BUTTERFLY DIVERSITY IN OBAFEMI AWOLOWO UNIVERSITY, ILE IFE, SOUTH-WEST NIGERIA

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Abstract

Butterfly diversity on Obafemi Awolowo University, Ile Ife, was investigated by the use of sweep nets along transects in different sites. The sites include; Parks and Gardens, Zoological Garden, Oxidation Pond, Botanical Garden, Teaching and Research Farm, New Bukkateria and open fields. Data was analyzed with descriptive statistics (%), Shannon-weiner's species richness index and Margalef's species diversity index. A total of 317 butterflies belonging to 41 species in 12 sub-families and five families were identified in this study. Nymphalidae was the highest in terms of abundance and species richness. This family accounted for 47 % of the total butterfly collection represented by 22 species while the least family, Papilionidae was represented by two species and accounted for 7.9 % of the total collection. The most abundant butterfly species recorded in this study was *Papilio demodocus* (Papilionidae) with 18 individuals, while *Borbo bevani (*Hesperidae) occurred with the least number (2). Generally, three genera from two families; *Junonia*, *Acraea* (Nymphalidae) and *Nepheroni* (Pieridae) were abundant than the others. Two sites (Parks and Gardens, Teaching and Research Farm) with larger water resources, heterogenous vegetation and grassland, had greater abundance of butterflies than the other sites.

Keywords: butterfly, diversity, abundance, Obafemi Awolowo University, Nigeria.

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Introduction

Butterflies (Lepidoptera) belong to probably the most popular order of insects and serve as good ecological indicators for other invertebrate taxa (Kremen, 1994; Kumar *et al,* 2009). They are generally considered as surrogate representatives of environmental quality changes. They perform essential ecosystem services (Schmidt and Roland, 2006) especially in the recycling of nutrients (NPK) and in pollination of both agricultural and natural plants. In addition, butterflies are food to birds, other predators and host to several parasitoids that suppress crop pests (Summerville *et al,* 2001). Butterflies are usually very sensitive to disturbances, which make habitat fragmentation, degradation and destruction of natural landscape, some of the most important causes for declines in the butterfly assemblages (Uehara-Prado *et al,* 2007).

Butterflies are also strongly associated with vegetation structure and composition which make them a suitable indicator taxon for various ecological studies (Lomov *et al,* 2006). Their sensitivity to environmental changes, responsiveness to bio-diversity patterns of other taxa, the comparatively well known life history and the fact that they are relatively easy to observe, catch and identify, all together make this order convenient for use in the monitoring of forest disturbances (Cleary, 2004).

The value of diversity of an ecosystem is viewed in

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terms of numbers of species interacting among themselves and with their physical environment. Undoubtedly, tropical forest ecosystems are globally under much pressure and such, stress on disturbed forests is very likely to escalate (Terborgh, 1999; Lewis, 2002). Even, the best protected areas may not be sufficient to maintain the original ecosystems because of their little magnitude and difficult political and social circumstances (Terborgh, 1999; Najam, 2002). Holling *et al* (1995) maintained that the removal of certain species seems to have minimal effects on the functioning while the deletion of others induces a serious transformation from one ecosystem type to another. Moreover, the rising human influence and associated degrees of pressure and shocks on the ecosystem have resulted into changes which many butterfly species cannot adapt to. Thus, many butterflies are threatened owing largely to habitat loss and modification. Indeed, concern for the earth bio-diversity (to which butterflies are part) is on the increase (Okali, 2010) and this arises from the observation that bio-diversity is being rapidly depleted, seriously threatening the continued support that nature provides for human existence and development.

