urban science

MDPI

Editorial

Urban Forestry for Greener and Healthier Cities

Ermes Lo Piccolo [1,2,*], Barbara Mariotti [1] and Francesco Ferrini [1,2,*]

[1] Department of Agriculture, Food, Environment and Forestry, University of Florence, 50144 Florence, Italy; barbara.mariotti@unifi.it
[2] National Biodiversity Future Center, 90146 Palermo, Italy
* Correspondence: ermes.lopiccolo@unifi.it (E.L.P.); francesco.ferrini@unifi.it (F.F.)

The global population is becoming increasingly urban, with approximately 68% of people projected to live in urban areas by 2050 [1,2]. Although urbanisation has generated substantial socioeconomic benefits, it has also been accompanied by profound environmental changes, deteriorating air quality, urban heat island effects, soil degradation, and greater exposure of urban populations to multiple environmental stressors [3–9]. These pressures directly affect urban ecosystem functioning, human health, and the overall liveability of cities [10].

Within this context, urban forestry has evolved from a discipline primarily concerned with the establishment and management of urban trees into an interdisciplinary field addressing the interactions among vegetation, urban ecosystems, and society. Urban forests are now widely recognised as key components of green infrastructure and nature-based solutions, delivering multiple ecosystem services and providing environmental, climatic, economic, and social benefits [11–16]. Their contribution extends well beyond carbon sequestration and urban cooling to include improvements in air quality, biodiversity conservation, stormwater regulation, public health, environmental justice and human well-being [17].

The contributions to this Special Issue illustrate the breadth of contemporary urban forestry research. Together, they show how the field now draws on plant science, ecology, environmental engineering, landscape architecture, urban planning, public health, and the social sciences to understand and manage urban forests as complex socio-ecological systems.

Several papers reinforce the fundamental role of vegetation in improving urban environmental quality. Air pollution remains one of the most significant challenges facing cities, and one study compares different methodologies for quantifying particulate matter retained on leaf surfaces and identifies tree species with a high capacity for particulate matter accumulation [18–20]. Beyond advancing methodological standardisation, such studies provide a scientific basis for evidence-based species selection in future urban tree planting programmes.

Another contribution emphasises the importance of integrating soil–plant indicators into the assessment of urban forests [21]. The review highlights how soil–plant indicators are linked to ecological stoichiometry and enzyme activities, as well as how C and N stable isotopes provide complementary information on nutrient cycling and ecosystem functionality, promoting a more holistic evaluation of urban forestry interventions. This systems-based perspective recognises the soil–plant continuum as a fundamental component of the long-term functioning and resilience of urban forests.

Beyond ecosystem functioning, the Special Issue emphasises the increasing importance of understanding novel environmental stressors associated with urbanisation.

Received: 5 August 2026
Accepted: 18 August 2026
Published: 21 August 2026

One article reviews the current knowledge on artificial light at night (ALAN) effects on tree physiology and phenology, identifies major gaps concerning species-specific responses, spectral composition, long-term physiological consequences, and interactions with other urban stressors, particularly heat and drought, and outlines priorities for future multidisciplinary research [22]. Beyond synthesising current knowledge, the article establishes a research agenda for future studies by identifying critical gaps in our understanding of ALAN impacts and advocating multidisciplinary approaches [23]. These insights may help inform both urban forestry practices and evidence-based lighting policies.

A further theme emerging from this Special Issue is the growing integration of human-centred perspectives into urban forestry research. While the ecological functions of urban vegetation remain fundamental, several contributions demonstrate that urban forests also shape human perceptions, behaviours, and place experiences. Collectively, these studies examine how urban green spaces influence visitors' preferences, perceived safety, multisensory landscape experiences through plant-derived smellscapes, and residential attractiveness, highlighting the increasingly important role of social and behavioural sciences in advancing urban forestry [24–27]. These contributions demonstrate that the success of urban forests should not be assessed solely through biophysical indicators, but also through the ways in which people perceive, experience, and interact with urban nature.

