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THE LA UNION BOTANICAL GARDEN PHILIPPINES REVISITED: ASSESSMENT AND DIVERSITY OF BUTTERFLIES AND THEIR FOOD PLANTS

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ABSTRACT

The butterfly sanctuary at the La Union Botanical Garden (LUBG) is the largest of its kind in the Philippines in terms of butterfly population. This study gives the details of the species richness and diversity of butterflies and their food plants at LUBG. A total of 158 butterfly and 77 food plant species were collected and identified by standard methods. Butterfly and food plant species richness are well correlated with diversity and areal density in all vegetation types surveyed. The collections comprised 17 endemic and 18 rare butterfly species that are predominantly represented by the families Nymphalidae, Pieridae, Papilionidae, Danaidae, Satyridae and Lycenidae. The food plants were widely represented by the families Rubiaceae, Asteraceae, Apocynaceae and Verbenaceae, yielding high diversity indices in 3 out of 6 vegetation types. This study was able to assess the species richness and diversity of butterflies and their food plants at LUBG.

Key words: Butterfly sanctuary, La Union Botanical Garden.

INTRODUCTION

A balance in the ecosystem exists among butterflies, their food plants and natural enemies such as insects and birds at the La Union Botanical Garden (LUBG) where the Philippine's largest butterfly sanctuary in terms of butterfly population is situated. LUBG is a 10 hectare garden, situated at $160^{o}55'30''$N and $120^{0}33'20''$E, the vegetation of which contains tropical flowering, medicinal as well as scented plants that host a great variety of arthropods. It is highlighted by a dipterocarp garden lined with opposite rows of *Diospyros philippinensis* A.DC. and *Mangifera indica* L. An arid garden grows several cacti, palms, *Heliconia* sp., *Bambusa* sp., *Morinda* sp. and *Ananas comosus* (L.) Merr. A previous study by Nacua et al [1] preliminary assessed the species richness of butterflies at LUBG as well as their natural enemies and preference for nectarine food plants. In this paper, the finer details of correlating species, diversity and densities among butterflies and their food plants at LUBG were assessed.

MATERIALS AND METHODS

Butterfly Collection

Butterflies were collected by the paper triangle method [2] by random in both sunny and shaded areas. The density of butterflies and their food plants per square meter was plotted by considering jungle to entrance latitudes and longitudes. Butterflies were relaxed in wide-mouth air-tight flint bottles containing cotton wools saturated with phenol and chloroform (1:1). Alternatively, about 1 mL of lukewarm water was injected into the thorax. An electric dryer was used to blow dry the specimens to remove debris after which butterflies were mounted using insect pins on a white board. Butterflies were identified according to an atlas by Baltazar [3].

Plant Collection

Plants at LUBG were collected randomly in 6 vegetation types from January to December of 2013 to ensure their flowering and fruiting stages. Plants were pressed in between newspapers after which they are poisoned with denatured alcohol – phenol (4:1) [4].

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Herbariums were prepared by mounting the plants on white boards with official labels. The specimens were authenticated at the Philippine National Herbarium.

Statistical Treatment

Replicate measurements were stated as mean ± standard error of the mean. Means were compared by 2-tailed t-test and the 90% confidence interval. Plots of species densities against area were analyzed by linear regression and Pearson r. The chi-square was used to correlate diversity indices with species density. Similarity factors were used to compare areas under the curve (AUCs).

RESULTS AND DISCUSSIONS

Butterfly Species Richness

A total of 400 butterflies representing 158 species belonging to 289 genera and 8 families were collected. The samples were largely represented by the families Nymphalidae (n = 65 or 22.5%), Pieridae (n = 60 or 20.8%), Papilionidae (n = 54 or 18.7%), Danaidae (n = 40 or 13.8%), Satyridae (n = 37 or 12.8%) and Lycenidae (n = 30 or 10.4%). The families Riodinidae and Libythidae were scarcely represented with 2 and 1 species each, respectively. Figure 1 compares areal butterfly density between the sunny and shaded areas of the butterfly sanctuary at LUBG. There is a good positive correlation between butterfly density and land area in both the sunny ($r > 0.9475$) and shaded ($r > 0.9416$) areas. The similarity factor between the sunny and shaded areas is more than 50% (i.e., $f_2 = 72.3\%$). In addition, the ratio of the AUCs between the sunny and shaded areas gave a 90% confidence interval of 98.7 – 111.2% at $p = 0.05$. These findings suggest that the increasing presence of butterflies at the sanctuary, regardless of genera, family and vegetation type, is influenced by increasing habitat size.

Butterfly Diversity

Table 1 compares different diversity indices for butterflies collected in the sunny and shaded areas of LUBG. Based on chi-square and linear regression correlation, there appears to be no significant difference among the 3 diversity indices when compared against number of species ($r > 0.9822$). Comparison of the results in Table 1 with the previous findings of Nacua et al showed no appreciable differences in terms of combined diversity indices between the sunny and shaded areas suggesting that high species diversity is not affected by the influence of sunlight and that butterflies at the sanctuary can be migratory by traversing any types of vegetation. Visual observations show that butterflies at LUBG thrives where there are abundance of food plants, water supply particularly at the creek sides, wet leaves and branches, manure and rotten fruits at the mango avenue.

