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Urban Sanctuaries of Wings: A Study on Butterfly Diversity in Metropolitan Bengaluru, Karnataka, India

Uddappanda Bopaiah Roy

Department of Zoology and Genetics, Government Science College Autonomous, Bengaluru - 560 001, Karnataka, India

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*Corresponding Author: **Uddappanda Bopaiah Roy** | Email Address: **royuroyu.dce@ka.gov.in**

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Abstract

Butterflies serve as critical bioindicators and pollinators, yet urbanization threatens their habitats. This study assesses butterfly diversity across nine ecological niches in urban Bengaluru, India, based on secondary data collected during an internship project. Using observational surveys and published records, the study identifies 120+ butterfly species spanning six families and 18 subfamilies. The family Lycaenidae emerged as the most abundant, followed by Nymphalidae and Pieridae. Several species fall under the Wildlife Protection Act of 1972. Notably, campus green spaces like Christ University and gardens such as Lalbagh and Cubbon Park demonstrated high species richness. Findings underscore the ecological importance of urban green corridors and recommend conservation initiatives rooted in sustainable landscape practices.

Keywords: *Urban biodiversity; Butterfly diversity; Lepidoptera; Lycaenidae; Conservation; Bengaluru; Urban ecology; Bioindicators*

1. Introduction

Urbanization exerts considerable pressure on native ecosystems, often leading to habitat fragmentation and biodiversity loss. Amid these transformations, butterflies stand out not only as pollinators but also as sensitive ecological indicators due to their habitat specificity and close plant associations. It is widely acknowledged that approximately 40% of the global economy and 80% of the livelihood of impoverished communities depend directly on biological resources. A richer biodiversity offers greater opportunities for medical advancements, sustainable economic development, and adaptive strategies to address climate change. To comprehend the diversity of wildlife, it is essential first to understand the concept of biodiversity [1]. While commonly defined as the variety of life on Earth, biodiversity extends far beyond this basic understanding—it represents the very essence of planetary vitality, the intricate web that sustains ecological balance and human well-being.

Biodiversity encompasses the vast array of species—including plants, animals, and microorganisms—as well as the genetic variation within these species and the myriad ecosystems they form, such as deserts, rivers, oceans, rainforests, and coral reefs [2]. This biological complexity is critical for maintaining ecosystem productivity, wherein every organism, regardless of size, plays a vital role in the functioning of natural processes. Healthy biodiversity provides invaluable ecosystem services free of cost: protection of water resources, soil formation and fertility, nutrient cycling, climate regulation, and air purification [3]. Biological resources further support human society through the provision of food, medicinal compounds, herbal remedies, timber, ornamental plants, and genetic diversity crucial for crop and livestock resilience.

A study published in *Nature* emphasized the significance of genetic diversity in preserving wildlife populations. This diversity reduces the risk of genetic bottlenecks and inbreeding depression, which are leading causes of extinction. By maintaining a broad genetic pool, species enhance their chances of adapting to changing environmental pressures and contribute to the repopulation and long-term sustainability of ecosystems, biodiversity is not merely a scientific term—it is the living fabric of the Earth. Safeguarding it is not only about conservation but about securing the foundation of life itself. Bengaluru, a rapidly expanding metropolitan city, still retains pockets of ecological richness such as botanical gardens, lakeshores, and institutional campuses. These green spaces may serve as biodiversity reservoirs. The present study explores butterfly diversity in key urban locations, aiming to understand species richness, habitat preferences, and conservation implications.

Butterflies (Order: *Lepidoptera*) have long been employed in ecological monitoring due to their visibility, short life cycles, and strong affinity to microclimatic conditions. Previous works by [1-2] emphasize South India's butterfly biodiversity, particularly in Western Ghats, with over 300 species recorded. However, less attention has been paid to urban environments

like Bengaluru, where isolated green patches may act as biodiversity islands [3]. Studies show that green spaces with native plant species and water features support higher butterfly diversity. Notably, research from Cubbon Park and Lalbagh reveals floral abundance correlating with increased lepidopteran activity [4]. Conservationists argue that even urban parks, if managed appropriately, could support threatened and endemic species [5].

2. Materials and Methods

2.1 Study Area

The study covered nine urban biodiversity hotspots in Bengaluru: Lalbagh Botanical Garden, Christ University, Cubbon Park, Madiwala Lake, Yediyur Lake, Indian Institute of Science (IISc) Campus, Puttenahalli Lake, Hebbal Lake, and RK Mission Shivanahalli.

