

Research Paper

BIODIVERSITY CONSERVATION AND ECOTOURISM IN URBAN FORESTS: A SYSTEMATIC REVIEW AND BIBLIOMETRIC ANALYSIS

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ARTICLE HIGHLIGHTS

- Urban forests link biodiversity protection with public health and recreation
- Five key research themes reflect ecological, social, and behavioral insights
- Visitor experiences influence support for conservation and green behaviors
- Most studies focus on the Global North, leaving tropical cities underexplored
- A new framework shows how cities can balance nature, tourism, and well-being

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ABSTRACT

Urban forests play a crucial role in connecting biodiversity conservation and human well-being, providing recreational and tourism benefits in urban areas. This systematic review and bibliometric analysis aimed to analyze the intersection of urban forests, biodiversity conservation, and their interaction with visitors, including preferences, perceptions, and behavior. We examined 83 open-access articles published between year 2010 and 2025, retrieved from Scopus databases, then analyzed the articles using bibliometric mapping and keyword co-occurrence analysis with VOSviewer, including clustering and thematic trends. This review identified five research clusters: 1) urban ecosystem and biodiversity; 2) recreational and ecotourism; 3) visitor preference and well-being; 4) human-nature interaction; and 5) behavioral science and health. Our results showed that interdisciplinary studies on urban forests have been conducted since 2020, with a focus on environmental services, mental health, psychology, and pro-environmental behavior. However, research remains geographically biased toward the Global North, with limited representation from the tropical and developing cities despite their rich biodiversity and rapid urbanization. Based on this review, we propose a conceptual framework that integrates the ecological and social dimensions of urban forest research, which emphasizes the need for geographical-based, society-based, and interdisciplinary approaches to maximize the multifunctional benefits of urban forests. As cities grow, urban forests, which serve as areas where people encounter biodiversity in the city, can act as strategic platforms for biodiversity conservation, community engagement, and enhancing public awareness, and perceptions of the environment.

Keywords: biodiversity conservation, ecotourism, urban forests, visitor behavior

INTRODUCTION

United Nations estimated that the number of people living in cities is expected to reach 6.252 billion by 2050, with an urbanization rate of 67.2% (Zhang *et al.* 2022). High levels of urbanization and the presence of residential areas can reduce species richness and habitat fragmentation (Bergeron & Pellerin 2014; Elmqvist *et al.* 2015). Urban expansion intensity and the type of urban growth can impact species richness, with more intense urbanization often leading to reduced biodiversity (Yang *et al.* 2024).

Urban forests include all trees, forests, and related vegetations that grow inside or close to urban areas, such as cities, towns, and communities where people live, work, and play, and are becoming increasingly recognized for their ability to support conservation efforts in urban areas and to mitigate the loss of biodiversity (Yang *et al.* 2024; Vogt 2020). An urban forest is a part of urban green space that provides ecosystem services and improves urban sustainability (Vogt 2020; Solomou *et al.* 2019). Both urban forests and urban green spaces play a crucial role in enhancing the resilience, livability, and health of cities (Mahajan *et al.* 2024; Bühler & Saluz 2024). Through their incorporation into urban design,

urban forests offer ecological, social, and economic benefits, making them a vital component of urban green spaces and a crucial part of resilient, sustainable cities (Vogt 2020; Mahajan *et al.* 2024; Niță *et al.* 2018).

Urban forests contribute significantly to the protection of biodiversity and the general ecological well-being of cities by supporting ecological connectedness, offering homes for a variety of species, and boosting floral and faunal diversity (Hwang *et al.* 2024; Khan *et al.* 2022). Among its many other advantages, urban forest management is a nature-based approach that helps mitigate the effects of climate change and biodiversity loss (Hutt-Taylor *et al.* 2024) sustainably manage, and restore ecosystems while simultaneously providing human wellbeing and biodiversity benefits. In addition to providing cultural services vital to human well-being and improving public health outcomes, urban forests offer a variety of environmental services such as better air quality, climate change adaptation, and higher tourism income (Nesbitt *et al.* 2017).

