

# STUDY ON THE IMPACT OF URBAN INSECT PRESENCE ON USER EXPERIENCE AND BEHAVIOUR IN PUBLIC SPACES: CASE STUDY IN COLOMBO.

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**Abstract:** Urban public spaces are vital for social interaction, recreation, and psychological well-being, yet the presence of insects in these environments can significantly shape user experience and behaviour. This study investigates the impact of urban insects on user perception and behaviour in selected public spaces in Colombo, focusing on both non-beneficial (mosquitoes, houseflies, cockroaches) and beneficial (butterflies, ladybugs, dragonflies) species. Data were collected through field observations, semi-structured interviews, and a scenario-based questionnaire administered to 73 respondents across Nugegoda, Viharamahadevi Park, and Battaramulla. Results indicate that non-beneficial insects negatively influence perceived cleanliness and comfort, prompting avoidance behaviours, while beneficial insects generally enhance aesthetic appreciation and engagement with the space. Findings also reveal that environmental conditions, waste management practices, and green infrastructure strongly mediate insect presence and its impact on users. The study underscores the importance of integrating insect-conscious design and management strategies in urban public spaces to balance ecological health with user comfort and usability.

**Keywords:** *Urban Insects, User Perception, Behavioural Response, Public Spaces*

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## 1. Introduction

Urban environments provide the perfect breeding grounds for a wide range of insects, especially when it comes to pest populations. With the increasing population density, improper waste disposal, stagnant water sources, and rising temperatures, insects such as mosquitoes, cockroaches, and houseflies have adapted to thrive in cities. These pests are not only a nuisance but also act as vectors for various harmful and potentially deadly diseases.

Insects like *Aedes aegypti* and *Aedes albopictus* are known carriers of viral infections such as dengue, chikungunya, and Zika virus, all of which have become recurring threats in tropical urban areas (Kolimenakis et al., 2021). Cockroaches and houseflies contribute to the spread of bacterial infections, including typhoid, cholera, and foodborne illnesses, especially in densely built and poorly maintained neighbourhoods. (Geng et al., 2025; Khamesipour et al., 2018)

Despite growing urban development and the push toward more inclusive and accessible public spaces, the persistent presence of urban insects and accessible public spaces, the persistent presence of urban insect populations significantly affects how people perceive, interact with, and return to these environments. While public spaces are designed to promote social interaction and sometimes leisure and mental well-being, the uncontrollable presence of insects, especially those posing health threats, deters users, impacts behaviours, and compromises overall space usability. In a topical, densely populated city like Colombo, where vector-borne diseases are prevalent and urban planning often lacks integrated pest control measures, understanding the behavioural consequences of insect presence is crucial for creating resilient, user-friendly urban landscapes.

Urban Insect populations, particularly non-beneficial and disease vectors, are increasingly influencing the way people experience and use public spaces. However, the role these insects play in shaping human behaviour and perception within public spaces remains underexplored in landscape architectural research. This gap limits the development of spatial and design strategies that could mitigate the negative impacts of pests and enhance user comfort and safety in Colombo's public spaces. This research aims to contribute to the subject by finding how the presence of urban insects affects user experience and behaviour in public spaces in Colombo.

## 2. Urban insects and users of public spaces.

According to the Cambridge dictionary, Urbanisation is "the process by which more and more people leave the countryside to live in cities", and according to the United Nations (2019), the world population in urban areas alone is calculated to be 6.7 billion by the year 2050. More than half of the world's population now lives in cities and towns, according to the United Nations Population Fund. And further, they have assumed Urbanisation to be more prominent in African and Asian regions

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compared to other continents in the world, bringing a drastic difference in social, economic, and environmental outcomes by the year 2030.

Urbanisation is a global phenomenon that happens all around the world, not limited to African and Asian countries, affecting the population, economic changes, and socio-cultural changes. (Roy & Das, 2021), blurring the lines between rural and urban areas as they continue to expand. Although the urban areas have no clear definition (Veckalne & Tambovceva, 2023). For this study, urban areas will be simply defined as areas with high human density, a higher built environment ratio compared to unbuilt areas, where the skyline is shaped by high-rise structures, and the primary economic activity is something other than agriculture.

