

COST Action CA23148 - INTUF
ANNUAL CONFERENCE 2026

**Building Capacity for Urban Forest Management across Europe:
Indicators, Knowledge, and Participation**

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Antalya, Türkiye

27–30 April 2026

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Building Capacity for Urban Forest Management across Europe: Indicators, Knowledge, and Participation

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ABOUT THIS BOOK

This Book of Abstracts compiles the research presented at the conference "*Building Capacity for Urban Forest Management across Europe: Indicators, Knowledge, and Participation*," held in Antalya, Türkiye, from April 27–30, 2026. Organized under the framework of COST Action Urban Forestry Network, CA23148 (INTUF), the event convened researchers, practitioners, and policymakers to evaluate current methodologies and present ongoing advancements in the fields of urban forestry and green infrastructure.

The core objective of the Action is to systematically advance the scientific understanding, governance structures, and practical management of urban forests across Europe. The Action facilitates interdisciplinary collaboration to develop standardized frameworks for assessing ecosystem services, optimizing urban forest governance, and integrating citizen science into municipal planning. By bridging the gap between scientific research and policy application, INTUF addresses the critical need for resilient and sustainable urban ecosystems.

The contributions detailed in this volume reflect the network's current research trajectories and working group outputs. The abstracts encompass a broad spectrum of research areas, ranging from the application of emerging technologies in ecological modelling and mobile inventory systems to the analysis of socio-ecological frameworks necessary for equitable green infrastructure management. The international representation of the authors underscores the transnational scope of the Action and the requisite interdisciplinary approach to urban forestry research.

We extend our formal appreciation to all authors, presenters, and participants for their scientific contributions to this conference. We also acknowledge the local organizing committee for their structural support in hosting the event, and the COST Association for their continued funding and facilitation of this collaborative research network.

Dieter Anseeuw Former Chair, COST Action CA23148

Ana Macías Chair, COST Action CA23148

FROM THE LOCAL ORGANISING COMMITTEE

As the local organizing committee, we were pleased to welcome colleagues to Antalya, Türkiye, for the conference “*Building Capacity for Urban Forest Management across Europe: Indicators, Knowledge, and Participation*,” held from April 27–30, 2026, within the framework of COST Action CA23148 (INTUF). Hosting this meeting provided an opportunity to contribute to the Action’s collaborative work and to support direct exchange among researchers, practitioners, and policymakers from different national and institutional contexts.

Urban forest management requires scientific knowledge that can inform decisions under diverse local conditions. Differences in climate, urban development, institutional responsibilities, and public expectations shape both the challenges faced by cities and the measures available to address them. Bringing these perspectives together is therefore essential to assessing the relevance and applicability of indicators, methods, and management approaches across Europe. Antalya offered a Mediterranean setting in which to consider these questions and their implications for urban forestry practice.

Our aim as local organizers was to provide a setting conducive to scientific discussion, working group activities, and informal exchange. The value of such meetings lies in the opportunity to examine ongoing work with colleagues, compare experiences, and identify questions that require further collaboration. The contributions collected in this volume document the research presented at the conference and provide a basis for continued discussion within the network.

We thank all authors, presenters, and participants for their contributions and engagement throughout the meeting. We also express our appreciation to the Action leadership and working group leaders for their cooperation during the preparation of the event, and to the colleagues and supporting staff whose work made it possible to host the conference in Antalya. We gratefully acknowledge the COST Association for supporting the meeting and the wider activities of INTUF.

The Local Organising Committee

Antalya, Türkiye

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ORGANISING COMMITTEES

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ABOUT COST ACTION INTUF



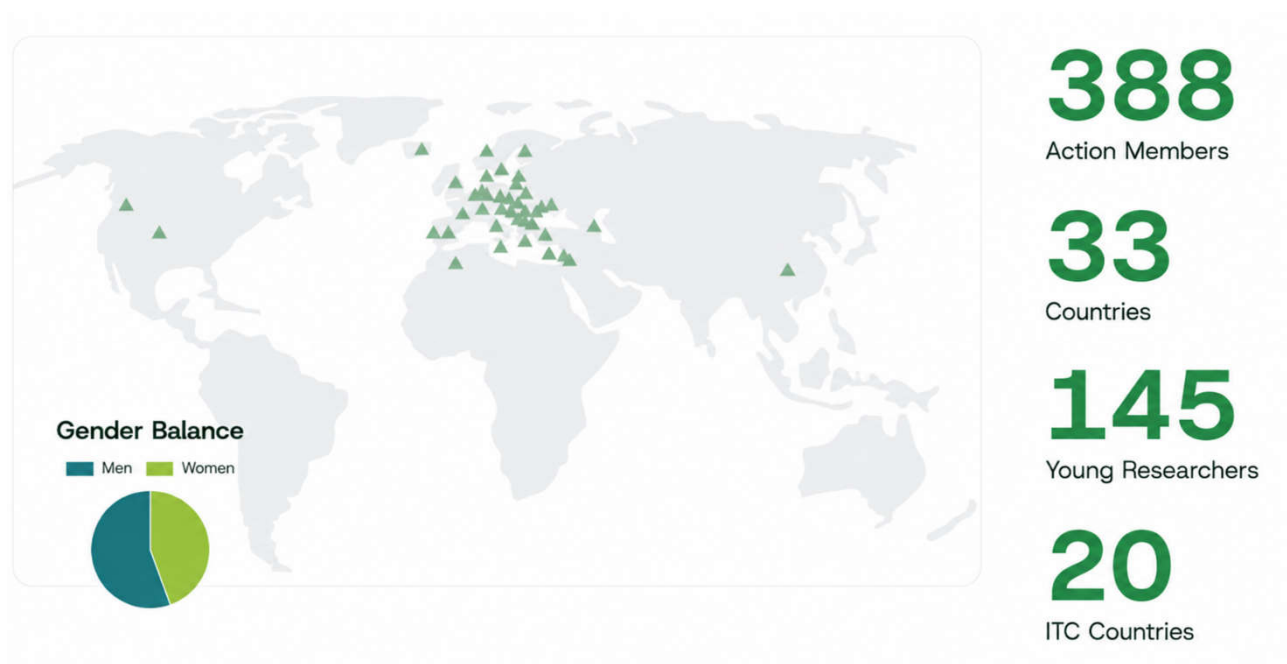
COST Action INTUF CA23148 (Urban Forestry Network) aims to promote a sustainable, inclusive, and science-based approach to urban forestry across Europe. The Action brings together researchers, practitioners, policymakers, and stakeholders to strengthen collaboration and knowledge exchange in urban forest planning, management, and governance.

INTUF supports integrative and long-term approaches to urban forestry through improved assessment, monitoring, and evidence-based management of urban forests. Through interdisciplinary collaboration and Working Group activities, the network promotes harmonization, capacity building, participatory approaches, and the development of innovative frameworks for resilient urban forest ecosystems.

The Action also contributes to European priorities related to climate adaptation, biodiversity, ecosystem services, and sustainable urban development, while fostering inclusiveness, young researcher involvement, and transnational cooperation across Europe.

