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An Inventory of Butterfly Species Diversity in Kano Metropolis, Nigeria

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Abstract- ***This study investigates the diversity and distribution of butterfly species across the eight metropolitan Local Government Areas (LGAs) of Kano, Nigeria, a region experiencing rapid urbanization and environmental change. Butterflies are crucial bio-indicators of ecosystem health, and understanding their population dynamics is essential for effective biodiversity conservation. This research provides a comprehensive inventory of butterfly species, quantifies their diversity using established ecological indices, and analyzes their spatial distribution in relation to different land use types. The findings reveal a significant diversity of butterfly species, with notable variations in abundance and community composition across the study sites. The study highlights the adverse impacts of habitat fragmentation, pollution, and other anthropogenic pressures on butterfly populations. By establishing a baseline dataset, this research offers valuable insights for urban planning, conservation strategies, and the sustainable management of green spaces within the Kano metropolis, ultimately contributing to the preservation of these vital insect pollinators and the overall ecological integrity of the region.***

Keywords: Butterfly diversity, Urbanization, Land use change, Species distribution and Biodiversity conservation

I. INTRODUCTION

The global population of insects has shown that butterflies have been tremendously affected around the globe, which has been stated in many places, such as California, which caused a 60% die-off of western monarch butterflies (Dhanalakshmi et al., 2019). Loss of insects, mainly butterflies, contributes a lot to the disturbance of ecosystem functions and natural food chains (Riaz et al., 2021). Pollinators are crucial to biodiversity conservation, ecosystem protection, agriculture, and climate change adaptation.

In Africa, butterflies are an integral part of the continent's rich biodiversity, with over 4,000 species recorded. Unfortunately, many African countries lack comprehensive data on butterfly diversity and distribution, hindering effective conservation efforts (Larsen, 2005). There are a considerable number of butterfly species that have not been described, and their trends are unknown despite the increasing trend in habitat fragmentation, climate change, farmland intensification, and chemical use (Kioko, 2019). The West African regions are rich with biodiversity with different flora and fauna and have been affected by several development in terms of infrastructure, construction, and other anthropogenic activities that alter the distribution of this insect. Like most other developing countries, Nigeria is experiencing biodiversity loss as a result of devastation of exotic habitats, pollution, and introduction of species (Bolaji et al., 2023).

Nigeria is an Afro-tropical country endowed with rich flora and fauna biodiversity, typical of most tropical countries of the world. Recently, studies have suggested a range of factors that affect the pattern and distribution of butterflies; these include competition, predation, numerical abundance of species, food web structure, genetic factors, short- and long-term aspects of evolutionary rate and size of the insect (Ombugadu et al., 2021). Northern Nigeria, as part of the dryland, is affected by the distribution of several species of plants and animals (Riaz et al., 2021). Pollinators are crucial to biodiversity conservation, ecosystem protection, agriculture, and climate change adaptation (Abdelmajid et al., 2021).

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In agricultural ecosystems, pollinator diversity increases the quality and quantity of crop yield. Furthermore, studies indicate that many pollinator groups are useful in monitoring environmental pollution, aid in pest and disease control, and provide cultural and aesthetic value (Mutavi et al., 2022).

II. MATERIALS AND METHOD

Study Area

Kano Metropolis is located within latitudes 12025'N to 12040'N and Longitudes 80 35'E to 80 45'E. The boundary of the Metropolis keeps changing with time (Mortimore, 1989). The Metropolis is made up of eight Local Government Areas namely: Municipal, Gwale, Dala, Fagge, Tarauni, Nasarawa, Kumbotso, and Ungoggo (Figure I). The Kano Region is characterised with marked wet and dry seasons. Generally, the Region has a semi-arid climate, with a mean daily temperature of 300C. The months of December to February are colder, with the lowest temperature recorded around 200C. The rainfall regime is characterized by two seasons, namely, the rainy season from May to October and the dry season from November to April. The average annual rainfall is about 884mm increasing from north to south. In the extreme south, it could reach 1200mm per annum around Riruwai and Doguwa.

