GLOBAL JOURNAL OF BIODIVERSITY SCIENCE AND MANAGEMENT
2017. 7(1): 1-10
ISSN: 2074-0875
Journal home page: http://www.aensiweb.com/ GJBSM/

RESEARCH ARTICLE

Diversity of Butterflies (Rhopalocera) and Spatial Distribution of Host Plants Using QGIS in Halang Lipa, Batangas, Philippines

[1]Jeffrey R. Manalo, [1,2]Alma E. Nacua, [1]Aleine Leilanie B. Oro, [1]Nikki Rose N. Tosoc, [1]Maria Rowena G. Zapanta, [1]Mary Grace D.C. Empasis, [1]Mark Joseph E. Mendoza, [1]Cariza Jane M. Soriano

[1]University of the East, Manila, CM Recto Manila Philippines and [2] Universidad de Manila, 659-A Cecilia Muñoz St, Ermita, Manila, Metro Manila

ABSTRACT

Background: There are few studies on butterflies, specifically in Halang Lipa Batangas City. **The aim of this paper:** is to determine the species composition and abundance of butterflies and the spatial distribution of host plant and nectarine plants with the used of QGIS. **Methods:** Rapid transect walk once on November 2016. **Results** revealed 25 species of butterflies belong to 22 genus to a family of Hespiridae, Lyceanidae, Papilionidae, Pieridae, Nymphalidae, and Satyridae of both in open and closed canopy forest. Butterflies are attracted to specific host plants and suitable nectarine plants to sustain life span, given the wrong host plant butterfly refuse to eat and die of starvation. **Conclusion:** The cluster analysis of the species composition has shown that the Dipterocarp forest have low similarity of species composition with only 50%, in both area of study. This supports the conservation of butterflies and host plants in Lipa Batangas.

Key words: QGIS, agro system, dipterocarp, Host plant, and nectarine plants,

Received; Accepted; Available online

Address For Correspondence:
Alma E. Nacua, LPT, PhD, University of the East, Manila Graduate School 2219 Recto Ave, Sampaloc, Manila, 1008 Metro Manila
Email add: almanacua@yahoo.com

INTRODUCTION

There were still scarcity of butterfly publications in the Philippines. A record of 1,615 species and subspecies of butterflies, forty-four percent (44%) of these species are endemic to the Philippines (Baltazar, Clare R., 1991). "Survey of the Rhopalocera (Lepidoptera) of Mt. Makiling" (Cayabyab, Bonifacio, F., 2000). This work provides important data relative to the host plant relationships (De Jong, R. And Treadway, G. Colin, 1993). An additional 59 species of Hespiriidae make a total of 1,674 species and subspecies all in all [3]. A recorded 142 species of butterflies at Mt. Hamiguitan, Davao Oriental, Philippines (Mohagan Alma, B., G. Treadaway Colin, 2009). La Union Botanical garden (LUBG), San Fernando La Union has 104 species recorded they belong to 6 families and 66 genera (Nacua Alma, E., et al., 2015) There were 22 species of butterflies recorded in Mehan Garden, Ermita, Manila belonging to 6 families of 17 genera. (Nacua Alma, E., et al., 2016) In Bulusukan, San Ildelfonso, Bulacan, 21 butterfly species belong to 19 genera, two (2) were found rare and 2 endemic were species (Nacua Alma, E., et al., 2016)

Halang Lipa, Batangas was a rolling dipterocarp forest overlooking the Taal volcano lake. Halang was a Filipino term meaning a barrier, and Lipa was the name of the city in the province of Batangas. According to the

To Cite This Article: Jeffrey R. Manalo, Alma E. Nacua, Aleine Leilanie B. Oro, Nikki Rose N. Tosoc, Maria Rowena G. Zapanta, Mary Grace D.C. Empasis, Mark Joseph E. Mendoza, Cariza Jane M. Soriano., Diversity of Butterflies (Rhopalocera) and Spatial Distribution of Host Plants Using QGIS in Halang Lipa, Batangas, Philippines. Glob. J. Biodivers. Sci. Manag, 7(1): 1-10, 2017

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local folks, Lipa got its name from a tree called *Dendrocnide meyeniana* (Urticaceae), a stinging leaves of trichrome. Many of these plant species found a barrier in the area of unnamed street and so people call it Barangay Halang, a good habitat for butterfly species .It was dipterocarp forest with many dried leaves on the ground. Many of Lyceanidae and Pieridae species of butterflies found on the ground sucking juices on it. Some of the butterfly sip moist and minerals from the soil, rotten fruits, animal manure and vomitus of hikers. The habitat is surrounded with a lake which is favorable for strong flyers like the Papilionidae, Danaidae and Nymphalidae. These butterflies' species found paddle on a lake water. The purpose of this paper is to study the species composition and abundance of butterflies and the spatial distribution of host plants and nectarine plants with the use of QGIS.

