Journal of Forestry and Natural Resources
Vol. 4(1), 2025

DOI: https://doi.org/10.20372/JFNR-hu/2025.1361

Research Article

Diversity and distribution pattern of butterflies at emerald forest reserve, Ikoyi, Osun state, Nigeria

A. A. Alarape[1]*,O. E. Omotayo[2], M. K. A. Wahab[3], I. A. Aderolu[4]

Article Info

[1] Department of Fisheries, Aquaculture and Wildlife Management, University of Abuja, Nigeria.
[2]Department of Wildlife and Ecotourism Management, University of Ibadan, Nigeria.
[3]Department of Wildlife and Ecotourism Management, Osun State University, Osogbo Nigeria
[4]Department of Crop Protection, University of Abuja, Nigeria.

***Corresponding author**:
munir.wahab@uniosun.edu.ng

Citation: Alarpe et.al.(2025). Diversity and distribution pattern of butterflies at emerald forest reserve, Ikoyi, Osun state, Nigeria *Journal of Forestry and Natural Resources*, 4(1), 36-43

Received: 09 April, 2025
Accepted: 30 June, 2025
Published Online: 04 July, 2025

Web link: https://journals.hu.edu.et/hu-journals/index.php/jfnr/\[0.3cm]

OPEN ACCESS

Abstract

Butterflies are key pollinators and crucial indicators of ecosystem health. Studying these beneficial cluster organisms is important to develop conservation strategies at Emerald Forest Reserve. This study aimed to assess the species' occurrence; the species' richness and abundance; and the habitat preferences at site. Field sampling was conducted (October to December 2023) using transect walks and hand netting method across three sites: upper slope, lower slope, and valley bottom (each divided into three 200m transects and surveyed twice), ensuring data consistency. Data were analyzed using SPSS version 21. Species occurrence and abundance were represented in tables and percentages. One-way ANOVA was conducted to test for significant differences in species composition across the slopes. Data were evaluated using Shannon diversity index, Simpson's diversity index, Pielou's Evenness, and Margalef's species richness index. A total of 406 butterflies belonging to 31 species, 23 genera, and 5 families were identified. Nymphalidae were highest in abundance and species richness (70.97%) of the total abundance representing 22 species, while the least family Lycaenidae was represented by one species (3.23%). There was no significant difference in species composition (P¿0.05). The highest Shannon diversity index was at the Upper slope (H=2.55). The upper slope had the highest species richness index (R=3.50). Simpson's diversity index indicated higher species diversity in the Upper slope and Valley bottom (D=0.91 each). In Upper slope, Hypolimnas anthedon, Leptosia alcesta, and Ypthima asterope were abundant. Hypolimnas anthedon, and Ypthima asterope, were species found at the Lower slope. At the Valley bottom, Euphaedra medon, Junonia sophia, and Euriphene amicia amicia were mostly in abundance. This study provided information on butterfly species occurrence, richness, and abundance across habitats while highlighting the ecological value of specific microhabitats. Integrated conservation strategies involving floral diversity protection, continuous monitoring of butterfly-plant association and reducing human pressure is indispensable.

Keywords: Butterfly diversity, Conservation strategies, Habitat preferences, Line transect, Nymphalidae

1 Introduction

Insects belong to Kingdom Animalia, Phylum Arthropoda and class Insecta. Presently, there are records of at least 1 million described insect species with indications that numerous undiscovered species remain globally due to new discoveries by entomologists and ecologists (Stork, 2018). Insects inhabit diverse regions, ranging from temperate zones to tropical areas, and thrive in various habitats on land and aquatic ecosystems. Butterflies belong to the order Lepidoptera, the second largest group that are mostly widespread and globally recognized among the class Insecta. They are good indicators for verifying ecological and vegetative conditions in various ecosystems. They are identified to be among excellent groups for investigating the loss of traditional pasture and the effects of vegetation encroachment (Koch et al., 2015; Ubach et al., 2020). In addition, butterflies serve as foods to many insectivorous birds and other predators. In West Africa, over 1400 butterfly species are documented, with Nigeria hosting over 1000 of these species (Safian & Warren, 2015). While butterflies adapt to diverse habitats, a significant majority prefer forested environments, which are becoming increasingly fragmented (Hedblom, 2007).