Urban forests and urban green spaces are essential for providing recreational services and influencing tourist preferences (Koo *et al.* 2013; Sunita *et al.* 2023). Visitors frequently visit urban forests due to their inherent beauty, peace, and opportunity to interact with nature (Fadila *et al.* 2021; Yi *et al.* 2024) many studies have highlighted the role of urban and peri-urban forests in mitigating environmental pollution and maintaining human quality of life by integrating the concepts of ecosystem services into forest management strategy. To increase the social acceptance and to reduce the conflicts between users, citizens' preferences towards ecosystem services should be included in the decision-making process. In the present study, a structured questionnaire was administered to a sample of 180 citizens and 50 forest managers of the Tlemcen peri-urban forest (Algeria). Understanding how visitors perceive, use, and value urban forests is essential for sustainable planning, particularly when conservation goals intersect with human activity (Chiesura 2004). The interest in investigating visitor preferences, behaviors, and perceptions, and how they influence and are influenced by urban forests, is growing (Choi *et al.* 2024; Xu *et al.* 2022; Sofyan *et al.* 2024). However, the ecological context related to biodiversity conservation is often discussed separately from the tourism aspect, which includes visitor preferences, behaviors, and perceptions.

Due to the increase of urbanization and its impact to biodiversity, it is important to highlight the role of urban forest in maintaining ecological balance and providing recreational opportunities. Our review bridges this gap by conducting a systematic literature review (SLR) on the relationship between urban forests, biodiversity conservation, and visitor or tourist interactions. This review aimed to analyze the intersection of urban forests, biodiversity conservation, and their interaction with visitors, including preferences, perceptions, and behavior. Bridging ecological and tourism aspects in urban forests could promote the implementation of ecotourism, helping to enhance public awareness about the importance of biodiversity and conservation among visitors. This, in turn, can lead to more support for conservation initiatives and responsible behavior toward the environment (Imran *et al.* 2014).

MATERIALS AND METHODS

Systematic Literature Review Methods

A systematic literature review was conducted using the Scopus database, covering the period from 2010 to 2025, and was retrieved in April 2025. The following search string was used to identify relevant documents: ("urban forest" OR "open green space") AND ("biodiversity" AND "conservation") OR ("tourist" OR "visitor") AND ("preference" OR "perception" OR "behavior" OR "attraction"). The search was limited to peer-reviewed journal articles, reviews, and conference papers in English, published in open-access format. An initial pool of 202 documents was obtained (Fig. 1; Supplementary Table 1).

Those documents were screened using specific keywords and topics, including titles and abstracts related to urban forests, biodiversity, and visitor preferences, perceptions, and behavior, employing Rayyan AI (<https://www.rayyan.ai/>). After this process, 107 articles were retained. A second round of screening, involving title and abstract refinement through full-text reviews to confirm relevance, further narrowed the selection to 83 final documents. The publications were not related to the main theme by reviewing the context in the abstract and also full paper were excluded in this review. Bibliometric analysis was conducted using VOSviewer (v1.6.20; <https://www.vosviewer.com/download>) to generate network and overlay visualizations of keyword co-occurrence, cluster analysis, and temporal trends. Keywords with

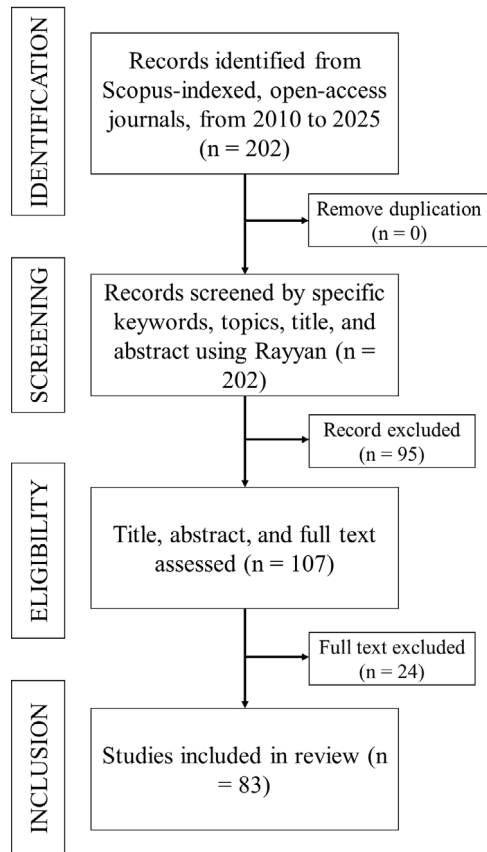


Figure 1 Research method framework

a high average publication year (≥ 2021) and moderate to high frequency (occurrences ≥ 5) were selected as the emerging topics.