Methods and Sampling:

Sampling site:

Halang is a 95 meter above sea level (MASL) and a mixed dipterocarp forest, a closed and open habitats for sampling site. Global positioning system (GPS) is used to record the coordinates, at the open canopy that light can penetrate without intervals, having the temperature ranges from 23-26Ċ. Lux meter is used to analyze the luminosity of light in the deep forest. Permission were sought at the Barangay official of Halang Lipa Batangas.

Rapid Sampling Techniques:

A transect walk of 1000 m x 100 was performed. Butterflies collected were kept in a paper triangle. Only 1-2 butterflies were collected, photographs were also taken.

1. Classification and Identification- were referred to "Butterflies of the World," Checklist of butterflies of the Philippine Islands (Laithewaite, E., et al., 1975) and "Butterflies of the South East Asian Island" (Treadaway, C.G., 1995).
2. Assessment of Status of butterflies- was found on the checklist of Butterflies in the Philippines Islands [10] was used to determine the national status of butterflies at Halang, Lipa Batangas.

Fig. 1: The satellite map of Halang Lipa City, Batangas shown the transect lines which represent the open and closed habitat of dipterocarp forest. It was 95 meter above sea level (MASL) and a mixed dipterocarp forest. The coordinates: 13°56′28″N; 121°09′44″E.

Results and Findings:

Table 1: Records revealed that Checklist of butterflies of Halang, Lipa City, Batangas, were composed of 27 species in 24 Genera of butterflies, recorded, both in closed and open dipterocarp forest. There were 62 individual of butterflies found in an open habitat and 60 individual of butterflies found in the closed canopy forest, and a 112 of abundance of butterflies.

BUTTERFLY FAMILY/SPECIES	HABITAT		STATUS	
	OPEN	CLOSED	LOCAL	NATIONAL ASSESSMENT
Hespiridae				
1. *Bibasis harica* cosonbrina	0	3	Common	Common
Lyceanidae				
2. *Jamides cyta* amphisissimus	3	2	Rare	Very Rare
3. *Jamides elps* psueudolpis	4	3	Rare	Rare
4. *Chilades lajus* tavoyanus Evans,1925	3	1	Common	Rare
5. *Jamides celeno* asianus	1	1	Rare	Rare
6. *Nakaduba kurava* fujinkai hayasi 1786	5	4	Very Common	Common

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7.	*Sinthusia nasaka* amba	1	1	Common	Rare
8.	*Zizinia Otis* oriens (Butler) 1883	10	2	Very common	Common
Papilionidae					
9.	*Achilledes palinurus Daedalus Felder & Felder 1864*	0	1	Rare	Endemic
10.	*Menelaides ledebouria polytes Felder & Felder, 1864*	0	1	Very common	Very common
11.	*Troides magellanus Felder & Felder, 1862*	0	1	Common	Common
12.	*Papilio demoleus* libanius Fruhstorfer 1908	1	4	common	Common
Nymphalidae					
13.	*Athyma sp.*	1	1	Rare	Rare
14.	*Neptis mahendra* Moore, 1872	1	2	Common	Common
15.	*Panopria dama*	1	2	Common	Common
16.	*Hypolimnas bolina*	1	3	Common	Common
17.	*Ideopsis juventa* Cramer 1777	1	3	Common	Common
18.	*Parantica vitrina* (C. & R. Felder), 1861	2	3	Common	Endemic
Pieridae					
19.	*Cepora aspasia* olga (Stall) Eschscholtz 1821	3	1	Common	Common
20.	*Delias henningia* henningia Eschscholtz 1821	3	2	Common	Common
21.	*Eurema hecabe* hecabe (Linnaeus) 1758	5	3	Common	Common
22.	*Gandaca harina* mindanensis Fruhstorfer 1910	4	2	Common	Common
23.	*Leptosia nina* georgi Fruhstorfer 1910	5	3	Common	Common
Satyridae					
24.	*Mycalesis visala* phamis	2	3	Rare	Rare
25.	*Mycalesis mineus* meneus malayana	2	3	Rare	Rare
26.	*Mycalesis fusca* fusca (C. & R. Felder), 1860	2	3	Rare	Rare
27.	*Ytima baldus* necoboldi	1	2	Very Common	Common, Endemic