most tropical countries of the world. Nigeria's tropical rainforest lies inside the Guinea Forests of West African Biodiversity Hotspots (Myers et al., 2000). This region is noted as the most threatened forests in the world and left out with 15.0% of its original forest cover(Conservation International, 2010). Evidence have depicted a 55.7% lost of Nigeria primary forest through anthropogenic activities such as massive logging, agricultural activities and fuel wood collection (Food and Agricultural Organization (FAO), 2005). This results to a high degree of threat to the endemic species, which affect the status of a global hotspot of biodiversity (Myers et al., 2000). Therefore, many species of butterflies have gone into extinction as a result of rapid disappearance of their natural habitats such as swamps and forests zone. This was corroborated in the study carried out by Kurylo et al. (2020), that modified habitats and anthropogenic activities influences abundance of butterfly species and their population dynamics. The increasing number of landscape fragmentation and destruction of natural habitats for the establishment of structures without deliberate attempts to maintain or re-establish pristine ecohabitat are detrimental to native butterfly species, which has resulted to imbalance in the ecosystem (Kurylo et al., 2020; Pignataro et al., 2020). Hence, the need to study species richness and abundance which are two critical variables required in conservation planning and Natural resources management (Jenber and Getu, 2020).

Emerald Forest Reserve was established to conserve biodiversity through various methods such as reforestation, conservation education, and the creation of garden with nectar sources and larval host plants. Previously, the forest reserve was a farmland that was highly exploited. However, recently, the implementation of strict conservation activities has brought protection to flora and fauna from poaching and illegal logging that has drastic effect on organism. Understanding the diversity and distribution pattern of the animals, especially butterflies, which are indicators of environmental health, would help to develop effective conservation strategies that would promote the sustainability of the resources in the reserve. Therefore, this humble effort was intended to contribute to the body of knowledge that would result in the documentation of empirical data on butterflies' diversity and distribution patterns at the reserve. Specifically, the objectives were to assess the butterfly species occurrence at the reserve, investigate their habitat preferences and evaluate their richness and abundance across various sites within the study area.

2 Materials and methods

2.1 Description of study area

Emerald Forest Reserve (EFR) is currently a 121-ha privately owned secondary rainforest located at the Abayomi Farm Estate, 25 km South of Ibadan in Ikoyi, Isokan Local Government Area of Osun State, South-West Nigeria (07°18'N 04°08'E). The Forest Reserve is bisected by two seasonal streams, the Aworin and Akinrin that join at the Emerald confluence to form the Aduni River, all of which are reduced to puddles in the dry season. The Aduni River flows over the Iyaniwura waterfall into the Osun River, which borders EFR in the West (Fig 1). The Osun River is an important perennial river, which is dammed by the government to provide water to2communities in the surrounding areas (Olajire & Imeokparia, 2000).

Topographically, the reserve has an elevation which changes across undulating landforms, and the forest ground is occasionally filled with rocky areas. Moreso, the region contains highly ferruginous tropical red soils which are associated with the basement rocks found in the region (Olusola & Adeboyejo, 2024). Emerald Forest Reserve is characterized by distinct wet season (spanning from April to November) and dry season (October to March), and within the reserve are a mix of trees, shrubs, and various types of undergrowth, creating a multi-layered canopy (Alade et al., 2023). The reserve is residence to many variety of wildlife, which includes numerous species of avifauna such as the endangered Ibadan Malimbe (Malimbus ibadanensis), Emerald cuckoo (Chrysococcyx cupreus), varieties of insects, and mammals such as Pangolins, Bushbuck (Tragelaphus scriptus), Tree squirrel (Sciurus spp.), African Civet cats (Civettictis civetta), and Mona monkeys (Cercopithecus mona). The proximity of the Osun River also contributes to the biodiversity of the area. In addition, the reserve experiences an annual precipitation of about 1400m, an average temparature of 24oC, and a relative humidity of about 88% (Olusola & Adeboyejo, 2024).

The abundance of butterflies in Nigeria often increases during the rainy season while some species may be more abundant during the dry season in specific locations like riverbanks, where resources may actually be more readily available. More so, some butterfly species are more widely distributed throughout the year, while others display effective seasonal patterns. For example, certain forms of Precis octavia, a common butterfly species, may not appear until December in the Calabar region (Ringim et al., 2022). In general, the availability of resources, such as host plants and nectar, which are often plentiful during the rainy season, heavily influences butterfly seasonality (Ojianwuna & Umoru, 2023).

2.2 Description of sampling site

The concept of catena sequence was adopted in this study for the selection of sampling sites. This concept is derived from the study of soil and vegetation science in which gradual changes in slope and drainage across a landscape influence the vegetation composition, and biodiversity present (Jenny, 1980). The Emerald Forest Reserve has a unique landscape to apply this model, creating rooms for the selection of three distinct sampling sites which are the upper slope, the lower slope, and the valley bottom (Fig 1). Each of these sites has different environmental composition thereby making it suitable to understand butterflies diversity, distribution pattern, and habitat preferences across the study area.