The global population of urban areas increases with rising birth rates compared to the decreasing death rates, due to improved healthcare infrastructure in cities, and the rural-to-urban migrations of people in search of better opportunities within city limits (World Bank, 2020). However, the lifestyles of the urban context are rather fast-paced and chaotic, compared to lifestyles in the rural context.

This urban condition adds a sense of rigidity, congestion, and physical and psychological fatigue to the day-to-day life of urban dwellers, making most people experience burnout and a growing disconnection with their family, peers, and their environment (Srivastava, 2009). In response, public spaces such as squares, promenades, and urban parks serve as much-needed space in cities for people to find refuge from their busy lifestyles, offering a moment of pause, to interact with other people, and to recharge.

Public spaces are usually defined as spaces that are open and usable for people, which are located within the boundaries of cities. (Nimashi & Dharmasena, 2023), and they have the potential to provide environmental, social, and economic benefits to communities (Elizalde, 2013). However, these public spaces are most often designed in a human-centred way, not considering wildlife, even though they remain as an unplanned yet important part of the urban ecosystem.

## 2.1. PRESENCE AND PATTERNS OF URBAN INSECTS IN TROPICAL REGIONS.

According to Merriam-Webster dictionary and other broader media, insects are a class of arthropods, with a three-part body (head, thorax, abdomen), a few pairs of legs, typically one or two pairs of wings, compound eyes, a pair of antennae, breathing via tracheae, and a life cycle involving metamorphosis (Merriam-Webster dictionary, n.d.). And insects can be divided into two main groups such as beneficial insects and non-beneficial insects (pests).

With rapid globalisation and a rising population, the current urban areas continue to grow and develop with time. The increase in urban areas with high human density creates a unique and perfect breeding space for urban pests with abundant food, water, and shelter near human dwellings and activities. (Bonney et al., 2008; Samways, 1996)

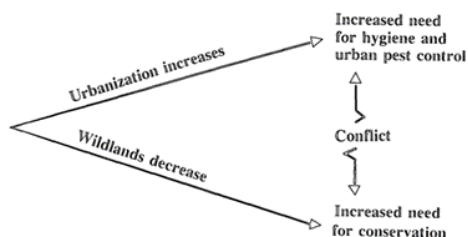


Figure 1: How Samway (1996) showed the relationship between the increase of urbanisation and decrease of wildland with relation to the pest population. (Insects In the Urban Environment: Pest Pressures Versus Conservation Concern, Samway 1996)

Mainly, with an increase in urbanisation, the spaces that humans can build decrease. This leads to situations like cramped dwellings, no space or methods for proper garbage disposal, a decrease in natural green spaces to absorb runoff water from urban areas, making the environment unhygienic, and complex works in favour of urban pests.

But with the rising urbanisation, the presence of beneficial insects gradually decreases in our urban neighbourhoods due to the decreasing natural environment, environmental pollution, and the use of pesticides in urban contexts. Making it uncommon to witness beneficial insects, especially in public spaces. (Ellis et al., 2023)

### 2.1.1 Common urban insect species in Tropical public spaces.

#### 2.1.1.1. Beneficial insects

Beneficial insects are generally considered to be insects that perform valuable ecological and economic roles that favour environmental health and agriculture. These insects contribute to the environment by being natural pollinators, pest controllers, and supporting various ecosystem services. (Rai et al., 2015; Theodorou, 2022).

According to Samways (1996) and Ellis (2023), with urbanisation, the population of beneficial insects gradually decreases as the natural environment they thrive in disappears to make spaces for the rising population in urban areas and

build an environment to accommodate the human density. (Samways, 1996; Ellis et al., 2023)

However, as there are still existing green patches in the urban context that have yet to disappear, we are lucky to witness a few of those beneficial insects in the urban environment, even though it is considered uncommon. (Sanllorrente et al., 2023). And a few of those insects that we can still see in urban context are, namely, butterflies, bees, ladybugs, dragonflies, praying mantis, grasshoppers, and a few others.

#### 2.1.1.2. Non-Beneficial insects

Non-beneficial insects are generally defined as insects that cause harm to human health, comfort, property, and resources, unlike beneficial insects that provide the environment and economic benefits. Non-beneficial insects are known to be a nuisance to humans and are hence called pests (Belluco et al., 2023).

Unlike beneficial insects, non-beneficial insects can thrive under rapid urbanisation, as it provides an abundance of food, water, breeding spaces, and shelters closer to high-density human settlements with improper waste disposal, stagnant water sources, and rising temperatures in urban neighbourhoods. (Bonnefoy et al., 2008; Xiang et al., 2020).