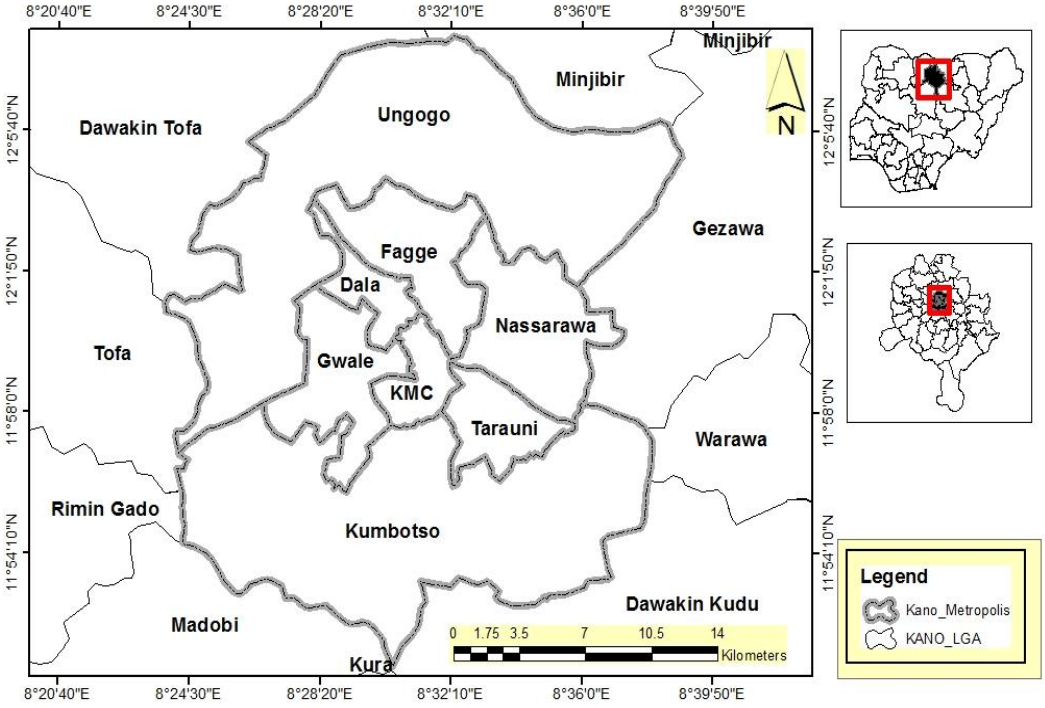

Figure 1: Study Area Map. Source: (Geo lab Buk, Kano)

2.2 Method of Butterfly Data Collection

To make an inventory the butterfly species diversity and distribution in the Kano metropolitan area, data were collected from six distinct locations representing different land use types: residential areas and vegetated areas with varying tree cover (tall, medium, and low trees), as well as other reserved areas.

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Butterflies were sampled within a 100-meter radius at each location using sweep nets. A capture-recapture method was employed, and observations were also recorded through photographs taken with a cellphone. Species identification was facilitated by the use of "Butterfly Identifier" and "iNaturalist" mobile applications.

2.3 Method of Data Analysis

The spatial distribution and patterns of species diversity were visualized and analyzed using maps to understand the relationship between butterfly distribution and different land use types. Diversity indices are calculated using the Shannon-Wiener Index to quantify diversity, The index determines the proportion of more dominant species in an area.

$$H = -\sum_{i}^{S} pi.\ln(pi) \quad (1)$$

Where H': is the Shannon diversity index
S: is the number of the species in the habitat
Pi: is the proportion of individuals belonging to the entire species

Evenness Index (E) which refers to how close in numbers each species is in an environment, is calculated as

$$(a)\ E = \frac{H}{Hmax}. \quad (2)$$

Where E=evenness index
H'= Shannon Weiner index
Hmax = the highest value of Shannon Weiner index

Simpson's Dominance index (D) can be used to calculate species Richness as

$$D = 1 - \frac{\Sigma n(n-1)}{N(N-1)} \quad (3)$$

Maps were used to locate the species distribution and the pattern related to different species diversity.

