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Jakarta's Urban Green Spaces as Butterfly Habitats and Its Implications for Climate Mitigation

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SYNOPSIS

Jakarta's urban green spaces are more than city parks. They are small ecosystems alive with pollinators that keep urban nature functioning. To understand how vegetation and human activity influence butterfly diversity, this study surveyed five parks across the city using standardized observation methods, namely the Pollard Walk and Point Count. A total of 157 butterflies representing 22 species were recorded, with *Eurema* sp. appearing most frequently. Parks with lush, layered vegetation like Penjaringan Urban Forest Park hosted the most species, while heavily urbanized areas had fewer. The findings reveal that preserving diverse plants and reducing disturbance can make cities more resilient to climate change, one butterfly at a time.

INTRODUCTION

As Jakarta grows upward and outward, its remaining green spaces carry responsibilities far greater than their size suggests. These pockets of urban nature cool overheated neighborhoods, store carbon, filter polluted air, and offer refuge for both people and wildlife (Aulia *et al.*, 2023). Yet rapid land-use change threatens to erode the very ecological functions that help the city withstand rising temperatures and worsening environmental stress (Maheng *et al.*, 2021). Understanding whether these green areas can continue performing their role is becoming increasingly urgent for climate-vulnerable megacities.

Pollinators are a crucial but often overlooked part of this picture. While discussions on urban resilience typically focus on trees and infrastructure, far less attention is given to the small organisms that keep urban vegetation alive. Butterflies, in particular, are highly sensitive to shifts in vegetation structure, temperature, and disturbance. Their presence often reflects deeper ecological conditions beneath the surface. Because they contribute to pollination and plant regeneration, their patterns also reveal how effectively urban green spaces can sustain the ecosystem processes that support climate mitigation (Azahra *et al.*, 2022; Aulia *et al.*, 2023).

Jakarta's parks vary widely in size, vegetation complexity, and levels of human activity, creating a mosaic of habitats with differing ecological potential. Some parks host dense canopies and flowering shrubs that support diverse butterfly assemblages, while others-smaller, more exposed, or heavily disturbed-struggle to maintain even common generalist species. These contrasts raise important questions about which green spaces still function effectively and what this means for urban climate strategies.

This study documents butterfly diversity across five representative parks in Jakarta, analyzes how vegetation structure and human disturbance shape species richness and abundance, and explores the ecological implications for climate-related ecosystem services. By linking butterfly ecology with urban climate resilience, the study provides empirical evidence to inform biodiversity-aware planning and strengthen nature-based solutions in dense urban environments.

ARTICLE CONTENT

Challenges in Maintaining Urban Ecological Functionality amid Rapid Urbanization

Rapid urbanization in Jakarta continues to fragment and degrade green spaces, threatening the ecosystem functions that support urban climate resilience. Parks help regulate temperature, store carbon, and purify air, but these benefits weaken when vegetation becomes sparse or isolated. Although these services are well recognized, the role of biodiversity-especially pollinators-remains underexplored in Southeast Asia. Butterflies are particularly informative because they respond quickly to vegetation structure, disturbance, and local microclimate-small-scale temperature and humidity conditions that can differ from the broader city environment. Their pollination activities also contribute to plant regeneration and ecological stability.

Butterfly communities in Jakarta vary widely across parks depending on floral resources, canopy cover, and habitat configuration. Parks with layered vegetation support richer assemblages, while smaller or heavily disturbed parks lose species more rapidly, especially specialists. These patterns illustrate how fragmentation and human pressure shape ecological resilience in dense urban settings. Yet biodiversity considerations remain largely absent from municipal climate plans, reflecting a persistent policy gap. This study addresses that gap by documenting butterfly diversity across five Jakarta parks and examining how vegetation and disturbance influence their distribution and ecological functions. To contextualize these patterns, the next section outlines the field observations conducted to capture how butterflies move, feed, and interact with different urban habitats.