And especially when it comes to Colombo, with its highly urbanised neighbourhoods, these conditions are practically visible in areas with dense population, poor waste management, inadequate drainage, or poor drainage management, creating ideal habitats for mosquitoes, houseflies, and cockroaches. (Udayanga et al., 2020). Mosquitoes, houseflies, and cockroaches can be used as examples for non-beneficial insects that we can commonly find in other areas; however, due to certain scenarios, even some of the beneficial insects, such as wasps and ants, can be considered pests when it comes to urban neighbourhoods (Lagucki et al., 2017).

In urban settings, non-beneficial insects often thrive due to improper waste management, stagnant water, and dense human activity. Mosquitoes, in particular, are notorious vectors for diseases such as dengue, chikungunya, and Zika virus, posing severe health risks in tropical cities like Colombo. Cockroaches, on the other hand, are linked to asthma and allergies, especially among children, as they release airborne allergens. Houseflies contribute to food contamination by transferring pathogens from decaying waste to surfaces humans frequently touch. These insects not only pose a direct threat to human health but also erode the perceived cleanliness and safety of public parks, discouraging repeated visits and long-term usage.

#### 2.1.2 Environmental conditions supporting Insect Proliferation in urban spaces.

When it comes to Urban Spaces, especially urban parks, they are naturally considered as green sanctuaries within busy cityscapes that present a combination of environmental factors that unintentionally provide favourable conditions for both beneficial and non-beneficial insects, depending on whether those factors are negative or positive.

For example, if the park is well-maintained with a variety of plants, a clean environment with a lack of pollution. These elements can be a great place for beneficial insects to thrive. Conversely, elements including pollution, habitat fragmentation, and a lack of biodiversity can promote the development of undesirable insect species. (Collins et al., 2024; Raupp et al., 2010).

When it comes to environmental conditions, Climate change contributes significantly to the insect population, and the urban heat island effect is particularly beneficial for breeding insects in urban areas. Combined with unpredictable weather in Colombo and improper stormwater management that leads to stagnant water, this situation provides perfect breeding space for non-beneficial organisms, such as mosquitoes. (Ahmed et al., 2019). Another environmental factor that heavily influences the rapid population of insects and the attraction of pests to urban public spaces is poor waste management, which attracts insects to those areas to find food, shelter, and breeding spaces, building their sanctuaries.

According to Qasim (2020) "Garbage is a major source of breeding for filth flies... Similarly, cockroach infestation was highest near the garbage dumps as compared to other sites." This means poor waste management is especially helpful for non-beneficial insects such as houseflies and cockroaches in urban areas, and attracts them.

## 2.2. PUBLIC PERCEPTION AND HUMAN-INSECT ENCOUNTER IN URBAN SPACES

Beyond ecology, insects shape how users emotionally and physically interact with urban spaces and how users perceive public spaces. Public attitudes toward insects can change depending on what kind of insects they meet, whether it's beneficial or nonbeneficial. However, most commonly, when it comes to most insect species, humans are often driven by sensory discomfort, cultural beliefs, and associations with cleanliness or disease.

### 2.2.1. Human-Insect Interaction in Urban Public Environment

Urban public spaces, especially parks, are more than just greenery. They're sensory landscapes shaped by sights, sounds, and also insects. Users' direct experiences with insects, whether a buzzing mosquito, a cluster of flies near rubbish, or an ant trail crossing a bench, spark immediate emotional responses. Studies show that such encounters can lead to sensations of

disgust, anxiety, and discomfort, which subsequently shape park usage patterns, avoidance behaviours, and perceptions of site cleanliness and safety.

Urbanisation further intensifies negative perceptions by altering insect community structures and reducing natural history knowledge, leading to a broader range of insects eliciting disgust. (Fukano & Soga, 2021). This aversion, termed 'entomophobia,' is increasingly recognised as a significant factor in the decline of insect populations, highlighting the urgent need to understand and mitigate these negative perceptions. (Fukano & Soga, 2023)

### *2.2.2 User perception of safety, comfort, and cleanliness in insect-populated urban areas/parks.*

Research indicates that users equate high insect activity, such as swarms near bins or mosquitoes near stagnant water, with unclean or unsafe environments, even if the actual threat is minimal. These perceptions lead to feelings of discomfort, distrust, and avoidance of certain park areas, especially during certain times of day or year.