The relationship between urban forestry and public health represents another important theme. While the health benefits of urban trees are widely acknowledged [28–30], one contribution highlights the complexity of these interactions by examining the association between tree canopy cover and asthma prevalence across Los Angeles. The study reports an inverse association between tree canopy cover and paediatric asthma prevalence, particularly in communities with larger minority populations, whereas the association with adult asthma is weaker and more context-dependent [31]. These findings emphasise the need for interdisciplinary research bridging urban forestry and epidemiology.

Questions of governance and environmental justice are also represented in this Special Issue. Urban greening cannot be considered successful if its benefits are distributed unequally or if greening initiatives unintentionally contribute to social displacement [32–35]. The Perspective article on the 3–30–300 rule argues that proximity-based greening strategies should be coordinated with housing and affordability policies to reduce the risk of green gentrification [36]. Similarly, the Opinion article on Urban Food Forests (UFFs) expands the scope of urban forestry by presenting UFFs as multifunctional systems that integrate urban forestry, urban agriculture, and agroforestry to simultaneously support ecosystem services, food production, biodiversity, and community well-being. At the same time, it identifies important conceptual and methodological gaps and outlines a research agenda aimed at supporting their wider integration into evidence-based urban planning [37]. Collectively, these contributions explain the expanding scope of urban forestry, highlighting its growing integration with urban governance, environmental justice, food systems, and sustainable development.

Taken together, the contributions to this Special Issue illustrate the growing conceptual and methodological breadth of urban forestry. Contemporary urban forestry extends beyond tree establishment and maintenance to examine the interactions among vegetation, soils, the atmosphere, biodiversity, built infrastructure, and human communities. Addressing these interactions requires sustained collaboration among plant physiologists, ecologists, soil scientists, landscape architects, urban planners, engineers, public health researchers, and social scientists.

Important challenges nevertheless remain. Long-term monitoring programmes are still limited, constraining our understanding of how urban forests respond to interacting environmental stressors under changing climatic conditions. Standardised, accessible,

and cost-effective methodologies are also needed to improve comparisons across cities and regions. Finally, local authorities should more systematically incorporate ecological evidence and socioeconomic considerations into urban forestry planning and management. This integration will be essential if urban greening interventions are to maximise ecosystem services while ensuring that their benefits are accessible to all sections of society.