https://www.biomes.be/product/eurema-hecabe-tamiathis-2

Chasing Wings in the Concrete Jungle: How We Tracked Jakarta's Urban Butterflies

For ecologists, spotting butterflies in a megacity is not just leisure; it is detective work. Each fluttering wing tells a story about how the city breathes, greens, and heals itself. But finding these fragile clues in Jakarta's maze of glass and traffic takes more than luck; it takes method and patience. That is why, from November to December 2024, this study explored five of Jakarta's green lungs, from the quiet Langsat Park to the lively Taman Ismail Marzuki. A simple but careful rhythm was followed during the survey. The Pollard Walk method was used by walking at a steady pace along predetermined transects and recording butterflies that appeared within a fixed observation width. In addition to this, the Point Count technique was applied by standing still at designated locations and noting all butterflies seen within a defined radius over a short, timed interval. Together, these approaches ensured that both mobile and more cryptic species were detected throughout the parks. Armed with cameras and the KupuKita citizen-science app, each sighting was captured and verified, from the bright *Eurema* to the shy skippers. Every photograph became part of a living database that connects citizens, scientists, and policymakers in understanding urban biodiversity.

Who's Thriving, Who's Hiding: The City's Butterfly Census

We recorded 157 butterflies representing 22 species across five Jakarta urban green spaces. Even this simple tally reveals clear patterns. Nymphalidae dominated with 10 species and 50 individuals, reflecting their adaptability to human-modified habitats. Pieridae, although represented by only seven species, had the highest number of individuals (94), with *Eurema* emerging as the most widespread urban generalist, appearing at every site. In contrast, Lycaenidae and Hesperiidae appeared only rarely; their small size and discreet behavior make them harder to detect, and they are among the first to disappear when habitat quality declines.

Location strongly influenced diversity. Penjaringan Urban Forest Park hosted the highest counts (58 individuals and 13 species), followed by Langsat Park (40 individuals, 12 species) and Ismail Marzuki Park (36 individuals, 11 species). The smallest and most exposed parks, Pulir Park and Ria Rio Park, supported only 13 and 10 individuals respectively. These contrasts function as ecological signals, showing where urban nature remains resilient and where it is most vulnerable. Understanding why such differences occur requires a closer look at the vegetation structures that shape habitat quality across sites.