RESULTS AND DISCUSSION

Trend in Research Publication and Geographical Distribution

Based on Scopus-indexed literature from 2010 to 2025, the analysis highlights an increasing research interest in the nexus between urban forest, biodiversity conservation, and ecotourism. Although the number of publications in 2025 appears to decline, this is due to the timing of the analysis, which was conducted in April 2025. The number of publications on these topics increased after 2020 (Fig. 2A). Those publications primarily focus on agricultural and biological sciences, environmental sciences, and social sciences (Fig. 2B), which indicated that the research topic of urban forests is mostly focused from the perspective of biological, environmental, and social sciences. This is because the urban forest is proposed as a nature-based solution to mitigate climate change and biodiversity loss (Hutt-Taylor *et al.* 2024) sustainably manage, and restore

ecosystems while simultaneously providing human wellbeing and biodiversity benefits. Managing urban forests for the environmental and human wellbeing benefits is recognized worldwide and is essential in this context of increased urbanization and climate change impacts (Endreny 2018). The social, psychological, and environmental benefits of urban forests are being increasingly studied worldwide, with growing consensus that nature-based solutions support both people and ecosystems while addressing climate change (Hutt-Taylor *et al.* 2022).

Although urban forests, which encompass biological, environmental, and social sciences, have a global focus, this subject is more concentrated in northern areas, such as East Asia (China and South Korea), Europe, and North America (Fig. 2C). It suggests a potential research gap in tropical and developing countries, especially in Southeast Asia and Africa. These regions' abundant biodiversity and increasing urbanization offer great opportunities for empirical research (Khan *et al.* 2022; Sofyan *et al.* 2024). For example, several studies were conducted in the Southeast Asia region, focused on the environmental benefits, socio-economic influences, and biodiversity (Igor & Chotib 2018; Foo 2022; Putrika *et al.* 2023).

Keyword Co-Occurrence and Thematic Structure

Based on the keyword co-occurrence generated by VOSviewer, five dominant thematic clusters were identified that characterize the research structure in this domain (Figs. 3A-B; Table 1). Cluster 1 (red color) encompasses keywords such as biodiversity, urban areas, green spaces, and ecosystem services. It suggests this cluster could be labeled as the urban ecosystem and biodiversity. This cluster encompasses studies examining the ecological functions of urban forests, including their role in enhancing species richness and diversity, conservation, and the provision of ecosystem services. These studies often frame urban forests as supporting biodiversity conservation even within a highly developed city environment (Yang *et al.* 2024; Elmqvist *et al.* 2015). This cluster encompasses 30% of the distribution keywords, indicating that ecological research forms a foundational pillar in the study of urban forests. A study in China suggests that specific management strategies like developing urban parks can enhance habitat connectivity and support diverse bird communities (Li *et al.* 2024).