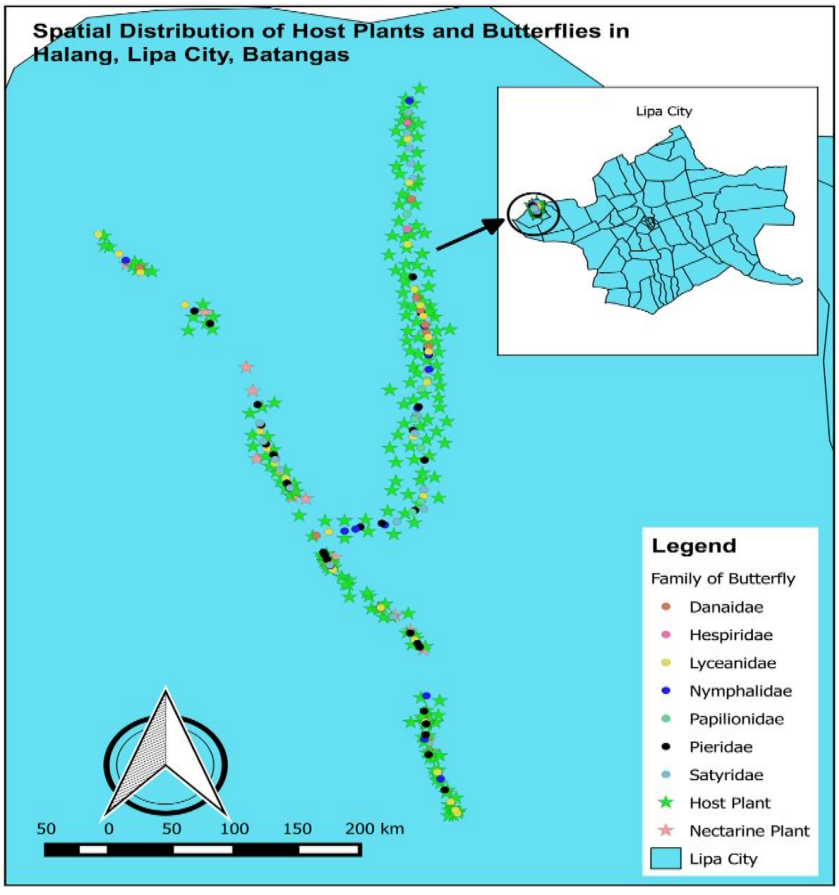

Fig. 2: The spatial distribution of Host plants and Butterflies of Halang Lipa Batangas which is supported by Table 1 and Table 5. List of butterflies and specific host plants.

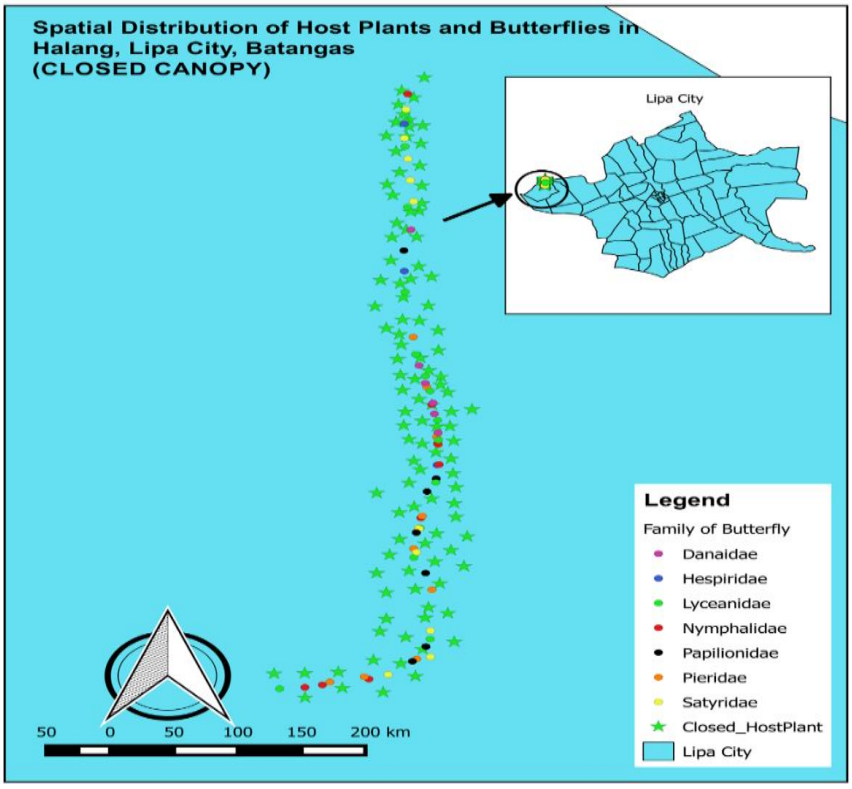

Fig. 3: The spatial distribution of host plants and butterflies in a closed dipterocarp canopy. There were 151 host plants and 60 individuals of butterflies found in closed canopy forest.