The estimation of such bio-diversity within a given habitat, community or area is scientifically necessary in order to gather baseline information for the biological assessment of the environment. Vane-wright *et al* (1991) reported that the knowledge of bio-diversity is needed to understand and appreciate the natural world as well as the natural and artificial changes it may experience. No published data exists which describes the diversity of butterflies found in Ile Ife area. However, such information is important for butterfly bio-diversity and ecosystem service conservation within this region. This is imperative because of the extent of anthropogenic disturbance this area is constantly exposed to, suggesting that the habitat may not support diverse butterfly community, hence the hypothesis that this study-area may not possess habitat suitable for diversed butterfly community. This study therefore, seeks to document the butterfly diversity in Obafemi Awolowo University and to determine the status of the various sites sampled and suggest ways or ideas on conservation of butterfly bio-diversity.

Materials and methods

Study area

The study was carried out on Obafemi Awolowo University, Ile Ife, Osun State, Nigeria. Ile Ife (south-western Nigeria) is located in the rainforest region of Nigeria on Latitude 07º 30′-07º 35′N and Longitude 004º 30′-004º 35′E. The study-area comprised three major gardens (which are semi-protected areas); university campus with dense vegetation, some large open spaces and four large water resources. The habitat ranged from wild forests, Botanical and Zoological Gardens, bare lands, ornamental plants (especially around Parks and Gardens Unit) to agricultural land (Teaching and Research Farm). The parks and natural areas are separated from one another by minor roads and streams providing wide range of habitats for butterflies in and around the university community. The vegetation of the area range from typical rainforest through degraded forest to mosaic forest inter-phase. The vegetation-type can be described as the Guinean Congolean forest (Adeniyi and Olabanji, 2005). Trees in the area shed their leaves in the dry season (November to March), produce new leaves with the onset of the rain in April and attain full canopy leafiness from July to August (Muoghalu and Johnson, 2000). The mean annual rainfall is 1,389 mm (Adediji, 2003) and the atmospheric temperature ranges from 21ºC-34ºC (Adeniyi and Olabanji, 2005). The selected sampling sites within the study-area include Parks and Gardens, Zoological Garden, Oxidation Pond, Botanical Garden, Teaching and Research Farm, New Bukkateria and Open Fields. The sampling sites were selected based on their accessibility, differing elevation and habitat types. The sites are mainly natural areas, forest ecosystems and semi-protected areas with different degrees of disturbance characterized by the presence of contrasting vegetation types within the vicinity.

Brief description of the sampling sites

Parks and Garden (Site 1): There is mixed vegetation comprising ornamental plants, shrubs and grassland. Natural forest is present with a stream running through the southern part of the garden. The area covers about 10 ha, while the canopy cover is about 60%. The average elevation for this area is 291 m above sea level.

Zoological Garden (Site 2): An area of matured woodland and wild plants characterized by relatively tall trees and open under-storey. Access to the main forest is restricted from human interference. However, a large area of this garden is heavily impacted by human activities. Canopy cover is about 70%. The area covers about 30 ha. The average elevation for this area is 214 m above sea level.

Oxidation Pond (Site 3): The site extends up to about 15 ha. This area is rich in wild plants and tall trees with dense under-storey foliage sparsely distributed

over the area. The canopy cover is about 50%. The average elevation for this area is 286 m above sea level.

Botanical Garden (Site 4): The vegetation here is mixed with natural forest, secondary forest re-growth and ornamental plants near buildings. Natural plantation is present in some areas and the rest of the area is covered with shrubs and little grassland. A small stream runs through the garden. The site is located close to a road side. Canopy cover is about 60%. The total land cover is 11 ha. The average elevation for this area is 274 m above sea level.

Teaching and Research Farm (Site 5): The vegetation here is heterogeneous. Food and cash crops are cultivated. A portion of the natural forest is still intact. Abundant grassland for animal grazing is evident. There is presence of two large water bodies for fishing and research activities. The area measured about 250 ha while the canopy-cover is about 50%. The average elevation for this area is 298 m above sea level.

New Bukkateria (Site 6): This site comprises natural forest with wild plants. Access to the main forest is restricted but a portion of the forest is densely impacted by human activities. A few grassland area is present. The area covers about 35 ha. Canopy cover is about 60%. The average elevation for this area is 324 m above sea level.