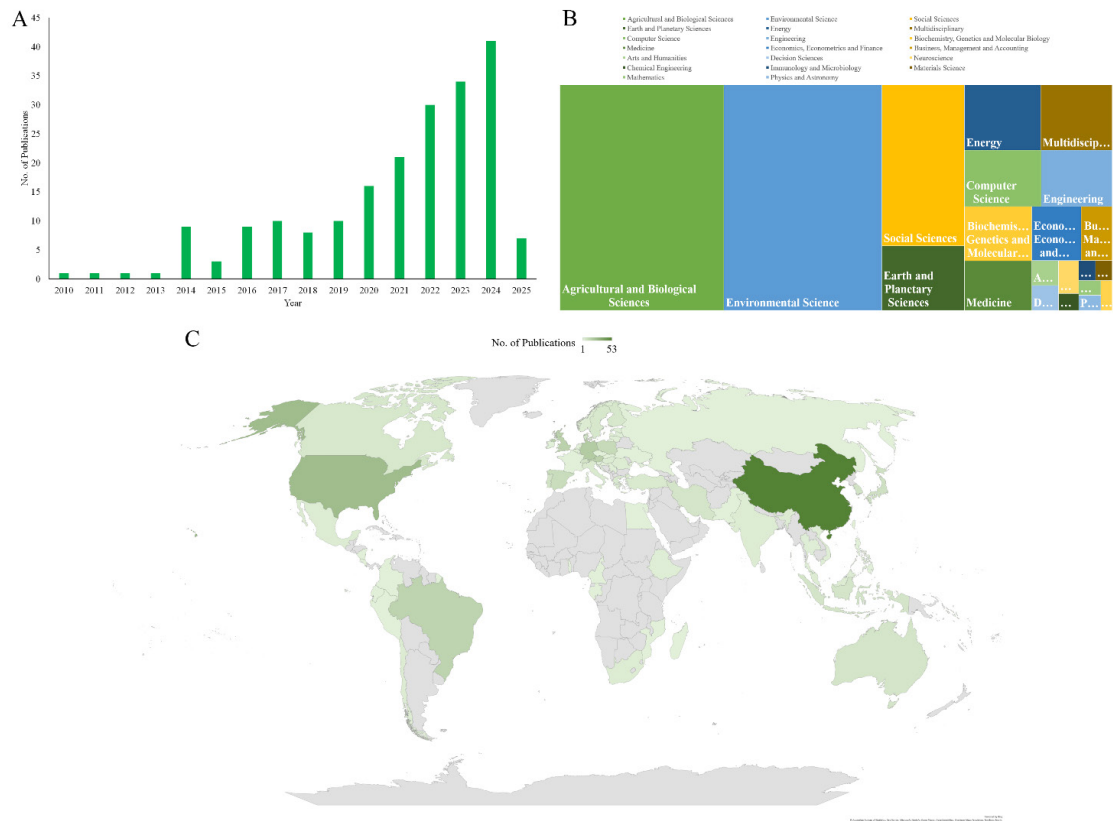


Figure 2 Summary of research trends on urban forest, biodiversity conservation, and visitor preferences

Notes: A = Annual publication trend from 2010 to 2025; B = Distribution of publications by subject area;
C = Number of publications by country.

A previous study shown that the biodiversity in urban forests, especially for trees, were dominated by exotic species than native species (Barrico *et al.* 2018). There was a proposed composition of tree diversity in urban, called the rule of thumb (10/20/30) (Santamour 1990). The evaluation of this rule showed that the existing urban forest were less diverse than the proposed benchmarks at species level by using Shannon index, however, it has similar at the genus and family level (Kendal *et al.* 2014).

Cluster 2 (green color) contains keywords like urban forest, recreation, ecotourism, and tourist attraction. It centers on the theme of recreation and ecotourism in urban forests, reflecting a surge of interest in exploring the recreational value and tourism potential of urban forests that was mostly published in 2022 or later (Table 1). These studies examine how urban forests can serve as ecotourism destinations, attracting visitors through scenic beauty, accessibility, and opportunities for outdoor recreation (Fadila *et al.* 2021; Yao *et al.* 2024). Urban forests provide recreational environments that

could increase visitors' satisfaction and experience, which can improve tourists' positive behavioral intentions (Yao *et al.* 2024). The conservation of urban forests depends on the development of pro-environmental attitudes and behaviors, which are greatly influenced by the environmental knowledge acquired from visits to forest parks (Zhao & Weng 2024; Erfanian *et al.* 2024)

Cluster 3 (blue color) focuses on visitor preferences and well-being, including keywords such as urban forestry, perception, preference behavior, mental health, and outdoor recreation. This cluster demonstrates a growing interest in determining what draws people to urban forests and how those pull factors affect their mental health. A previous study suggests that individual characteristics of visitors influence the variety of their post-visit experience (Yildirim *et al.* 2024). Another study also showed that forest landscapes influenced visitor preferences, and it has a strong correlation to the restorative effect (Zhi Zhang *et al.* 2022).