Acknowledgments: During the preparation of this manuscript/study, the authors used ChatGPT (GPT-5.6 Sol) for the purposes of language editing and Graphical Abstract creating. The authors have reviewed and edited the output and take full responsibility for the content of this publication.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. UN United Nations. *World Urbanization Prospects 2025: Summary of Results*; UN DESA/POP/2025/TR/NO. 12 2025; UN United Nations: New York, NY, USA, 2025.
2. UN United Nations, Department of Economic and Social Affairs, Population Division. *World Urbanization Prospects: The 2018 Revision*; (ST/ESA/SER.A/420); UN United Nations: New York, NY, USA, 2019.
3. Bai, X.; McPhearson, T.; Cleugh, H.; Nagendra, H.; Tong, X.; Zhu, T.; Zhu, Y.-G. Linking Urbanization and the Environment: Conceptual and Empirical Advances. *Annu. Rev. Environ. Resour.* **2017**, *42*, 215–240. [CrossRef]
4. Li, G.; Sun, G.-X.; Ren, Y.; Luo, X.-S.; Zhu, Y.-G. Urban Soil and Human Health: A Review. *Eur. J. Soil Sci.* **2018**, *69*, 196–215. [CrossRef]
5. Deilami, K.; Kamruzzaman, M.; Liu, Y. Urban Heat Island Effect: A Systematic Review of Spatio-Temporal Factors, Data, Methods, and Mitigation Measures. *Int. J. Appl. Earth Obs. Geoinf.* **2018**, *67*, 30–42. [CrossRef]
6. Fineschi, S.; Loreto, F. A Survey of Multiple Interactions between Plants and the Urban Environment. *Front. For. Glob. Change* **2020**, *3*, 30. [CrossRef]
7. Bowler, D.E.; Buyung-Ali, L.; Knight, T.M.; Pullin, A.S. Urban Greening to Cool Towns and Cities: A Systematic Review of the Empirical Evidence. *Landsc. Urban Plan.* **2010**, *97*, 147–155. [CrossRef]
8. Norton, B.A.; Coutts, A.M.; Livesley, S.J.; Harris, R.J.; Hunter, A.M.; Williams, N.S.G. Planning for Cooler Cities: A Framework to Prioritise Green Infrastructure to Mitigate High Temperatures in Urban Landscapes. *Landsc. Urban Plan.* **2015**, *134*, 127–138. [CrossRef]
9. Armson, D.; Stringer, P.; Ennos, A.R. The Effect of Tree Shade and Grass on Surface and Globe Temperatures in an Urban Area. *Urban For. Urban Green.* **2012**, *11*, 245–255. [CrossRef]
10. Elmqvist, T.; Fragkias, M.; Goodness, J.; Güneralp, B.; Marcotullio, P.J.; McDonald, R.I.; Parnell, S.; Schewenius, M.; Sendstad, M.; Seto, K.C.; et al. (Eds.) *Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities: A Global Assessment*; Springer: Dordrecht, The Netherlands, 2013.
11. Livesley, S.J.; McPherson, E.G.; Calfapietra, C. The Urban Forest and Ecosystem Services: Impacts on Urban Water, Heat, and Pollution Cycles at the Tree, Street, and City Scale. *J. Environ. Qual.* **2016**, *45*, 119–124. [CrossRef] [PubMed]
12. Konijnendijk, C.C.; Ricard, R.M.; Kenney, A.; Randrup, T.B. Defining Urban Forestry—A Comparative Perspective of North America and Europe. *Urban For. Urban Green.* **2006**, *4*, 93–103. [CrossRef]
13. Nowak, D.J.; Hoehn, R.E.; Bodine, A.R.; Greenfield, E.J.; O'Neil-Dunne, J. Urban Forest Structure, Ecosystem Services and Change in Syracuse, NY. *Urban Ecosyst.* **2016**, *19*, 1455–1477. [CrossRef]
14. Nieuwenhuijsen, M.J. Green Infrastructure and Health. *Annu. Rev. Public Health* **2021**, *42*, 317–328. [CrossRef] [PubMed]
15. Endreny, T.; Santagata, R.; Perna, A.; Stefano, C.D.; Rallo, R.F.; Ulgiati, S. Implementing and Managing Urban Forests: A Much Needed Conservation Strategy to Increase Ecosystem Services and Urban Wellbeing. *Ecol. Model.* **2017**, *360*, 328–335. [CrossRef]
16. Roy, S.; Byrne, J.; Pickering, C. A Systematic Quantitative Review of Urban Tree Benefits, Costs, and Assessment Methods across Cities in Different Climatic Zones. *Urban For. Urban Green.* **2012**, *11*, 351–363. [CrossRef]
17. Berland, A.; Shiflett, S.A.; Shuster, W.D.; Garmestani, A.S.; Goddard, H.C.; Herrmann, D.L.; Hopton, M.E. The Role of Trees in Urban Stormwater Management. *Landsc. Urban Plan.* **2017**, *162*, 167–177. [CrossRef] [PubMed]
18. Baesso Moura, B.; Zammarchi, F.; Hoshika, Y.; Martinelli, F.; Paoletti, E.; Ferrini, F. Comparing Different Methodologies to Quantify Particulate Matter Accumulation on Plant Leaves. *Urban Sci.* **2024**, *8*, 125. [CrossRef]
19. Nowak, D.J.; Hirabayashi, S.; Bodine, A.; Greenfield, E. Tree and Forest Effects on Air Quality and Human Health in the United States. *Environ. Pollut.* **2014**, *193*, 119–129. [CrossRef] [PubMed]
20. Escobedo, F.J.; Kroeger, T.; Wagner, J.E. Urban Forests and Pollution Mitigation: Analyzing Ecosystem Services and Disservices. *Environ. Pollut.* **2011**, *159*, 2078–2087. [CrossRef] [PubMed]