Upper slope: It is made up of butterfly garden, shrubs, grasses, trees with fewer canopies, agricultural farm, and accommodation center. Various plants are located in the butterfly garden. Examples are Hibiscus spp., Resinia spp., Hydrogea spp., Jasmine spp., Bachelor's button (Centaurea cyanus), Rose periwinkle (Catharanthus roseus), Cordyline (Cordyline fruticosa), Asparagon spp, Sunflower spp., Morning glory spp., Lantana (Lantana camara), etc. Other plants that are found at the upper slope include Elaeis guineensis, Citrus sinensis, and Ananas comosus.

Lower Slope: It is composed of trees with denser canopies, climbers, fewer grasses and shrubs. Examples of plants in this region are Croton caudatus, Albizia zygia, Antiaris toxicaria, Ceiba pentandra, Cola gigantea, Triplochiton scleroxylon, etc. The lower slope is mainly calm and cool due to tree canopies obstructing the penetration of sunlight.

Valley bottom: The valley bottom is the riverine area of the forest. Climbers, shrubs, rocks, few grasses, and less dense trees are present along the coastal region. The presence of the water bodies facilitates the biodiversity richness in this area.

2.3 Field sampling of Butterflies and Identification

Field sampling of butterflies was carried out across the three distinct study sites. Each of the sites was further divided into three sampling locations using a 200m transect per location following the study of (Alarape et al., 2018). Sample species were identified for prerecorded close to 5 meters length to the observer, naturally covering both broadside. A combination of Transect walk-and-count, and hand-netting methods was conducted. These two methods were chosen as they are non-invasive and among the most widely accepted techniques for butterfly sampling, especially in tropical forest habitats according to (Bonebrake et al., 2010). Using the two methods above, butterflies were sampled during nine consecutive rounds from October 2023 to December 2023. Each location was surveyed twice both in the early morning (9:00 AM and 12:00 PM) and evening period of the day (3:00 PM to 6:00 PM.), as these periods were the most active periods of butterflies observed during preliminary survey and supported by existing studies (Franzen et al., 2022). During transect walk, a steady walking pace of 10m/min Handersen and Correzzola (2014) making a total of 20 mins per transect, was maintained along the transect lines with frequent pauses to observe and record butterfly species within the transect range. Following this was the hand-netting method which was conducted for 10m/3 mins to make a total of 60 mins per transect, using sweep net with an orifice of 15cm in diameter. Therefore, a time range of 1hr 20 minutes was utilized for sampling in each location, creating space for repeatability (twice), and increased the homogeneity of the result. Though the sampling duration is shorter than it was recommended in intensive biodiversity inventories (Iserhard et al., 2013), it allowed a rapid assessment strategy without causing prolonged disturbance in the reserve.

Sampling was done by the lead researcher and the butterflies that were caught were counted and subsequently released after being identified in the field. For those butterflies that couldn't be identified on the spot, a capture-and-release approach was adopted, with careful consideration to minimize any harm to their physical well being. Photographs were taken of these unidentified butterflies from various angles to ensure an adequate visual record for later species identification. The photography process was carried out using a Digital camera (Canon Camera IXUS 175). Identification of butterflies relied on key characteristics such as their color patterns, wing spans, and body size. Field guides (Common Butterflies of West Africa by Larsen, 2003; Common Butterflies of IITA by Safian and Warren, 2015, and online field guide) were utilized for the identification process.

2.4 Data Analysis

Data collected from the field survey were analyzed using SPSS version 21. Descriptive statistics, specifically percentages and tables, were used to represent species occurrence and distribution. One-way ANOVA was conducted to test for significant differences in species composition across the three sites. Data were further evaluated using Shannon diversity index, Simpson's diversity index, Pielou's Evenness, and Margalef's species richness index.

A. Measurement of species richness

Species richness in the study area was determined by the use of Margalef's index. This was used as a simple measure of species richness (Magurran, 1988).

