

Brief photographic documentation of floral and faunal diversity in the polluted Gombak River ecosystem, Kuala Lumpur, Malaysia

Abstract

This study evaluates the biodiversity and ecological condition of the Gombak River ecosystem in Kampung Padang Balang, Kuala Lumpur, Malaysia, amidst significant urbanization and pollution pressures. Field surveys identified 15 species, comprising 15 genera, 12 families, 12 orders, and six classes, showcasing the river's rich but vulnerable biodiversity. Terrestrial and marine plants from the division *Magnoliophyta* dominated the ecosystem, accounting for 66.67% of the recorded species, with notable representatives including *Trichosanthes scabra*, *Leucaena leucocephala*, and *Ipomoea triloba*. Vertebrate species from the division *Chordata* contributed 26.67% of the diversity, with the reptile *Varanus salvator* and three bird species—*Mycteria leucocephala*, *Butorides striata*, and *Acridotheres tristis*—being recorded. Additionally, the invertebrate *Junonia orithya* from the division *Arthropoda* accounted for 6.67% of the species. Photographic documentation provided detailed visual records of the floral and faunal diversity, emphasizing the intricate ecological interactions within this urban riverine system. The results highlight the Gombak River's ecological importance and the urgent need for coordinated conservation efforts and pollution control measures to protect its biodiversity. This study serves as a foundation for future research and conservation strategies aimed at preserving urban river ecosystems amidst growing environmental challenges.

Keywords: biodiversity, urban river ecosystems, Gombak River, pollution impact, conservation strategies

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Introduction

Rivers are the lifeblood of natural landscapes, functioning as vital arteries that sustain diverse ecosystems and human communities.¹⁻³ These complex, multifunctional systems embody a multitude of attributes,⁴⁻⁸ linking the atmosphere, lithosphere, biosphere, and human sphere.⁹⁻³² Acting as conduits for energy and naturally occurring compounds, rivers are integral to regional environmental features, which are shaped by their temporal and spatial distributions.¹⁴ Beyond their ecological significance, rivers inspire and sustain cultural ideas, values, and ways of life, connecting people, places, and other forms of life.^{1,11} The concept of environmental flows provides a valuable framework for understanding the dynamic interactions between people and river systems, fostering relationships that benefit both humans and nature.²

However, the relentless pressures of urbanization and industrialization have exacted a significant toll on rivers worldwide, subjecting them to pollution and ecological degradation. The Gombak River in Kuala Lumpur, Malaysia, exemplifies the adverse effects of anthropogenic activities on aquatic ecosystems. Pollution in riverine environments disrupts food webs, alters habitats, and diminishes biodiversity [5,6]. Food webs are essential for maintaining the

resilience and functioning of ecosystems, mediating critical processes, and linking individuals and populations.⁷ As species struggle to adapt to the rapid environmental changes, populations decline, unraveling the intricate web of life that sustains these ecosystems.

The stretch of the Gombak River passing through Kampung Padang Balang (3°12'25.9"N 101°42'00.5"E) has been especially impacted by urban encroachment. Flowing through densely populated areas, the river serves as a sink for pollutants, including industrial effluents and domestic waste, which severely threaten its ecological balance. The lack of adequate waste disposal and sanitation facilities among local residents further exacerbates pollution levels.^{4,12} These factors highlight the urgent need for interventions to mitigate environmental degradation.

Regular monitoring and documentation of floral and faunal diversity are critical for assessing environmental damage and devising effective conservation strategies.⁸⁻¹⁰ Establishing comprehensive checklists and visual records enables researchers to track ecological changes, identify vulnerable species, and implement targeted interventions to counteract pollution's impact. Photographic documentation, in particular, offers a powerful tool for capturing the beauty and diversity of these ecosystems. These visual records not

only provide valuable scientific data but also inspire stakeholders by emphasizing the importance of conservation efforts.

This study aims to evaluate the ecological state of the polluted Gombak River ecosystem and document its floral and faunal diversity, with a focus on the Kampung Padang Balang area. Through detailed field surveys, visual observations, and high-resolution photography, this research seeks to compile an exhaustive inventory of plant and animal species inhabiting the river and its surroundings. By doing so, the study aims to provide critical insights into the ecological dynamics of polluted urban rivers, laying the groundwork for effective conservation measures and future research.

Materials and methods

Gombak river, Kuala Lumpur (3°12'25.9"N 101°42'00.5"E) is the location of western part of Peninsular Malaysia that was selected for the present study. Field sampling was carried out on April 13, 2024, to observe and document the flora and fauna present in the polluted area around the Gombak River. The sampling area covered both terrestrial and aquatic habitats, including the river banks, riparian zones, and the river itself (Figure 1). The flora survey involved visual observation and documentation of plant species found in the study area. Photographs were taken for identification purposes and the fauna survey focused on documenting terrestrial and aquatic organisms present in the study area. Pictures of 15 species of flora and fauna were taken around the polluted Gombak River area.