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INTUF AT A GLANCE



Working Group 1

Assessing and monitoring the urban forest

Working Group 2

Strategic management: towards long-term, science-driven approaches in urban forestry

Working Group 3

Stewardship: building cross-sectoral and inclusive management partnerships

Working Group 4

Outreach and dissemination

PROGRAMME

Monday 27 April Management Committee meeting	
8:30-9:00	Registration
9:00-9:10	Welcome by Burdur Mehmet Akif Ersoy University. (<i>Cengiz Yücedağ</i>)
9:10-9:40	Welcome Antalya City
9:40-10:30	Action CA23148 Introduction, Period 1 and 2 (Tomáš Goga)
10:30-11:00	COFFEE
11:00-12:00	KEYNOTE SPEAKER: Pascal Verheye , (Flanders Innovation & Entrepreneurship VLAIO). <i>Online “Information session on Horizon Europe”</i>
12:00-12:45	Communication (Ana Macias) and Grants. (Malgorzata Kacprzak)
13:00-14:00	LUNCH
14:00-14:30	WG1: Progress and activities (Dimitrios Fotakis)
14:30-15:00	WG2: Progress and activities (Cengiz Yücedağ)
15:00-15:30	COFFEE
15:30-16:00	WG3. Progress and activities (Claudia Menéndez)
16:00-16:30	WG4. Progress and activities (Alexandru Petrisor)
16:30-17:00	MC Meeting Closure (Tomáš Goga)

PROGRAMME

Tuesday 28 April Working Groups meeting	
8:30-9:00	Registration
9.00-10:00	KEYNOTE: Prof. Thomas Randrup “From Maintenance to Strategic Management of Urban Forests.”
10:00-10:30	COST Action objectives and plans (Dieter Anseeuw)
10:30-11:00	COFFEE
11:00-11:30	Overview General Surveys (Ana Macias, Gerd Lupp, Naomi Zürcher)
11:30-12:30	WG 1 Meeting (Kieron Doick-Dimitris Fotakis) Task 2.1 (Leonia Nunes, Dimitris Fotakis)
12:30-13:00	WG 2 Meeting (Cengiz Yücedağ- Martina Dell'Unto) Task 1: (Anna Codemo) <i>online</i>
13:00-14:00	LUNCH
14:00-15:00	WG 2 Meeting (Cengiz Yücedağ- Martina Dell'Unto) Task 2: (Eugene McGee) <i>online</i> Task 3: (Veronika Andrea) <i>online</i> Task 4: (Malgorzata Kacprzak) Task 5: (Liina Jürisoo)
15:00-16:00	WG 3 Meeting (Claudia Menéndez-Dimitris Athanassiadis) Task 1: (Gerd Lupp, Lazar Pavlović) Task 2: (Barbara Darr, Naomi Zürcher) Task 3: (Selim Bayraktar, Ieva Misiüne) Task 4: (Philip Chambers, Ana Macias)
16:00-16:30	COFFEE
16:30-17:15	WG4 Meeting (Alexandru Petrisor)
19:00	SOCIAL DINNER

PROGRAMME

Wednesday 29 April Annual Conference	
8:15-8:30	Registration
8:30-9:30	KEYNOTE: Naomi Zürcher <i>"Growing the Urban Forest's Stakeholder Capacity: Exploring the Art and Science of Participatory Management"</i>
9:30-10:30	Topic 1: REMOTE SENSING AND KEY PERFORMANCE INDICATORS (KPI) (Chair: Kieron Doick) Antonis Kavvadias <i>"Integrated UAS, Satellite and Ground Microclimate Monitoring of Urban Vegetation Performance in Mediterranean Parks"</i> Ibrahim Öztürk <i>"Automated LiDAR-Based Environmental Mapping for Optimizing Digital Infrastructure in Urban Forest Management Facilities"</i> Turgay Dindaroğlu <i>"Paraecology and AHP-Based Participatory Urban Green Belt Management (Kahramanmaraş Green Belt Case Study)"</i> Ling Yang <i>"Linking Extreme Climate Events to Functional KPIs for Urban Forest Management"</i> Murat Sargıncı <i>"Climate Smart Urban Forestry"</i>
10:30-11:00	COFFEE
11:00-12:00	Flash Posters Presentations (Chair: Ana Macias) Irfan Abbas <i>"UrbanTreeViT-Net: A Hybrid Vision Transformer and U-Net Framework for Urban Tree Segmentation from Remote Sensing Imagery"</i> Ece Çalışkan Altınok <i>"Evaluating Urban Forestry Performance through Key Indicators and Public Participation: The Case of Bilecik, Türkiye"</i> Saman Shokrpour <i>"Botanical Gardens and Green Façades as Urban Living Labs: A KPI Framework for Nature-Based Solutions in Urban Forest Management Plans"</i> Sasa Orlovic <i>"Towards integrated key performance indicators for nature-based solutions and green infrastructure: A multidisciplinary urban forestry framework from Novi Sad (Serbia)"</i> Parisa Günes <i>"Enhancing Climate-Resilient Urban Forest Landscapes in Mediterranean Cities: Soil-Based Indicators, Adaptive Planning Methods, and Ecological Outcomes"</i> Murat Yilmaz <i>"Valorization of Urban Forest Biomass into Activated Carbon: A Circular Bioeconomy Approach for Urban Forest Management Plans"</i> Bulent Ozel <i>"gAla Giving Trees a Voice: An Agent-Based Urban Ecosystem Modelling Augmented with Generative AI"</i>
12:00-13:30	Visit: Antalya Municipality in Atatürk Kültür Park
13:30-14:30	LUNCH
14:30-15:30	Topic 2: LOCAL GOVERNANCE AND MUNICIPALITIES EXAMPLES (Chair: Cengiz Yücedağ) Vladimir Stojanovski <i>"Citizen perception, use intensity and governance implications of urban green spaces: Evidence from Skopje City Park"</i>

	Marija Perkunic <i>“Engaging Small Cities and Towns in Urban Forestry Capacity Building: Strengthening Local Governance through Multi-Stakeholder Partnerships”</i> Antonella Cristofori <i>“Air biodiversity and ecosystem services of urban green el The AirBiD project”</i> Ieva Misiune <i>“Perceived Effects of Nature Therapy across Urban and Non-Urban Forest Types: The Role of Forest Characteristics”</i> Gerd Lupp <i>“More than Green: Stakeholder Engagement and Co-Creation of NbS – Insights from the Horizon Europe Project TRANS-lighthouses”</i>
15:30-16:00	COFFEE
16:00-17:30	Ideation Workshop: Urban Forest Stakeholders and Communication tools (WG3)

Note: The programme reflects the original schedule, while the abstracts are organised according to the actual presentation sessions.

PROGRAMME

Thursday 30 April Annual Conference	
8:15-8:30	Registration
8:30-9:30	Topic 3: COMMUNICATION AND CAPACITY BUILDING (Chair: Claudia Menéndez) Besa Shahini <i>“Capacity Building for Urban Forestry in Small Cities and Towns. Institutional Constraints, Participatory Pathways, and Planning Outcomes”</i> Pedro Obregon Santander <i>“From Ladders to Choices: Linking Participation Theory to Residents' Preferences in Urban Green Space Governance”</i> Milutin Milenković <i>“Tree-Quest: A Free App for Measuring Urban Tree Attributes for Biomass and Carbon Assessment”</i> Dimitris Athanassiadis <i>“Advancing inclusive, cross-sector collaboration in urban forest governance in North Sweden”</i>
9:30-11:30	Workshop. “7 Glasses”- lessons for urban forestry. (WG1)
11:30-12:00	COFFEE
12:00-12:30	Workshop. “7 Glasses”- lessons for urban forestry. (WG1)
12:30-13:30	Topic 4: Urban Forest Planning, Management and Development (Chair: Alexandru Petrisor) Todor Stoyanov <i>“Management of urban forests, green areas, parks and suburban forests in Sofia”</i> Itziar Aurora Montalbán (online) <i>“Biotechnology for Greener Cities: The Role of Plant Tissue Culture in Urban Forest Development”</i> Anna Codemo (online) <i>“Insights from a content analysis of urban forest management plans among European municipalities”</i> Martina Dell'Unto <i>“Feasibility mapping for Urban Tree Planting: A scenario analysis applied to Antalya”</i>
13:30-14:00	CLOSURE (Dieter Anseeuw)
14:00-14:30	LUNCH
15:00-16:30	Training of trainers. Citizen science inventory TreeQuest, (with Antalya municipality) (WG2)

Note: The programme reflects the original schedule, while the abstracts are organised according to the actual presentation sessions.

KEYNOTE SPEAKERS



Pascal Verheye

Horizon Europe National Contact Point at NCP Flanders, specialising in research funding opportunities and guidance on European project applications.



Thomas Randrup

Professor specialising in urban forestry and NbS governance.