Open Fields (Site 7): This site is primarily dominated by grassland with presence of disturbed forest and secondary forest re-growth. This area also shows a wide range of habitat. The position of this site is at the central campus where heavy human and vehicular movement is evident. Canopy cover is about 40%. The average elevation for this area is 281 m above sea level.

Sampling, preservation and storage of butterfly specimens

The sampling sites are separated from one another by an average of 150 m. Each study-site was divided into transects, which were sufficiently sampled using hand-held insect sweep nets with an orifice 35 cm in diameter. This study was carried out between March and September, 2012. Sampling was carried out twice each week. Hand netting of butterflies was conducted for about three hours each collecting day between 07.00 and 11.00 hrs. Collection from the sites focused on maximizing the number of species captured and this yielded data on species diversity. All captured butterflies were killed in air-tight specimen jars containing ethyl-acetate soaked in cotton wool. Samples were later pinned using No.3 entomological pins, set on a setting board and dried in a wooden box for a week at about 30ºC. The specimens were then transferred to a permanent storage insect box stuffed with naphthalene balls. They were also identified using taxonomical keys by Lewis (1973) and Larsen (2005). Data analysis was achieved with descriptive statistics. Shannon-weiner's species richness and Margalef's species diversity indices were used to evaluate the species richness and diversity of species in the study-area.

Results

During the course of this study, a total of 317 butterflies were collected from various habitats on Obafemi Awolowo University, Ile Ife. A total of 41 species distributed in five families and twelve sub-families were recorded. The highest number of butterflies was recorded in the Nymphalidae (Figure 1). A total of 152 butterflies were recorded for this family, thus suggesting Nymphalidae as the most abundant family. The least abundant family is the Lycaenidae which occurred with only 20 individuals. Parks and Garden and Teaching and Research Farm had relatively higher abundance of butterflies than other sampling sites with % occurrence of 19.2% and 27.7% respectively while very low numbers were recorded in both Oxidation Pond and New Bukkateria with % occurrence of 4.7 and 8.2% respectively (Table 1). The highest number

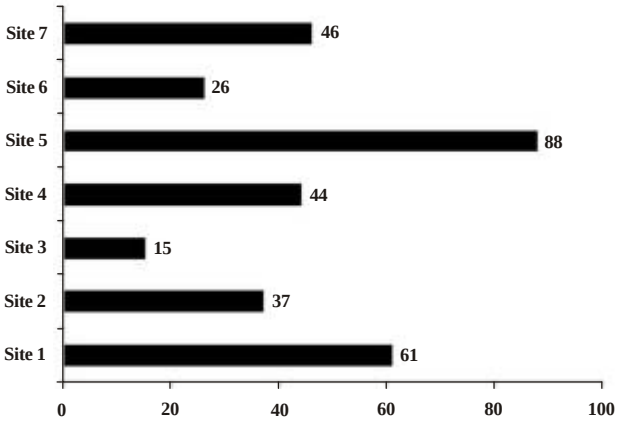

Figure 1: Comparison of abundance of butterflies collected from seven sites in Obafemi Awolowo University, Ile Ife, south-western Nigeria.

(**Site 1** – Parks and Garden, **Site 2** – Zological Garden, **Site 3** – Oxidation Pond, **Site 4** – Botanical Garden, **Site 5** – Teaching and Fesearch Farm, **Site 6** – New Bukkateria, **Site 7** – Open Fields).

of butterfly species was also recorded in the Nymphalidae which accounted for 22 species (Table 2) while the least number of species was recorded in Papilionidae which had just two species (Table 3). Interestingly, the most abundant butterfly species collected in this study is *Papilio demodocus* which belongs to the family Papilionidae (Table 3). A total of 18 butterflies belonging to this species were collected, although most of them were collected at the Teaching and Research Farm. The species that occurred with the least number (2) is *Borbo bevani,* which belongs to the family Hesperidae. Generally, three general from two families were relatively more abundant in this study than the others. They were: *Acraea* (Nymphalidae) with a total of 33; *Junonia* (Nymphalidae) with a total of 24; and *Nepheroni* (Pieridae) with a total of 31 individuals respectively.