Comfort in public parks isn't solely physical; it's also psychological. When users feel a lack of cleanliness or a risk to safety, their willingness to engage in leisure, rest, or physical activity declines, diminishing the intended value of urban green spaces. In a research done by (Mohamed & Kronenberg, 2025), the study highlights that cleanliness in public parks strongly correlates with user satisfaction and repeat visitation. Insects, particularly those associated with filth or decay, act as visual and psychological triggers of unsanitary conditions.

A study by De Vries et al (2013) Found that the presence of litter and insects significantly reduced perceived safety, especially among female visitors and elderly users. These elements subconsciously signal neglect and lack of maintenance, which can foster discomfort, avoidance, or even fear. Such perceptions may be further amplified in cities facing rapid urbanisation, where public space upkeep often lags behind infrastructure growth.

## 2.3. BEHAVIOURAL RESPONSES TO INSECT PRESENCE IN URBAN SPACES.

The behavioural patterns of public space users often shift in response to perceived threats or discomfort posed by insects. These micro-behaviours can influence overall public space usage and perceptions of space quality.

### *2.3.1. Visitor behaviour and adaptation in response to insect presence.*

According to a study done in urban parks on Staten Island, New York. The researchers have found out that users have started to avoid some parts of the parks, that's revealed as areas with higher tick densities, and start preferring the areas with maintained grass and open spaces. Indicating that the presence of or the suspicion of a pest could change how users behave and interact with the space to reduce the exposure to discomfort and diseases (Hassett et al., 2022)

While the presence of certain insects in public spaces can cause discomfort, it is important to note that not all insect interactions are negative. Some species, particularly beneficial or visually appealing ones such as butterflies, bees, and dragonflies, can positively influence user perception and experience. These insects are often associated with biodiversity, ecological health, and aesthetic value. Their presence can enhance the natural character of a space and may even attract visitors who appreciate nature-based experiences. In this sense, insect visibility does not always discourage usage; in some cases, it enriches the sensory and emotional quality of public parks, especially in areas designed to support pollinators or flowering plants.

## 3. Methodology of the research

Since user experiences, feelings, and actions cannot be captured through only using numerical data, the study will be focusing on mixed method approach, such as interviews with users met in public spaces to gather qualitative data, an online questionnaire with a Likert scale to gather both quantitative and qualitative data, and on-site observations to gather comprehensive insight from different user groups across the selected areas.

- In-depth, semi-structured interviews
- On-site Observation
- Online Questionnaire

### 3.1. CASE STUDIES FOR THE STUDY.

The observation and data gathering for the study were mainly done within three selected public spaces in the Colombo area: Nugegoda market space, Viharamahadevi park, and Diyatha Uyana. All three sites were carefully selected according to the insect species present and the different backgrounds that they provided. The three spaces represent different types of diversity in urban settings, each with changing levels of commercial activities and density.

In the field, visits were carried out in two phases; the first visit was mainly done to identify the species present in the selected areas for the study. Based on the first field visit, the study focused on insect species: Houseflies, mosquitoes, and

cockroaches that belong to the non-beneficial insect group, along with butterflies, dragonflies, and ladybugs that belong to the beneficial insect group.

After the first field visit, the second visit was carried out to gather data on how users of public spaces would perceive spaces with insects and how they would behave in said spaces. In this phase, in-depth, semi-structured interviews, on-site observations, and an online questionnaire were carried out to gather data.



Figure 2: Case study locations-Nugegoda Market space, Viharamahadevi park, and Diyatha Uyana (from Left to right). Study areas are demarcated by red lines. (Google Maps, 2025)

## 3.2. DATA COLLECTION

### 3.2.1 Field Visits

This section presents observational and interview-based data gathered from three selected public spaces in Colombo: Nugegoda Market, Viharamahadevi Park, and Diyatha Uyana. Observations focused on insect presence and user reactions, while interviews provided qualitative context to complement the survey data.

#### 3.2.1.1. Nugegoda Market space

During the first visit to the site, Houseflies and cockroaches were identified as most prominent, particularly around food stalls and damp areas near the washrooms in the market space, and observed User Reactions included:

- Houseflies: Users mostly waved flies away, while continuing as normal, and some users moved to other areas, avoiding stalls with houseflies present near them.
- Cockroaches: Strong avoidance behaviours were noted, especially among small children who came to market spaces with their parents. Discomfort and disgust were clearly present in most of the users' facial expressions.