Margalef's index is given by:

$$R = \frac{(S-1)}{\ln N}, \tag{1}$$

where: S = total number of species, N = total number of individuals in the sample and ln = natural logarithm

B. Measurement of evenness

The Pielou's Evenness Index (e) was also used to determine the evenness of the species (Pielou, 1971).

$$e = \frac{H}{\ln S}, \tag{2}$$

where: H = Shannon-Wiener diversity index, S = total number of species in the sample

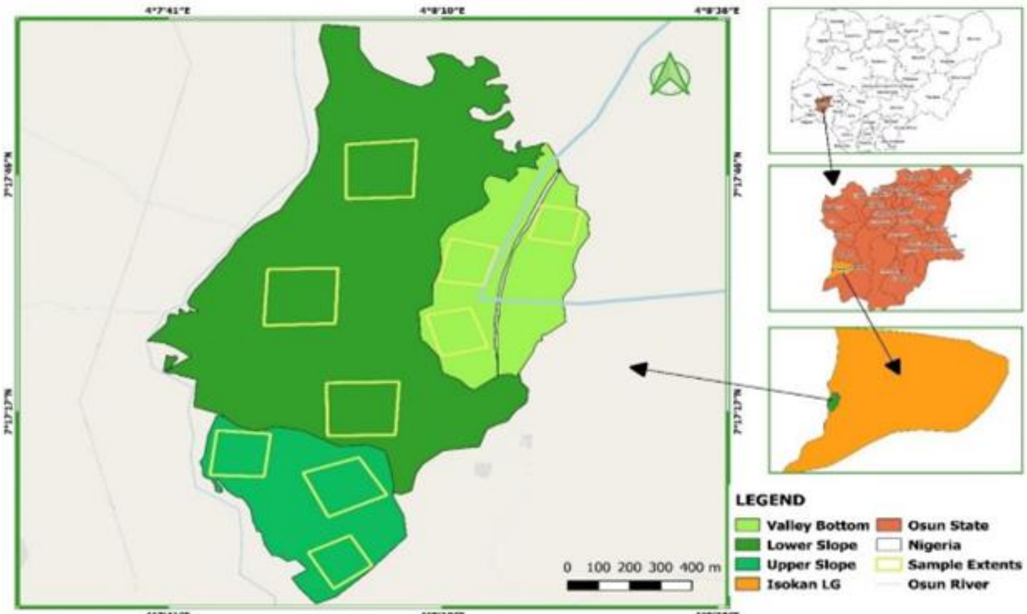

Figure 1: Map of Emerald Forest Reserve, Ikoyi, Osun state, Nigeria, showing the study sites. Source: Field work (2023)

C. Shannon diversity

The diversity of the species were compared during the study through Shannon-Wiener diversity index. This was measured by the given formula:

$$H' = -\sum_{i}^{h} P_i \ln P_i , \qquad (3)$$

where: H' = Diversity Index, P_i = proportion of each species in the sample and $\ln P_i$ = natural logarithm of this proportion

D. Simpson Index (D)

This was used to evaluate the butterfly species diversity. The probability to determine two individuals randomly selected in a sample that belong to the same species was known. This is calculated by the formula:

$$D = 1 - \frac{\sum n(n-1)}{N(N-1)} , \qquad (4)$$

where: n = total number of butterflies of a particular species and N = total number of butterflies of all species

3 Results

3.1 Butterfly Diversity at Different Sites in Emerald Forest Reserve

The total number of 406 individual butterflies that belonged to 31 species, 23 genera, and 5 families were transcribed during the study. The abundance species with their proportion at different sites are reflected in Table 1. Observation revealed highest number (19) of species at the upper slope, followed by moderate number (17) of species at the valley button while the least number (15) of species were at the lower slope. Also, it was showed that highest number (170) of individual species was at the upper slope, followed by the moderate number (151) of individual species at the valley bottom while the least number (85) of individual species were at the lower slope. The most abundant species at the upper slope were Hypolimnas anthedon (Variable eggfly), Leptosia alcesta (African Spirit), and Ypthima asterope (Common three-ring) The most abundant species in the valley bottom were Euphaedra medon (Widespread Forester), Junonia sophia (Little commodore) and Euriphene amicia amicia (Friendly nymph). The most abundant species in the Lower slope were Hypolimnas anthedon (Variable Eggfly), and Ypthima asterope (Common three-ring).