Shanon-Wiener's species richness index showed that Parks and Gardens and Teaching and Research Farm were relatively higher than others in species richness with Shanon-wiener's index value of 0.83 and 0.91 respectively while Oxidation Pond Site was the poorest in species richness with a Shanon-wiener's index value of 0.54. Also, Margalef' species diversity index indicated that Parks and Gardens and Teaching and Research Farm were relatively higher in diversity of species than the other sites with Margalef's index value of 0.91 and 0.93 respectively while Oxidation Pond had the lowest species diversity as shown by Margalef's index value of 0.56 (Table 4).

Table 1. Butterfly species richness across the various sites at Obafemi Awolowo University, Ile Ife, south-western Nigeria from March to September, 2012.

Sites	%occurrence	Papilionidae	Pieridae	Nymphalidae	Lycaenidae	Hesperidae
Site 1	19.2	4	24	23	3	7
Site 2	11.7	2	10	15	1	9
Site 3	4.7	0	5	8	0	2
Site 4	13.8	1	9	27	4	3
Site 5	27.7	11	13	49	6	8
Site 6	8.2	0	8	11	3	5
Site 7	14.5	7	15	19	3	2
	100%	**25**	**84**	**152**	**20**	**36**

(**Site 1** – Parks and Garden, **Site 2** – Zological Garden, **Site 3** – Oxidation Pond, **Site 4** – Botanical Garden, **Site 5** – Teaching and Research Farm, **Site 6** – New Bukkateria, **Site 7** – Open fields).

Table 2. Inventory and number of individuals of the species of butterfly recorded in Obafemi Awolowo University, Ile Ife, south-western Nigeria.

Taxa	No. of individuals
NYMPHALIDAE	
Danainae	
Amauris damocles Damocles	9
Danaus chrysippus chrysippus	7
Nymphalinae	
Acraea orestia orestia	7
Acraea serena	6
Hypolimnas anthedon anthedon	4
Junonia oenone oenone	10
Junonia sophia sophia	7
Junonia terea terea	7
Precis pelarga	13
Heliconiinae	
Acraea pseudoginia	5
Acraeae bonasia bonasia	8
Acraea encedon encedon	7
Limenitidinae	
Cymothoe coccinata coccinata	8
Euphaedra Proserpina proserpina	5
Aterica galena galena	4
Euphaedra viridicaerulea viridicaerulea	5
Neptis morose	9
Satyrinae	
Elymniopsis bammakoo bammakoo	7
Melanitis leda	3
Bicyclus dorothea dorothea	9
Bicyclus evadneelionas	8
Charaxinae	
Charaxes tiridates tiridates	4

Table 3. Inventory and number of individuals of the species of butterfly recorded in Obafemi Awolowo University, Ile Ife, south-western Nigeria, from March to September, 2012.

Taxa	No. of individuals
PIERIDAE	
Pierinae	
Belenois calypso calypso	13
Mylothris chloris chloris	14
Mylothris sulphurea	10
Nepheronia argia argia	13
Nepheronia pharis pharis	11
Nepheroni athalassin athalassina	7
Coliadinae	
Eurema hecabe solifera	9
Catopsilia florella	7
HESPERIDAE	
Pyrginae	
Tagiades flestus	9
Borbo bevani	2
Telicota ancilla	7
Telicota colon	7
Hesperinae	
Pardaleodes incerta murcia	11
PAPILIONIDAE	
Papilioninae	
Papilio charapkowskoides	7
Papilio demodocus	18

Table 3. *Cont'd*

LYCAENIDAE	
Polymmatinae	
Leptotis pulchra	7
Azanus jesous	3
Zizina otis	5
Rapala manea	5

Table 4. Species richness and species diversity of the sampling sites on Obafemi Awolowo University, Ile Ife, from March to September, 2012.