Figure 1 Observation study at Gombak River.

To identify the species of organisms, high-resolution digital photographs were taken for all observed flora and fauna species using a digital camera model Redmi Note 9. The identification of flora organisms was conducted through meticulous examination of morphological characteristics, including vein type, leaf shape, margin, and arrangement. Concurrently, fauna identification relied on class distinctions, specifically aves, reptiles, and Insecta, facilitating precise taxonomic categorization. The taxonomy of the individual organisms was taken from the websites mybis (<https://mybis.gov.my/one/>), iucn red list Malaysia (<https://www.iucnredlist.org/>), iNaturalist (<https://www.inaturalist.org/places/malaysia>) and google lens.

Results

Table 1 presents the species collected from the Gombak River, Kuala Lumpur. During each nearly two-hour sampling session, a total of 15 species of flora and fauna were recorded, encompassing 15 genera, 12 families, 12 orders, and six classes (Figure 2). Among these, 10 species of terrestrial and marine plants were identified, representing 10 genera, seven families, seven orders, and three classes. All 10 plant species belong to the division *Magnoliophyta*, which accounts for 66.67% of the total collected species.



Figure 2 Terrestrial and marine floral and faunal organisms in Gombak River, Kuala Lumpur: (a) *Trichosanthes scabra*, (b) *Leucaena leucocephala*, (c) *Ipomoea triloba*, (d) *Acalypha arvensis*, (e) *Cymbopogon citratus*, (f) *Digitaria sanguinalis*, (g) *Eichhornia crassipes*, (h) *Mimosa pudica*, (i) *Tridax procumbens*, (j) *Varanus salvator*, (k) *Mycteria leucocephala*, (l) *Butorides striata*, (m) *Acridotheres tristis*, (n) *Junonia orithya*, (o) *Bidens frondosa*.

Table 1 Checklist of benthic macrophytes and macrofauna recorded from Gombak River, Kuala Lumpur, Malaysia

Class	Order	Family	Scientific name
Terrestrial and marine plants: Division Magnoliophyta			
Equisetopsida	Cucurbitales	Cucurbitaceae	<i>Trichosanthes scabra</i> , 1790
Magnoliopsida	Fabales	Fabaceae	<i>Leucaena leucocephala</i>
Magnoliopsida	Solanales	Convolvulaceae	<i>Ipomoea triloba</i> , 1752
Equisetopsida	Malpighiales	Euphorbiaceae	<i>Acalypha arvensis</i> , 1841
Liliopsida	Poales	Poaceae	<i>Cymbopogon citratus</i>
Liliopsida	Poales	Poaceae	<i>Digitaria sanguinalis</i> , 1771
Liliopsida	Commelinales	Pontederiaceae	<i>Eichhornia crassipes</i>
Magnoliopsida	Fabales	Fabaceae	<i>Mimosa pudica</i>
Magnoliopsida	Asterales	Asteraceae	<i>Tridax procumbens</i>
Magnoliopsida	Asterales	Asteraceae	<i>Bidens frondosa</i>
Vertebrate organism: Division Chordata			
Reptilia	Squamata	Varanidae	<i>Varanus salvator</i> , 1768
Aves	Ciconiiformes	Ciconiidae	<i>Mycteria leucocephala</i> , 1769
Aves	Pelecaniformes	Ardeidae	<i>Butorides striata</i> , 1758
Aves	Passeriformes	Sturnidae	<i>Acridotheres tristis</i> , 1766
Invertebrate organism: Division Arthropoda			
Insecta	Lepidoptera	Nymphalidae	<i>Junonia orithya</i> , 1758

Four species of vertebrate organisms were recorded, representing four genera, four families, four orders, and two classes. All these species belong to the division *Chordata*. The phylum *Chordata* is characterized by animals that, at some stage in their development, possess a flexible rod called a notochord to support their bodies. Within the *Chordata* division, the reptile class constitutes 6.67%, while the aves (bird) class represents 20% of the total species collected.

Additionally, one invertebrate species was identified, representing one genus, one family, one order, and one class. This invertebrate belongs to the division *Arthropoda*. Arthropods are characterized by their jointed legs and segmented bodies. This single invertebrate species accounts for 6.67% of the total collected species.