During the second field visit, 5 vendors and 6 customers (a total of 11) were interviewed. Where the few customers admitted to avoid stalls that are covered with houseflies, mainly due to the annoyance caused by them. However, during the second visit, the absence of cockroaches in the space, at the time of observation, meant that questions regarding them had to be skipped. But to ensure this aspect was still covered, cockroach-related questions were instead incorporated into the questionnaire and addressed there.

Overall, the crowded, commercial environment with abundant food and waste created ideal conditions for non-beneficial insects in the Nugegoda market. Users' avoidance and defensive behaviours mirrored patterns observed in the questionnaire, highlighting discomfort and hygiene concerns.

#### 3.2.1.2. Viharamahadevi Park

During the first Visit, Mosquitoes were observed in shaded, canopy-covered areas, especially during the evening time compared to morning and afternoon, while dragonflies were spotted on a pathway slightly away from the main waterbody, occasionally blocking pedestrian movement. Observed User Reactions included:

- Mosquitoes: Most participants avoided the shaded areas where mosquitoes were present, reflecting concern over bites and discomfort.
- Dragonflies: Because some dragonflies were directly on the pathway, participants' reactions were mixed: a few stopped to watch or moved past them, but most chose to avoid the area altogether to continue walking.

During the second field visit, 10 visitors were interviewed. Where most of them agreed upon avoiding canopy-covered areas with mosquito presence, mainly to avoid the discomfort caused by the bites, instead of diseases.

Overall, the presence of mosquitoes and pathway-blocking dragonflies created localised avoidance behaviours, while demonstrating that even visually appealing insects can affect user movement when they interfere with space usability. This highlights the importance of spatial placement and habitat management for beneficial insects in urban public spaces.

### 3.2.1.3. Diyatha Uyana

Insect presence was surprisingly lower in Diyatha Uyana compared to the other two sites, as only a few butterflies (2–3) were spotted near flowering plant stalls with one single ladybug, and houseflies were primarily concentrated around eating areas. Observed User Reactions included:

- Butterflies: Visitors and customers of the flowering plant stalls mostly observed them casually or continued their activities, showing minor engagement given the small number of insects present.
- Houseflies: Users displayed avoidance behaviours around eating areas, such as waving flies away or moving slightly to another spot to continue eating comfortably.

During the second field visit, 8 visitors were interviewed. However, due to the minimal presence of insects, the gathered data mostly favoured neutral responses over positive or negative responses when it comes to beneficial insects, as well as non-beneficial insects.

Overall, the presence of beneficial insects was minimal and did not significantly influence user behaviour or perception, whereas houseflies near eating areas prompted slight avoidance. This reinforces the pattern observed in other sites that non-beneficial insects strongly affect comfort and activity, even when beneficial insects are present.

### 3.2.2 Online Questionnaire

Since insect presence differed between sites and could sometimes go unnoticed by users, even when they reacted to it, a scenario-based questionnaire was developed to help participants of the questionnaire imagine situations themselves and provide extra insights beyond the field observations, and as backing to the data collected from the field visits. Each scenario described a specific situation involving target insect species that were noticed within the three sites, followed by two questions: the first asked participants to rate their perception of the space using a Likert scale, and the second asked how they would most likely respond behaviourally while giving users options to choose from.

For example, in the scenario created for mosquitoes, participants were asked to imagine waiting for a friend just after sunset, surrounded by a swarm of mosquitoes, and then indicate their perception of the space and subsequent actions, such as moving away, swatting the mosquitoes, or leaving the area, while also giving option for them to write an answer on their own if the action they take isn't mentioned in one of provided options. Similarly, scenarios involving ladybugs, butterflies, dragonflies, houseflies, and cockroaches were developed for participants of the questionnaire to consider realistic encounters in various public spaces, including markets, parks, tea stalls, and transport hubs.

The scenario-based approach allowed participants to respond based on imagined but plausible encounters, capturing qualitative insights into both perception and behaviour without requiring actual insect sightings. This method provided a rich dataset to analyse patterns of user experience in relation to urban insects while maintaining consistency across respondents, while reinforcing the data gathered from the field visit as planned.