3.2 Frequency of the distribution of butterflies' species and abundance among families at different sites

The species distribution and abundance among families at various sites were depicted in Table 2. Nymphalidae species were of the highest percentage (73.68%) at the Upper slope, followed by the moderate percentage (21.05%) of the Pieridae while the least percentage (5.26%) is the Papilionidae. Observation at the lower slope revealed that Nymphalidae have the major percentage 60.00% while the least percentage (20.00%) was shown. In Valley Bottom, the

Table 1: Families of butterflies in the three study sites at Emerald Forest Reserve indicating the total number of species, abundance, and their proportions

Family	TS	PTS (%)	TA	PTA (%)	Study sites					
					US		LS		VB	
					NS	NO	NS	NO	NS	NO
Nymphalidae	22	70.97	295	72.66	14	112	9	70	12	113
Pieridae	4	12.90	83	20.44	4	57	3	10	2	16
Lycaenidae	1	3.23	7	1.72	0	0	1	2	1	5
Hesperiidae	2	6.45	7	1.72	0	0	1	2	1	5
Papilionidae	2	6.45	14	3.45	1	1	1	1	1	12
Total	31	100	406	100	19	170	15	85	17	151

TS = Total of the species; PTS = Proportion of the total species; TA = Total of the abundance; PTA = Proportion of the total abundance; US = Upper slope; LS = Lower slope; VB = Valley bottom; NS = number of species; NO = total number of individuals.

highest percentage (70.59%) of Nymphalidae and least percentage (11.76%) Pieridae were recorded respectively. It was identified that Lycaenidae, Hesperiidae, and Papilionidae had the least percentage (6.67% each) number of species at the Lower slope and (5.87% percent at the Valley bottom while Lycaenidae and Hespriidae are absent in the Upper slope. High percentage (65.88%) of individual species of Nymphalidae species were recorded in the Upper slope habitat followed by moderate percentage (33.53%) Pieridae while the least percentage of individuals with an absence of Lycaenidae and Hesperidae. In the Lower slope, Nymphalidae has highest percentage (82.35%), followed by Pieridae (11.76%), and the least percentage (1.18%) is the Papilionidae . In the Valley bottom, Nymphalidae revealed the highest percentage,(74.83%) followed by moderate percentage (10.60%) in Pieridae and Papilionidae (7.95%) while the least percentages (3.31%) are in the Lycaenidae and Hesperidae.

3.3 Butterfly diversity indices

The significant test on the butterfly species diversity were determined at the three study sites. These were depicted in table 3 which shows that there is no significant difference in the composition of butterflies across the three sites ($P < 0.05$). From table 3, it can be depicted that the evenness indices of butterfly communities were similar. The highest Shannon diversity index of butterfly communities was at the Upper slope. The species richness index of butterfly communities was highest at the Upper slope while Simpson's diversity index also indicated higher butterfly species diversity in the Upper slope.

4 Discussion and conclusion

In this study, it was observed that the butterflies sighted represent about 3.10% of the 1000 known butterfly species in Nigeria. The outcome may be attributed relatively to the size of the study area and activities such as building construction and agricultural practices, especially at the upper slope which may negatively impact the butterfly community. Valley bottom habitat exhibited high butterfly richness and evenness which can be a result of the presence of water bodies. The diverse environment along riverbanks, characterized by abundant vegetation, rocks, and mud, provides essential resources for butterflies, including hydration and nutrient intake. Additionally, the open vegetation at the valley bottom provides ample breeding grounds and supports a variety of butterfly species, as exposure to sunlight facilitates optimal body temperature regulation to carry out their daily activities (Purnamasari & Santosa, 2017).

Conversely, the Lower slope habitat recorded the lowest diversity index. This could be a result of the presence of dense canopy covers inhibiting sunlight penetration. Plant photosynthesis required solar radiation to function. Hence, shaded areas that need different understory vegetation such as herbs and shrubs, which are potential nectar sources for butterflies for pollination activities (Weerakoon et al., 2015). Also, butterflies are ectothermic organisms with their activities depending on environmental temperature. As a result of this, they are mostly found in areas with abundant sunlight except for a few species which prefer shaded areas. This shaded area preference accounts for the reason why some forested species were specifically found on the Lower slope. This corroborates the finding of Rija (2022) who stated that some forested butterfly species prefer shaded areas, as shade availability favors egg oviposition and larval development during their breeding season. The rich diversity of the species at the upper slope habitat is due to openness of the areas as supported in the study which revealed that species diversity of butterflies is higher in open habitats than in habitats with dense canopy cover (Weerakoon et al., 2015).