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Shanon-Weiner's index	0.83	0.75	0.54	0.78	0.91	0.69	0.79
Margalef's index	0.91	0.82	0.56	0.67	0.93	0.61	0.81

(**Site 1** – Parks and Garden, **Site 2** – Zological Garden, **Site 3** – Oxidation Pond, **Site 4** – Botanical Garden, **Site 5** – Teaching and Research Farm, **Site 6** – New Bukkateria, **Site 7** – Open Fields).

Discussion

The total number of species recorded in this study constitute about 4.1% of all the known species of butterfly recorded in West Africa and only about a thousand butterflies species have been recorded so far in this region (Akwashiki *et al,* 2007; Sundufu and Dumbuya, 2008). This result marked a relatively high diversity of butterfly species in Obafemi Awolowo University and that seems to support by works of Akwashiki *et al* (2007) and Sundufu and Dumbuya (2008). The result is further corroborated by Thomas *et al* (1992), Hill *et al* (1995) and Brown (1997) who reported rich butterfly fauna in typical tropical rainforest areas.

Nymphalidae was the most abundant family recorded across all the sites and this contradicts the works of Nwosu and Iwu (2011) who reported a very low number of butterflies in the family Nymphalidae in a similar forested region in Nigeria. The presence of Nymphalidae in high numbers has implications for pollination in this area, since they are known to be among the exceptional fruit-feeding butterfly community. The probable reason for this could be that the study-area provides a better opportunity for these species in terms of larval host plants and nectar plants (Tiple, 2009). This is evident in the study-area with the abundance of ornamental plants and grassland specifically grown to beautify the environment, and they are well distributed in most parts of the sampling sites. *Junonia*, *Acraea* and *Nepheroni* are three genera which had greater abundance than the other genera. It is not unusual that these three genera were the most abundant in the sampling sites, despite the different levels of disturbance and other anthropogenic activities in the sites, since Pierce *et al* (2002) had earlier reported that these species as polyphagous, with the capacity to adapt to a wide range of habitats. This could probably be the reason why these three genera were recorded in a greater number than the other genera.

When comparison was made at different sites under investigation, the highest numbers of butterflies were recorded from Parks and Garden and Teaching and Research Farm while the least number occurred in Oxidation Pond and New Bukkateria. The probable reason behind this numerical difference is that Parks and Garden and Teaching and Research Farm have large water resources, tree plantations and grassland areas providing various breeding sites for different butterfly species. In contrast to this, Site 3 and Site 6 have more or less monotonous type of flora of wild plants and were not well protected as several human activities have brought about significant changes in the habitats.

It was hypothesized at the commencement of this study that the study-area does not possess habitats suitable for diverse butterfly community. The reason for this is that the area is often disturbed with high level of human activities. There is frequent destruction of habitats (e.g. cutting of grasses, shrubs and trees; construction of buildings and roads) for beautification and expansion of the university. All these activities reduce the areas of natural habitats and semi-natural habitats usually preferred by butterflies. However, the result suggests otherwise. This points to the fact that this area still supports a high diversity of butterfly species despite the relatively high level of disturbance and manipulation in the environment. These observations are in agreement with Kunte (2001), Padley *et al* (2006) and Tiple *et al* (2007) who stated that impacted areas may have higher species richness. Although, some other factors like the climatic conditions such as relatively low temperature and heavy rainfall in most part of the year as witnessed in this study-area during the period of collection might have contributed significantly to the richness of butterfly species in this area.