The Online scenario-based questionnaire was created using Google Forms and circulated among the users interviewed or met during the field visits. A total of 73 participants were counted at the time the form finished gathering data.

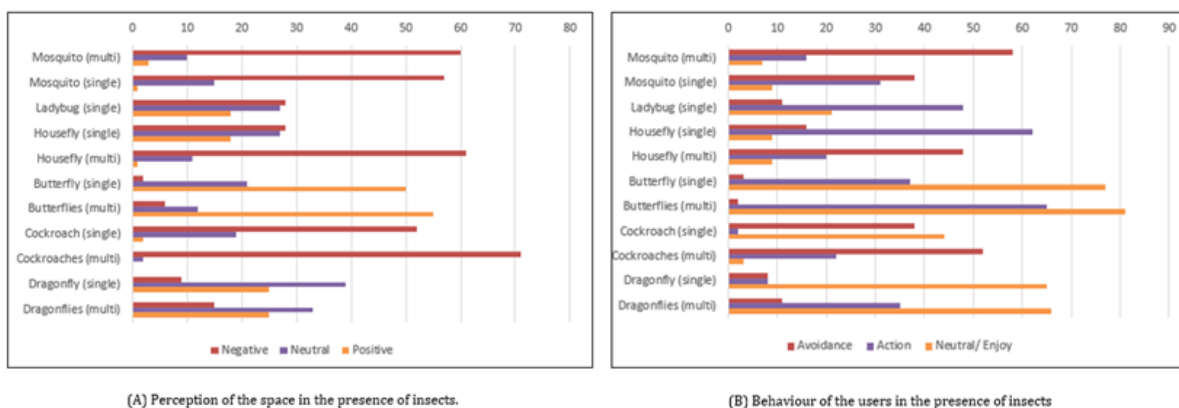


Figure 3: Results of Online Questionnaire – How user would perceive the space and behaviour according to the Likert scales provided.

## 4. Data Analysis and Discussion

### 4.1. DATA ANALYSIS

The analysis is done in two parts. The first part focuses on the questionnaire responses, using descriptive statistics and chi-square tests to identify the connection between presence of insect types and user perceptions or behaviours towards them.

The second part focuses on the data gathered from case studies. By connecting these findings together, this section aims to interpret patterns of human-insect encounters, linking them with the literature on urban insect and user experience, and come up with suggestions for the design and management of urban public spaces in Colombo

4.1.1. Questionnaire Data Analysis

The data collected through the online questionnaire were analysed using the Chi-square test, which is a popular statistical method used to determine and see if there is a significant association between categorical variables. In this case, participants' perceptions of insects and their reported behaviours. With the Chi-square value represents the difference between observed and expected incidences; a higher value shows a stronger deviation from what would be expected by chance.

A p-value was calculated for each test to assess the significance, with  $p < 0.05$  considered to be the value to be significant. Which indicates that there is less than a 5% probability that the observed associations occurred by chance (Wang, 2024). The Chi-square test was chosen because it is suitable for analysing categorical data derived from Likert-scale responses and scenario-based behaviour choices, allowing the study to identify meaningful relationships between insect encounters and user reactions.

Table 1: Chi-square Analysis of User Perception

Insect	Chi-square ( $\chi^2$ )	p-value	Interpretation
Mosquito (multi)	37.72	0.000	Significant effect on perception
Mosquito (single)	36.83	0.000	Significant effect on perception
Ladybug (single)	1.34	0.511	No significant effect
Housefly (single)	1.34	0.511	No significant effect
Housefly (multi)	42.28	0.000	Significant effect on perception
Butterfly (single)	28.05	0.000	Significant effect on perception
Butterflies (multi)	27.12	0.000	Significant effect on perception
Cockroach (single)	29.62	0.000	Significant effect on perception
Cockroaches (multi)	66.12	0.000	Significant effect on perception
Dragonfly (single)	10.46	0.005	Significant effect on perception
Dragonflies (multi)	3.53	0.171	No significant effect

The results of chi-square analysis on user perception came out as that the non-beneficial insects, such as mosquitoes, houseflies, and cockroaches, could significantly influence how participants would perceive the space, and the scenarios with a swarm of insects instead of one caused stronger negative reactions to the space. At the same time, beneficial insects, such as ladybugs and dragonflies, had a minimal effect on perception during imagined encounters, while butterflies (both single and multiple) showed significant positive effects on how participants would perceive the space.