Furthermore, the presence of Butterfly Garden and the absence of pesticide use on the plants could also have contributed to the high species richness in this habitat. Plants such as Centaurea cyanus, Gardenia Jasminoides, Catharanthus roseus, Cordyline fruticosa, present in the garden could serve as food sources for many butterfly species. This therefore aligns with the study of Fontaine et al. (2016) who stated that gardens represent food sources for butterflies and can contribute to their abundance in a particular region. In general, the habitat specificity of butterflies is closely linked to suitable environments that support plant food source which provide habitat of unique micro environment conducive to specific

Table 2: Frequency distribution of butterfly species encountered according to family at different sites in Emerald Forest Reserve

	Upper Slope		Lower Slope		Valley Bottom	
Family	Species (%)	Abundance (%)	Species (%)	Abundance (%)	Species (%)	Abundance (%)
Nymphalidae	73.68	65.88	60.00	82.35	70.59	74.83
Pieridae	21.05	33.53	20.00	11.76	11.76	10.60
Lycaenidae	0.00	0.00	6.67	2.35	5.87	3.31
Hesperiidae	0.00	0.00	6.67	2.35	5.87	3.31
Papilionidae	5.26	0.59	6.67	1.18	5.87	7.98
Total	100	100	100	100	100	100

Table 3: Species Diversity Indices at Various Sites in Emerald Forest Reserve

Habitat	Species Number	Shannon Diversity Index (H)	Evenness Pielou's Index (e)	Margalef Index (R)	Simpson's Diversity Index (D)
Upper Slope	19	2.55	0.87	3.50	0.91
Lower Slope	15	2.32	0.86	3.15	0.87
Valley Bottom	17	2.50	0.88	3.19	0.91

species. For example, species like Precis archesia, Charaxes protoclea, Junonia oenone, Euxanthe trajanus, Danaus chrysippus, Euriphene barombina, and Pseudoneptis bugandensis, were recorded from the Upper slope habitat; Sarangesa bouvieri and Amauris niavius were recorded specifically from the Lower slope habitat, and species-specific to the Valley bottom habitat were Catuna angustatum, Papilio nireus, Alcraea alciope, Euriphene amicia amicia, and Pyrrhochalcia iphis. However, approximately 13.0% of the species at the Emerald Forest Reserve exhibited a generalist distribution, indicating their ability to thrive across multiple habitats.

The study showed that Nymphalidae was the most occurrence species sighted in all sites. This corroborated similar findings in a forested region in Nigeria study conducted by Alarape et al. (2018). Also, the presence of fruit-bearing trees in the study area may have contributed to the abundance of Nymphalidae. This is in accordance with the work of (Amusan et al., 2014) who stated that Nymphalidae are exceptional fruit-feeding butterflies and are mostly found in areas with fruit trees. Pieridae ranked second in both abundance and species richness, likely due to their preference for sun-exposed environments, particularly in the upper slope habitat. Lycaenidae have a lower abundance which may be a result of the absence of their preferred host plants. This is contrary to the findings of Chidi and Emeka (2020) in the College of Education, Warri, Delta State but similar in findings conducted by Nwosu and Iwu (2011) in Okwu Ogbaku forest reserve, Imo State. Family Hesperiidae was represented by only two species. This resulted to their dawn general flight period as reported by Jenber and Getu (2020) while this study was day time.

Papilionidae was also represented by only two species. According to Matthew and Anto (2007), species in this family mostly prefer tall trees with moderate sunlight. This could typically be found in the Upper slope and Valley bottom since the Lower slope had lower sunlight because of the presence of trees with denser canopy cover. However, their presence is still lower at the Upper slope. This could be a result of human activities in the form of palm oil production, animal husbandry, building construction, ecotourism activities, and crop farming in the study site which may disrupt the availability or survival of certain species of butterflies. This study ultimately provides the first documentation of butterfly biodiversity in EMF, thereby providing a baseline for long-term ecological monitoring. The study on habitat preferences suggests that butterflies are definitely a reliable indicators of forest microhabitat conditions. More so, the high richness recorded at the valley bottom indicates that this site may serve as a biodiversity hotspot within the reserve and hence, should be prioritized for conservation. Conversely, the reduction in butterfly diversity noticed in more disturbed sites raises concerns about habitat degradation which may have broader implications for forest management and biodiversity conservation. Notably, maintaining habitat heterogeneity by preserving open, riparian, and lightly shaded areas is very essential for supporting both generalist and specialist species of butterfly, and conservation efforts should also aim to minimize land-use pressure, especially in upper slope which has evidence of agricultural encroachment and building construction. Furthermore, it cannot be concluded whether the butterfly fauna is increasing or decreasing since there's no existing data on it, hence, further study may be undertaken at five-year intervals as part of management plan, for proper identification and conservation. Additionally, this study identifies a limitation in the sampling strategy. This is embedded in the fact that the research is carried out during the dry season (October to December 2023), meaning that further study needs to be carried out in the study area to understand butterfly compositions during the rainy season. This would provide insight as to when certain species of butterflies are available and help in the proper documentation of the butterfly species. This study did not only meet its objective of assessing butterfly species occurrence, richness, and abundance across habitats but also highlighted the ecological value of specific microhabitats. The results emphasized the importance of integrated conservation strategies which involve pro-