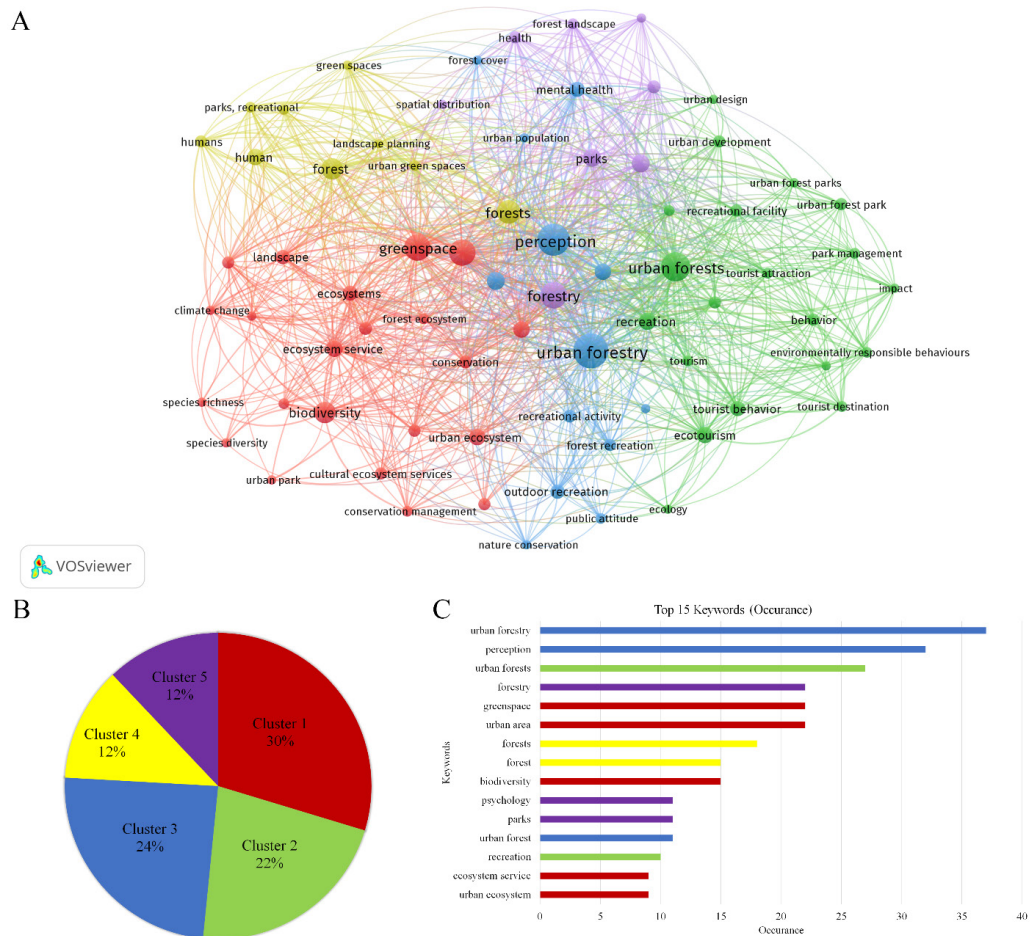


Figure 3 Keyword co-occurrence in the literature on urban forests, biodiversity, and tourism

Notes: A = Network visualization showing keyword clusters; B = Cluster distribution of keywords;

C = Top 15 most frequently occurring keywords (colors represent cluster).

Cluster 4 (yellow color) centers on the theme of human-nature interaction, encompassing keywords such as forest, humans, recreational park, and urban green spaces. This cluster focuses on how people interact with and value the green environment, examining the social and cultural aspects of human interaction with urban nature. A recent study found that visitors perceived more benefits than disbenefits in urban green spaces, including aesthetic value, memories, reflection, strengthening social bonds, connection to nature, and a sense of freedom (Nowak-Olejniki *et al.* 2024). The human-nature interaction, including human perception, generates cultural ecosystem services, which are the benefits that ecosystems provide to human well-being in terms of identities, experiences, and capacities (Fish *et al.* 2016). Recreational, aesthetic, and cultural values are the benefits of ecosystem values from forests (Crețan *et al.* 2024).