III. RESULTS AND DISCUSSION

3.1 Inventory of butterfly species diversity and distribution

Butterflies serve as important biomarkers of environmental health and biodiversity, reflecting the state of ecosystems and habitat quality. In Kano State, Nigeria, assessing butterfly species diversity and spatial distribution is essential to understanding ecosystem dynamics, guiding conservation efforts, and informing sustainable land management practices. This section provides a comprehensive inventory of butterfly species observed across six key locations in Kano State during the study period. The collected data provide a baseline for assessing species richness, abundance, and community composition within diverse habitats.

3.2 Butterfly Species Inventory

This subsection documents the different species of butterflies identified in the study area, categorized by family, common names, and scientific classification (Table 1). The inventory reflects systematic field observations and sample collections aimed at capturing the breadth of butterfly varieties found in Kano State. It provides an essential reference for monitoring biodiversity changes over time and supports efforts to conserve rare and environmentally important species.

Table 1. Inventory of Butterfly Species

S/N	Family	Common Name	Scientific Name
1	Pieridae	Pioneer	*Belenoi Aurota*
2		African migrant	*Catopsilia Pomona*
3		Common Gull	*Cepora Nerissa*
4		Small Salmon Arab	*Colotis Amata*
5		Plain Orange-tip	*Colotis Aurora*

6		Crimson-tip	*Colotis Danae*
7		Little Orange-tip	*Colotis Etrida*
8		Three-spot Grass Yellow	*Eurema Blanda*
9		Small Grass Yellow	*Eurema Brigitta*
10		Common Grass Yellow	*Eurema Hecabe*
11		Spotless Grass Yellow	*Eurema Laeta*
1		African Monarch	*Danaus Chrysippus*
2	Nymphalidae	Tawny Coster	*Acraea Terpsicore*
3		Angled Castor	*Ariadne Ariadne*
4		Joker	*Byblia Ilithyia*
5			*Danaus Chrysippus*
6		Striped Tiger	*Danaus Genutia*
7			*Hypolimnas Bolina*
8			*Hypolimnas Misippus*
9		Peacock Pansy	*Junonia Almana*
10		Blue Pansy	*Junonia Orithya*
11		Common Evening Brown	*Melanitis Leda*
12		Common threering	*Ypthima Asterope*
1	Lycaenidae	Gram Blue	*Euchrysops Cnejus*
2		Tailless Lineblue	*Prosotas Dubiosa*
3		Pale Grass Blue	*Pseudozizeeria Maha*
4			*Virachola Isocrates*
5		Dark Grass Blue	*Zizeeria Karsandra*
6		Lesser Grass Blue	*Zizina Otis*
7		Tiny Grass Blue	*Zizula Hylax*
	Papilionidae		
1		Common Rose	*Pachliopta Aristolochiae*
2		Lime Swallowtail	*Papilio Demoleus*
3		Common Mormon	*Papilio Polytes*
1	Hesperiidae	Common Banded Awl	*Hasora Chromus*
2		Dark Palm-Dart	*Telicota Bambusae*
3		Tricolour Pied Flat	*Coladenia Indrani*
4		Lesser Rice Swift	*Borbo Bevani*

Table 2 presents the distribution and abundance of butterfly species across the six sample locations in Kano State. The table records a total number of 1450 species belonging to 5 different families. A total of 261 species were recorded in the BUK new campus, with Eurema Blanda species in the Pieridae family as the highest, while Colotis Aurora and Borbo Bevani as the lowest recorded specie in the area, the area having the highest number of Pieridae Family indicated by the Figure 2 from the study area map. 248 species in Buk old campus, with also Eurema Blanda species in the Pieridae family as the highest, it has the second largest number of specie showed by Figure 3 from the study area map while Colotis Aurora, Zizula Hylax, and Nymphalidae Hypolimnas are the lowest species recorded in the area. 246 species in the Kano Zoological Garden shown by the Figure 4 in the study area map with 31 Lycaenidae