Table 2: Chi-Square Analysis on User Behaviour

Insect	Chi-square ( $\chi^2$ )	p-value	Interpretation
Mosquito (multi)	25.88	0.000	Significant effect on behaviour
Mosquito (single)	10.95	0.004	Significant effect on behaviour
Ladybug (single)	13.29	0.001	Significant effect on behaviour
Housefly (single)	26.25	0.000	Significant effect on behaviour
Housefly (multi)	15.49	0.000	Significant effect on behaviour
Butterfly (single)	43.36	0.000	Significant effect on behaviour
Butterflies (multi)	53.49	0.000	Significant effect on behaviour
Cockroach (single)	27.60	0.000	Significant effect on behaviour
Cockroaches (multi)	27.13	0.000	Significant effect on behaviour
Dragonfly (single)	36.32	0.000	Significant effect on behaviour
Dragonflies (multi)	22.38	0.000	Significant effect on behaviour

The findings of chi square test analysis on user behaviour showed that all insect types, included in the questionnaire, had a statistically significant effect on how participants would behave in public spaces. As they were more likely to avoid or show defensive behaviours in response to non-beneficial insects, especially when facing a swarm of non-beneficial insects

mentioned in the questionnaire, rather than a single one. And when it came to beneficial insects, they caused more neutral or positive behaviours, including observing or photographing the insects, reflecting a generally favourable interaction.

#### 4.1.2. Field Visit Data Analysis

Across the three public spaces selected for the study, a clear pattern appears addressing the user responses to insect presence. Non-beneficial insects such as mosquitoes, houseflies, and cockroaches consistently triggered avoidance behaviours.

In Nugegoda market, houseflies and cockroaches near food stalls and damp areas led participants to move away, wave insects off, or leave the area entirely. At Diyatha Uyana, houseflies around eating areas similarly caused users to adjust their activities to maintain comfort. Beneficial insects such as butterflies and dragonflies caused neutral or positive reactions, but their impact was context-dependent. At Diyatha Uyana, only 2–3 butterflies were present near flower stalls, resulting in minor engagement.

At Viharamahadevi park, dragonflies on the pathway, occasionally blocking movement, prompted mixed reactions, with many visitors avoiding the area entirely. This demonstrates that even visually appealing insects can influence spatial use if their placement interferes with accessibility or movement.

Spatial context and abundance play a crucial role in shaping user behaviour. Areas with higher densities of non-beneficial insects were actively avoided, while low densities of beneficial insects generally promoted neutral or observational engagement.

The site-specific observations presented in the data collection part provide contextual insight into how insect presence influences user behaviour and perception in Colombo's public spaces. While the quantitative questionnaire data offered broad patterns across multiple participants, the case study findings showed that how these patterns would come out in real-life spatial contexts, including how abundance, location, and type of insect affect user interactions.

By combining these two sources of data, it is possible to interpret not only what kind of behaviours and perceptions occur, but also why they appear, providing a comprehensive understanding of the interaction between urban insects and human experience. The following discussion shows these insights, connecting them to relevant literature and exploring suggestions for urban public space design and management.

## 4.2. DISCUSSION

The combined analysis of questionnaire responses and site observations reveals consistent patterns about how urban insect presence influences user perception and behaviour in public spaces.

As shown in Table 1, questionnaire data showed that non-beneficial insects, mosquitoes, cockroaches, and houseflies caused strong negative perceptions of space, especially in scenarios with swarm of insects. Participants chose the space with these insects as very unpleasant or unclean, reflecting discomfort and concerns about hygiene and disease risk (Fukano & Soga, 2021; Ahmed et al., 2019). Spaces with beneficial insects such as butterflies and dragonflies were generally perceived positively or neutrally, with space with multiple butterflies showing the highest attractive score compared to other scenarios.

Site observations strengthened these patterns. In Nugegoda market, participants actively avoided areas with a high density of houseflies and cockroaches. In Diyatha Uyana, although a small number of butterflies were present, participants engaged minimally, indicating that low abundance limits perceptual impact. At Viharamahadevi park, dragonflies occasionally blocked pathways, making users avoid the area altogether, demonstrating that even aesthetically appealing insects can influence perception and space use if their placement interferes with movement.