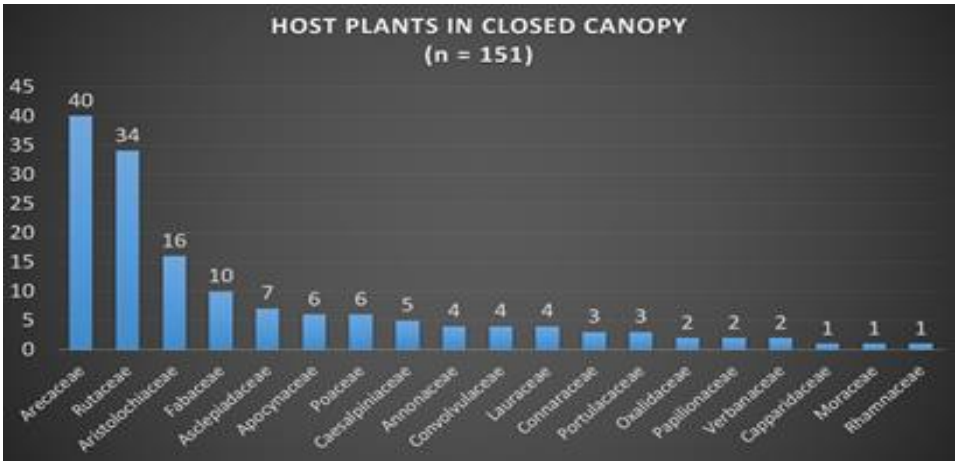

Fig. 4: The 151 host plants found in closed canopy belonging to the family of Arecaeae, Rutaceae, Aristolochiaceae, Fabaceae, Asclepiadaceae, Poaceae, Caesalpinaceae, Annonaceae, Convolvulaceae, Lauraceae, Connaraceae, Portalaceae, Oxalidaceae, Papilionaceae, Verbenaceae, Capparidaceae, Moraceae, and Rhamnaceae.

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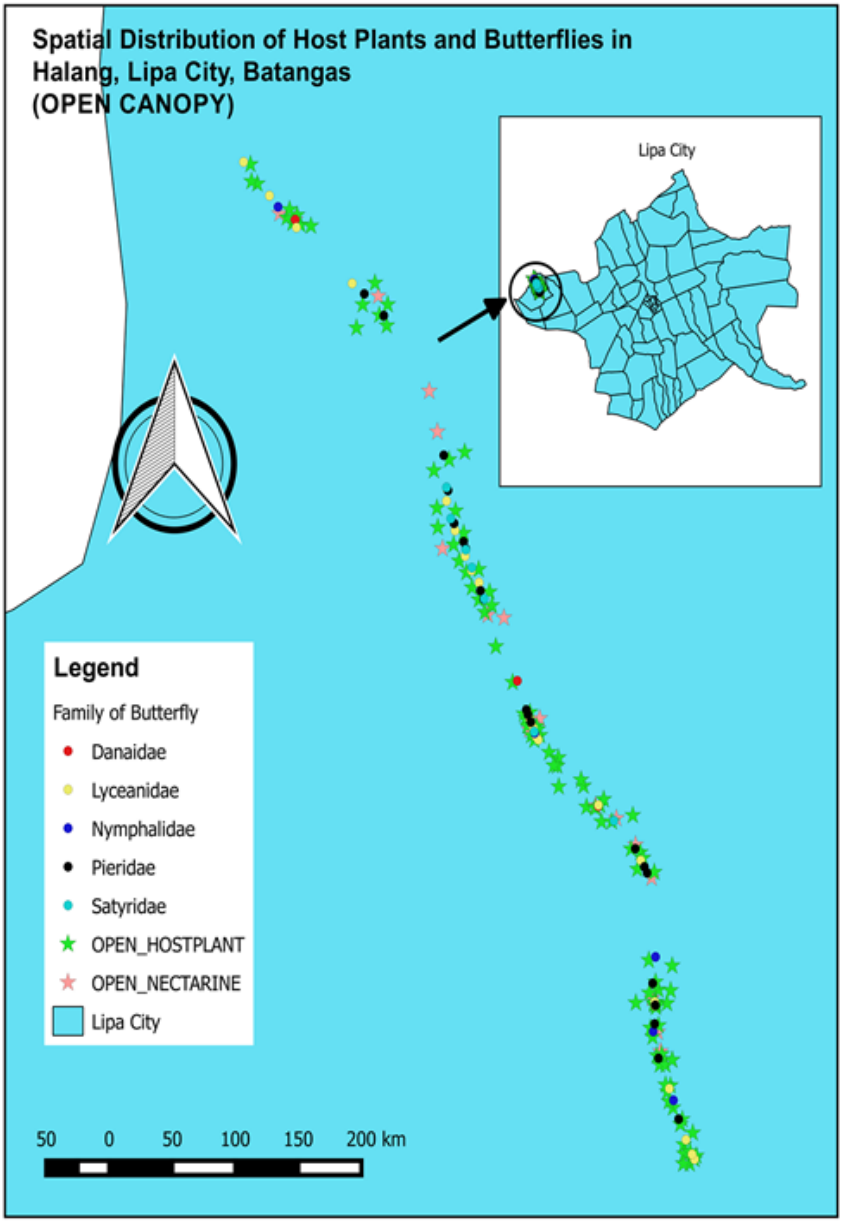