Naomi Zürcher

Naomi Zürcher is a practising Urban Forester, Consulting Arborist, Chartered Environmentalist, an affiliate member of the i-Tree team and a Board Trustee of the Arboricultural Assn UK with 4+ decades of professional experience in her native New York and now in Switzerland. Her work has spanned the full range of Urban Forestry planning and management, covering practice, education and applied research.

KEYNOTE SPEAKER

From maintenance to strategic management of urban forests

Thomas Randrup

ABSTRACT

Urban forestry in Europe has evolved from a focus on individual trees, public parks and maintenance into a broad, interdisciplinary field concerned with the planning, governance and long-term development of urban landscapes. Originating in the nineteenth-century public park movement, urban green spaces have increasingly become recognised as essential infrastructure for addressing societal needs. Today, urban forests are expected to contribute simultaneously to climate adaptation, biodiversity, recreation, health, social inclusion and urban liveability.

European urban forestry research has developed accordingly. COST Action E12 Urban Forests and Trees around the turn of the millennium helped establish urban forestry as a European scientific field. Since then, research has expanded from trees and their management towards ecosystem services, green infrastructure, climate adaptation, human health, environmental justice, governance and Nature-based Solutions (NbS). The current COST Action CA23148, INTUF, represents a further step towards an integrated and strategic approach to urban forestry.

This development requires a rethinking of management. Rather than regarding maintenance as an activity that follows planning and design, strategic management understands urban landscapes as continuously evolving. Management consequently encompasses (re-)planning, (re-)design, (re-)construction and maintenance. This shifts management from a largely operational activity to a strategic practice based on adaptation, monitoring, learning, governance and engagement with users.

Nature-based Solutions have reinforced the role of nature in addressing urban challenges, but they can also encourage a human-centred understanding of nature as a provider of specific services or technical solutions. Nature-based Thinking (NbT) offers a broader perspective: a problem-solving mindset that regards nature and humanity as inseparably connected. It positions cities as social-ecological systems rather than places where nature is simply added to solve particular problems.

The future of urban forestry therefore lies in moving from maintaining green assets to strategically managing living landscapes, integrating ecological processes, human needs, professional knowledge and governance in their continuous development.

KEYNOTE SPEAKER

Growing the urban forest's stakeholder capacity: Exploring the art and science of participatory management

Naomi Zürcher

ABSTRACT

The Urban Forest, an ecosystem consisting of urban tolerant forest trees and associates - related flora, fungi, fauna, soil, water plus humans and our built environment – in total, an URBAN ecosystem in which the speed of development combined with our population demands, imposes a dynamic on our urban trees that challenges the planning and management of this vital resource and the accommodation of their essential needs.

While our urban trees have found ways to deal with what the built environment inflicts on them, they are not invincible. Although research has made extraordinary advances in the practices that address and mitigate the challenges, the challenges persist. Thus, the human dynamic requires a much more inclusive planning and management approach – a collaborative capacity-building effort between interdisciplinary professionals and informed residents that sustains and supports the needs of our urban trees and their non-human associates which in turn, sustains and supports human well-being.

In the five decades that Urban Forestry has existed as a philosophy, an area of study and a profession, we have amassed many science-based participatory management strategies that GROW informed capacity - strategies that have been put to the real world test and have translated into positive outcomes for our trees and all their associates.

And while capacity building is defined as the improvement in an individual's or organization's capability to produce, perform or deploy, does capacity building and the definition put forward really express what is required of us to engage, inspire, inform and motivate stakeholder participation? Since the foundation of our COST focus is networking the LIFE between the buildings with the LIFE inside the buildings, this presentation explores the art and science of GROWING the capacity that supports and sustains the entire ecosystem.

ABSTRACTS – ORAL PRESENTATION

TOPIC 1: REMOTE SENSING AND KEY PERFORMANCE INDICATORS (KPI)

Chair: Kieron Doick

Presenters:

Antonis Kavvadias- “Integrated UAS, Satellite and Ground Microclimate Monitoring of Urban Vegetation Performance in Mediterranean Parks”

İbrahim Öztürk- “Automated LiDAR-Based Environmental Mapping for Optimizing Digital Infrastructure in Urban Forest Management Facilities”

Ling Yang-“Linking Extreme Climate Events to Functional KPIs for Urban Forest Management”

Integrated UAS, satellite and ground microclimate monitoring of urban vegetation performance in Mediterranean parks

Antonis Kavvadias^{1*}, Emmanouil Psomiadis¹

¹ *Agricultural University of Athens, Greece*

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ABSTRACT

Urban green areas are increasingly recognized as critical infrastructures for climate adaptation, yet operational and standardized assessment approaches remain limited across European cities. This presentation introduces an ongoing high-resolution monitoring framework applied in a Mediterranean urban park in Athens, Greece, integrating UAS-derived products, Copernicus Sentinel multispectral data, and ground-based microclimate measurements.

RGB and multispectral indices (e.g. NDVI), thermal mosaics, Digital Surface Models, and LiDAR-derived 3D Point Clouds of vegetation structure enable the characterization of vegetation vigor condition, spatial variability in park surfaces temperatures and canopy structure and density. These datasets are combined with in-situ air temperature and microclimatic recordings to explore localized cooling dynamics under Mediterranean summer heatwave conditions.

GIS-based raster workflows (canopy delineation, zonal statistics, structural metric extraction, spatial overlay analysis) and exploratory statistical approaches support the investigation of structural–thermal relationships and cross-scale integration within the trinity of ground, drone and satellite data.

Drawing on existing urban forestry KPI frameworks in the literature, the study discusses how multi-source datasets deriving from State-of-the-Art drones, sensors and photogrammetric SW can contribute to the quantification of indicators related to canopy structure, cooling performance, and resilience of Urban Green Areas. The ongoing case highlights the potential of integrated monitoring systems to support evidence-based urban vegetation and peri-urban forest management and benchmarking in Mediterranean contexts.

Keywords: urban vegetation, UAS, thermal imagery, microclimate monitoring

Automated LiDAR-based environmental mapping for optimizing digital infrastructure in urban forest management facilities

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ABSTRACT

As European cities integrate Urban Forest Management Plans (UFMPs) into smart city frameworks, the need for robust digital infrastructure within municipal and park management facilities has become critical. Efficient management of urban forests relies on real-time data transmission from IoT sensors and seamless connectivity for stakeholders. However, signal propagation in complex indoor-outdoor administrative environments is often hindered by structural obstacles, leading to "dead zones" that disrupt data flow. This study presents an automated, LiDAR-assisted solution for environmental mapping and wireless network optimization, originally validated in a Q1-ranked journal study (Ozturk & Payal, 2026). By utilizing Point Cloud (PC) data captured via consumer-grade LiDAR sensors, we propose a method to automatically detect structural boundaries (walls and partitions) and classify their impact on Wi-Fi 6 and Wi-Fi 7 signal behavior. Our model achieved high predictive accuracy, with Mean Absolute Error (MAE) values as low as 1.8 dB for the 2.4 GHz band. We demonstrate how this technology can be utilized as a "knowledge tool" for municipal representatives to build capacity in urban forest administration. By eliminating the need for manual architectural inputs, this approach allows for the rapid deployment of optimized communication hubs in diverse park facilities. The integration of such automated mapping tools supports the conference's goal of advancing practical tools for UFMPs, ensuring that the digital layer of urban forest management is as resilient and well-planned as the green infrastructure it supports.

Keywords: LiDAR, RSSI, signal propagation, Wi-Fi coverage, urban forest management

Acknowledgements

This work was supported by the AIoT Research Laboratory. The authors would also like to acknowledge the Scientific and Technological Research Council of Türkiye (TÜBİTAK) for their support under the ARDEB 1001 programs (Project No: 124E283).

References

I. Ozturk and E. Payal, (2026), "Automated Environment Mapping Using LiDAR for Optimal Wi-Fi 6 and Wi-Fi 7 Router Placement," in IEEE Access, DOI: 10.1109/ACCESS.2025.3649991.