Table 1: Study area name, Acres covered, vegetation profile and Butterfly notes on Bengaluru, Karnataka, India

Site Name	Area (Acres)	Dominant Vegetation	Notes
Lalbagh	240	Exotic and native flora	Key butterfly site
Christ University	25	Angiosperms, gymnosperms	Campus habitat
Cubbon Park	100	Bamboos, flowering trees	Low anthropogenic pressure
Madiwala Lake	~114	Garden species, wetlands	Seasonal bird migration zone
Yediyur Lake	~31	Jogging trails, flowering beds	Urban oasis
IISc Campus	170	Rain trees, lantana	Semi-natural habitat
Puttenahalli Lake	13.6	Bird sanctuary potential	Rain-fed lake
Hebbal Lake	150	Two artificial islands	Roosting sites
RK Mission, Shivanahalli	~Unknown	Thorny scrub, dry deciduous	Fringe of Western Ghats

2.2 Data Collection

The study was based on secondary data sources, including field records maintained during an internship, biodiversity manuals, published literature, and identification keys [6-7].

Two key survey techniques were used:

- **Line Transect Method**: Observations made along pathways within parks and campuses.
- **Random Sampling**: Irregular observations to minimize sampling bias.

Physical features such as wing pattern, coloration, and flight behaviour were documented for identification.

3. Results and Discussion

A total of 120+ butterfly species were identified, classified under six families. The highest diversity belonged to *Lycaenidae* (35 species), followed by *Nymphalidae* (33 species), and *Pieridae* (19 species).

Table 2: Family-wise Distribution of Butterflies of Bengaluru, Karnataka, India

Family	Number of Species	Dominant Sites
Lycaenidae	35	Cubbon Park, IISc, Lalbagh
Nymphalidae	33	Christ University, Hebbal Lake
Pieridae	19	Lalbagh, Puttenahalli
Hesperiidae	17	IISc, Cubbon Park
Papilionidae	10	Lalbagh, Madiwala
Riodinidae	1	Christ University

3.2 Protected Species under Wildlife Protection Act (1972)

Out of the recorded species, **10-15 species** are under legal protection, including Schedule I (e.g., *Papilio polymnestor*), Schedule II (e.g., *Tirumala limniace*), and Schedule IV species.

3.3 Site-wise Diversity

At Christ University, a total of 41 species were recorded, with *Nymphalidae* showing dominance. Genera such as *Papilio*, *Junonia*, and *Eurema* were most frequent.

3.4 Observational Highlights

- *Tailed Jay* (*Graphium agamemnon*) and *Common Mormon* (*Papilio polytes*) were common in gardens.
- Roosting behavior of *Euploea core* and *Parantica aglea* was noted during migration in early spring.

Figure 1: Various common butterflies of Bengaluru, Karnataka, India

Figure 2: Various common and geographical specific butterflies of Bengaluru, Karnataka, India

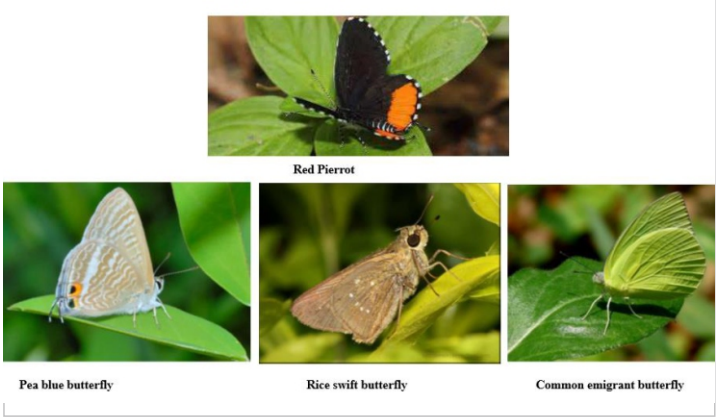

Figure 3: Various common and geographical specific butterfly diversity of Bengaluru, Karnataka, India

4. Conclusion

The study reveals that urban Bengaluru, despite intense development, retains ecologically viable habitats for butterflies. Green spaces like Lalbagh and IISc play a pivotal role in supporting butterfly metapopulations. Immediate conservation strategies—such as increasing host plant cover, mitigating pollution, and regulating urban sprawl—are needed to preserve this diversity. The report observation has noted that the diversity of lycaenidae is the largest in number followed by nymphalidae and pieridae. The least number of diversities observe in hesperridae and papillionidae. Though many butterflies can be observed physically or through direct observation but there are many butterflies whose observation needs specific amount of time and patience. They are seasonally, locally and individually observed. However, there are many female species which mimics like other species for their protection from other animals and sometimes the difference between two different species is very minute that they kept in continuous monitoring of butterfly species. Butterfly depends upon host plants for their survival and growth and development. The selection of host plant by them is very specific. They have greater ecological significance as compared to various higher organisms. Since butterflies are important part of ecosystem to function efficiently. But due to growing population and urbanisation, natural habitat of butterflies is getting lost somewhere to the verge of extinction. Well, this is everyone responsibility to keep a tract on our ecosystem and its most important organisms. We can follow the method of sustainable development, reducing pollution, unnecessary destruction of habitat, natural growth has been supported more, planting more greens and specially planting more fragmented plants. If similarly, in this way butterflies continue to get verge of extinction, then this generation might be last ones witness such beautiful creature in abundance.

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