A good number of the species recorded in this study have been classified as generalist or open habitat species (Carcasson, 1964). However, finding grassland species inside a forest indicated that non-forest conditions occur inside the forest, but it is possible that the area could still be relatively undisturbed (Rogo and Odulaja, 2001). It was obvious that in most part of the

study sites, the grass cover was abundant; this could be a possible explanation for the presence of these grassland butterflies in areas where the forest was actually dense. In addition, the occurrence of forest butterflies in the open areas could perhaps be explained by the fact that some of the species present might not be really sensitive to trees being cut in their habitat, as long as a few large trees remain. However, the presence of roads and artificial clearings can be beneficial to some species, especially the ubiquitous species for which virgin forest is the most difficult habitat for them to thrive. The study-areas also differed in ways that has not been taken into account here and which could affect the species found in a certain sites, e.g. access to water, presence of ravines and the history of human impacts as it might take a while for characteristic species to disappear completely from the area. The season during which the study was carried out could also affect where the different species were found. During the rainy season, forest species tend to fly out into the open areas seeking the warmth of the sun while during the dry season; open land species might enter the forest in order to find some shade (Owen, 1971). The diversity of butterflies in this area may prove to be surprising because of the high numbers which is above the common expectation but this does not suggest that the condition in this ecosystem is close to an ideal one. Perhaps the species richness could have been higher save the extent of disturbance via anthropogenic activities. Therefore, it is expected that necessary measures will be put in place to avert the progressive habitat destruction and fragmentation in order to preserve its biodiversity.

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References

Adediji, A. 2003. Sediment Delivery Ratios in Opa Reservoir catchments, south-western Nigeria. Unpublished M.Sc Thesis, Department of Geography, Obafemi Awolowo University, Ile Ife. 89pp.

Adeniyi, I. F. and Olabanji, I. O. 2005. The physico-chemical and bacteriological quality of rain water collected over different roofing materials in Ile Ife, South-western Nigeria. *Chemistry and Ecology, 21(3).* 149-166.

Akwashiki, B. A., Amuga, G. A., Nwansat, G. S. and Ombugadu, R. J. 2007. Assessment of Butterfly Diversity in Eagle Owl Gully of Amurum Forest Reserve, Jos East Local Government Area, Plateau State, Nigeria. *The Zoologist 5.* 33-38.

Brown Jr. K. S. 1997. Diversity, distance and sustainable use of Neotropical Forest: Insects as indications for conservation monitoring. *Journal of Insects Conservation 1.* 25-42.

Carcasson, R. H. 1964. A preliminary survey of the zoo-geography of African butterflies. *East African Wildlife J. 2.* 122-157.

Cleary, D.F.R. 2004. Assessing the use of butterflies as indicators of logging in Borneo at three taxonomic levels. *Journal of Economic Entomology 97.* 429-435.

Hill, J. K., Kramer, K. C., Lace, L. A. and Banham, W. M. T. 1995. Effects of selective logging on tropical forest butterflies on Buru, Indonesia. *Journal of Applied Ecology 32.* 754-760.

Holling, C. S., Schindler, D. W. W., Walker, B. H. and Roughgarden, J. 1995. Bio-diversity in the functioning of an ecosystem: An ecological synthesis. In: *Biological Diversity: Economic and Ecological Issues.* Cambridge: University Press. 448pp.

Kremen, C. 1994. Biological inventory using target taxa: A case study of the butterflies of Madagascar, *Ecological Applications*, *4(3).* 407-422.

Kumar, S., Simonson, S. E. and Stohlgren, T. J. 2009. Effects of spatial heterogeneity on butterfly species richness in Rocky Mountain National Park, CO, USA *Biodiversity and Conservation 18 (3).* 739-763.

Kunte, K. J. 2001. Butterfly diversity of pune city along the human impact gradient. *J. Ecol. Soc., 13/14.* 40-45.

Larsen, T. B. 2005. *Butterflies of West Africa.* 2 Vols, 596pp, 125 plates. Apollo Books, Stenstrup, DK.

Lewis, H.E. 1973. *Butterflies of the world, African section.* Forwarded by J.M Chalmers-Hunt F.R.E.S. President of the British Entomological and Natural History Society. Harrap, London. 179pp.