Cluster 5 (purple color) mainly focuses on interdisciplinary approaches in urban forest studies. Emerging terms include psychology, forest therapy, behavioral research, and health, which are labelled as behavioral science and health. This cluster represents the interest of urban forest researchers in the visitor experience of urban forests, linked with the psychological and physiological outcomes. This cluster is starting to focus on issues including environmentally responsible behavior, therapeutic landscape design, and the health benefits of forest experience (Weng *et al.* 2023; Zhao & Weng 2024; He *et al.* 2022). The interest in the health benefits of urban forests has increased after the COVID-19 pandemic, which clearly shows the importance of green areas in cities for strengthening the physical and mental well-being of the urban population (Derks *et al.* 2020; da Schio *et al.* 2021). A previous study showed that the health benefits of

green areas are significant, suggesting that higher-quality green regions are associated with reduced medication spending and fewer doctor visits (Simović *et al.* 2023). Furthermore, behavioral studies in urban forests highlight the importance of increasing awareness and enhancing the environmental awareness and skills of urban forest visitors (Erfanian *et al.* 2024). It is also important to consider the fit between the tourist and the recreational environment of the urban forest to promote the emergence of empathy and awe to stimulate the visitor's environmentally responsible behavior (Li & Song 2024).

We then listed the top 15 keywords based on the co-occurrence data to illustrate the conceptual landscape across the dataset (Fig. 3C). These keywords represent the most influential and recurrent concepts within the literature that emphasize the core of research topics on urban forest, biodiversity conservation, and ecotourism. Urban forestry is the most commonly used keyword in the literature. It shows that the focus of the study across the literature is related to the management of trees and forest resources in urban areas, which provide various benefits, including physiological, sociological, economic, and aesthetic advantages (Volder & Watson 2015). Several studies also suggest considering the perception and perceived values, including visitor experiences, in developing urban forest (Yıldırım *et al.* 2024; Jamean & Abas 2023; Roman *et al.* 2021; Terkenli *et al.* 2020).

Studies on urban forests encompass diverse fields, including ecological, social, and psychological aspects, and have been increasingly studied over the years (Table 1). Based on our analysis, the topic of recreation and ecotourism is increasingly studied in urban forest areas. The study focuses on the relationship between urban forests and recreation, ecotourism, and tourist behavior. These topics could contribute to urban forest planning and construction, which directly or indirectly influences tourist behavior (Yao *et al.* 2024).

Emerging Topics and Temporal Trends

Several emerging themes were identified using the temporal overlay visualization (Fig. 4A) and the average publication year analysis (Fig. 4B), particularly for publications released after 2021. Our data showed that there have been shifts in topics over the years in the urban forest study. The publications in 2021 focused on the concepts of "urban forestry" and "perceptions," which are fundamental to discussions about urban forests. In 2022, the discussions shifted to the role of urban forest parks in promoting mental health, psychology, and ecosystem services. Furthermore, it is more enhanced in 2023 in health, behavior, and conservation topics. It might be influenced by the COVID-19 pandemic, when mental health has become an issue, such as depression, stress, anger, anxiety, and so on (Jevtic *et al.* 2022).

Table 1 Summary of thematic clusters based on keyword co-occurrence analysis

Cluster	Description	Keywords	Total Occurrences	Avg. Pub. Year*
1	Urban ecosystem and biodiversity	Greenspace, urban area, biodiversity, urban ecosystem, ecosystem services	160	2021.23
2	Recreation and ecotourism	Urban forests, recreation, ecotourism, tourist behavior	118	2022.24
3	Visitor preference and well-being	Urban forestry, perception, preference behavior, mental health, outdoor recreation	131	2021.30
4	Human-nature interaction	Forest, human, urban green space, recreational park	65	2021.94
5	Behavioral science and health	Psychology, forestry, behavioral research, health, forest therapy	65	2021.96

Notes: Each cluster represents a dominant research focus area, characterized by its most frequent keywords, total occurrences, and average publication year;

* = The publication years of all documents containing those keywords and then divided by the total number of times the keywords appeared.