As shown in Table 2, The questionnaire revealed that users adopted adaptive behaviours in response to insect presence: swatting, moving away, or leaving areas when encountering non-beneficial insects, and watching or photographing beneficial insects. Case study observations mirrored these behaviours:

High-density non-beneficial insect areas encouraged clear avoidance, with users leaving spaces or adjusting activities (Nugegoda, Diyatha). Beneficial insects led to observational engagement or neutral continuation of activities, though minimal presence or spatial interference reduced positive interaction (Diyatha, Viharamahadevi). These findings align with the behavioural adaptation theory, which suggests that individuals modify actions to reduce exposure to environmental stressors (Hassett et al., 2022). Negative insects acted as stressors, while beneficial insects generally supported engagement unless spatially inconvenient.

The findings from the questionnaire and case study observations illustrate the multifaceted influence of urban insects on user experiences in public spaces. Non-beneficial insects, including mosquitoes, houseflies, and cockroaches, consistently

triggered negative perceptions and avoidance behaviours, reducing comfort and deterring engagement in affected areas. In the scenarios with multiple insects, these effects were amplified, with participants actively moving away, leaving spaces, or adjusting their activities to minimise exposure.

Beneficial insects, such as butterflies and dragonflies, generally caused neutral or positive responses, including observation, photography, or continued activity. However, their impact was highly context-dependent; low abundance or spatial interference, such as dragonflies partially blocking pathways limited engagement and, in some cases, prompted users to avoid the area. These patterns confirm the dual role of insects in shaping both perception and behaviour and align with existing literature on urban entomology, human-insect interactions, and the behavioural adaptation theory (Fukano & Soga, 2021; Hassett et al., 2022).

From a design perspective, these insights highlight the importance of integrating insect-conscious strategies into urban public space planning. Mitigation measures such as improved waste management, drainage for mosquito-prone areas, and careful placement of beneficial insect habitats can reduce negative interactions while enhancing ecological and aesthetic benefits. Ensuring pathways remain clear and high-traffic areas are less prone to nuisance insects can maintain usability without eliminating opportunities for biodiversity. By balancing human comfort with ecological presence, urban landscapes can promote inclusive, resilient, and engaging public spaces that encourage users to interact safely with both the environment and its insect inhabitants.

## 5. Conclusion

This research explored the impact of insect presence on user experience in urban public spaces, combining field observations with a scenario-based questionnaire. Across all study sites, insects were perceived as unpleasant, unattractive, and unclean, with strong behavioural implications such as shortened visits, avoidance of particular areas, and reduced overall comfort. Statistical analysis further demonstrated significant associations between insect presence and negative user responses, particularly in scenarios involving multiple insects.

These findings suggest that insects, though often overlooked in urban design discourse, play a decisive role in shaping how people engage with public spaces. While insects are ecologically essential, unmanaged presence in user-focused environments can deter visitation and compromise the quality of experience. For urban planners and designers, this highlights the need to integrate pest management strategies, maintenance practices, and design interventions that reduce human-insect conflict.

Ultimately, the study underscores the necessity of balancing ecological value with human comfort. By recognising insects as active agents in shaping spatial experience, urban design can move toward creating public environments that are not only environmentally resilient but also socially welcoming.

This study provides a foundational understanding of how urban insects influence user perception and behaviour in public spaces, particularly in the context of Colombo. By documenting both beneficial and non-beneficial insect encounters and their behavioural impacts, the research offers a reference point for future studies exploring human-insect interactions in urban landscapes.

## 6. Future Research Directions, Implications, or Recommendations

This study provides a foundational understanding of how urban insects influence user perception and behaviour in public spaces, particularly in the context of Colombo. By documenting both beneficial and non-beneficial insect encounters and their behavioural impacts, the research offers a reference point for future studies exploring human-insect interactions in urban landscapes.

Future researchers can build on these findings to investigate similar topics in other cities, climates, or types of public spaces, extending knowledge about the ecological, social, and psychological dimensions of urban insect presence. Additionally, the study highlights potential design and management interventions, such as incorporating Integrated Pest Management (IPM) strategies in designs, improving waste management, and optimising green infrastructure to enhance user experience.

Overall, these insights can inform evidence-based landscape design, encouraging the development of public spaces that balance ecological health, biodiversity, and human comfort while mitigating the negative impacts of non-beneficial insects.

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