Linking extreme climate events to functional KPIs for urban forest management

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ABSTRACT

Urban forest management under increasingly frequent climate extremes requires functional key performance indicators that capture ecosystem resistance and resilience. However, such indicators remain poorly defined for extreme heat and atmospheric drought. This study proposes a standardized framework to identify heatwave and vapour pressure deficit drought events and quantify associated ecosystem carbon responses. Using eddy-covariance observations and Earth Observation-derived indicators from 70 mid- to high-latitude Northern Hemisphere Forest sites, we examined the biotic, abiotic, and climatic controls of carbon anomalies during extreme events.

The results show that heatwave responses are strongly linked to local buffering capacity, including canopy height, long-term leaf area index, fraction of absorbed photosynthetically active radiation, and soil available water capacity. These factors highlight the role of canopy structure, vegetation density, and soil water retention in reducing carbon losses. In contrast, atmospheric drought responses are mainly governed by broader climatic gradients, particularly mean annual temperature and latitude.

These findings provide a basis for functional KPIs in climate-resilient urban forest management, suggesting that heatwave adaptation should prioritize canopy development and soil water buffering, while atmospheric drought requires broader strategies for moisture regulation, drought tolerance, and long-term climate adaptation.

Keywords: urban forest management, climate extremes, functional KPIs, heatwave, atmospheric drought

ABSTRACTS – ORAL PRESENTATION

TOPIC 2: LOCAL GOVERNANCE AND MUNICIPALITIES EXAMPLES

Chair: Cengiz Yücedağ

Presenters:

Turgay Dindaroglu - “Paraecology and AHP-Based Participatory Urban Green Belt Management (Kahramanmaraş Green Belt Case Study)”

Vladimir Stojanovski - “Citizen perception, use intensity and governance implications of urban green spaces: Evidence from Skopje City Park”

Marija Perkunic - “Engaging Small Cities and Towns in Urban Forestry Capacity Building: Strengthening Local Governance through Multi-Stakeholder Partnerships”

Anna Codemo - “Insights from a content analysis of urban forest management plans among European municipalities”

Martina Dell'Unto - “Feasibility mapping for Urban Tree Planting: A scenario analysis applied to Antalya”

Todor Stoyanov – “Management of urban forests, green areas, parks and suburban forests in Sofia”

Dimitris Athanassiadis - “Advancing inclusive, cross-sector collaboration in urban forest governance in North Sweden”

Paraecology and AHP-based participatory urban green belt management

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ABSTRACT

Green belts in cities are critical landscape components in terms of ecological continuity, climate resilience, and social well-being; however, they are increasingly losing their function due to rapid urbanization, infrastructure pressure, and administrative fragmentation. This process is often evaluated solely through spatial and biophysical indicators, excluding local knowledge and experience from decision-making processes. Yet, urban forestry is a socio-ecological system shaped by local experience, daily use practices, and social ownership, as well as scientific expertise. This study is based on the assumption that green belt fragmentation occurs not only physically but also at the levels of knowledge, governance, and social belonging. Kahramanmaraş, as the study area, is located in a semi-arid-Mediterranean transition zone where drought, soil degradation, rapid urbanization, and post-earthquake reconstruction pressures coexist. The methodology is based on a multi-actor and multi-source approach. Ecological fragmentation, ecosystem continuity, potential for social participation, and administrative feasibility criteria were determined through joint assessments by scientists, local administrators, and neighborhood stakeholders, weighted using AHP (Analytic Hierarchy Process), and transformed into priority maps in a GIS environment. In this context, the study adopts the paraecology approach as its theoretical framework. Paraecology is an approach that argues that local and experiential knowledge is of equivalent value to scientific knowledge, and questions expert-centered knowledge production. The research aims to establish a functional bridge between scientific knowledge and communities of practice by integrating the paraecological approach with an AHP-GIS-based Participatory Urban Green Belt Fragmentation Decision Support System. The results show that green belt fragmentation stems not only from spatial disconnections but also from low social ownership, institutional fragmentation, and insufficient reflection of local knowledge in decision-making processes.

Keywords: paraecological approach, epistemic bridging, decision-making, urban forest governance, landscape fragmentation, socio-ecological systems

Citizen perception, use intensity and governance implications of urban green spaces: Evidence from Skopje City Park

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ABSTRACT

Urban green spaces are increasingly recognized as essential components of resilient and livable cities. Harmonizing urban forest management across Europe requires understanding how citizens perceive, use, and value these spaces. In the context of Skopje, where formal urban green space management plans are lacking, this study explores the significance and perception of Skopje's City Park through a structured online survey conducted in October 2025 with 98 respondents.

Results indicates a high level of awareness: 95% of respondents regularly visit green spaces, while 96% evaluate them as highly significant for urban life. Moreover, 88% strongly agree that green spaces substantially improve public health. Frequency of use correlates with perceived importance: 96% of respondents visiting more than eight times per month rate green spaces as "very significant," compared to 74% among less frequent visitors. The findings indicate that frequency of use significantly strengthens perceived importance, while satisfaction and accessibility directly influence civic support for future investments.

Most respondents access the park on foot of within short travel time, confirming its strong local character. Reported shortcomings primarily relate to infrastructure and maintenance rather than questioning the intrinsic value of green spaces. This suggests that citizens do not question the importance of urban nature, but rather the quality of its management.

The study demonstrates that the use intensity strengthens ecological awareness, satisfaction fosters governance legitimacy, and accessibility shapes emotional attachment. These findings highlight the need to integrate citizen-driven monitoring, support evidence-based planning, and foster inclusive stewardship to guide urban green space management in Skopje and similar contexts.

Keywords: urban green spaces, citizen perception, use intensity, urban forest governance, South-East Europe

Engaging small cities and towns in urban forestry capacity building: Strengthening local governance through multi-stakeholder partnerships

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ABSTRACT

Urban forests play a significant role in delivering ecosystem services, fostering social cohesion, and enhancing quality of life in urban areas. However, effective planning and management of urban green spaces are often obstructed by structural, financial, and institutional limitations, particularly in small cities and towns. This paper explores the potential for enhancing capacity building in the domain of urban forestry through integrated collaboration between municipalities, non-governmental organisations (NGOs), and academic institutions.

The study is based on a case study of the Čačalica Memorial Park in Požarevac, Serbia, where a multi-stakeholder partnership was established. In 2020, the City of Požarevac introduced the Development Program and Management Basis for Čačalica Memorial Park. Due to limited implementation capacity, the management approach was expanded through the involvement of the environmental association “Friends of Čačalica”. The NGO supports park maintenance through volunteer engagement, planting and pruning activities, and environmental education aimed at raising public awareness. The collaboration with the Academy of Applied Studies Polytechnic, a local higher education institution, has further strengthened knowledge production through biodiversity surveys conducted by academic staff, with the results disseminated at scientific conferences. This collaborative governance model enhances knowledge exchange, public participation, and institutional responsibility, contributing to sustainable urban forest management and long-term preservation. The findings provide transferable lessons for small cities and towns seeking to strengthen urban forestry capacity as part of broader climate adaptation and biodiversity conservation strategies.

Keywords: urban forestry, capacity building, multi-stakeholder partnership, environmental education, ecosystem services

Acknowledgements

The author gratefully acknowledges the support provided by the Ecological Society “Friends of Cacalica”, which contributed to this work.