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family. Eurema Hecabe species in the Pieridae family as the highest, Ixias pyrene, Zizina Otis, and Borbo Bevani as the lowest species. 241 in the Kano State College of Education, with Danaus Chrysippus in the Nymphalidae Family as the highest, and Hypolimnas Bolina, Zizeeria Karsandra, Pachliopta Aristolochiae, Papilio Polytes, and Borbo Bevari as the lowest recorded species in the area, Figure 5 shown that Kano zoological Garden has the highest Number of Papilionidae family

There are 224 species in the Mallam Aminu Kano International Airport (MAKIA), with Danaus Chrysippus species in the Nymphalidae Family as the highest number, and Eurema Brigitta, Ixias Pyrene in Pieridae Family, lastly Junonia Orithya in Nymphalidae Family. 230 species in the Emir Palace, Kano, with Danaus Chrysippus in the Nymphalidae Family as the highest recorded, and Zizina Otis in the Lycaenidae Family, Figure 6 shown the area has the highest number of Hesperiidae Family. Nymphalidae has the highest number of Genera, while Lycaenidae has the lowest number of Genera. A few species were recorded, such as Ixias pyrene and Colotis aurora, as they require a specific habitat. This result indicated that the habitat had a considerable relationship with diversity and an abundant number of butterfly species, which is in line with Aina et al., (2021) and Ojianwuna and Umoru (2023). and Species like Eurema Blanda were found in high numbers at every single location because the species is adapted to the Sudan and Sahel savanna region. The savanna region is a direct result of its ecological adaptations. The findings are supported by Larsen et al., (2