Table 4: Checklist of Butterfly species at Emerald Forest Reserve, Ikoyi, Osun State, Nigeria

Family	Scientific Name	Common Name
Nymphalidae	*Precis archesia*	Garden Commodore
	Ypthima Asterope	Common three-ring
	Melanitis leda	Common evening brown
	Charaxes protoclea	Flame bordered emperor
	Junonia Sophia	Little commodore
	Hypolimnas anthedon	Variable egg fly
	Charaxes zingha	The Shining Red Charaxes
	Charaxes fulvescens	Forest Pearl Charaxes
	Junonia oenone	Dark Blue Pansy
	Euxanthe trajanus	Traja Forest Queen Butterfly
	Euphaedra medon	Widespread Forester
	Danaus chryssipus	Plain Tiger
	Junonia chorimene	Golden Pansy
	Euriphene barombina	The Common Nymph
	Catuna angustatum	Large Pathfinder
	Protagoniomorpha parhassus	Forest Mother of Pearl
	Hypolimnas misippus	Daneid Eggfly
	Acraea serena	Dancing Acraea
	Amauris niavius	Friar
	Acraea alciope	Alciope Acraea
	Euriphene amicia amicia	Friendly nymph
	Pseudoneptis bugandensis	Blue Sailor
Pieridae	*Eurema hecabe*	Common grass yellow
	Belenois calypso	Calypso white
	Leptosia alcesta	African Spirit
	Eurema floricola	Malagasy grass yellow
Lycaenidae	*Hypophytala nigrescens*	Black Flash
Hesperiidae	*Sarangesa bouvieri*	Bouvier's Elfin
	Pyrrhochalcia iphis	African giant skipper
Papilionidae	*Papilio dardanus*	Flying Handkerchief
	Papilio nireus	African blue-banded swallowtail

tecting floral diversity, reducing human pressure, and ensuring sustainable ecosystem functioning within the Emerald Forest Reserve.

Competing interests

The authors have no conflicts of interest.

References

Alade, A. A., Oluwajuwon, T. V., Alo, A. A., Ogana, F. N., & Aghimien, E. V. (2023). Aboveground biomass allometric models for a private semi-natural forest in nigeria. *Journal of Research in Forestry, Wildlife and Environment*, *15*(2), 169–180.

Alarape, A. A., Awoyemi, A. W., Yager, G. O., & Oluwafemi, G. S. (2018). Butterfly count on different habitats in international institute of tropical agriculture (iita), ibadan, nigeria. *Agriculture and Forestry Journal*, *6*(2), 61–69. https://doi.org/10.46325/afj.v6i2.101

Amusan, B., Ojianwuna, C., Kehinde, T., & Akanbi, A. (2014). Butterfly diversity in obafemi awolowo university, ile-ife, southwest nigeria. *The Zoologist*, *12*, 1–7.

Bonebrake, T. C., Ponisio, L. C., Boggs, C. L., & Ehrlich, P. R. (2010). More than just indicators: A review of tropical butterfly ecology and conservation. *Biological Conservation*, *143*, 1831–1841. https://doi.org/10.1016/j.biocon.2010.04.044

Conservation International. (2010). Guinea forests of west africa [Accessed May 2010]. http://www.conservation.org/how/pages/hotspots.aspx

Fontaine, B., Bergerot, B., Le viol, I., & Julliard, R. (2016). Impact of urbanization and gardening practices on common butterfly communities in france. *Ecology and Evolution*, 8174–8180. https://doi.org/10.1002/ece3.2526

Food and Agricultural Organization (FAO). (2005). Towards sustainable forest management [Accessed August 2012]. www.mongabay.com

Franzen, M., Francioli, Y., Askling, J., Kindvall, O., Johansson, V., & Forsman, A. (2022). Differences in phenology, daily timing of activity, and associations of temperature utilization with survival in three threatened butterflies. *Scientific Reports*, *12*(1), 7534. https://doi.org/10.1038/s41598-022-10676-0

Handersen, S., & Correzzola, S. (2014). Plot-based butterfly surveys: Statistical and methodological aspects. *Journal of Insect Conservation*, *18*(6), 1171–1183. https://doi.org/10.1007/s10841-014-9728-3

Hedblom, M. (2007). *Birds and butterflies in swedish urban and peri-urban habitats: A landscape perspective*. Dept. of Ecology, Swedish University of Agricultural Sciences.