21. Macci, C.; Vannucchi, F.; Scartazza, A.; Masciandaro, G.; Doni, S.; Peruzzi, E. Soil–Plant Indicators for Assessing Nutrient Cycling and Ecosystem Functionality in Urban Forestry. *Urban Sci.* **2025**, *9*, 82. [CrossRef]
22. Friulla, L.; Varone, L. Artificial Light at Night (ALAN) as an Emerging Urban Stressor for Tree Phenology and Physiology: A Review. *Urban Sci.* **2025**, *9*, 14. [CrossRef]
23. Gaston, K.J.; Visser, M.E.; Hölker, F. The Biological Impacts of Artificial Light at Night: The Research Challenge. *Phil. Trans. R. Soc. B* **2015**, *370*, 20140133. [CrossRef] [PubMed]
24. Ezebilo, E.E. Sustainable Management of an Urban Green Space in a Papua New Guinean City: Accessibility, Use and Preferences. *Urban Sci.* **2024**, *8*, 243. [CrossRef]
25. Hou, F.; Hedayati Marzbali, M.; Maghsoodi Tilaki, M.J.; Abdullah, A. Rethinking Urban Greening: Implications of Crime Prevention through Environmental Design for Enhancing Perceived Safety in Baitashan Park, Lanzhou. *Urban Sci.* **2025**, *9*, 9. [CrossRef]
26. Lygum, V.L.; Xiao, J. Creating Smellscapes with Plants: A Landscape Architectural Framework. *Urban Sci.* **2025**, *9*, 68. [CrossRef]
27. Kato, T.; Endo, Y.; Fujiwara, S.; Kamei, S. Green or Nature? Comparison of the Effects of the Symbolic Presence of the City on Residential Intention among Tokyo Residents. *Urban Sci.* **2026**, *10*, 83. [CrossRef]
28. Markevych, I.; Schoierer, J.; Hartig, T.; Chudnovsky, A.; Hystad, P.; Dzhambov, A.M.; De Vries, S.; Triguero-Mas, M.; Brauer, M.; Nieuwenhuijsen, M.J.; et al. Exploring Pathways Linking Greenspace to Health: Theoretical and Methodological Guidance. *Environ. Res.* **2017**, *158*, 301–317. [CrossRef] [PubMed]
29. Van Den Bosch, M.; Ode Sang, Å. Urban Natural Environments as Nature-Based Solutions for Improved Public Health—A Systematic Review of Reviews. *Environ. Res.* **2017**, *158*, 373–384. [CrossRef]
30. Twohig-Bennett, C.; Jones, A. The Health Benefits of the Great Outdoors: A Systematic Review and Meta-Analysis of Greenspace Exposure and Health Outcomes. *Environ. Res.* **2018**, *166*, 628–637. [CrossRef] [PubMed]
31. Aiyer, P.; Mominkhawaja, A.; Surani, S.; Shankar, H.M. Urban Tree Canopy, Asthma Prevalence, and Health Equity in Los Angeles: A Geospatial Analysis with Implications for Urban Forestry. *Urban Sci.* **2025**, *9*, 476. [CrossRef]
32. Lawrence, A.; De Vreese, R.; Johnston, M.; Konijnendijk van den Bosch, C.C.; Sanesi, G. Urban Forest Governance: Towards a Framework for Comparing Approaches. *Urban For. Urban Green.* **2013**, *12*, 464–473. [CrossRef]
33. Nesbitt, L.; Meitner, M.J.; Girling, C.; Sheppard, S.R.J.; Lu, Y. Who Has Access to Urban Vegetation? A Spatial Analysis of Distributional Green Equity in 10 US Cities. *Landsc. Urban Plan.* **2019**, *181*, 51–79. [CrossRef]
34. Wolch, J.R.; Byrne, J.; Newell, J.P. Urban Green Space, Public Health, and Environmental Justice: The Challenge of Making Cities 'Just Green Enough'. *Landsc. Urban Plan.* **2014**, *125*, 234–244. [CrossRef]
35. Rigolon, A. A Complex Landscape of Inequity in Access to Urban Parks: A Literature Review. *Landsc. Urban Plan.* **2016**, *153*, 160–169. [CrossRef]
36. Aliakbari, S.; Russo, A. Greening the City with the 3–30–300 Rule: A Spatial Justice Perspective on Housing Governance and Green Gentrification. *Urban Sci.* **2026**, *10*, 244. [CrossRef]
37. Ferrini, F.; Gori, A.; Lo Piccolo, E. Urban Food Forests: From Theory to Empirical Research. *Urban Sci.* **2026**, *10*, 155. [CrossRef]