Food Plants Species Richness

There are 77 nectarine flowering plants collected and identified from the butterfly sanctuary alone. These plants are dominated by the family Rubiaceae (n = 39 or 21.9%) which is represented abundantly by the genera *Ixora* L. and *Morinda* L. This is followed by the families Asteraceae (n = 21 or 11.8%), Apocynaceae (n = 16 or 9.0%) and Verbenaceae (n = 15 or 8.4%). Several plant assessments conducted in the Philippines show the predominance of the Rubiaceae family such as in the studies of Laurente et al [5] in Mt. Kingfisher Park in the Palawan archipelago, Raterta et al [6] in the Batanes archipelago and Prigge et al [7] in the Leyte Cordillera tribes. Figure 2 shows the proportion of the natural habits of the 178 plants collected from the 6 major vegetation types at LUBG while Table 2 shows the tree statistics and diversity indices. The abundance of trees over shrubs, herbs and woody vines at LUBG is due to the increased tree planting projects over the past 2 decades, although several dipterocarp trees have already been in existence for centuries. *Mangifera indica* L., *Pterocarpus indicus* Wild., *Bambusa* sp. and *Diospyros blancoi* A.DC. were abundantly found lining the pathways in the butterfly sanctuary, the dipterocarp forest and the Japanese garden for which more than 2000 trees were accounted for. The significantly greater tree dimensions ($p < 0.01$) and higher plant diversity indices in the butterfly sanctuary, the dipterocarp forest and the Japanese garden over the other vegetation types offers host advantages to insects, arachnids and birds which interact with the butterflies either mutually, commensally or as preys.

Figure 3 compares the plots in areal plant densities between the 2 vegetations at the butterfly sanctuary of LUBG. There is a similar plant density between the sunny and shaded areas up to an area of 32 sq. m. ($f_2 = 78.5\%$; 90% confidence interval for AUC = 97.6 to 108.9% at $p = 0.05$). From 64 to 256 sq. m., the f_2 significantly dropped to 47.9% which is below 50%, the required f_2 level to ascertain similarities among variables. Deconvolution of Figures 1 and 3 to correlate butterfly with plant densities shows that there is a high correspondence between plant and butterfly populations in both sunny ($r > 0.95$) and shaded ($r > 0.97$) areas.

Table 1. Butterfly Diversity Indices at the La Union Botanical Garden

Vegetation Type	No. of Species	Diversity Indices		
		Shannon's	Dominance	Simpson's
Sunny Area	82	4.41	1.11	0.76
Shaded Area	78	4.28	1.25	0.81

Table 2. Tree Statistics and Plant Diversity Indices at the La Union Botanical Garden

Vegetation Type	No.of Tree Species	Mean Tree Dimensions		Plant Diversity Indices (n = 178)		
		Height(Meters)	Diameter (Cms.)	Shannon	Dominance	Simpsons
Butterfly Sanctuary	21	7.34 ± 1.02*	71.2 ± 3.8*	6.24	0.89	0.31
Dipterocarp Forest	22	7.11 ± 0.97*	67.5 ± 4.7*	4.92	0.85	0.23
Japanese Garden	11	6.97 ± 1.13*	68.4 ± 2.8*	4.69	0.71	0.19
Chinese Garden	10	4.23 ± 0.56	56.3 ± 3.1	2.34	0.42	0.11
Sunken Garden	9	4.11 ± 0.38	48.2 ± 4.5	1.88	0.39	0.1
Fragrance Garden	6	3.72 ± 0.67	50.4 ± 2.9	1.69	0.21	0.08

*p < 0.01 vs. Chinese, Sunken and Fragrance gardens.

Table 3. Endemic and Rare Butterflies at the La Union Botanical Garden

Family	Endemic	Rare
Lycaenidae	*Cheritea orpheus orpheus* C. & R. Felder (1862)	*Arhopala myrzala* Hewitson (1869) *Chilades mindora* C. & R. Felder *Jamides celeno lydanius* Cramer (1775) *Jamides cyta koenigswarteri* Schr. (1984) *Spindasis syama negrita* C. Felder (1862)
Papilionidae	*Achilledes palinurus sempera* Felder (1787) *Menelaides helenus hystaspes* L. (1758) *Troides magellanus C. & R.* Felder (1862)	*Atrophaneura sempera* C.& R. Felder (1861) *Chilasa clytia paliphates* Westwood (1844) *Pachliopta Kotzebuea asina* Tsukada (1821)
Nymphalidae	*Amathusia phidippus pollicaris* Butler (1870) *Athyma saskia* Schroeder and Treadaway (1991) *Mycalesis tagala-tagala* C. & R. Felder (1863) *Pantoporia dama* Moore (1858) *Parantica luzonensis* C. & R. Felder (1863) *Phalanta phalanta* Drury (1773) *Ptychandra lorquinii* C. Felder (1861) *Vindula dejone* Erichson (1834) *Ypthima sempera* C. & R. Felder (1863) *Zethera pimplea* Erichson (1834)	*Cethosia biblis insularis* C. & R. Felder (1867) *Charaxes semper semper* C. & R. Felder (1878) *Euploea sempera laetifica* Butler (1866) *Mycalesis kashiwaii pula* Aoki Uemura (1982) *Mycalesis mineus philippina* Moore (1866) *Mycalesis perseus caesonia* Wallgreen (1860) *Neptis* sp. Fabricius (1807)
Pieridae	*Appias maria* Semper (1875) *Appias phoebe* C. & R. Felder (1861) *Cepora boisduvaliana* C. & R. Felder (1862)	*Appias nero domitia* C. & R. Felder (1862) *Delias baracasa benguetana* Inomata (1979) *Delias georgina* C. & R. Felder (1861)