Fig. 5: The spatial distribution of Host plants and butterflies in an open agro system habitat of Halang, Lipa City. There were 115 host plants and 18 nectarine plants. And 62 individuals of butterflies. Butterflies were attracted to the intensity of light and the presence of nectarine plants and specific host plants to complete the life cycle of the butterflies

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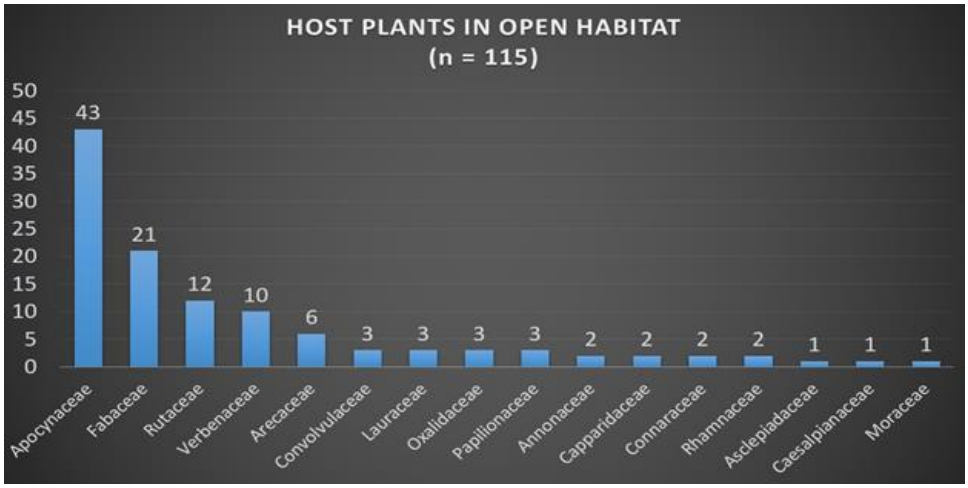

Fig. 6: The 115 Host plants found at the open habitat found on this bar graph, Apocynaceae. Fabaceae, Rutaceae, Verbenacae, Arecaeae, Convolvulaceae, Lauraceae, Oxalidaceae, Papilionaceae, Annonaceae, Capparidaceae, Connaraceae, Rhamnaceae, Asclepiadaceae, Caesalpinaceae, Oxalidaceae.

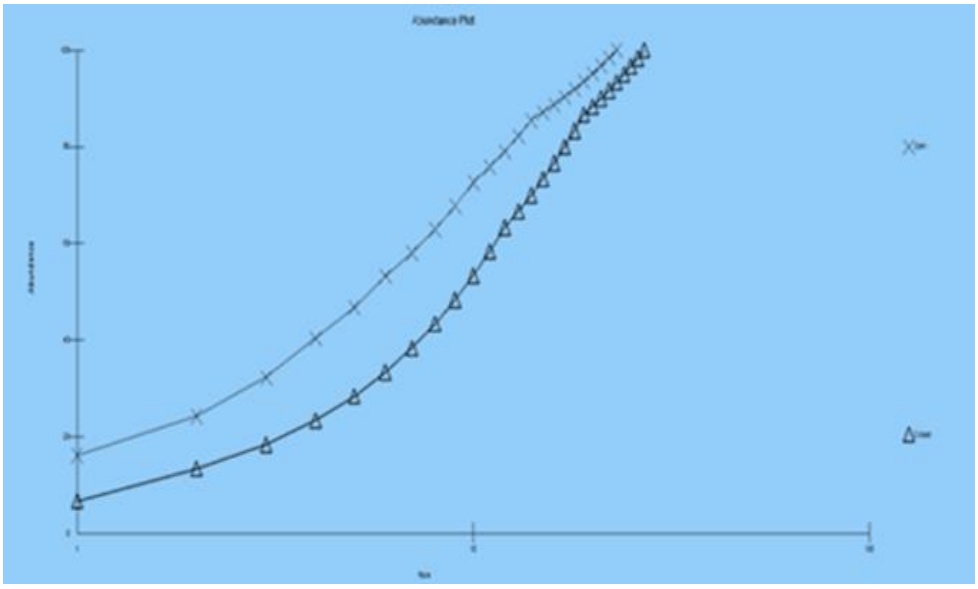

Fig. 7: Shows the Abundance plot characterized species richness both in open and in closed habitat. There were 27 species composition both in open and closed canopy.