Insights from a content analysis of urban forest management plans among European municipalities

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ABSTRACT

In the context of environmental challenges and urbanisation, many cities have developed agendas to increase the number of urban trees and improve their quality. Given their relationship with the built environment, urban trees are an integral part of urban planning and require careful management to provide community benefits and define technical management approaches. This process includes appropriate documentation describing policies and practices. However, despite common targets and goals being shared at the European level, there is currently no shared structure for assessing, planning and managing urban forests. Furthermore, compared to North America and other international contexts, research on urban forest management plans remains limited in Europe. This study investigates to which extent the planning and management of urban trees is harmonized across European countries. To this end, 219 plans from 166 cities in 32 countries are analysed and compared. Several aspects of the plans are investigated through content analysis extracted from the documents, including the context in which they were developed (e.g. year, city size, author), their target and scope (e.g. green asset included and their conceptualization), their purpose as a policy instrument to achieve political priorities and common aims (e.g. types of plans and management functions), and the indicators used to plan and monitor the urban forests. Textual data from the urban forest management plans were analysed using qualitative content analysis. Content was extracted from the plans either relying on the explicit mention of a term or concept or through interpretation. The extracted data was then compiled into a database, organised into categories, and compared using qualitative methods. The findings provide insights into the approaches, limitations, and best practices across case studies. Moreover, the study may inform the work of future researchers and practitioners working on urban trees at the local level.

Keywords: urban forest, urban trees, urban forest planning and management, content analysis, urban forest management plans

Acknowledgements

This research is supported by the European Cooperation in Science and Technology (COST) Action CA23148, the European Network for the Integrative Approach of Urban Forestry (INTUF), and was carried out by WG2 Task 1 researchers. The dataset is publicly available: <https://doi.org/10.5281/zenodo.17941191>.

Feasibility mapping for urban tree planting: A scenario analysis applied to Antalya

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ABSTRACT

Nature-based solutions play a key role in supporting the sustainable transition of cities and mitigating the impacts of climate change. Urban renaturalization has proven effective in reducing the urban heat island effect, while urban forests represent a relevant nature-based strategy due to the ecosystem services they provide. These services are particularly crucial for addressing the increasing demand for climate adaptation in urban environments. This study investigates how scenario mapping of increased urban tree cover can support urban systems that contribute to emission reduction and sustainable transition goals. Within the framework of POSEIDON, a European project, a district of the city of Antalya was selected as a case study to evaluate the feasibility of implementing urban tree-planting strategies. The mapping approach integrates satellite data with simulation data to identify areas most in need of additional tree planting. The findings provide evidence-based insights to guide local authorities in planning, prioritizing, and forecasting future urban greening interventions. This map can also support the development of citizen science activities, such as Urban Living Lab workshops, aimed at raising public awareness and engagement in tree stewardship. Overall, this work contributes to more climate-resilient and sustainable urban development by identifying feasible and high-priority locations for expanding urban tree cover.

Keywords: urban tree planting, scenario analysis, nature-based solution, urban greening, urban resilience

Acknowledgements

This research was carried out as part of the POSEIDON project (PCI2023-145997-2), which is funded by the MICIU/AEI/<https://doi.org/10.13039/501100011033>. The project is part of the Driving Urban Transitions Partnership, which has been co-funded by the European Commission.

Management of urban forests, green areas, parks and suburban forests in Sofia

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ABSTRACT

As the largest urban center in Bulgaria, Sofia provides a particularly relevant case for examining the interaction between urban expansion and the preservation of natural resources.

This study analyzes the regulatory, institutional, and practical framework governing the management of green areas in Sofia. It aims to identify the key challenges and opportunities for improving the sustainability and effectiveness of green space management.

The methodology is based on a review of legislative documents, strategic planning frameworks, institutional arrangements, and statistical data. An analytical approach is applied to assess the coherence between planning policies and their implementation.

The results indicate that Sofia possesses a relatively well-developed green system, covering 51% of the municipal territory, with woody vegetation about 31%. Central districts benefit from well-maintained parks, whereas peripheral neighborhoods often experience insufficient maintenance and limited green infrastructure.

The analysis identifies challenges as strong development pressure, fragmented institutional responsibilities, limited funding, insufficient monitoring systems, and increasing risks with climate change. Positive trends are ongoing park renovations, expansion of green corridors, and strategic initiatives aimed at improving connectivity within the urban green network.

The study concludes that improving the management of Sofia’s green system requires a long-term strategy, institutional coordination, the application of innovative technologies, and active engagement of citizens. These measures are essential for strengthening urban resilience and improving quality of life.

Keywords: urban green areas, parks, urban forests, Sofia, sustainable management

Advancing inclusive, cross-sector collaboration in urban forest governance in North Sweden

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ABSTRACT

Urban forest managers cannot afford to ignore stakeholder perceptions, expectations, and preferences. Communication must function in two directions: from cities, municipalities, or private forest owners to stakeholders, and from stakeholders back to decision-makers. In practice, a purely top-down approach to urban tree management frequently leads to resistance, formal objections, activist groups, and negative attention in social and traditional media.

At the same time, effective communication is vital for helping stakeholders understand the substantial contribution that both publicly and privately owned urban forests make to building climate-resilient cities. Good stewardship therefore requires several levels of interaction:

- a) one-way communication, such as education, capacity building, and guidelines;
- b) two-way dialogue among stakeholders; and
- c) active community participation in collaborative decision-making and citizen science.

This presentation discusses findings from a survey of municipalities in northern Sweden, focusing primarily on challenges related to communication among the actors involved in urban forestry.

Urban forest ownership in the region is largely concentrated in municipalities. Although management is generally active, it is constrained by limited resources, conflicting objectives, and a lack of guidance tailored specifically to urban settings. Stakeholder opposition commonly relates to insufficient knowledge, perceived safety risks, expectations of an unchanged landscape, and reactions to logging operations.

Drawing on the survey results, we introduce distinct frameworks for strengthening stakeholder participation in urban forest management, each based on well-established principles of governance and public engagement.

Keywords: stakeholder engagement, urban forest management, communication

ABSTRACTS – ORAL PRESENTATION

TOPIC 3: COMMUNICATION AND CAPACITY BUILDING

Chair: Claudia Menéndez

Presenters:

Besa Shahini - "Capacity Building for Urban Forestry in Small Cities and Towns. Institutional Constraints, Participatory Pathways, and Planning Outcomes"

Pedro Obregon Santander - "From Ladders to Choices: Linking Participation Theory to Residents' Preferences in Urban Green Space Governance"

Milutin Milenković - "Tree-Quest: A Free App for Measuring Urban Tree Attributes for Biomass and Carbon Assessment"

Capacity building for urban forestry in small cities and towns: Institutional constraints, participatory pathways, and planning outcomes

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ABSTRACT

Urban forestry is increasingly recognized as a route to climate adaptation, public health, and biodiversity in European cities. Yet most tools and planning guidance target large municipalities. Small cities and towns work with thin technical teams, short budget cycles, and overlapping mandates. In this setting, capacity building is often reduced to training. This paper argues that capacity is institutional and relational embedded in rules, routines, trust, and the ability to turn participation into decisions that survive electoral shifts. The study asks: Which institutional constraints most limit urban forestry planning in small municipalities? Which participatory pathways help overcome them? How do these choices shape planning outcomes such as plan quality, implementation readiness, and legitimacy? We use a mixed-method design across small European municipalities. First, we map institutional conditions through document analysis and expert input. Second, we classify participation pathways, from consultation to co-creation, examining who participates and who is excluded. Third, we assess outcomes using rubric capturing strategic coherence, cross-sector integration, equity, and monitoring. We expect three patterns: bottlenecks cluster around coordination failures, not technical skills alone; participation improves outcomes when tied to decision points and shared responsibilities; low-cost templates and peer networks work best when aligned with administrative rhythms. The paper offers a grounded framework and actionable implications for researchers and practitioners.