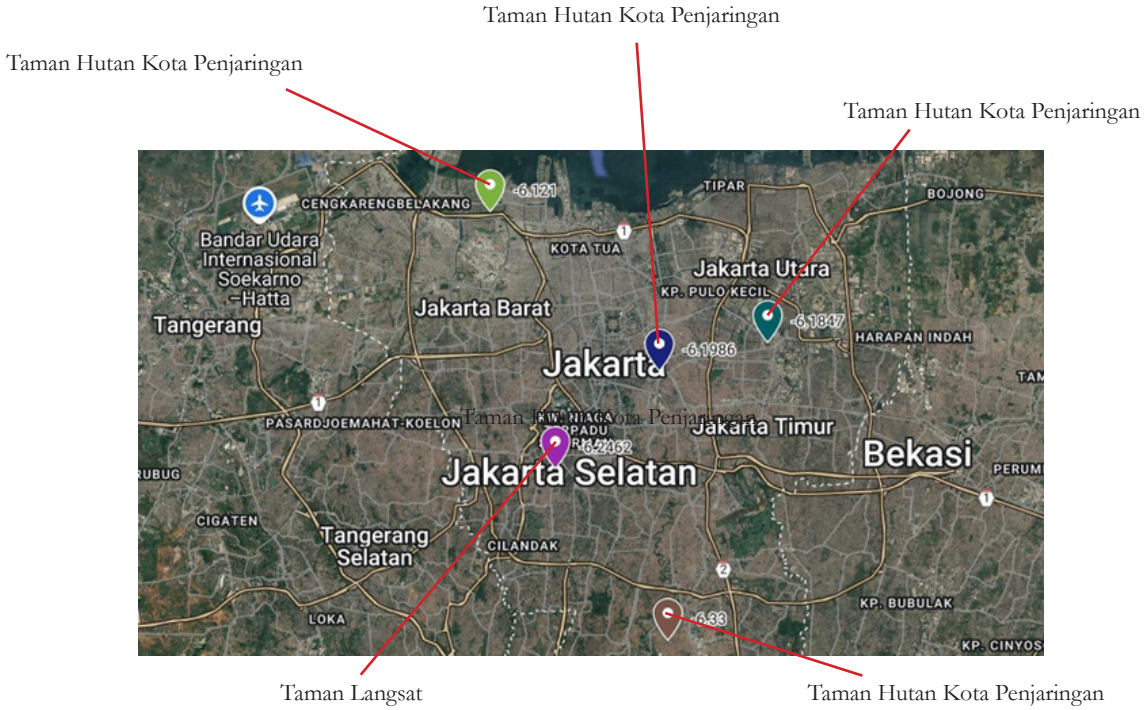

Figure 1 Geographic Distribution of Surveyed Parks in Jakarta
Source: Author, base map from Google Earth

Table 1 Summary of Butterfly Families, Representative Species, and Total Individuals Recorded Across Five Jakarta Parks.

Family	Representative species	Total individuals	Total species	Most common sites
Pieridae	*Eurema* sp. *Catopsilia pomona*	94	7	Penjaringan Urban Forest Park
Nymphalidae	*Ypthima philomela* *Hypolimnas bolina*	50	10	Langsat Park
Papilionidae	*Graphium doson* *Papilio demoleus*	5	2	Penjaringan Urban Forest Park Langsat Park
Hesperiidae	*Suastus gremius*	5	1	Langsat Park
Lycaenidae	*Euchrysops cnejus* *Zizina otis*	2	2	Langsat Park Ismail Marzuki Park
Total	-	**22**	**157**	-

Source: Data obtained from field observations (November – December 2024).

Table 2 Butterfly Richness and Abundance Recorded in Five Jakarta Parks.

Research site	Total species	Total individuals	Dominant family/species
Penjaringan Urban Forest Park	13	58	Pieridae (*Appias olferna*)
Langsat Park	12	40	Pieridae (*Eurema* sp.)
Ismail Marzuki Park	11	36	Nymphalidae (*Ypthima philomela*)
Pulir Park	8	13	Pieridae (*Catopsilia pomona*)
Ria Rio Park	7	10	Pieridae (*Eurema* sp.)
Total	**22**	**157**	-

Source: Data obtained from field observations (November – December 2024).

Plants Set the Rules: Why Vegetation Structure Shapes Butterfly Life

Butterflies are ecological minimalists: they need nectar for adults and host plants for larvae. Parks that offer a canopy, shrub layers, and flowering herbs meet these needs, which is why Penjaringan Urban Forest Park and Langsat Park, with tall flowering trees and stratified understorey-layers of vegetation ranging from shrubs to herbs beneath the canopy-supported more species and more individuals. Open, grassy parks with few flowers provide neither shade nor food, and butterflies respond instantly.

Vegetation structure shapes more than resource availability. Vertical complexity, the layering of plants from ground cover to canopy, helps cool the microclimate and reduce heat stress. Horizontal heterogeneity, the varied arrangement of plant patches across a park, creates diverse microhabitats for species with specialized requirements. Species such as *Appias olferna*, *Catopsilia pomona*, and *Eurema* were closely associated with sites rich in floral and host plants, and were scarce in parks lacking these resources. These patterns make one point clear: planting is not ornamental, it is essential ecological infrastructure. They also raise a broader question: how can cities translate these insights into practical actions that strengthen climate resilience?