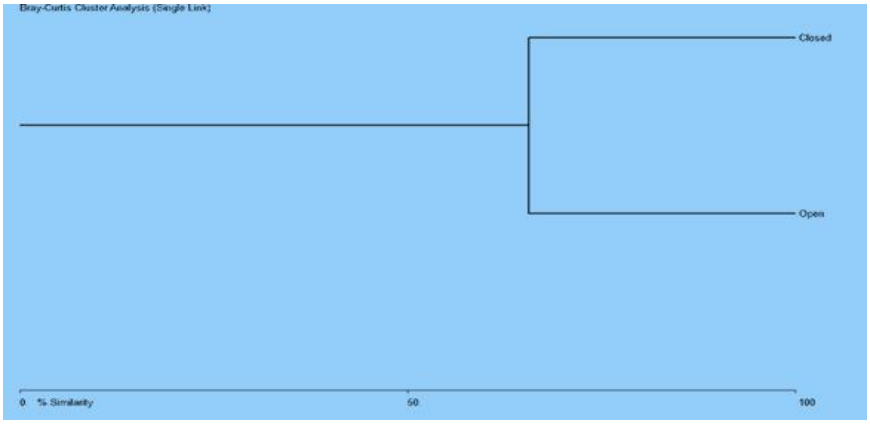

Fig. 8: Shows the Dendrogram (Bray Curtis Analysis): suggest that the similarity between the Open and close habitat were 50%. It was suggested that the two (2) area of study are consistent which each other and the remaining 50% is inconsistent.

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Table 2 below shows the Descriptive analysis in a closed and open habitat strengthens the findings of table 1, 2, 3, that valued in an open habitat (2.296) were much greater than in closed canopy (2.222). Indeed many of the butterflies were attracted to sunlight and the presence of host plants and nectarine plants. While in closed canopy, there was also an indication of presence of butterflies due to presence of host plants. Butterflies rest in the shady forest.

Table 2: Descriptive Analysis

1	Sample	Mean Individuals	Variance	Standard deviation	Standard error	Total individuals	Total species	Minimum	maximum	Mean interval
2	Open	2.296	4.832	2.198	0.423	62	23	0	10	1.823
3	Closed	2.222	0.949	0.974	0.187	60	27	1	4	0.358

Table 3 shows the Correlation between butterflies in a closed dipterocarp forest and open agro system. An open forest was perfectly correlated and in a closed dipterocarp was mildly correlated. This was supported by the presence of host plants and appropriate nectarine plants (Mohagan Alma, B., G. Treadaway Colin, 2010) considering the distance from open habitat and to closed dipterocarp forest was not too far with each other.

Table 3: Correlations between butterflies in open and closed dipterocarp

1		open	closed
2	Open	1.	*
3	Closed	0.2375	1.

Table 4. The tables below are the families of nectarine plants. They were repeatedly visited by butterflies in two vegetation types (Closed and Open). Butterflies were attracted to volume of nectar found on the pistil of flowering plants. Nectar consist of sugar, glucose and fructose (Schneider, Christine, 2003). Butterflies sips on nectar to sustain its plight pattern. They patrol under the heat of the sun drying wings, searching for mate and a suitable host plant to oviposit eggs. With a sustainable supply of host plants and nectarine plants, butterflies keep flying back and forth to their habitat. These species of nectarine plants were observed outside the transect walk of 1000 m but within the 100 m distance.

Table 4: Nectarine plants and butterfly families

Family and species	Butterfly Family	No of times (x) of nectarine
Rubiaceae- *Ixora sp. Carphalea kirondon Bail. Pentas lanceolata Deflers,*	Danaidae, Nymphalidae, Papilionidae, Pieridae, Satyridae,	50x repeatedly
Asteraceae- *Cosmos sulphurreus L., Helinathus annus L. Chromolaena odorata King, Zinia elegans Jacq.*	Lyceanidae, Danaidae, Nymphalidae, Pieridae, Papilionidae, Satyridae,	38x repeatedly
Verbenaceae, *Lantana Camara L., Stachytarpheta jamaicencsis*	Lyceanidae, Danaidae, Nymphalidae, Pieridae, Papilionidae, Satyridae,	28x repeatedly
Compositae- *Helianthus annus L. Zizinia elegans, Tithonia diversifolia*	Satyridae, Nymphalidae, Papilionidae,	20x repeatedly
Apocynaceae- *Catharantus roseus, Nerium oleander*	Danaidae, Satyridae, Nymphalidae,	20x repeatedly

The families of nectarine plants i.e Rubiaceae, Asteraceae were the most predominant nectarine food plants, because of high nectary production with sucrose being most concentrated sugar. Among the pollinators, the family Danaidae, Nymphalidae and Papilionidae are the common denominators of all nectarine plants from the families of Rubiaceae and Asteraceae. The plants Ixora sp. cosmos sulphureus and Chromolaena odorata are all pollinated by butterflies' species.