Keywords: urban forestry, capacity building, small cities and towns, participatory planning, local governance

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From ladders to choices: Linking participatory theory to residents' preferences in green space governance

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ABSTRACT

Citizen and stakeholder participation is increasingly promoted as essential for improving the governance of natural resources and urban commons, yet "participation" varies widely in the degree of power actually shared and the governance benefits it delivers. This paper links a conceptual analysis of participation ladders and natural resource management (NRM) governance principles to an empirical discrete choice experiment (DCE) examining preferences for participation in urban green space (UGS) management in Umeå, Sweden. Drawing on peer-reviewed case studies, we first examine how increasing levels of participation shape the realization of key governance principles. The synthesis reveals that lower participation levels generally provide limited support for effective governance, while mid-range levels represent a threshold at which participation begins to meaningfully improve governance outcomes. At the highest levels, participation can strengthen legitimacy and sustainability-oriented governance, though it may also introduce trade-offs where institutional capacity is weak or coordination costs are high. We then operationalize these insights through a DCE testing residents' willingness to participate in planning and decision-making for UGS management in a rapidly growing, demographically diverse city. Results reveal substantial preference heterogeneity: a sizeable share of residents (45%) prefers low-commitment participation formats, indicating that highly demanding or time-intensive designs risk excluding significant portions of the population and undermining inclusiveness. Together, the two analyses underscore that participation is not inherently beneficial; rather, outcomes depend on matching the degree and form of participation to local institutional capacity, coordination constraints, and diverse citizen preferences. We therefore argue for differentiated and adaptive participatory frameworks that combine accessible, low-barrier entry points with targeted opportunities for deeper influence — enabling planners to balance inclusivity with governance effectiveness and support equitable, sustainable management of shared green spaces.

Keywords: participation, governance, urban commons, power, sustainability

Tree-Quest: A free app for measuring urban tree attributes for biomass and carbon assessment

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ABSTRACT

Quantifying single-tree structural attributes, such as diameter and height, is essential for managing urban forests and monitoring climate adaptation efforts in cities. Yet urban tree-level structural data are often outdated or absent. Citizen science offers a scalable solution by mobilizing residents to collect standardized ground measurements that complement expert-led forest inventory (FI) and remote sensing-derived attributes. We present Tree-Quest (TQ), a free mobile app designed to engage citizen scientists in measuring single-tree attributes, including diameter at breast height (DBH), tree height (TH), and species. The app uses the mobile phone's augmented reality capabilities to measure DBH and TH interactively and integrates the Pl@ntNET API for tree species identification. Validation using over 700 single tree measurements across two urban parks in Austria showed that the app's relative mean absolute error was 6% and 11% for DBH and TH, respectively, compared with traditional FI tools. TQ measurements also agreed with those from other mobile applications and with estimates derived from terrestrial laser scanning. The app has already demonstrated strong potential for citizen engagement during a citizen science campaign in 2025, when over 250 participants contributed more than 1,200 single tree records just in six months, primarily from Austria, with additional submissions worldwide. TQ also captures auxiliary data and implements quality control checks, enabling the curation of non-standardized citizen measurements. These capabilities provide a practical, scalable pathway for crowdsourcing single tree measurements in urban settings and for improving carbon mapping.

Keywords: crowdsourcing, augmented reality, urban trees, aboveground biomass

Acknowledgements

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ABSTRACTS – ORAL PRESENTATION

TOPIC 4: Urban Forest Planning, Management and Development

Chair: Alexandru Petrisor

Presenters:

Murat Sarginci - *“Climate Smart Urban Forestry”*

Itziar Aurora Montalbán (online)- *“Biotechnology for Greener Cities: The Role of Plant Tissue Culture in Urban Forest Development”*

Antonella Cristofori-*“Urban green elements and the air biodiversity- the AirBiD project”*

Ieva Misiune-(online) - *“Perceived Effects of Nature Therapy across Urban and Non-Urban Forest Types: The Role of Forest Characteristics”*

Gerd Lupp - *“More than Green: Stakeholder Engagement and Co-Creation of NbS – Insights from the Horizon Europe Project TRANS-lighthouses*

Climate smart urban forestry

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ABSTRACT

Urban forests are increasingly affected by many factors, including rapid climate change and human-based ecological disturbances, in the Anthropocene era. There are still uncertainties for future climate projections, and the 5 socioeconomic trend scenarios range from limiting warming at 1.5°C to exceeding warming by 4°C. Therefore, there is still a need for further research on climate vulnerability in urban forests if responses are to be understood. With these uncertainties, maladaptive strategies worsen the climate impacts on urban forests. Climate-Smart Forestry (CSF), including urban forests, is a developing concept to help policymakers and practitioners develop focused forestry governance and management to adapt to and mitigate climate change. To be able to put Climate Smart Urban Forestry (CSUF) in context, it is important to know the evolution of our understanding of the importance of urban forests in the global climate. CSUF depends on three main thematic areas: 1) mitigation, 2) adaptation, and 3) social dimension and integrates the three dimensions of sustainable development (economic, social, and environmental). In this context, this study aims to reveal the scientific studies conducted on climate and climate change effects on urban forests both globally and in Türkiye, and the responses developed in recent years to understand the climate dependencies of urban forests. Furthermore, it aims to seek answers to questions such as how climate change is globally affecting urban forests and specifically Türkiye, what scenarios are used to combat the problem, and what the impact of climate change will be on urban forests.

Keywords: climate smart urban forestry, disturbance, forest management

Biotechnology for greener cities: The role of plant tissue culture in urban forest development

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ABSTRACT

Climate change has intensified abiotic (drought, extreme weather events and their consequences) and biotic stresses (pests such as insects, fungal or bacterial infections) suffered by urban vegetation. The solution to these problems lies usually in selecting different species or varieties, but the cultural value of a particular species or individual can impact the citizen's perception of the urban forest. In vitro culture offers solutions that include the generation and multiplication of plants better adapted to these stresses, or the rescue and conservation of others with ecological and/or cultural significance.

Some practical examples in which micropropagation is contributing to the conservation and establishment of vegetation with added value will be presented. For instance, in the Basque country (Spain) efforts are being carried out to clone individuals of *Ulmus laevis* from relict populations with the perspective of being reintroduced in urban and peri-urban areas. Furthermore, In Spain and Poland, tissue culture is being used to propagate ancient *Quercus robur* trees (300 to 800 years old) that were vulnerable due to their age or urban development; the cloned trees have been planted near their respective mother trees and later in locations such as schools and other meaningful places for citizens. These events were complemented by interactive talks to involve the community in these biotechnological approaches, as well as in the respect and care of these living monuments.

Keywords: in vitro, micropropagation, stress

Acknowledgements

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Air biodiversity and ecosystem services of urban green elements: The AirBiD project

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ABSTRACT

The air we breathe contains large amounts of biological particles such as bacteria, fungi, and pollen (the aerobiome), which can affect our health and well-being in many ways. Urban green elements, such as urban woodlands, parks, gardens, etc., play a fundamental role in shaping this invisible world. The aim of the AirBiD project (airbidproject.eu) is to find connections between green spaces, air biodiversity, and human well-being by building spatial and temporal biodiversity maps of five European cities.

The project started its fieldwork phase consisting of collecting samples of airborne biological particulate matter in the green spaces of Trento (IT), Vienna (AT), Évora (PT), Copenhagen (DK), and Gothenburg (SW), over a year. Sampling design involved the classification of green areas into 9 categories with the installation of 25 sampling points per city, according to a grid covering the entire urban area. Ground-based and satellite-based information on the quantity and diversity of vegetation in green areas of cities was also collected.

Local communities are involved in biodiversity outreach initiatives through workshops and events, and in data collection through citizen science approaches.

Aerobiological samples are analyzed using advanced DNA methods and conventional light microscopy analysis to characterize the aerobiome. Biodiversity data will be mapped and

modeled according to the FAIR principles, showing how green spaces influence air quality, biodiversity, well-being, and human health. The outputs will allow a scientific approach to the planning and management of more sustainable urban greenery, promoting human health, maximizing beneficial effects of NbS and air biodiversity, and minimizing the potential disservices. This will help guiding decision-making processes in urban green plans by policymakers and urban planners.

The AirBiD European partnership is funded by national organizations within the Biodiversa+ 2023-2024 Joint Call BiodivNBS call, “Nature-based solutions for biodiversity, human well-being and transformative change.