Lewis, O. T. 2002. Effects of experimental selective logging on tropical butterflies. *Conservation Biology*, *15*: 389-400.

Lomov, B., Keith, D. A., Britton, D. R. and Hochuli, D. F., 2006. Are butterflies and moths useful indicators for restoration and monitoring? A pilot study in Sydney's Cumberland. Plain Woodland. *Ecological Management Restoration 7.* 204-210.

Muoghalu, J. I. and Johnson, S. O. 2000. Interception, pH and soil content of rainfall in a Nigerian lowland rainforest. *J. Ecol*, *38.* 38-46.

Najam, A. 2002. Legitmacy as a systematic challenge. In: *Financing Sustainable Development.* London: IIED.

Nwosu, L. C. and Iwu, C. J. 2011. A comparative study of diversity of species of butterflies in protected and unprotected habitats of Okwu Ogbaku Forest Reserve in Mbaitoli LGA, Imo State, Nigeria.

Okali, D. 2010. Many species one planet; one future. *Proceeding of the 3rd Annual Conference of the Institute of Ecology and Environmental Studies Vol. 3.* Held at Oduduwa Hall, Obafemi Awolowo University Ile Ife, Nigeria 15-17th June, 2010. 11pp

Owen, D. F. 1971. *Tropical Butterflies: The ecology and behaviour of butterflies in the tropics with special reference to African species.* Clarendon Press. Oxford. 91pp.

Padley, N., Dahanular, M., Paigankar, Deshpanda, M. and Desphanda, D. 2006. Season and Landscape-wise distribution of butterflies in Tamhini, Northern Western Ghats, India. *Zros' Print J., 21:* 2175-2181.

Pierce, E. N., Michael F. B., and Health, A. 2002. The ecology and evolution of ants association in the Lycaenidae (Lepidoptera), *Annual Reviews of Entomology, 47.* 733-771.

Rogo, L. and Odulaja, A. 2001. Butterfly populations in two forest fragments at the Kenya Coast. *East African Wild Life Society. 39.* 266-275.

Schmidt, B. C. and Roland, J. 2006. Moth diversity in a fragmented habitat: "Importance of functional groups of landscape scale in the boreal forest" *Annals of the Entomological Society of America, 99 (6).* 1110-1120.

Summervilla, K. S., Matzler, E. H. and Crist, T. O. 2001. Diversity of Lepidoptera in Ohio Forests of local and regional scales: how heterogenous is the fauna? *Annals of the Entomological Society of America 94 (4).* 583-591.

Sundufu, A. and Dumbuya, R. 2008. Habitat preferences of butterflies in the Bumbuna forest Northern Sierra Leone. *Journal of Insect Science, 8 (64).* 1-17.

Terborgh, J. 1999. *Requiem for Nature.* Island Press.

Tiple, A. D. 2009. Butterflies from Napgur City, central India: Diversity, population, nectar and larval host plants and the implications for conservation, Ph.D Thesis, RT. Napgur University, Napgur, India.146pp.

Tipl, A. D., Khurad, A. M. and Dennis R. L. H. 2007. Butterfly diversity in relation to a human-impact gradient on an Indian university campus. *Nota Lepid. 30 (1).* 179-188.

Thomas, C. D., James, A. and Warren, M.S. 1992. Distribution of occupied and vacant butterfly habitats in fragmented land-scapes. *Ecology, 62:* 563-567.

Uehara-Prado, M., Brown, K. S. Jr., Freitas, A. V. L. 2007. Species richness in the Brazilian Atlantic Forest: Comparism between a fragmented and a continuous landscape. *Global Ecology and Biogeography, 16.* 43-54.

Vane-wright, R. I., Humpheries, C. J. and Williams, P. H. 1991. What to protect: Systematic and the agony of choice. *Biological Conservation 55.* 235-254.

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