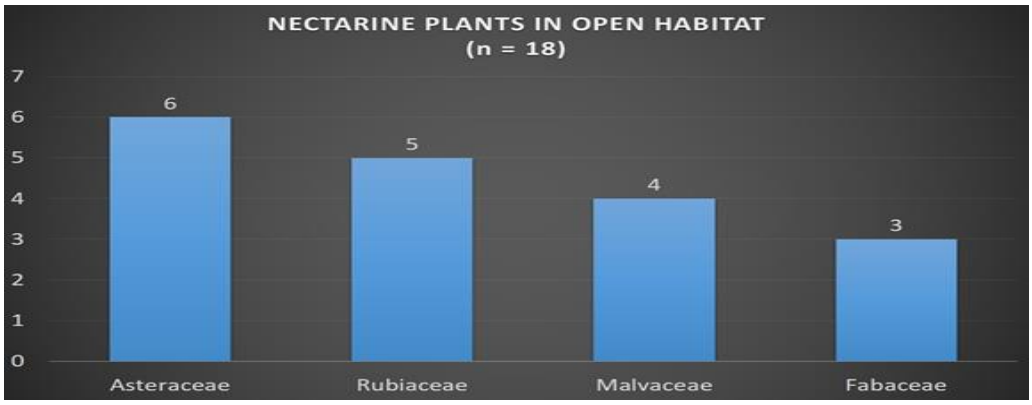

Fig. 9: Shows the Families of Nectarine plants found within the transect line, of 1000 m, butterflies visited either perching, or nectarine.

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The study site at Halang, Lipa Batangas City:

Fig. 10: Open habitat- 280 lux

Fig. 11: Closed habitat 350 Lux

Table 5 below shows that butterfly species and host plants found in closed and open forest in Halang, Lipa Batangas, were also similar in Dipterocarp forest of La Union Botanical garden. Butterflies are host plant specific. Once you feed the butterfly with the wrong host plants, they will die of starvation as they refused to eat.

Table 5: Butterflies and Host plants of Halang, Lipa Batangas.

Butterfly species	Specific larval host plants
Hespiridae	
Bibasis harica cosonbrina	Catharantus roseus (Apocynaceae), Lantana camara (Verbenaceae)
Papilionidae	
Achilledes palinurus Daedalus Felder & Felder 1864	*Micromelum minutum* Forsst f. (Rutaceae)
Menelaides polytes ledebouria Felder & Felder, 1864	*Micromelum minutum* Forsst f. (Rutaceae) *Citrus nobilis* Andr. (Rutaceae)
Troides magellanus Felder & Felder, 1862	*Aristolochia philippensis* Warb. (Aristolochiaceae)
Papilio demoleus	*Citrus aurantifolia* (Rutaceae), *Citrus mitis* (Rutaceae), *Citrus nobilis* Andr. (Rutaceae), *Citrus microcarpa* bunge (Rutaceae),
Pieridae	
Cepora aspasia olga (Stall) Eschscholtz 1821	*Pterocarpus indicus* (Fabaceae),
Delias henningia henningia Eschscholtz 1821	*Cassia fistula*, (Fabaceae),
Eurema hecabe hecabe (Linnaeus) 1758	*Cassia alata* (Fabaceae), *Cassia fistula* (Fabaceae),
Gandaca harina mindanensis Fruhstorfer 1910	*Ventilago oblingifolia* Blm. (Rhamnaceae), *Cassia alata* (Fabaceae),
Leptosia nina georgi Fruhstorfer 1910	*Cassia alata* (Fabaceae) , *Cassia fistula* (Fabaceae).
Nymphalidae	
Ideopsis juventa Cramer 1777	*Toxocarpus rubricaulis* Elm. (Asclepiadaceae)
Parantica vitrina (C. & R. Felder), 1861	*Calotropis gigantea* (Wild)(Apocynaceae)
Neptis mahendra Moore, 1872	*Broussonetia papyrifera* (L.) Vent (Moraceae)
Hypolimnas bolina (Nymphalidae)	*Ipomoea batatas* (Convolvulaceae)
Mycalesis visala phamis	*Imperata sp.* (Poaceae)
Mycalesis mineus meneus malayana	*Bambusa sp.* (Poaceae),
Lyceanidae	
Jamides cyta amphisissimus	*Lantana camara* (Verbenacae)
Jamides elps psueudolpis	*Litsea glutinosa* (Lour.) C.B. Rob. (Lauraceae) *Lantana camara* (Verbenacae) *Pithecellobium dulce* (Roxb) Benth.
Chilades lajus tavoyanus Evans,1925	*Litsea glutinosa* (Lour.) C.B. Rob. (Lauraceae), *Lantana camara* (Verbenacae)
Jamides celeno asianus	*Delonix regia* (Borg. ex. Hook) Raf. (Caesalpinaceae), *Lantana camara* (Verbenacae), *Pithecellobium dulce* (Roxb) Benth.
Nacaduba kurava fujinkai hayasi 1786	*Lantana camara* (Verbenacae), *Pithecellobium dulce* (Roxb) Benth.
Sinthusia nasaka amba	*Indigofera spicata* Forssk. (Papilionaceae) *Pithecellobium dulce* (Roxb) Benth.
Zizina Otis oriens (Butler) 1883	*Indigofera spicata* Forssk. (Papilionaceae), *Lantana camara* (Verbenacae), *Pithecellobium dulce* (Roxb) Benth.