Keywords: aerobiome, NbS, wellbeing, biodiversity mapping, urban green plans

Perceived effects of nature therapy across urban and non-urban forest types: The role of forest characteristics

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ABSTRACT

Understanding how people experience (urban) forests with different ecological qualities is essential for biodiversity governance as urbanisation increases and natural spaces become key sites for emotional relaxation. This research examines how nature therapy is perceived in different forest types, considering location (urban vs. non-urban), age, type, and size, and investigates whether these characteristics affects the physical perception of nature, its aesthetic qualities, the feelings of meaningfulness experienced by individuals, etc.

The empirical basis of this study draws on a survey conducted during the summers of 2024, 2025. The survey captured participants' experiences of a forest bathing (Shinrin-yoku) session — a three-hour structured walk for 10–15 participants in the forest, designed to engage multiple senses and deepen connection with nature. The data were collected in situ—immediately after the forest bathing session. Approximately 20 sessions were implemented and over 200 responses collected from those who voluntarily agreed to participate in the survey. The activities were conducted in four distinct forest types: an urban park, an urban forest, a natural forest, and an old-growth forest. The last two were outside the city limits.

Preliminary findings show that forest characteristics significantly shape the experience. The location of the forest affected the sense of community—in the urban forest, a sense of community and connection with other participants was felt most strongly, and this difference was statistically significant. A sense of meaning (depth, majesty, astonishment), however, are closely linked to biodiversity-related features such as forest age, species composition, and degree of naturalness. The study highlights how the location of forest ecosystems and its features influence human experience and provides arguments for more protective and restoration-oriented forest governance.

Keywords: recreation, forest type, perception, forest bathing

More than green: Stakeholder engagement and co-creation in nature-based solutions – Insights from the Horizon Europe project TRANS-lighthouses

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ABSTRACT

Collaborative planning involving a broad range of stakeholders are increasingly applied for addressing environmental issues and achieving multifunctionality of solutions in the context of nature-based solutions (NbS) and Urban Forestry. Intense collaboration among different public and private actors is increasingly gaining relevance in environmental governance to overcome diverging interests, finding new pathways for solutions to solve problems, developing new innovative designs and creating ownership for solutions (EC, 2023).

The mission of the Horizon Europe Project TRANS-lighthouses is to create a deeper understanding of stakeholder involvement and co-creation processes to develop NbS in a better way. With a “More than Green” approach, TRANS-lighthouses create spaces to integrate and embrace the diversity of actors, institutions, knowledge(s), practices and values into co-creating NbS. Based on Living Labs for co-creating NBS (EC, 2023), the co-creation pathway following the main steps with co-diagnosis of the challenges to be addressed with NbS, co-design of solutions, their co-implementation, and co-monitoring of the solutions. Stakeholder engagement starts with identifying, mapping and identification of people to be engaged in co-creation processes from the very beginning. Following an inclusive approach, the intention is to give voice to marginalized, voiceless and underrepresented groups through respective approaches and design of co-creation processes (EC, 2025).

Keywords: nature-based solutions, stakeholder engagement, collaborative planning, co-creation, living labs

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Acknowledgements

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ABSTRACTS – POSTER PRESENTATION

Chair: Ana Macias

Presenters:

Irfan Abbas- “UrbanTreeViT-Net: A Hybrid Vision Transformer and U-Net Framework for Urban Tree Segmentation from Remote Sensing Imagery”

Sultan Ece Çalışkan Altınok “Evaluating Urban Forestry Performance through Key Indicators and Public Participation: The Case of Bilecik, Türkiye”

Saman Shokrpour “Botanical Gardens and Green Façades as Urban Living Labs: A KPI Framework for Nature-Based Solutions in Urban Forest Management Plans”

Sasa Orlovic “Towards Integrated Key Performance Indicators for Nature-Based Solutions and Green Infrastructure: A Multidisciplinary Urban Forestry Framework from Novi Sad (Serbia)”

Parisa Güneş “Enhancing Climate-Resilient Urban Forest Landscapes in Mediterranean Cities: Soil-Based Indicators, Adaptive Planning Methods, and Ecological Outcomes”

Murat Yılmaz “Valorization of Urban Forest Biomass into Activated Carbon: A Circular Bioeconomy Approach for Urban Forest Management Plans”

Bülent Özel “gAla Giving Trees a Voice: An Agent-Based Urban Ecosystem Modelling Augmented with Generative AI”

UrbanTreeViT-Net: A hybrid vision transformer and U-Net framework for urban tree segmentation from remote sensing imagery

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ABSTRACT

Urban forest monitoring is essential for sustainable urban planning, climate adaptation, and ecosystem service assessment; however, accurate individual tree segmentation remains challenging due to complex canopy structures and heterogeneous urban environments. To address these challenges, this study proposes UrbanTreeViT-Net, a hybrid deep learning model for urban tree segmentation from remote sensing imagery. The proposed architecture integrates a Vision Transformer (ViT) encoder to capture global contextual information with a convolutional neural network and U-Net–based decoder to preserve fine-grained spatial details and accurately delineate tree boundaries. A feature fusion mechanism combines global and local representations, enabling robust performance in complex urban scenes.

UrbanTreeViT-Net is evaluated on two benchmark datasets, DeepGlobe 2018 and GermanForest 2024, representing diverse forest and urban vegetation conditions. On the DeepGlobe 2018 dataset, the proposed model achieves a Dice score of 0.9118, an IoU of 0.9027, and an accuracy of 0.9561. On the GermanForest 2024 dataset, it attains a Dice score of 0.9369, an IoU of 0.9481, and an accuracy of 0.9309, demonstrating strong robustness and generalization across datasets. Future work will focus on integrating LiDAR data, cross-city validation, and deployment within automated urban forest monitoring and decision-support frameworks.

Keywords: urban tree segmentation, urban forest monitoring, remote sensing imagery, vision transformer, U-Net, hybrid deep learning, individual trees

Evaluating urban forestry performance through key indicators and public participation: The case of Bilecik, Türkiye

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ABSTRACT

Urban forestry is considered a fundamental component of green infrastructure within sustainable urbanization, as it enhances ecological resilience, supports quality of life, provides ecosystem services, and contributes to climate change mitigation. Effectively identifying the environmental, social, and economic contributions of urban forests requires systematic performance evaluation supported by public participation. However, particularly in medium-sized cities, comprehensive performance indicators and participatory governance approaches in urban forestry remain limited.

This study aims to evaluate urban forestry performance by jointly examining Key Performance Indicators (KPIs) and public participation, using Bilecik Province in northwestern Türkiye as a case study. Bilecik is characterized by a strong urban–forest interaction and a unique geographical position, as it extends across four regions and lies at the intersection of three phytogeographical zones—Mediterranean, Irano-Turanian, and Euro-Siberian resulting in high biological diversity and endemism.

A multi-dimensional KPI framework encompassing ecological, social, and governance-related indicators was developed. Data were analyzed using geographic information systems (GIS), local government documents, open-access spatial data, and a literature review. The findings indicate that urban forest areas in Bilecik have strong ecological sustainability potential; however, access to green spaces and the effectiveness of public participation mechanisms vary across different areas.

The study concludes that integrating KPI-based performance assessment with public participation offers a holistic and applicable framework for strengthening urban forestry management in medium-sized cities and provides a transferable model for similar urban contexts.

Keywords: urban forestry, key performance indicators, Bilecik

Botanical gardens and green façades as urban living labs: A KPI framework for nature-based solutions in urban forest management plans

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ABSTRACT

Urban Forest Management Plans (UFMPs) need clear indicators to plan, track and communicate how Nature-based solutions (NbS) and green infrastructure (GI) deliver ecosystem services. Botanical gardens are part of the urban forest mosaic and can operate as urban living labs: they host diverse flora, demonstrate habitat-based planting under real site constraints, and translate ecological knowledge into public learning. Innovative green façades can extend this living-lab logic to the building envelope and support UFMP targets in dense districts. This research proposes a literature-informed KPI framework to assess ecosystem-service benefits and trade-offs of habitat-based planting across botanical gardens and façade greening. Indicators focus on measurable attributes such as species composition, canopy cover and vegetation condition that drive ecosystem-service outcomes. KPI groups cover: (1) biodiversity and habitat representation (native/adapted species share, species richness, structural diversity); (2) regulating services and thermal comfort (canopy cover proxies, shaded hours, local ΔT cooling checks); (3) water and maintenance performance (irrigation-demand category, maintenance intensity, system reliability); (4) cultural services (interpretation assets, educational programming, participation proxies); and (5) risks/disservices (allergenicity screening, invasiveness risk, conflicts with infrastructure). The output is a concise KPI checklist and reporting template aligned with UFMP cycles, enabling comparison between sites and clearer communication of co-benefits and risks to managers and stakeholders, with a pathway to extend the same indicator logic to multifunctional façades.