From Wings to Climate Action: Practical Fixes that Matter

Butterflies may be small, but they are powerful allies for urban climate resilience. Through pollination and plant regeneration, healthy butterfly communities help sustain vegetation that cools neighborhoods, stores carbon, and filters air. This creates a clear opportunity for urban planners: protecting pollinators strengthens many ecosystem services at once.

What to do, specifically and site by site: at Penjaringan Urban Forest Park, protect existing canopy and fix management failures: improve access, stop illegal dumping and burning, and maintain regular waste services so habitat quality is not eroded. At Langsat Park, increase native flowering species and protect calm weekday windows from disturbance. At Ismail Marzuki Park, use underutilized corners for nectar planting and regulate events that fragment habitat. For Pulir Park and Ria Rio Park, urgent greening is required: add vertical layers, flowering shrubs, and roadside buffer strips to reduce exposure to traffic emissions and noise. Across all parks, reduce frequent mowing, establish pocket pollinator gardens, and integrate citizen science with expert verification so data can inform management.

Several site-specific actions can move this forward. Penjaringan Urban Forest Park should prioritize canopy protection and improve basic management by preventing illegal dumping, reducing burning, and maintaining waste services. Langsat Park would benefit from more native flowering plants and reduced disturbance during quieter periods. At Ismail Marzuki Park, unused corners can be converted into nectar-rich pockets while event activities are managed to avoid habitat fragmentation. Pulir Park and Ria Rio Park require urgent greening through added vegetation layers, flowering shrubs, and buffer strips to reduce pollution exposure. Across all parks, limiting frequent mowing, expanding small pollinator gardens, and strengthening citizen-science programs with expert support will help ensure decisions are grounded in reliable ecological data.

CONCLUSION

A final caveat: these patterns come from a short, season-limited survey, so the fine details of rarity and temporal trends remain uncertain. Even so, the spatial contrasts are robust enough to justify immediate, low-cost interventions. In other words, we do not need perfect data to act; we need the right planting, better maintenance, and smarter park design so butterflies can keep reading the city's health for us.

Future Direction for Nature-Based Solutions in Urban Areas

Urban biodiversity research is only just beginning to reveal how much pollinators contribute to climate-relevant ecosystem services. To strengthen this understanding, future studies should extend butterfly monitoring across multiple seasons and expand observations to a wider range of parks, including informal green pockets that often fall outside formal surveys. Integrating microclimate data, vegetation mapping, and pollution metrics will help uncover how urban environmental gradients shape butterfly

communities and the ecological services they support. Strengthening citizen-science platforms can turn everyday observers into active contributors to urban conservation. Experimental restoration, such as planting native flowering shrubs and larval host plants in degraded parks, offers a promising pathway to test how vegetation enrichment can boost pollinator resilience and enhance climate-supporting functions.

These efforts should not be left to researchers alone. Urban residents, park managers, students, and policymakers all have a role in shaping greener, more climate-resilient cities. Every planted flower bed, every protected green patch, and every butterfly record helps build a shared ecological foundation for Jakarta's future. As the city grows hotter and denser, the real question becomes whether we choose to let urban nature fade or help it flourish. The path forward is in our hands-small actions today can shape the resilient city we hope to inherit tomorrow.

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READINGS

Aulia, R., Kaswanto, K., Arifin, H. S., Mosyaftiani, A., Syasita, N., Wahyu, A., & Wiyoga, H. (2023). Assessing the benefits and management of urban forest in supporting low Carbon City in Jakarta, Indonesia. Biodiversitas Journal of Biological Diversity, 24(11). https://doi.org/10.13057/biodiv/d241136

Azahra, S. D., Rushayati, S. B., & Destiana, D. (2022). Green open spaces as butterfly refuge habitat: Potential, issues, and management strategies for Butterfly Conservation in urban areas. BERKALA SAINSTEK, 10(4), 227. https://doi.org/10.19184/bst.v10i4.33123