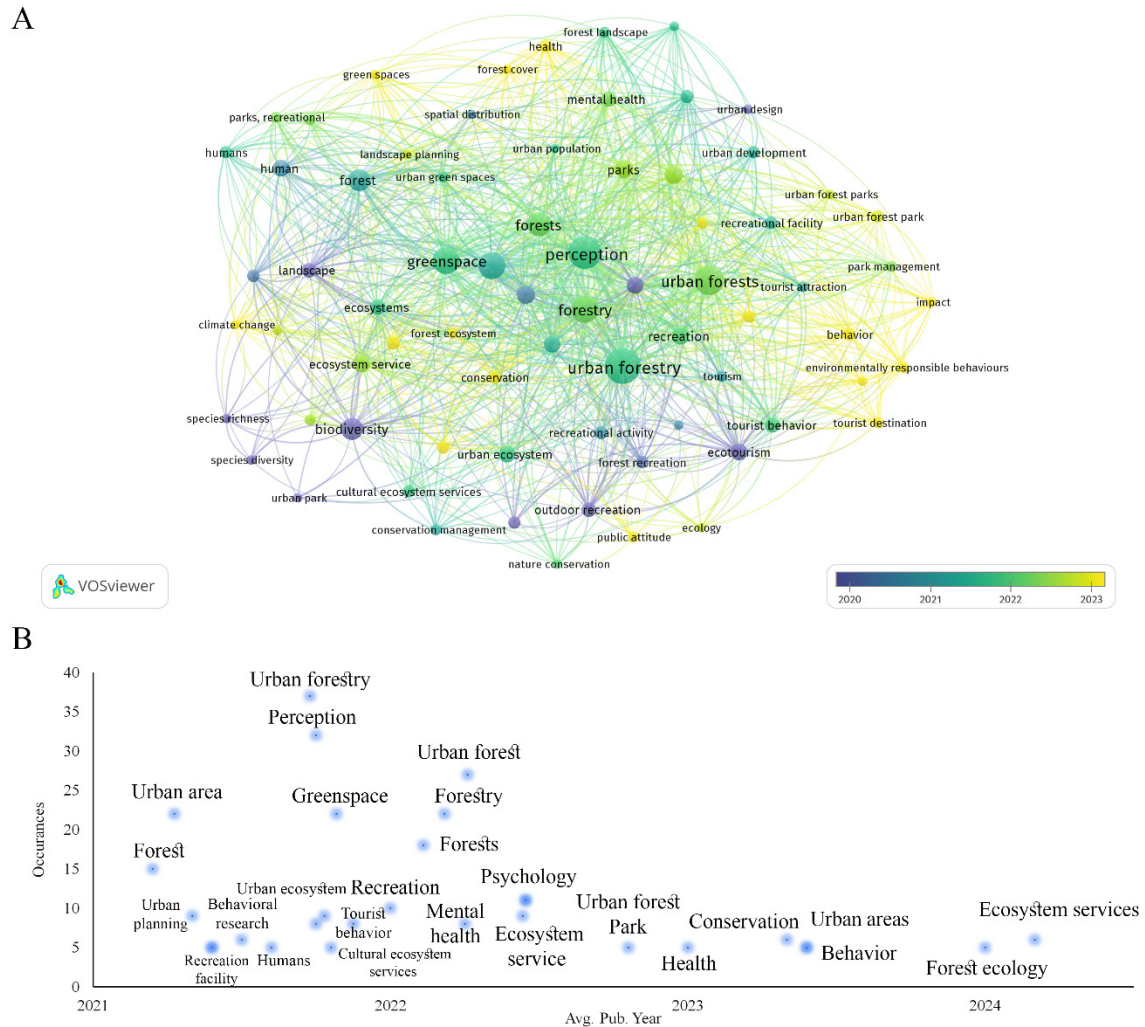


Figure 4 Thematic and temporal analysis of key terms in selected publications

Notes: A = Overlay visualization indicating temporal trends (based on average publication year;

B = Emerging topics based on the keyword frequency and average publication year.

The keyword occurrences “behavior” have prominently gained focus and discuss the tourists’ perceived value, post-visit behavior, and visitors’ experience of the environmentally responsible behavior in urban forests (Zhao & Weng 2024; Weng *et al.* 2023; Li & Song 2024; Yao *et al.* 2024; Borthakur & Kondasani 2024). A shift toward a more behavioral and impact-driven research agenda is evident in the growing emphasis on studies that aim to understand how visitor experiences in urban forests can promote sustainable attitudes and actions.

These patterns indicate an increasing emphasis on interdisciplinary research that combines

tourism studies, environmental psychology, and conservation science. Multisensory experiences, forest therapy, and the utilization of urban forest parks as tools for mental and physical health interventions are also gaining popularity.

In summary, studies of urban forests encompass a range of perspectives and diverse research topics. Based on the review conducted, we provide a conceptual framework to summarize the connections between each cluster, which will help illustrate how urban forests are studied (Fig. 5). This conceptual framework portrays the urban forest as a nexus of ecological, psychological, and recreational dimensions.