Keywords: urban forestry, nature-based solutions, botanical gardens, KPIs, green infrastructure

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Towards integrated key performance indicators for Nature-based solutions and green infrastructure: A multidisciplinary urban forestry framework from Novi Sad (Serbia)

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ABSTRACT

Urban forests and green infrastructure are key nature-based solutions (NbS) for climate adaptation, air-quality regulation, biodiversity conservation, and human well-being. Effective planning requires robust, scalable Key Performance Indicators (KPIs) linking tree-level processes to ecosystem services. In line with COST Action INTUF, we present a multidisciplinary framework developed at the Institute of Lowland Forestry and Environment (ILFE, Serbia) for operationalising KPIs in urban forestry. Implemented in Novi Sad, a Danube city exposed to heat, drought, air pollution, and biological invasions, the framework integrates field monitoring, laboratory analyses, UAV and satellite remote sensing, and in situ digital sensing.

KPIs are structured into five domains.

- (1) Structural KPIs derived from UAV, LiDAR, and satellite data (tree height, crown dimensions, canopy connectivity) assess shading, cooling, and carbon storage.
- (2) Ecophysiological and biochemical KPIs include sap flow, chlorophyll fluorescence, spectral indices (NDVI, NDWI, PRI), dendrometers, IoT sensors, and biochemical stress indicators to evaluate vitality and resilience.
- (3) Biosecurity and forest health KPIs integrate pest, pathogen and tree stability monitoring, and molecular early-warning approaches for risk-based management.
- (4) Soil-atmosphere KPIs combine soil respiration, CO₂ fluxes, carbon sequestration, and soil metabarcoding to capture belowground processes and climate regulation.
- (5) BVOC KPIs assess species-specific emissions affecting human health and air quality, together with PAHs and PCBs as indicators of pollution pressure.

The framework supports evidence-based management, inclusive planning, and adaptive governance, strengthening urban forests as resilient NbS. This integrated approach enables harmonised monitoring across spatial and temporal scales, supporting future smart urban forestry planning and climate-resilient green infrastructure development in European cities in use.

Keywords: urban forestry, nature-based solutions (NbS), key performance indicators (KPIs), remote sensing, ecosystem services

Enhancing climate-resilient urban forest landscapes in Mediterranean cities soil-based indicators, adaptive planning methods and ecological outcomes

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ABSTRACT

Urban forests in Mediterranean regions face increasing pressure from climate-induced stressors such as heatwaves, drought, and soil salinity—factors that directly influence vegetation performance and long-term resilience. My research focuses on the interaction between soil constraints, land-use dynamics, and ecological functioning in dryland and salt-affected landscapes, generating evidence that can guide climate-adaptive planning in urban contexts.

This contribution presents an integrated methodology combining soil quality assessment, eco-hydrological evaluation, and geospatial analysis to determine the suitability of species selection and spatial configuration in urban forest systems. Methods include field-based soil sampling, salinity and moisture profiling, vegetation stress indexing, and the use of spatial decision-support tools to map ecological sensitivity and adaptive potential.

Expected outcomes include the development of a soil-based indicator set for urban forestry, improved suitability maps for species and planting design, and a planning framework that strengthens climate resilience in Mediterranean cities. These results aim to support municipalities and practitioners in implementing nature-based solutions that enhance microclimate regulation, biodiversity benefits, and long-term ecosystem stability.

By linking ecological evidence with applied planning practices, this work contributes directly to the meeting's goal of building capacity for sustainable and resilient urban forest management across Europe.

Keywords: urban forestry, Mediterranean climate, soil salinity, climate adaptation, geospatial analysis

Valorization of urban forest biomass into activated carbon: A circular bioeconomy approach for urban forest management plans

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ABSTRACT

Urban forests are increasingly recognized as multifunctional green infrastructure systems delivering ecosystem services including air purification, stormwater regulation, and climate mitigation. However, Urban Forest Management Plans (UFMPs) rarely integrate circular bioeconomy strategies that valorize urban biomass residues into high-value environmental materials. This study explores the potential of converting urban forestry biomass (pruning residues, leaf litter, and lignocellulosic wastes) into activated carbon for environmental remediation and energy-related applications. Drawing on recent advances in biomass-derived porous carbons, the research synthesizes evidence on physicochemical activation methods, surface functionalization, adsorption performance for heavy metals, emerging contaminants, dyes, and CO₂, as well as electrochemical performance in energy storage systems. Literature indicates that bio-based activated carbons can achieve high specific surface areas (>1000 m² g⁻¹), enhanced microporosity, and significant pollutant removal efficiencies, while simultaneously contributing to carbon sequestration and waste reduction. The study proposes a framework linking urban forest biomass valorization to measurable Key Performance Indicators (KPIs) within UFMPs, including pollutant removal capacity, lifecycle carbon balance, biomass recovery rates, and contribution to nature-based climate solutions. By bridging material science innovation with urban forestry management, this work supports the integration of scientific knowledge into practical urban planning tools. The approach aligns with European sustainability goals by promoting circular resource use, climate resilience, and community-based green infrastructure strategies. This contribution aims to stimulate interdisciplinary dialogue between urban foresters, municipalities, and environmental engineers toward implementing biomass-to-carbon pathways as an innovative component of urban forest management.

Keywords: urban forest biomass, activated carbon, circular bioeconomy

gAla: Giving urban trees a voice

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ABSTRACT

Urban trees function as distributed infrastructure, providing measurable socio-ecological services including carbon sequestration, microclimate regulation, air-quality improvement, biodiversity support, and stormwater mitigation. While these services are increasingly quantified in urban economics and planning, they remain difficult to integrate into decision-making workflows and public understanding.

This work presents gAla (<https://gaia.gus.earth/>), an agentic generative AI system built on top of the Green Unified Scenarios (GUS) framework (Ozel & Petrovic, 2024) which combines agent-based modelling (ABM) with multi-source environmental data to simulate and communicate the dynamic role of trees in urban systems. GUS models trees as individual agents whose growth, health, and ecosystem service provision evolve under heterogeneous conditions, including weather, maintenance regimes, species characteristics, disease dynamics, and spatial interactions.

Using ABM, the framework constructs high-resolution digital twins of urban ecosystems —down to individual trees— embedded within a city’s ecological, spatial, economic, and social context. These simulations integrate municipal inventories, remote sensing, street-level imagery, and real-time weather data to forecast long-term impact trajectories under alternative scenarios.

gAla extends this modelling layer with a novel agentic GenAI architecture that allows simulated entities —individual trees or tree collectives— to become interactive interfaces. AI agents combine empirical data with simulation outputs to produce transparent, queryable, and conversational explanations of model behaviour, enabling users to explore “what-if” scenarios, trade-offs, and long-term impacts without abstracting away model complexity.

The work demonstrates how this approach bridges agent-based socio-ecological modelling with explainable, human-facing interfaces, opening new pathways for urban decision support, urban forest data collection, verification, participatory planning, and economic valuation of green infrastructure. Urban trees are essential infrastructure, offering measurable services like carbon sequestration, microclimate regulation, and biodiversity support. However, these benefits are hard to integrate into urban planning.

Keywords: urban tree management, agentic AI, tree growth simulation, ecosystem services

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