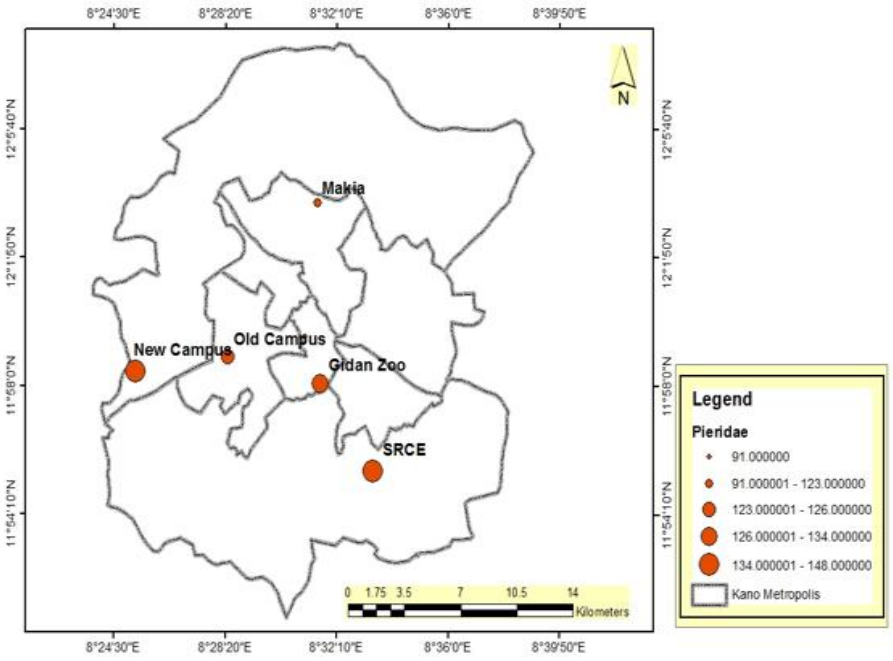

Figure 2: Map of the study area Showing Number of Butterfly Pieridae Family

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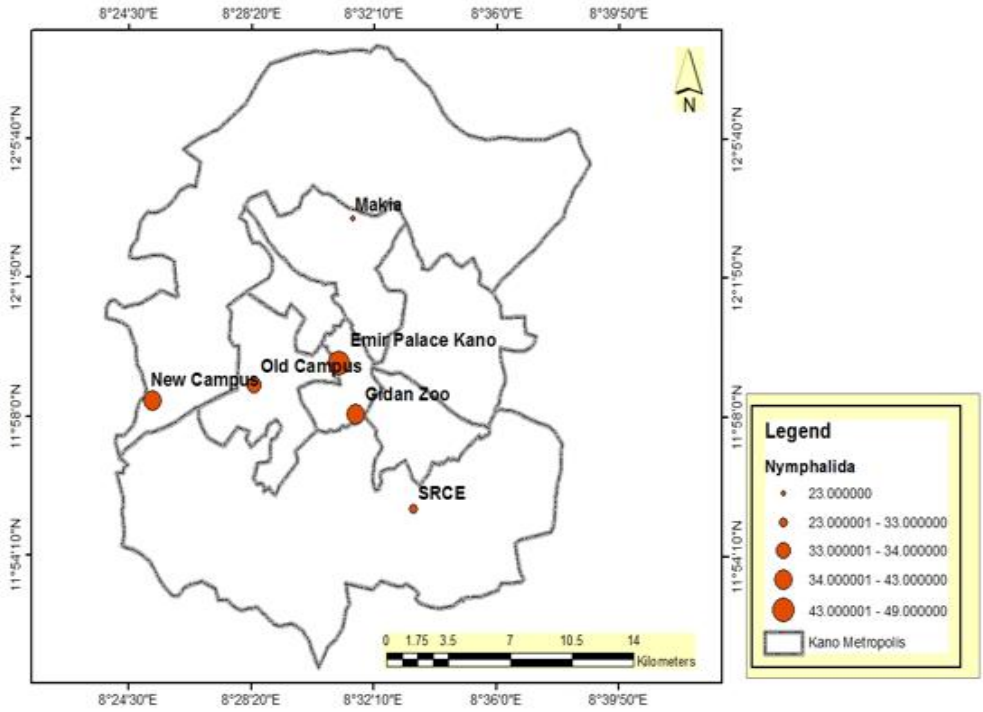