Baró, F., & Gómez-Baggethun, E. (2017). Assessing the potential of regulating ecosystem services as nature-based solutions in urban areas. Theory and Practice of Urban Sustainability Transitions, 139–158. https://doi.org/10.1007/978-3-319-56091-5_9

Butt, N., Shanahan, D. F., Shumway, N., Bekessy, S. A., Fuller, R. A., Watson, J. E., Maggini, R., & Hole, D. G. (2018). Opportunities for biodiversity conservation as cities adapt to climate change. Geo: Geography and Environment, 5(1). https://doi.org/10.1002/geo2.52

Cohen, H., Philpott, S. M., Liere, H., Lin, B. B., & Jha, S. (2020). The relationship between pollinator community and pollination services is mediated by floral abundance in urban landscapes. Urban Ecosystems, 24(2), 275–290. https://doi.org/10.1007/s11252-020-01024-z

Han, D., Zhang, C., Wang, C., She, J., Sun, Z., Zhao, D., Bian, Q., Han, W., Yin, L., Sun, R., Wang, X., & Cheng, H. (2021). Differences in response of butterfly diversity and species composition in urban parks to land cover and local habitat variables. Forests, 12(2), 140. https://doi.org/10.3390/f12020140

Lim, V.-C., Sing, K.-W., Chong, K. Y., Jaturas, N., Dong, H., Lee, P.-S., Tao, N. T., Le, D. T., Bonebrake, T. C., Tsang, T. P., Chu, L., Brandon-Mong, G.-J., Kong, W.-L., Soga, M., & Wilson, J.-J. (2022). Familiarity with, perceptions of and attitudes toward butterflies of urban park users in megacities across East and Southeast Asia. Royal Society Open Science, 9(11). https://doi.org/10.1098/rsos.220161

Lin, Y., Huang, S., Fang, W., Huang, Y., Gao, C., Huang, Y., Zheng, R., & Fu, W. (2024). Impact of urban landscape patterns on Butterfly Diversity in Fuzhou city parks. Science of The Total Environment, 957, 177165. https://doi.org/10.1016/j.scitotenv.2024.177165

Maheng, D., Pathirana, A., & Zevenbergen, C. (2021). A preliminary study on the impact of landscape pattern changes due to urbanization: Case study of Jakarta, Indonesia. Land, 10(2), 218. https://doi.org/10.3390/land10020218

Pollard, E. (1977). A method for assessing changes in the abundance of butterflies. Biological Conservation, 12(2), 115–134. https://doi.org/10.1016/0006-3207(77)90065-9

Purohit, S. (2024). The role of urban green spaces in mitigating urban heat island effect amidst climate change. Research Journal of Chemistry and Environment, 29(1), 75–84. https://doi.org/10.25303/291rjce075084

Rushayati, S. B., & Azahra, S. D. (2024). Beyond concrete jungles: Managing urban green spaces as butterfly hotspot and their implications for ecotourism in Pontianak City, Indonesia. IOP Conference Series: Earth and Environmental Science, 1366(1), 012026. https://doi.org/10.1088/1755-1315/1366/1/012026

Vieira, J., Matos, P., Mexia, T., Silva, P., Lopes, N., Freitas, C., Correia, O., Santos-Reis, M., Branquinho, C., & Pinho, P. (2018). Green spaces are not all the same for the provision of air purification and climate regulation services: The case of urban parks. Environmental Research, 160, 306–313. https://doi.org/10.1016/j.envres.2017.10.006

Winarni, N. L., Nuruliawati, N., Anugra, B. G., Junaid, A. R., Widayanti, S., Aslan, A., Nugroho, A., Miga, I., Kurniawan, M. B., Liestanti, M., Lutfiani, R. A., & Wulandari, Y. (2023). Can cities provide butterfly-friendly habitats? Biodiversitas Journal of Biological Diversity, 24(4). https://doi.org/10.13057/biodiv/d240447

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https://indiabiodiversity.org/species/show/235706