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Discussion:

Species Diversity:

Species composition:

Results revealed that that there were 27 species both in open and closed canopy forest. As to national status of butterflies, nine species were found rare, *Jamides cyta amphisissimus, Jamides elps psueudolpis, Jamides celeno asianus, Achilledes palinurus Daedalus Felder* & Felder 1864, *Sinthusia nasaka* amba, *Athyma sp*., *Mycalesis visala phamis*, *Mycalesis mineus meneus* malayana, *Mycalesis fusca fusca* (C. & R. Felder), 1860.

Three (3) were found endemic in the area, *Achilledes palinurus Daedalus* Felder & Felder 1864, *Parantica vitrina* (C. & R. Felder), 1861, *Ytima baldus* necoboldi. The open and closed canopy are two (2) different vegetation's. Vegetation types might be the most important factor that affects the diversity of the species. This result is consistent to Butterfly species that are highly diverse with some concordant species in the montane forest. Fair levels of diversity in some unique habitats like dipterocarp, mossy, and pygmy forest of Mt. Hamiguitan has disconcordant species . Halang Lipa Batangas has an open agronomy and with grass land while the closed canopy were a dipterocarp forest, mostly tall shaded trees that the light penetrates the ground with a 350 LUX. It is like coconut plantation and in between these trees you may find the host plants found on table 5. On the ground, many of dried leaves and rotten citrus fruits found thrives by species of butterflies like the Pierid, lyceanid and Papilio. Host plants feeds on butterfly larva. And nectarine plants feeds on the adult butterflies. These host plants were identified both in open and closed canopy forest. Although, butterflies are heat loving insects, they fly back and forth from closed canopy to an open habitat due to intensity of light Lux meter recorded a 280 Lux. Butterflies are cold loving insects that they dry wings by flying under the heat of the sun.

Species abundance:

Rapid sampling once in a month was a short period of time, it could have been represented by all species of butterflies however, despite a short period of time. This study documented one hundred (112) of individual butterflies in both areas of study. Sixty (60) individual of butterflies and one hundred fifty one (151) species of host plants in closed canopy forest. While in an open habitat. There were sixty two (62) individual butterflies and one hundred fifteen (115) species of host plants and eighteen (18) species nectarine plants were studied, which was described in the spatial distribution using QGIS. In both habitat, characteristics and landscape structure influenced species numbers and abundance of butterflies in grasslands. [16] Butterflies were observed host plants specific. They stayed in the area of study when there are abundance of host plants and nectarine plants to sustain their life cycle.

Similarity Index:

Dendrogram (Bray Curtis Analysis): suggests that the similarity between the Open and close habitat is 50%. It is because the distance between the two (2) areas of field study were not very far from each other. The clustering of the agroecosystem and dipterocarp in the closed canopy can explained 50% slight similarity of abundance of butterflies with the Agro system.

Conclusion:

Halang, Lipa Batangas is the habitat for 27 species of butterflies both in an open and closed canopy dipterocarp forest. Among the butterflies, only 9 were rare, 2 were endemic, and 16 were endemic. Similarity index using Bray Curtis conclude that 50% both in an open and closed canopy forest. Spatial distribution of butterflies, host plants and nectarine plants are well distributed in both area of study.

ACKNOWLEDGEMENT

The authors would like to thank the support of Dr. Julian Abuso and Dr. Lourdes Terrado, of the University of the East, Manila, for their endless support. Special thanks to the family of Mr. Antonio M. Oro and Hon. Leilanie B. Oro for the warm accommodation and to Mr. Elpidio de Roxas for his guidance during the sampling.

Conflict of interest:

The authors declare that there was no conflict of interest in writing this paper.

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