Figure 3: Map of the Study area Showing Number of Butterfly Nymphalidae Family

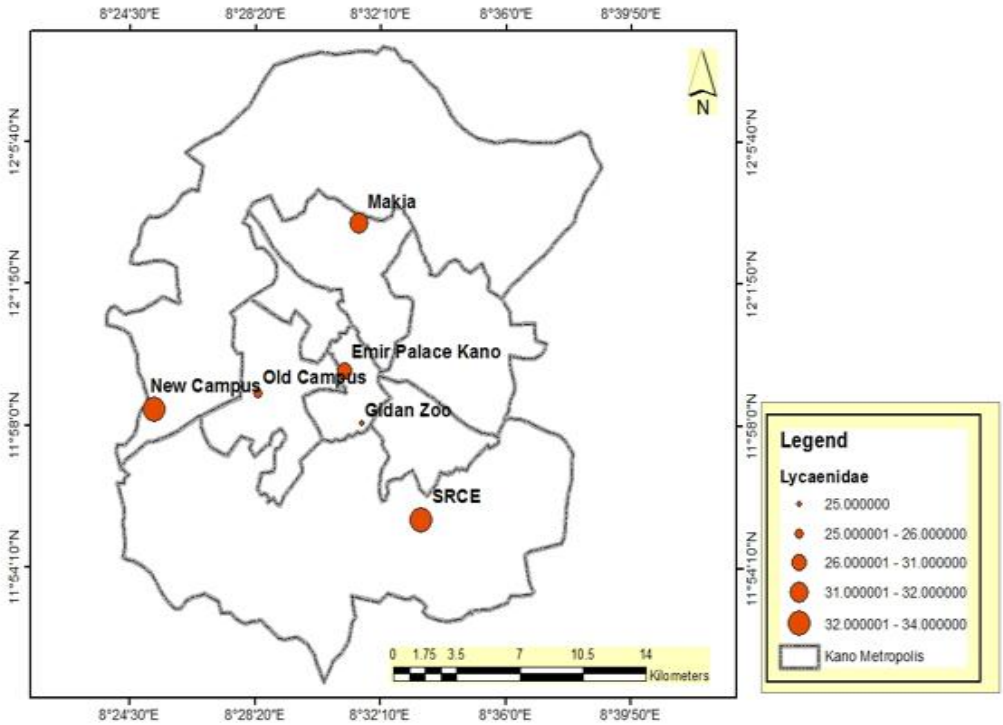

Figure 4: Map of the study area Showing Number of Butterfly Lycaenidae Family

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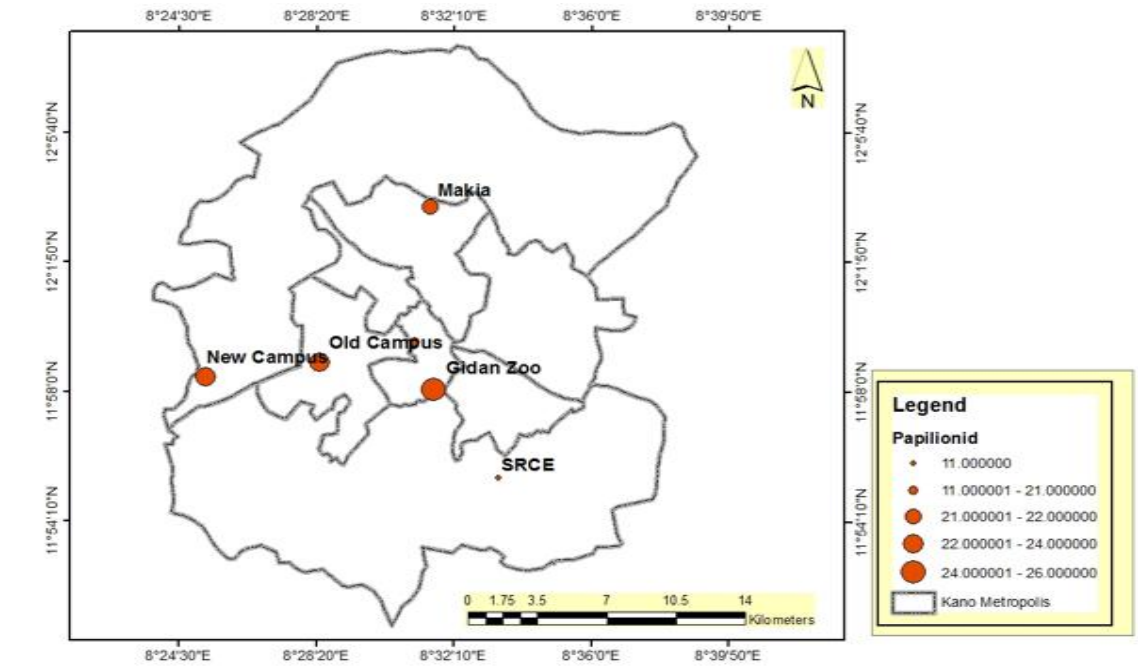