Iserhard, C. A., Brown, K. S., & Freitas, A. V. L. (2013). Maximized sampling of butterflies to detect temporal changes in tropical communities. *Journal of Insect Conservation*, *17*(3). https://doi.org/10.1007/s10841-013-9546-z

Jenber, A. J., & Getu, E. (2020). Studies on butterflies' diversity in relation to habitats and seasons at gulele botanical garden in central ethiopia: Implication of protected area for in-situ conservation of biological entity. *Ethiopian Journal of Science*, *43*(2), 1–13.

Koch, B., Edwards, P. J., Blanckenhorn, W. U., Walter, T., & Hofer, G. (2015). Shrub encroachment affects the diversity of (zerynthia polyxena); adult, egg and larval distribution in a highly degraded habitat complex. *Acta Zoologica Academiae Scientiarum Hungaricae*, *60*(4), 371–87.

Kurylo, J. S., Threlfall, C. G., Parris, K. M., Ossola, A., Williams, N. S., & Evans, K. L. (2020). Butterfly richness and abundance along a gradient of imperviousness and the importance of matrix quality. *Ecological Applications*, *30*(7). https://doi.org/10.1002/eap.2144

Magurran, A. E. (1988). *Ecological diversity and its measurements* [Journal of Biosciences and Medicines, Vol. 2, No. 1]. University Press. https://doi.org/10.1007/978-94-015-7358-0

Myers, N., Mittermeier, R., Mittermeier, C., DaFonseca, G. A., & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, *403*, 853–858. https://doi.org/10.1038/35002501

Ojianwuna, C. C., & Umoru, P. A. (2023). Temporal variation in abundance and distribution of butterflies in a southern nigerian national park. *The Open Environmental Research Journal*, *16*(1). https://doi.org/10.2174/25902776-v15-e221226-2021-16

Olajire, A. A., & Imeokparia, F. E. (2000). A study of the water quality of the osun river, metal monitoring and geochemistry. *Bulletin of the Chemical Society of Ethiopia*, *14*, 1–8. https://doi.org/10.4314/bcse.v14i1.71976

Olusola, J. A., & Adeboyejo, A. A. (2024). Soil seed banks dynamics and restoration potential of some selected forest reserves in southwest, nigeria. *African Journal of Environment and Natural Science Research*, *7*(4), 65–83.

Pielou, E. (1971). *An introduction to mathematical ecology*. Wiley-Interscience. https://doi.org/10.1002/bimj.19710130308

Pignataro, T., Bressan, P., Santos, A. L., & Cornelissen, T. (2020). Urban gradients alter the diversity, specific composition and guild distribution in tropical butterfly communities. *Urban Ecosystems*, *23*(3), 1–8. https://doi.org/10.1007/s11252-020-00975-7

Purnamasari, I., & Santosa, Y. (2017). Variation of butterfly diversity in different ages palm oil plantations in kampar, riau. *Pros Sem Nas Masy Biodiv Indon*, *3*, 278–285.

Rija, A. A. (2022). Local habitat characteristics determine butterfly diversity and community structure in a threatened kihansi gorge forest, southern udzungwa mountains. *Ecological Processes*. https://doi.org/10.1186/s13717-022-00359-z

Ringim, A. S., Abubakar, H. M., Acha, E. K., Okpanachi, A. L., & Rautenbach, F. (2022). Atlas of the butterflies and moths of nigeria, lepimap report, 2010–2021. *Lepidopterists' Society of Nigeria*, *33*, 92–106. https://doi.org/10.4314/met.v33i1.12

Safian, S., & Warren, R. D. (2015). *Common butterflies of iita*. International Institute of Tropical Agriculture. https://hdl.handle.net/10568/80824

Stork, N. E. (2018). How many species of insects and other terrestrial arthropods are there on earth? *Annual Review of Entomology*, *63*, 31–45. https://doi.org/10.1146/annurev-ento-020117-043348

Ubach, A., Pa´ramo, F., Gutie´rrez, C., & Stefanescu, C. (2020). Vegetation encroachment drives changes in the composition of butterfly assemblages and species loss in mediterranean ecosystems. *Insect Conservation Diversity*, *13*, 151–161.

Weerakoon, B., Ranawana, K., & Bandara, S. (2015). Impact of canopy cover on butterfly abundance and diversity in intermediate zone forest of sri lanka. *Journal of Tropical Forestry and Environment*. https://doi.org/10.31357/jtfe.v5il.2496