi*	0	0	0	0	1	1	1
26	*Faunin cannens*	0	0	0	0	1	1	1
27	*Hypolimnas bolina*	0	1	1	0	0	0	1
28	*Lexias perdalis*	0	0	0	0	1	1	1
29	*Melanithis phedima*	0	2	2	0	2	2	4
30	*Moduza procis*	1	1	2	0	0	0	2
31	*Mycalesis felderi*	2	3	5	3	1	4	9
32	*Mycalesis ita*	1	2	3	5	1	6	9
33	*Mycalesis lepcha*	1	0	1	0	0	0	1
34	*Mycalesis mineus*	7	17	24	26	32	58	82
35	*Mycalesis mnasicles*	0	1	1	0	0	0	1
36	*Mycalesis perseoides*	0	1	1	0	0	0	1
37	*Mycalesis perseus*	6	5	11	2	0	2	13
38	*Mycalesis sirius*	0	0	0	5	1	6	6
39	*Neorina lowii*	4	8	12	1	1	2	14
40	*Neptis hylas*	0	1	1	0	0	0	1
41	*Neptis vibusa*	1	0	1	0	0	0	1
42	*Polyura hebe*	2	1	3	1	1	2	5
43	*Protoe franck*	2	2	4	3	1	4	8
44	*Ragadia crito*	0	1	1	0	0	0	1
45	*Taenacia aegis*	1	0	1	0	0	0	1
46	*Taenacia coelebs*	4	4	8	2	0	2	10
47	*Taenacia iapis*	2	2	4	0	1	1	5
48	*Taenacia palguna*	8	7	15	3	3	6	21
49	*Taenacia pelea*	2	2	4	0	2	2	6
50	*Yptima philomela*	1	0	1	1	0	1	2
51	*Yptima praenubila*	0	0	0	1	1	2	2
52	*Zeuxidia amethystus*	1	0	1	0	0	0	1
	Total of Individuals	**91**	**136**	**227**	**99**	**91**	**190**	**417**
	Total of Species	**31**	**33**	**41**	**25**	**29**	**36**	**52**

Note: B (banana bait); P (pineapple bait)

SUMMARY

The diversity and abundance of butterfly species in forests is higher compared to jungle rubber, rubber plantation, oil palm plantation, riparian forest, riparian rubber plantation, and riparian oil palm plantation. Land use differences affect the diversity and abundance of butterfly species.

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