Figure 5: Map of the Study area Showing Number of Butterfly Papilionidae Family

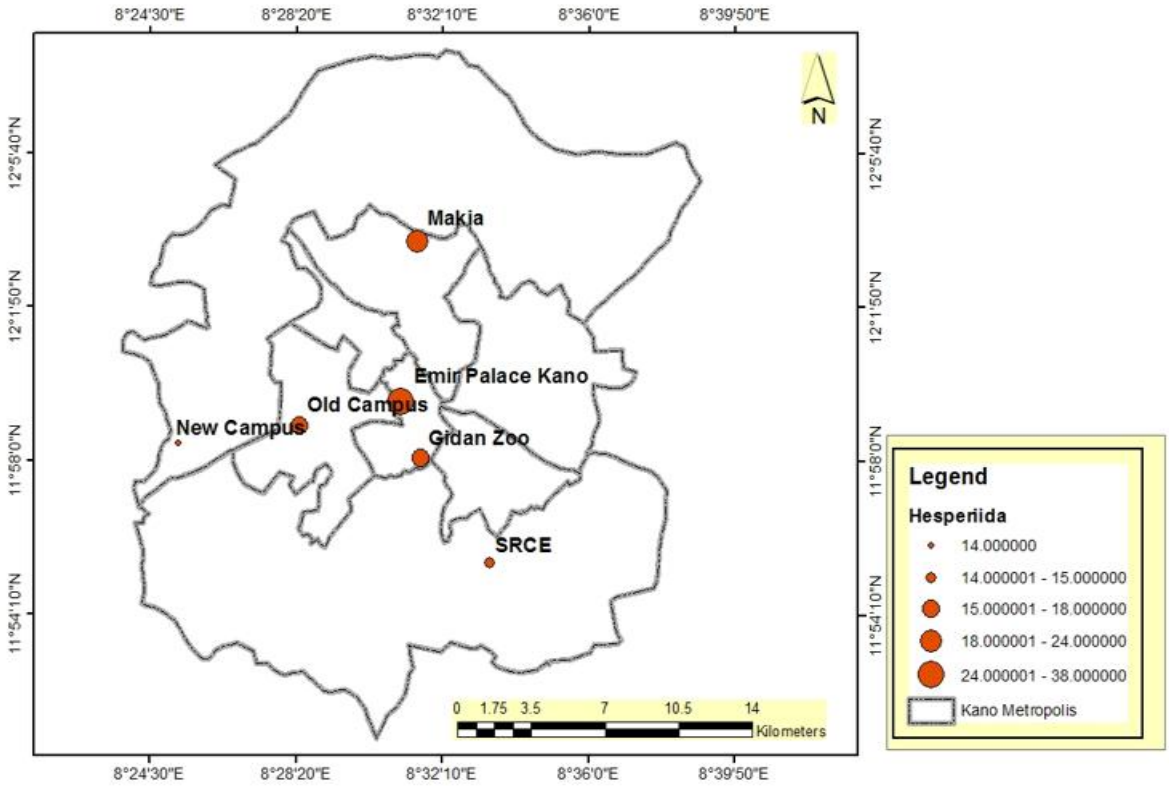

Figure 6: Map of the Study area Showing Number of Butterfly species Hesperiidae Family

IV. CONCLUSION

This study provides a detailed inventory of butterfly species diversity across the varied landscapes of the Kano metropolis. The findings quantify the impacts of anthropogenic disturbances such as deforestation, urbanization, and agricultural expansion on butterfly communities. By identifying key habitats and the pressures they face, this research serves as a crucial tool for safeguarding butterfly populations and preserving the vital role of these insect pollinators. The data generated will aid in the development of targeted conservation strategies and informed urban planning to enhance agricultural productivity and the overall ecological health of Kano State

V. RECOMMENDATION

Future researchers should expand butterfly diversity and surveys by sampling across multiple seasons and over a longer study period to account for seasonal fluctuations in species abundance and richness. Increasing the number of sampling sites and including different habitat types will provide a more comprehensive inventory of butterfly species and their distribution patterns. Researchers are also encouraged to incorporate modern identification techniques, such as DNA barcoding and geographic information system (GIS) mapping, alongside traditional field observations to improve species identification accuracy and spatial analysis. In addition, collecting environmental data such as vegetation composition, temperature, humidity, and land-use characteristics will help explain factors influencing butterfly diversity

Long-term monitoring programs are recommended to detect changes in butterfly populations over time, particularly in response to habitat alteration and climate change. The findings from such studies can provide valuable information for biodiversity conservation, habitat management, and the development of effective conservation strategies for butterfly species.

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