Discussion

The Gombak River ecosystem in Kuala Lumpur, Malaysia, exemplifies a unique ecological challenge due to the increasing impact of pollution driven by rapid urbanization, industrial activities, and population growth.¹⁵ The strategic selection of this river, located along Peninsular Malaysia's western region, reflects its importance as an indicator of the environmental pressures urban areas face. The river's water quality and ecosystem health are under severe stress from unchecked industrialization, rapid infrastructure development, and the expanding population in the catchment area.^{16,18} Urbanization has amplified the demand for housing, infrastructure, and services, which has, in turn, escalated anthropogenic pressures on the river system. Improper waste management, increased domestic sewage discharge,

and surface runoff from paved areas contribute significantly to water quality degradation and pollutant accumulation.^{17,19}

Waste generation from the growing residential and commercial sectors has exacerbated pollution levels in the river. Practices such as illegal dumping and littering introduce plastics, solid waste, and other contaminants into the river, endangering aquatic life and the broader ecosystem.²⁰ Point source pollution, such as factory effluents directly discharged into the river, and non-point source pollution, including urban runoff carrying fertilizers, pesticides, and sediments, further degrade the river's health. The cumulative impact of these pollution sources underscores the urgent need for effective waste management systems, public awareness campaigns, and stringent regulatory measures to mitigate pollution.^{29,31}

Despite these challenges, certain plant and animal species have demonstrated remarkable tolerance to pollution, adapting to the contaminated conditions of the Gombak River. *Eichhornia crassipes* (Water Hyacinth) and *Tridax procumbens* (Coat Buttons) are invasive plants that thrive in polluted environments, often outcompeting native species. *Eichhornia crassipes*, in particular, exhibits a strong capacity for phytoaccumulation, concentrating toxic metals such as chromium (Cr), copper (Cu), nickel (Ni), zinc (Zn), lead (Pb), and cadmium (Cd) within its tissues.²⁴ Similarly, opportunistic plant species such as *Digitaria sanguinalis* (Large Crabgrass), *Acalypha arvensis* (Asian Copperleaf), and *Mimosa pudica* (Sensitive Plant) have adapted to thrive in disturbed, polluted environments. Their rapid growth, high reproductive rates, and ability to tolerate environmental stressors highlight their ecological resilience and potential role in understanding pollution tolerance mechanisms.^{21,22}

Among vertebrates, *Varanus salvator* (Asian Water Monitor) stands out for its ability to flourish in highly contaminated environments. This species has likely developed physiological adaptations, such as enhanced oxygen absorption and modified feeding habits, to survive in polluted habitats with reduced dissolved oxygen levels.²⁶ Similarly, *Bidens frondosa*, an invasive plant from the Asteraceae family, demonstrates tolerance to heavy metals and is capable of hyperaccumulating pollutants, making it both a challenge for native biodiversity and a potential tool for phytoremediation.^{27,28}

Pollution in the Gombak River arises from a combination of point and non-point sources. Point sources, such as industrial discharges and waste from factories, directly introduce pollutants into the river. For example, factories release untreated effluents, while some local residents illegally dump garbage and rubbish into the river. These activities represent specific, identifiable pollution sources that can be regulated through permits, enforcement of environmental standards, and adoption of pollution control technologies.³² Conversely, non-point sources, including agricultural runoff, urban stormwater, and construction site runoff, are diffuse and harder to control, contributing significantly to the degradation of water quality and ecosystem health.^{30,31}

The findings emphasize the critical need for coordinated conservation efforts to address both point and non-point source pollution. Comprehensive strategies, including the implementation of proper waste management systems, pollution control technologies, and public awareness initiatives, are necessary to preserve the ecological balance of the Gombak River. Furthermore, studying the adaptive mechanisms of pollution-tolerant species can provide insights into ecological resilience and inform sustainable restoration efforts for polluted river ecosystems.

Conclusion

In conclusion, the Gombak River ecosystem in Kuala Lumpur exemplifies the profound impact of urbanization, industrialization, and population growth on urban riverine environments. Pollution from both point and non-point sources, such as industrial effluents, domestic waste, and urban runoff, has significantly degraded water quality and disrupted the river's ecological balance. Despite these challenges, certain species like *Eichhornia crassipes* and *Varanus salvator* have demonstrated remarkable tolerance to pollution, providing insights into resilience and potential bioremediation applications. However, the proliferation of invasive species further threatens native biodiversity, necessitating strategic management efforts. Addressing these issues requires stricter enforcement of environmental regulations, improved waste management systems, and public awareness initiatives to mitigate pollution and promote sustainable practices. Regular biodiversity monitoring is essential to guide conservation strategies and restore ecological health, ensuring the long-term sustainability of the Gombak River amidst ongoing urban pressures.

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Conflicts of interest

The author declares there is no conflict of interest.

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