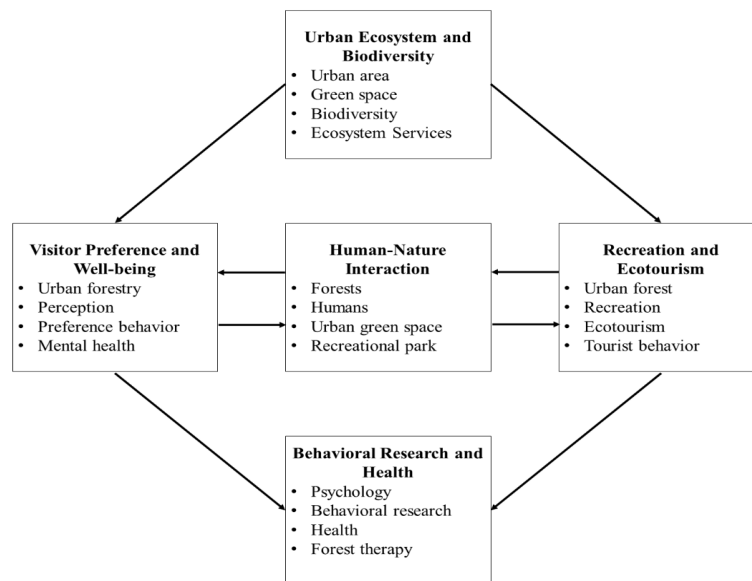


Figure 5 Conceptual framework

Research Gap and Future Study Direction

Urban forests, biodiversity conservation, and their interaction with visitors are studied as interdisciplinary research. However, several critical gaps and future opportunities will guide the next phase of interdisciplinary inquiry. As shown in the geographical distribution of publication (Fig. 2C), the research is concentrated in East Asia, Europe, and North America. The urban forest area in tropical and developing regions, including Southeast Asia and Africa, remains underexplored, despite being biodiversity hotspots and experiencing rapid urbanization (Foo 2022; Khan *et al.* 2022; Putrika *et al.* 2023). It suggests that there is a need to explore how urban forests function within the specific biophysical, social, and policy contexts of the Global South, such as South America, Africa, and Southeast Asia.

It could also involve cultural studies, how multicultural values are perceived in urban forests, integrating traditional ecological knowledge, and localized tourism behavior models. Several studies have indicated the necessity for enhanced interdisciplinary methods in urban forestry research to address the complex socio-ecological dynamics

within multicultural metropolitan environments and to incorporate diverse viewpoints and techniques for improved urban forest sustainability and resilience (Barona *et al.* 2022; Vogt *et al.* 2016).

The thematic cluster shows a strong divide between ecological studies (Cluster 1) and visitor-focused research (Clusters 2 & 3) (Fig. 3B, Table 1). There are not many studies that investigate both biodiversity assessment and visitor engagement at the same time, as urban forests are managed as multifunctional spaces that serve conservation and recreation purposes (Imran *et al.* 2014; Zhao & Weng 2024). Interdisciplinary studies should integrate biodiversity indicators and visitor engagement, which can be evaluated through participatory mapping and visitor impact assessments.

CONCLUSION

By systematically reviewing all publications on urban forests published over the past fifteen years, we identified five major research clusters that focus on biodiversity conservation and visitor engagement. These clusters demonstrate the application of interdisciplinary approaches

to investigate how urban forests function, encompassing ecological, cultural, and recreational spaces within the urban environment. Through years of publication, urban forests are increasingly recognized as nature-based solutions that provide ecological connectivity, promote well-being, and offer recreational opportunities. Several key research gaps need to be addressed in future studies, such as the fact that the research was concentrated in the Global North and the need for an integrated study on both ecological and visitor aspects. Moving forward, future research should prioritize interdisciplinary designs, incorporate behavioral and psychological metrics, and include geographical-based studies in the Global South. This systematic review and bibliometric analysis can be utilized as a recommendation for managing urban forests which should also considered visitors' preferences and perceptions. Urban forests, when managed inclusively, have the potential to serve as platforms for biodiversity conservation, community engagement, and the enhancement of public awareness and perceptions regarding the environment. It shows the potential of urban forests for ecotourism area.

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