Figure 1. Butterfly Density Plot at the Butterfly Sanctuary, La Union Botanical Garden

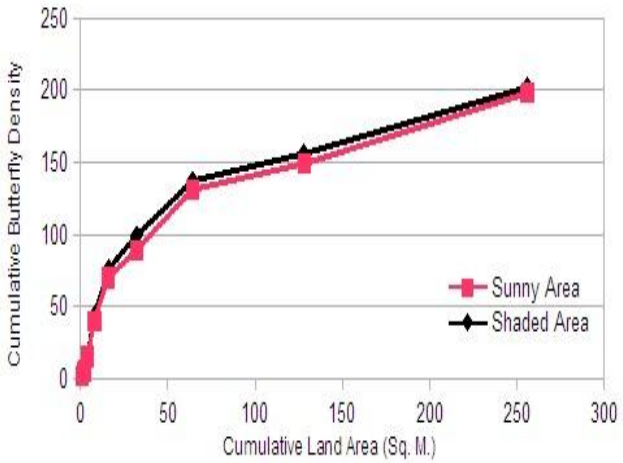


Figure 2. Distribution According to Habits Among Plants at the La Union Botanical Garden

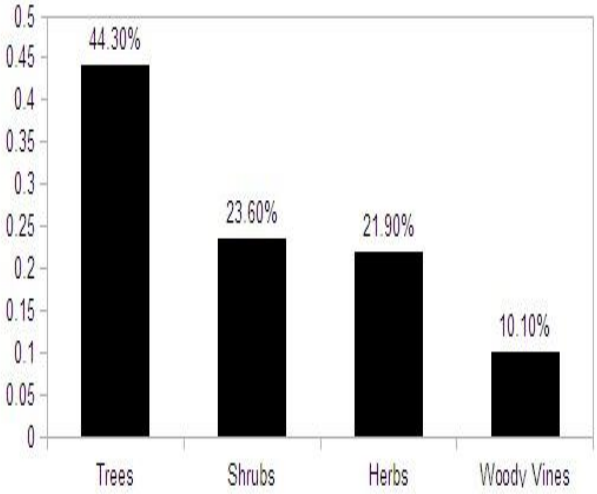
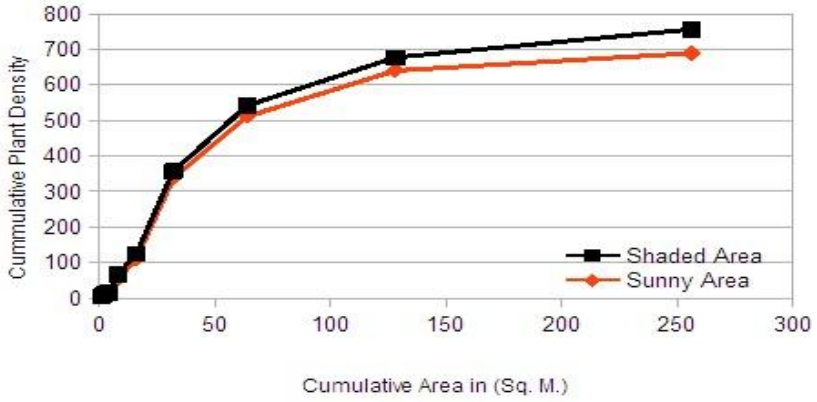


Figure 3. Plant Density Plot at the Butterfly Sanctuary Perimeter of the La Union Botanical Garden



Endemic and Rare Butterflies

Table 3 shows 17 endemic and 18 rare butterfly species among 4 families from the 158 species collected.

CONCLUSION

This study was able to assess butterflies and their food plants at LUBG. A good correspondence was obtained between butterfly species richness and diversity was obtained in both sunny and shaded areas of the butterfly sanctuary. The 158 butterfly species collected, consisting of 17 endemic and 18 rare or endangered species, were largely represented by the families Nymphalidae, Pieridae, Papilionidae, Danaidae, Satyridae and Lycenidae. Areal density correlated well with food plants population. Assessment and diversity of the 77 food plant species at the butterfly sanctuary of LUBG showed the predominance of the families Rubiaceae, Asteraceae, Apocynaceae and Verbenaceae and comparatively higher diversity indices in 3 out of 6 major vegetation types from which the plants were collected.

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